



River Basin Planning

An Indian Guide



AWP Knowledge Framework

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1 Introduction

1.1 Purpose and objective of river basin planning – Why plan at the basin scale?

Rivers are celebrated through story and worship in India, some are considered goddesses and declared as nature's wonder (India Today, 2018). Despite the importance of rivers and aquifers in India, like so many countries around the world, they are challenged through competing uses and the lack of coordinated planning and management. India is among the world's most water-stressed countries. In 1950, India had 3,000–4,000 cubic metres of water per person, but today this has fallen to around 1,000 cubic metres, largely due to population growth (World Bank, 2019). India, along with many countries, faces significant challenges in water governance and integration of water management issues across a broad range of other priority issues. Rivers are shared by a vast range of people for different uses and across geographical and administrative boundaries, hence they need to be managed in a planned, integrated and adaptive way to ensure their long-term productivity and sustainability.

“India's rivers are goddesses, and yet they are not treated like goddesses”

(Water Resources Manager, Krishna Basin).

Experts in India have called for effective sustainable planning and management of river basins, to properly utilise available water resources (Swetapadma and Ojha, 2017, Sadoff, 2019), as have water managers throughout the country. This wish is echoed in India's Draft River Basin Management Bill (2018), which calls for better management of water resources for domestic, agricultural, industrial, environmental and other purposes, as a result of increasing population and water management pressures (MoWR, 2018). There are clear drivers for improved water management, as evidenced through increasing severity of droughts and floods. For example, in 2019, Maharashtra witnessed its worst drought in 47 years, forcing many to leave their lands and take shelter in relief camps, as they wait for monsoon rains (Aljazeera, 2019). Box 1 highlights some of the challenges for urban water management in India, which are relevant to river basin planning.

Box 1: India's water management challenges – the case for river basin planning

India's TERI University (The Energy and Resources Institute) highlights the need for action on water management and water scarcity in India (2018):

It is estimated that by 2050, half of India's population will be living in urban areas and will face acute water problems. At present, 163 million people do not have access to safe drinking-water and 210 million people lack access to improved basic sanitation in India.

There is a vast gap between demand and supply of water in urban areas of India.

There is a lack of wastewater treatment facilities to treat the wastewater of a growing population. There is a need to reuse treated wastewater in order to meet the current and future demands for water.

More than 100 million people in urban areas in India are exposed to poor water quality.

Box 2: Why Plan at the river basin scale?

- Increasing water security across an integrated system – improving certainty and therefore ability to plan for and manage water resources across jurisdictions
- Recognising that land use, surface water and groundwater resources are highly interconnected
- Recognising the multiple benefits and values communities derive from river basin water resources
- Providing water for critical human needs including drinking water, sanitation and public health
- Sharing water for food security and agricultural water needs
- Sharing water for broader economic benefits including industry, power and fisheries
- Providing a process to adapt to seasonal variation in water availability and changing climate
- Planning for extreme events
- Providing a process to identify cultural water needs
- Providing a process to identify environmental and water quality needs
- Resolving competing upstream and downstream demands
- Providing a process and framework to make clear decisions about the most appropriate distribution and management of water resources between multiple beneficiaries
- Providing a process and framework to review and improve over time
- Clarity on governance, responsibilities and stakeholder input.

1.2 River basin planning

The pressures on Indian river systems and groundwater resources are becoming more and more apparent, as cities expand, food production needs increase, fisheries are under pressure and water quality declines. Addressing these pressures will require clear data and information, clear governance and responsibility for decision-making, engagement with agricultural and urban communities and other water user interests, and a framework to make choices about distribution of water resources and the associated costs and benefits.

River basin planning recognises that water resources and the consequences of their management operate across the boundaries of nations, states and other political and administrative units. A river basin plan therefore aims to manage a basin as a whole system. Benefits of this approach include assessment of planning impacts at a system level, delivering ‘whole of basin’ solutions and resolving upstream-downstream conflicts and many more as outlined in Box 2 above (GWP, 2009).

The planning components can be applied at a range of scales, from small sub-basins wholly within a state, to large cross-jurisdictional basins bringing together many different actions that may have been put in place to manage single issues, to consider how they interact and integrate. A River Basin Plan is not something that is applied in exactly the same way each time, but is a process that can be adapted to the issues at hand, at appropriate time and space scales. It is also not meant to be a static plan, but one that is continually reviewed and improved, with better information, science, management and engagement as the plan is implemented.

River basin planning provides a process, and ultimately a plan, to consider and resolve competition and conflict in access to the water resources of a river basin. Water resources are a classic example of the “tragedy of the commons” principle, where users of a common resource will usually focus on their own

needs and will rarely collaborate to manage the resource sustainably with others. At the scale of a river basin (whether within a state or across many states or nations), this principle is even more applicable as the resource users are separated from others dependent on the resource by distance, jurisdiction and often by culture, language and many other factors. Managing the inherent conflicts of interest of the many users of a river basin water resource is a major function of river basin planning, its governance, stakeholder engagement, management strategies and implementation. While conflict at some level is inherent and inevitable, it is possible for the process of integrated river basin planning to reach a settlement that governments, water users and other stakeholders can accept as a reasonable solution to their water needs.

By integrating the consideration of quantity, quality, development and sustainability, the river basin planning process provides a vehicle for communities, water users, stakeholders and agencies to develop clear objectives, and technical and policy solutions and to implement, monitor and evaluate success. A well-developed, implemented and monitored river basin plan planning process can provide the basis for sustainable development of water resources.

Experience has shown that robust and sustainable river basin planning requires a legislative basis to establish roles and responsibilities of organisations, as well as accountability for development, implementation, monitoring, evaluation and review of the plan. The legislation on its own is not a guarantee of success, but it provides the authority and governance to progress and implement the plan. Governments and their agencies play a key role in developing, resourcing, endorsing and implementing a river basin plan. However, governments cannot effectively develop or implement a plan in isolation. Community and industry engagement are critical to inform, support, develop and implement a river basin plan.

The river basin plan itself should provide a coherent framework, vision, objectives, strategies and actions for sustainable limits and system needs for river health, water quality and critical human needs, sharing water between users, river management, development of resources and improvements for water supply to industries and irrigation. Certain types of basin plans can provide regulatory frameworks for economic and market activity that enable the market to allocate resources, while guarding against the consequences of market failure. While guidance documents have their place as part of water management, river basin plans need to be established in legislation if they are to securely give effect to the strategies and water sharing agreed through stakeholder engagement and intergovernmental decision-making.

1.3 Integrated and system level planning and management

Planning at the basin scale also allows and encourages planners to take into account the food-energy-water nexus (Figure 1). The nexus acknowledges the interrelated and dependent nature of food, water and energy, and indicates that a change in one domain could well have flow-on effects, or unintended consequences, in another domain. Considering these sectors together in an integrated way (along with land-use planning), will help to make river basin planning holistic and more balanced across a range of water-dependent and intensive industries.

In addition, climate change will impact on all elements of the food-water-energy nexus. Climate change therefore needs to be considered in terms of: (i) climate events disrupting these relationships and (ii) climate change mitigation opportunities (such as energy efficiency and conservation, drought tolerant crop varieties/crops with low irrigation needs).

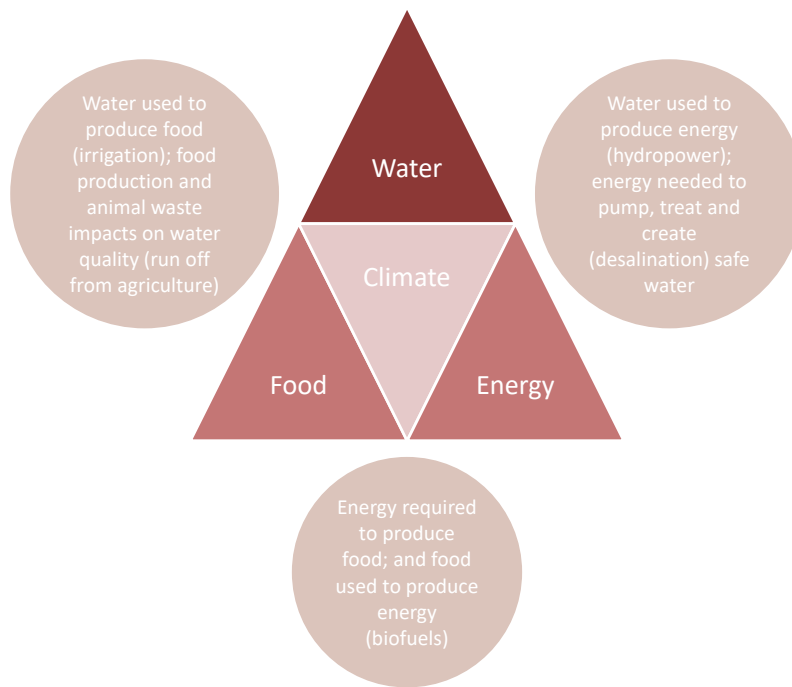


Figure 1. Food-Energy-Water-Climate Nexus

1.4 Integrated water management to meet the needs of people, animals, environments and economies

The essential role that water plays in poverty reduction and sustainable development is widely recognised, and captured in Goal 6 of the United Nations Sustainable Development Goals which calls for all people, with special focus on women and girls and peoples with disabilities, to have access to safely managed water and sanitation by 2030. The integrated and mutually dependent elements of the water cycle and its relationship with human and economic development are depicted in Figure 2.



Figure 2. Sustainable Development Goal 6 (Source: UN Water)

The role of water resources for economic development – whether it be through farming (small and large scale), industry, good health (through the reduced incidence of water borne diseases) and household water needs is well recognised in India. Indian water managers consulted to inform this User Guide expressed that as awareness and recognition of integrated water management increases, so will water resources be able to be more sustainably managed. Food security in India is dependent on good water management processes. The long-term sustainability of the water resources is therefore paramount to good river basin planning in India.

One of the main challenges of basin planning is the tension between planning at a system scale and accommodating the limits and interests of the different administrations in the basin. Therefore, two complementary approaches are often needed – national or state scale reform that sets the overall mandate for water management in a country or state and planning at the basin scale which allows for the interpretation of the national scale reforms in a coherent basin plan. Note that this User Guide focusses on within-country river basin planning. Many aspects will be applicable to international river basin planning. However, the diplomatic and international relations aspects of international river basin planning are not within scope of this User Guide.

1.5 River basin planning in Indian and Australian contexts

Whilst this User Guide is drawn from materials and experiences on river basin planning globally, it particularly draws on the experience of the Krishna and Godavari River Basins in India, and the Australian experience in the Murray-Darling Basin. While the Indian and Australian contexts have clear differences, there are also many similarities in legal, bio-physical, agricultural and social dependencies, which make the exchange of knowledge and lessons in basin planning beneficial for both. As a result, technical exchanges, knowledge sharing and consultations underpin the development of this Guide.

Indian river basin planning is understandably focused on measures to reduce rural poverty, enhance economic growth and increase food security, through building infrastructure to harness water resources for irrigated agriculture and / or inter-catchment transfer. In the Murray-Darling Basin in Australia, water management infrastructure development (such as dams, weirs, canals) mostly took place between 1900- 1980s. More recently it has been recognised that this led to over-allocation of water resources and the Murray-Darling Basin Plan has focused on water resources management to reset the balance to a sustainable level. Increased scientific understanding of the requirements for water and flows for water-dependent ecosystems and water quality (especially to reduce salinity) drove a cap on water diversions in the Murray-Darling Basin at 1993/94 levels and works to reduce salinity. This has been followed by recovery of water for environmental purposes and the setting of a lower sustainable diversion limit (SDL), as key elements of the Murray-Darling Basin Plan.

India is likely to increasingly face pressures that require integrated water resources management and planning across river basins, to address poverty and food security. Indian river basins include many large and growing urban centres, as well as agriculture, whereas most of Australia's urban areas are coastal and located away from most irrigated agriculture. For this reason, this User Guide includes a brief consideration of urban water management and pollution control, drawing on Australia's experience in these fields.

India is predicted to face considerable impacts from climate change. A study funded by the World Bank (2013) predicted unusual and unprecedented spells of hot weather and that with a 4°C global average temperature rise, east coast and southern India could shift to high temperature climatic regimes with significant impacts on agriculture, including lower crop yields. Since the 1950s, a decline in average monsoon rainfall has been observed while the frequency of heavy rainfall events has increased. A 2°C global average temperature rise is predicted to make the monsoon highly unpredictable,

while a 4°C rise an extremely wet monsoon currently a 1 in 100-year event is projected to occur 1 in every 10 years. With a 4°C rise, a 10 percent increase in annual mean monsoon intensity and a 15 percent increase in year-to-year variability of Indian summer monsoon precipitation is projected compared to normal levels during the first half of the 20th century. Both more frequent droughts and greater flooding are predicted. Alterations in glacier melt are predicted to impact the Indus and Brahmaputra rivers. Studies have found that the threat to water security is very high over central India, along the mountain ranges of the Western Ghats, and in India's north-eastern states (World Bank 2013).

Australian irrigated agriculture is predominantly large scale and increasingly tending towards a corporate and/or agribusiness approach. Indian agriculture runs from small to large scale farming, including many subsistence farmers. According to the Indian Agricultural Census (2016), marginal (less than one hectare) and small scale (1-2 hectare) landholdings have risen over the last 25 years to represent between a third and a half of the area of landholdings (Figure 3). The number of landholdings has also risen from 71 million in 1970-71, to 138 million in 2010-11, while the average size of holdings has shown a decline over the same period from 2.28 hectares to 1.15 hectares (Agricultural Census 2016). Agriculture in India represents 17-18.6% of GDP (Agricultural Census 2016, MOSPI 2018; Table 1).

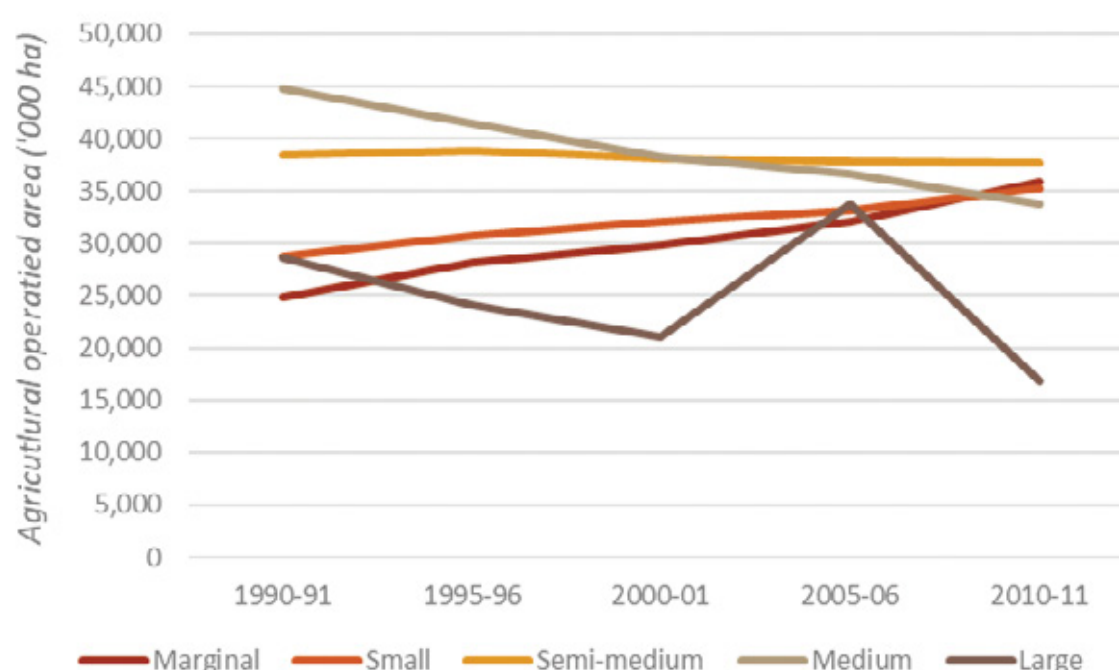


Figure 3. Statistical data on farmland distribution in India. Marginal holdings are less than one hectare, small scale holdings are 1-2 hectare (Agricultural Census 2016)

Table 1. Share of Agriculture & Allied sectors in overall GDP of India

Year	Over-all GDP (Rs in Cr)	GVA – Agri and Allied (Rs in Cr)	% share in GDP
2011–12	81,06,946	15,01,947	18.5
2012–13	92,02,692	16,75,107	18.2
2013–14	1,03,63,153	19,26,372	18.6
2014–15	1,15,04,279	20,93,612	18.2
2015–16	1,25,66,646	22,25368	17.7

A key challenge of basin planning in India is to develop strategies and water sharing arrangements that enable small-scale farmers to manage through varying seasonal water availability and drought. Other challenges are to improve productivity and maintain water share appropriately between different types of farmers and between different parts of the basin across state boundaries. The User Guide provides a number of relevant case studies from Indian and Australian experience.

Australian and global experiences have shown that the basin planning process historically is generally unstructured, iterative and adaptive. This is unsurprising given the institutional, environmental, cultural and social complexity of many river basins. It means that it is difficult to establish a clear set of linear steps for basin planning based on past experiences. That said, it is useful to outline a broad set of processes that are common to many successful basin planning initiatives around the world.

The planning and implementation pathway is broadly envisaged as a cyclic process with seven key phases (Table 2 and Figure 4), each of which is described below. However, often a river basin planning process will start with some elements already in place, that will only require review, or there may be a driver to start at a different point. The key is to adapt these stages to the situation in each river basin.

1.6 Structure of the User Guide

This User Guide is structured around six key stages outlined in Table 2 and Figure 4.

Table 2. Key stages of river basin planning

Stage in river basin planning	Brief summary
1. Initiation, governance and visioning	<p>Initiation may occur in a range of circumstances, for example due to stakeholder pressure, drought, flood, water management disputes, funding initiatives and objectives, or leadership from government representatives and agencies. Initiation includes establishing appropriate institutional arrangements that support transparency, accountability and openness. This will include beginning interjurisdictional dialogue and developing agreements on the process and forum for discussing and addressing issues and decision-making (the governance arrangements).</p> <p>Through inclusive community engagement, develop the vision describing the desired long-term state of the basin. As part of this process, develop long-term objectives, as well as a monitoring, evaluation, reporting and learning (MERL) framework to provide a clear 'line of sight' through the vision, objectives, strategies, actions and performance indicators.</p>
2. Inclusive community engagement (ongoing throughout)	<p>Engagement with community, business, and government stakeholders throughout the basin plan development and implementation process is necessary to ensure that the plan reflects the vision and needs of the community (including women and marginalised peoples), draws on the knowledge of the whole community, garners maximum support, and mitigates risks.</p>

Stage in river basin planning	Brief summary
3. Situation assessment	A situational analysis of the available resources, their characteristics and the risks to those resources informs the baseline for the basin. At this stage it is important to understand (through consultation and modelling) current and future water demands, environmental risks, water quality status and drivers, as well as current and future supply (considering climate change).
4. Strategies and planning	<p>Basin strategies are designed to achieve the basin objectives and vision in the long-term. Engagement and decision-making will require scenarios and options analysis using tools described in the situation assessment. Scenario building, testing, analysis and decision-making need to consider economic, social, cultural and environmental implications.</p> <p>Key strategies for a basin plan are likely to include establishing system needs and sustainable limits on extraction, distribution of shares between states and between water users, demand management, supply management, managing competition for water resources under scarcity and drought, water quality management and flood management.</p>
5. Implementation	Implementation involves clear responsibilities, accountability and timeframes to give effect to the basin strategies. Governance and accountability for implementation and review must be clearly outlined and often involves the establishment of a river basin organisation to provide oversight and progress reporting.
6. Monitoring, evaluation, reporting and learning (MERL)	A plan, accountabilities and funding for monitoring, evaluation, reporting and learning (MERL) need to be established. This allows progress to be tracked and reported, and plan review to respond to what is learned. It should describe a clear data sharing and data management arrangement to ensure that all relevant data is collected, reviewed and made available to river basin stakeholders in a fit-for-purpose and agreed manner. The MERL data and information need to inform review of the river basin plan, and re-starting the planning and adaptive management cycle.

An important component of the basin planning process is to consultatively build and document the logic behind the plan (i.e. the conceptual framework). The steps outlined in this User Guide can support the development of the process and ensure that all key aspects are considered through the planning and implementation process.

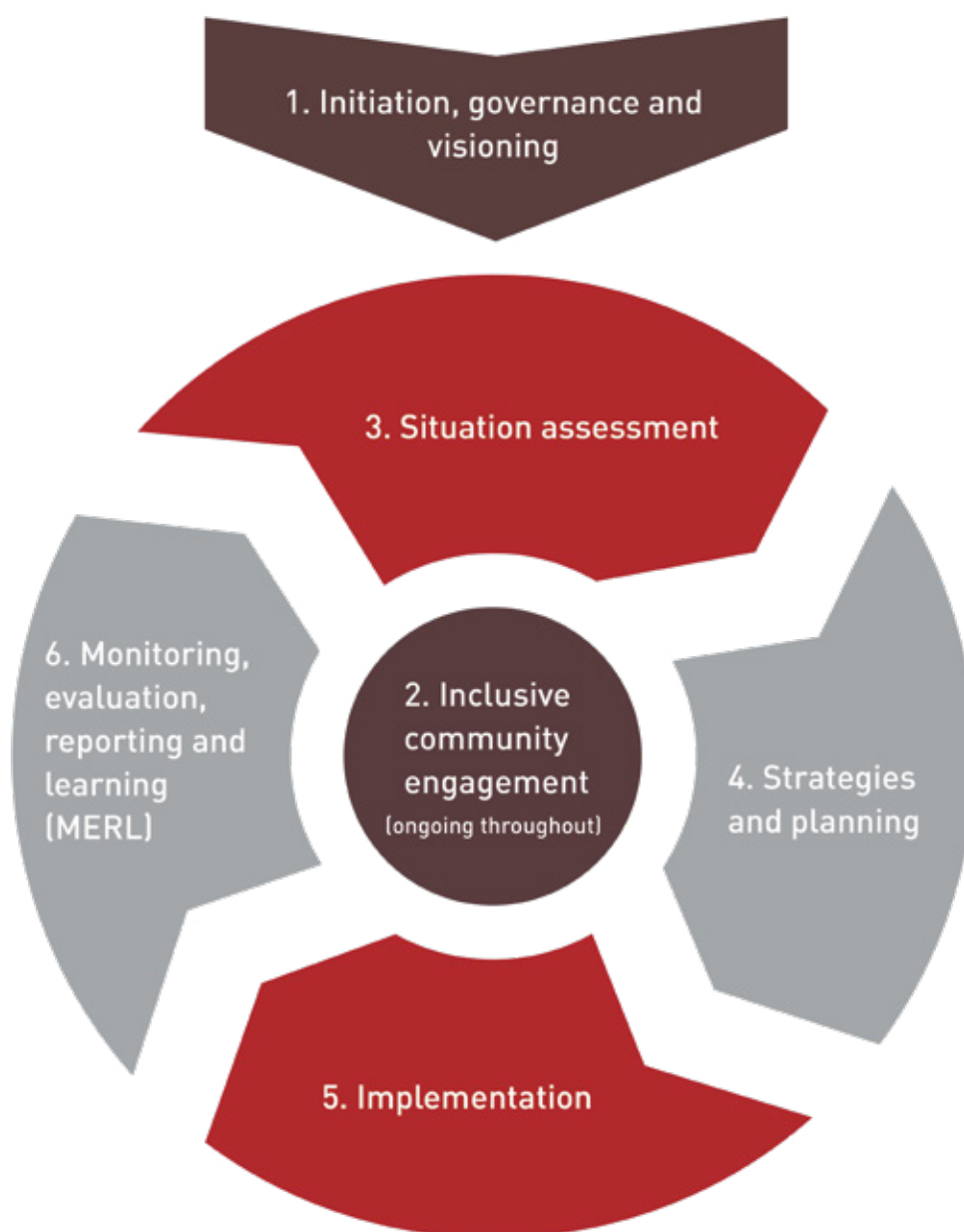


Figure 4. Six key stages of river basin planning outlined in this User Guide

2 Stage 1: Initiation, governance and visioning

2.1 Key messages

1. Initiation of river basin planning may occur due to proactive managers, legislation, funder requirements, stakeholder pressure, water scarcity or crises such as floods or droughts and/or competition for resources.
2. Initiation includes establishing appropriate institutional arrangements that support transparency, accountability and openness. This will include beginning interjurisdictional dialogue and developing agreements on the process and forum for discussing issues and resolving decisions (the governance arrangements).
3. Institutional arrangements will need to be established in legislation and also need to include clear requirements for stakeholder engagement and considering the needs and views of all interest groups.
4. Important institutions include river basin organisations, central and state governments and their water agencies, water users (including power, water supply, agriculture and industry)
5. For each institution, clear obligations and responsibilities need to be defined by the appropriate legislative and administrative powers. Without genuine recognition and backing of their legal status, institutions cannot properly undertake the function for which they have been established. The governments involved in the river basin plan will need to establish complementary, linked legislation with common principles and approaches, enabling and empowering their officials to cooperate in development of the river basin plan, while still representing their state's interests and decisions.
6. Dispute resolution processes will vary across river basin organisations, but need to ensure the timely resolution of conflicts, and guarantee member states' commitment to complying with decisions taken in this context.
7. The legislation and institutional arrangements need to include clear regulatory powers to provide assurance that the measures in the river basin plan will be implemented.
8. Through pro-active inclusive engagement processes, the river basin plan will better reflect the needs of all people in society and build a more sustainable approach to river basin management.
9. A key first step in basin planning is building a network of support amongst key leaders in the community, industry and governments. Water resource management professionals in state, regional or national governments can play a key role in building understanding and support for the concept. At an early stage, identify all the stakeholders, users and other groups with a legitimate interest in the water resources of the river basin.
10. It is important not to try to solve all the issues at once – keep the focus on agreed priority issues and issues of common concern.
11. Another early step is to build a unifying vision for the river basin. The vision is a description of the desired long-term state of the basin. Develop the vision with the engagement and agreement of all relevant stakeholders.

12. Develop long-term objectives with stakeholders, to translate the basin vision into specific aims for the plan to achieve within a time timeframe and available resources.
13. Develop a plan design and evaluation framework at this stage to provide a clear logic (a 'line of sight') through the plan's vision, objectives, strategies, actions and performance indicators.

Initiation of river basin planning is the beginning of the planning process. Initiation may occur in a range of circumstances, for example due to stakeholder pressure, environmental degradation, crises such as drought or floods, water management disputes, funding drivers, or leadership from government representatives and agencies.

At this early stage, identification of all the stakeholders, users and other groups with a legitimate interest or dependency on the water resources will help to ensure that all the relevant issues are included, and that a suitable strategy is developed to engage the community.

2.2 Initiation of river basin planning

While river basin planning can be undertaken both proactively and preventatively, it is usually initiated in response to resource competition – i.e. conflict over access to or quality of the water resource. This holds true in both Australia and India. Past basin planning initiatives in India have mostly been initiated due to resource competition, particularly due to rising demands for water for irrigation, mining and urban expansion, as well as issues such as pollution and flood control.

Some examples of drivers for river basin planning processes in India are shown in Table 3 (Aahrensberg et al., 2011; Tare et al., 2015; Tiwari and Chaube, 2016; ADB, 2011; ACIWRM, 2018).

Table 3. Drivers for planning in India – some examples

Basin	Incentive for planning
Tungabhadra Sub-Basin	Water sharing and security under the conditions of water scarcity.
Pamba Basin, Kerala	A need to solve urban water pollution issues, meet rising irrigation demand and ensure the river is in good condition for the Sabarimala annual pilgrimage, undertaken by an estimated 45–50 million devotees every year.
Ganga Basin	Meeting increasing water demand and addressing the deterioration in the quality of land and natural waters due to pollution, especially in the way this limits cultural and historical uses of the river.
Brahmaputra River	A need to limit the impacts of flooding.
Upper Tungabhadra River	A need for an efficient and economically viable irrigation, drainage and flood control.

In Australia, drivers for river basin planning included environmental decline, severe water shortages in drought, extreme floods and increasing competition for available water for irrigation and water use industries. In order to encourage states to work together, Australia set up a range of incentives and policy drivers, including conditional funding from the national government, multilateral and bilateral agreements.

Once the decision is taken to initiate a planning process and stakeholders are identified, experience has shown that a first step is to build a network of support, including amongst key leaders in the community, industry and governments. Water resource management professionals in state, regional or national governments can play a key role in building understanding and support for the concept. At an early stage, identify all the stakeholders, users and other groups with an interest in the water resources of the river basin. Small, face-to-face meetings allow discussion of new ideas and the identification of common issues. They build a consensus and generate support for larger meetings, negotiations, workshops or conferences involving all parties.

Understanding the context is vital when establishing a river basin planning process and the arrangements for decision-making, planning and implementation, policy and legislation. Getting the context clear early is an important factor in success. This includes the social, economic, environmental and cultural context within which the planning is taking place. A key principle is for decision-making to value all kinds of knowledge – cultural, traditional, local, technical and scientific.

The fundamental nature of water for human life, food, energy and economy means that there is always competition for water and river basin planning is inevitably political. Building broad support across political groups for river basin planning enables a more productive engagement with communities. Political leaders’ support for integrated river basin planning is important for stakeholder engagement, data collection and management, governance and compliance processes to be prioritised, funded, and actioned.

2.3 Enabling environment for river basin planning

The enabling environment (Figure 5) for river basin planning is the legal, organisational, fiscal, informational, political and cultural context within which a basin plan is developed and implemented. Developing a basin plan is a challenging process, so the establishment of a supportive enabling environment is essential to its long-term success, including appropriate institutional arrangements and supportive policy and legislation. In principle community and political support for a planning process will make the path smoother for technical and policy discussions. This will include beginning interjurisdictional dialogue and developing agreements on the process and a forum for discussing issues and resolving decisions (the governance arrangements).

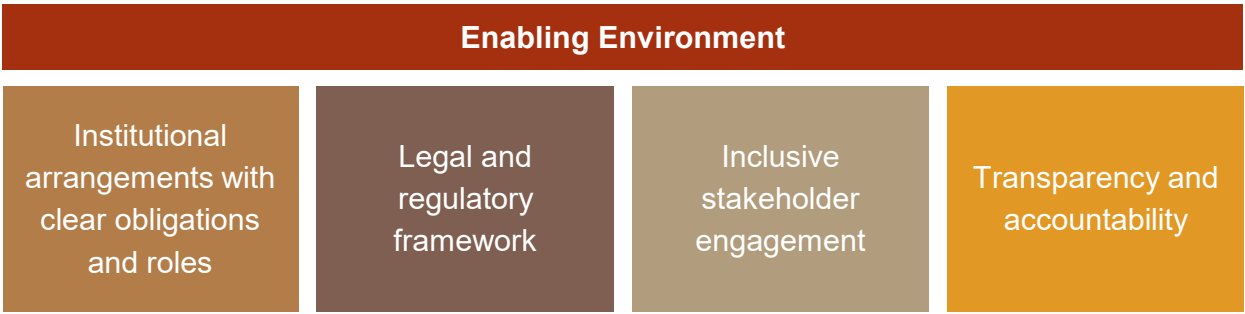


Figure 5. Enabling environment for river basin planning

2.4 Institutional arrangements and governance

Governance refers to the processes, structures and institutions by which decisions are made concerning water policy and management, and the mechanisms by which decisions are implemented. Successful governance requires a level of engagement in and acceptance of decisions by those affected, including all levels of government, stakeholders and community.

It is important that the decision-making and implementation framework provides for transparency, natural justice and an ethical approach. How to maintain momentum in implementation, is just as important as establishing plans and organisations.

It is good governance in general, rather than simply good water governance that is needed.

(Global Water Partnership, 2017)

Subsidiarity is a key principle of governance: decisions should be taken at the lowest appropriate level possible. For example, the decision on the overall limit to extraction for the basin can only be taken at a basin scale, because the interests of individual water users or even regional irrigation areas are unlikely to consider the basin-scale issues of water sharing and the impacts of extraction. On the other hand, the detailed arrangements for distribution of water shares within an irrigation area can be taken at the local level.

Many different types of institutions take part in river basin planning. They include large transboundary or international entities, national, state and local governments, environmental organisations, private sector water users (e.g. irrigators associations), and civil society groups and community organisations. In this Guide, 'institutional arrangements' refers to the responsibilities, modes of operation and legal status of these various entities, and how they relate to one another.

The key approaches and principles that are foundations for establishing institutional arrangements in support of good water governance and basin planning include (GWP, 2017):

1. transparency, accountability
2. inclusive stakeholder engagement
3. legal and regulatory frameworks, which are predictable, equitable and fair
4. clear obligations for each institution that are defined by the appropriate legislative and executive powers.

In Australia, governments agreed to separate the roles of water resource management, service delivery and regulatory enforcement. This provided a means for governments and communities to understand and make transparent the trade-offs between these elements. It also ensured that the water sector was subject to independent regulation on water access, environmental and health issues. Each of these four aspects is a key aspect of sound governance in general, and they have also been shown to be essential in water management and basin planning.

Transparency and accountability in relation to policy development, water sharing, water allocation and financial decisions, is necessary for water users and the general community to have confidence in the proposed river basin planning arrangements. Clear and published information about the rationale for decisions, who makes them and how often they will be reviewed, provides stability and security for water users, and this encourages them to support basin planning initiatives. Publication and transparency of the information base and modelling that is used as the basis for decisions is also a critical part of the institutional arrangements.

Inclusive stakeholder engagement with water users and the broader community is essential for any river basin plan to have effect. In practical terms, stakeholder engagement and consultation also help water planners and managers to cater for all user and community needs in the most equitable manner possible, as well as draw on the knowledge of the broader community. If stakeholder engagement is done well, it can build the social support for a stable planning, regulatory and management framework, as well as support implementation and compliance. It also helps build and maintain stable political support for the planning process.

Legal and regulatory frameworks: Institutional arrangements will need to be established in legislation, including compliance mechanisms. The legislation needs to include clear requirements for stakeholder engagement that is equitable and accessible to all interest groups, and that seek to support gender equality and social inclusion, underpin a stable water management regime that will support sustainable economic and social development. The legislation and institutional arrangements need to include clear regulatory powers to provide assurance that the measures in the river basin plan will be implemented. Combined with the principles of transparency and accountability, a best practice regulatory framework provides predictability and security of water access. This enables confidence in investment decisions.

Having clear obligations and responsibilities for each institution supports not only efficient operation (by reducing duplication, overlaps and gaps), but also enables each institution and its staff to act fearlessly and rigorously in pursuit of their role. Without genuine recognition and backing of their legal status, it is more difficult for institutions to function properly. Clarity about responsibilities promotes accountability and a clear and unambiguous policy and regulatory framework.

In developing these requirements for institutional arrangements, a first critical path is to begin interjurisdictional dialogue and developing agreements on the process and forum for discussing issues and resolving decisions (the governance arrangements). The exact pathway for establishing dialogue will vary. In some river basins there may already be a suitable forum or interstate (or international) process for such discussions. In some basins, initiation of the interjurisdictional dialogue may require political support and sponsorship (for example an initial meeting and declaration of Ministers that discussion and development of the plan should begin). Development of the river basin plan will ultimately require some kind of formal governance and process to clarify who can make and agree decisions on behalf of each jurisdiction and how joint decisions are made. However, it is also important that in parallel or between formal meetings, state officers can meet to work out technical issues or to gather input from stakeholders and experts.

In Australia, water management in the Murray-Darling Basin is administered through a range of formal committees, working groups, an Authority and a Ministerial Council that operates under an Intergovernmental Agreement and is reflected in the water legislation of each government. However, in addition, officials of the national and state water agencies and the river basin organisation will meet from time to time to work through detailed technical, policy and project planning issues, without taking formal decisions. These less formal discussions provide the basis for briefings to the formal committees, Authority and Council.

2.5 *Dispute resolution*

Disputes over water resources are common where water is shared across boundaries within a basin – and therefore sound dispute resolution mechanisms are needed within the policy-legal framework of a river basin planning process.

Dispute resolution processes will vary across river basin organisations, but need to ensure the timely resolution of conflicts, and guarantee member states' commitment to complying with decisions taken

in this context (Schulz and Schmeier 2012). External conflict management institutions such as regional or international courts or tribunals that are considered independent and impartial to the conflicting parties may offer effective ways to manage disputes over transboundary watershed issues. Examples of dispute resolution frameworks in India and Australia are provided in case study 1 and 2 respectively.

Case study 1: Dispute resolution in India – Krishna Basin Water Dispute Tribunals

India has a mechanism allowing for the central government to set up a dispute resolution tribunal when riparian states are not able to reach agreement on sharing of an interstate river. The Interstate River Water Disputes Act (1956, amended in 2017) allows the central government to ask the affected states to undertake negotiations to settle the dispute. If the dispute cannot be settled through negotiations, the central government must set up a Water Disputes Tribunal within a year of receiving such a complaint.

Under the Interstate River Water Disputes Act two inter-state water disputes have been brought to tribunal in the Krishna Basin. The first tribunal (KWDT I) was established in 1969 to resolve disputes between the states of Karnataka, Maharashtra and Andhra Pradesh (the three riparian states at the time). The tribunal delivered its Award in May 1976, allocating the available water between the states based on 75% dependability- Maharashtra (560 TMC¹), Karnataka (700 TMC) and Andhra Pradesh (800 TMC) (KWDT, 2010). The tribunal stipulated that after the 31st May 2000, the award may be reviewed by another tribunal if requested by the basin states (MOWR, 2015).

Following the passing of the 2000 review limitation and requests from the basin states, a second tribunal (KWDT II) was established in April 2004. The KWDT II first Award was delivered in 2010, allocating water according to 65% dependability based on 47 years of records- Andhra Pradesh (1001 TMC), Karnataka (911 TMC), Maharashtra (666 TMC) and minimum environmental flows (6 TMC to be released downstream of Prakasam Barrage). The award is to be reviewed in 2050. Following submissions from each of the states, the KWDT II released a revised Award in 2013. The revised Award was only slightly changed from the 2010 version with the allocations as follows - Andhra Pradesh (1005 TMC), Karnataka (907 TMC) and Maharashtra (666 TMC). The dispute between states is still ongoing, and the KWDT II term has been extended to 2016 so that it can make project-specific allocations and determine operational protocols for release of water during low flows (MOWR, 2015). However, in 2016, the tribunal got extended twice for one year to hear the matter related to newly formed state Telangana after its bifurcation from Andhra Pradesh.

Case study 2: Dispute resolution in Australia – Murray-Darling Basin

In Australia, the Murray-Darling Basin Ministerial Council provides a forum to negotiate disputes. In the mid-2000s a major drought led to pressure for the national government to act, resulting in Water Act 2007 and the Basin Plan. These mechanisms established national forums for states and federal government to play a key role in reaching agreements (Council of Australian Governments- COAG, Ministerial Councils, Basin Officials Committee and various working groups).

In 2015, a Dispute Management Plan was developed by the Murray-Darling Basin Authority (the MDBA), outlining the process to manage all disputes relevant to stakeholders and the general community that arise within the Murray-Darling Basin context in Australia (MDBA 2015).

The Murray-Darling Basin Agreement dispute resolution mechanism allows for an independent arbiter to be appointed by the Chief Justice of the Supreme Court in Tasmania—an Australian state that is outside the Basin and therefore independent.

1 TMC is Thousand Million Cubic feet, which is equal to 28,317 Million litres (28,317 MegaLitres or 28.317 GigaLitres)

2.6 Types of institutions

2.6.1 River basin organisations

A ‘river basin organisation’ (RBO) in this Guide is any organisation set up to develop and implement a basin plan, regardless of its regulatory powers and level of political commitment (Schulz and Schmeier, 2012). The RBO needs to be empowered with oversight and authority, allowing it to engage authoritatively with other institutions, such as states, power and water utilities, agricultural industries, fishery representatives and other water users and the community.

Many authors have argued that regulatory powers are needed for the development and implementation of basin plans (Molle, Wester and Hirsch, 2007; Pegram et al., 2013). The regulatory powers required will be situation-specific, ranging from an agreement between parties, with regular independent auditing and oversight, through to legislation and regulatory compliance and enforcement. The success of any regulatory framework will depend on the standard principles of best practice regulation and legislation. Success will also require community and political support, but with regulatory distance from politics, as well as the skilful use of a range of regulatory tools.

Experience globally has highlighted that institutional arrangements involving organisations with the management and technical capacity to effect change are essential if a river basin plan is to be developed and implemented, and the most effective approach is to have a single mandated lead institution (Pegram et al., 2013; Molle, Wester and Hirsch, 2007). This institution can take many forms with varying degrees of legislative power:

- **Basin commission** has the power to convene stakeholders to assist them to develop a basin plan but not to enforce a basin plan. Examples include the Mekong River Commission in South-East Asia and the Lake Chad Basin Commission in northern Africa. In Australia, this model was used and remains in place for the operation of the River Murray since 1914 and was used for the Murray-Darling Basin from 1986 to 2008.
- **Basin authority** generally has regulatory power to develop, implement, audit implementation by others, publish reports and potentially enforce a basin plan. An example is the Murray-Darling Basin Authority in Australia, since 2008 (noting that its powers are limited by the Australian Constitution).
- **River management board** may be responsible for the administration, regulation, maintenance and operation of projects.

2.6.2 River Basin Organisations in India

Several river basin organisations (RBOs) exist in basins across India. The RBOs are generally headed by the Central Government Ministry of Jal Shakti, the Ministry of Power or a chairman appointed by the Government of India (GoI). In recognition that the existing RBOs require improved capacity for basin planning, the GoI is currently implementing the NHP III which in part aims to provide RBOs, and other water management agencies, with the data, tools and expertise for river basin planning. Case studies 3 and 4 provide examples of RBOs in India and Australia, respectively.

Without integrated river basin management through the RBOs, there would be interstate disputes and limited collaboration between departments related to water (irrigation, agriculture, industries and environment). Water related data and information would remain fragmented, consequently reducing the possibilities to conserve water

(Government of India, 2016, p 7).

Case study 3: River Basin Organisations in India

In India, there are in total 49 Implementing Agencies for water governance and management, consisting of 8 central level agencies, 39 state or union territory level agencies, and two river basin organisations (RBOs). One river basin organisation is the Damodar Valley Corporation (DVC), which was founded in the year 1948 as the first multi-purpose river basin organisation of independent India. The basin had experienced massive destruction by flooding from 1790 till 1943 and thus the DVC was set up to manage and protect the command area from frequent flooding. The central government along with the states of West Bengal and Jharkhand jointly manages the DVC. The primary functions of DVC are to provide flood control, irrigation, water supply, power supply, and soil conservation to local community. DVC has a network of four dams over the Barakar, Damodar, and Konar River. The corporation has also constructed four additional multi-purpose dams in the command area. (Damodar Valley Corporation, 2019).

Case Study 4: River Basin Organisations in Australia

One way to characterise the “commission” and “authority” models is to compare a “round table” approach, where consensus of all parties is required, and a “regulatory” approach, where all parties are consulted, while the regulatory authority makes the final decisions, creates a Basin Plan and audits compliance. In the Murray-Darling Basin, a consensus-based “round table” cooperative joint-venture approach has been used since 1914 on the River Murray (and since 1992 as the former Murray-Darling Basin Commission) and still continues for some programs. The legislative and regulatory approach was introduced in 2007 to create the Murray-Darling Basin Authority and in 2012 the Murray-Darling Basin Plan. The two models now operate in parallel, but with clearly defined and separated roles for each.

Elsewhere in Australia, the consensus-based approach is still used, for example in the Lake Eyre Basin and for a large cross-border groundwater system in the Great Artesian Basin.

The investment (funding) context will influence the roles and responsibilities of the RBO. Adequate financial resources will be required for it to:

- conduct thorough and genuine stakeholder engagement;
- develop the plan and adaptively manage it;
- collect, audit and respond to monitoring data; and resolve conflict effectively as it arises.

While there are costs involved in good governance of river basins, economic gains are also achieved. Given the economic, social and environmental dependence on water resources, the case for sustainably managing river basins, especially in contexts of water scarcity and climate change, is evident and well documented (e.g. Pegram et al. 2013).

Typically, the key functions of the river basin organisation are summarised in the following Table 4 (Molle, Wester and Hirsch, 2007; GWP, 2009; CAP NET, 2005).

Table 4. Key functions of a river basin organisation

Function	Description
Planning	Formulate a river basin plan for the medium- and long-term management and development of water resources.
Constructing, operating and maintaining infrastructure	Develop and maintain the infrastructure needed to regulate, operate and deliver water along multi-jurisdictional rivers, according to the basin plan.
Allocating water	Apportion water to different sectors and geographic areas. This includes catering for the needs of rivers and groundwater systems.
Distributing water	Ensure that the allocated water reaches its point of use.
Resolving conflict	Enable and promote negotiation and resolution between basin stakeholders.
Monitoring and investigating	Collect the information needed to assess and inform river basin planning.

2.7 Policy and legislation

For basin planning to succeed it needs to be enabled and supported by a strong and accountable legislative and policy framework. The exact legislation and policies needed to develop an enabling framework will differ between countries and even states within countries, but they generally include national water legislation and policy linked to and supported by state legislation and policies outlining the basin planning process and empowering the relevant agencies. To assist in basin planning, the policy and legislative enabling environment needs to:

- clarify the purpose(s) of basin planning
- define the basin planning process
- empower river basin organisations
- mandate stakeholder engagement
- establish mechanisms and instruments to achieve the purpose(s) (for example, water sharing or allocation instruments)
- identify the scale of the planning process.

Case study 5 discusses India's River Basin Management Bill and the consultation underway at the time of writing this Guide.

Case study 5: India's River Basin Management Bill, 2018

India's draft River Basin Management Bill 2018 was developed to amend the River Boards Act of 1956, in order to provide for the establishment of River Basin Authorities to regulate and develop inter-state rivers and river basins.

Importantly, the Bill defines water as a 'common pool community resource' whereby water will be held and managed by the State under public trust doctrine to achieve food security, support livelihood and ensure equitable and sustainable development for all. The Bill seeks to enhance participation and cooperation among the basin states and inter-basin water management and at the same time allow equitable and sustainable utilisation of water. The bill promotes conjunctive and integrated management of water resources, and defines integrated river basin management (IRBM) as *'a process which promotes the coordinated development and management of water, land and related resources in a river basin, in order to optimize the river basin's resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems'* (MoWR, 2018).

Demand management is highlighted in the Bill as needing to be given priority, "especially through a) evolving an agricultural system which economizes on water use and maximizes value from water, and b) bringing in maximum efficiency in use of water and avoiding wastages".

The Bill calls for a River Basin Authority to ensure that a River Basin Master Plan for river basin development, management and regulation is prepared for the inter-State river basin under its jurisdiction (Chapter VI).

The River Basin Authorities stipulated within the Bill by way of clause 22 have power to exercise their functions: "Any recommendations made by a River Basin Authority in exercise of its powers and functions under this Act shall be binding upon the Governments interested". The Authorities will be funded by the Central Government, and annual reports will be required and laid before both Houses of Parliament. Nevertheless, the Central Government maintains power to give "directions as it may consider necessary to the Governments interested, for the effective implementation of the provisions of this Act".

The Bill allows every basin to establish its own river basin authority consisting of a two-tier system; a Governing Council and an Executive Board. The Governing Council will be led by the chief ministers of each basin states and comprise of water resources ministers of each state and chairman of the Executive Board. The Bill provides a dispute resolution framework, which stipulates that if the Council is unable to resolve a dispute, then and only then, will it will be transferred to the Inter-state River Water Disputes Tribunal.

The Bill under the Act defines thirteen "inter-State river basins for which River Basin Authorities are to be constituted" which include: Krishna, Godavari, Ganga, Indus, Mahanadi, Mahi, Narmada, Pennar, Cauvery, Tapi, Subarnarekha, Brahmani-Baitarini and Bramhaputra-Barak-inter-state rivers of North East.

Critiques of the Draft Bill (e.g. Panda 2018) have identified that it contains no scope for communities to be involved in river basin planning, and that the Draft Bill should ensure that local communities, village councils and other traditional institutions of indigenous peoples are involved in all decision-making processes that impact their lives.

At the time of writing this User Guide, the Draft Bill was undergoing consultation processes with States and NGOs in India.

2.8 Formulating a vision and objectives

Formulating a vision for the basin involves working with stakeholders to develop a description of the desired long-term state of the basin. The vision will outline a desired state for the basin in the long-term future – typically between 20 and 100 years. It is important that the vision encompass the broad range of values and benefits dependent on the water resources. Focussing on a restricted range of values and benefits (for example, only one industry) is likely to build up social, economic and environmental pressures for the future, as the resulting Plan will fail to consider all benefits and impacts from the Plan's strategies.

Based on the basin vision, develop long-term objectives with stakeholders and the broader community. These long-term objectives translate the basin vision into specific aims for the plan to achieve within a timeframe and using the available resources. The objectives are the building blocks that will underlie and shape the long- and short-term basin strategies and ensure they are designed to meet the basin vision. The objectives will also support the values identified in the situation assessment.

When asked what their vision was for river basin management in India, water agency stakeholders from the Krishna and Godavari Basins responded with the following key points:

- Equitable water to all
- Improved water quality and quantity (including application of environmental flows)
- Irrigation modernisation
- Water accounting and security
- Capacity building of stakeholders (both in agencies and of farmers in particular).

The vision will provide guiding principles and direction to the planning process but is often aspirational, rather than specific. The vision is the foundation of the plan logic and provides the basis for development of specific long- and short-term objectives and planning. Due to its importance in setting the direction of the basin plan, it is important to develop the vision using participatory processes and with engagement of all relevant stakeholders.

Frequently, as is the case for many public policy issues, the objectives for a large river basin will embody the diversity and conflicting objectives and values of different groups in society. Since the objectives reflect social values, the highest level of objectives may be difficult to measure. However, from these broader, values-based objectives, more specific and measurable targets will then be developed. The process of engaging and negotiating with communities, users and stakeholders will help to reveal the interests and needs of all parties. The process of engagement helps to build trust even with those parties whose personal vision may not be fully reflected in the final river basin plan, given that the plan draws together a range of interests and will inevitably involve compromise.

When developing the vision for the basin or sub-basin, the following will need to be developed:

- objectives – a statement of the overarching rationale for why the project is being conducted focusing on what is going to be achieved rather than what is going to be produced
- outcomes – the benefits or other long-term changes that are sought from implementing the plan and that will be achieved by meeting the plan's targets. Outcomes are linked with objectives, in that if the outcomes are achieved then the project's objective/s have been met
- targets – outcomes that have a measurable benefit and will be used to gauge the success of the plan. The targets will be specific and so can only be finalised once the strategies in the river basin plan have been decided after engagement and negotiation with stakeholders.

Best practice indicates that SMART targets should be identified and adopted. These targets are:

- **Specific** – target a clear and specific area/theme
- **Measurable** – can be quantitatively assessed
- **Achievable** – is realistic and attainable within the time period and resources
- **Relevant** – all (or most) stakeholders must agree on the target
- **Time-bound** – specify when the target will be achieved.

Case study 6 (Tare et al., 2015) provides an example of a vision for the River Ganga, while case study 7 provides an example from the Tungabhadra Basin within Karnataka state.

Case study 6: The National River Ganga Vision

In 2015, a visioning process for the River Ganga was undertaken, and it developed the following vision. The vision was not tied to a basin planning process, but could be adopted as part of a future basin planning process for the Ganga and other river basins.

“... wholesomeness of the National River Ganga including: i) Aviral Dhara (Continuous Flow): constituents of River Ganga are continuous and adequate over the entire length of the river throughout the year; ii) Nirmal Dhara (Unpolluted Flow): river water quality should not be adversely affected by human activities; iii) Geologic Entity: The Ganga River System is a heritage of past geological ages; iv) Ecological Entity: The Ganga River System is a delicately structured balance between various living species and the physical environment, achieved by nature over thousands of years and vulnerable to irreversible changes.”

Case study 7: Tungabhadra Basin vision and goals

The Tungabhadra River Basin is a sub-basin of the Krishna Basin. Karnataka state’s Advanced Centre for Integrated Water Resources Management has been studying and developing plans for the Tungabhadra River Basin, which forms 30% of the area of the state and supplies 37% of food production for Karnataka.

“The vision for the Basin is a secure supply of good quality water for all domestic, agricultural, industrial and environmental water users that maximise benefits to the State”.

The Goals for the Tungabhadra River Basin have been defined as:

1. Water users, including the environment, have clear, transparent and effective entitlements to water.
2. Water entitlements are implemented efficiently and productively.
3. The use of the basin’s water resources will not be adversely affected by poor water quality.
4. Water users are informed, resilient and able to plan for drought and climate change.

Source: Advanced Centre for Integrated Water Resources Management

2.9 Building a long-term vision using lessons from others

Importantly formulating a vision and objectives should incorporate lessons from both other domestic and international situations. By doing this the basin planning can incorporate an element of ‘avoiding the mistakes of others’.

The development and management of Indian water resources takes place in the context of India’s economic development and the need to assure food security and lifting the population out of poverty. It is important to realise that the path to these goals does not have to be a linear one that follows exactly the same stages as elsewhere. For example, Australia has now identified in the Murray-Darling Basin that development of water extraction had passed sustainable levels and the Australian government has had to invest in recovery of water for the environment, while improving irrigation efficiency to increase productivity from water that is extracted. In order to best harness water resources for development, it is not necessary to develop to unsustainable levels, when the technology and knowledge is available to achieve the same goals with sustainable water use.

Ideally River Basin Planning can incorporate elements of what the future drivers are likely to be as well as the immediate context. By incorporating this basin planners can design their governance, administrative and technical process to cater for future demands.

2.10 Planning the monitoring, evaluation and learning framework

An evaluation framework should be developed at this stage so that it is integrated throughout the whole basin planning process. Development of the framework involves drawing links (a ‘line of sight’, a logic diagram) between the basin vision and objectives, establishing key evaluation questions to assess the success of the plan, and identifying indicators to measure the achievement of objectives. At this stage, the evaluation framework will not include measurement of activities and strategies; these will need to be developed at a later stage.

3 Stage 2: Inclusive community engagement

3.1 Key messages

1. Inclusive approaches have been found to make water governance interventions more sustainable – providing confidence that plans and strategies are able to contribute to multiple objectives which support sustainable development.
2. Inclusive community engagement requires ensuring that the needs of the poor and marginalised are considered, in order to ensure that critical human water needs are met in any river basin planning intervention. It also requires that women and marginalised peoples are genuinely involved and that their voices are incorporated into water management decision-making.
3. Processes for community and stakeholder engagement need to be built into all key river basin planning phases for stakeholder engagement to be effective. Frequent and ongoing engagement with the community, with key user groups and stakeholders, is needed to build trust in the process and to get input on defining issues, options and making decisions.
4. Governments (national and state) are leading facilitators in enabling river basin planning, and will need to listen to communities and stakeholders dependent on river water resources, if river basin planning is to successfully achieve its objectives. Water resources professionals have a key role to play in listening to and working with stakeholders, to understand benefits and impacts and to communicate these to politicians and Ministers.
5. Stakeholders include representatives from government, businesses, communities and the knowledge sector. It is important to have an understanding of the power dynamics within and between these sectors of society, and to manage these in transparent and accountable ways.
6. Stakeholder engagement can take many forms, and can vary from low levels of engagement, through to high levels of engagement that give stakeholders decision-making power. It is important that the level of influence that stakeholders have on a decision is understood and is equitable, so that expectations are managed, and processes are transparent. For water sharing and water allocation, the decision-making power will most likely be the role of governments, informed by stakeholder engagement.
7. Co-ownership of the Plan (by government, industry and community) is necessary for the Plan to be carried out, and to be enforced.
8. Safeguarding gender equality and social inclusion at each step of the process is important, to ensure that people are not further marginalised or disadvantaged in river basin planning, water allocation and sharing decisions. Inclusion means that marginalised people are represented, not only in numbers during decision-making processes, but supported so that they can contribute equally and influence decisions.

Engagement with community, business, and other stakeholders throughout the basin plan development and implementation process is necessary to ensure that the plan reflects the vision and needs of the community, garners maximum support, and mitigates risks. Governments will most likely have the role of taking decisions on water sharing, allocation and other significant matters. However, involving, engaging and listening to stakeholders can have multiple benefits including:

- Stakeholders can bring important information to the table that will inform decision-making and increase understanding by all parties.
- Aiming for consensus throughout the planning process can reduce the risk of conflicts that can hinder the success of the plan. It is rare that all stakeholders will agree, but it is possible to reach understanding and acceptance where stakeholders feel they have been listened to and the decision taken considers their needs.
- Involving stakeholders increases the transparency of public and private actions.
- Involving stakeholders increases trust between the government and other stakeholders. This can lead to long-term collaborative relationships and a more effective river basin plan (Cap-Net, 2005). Common understanding puts the plan on a solid footing for implementation.

Governments (national and state) are leading actors in enabling, resourcing and enacting legislation for river basin planning. Balanced alongside this role, governments will need to listen to communities and stakeholders dependent on river water resources, if river basin planning is to successfully achieve its objectives. The water resources professionals employed in the relevant government departments have a key role to play in listening to and working with stakeholders, to understand benefits and impacts of river basin planning options and to communicate these to politicians and Ministers.

Case study 8 provides an example from Tungabhadra River in Karnataka state.

Case study 8: Stakeholder engagement in India, Tungabhadra River in Karnataka

The Advanced Centre for Integrated Water Resources Management (ACIWRM) has developed a basin plan for Tungabhadra River in Karnataka, incorporating principles of IWRM in the basin plan with a focus on stakeholder consultation and community engagement. The progress report published by ACIWRM underpinned the importance of stakeholder consultation in the success of the basin plan. Figure 6 illustrates the inclusion of stakeholder consultation at each stage of the basin plan. In the Tungabhadra basin, ACIWRM identified the stakeholders from each scale such as government, farmers, and local residents. Workshops were organised during the river basin profiling stage and continued for the rest of the process. The first workshop was held at capital location Bengaluru and then at an onsite location, such as Hosapete, Shimoga, and Chitradurga. The stakeholders included were representatives from water resources, groundwater, pollution control, horticulture, agriculture, and fisheries department, community, Water User Cooperative Societies (WUCS), and Non-Government Organisations (NGOs). Along with these consultation workshops, several technical workshops were also conducted to evaluate and discuss the modelling results with relevant water governing institutions (ACIWRM, 2018).

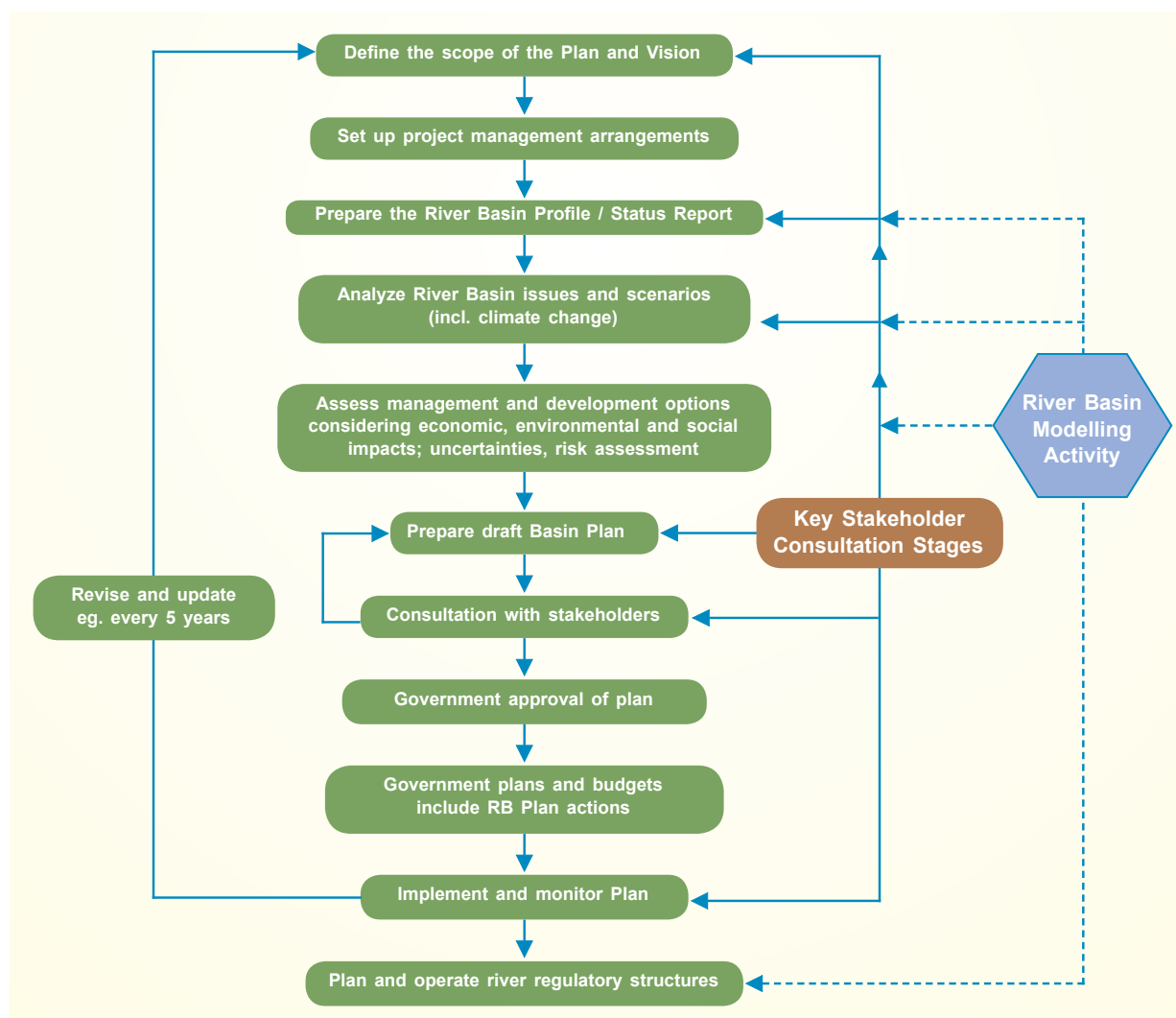


Figure 6. Stakeholder engagement processes used for the development of the sub-basin plan for the Tungabhadra River (adapted from ACIWRM, 2018)

3.2 Who to engage in river basin planning?

When identifying stakeholders, it is important to consider who is involved in decision-making on water resources in the basin, as well as who will be affected by the basin plan (GWP, 2009). Governments and their agencies play a leading enabling and decision-making role in establishing legislation, institutional arrangements, adopting the final agreed river basin plan into legislation, establishing water rights, allocations and entitlements and setting the legal and regulatory framework. Experience has shown that for all these roles to achieve their objectives, engaging and listening with community, industry and other stakeholders is essential. Stakeholders include:

- community: water users, farmers, indigenous groups, water user associations, women's groups, communities relying on the river for fisheries and river-dependent harvests, such as reeds or birds, conservation groups, interest groups, non-government organisations (NGOs), international non-government organisations, schools, sports clubs, families, community leaders, communities dependent on the river for cultural purposes, such as immersion in the river or other religious rituals
- government: government entities that are not leading the river basin planning decision-making, can be regarded as stakeholders. These may include water utilities, federal/state/local government agencies for agriculture and water, local government officials

- business: agribusiness, businesses that utilise water resources, businesses that discharge wastewater into the river system, private sector operators utilising water resources (for production etc.), industry groups, fishing companies, mining companies, hydroelectricity generators, media outlets
- the knowledge sector: universities and institutes (Indian Institutes of Technology, etc).

Not all stakeholder engagement is the same, and the type of engagement must suit the context. For example, passive participation where stakeholders are simply told what is going to happen is not likely to have significant benefits (CAP-Net, 2005). In designing the engagement, it is important to understand the power dynamics within and between groups/sectors of society, and to manage these in transparent and accountable ways. As shown in Figure 7, different types of stakeholder engagement can be placed on a continuum according to the amount of influence the stakeholders have (Pegram et al. 2013). It is important that all stakeholders have an equitable opportunity at the same point on this continuum, noting that governments by their nature have ultimate decision-making power.

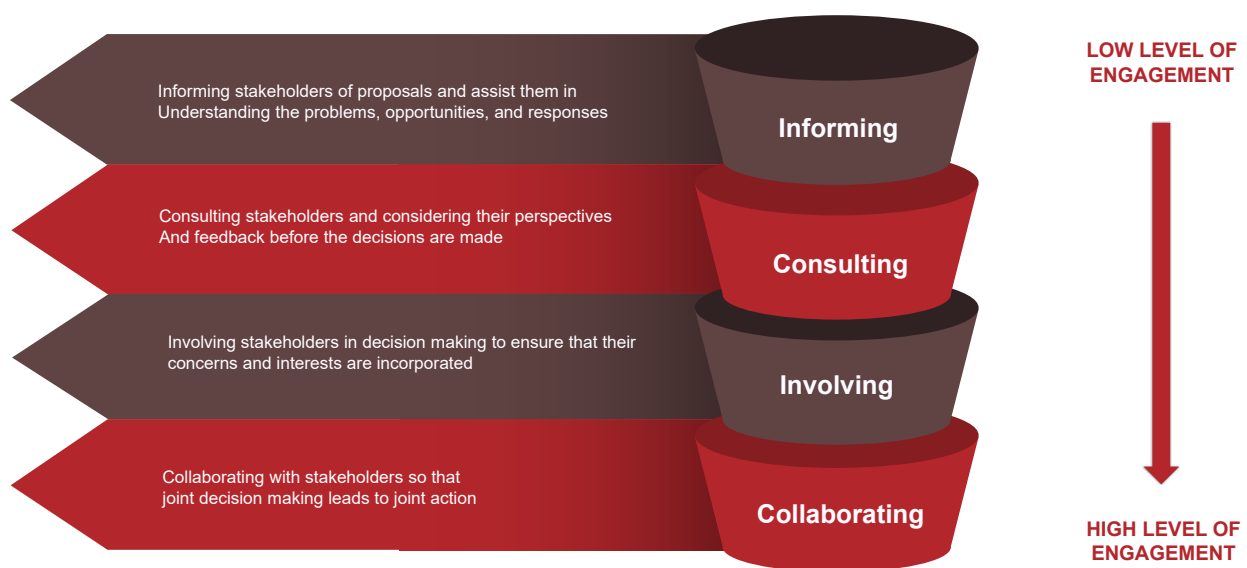


Figure 7. Spectrum of stakeholder consultation (Pegram et al. 2013)

Stakeholder engagement can take many forms, and can range from low-level engagement, through to high-level of engagement that includes decision-making power (Figure 7). Co-ownership of the Plan (by government, industry and community) is necessary for the Plan to be carried out, and to be enforced. It is important that the amount of power that a stakeholder group has in a decision is discussed and understood, so that expectations are managed, and processes are transparent. To ensure stakeholder participation is integrated into the basin planning process it is generally accepted that a stakeholder participation strategy is required. This strategy will identify the key stakeholders and their interests, assess the influence and importance of stakeholders, and outline a plan for engagement with each stakeholder group (CAP-NET, 2005). This may include engagement forums such as: workshops and information sessions; deliberative decision-making processes; online engagement through websites and social media; and public awareness and education campaigns.

Early engagement will help to identify who is reliant on the river, how they may be affected by river basin planning and how river basin planning can balance costs and benefits across different sectors of society. For example, identifying that riverside villages are dependent on a certain fishery, will enable the river basin planners to assess impacts of the plan on that type of fish and therefore on those villagers. Another example is where early identification of cultural needs for a certain depth and velocity of river flow will enable river basin planners to develop models that predict how those cultural needs are affected by withdrawal of water for 'lift schemes'.

3.3 Gender equality and social inclusion

When establishing an enabling environment for river basin planning, it is important to consider existing inequalities and power dynamics to ensure inclusion of all relevant stakeholders. Inclusive approaches have been found to make water governance interventions more socially, economically and environmentally sustainable, providing confidence that plans and strategies are more able to contribute to multiple

“The lack of water, sanitation and hygiene facilities that meet women and girls’ needs can be largely attributed to the absence of women’s participation in decision-making and planning”

(Mr Léo Heller – second Special Rapporteur on the human right to safe drinking water and sanitation, 2016)

objectives, which support sustainable development (Grant et al., 2017). The United Nations World Water Assessment Program reported in 2015 that: “No water assessment can be realistic without a gender perspective. And no decision-making is inclusive unless both women and men participate in the process”.

Inclusive stakeholder engagement requires ensuring that the needs of the poor and marginalised are considered, in order to ensure that critical human water needs are met in any river basin planning intervention. It also requires that marginalised peoples can be involved and that their voices are incorporated into water management decision-making.

While women comprise at least 43 percent of the agricultural labour force globally, their ownership of and access to land and water resources is not equal to that of men (de Jong et al., 2012). Simultaneously, in many countries, including India, many men are moving from farming to employment in urban areas, resulting in women needing to take up increasing roles in agriculture. This trend highlights the need for inclusive processes in river basin planning, that take into account the needs and knowledge of women as well as men.

One key issue that serves to exclude women from decision-making forums related to water management is unequal land ownership laws and practices. In India, as in many countries, significant disparities exist between men and women in the ownership of agricultural land (Garikipati, 2008). It has recently been reported that in Andhra Pradesh, while there has been an increase in the number of women who depend on agriculture for their employment, “little recognition of their role in land and livestock management meant that women have largely remained invisible to the government in terms of agricultural policies, programmes and budgets” (Seethalakshmi, 2016). Inclusive river basin planning requires policy makers and planners to draw on the knowledge and needs of the broader community, including women, many of whom are working in agriculture and have strong connections to water management at a range of levels.

3.4 Examples of stakeholder engagement

Case studies 9, 10 and 11 provide examples of implementing gender equality, social inclusion and stakeholder engagement from India and Australia.

Case study 9: Gender equality and inclusion in water resources management, India

Over the past three years TERI School of Advanced Studies (India) and ICE WaRM (Australia) have partnered to deliver training on Gender, Equity and Water Management, targeting mid to senior career professionals in government agencies and NGOs.

The two-day training sessions were held in four cities (Delhi, Hyderabad, Guwahati, and Gurgaon) in partnership with local water management institutions and have engaged over 200 water professionals (2016 – 2019). The training sessions were delivered through expert presentations, interactive group problem solving and action planning, on issues such as conceptualising gender equity and water management and mainstreaming gender equality in policy and planning. The program takes a focussed look at the status of female water professionals in South Asia, by looking at the challenges faced by women in the sector, as well as the benefits of increased participation and what is needed to support this. The course looks deeply at the role of institutions, and how institutions shape access to water resources and how gender dimensions impact on this access.

River basin planners require a combination of technical and social skills in order to meet competing social and environmental demands with a variable water supply. A strong understanding of gender issues, along with other forms of disadvantages such as class, caste and poverty are necessary to ensure that river basin planning processes are sound, as well as the needs of all members of society met by water resources management decisions. The training program is supported by the Sustainable Development Investment Portfolio of the Australian Government.

Case study 10: Community stakeholder engagement in the Murray-Darling Basin

At the basin scale, a forum for consultation with community representatives was established in the 1980s and continues today as the “Basin Community Committee”. At the valley scale, NSW established River Management Committees in the 1990s which developed the major NSW Murray-Darling Basin water sharing plans. Basin states have established catchment management bodies which involve regional communities in natural resource management, including river basin planning. These bodies and the state and federal water agencies engage with locally based water users’ associations and other community- and industry-initiated groups. The experience has been that enabling local consultation and discussion of the reforms, and being open to locally developed solutions, fosters commitment to the agreed outcomes.

Case study 11: Aboriginal leadership in the Murray-Darling Basin

Australian Aboriginal peoples have maintained strong cultural connections to country and to water sources for over 50,000 years (Cooper et al. 2018, O’Connell et al. 2018), despite being oppressed, marginalised and dispossessed of land, water, knowledge and a cultural life. The legacy of the dispossession continues in economic, social and political disadvantage. In the Aboriginal world view, peoples and Country (including lands, waterways and seas) are interdependent entities that are intrinsically linked in the landscape through cultural and spiritual significance. This means that there is no separation of nature and culture – the health of the natural environment and cultural wellbeing of Aboriginal peoples is directly influenced by the health of the cultural landscapes, including waterways.

Aboriginal and Torres Strait Islander Peoples’ traditional ecological knowledge and stories are passed down from generation to generation and continue to this day, supporting a symbiotic relationship with land and water. This knowledge and connection to Country is essential to managing rivers in Australia, and increasingly drawn upon to support decision-making about water sharing and management. For example, as a result of advocacy efforts by Aboriginal peoples in Australia, engagement forums were established, such as the “Murray-Lower Darling Indigenous Nations” and the “Northern Basin Aboriginal Nations”. Through these forums, Australian Aboriginal peoples have discussed water management issues with Murray-Darling Basin bureaucrats and decision-makers, informing and influencing decision-making relevant to the Murray-Darling Basin Authority and the Basin States.

4 Stage 3: Situation assessment

4.1 Key messages

These key messages also act as key criteria for the situation assessment.

1. One framework used to guide a strategic situation assessment is STEEPL (Social, Technological, Environmental, Economic, Policy, Legal). This framework provides a useful prompt to structure the relevant information for a river basin plan.
2. Define the water resources to be subject to the river basin assessment and plan.
3. Describe the setting and context of the river basin and its geology, hydrology and geomorphology, hydrogeology and surface-groundwater connectivity, as well as its ecological, economic and social resources, and the community's values and uses for the river basin.
4. Conduct a situational analysis of the available resources, their status, trends, characteristics and the risks to those resources, to inform a baseline for the basin.
5. Understand current and future water demands, including environmental needs, water quality needs and multiple parts of industry and community dependent on water volumes and flows.
6. Understand current and future supply.
7. Document the existing governance, legislation, regulatory and compliance status.
8. Identify issues of common concern and potential management options using risk assessment, and multi-criteria analysis, including "triple bottom line" considerations (economic, environment, social). The situation assessment should be framed around a set of topics and questions that will identify the key deficiencies so that the river basin planning process can give priority to addressing the most pressing problems. The situation assessment should also be framed by the vision and objectives.
9. Understand, and model, different scenarios of climate and climate change-related impacts, and design strategies to mitigate and adapt to the impacts.
10. Basin planners need access to a range of representative and reliable information on the basin to understand the historical, current and future condition of the basin, to understand the impacts of different development scenarios, and to provide the basis for monitoring.
11. A coherent and planned monitoring program that is coordinated across different agencies in the basin ensures that the relevant information for basin planning is being collected.
12. The information collected for a river basin is often used to develop basin models which provide a basis for understanding and analysing the historical, current and future trends of water resources and their use in a basin, as well as scenario analysis to compare different options for future management.
13. Whilst collection of information and modelling is important, it is essential to have a clear objective and process in place for analysing and using the information and results produced, as well as making it available for basin planners and other stakeholders.

The situation assessment establishes an understanding of the current and future conditions of the basin, as well as identifying key issues that need to be addressed by the plan. Another name for the situation assessment is a “State of the Basin” assessment. The situation assessment should be framed by the vision and objectives.

One framework used to guide a strategic situation assessment is STEEPL (Social, Technological, Environmental, Economic, Policy, Legal). This framework provides a useful prompt to structure the relevant information for a river basin plan.

The Social context and the social benefits from water resources are an important consideration. Which communities are dependent on the volumes, flows, quality and groundwater levels of the water resources? Within the communities, which social groups are most dependent and likely to feel the impacts of water resources issues covered by the river basin plan? The inclusion of this information in the situation analysis is a key part of addressing gender equality and social inclusion.

Technology status, accessibility and technological developments can have benefits and impacts on availability and distribution of water resources. The situation assessment can provide a snapshot of the status of relevant technologies and the likely future uptake of technology.

Environmental information is a key part of the situation assessment, providing a baseline of whether environmental requirements are being met for ecosystems and for human uses, as well as the trends and predictions of key environmental indicators, including hydrological, physicochemical and ecological indicators. This will inform negotiation and decisions about the river (or aquifer) system needs and the setting of a diversion limit to balance amongst environmental and various human needs. Assessment of interdependency between surface and groundwater is one key element.

Economic assessment needs to include all parts of the economy that benefit from (or are impacted by) the water resources. Agriculture will be a key component, but other economic dependencies on water resources are likely to include power, urban water supply and related industries, fisheries and mining. Economic assessment can also extend to methods to value the ecosystem services provided to humans by water resources, including for example water treatment and increased fertility of floodplain agriculture.

The situation assessment also provides an opportunity to document the baseline policy and legal context. Document the existing governance, legislation, regulatory and compliance status. This is the context in which river basin planning will take place and will also include enabling legislation and policy. The decisions made on the content of the river basin plan may then change some of the legal and policy context.

The first task in the situation assessment is to identify the water resources to be covered by the plan. Ideally, for surface water this should be at the whole river basin scale, although there may be circumstances where another form of identification is appropriate for sound water resources management, e.g. aquifers, interdependent surface and groundwater resources, irrigation areas or biogeographic-agricultural units, such as tablelands that cross catchment boundaries. If the basin is large, sub-catchments may also be identified for more detailed issues analysis and implementation planning. These sub-catchments are generally identified using catchment boundaries, but the identification may also consider issues such as dominant water use, water infrastructure and administrative boundaries.

Situational assessments will usually need considerable data input. This can come from a range of sources, including:

- Geographic information Systems (e.g. land use information, remote sensing of vegetation)
- Administrative/geopolitical records (e.g. agricultural productivity, population census)
- Measured records (e.g. rainfall, temperature, streamflow)
- Modelling and forecasting (e.g. for assessing areas where data may be poor from one area)

Once the water resources to be included in the plan are defined, four key actions are undertaken during the situation assessment (Pegram et al., 2013):

- 1. Setting and context** – Research the basin origin and processes. Include a qualitative and quantitative description of the major biophysical and socio-economic processes of the basin. This may include geological origin and formation of the basin; hydro-climate processes such as monsoon and cyclone systems; cycling of sediment, carbon and nutrients; delta formation; key environmental assets; and human settlement and migration.
- 2. Status and trends** – Understand the hydro-meteorological, ecological, social, sectoral (e.g. agriculture, forestry, fisheries, mining, industry, tourism) and socio-economic status and trends in the basin. Assessment of water resources and their current uses and users is fundamental here and will require information from all sources outlined above.
- 3. Future development scenario testing** – Project future development scenarios (across all sectors dependent on water resources) and climate scenarios to test the implications for water supply and demand. This is typically completed through modelling analysis.
- 4. Identifying issues** – Identify critical planning issues facing basin planners and communities, as well as aspirations and development objectives. Document the issues of common concern to stakeholders. It is also important at this stage to identify all the users dependent on the water resources, including those users not extracting water, such as fisheries, hydropower, cultural, ecological and recreational users. A critical part of this is understanding how the system works under drought and in times of water scarcity.

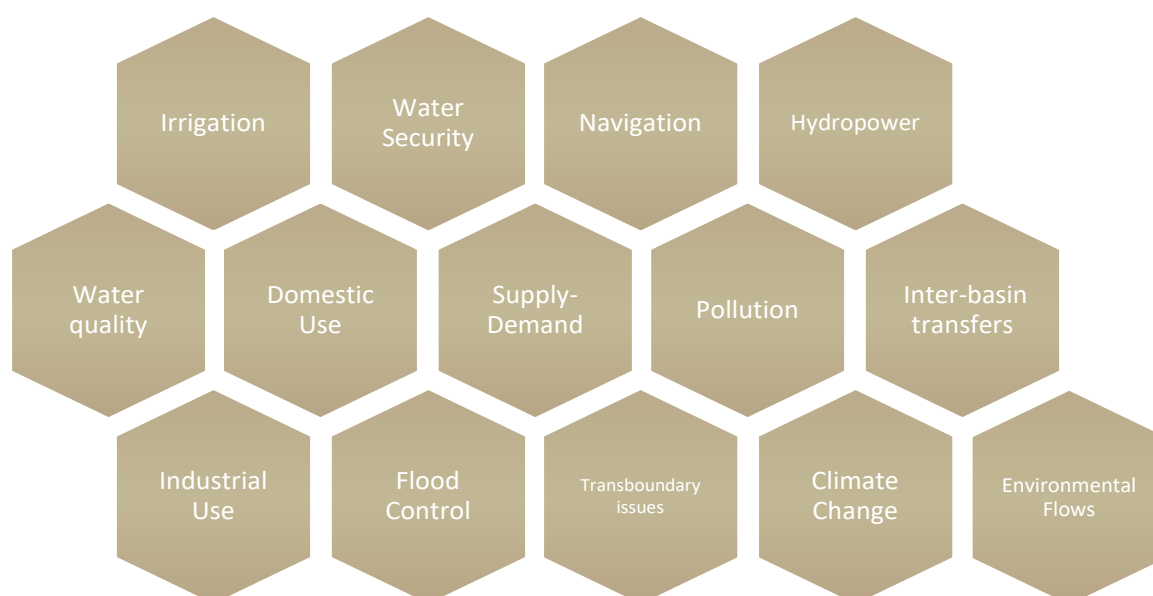


Figure 8. Issues of common concern may include many of those identified in this graphic

Identifying issues of common concern is a key outcome of this phase. Once a basin description has been developed with the involvement of communities, water users and water managers, it is necessary to identify the key issues of “common concern” experienced by river basin stakeholders. These typically fit within water quantity (supply-demand); water quality; environmental, fisheries, cultural, navigation and flood management areas (Figure 8). Food security may also be an important issue, such as through irrigated agriculture or through fisheries that support riverside villages. Identifying issues of common concern will serve to draw key stakeholders together around areas of mutual interest and priority needs. The situation assessment should be framed around a set of topics and questions that will identify the key deficiencies so that the river basin planning process can give priority to addressing the most pressing problems.

Once the issues are broadly defined, studies will be required to obtain a better understanding of these issues of common concern, and to then identify options for managing them. Studies may include population and water demand projections, bulk supply and distribution, navigation requirements, water-dependent ecosystems (their water requirements and the risks they face), key sources of water pollution.

Impacts from climate change are likely to arise as a key threat to water quantity, quality, drought and flood management. Consideration (and modelling) of potential climate change scenarios will be necessary to inform water resources management at the basin level.

Case studies 12 and 13 provide examples of the evolution of situation assessment for the Ganga River Basin.

Case study 12: Environmental Flows Assessment in India on the Ganga

Evaluation and maintenance of environmental flows (e-flows) are key components of an integrated river basin management plan. The e-flows are the amount for freshwater flow required in the river to keep determined/priority ecological outcomes and processes intact while supporting social, cultural and livelihood activities.

In 2008, the World Wildlife Fund-India proposed an e-flows assessment for Ganga River based on international best practice. It was determined that the assessment consider aspects of river flow such as hydrology and hydraulics, ecology, water quality, social needs and importantly, the cultural and spiritual requirements in the context of India. The flow requirements under three scenarios were modelled. (i) Flow under normal circumstance (ii) Flow required during drought (iii) Flows for both drought and normal period (O’Keeffe et al., 2012).

As there are several methods for assessing the e-flows, the study grouped five key methods for assessing the e-flows requirement in the Ganga basin.

1. Hydrology based assessment
2. Hydraulic-based assessment
3. Habitat simulation methodologies
4. Holistic methodologies
5. Extrapolation approach

The Central Government has now notified minimum e-flows on the Ganga (Press Information Bureau Government of India Ministry of Water Resources 2018) and a Ganga River Basin Planning Assessment has been published (Bons, 2019).

Case study 13: Ganga River Basin Planning Assessment

The Ganga river basin is the most populated river basin in the world and is home to half the population of India including two-thirds of the nation's poor people. The basin provides over one-third of the available surface water in India and contributes to more than half the national water use of which 90 percent is diverted to irrigation.

The World Bank has funded a project "Analytical Work and Technical Assistance to support Strategic Basin Planning for Ganga River Basin in India" in cooperation with the Government of India. The objectives of the project are

1. to strengthen the capacity with respect to strategic basin planning,
2. to develop a set of scenarios for the development of the Ganga basin,
3. to build a strong and accessible knowledge base and
4. to establish a multi-stakeholder engagement process to support strategic basin planning.

The Ganga River Basin Planning Assessment Report contains:

- The scenario and strategy assessment;
- The environmental flow assessment;
- The groundwater-surface water interaction assessment.

The scenario assessments indicate a significant decrease in future water availability, water quality and ecological status in the event no additional interventions are made. The intervention that has the most beneficial impact is improvement of municipal wastewater treatment.

The environmental flow assessment showed a significant alteration compared with the pristine state, with the most strongly degraded sector being the middle reaches of the Ganga basin. The assessment identifies the need for clear choices reflecting Indian society values for off stream water use and instream ecosystems and their services.

The groundwater-surface water interaction assessment found a number of knowledge gaps, as well as threats to water quality and threats of subsidence due to extraction.

This case study content is summarised and reproduced from Bons (2018).

4.2 Role of science, community and a decision framework

Community and stakeholder engagement to build common understanding of the information is important, as are principles for decision-making and a governance framework for trade-offs and decision-making. It is important that there is joint discovery of the information and the ideas, with community and stakeholders. Undertaking joint analysis and develop modelling with stakeholders is beneficial. Of course, the way that information is presented and worked through will need to be appropriate to the audience and education level. The principle is that achieving common understanding will help make good plans last, and that science on its own won't deliver the answer. This is because river basin planning is about compromise, trade-offs, and prioritisation based on social, cultural and political factors.

Decisions should draw on the best available science and other sources of knowledge, but science on its own won't always deliver the answer. There are many sophisticated tools and platforms available for water resources data and modelling, but the key consideration is how we apply those tools as an

input to decision-making. Decisions should be made on best available information, but cannot wait and do not need to wait for perfect information. Whilst it is often stated that ‘if it can’t be measured then it can’t be managed’, this is not entirely true if models are available to provide information to fill in gaps in information and understanding, recognising the uncertainties and assumptions made.

4.3 Data and gender equity and social inclusion

Water users and managers are not a homogenous group, and are made up of women, men, children, people with disabilities, people from different ethnic backgrounds, indigenous peoples, youth and the elderly. All these water users have slightly different water needs and responsibilities with respect to water management. This can be better understood through quantitative and qualitative data collection and analysis processes.

Disaggregated data (by sex and disability status) is therefore required to understand how water management decisions affect men, women, boys and girls differently. Data can be a tool for empowerment, but it can also hide disparities when data is not disaggregated, or parts of the population and their water needs and knowledge are excluded.

4.4 Using water resources modelling to support the situation assessment

To undertake basin planning, it is important that planners have access to a range of representative and reliable information on the basin. This information is needed to understand the historical, current and future condition of the basin, to understand the impacts of different development scenarios, and to provide the basis for monitoring.

A coherent and planned data collection, monitoring and modelling program that is coordinated across different agencies in the basin ensures that the relevant information for basin planning is being collected, whilst avoiding wasting resources on unneeded information. Information required for basin planning may include (GWP, 2009):

- quantity and quality of both surface and groundwater resources and their interdependence and connectivity, as well as seasonal and annual fluctuations
- water demand (total and seasonal) including for irrigation, urban supply, industry, drinking water and the environment
- meteorological information such as rainfall, temperature, humidity, flood recurrence
- occurrence and severity of extreme weather such as floods and droughts
- environmental condition of the catchment, main river and tributaries
- social and economic information such as agricultural production, energy demands and demographics
- water and flow requirements for values and uses depending on the water resources, such as hydropower, fisheries, cultural uses, drinking water, recreational uses and existing water user rights, allocations, or entitlements
- modelling approaches need to have due regard to dealing with ungauged basins effectively and a range of methods are available for this.

4.5 Roles that models play in river basin planning

There are two key roles for models and data in river basin planning. The first is in the development of policies and strategies. This usually involves the creation of a “base case” scenario against which planning and policy decisions are tested, to evaluate how the river system will respond and what the water supply or flow implications are for stakeholders and water-dependent processes. Typically, such models are developed with the existing system being represented, but also including future possible outcomes. It is important that strategic planning models are able to include the likely variability in system drivers, such as climate, water demands, infrastructure performance (including reliability and failures) and potential or actual constraints such as system needs. Assumptions used in the models must be documented transparently.

The second role of models can be in assisting with system operations. These are usually run in real time, so that decisions regarding infrastructure changes (such as opening or closing storage regulators, timing of pumping or access restrictions) are informed by simulating those decisions to evaluate system impacts. They can also be used to develop operational rules or controls based on real time data thresholds, so that upstream and downstream conditions are understood when changes to river operations are required.

In both cases, decision-making can be supported through a Real Time Decision Support System (RTDSS), which includes hydrological modelling and Real Time Data Acquisition Systems (RTDAS). It is important to remember that the model and the RTDSS support the decision-making process, but they do not make the decision.

4.6 Model development and application

The development of planning and operational models can be onerous and challenging. River systems are inherently complex, and while computing power and software development is always providing more capabilities, ultimately the performance of any model will be limited by financial and human resources available for their development and the data on which it is based. In a series on model development and application, Jakeman *et al.* (2006) outlines 10 iterative steps in model development which are a very useful guide to the process (Figure 9).

The skills of the modellers are dependent on having a good understanding of the system being modelled. This understanding does not rest solely with the modellers and only through involvement of a range of river stakeholders can reliable models be developed. In Australia, the role of cooperative research agencies, involving government, private sector and academic institutions and groups have demonstrated considerable success in this area (e.g. eWater 2018).

Ensuring that the models have passed the “believability” test is an excellent way to provide ownership and assurance that they can be relied on in the decision-making process. Care also needs to be taken around demonstrating the model reliability through assessment of model uncertainty so that a proper understanding is developed of the bounds in which the model can provide useful answers. Users of model results need to also realise that once generated, a model result can often be taken as being the “correct” or only answer to a given question, when in fact there may be many different answers, each one with an equal likelihood of success. Models can therefore be a very useful tool in understanding complex system interactions by providing greater understanding of the range of possibilities to achieve a certain objective or series of objectives. However, the use of the model results has to be done in a context that is transparent about the model and modelling limitations and assumptions.

Models also rely on the quality and availability of the data inputs. Robust and quality assured data acquisition systems for hydrometeorological, hydrologic, hydrographic, rainfall, runoff and water user behaviour data are an important foundation for building useful models.

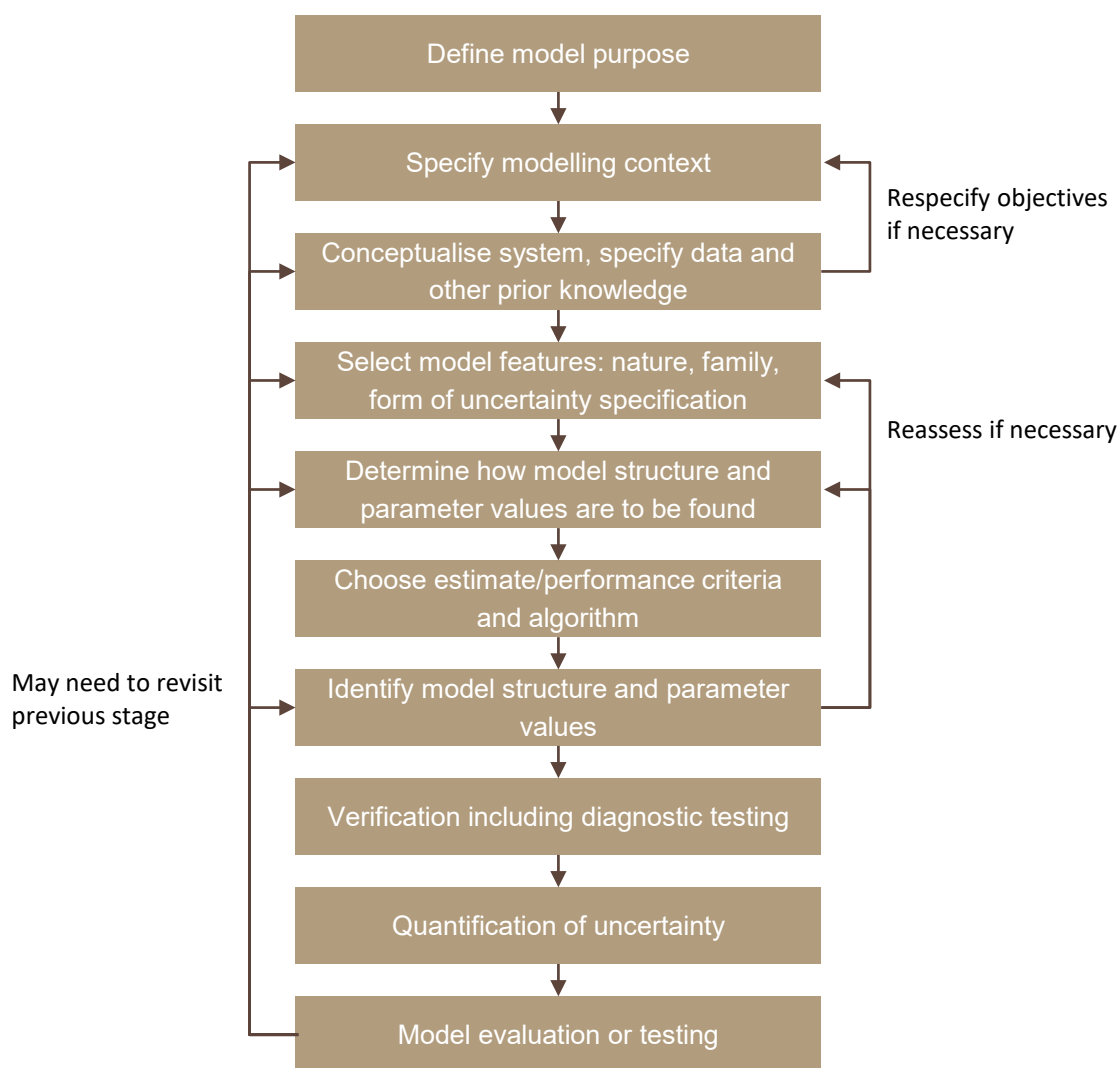


Figure 9. Ten iterative steps in model development (adapted from Jakeman et al. 2006)

4.7 Models are but one tool

In summary, models are a set of tools that can support river basin planning and operation. They should never be considered as the only tool, or the only “correct” answer, they are providers of information and understanding that support planning and decision processes. Ensuring that they therefore have a proper place in the process is essential, as is an understanding of their performance and limitations, so that river managers know how best to use the information that they provide.

Hydrological models assist the policy makers in the following purposes:

- representing the current scientific understanding of the historical and current condition of the basin (e.g. flow regime, agricultural production, impacts of existing infrastructure)
- enabling running of scenarios of possible future plans (for example models could be used to predict based on current understanding the downstream hydrological impact of the development of a hydropower dam and the potential impacts on downstream agricultural production)
- providing a basis for monitoring and review against the modelled scenario results.

Case study 14 provides one example of water resources modelling in India.

Case study 14: Water resources modelling in India

The Australian state of New South Wales and the Indian state of Maharashtra signed an MOU in 2014 for knowledge exchange in the sectors of water accounting and water governance. Thus, Maharashtra state decided to incorporate the 'Source' model platform for basin planning of Upper-Godavari sub-basin. The river basin modelling project under the integrated water resource management system consists of five main phases: Data collection, Modelling Phase I (baseline model), Modelling Phase II (developing rules and modelling equitable distribution of water), Modelling Phase III (further developing water management options), and capacity building.

The primary motive of modelling is to improve conditions of 'Equitable Distribution' of water within the basin. At present, four water management scenarios are modelled to analyse different possibilities of equitable distribution. During the model run, calculations are conducted on 15th October every year, based on water levels in Jayakwadi reservoir and depending on that amount of water to be released is decided. The modelling scenarios include variations around cropping practices and water storages. The model is currently under review to understand how much water is required if equal distribution of water is actually implemented on the strategy of (MCM/1000 ha for irrigation + non-irrigation purposes + evaporation) (GMIRDC 2019).

Whilst collection of information and modelling is important, it is also essential to have a clear process in place for analysing and using the information and results produced, as well as making it available for basin planners and other stakeholders. An open and accessible information and modelling system is needed to enable basin planners and other relevant stakeholders have access to the information required for development of a basin plan.

4.8 Economic tools, valuing multiple benefits and trade-offs

When it comes to economic modelling, it is important to have all values explicit to support clear communication, negotiation of trade-offs and consideration of a range of outcomes.

Drawing on economic tools can help planners and stakeholders to identify which development (or water policy) option offers the greatest value (i.e. utility) to society if a range of factors are considered and quantified. Various methods are available including cost-benefit analysis, distribution of benefits analysis, environmental impacts assessment and development of a business case for investment. To obtain a more holistic understanding of the benefits and trade-offs, multiple tools to assess options, which go beyond traditional "cost-benefit" analysis, should be used to assess the environmental costs and benefits, ecosystem services, liveability, cultural and other values.

Economic analysis, as with all technical analysis, does not make the decisions, but can inform decision-making.

4.9 Water quality planning and management framework

The objective of establishing a water quality planning and management framework is to ensure that the quality of water is suitable for a range of identified uses.

Water quality management requires the development of a coherent set of strategies and plans to safeguard the water quality within a river or aquifer. The full set of water quality strategies and plans may be included in the basin plan, or alternatively the basin plan may clearly outline the requirements, principles, responsibilities and schedule for developing a subsidiary water quality plan. It is important that

the strategies align closely with those in the overall river basin plan but may need specific focus for higher priority issues (e.g. improving drinking water quality).

Key principles for water quality management strategies include:

- **Establish waterway values and uses in a river basin** – these will need to be consistent with those in the overall basin plan, but may address specific water quality values, such as the use of the river for drinking water supply, cultural needs and irrigation water quality. Ideally these would have been recognised in the overall plan. The identification of which values are to be applied to the management of the river is essential to enable the definition of numerical objectives, targets, thresholds or ranges related to adequate water quality.
- **Identify the minimum water quality standards** – These are the technical criteria required for each of the values and uses of the water. These standards could be expressed as objectives, targets, thresholds or ranges. These numerical quantities are derived from scientific evidence in a range of disciplines including public health, ecology, biochemistry and toxicology. A range of best practice methods are available internationally – for example the Australian National Water Quality Management System and associated guidelines (ANZECC, 1994, 2000; Australian Government 2017).
- **Identify the drivers of water quality risks**, including system understanding and, for example, the relationship between low flow and water quality
- **Establish monitoring programs** – These are required to evaluate existing quality and where the standards are and are not being achieved.

Once the values and numerical targets are identified from the previous steps, a situational assessment is needed to find out where objectives are not being met or under what conditions they are likely not to be met. This involves collating all available water quality-related datasets, and collecting new data where feasible and timely, to judge against the numerical objectives. New data collection is best focussed on those locations where water quality is most important for water uses, such as drinking water offtakes and fishery zones. An understanding of where water quality numerical objectives are not being met provides a snapshot of where values are being supported, where they are under threat and where they are not being supported.

Where values are not met or are under threat, the context and causes of poor water quality must be assessed. Possible causes can include direct point source pollution, diffuse pollutants from urban or agricultural areas, and the effects of altered flow regimes from resources development. In some areas, the causes of water quality issues may be natural (e.g. geologically high levels of toxicants or natural seasonal flow variations), in which case the focus of management measures will be on consequences for human users.

- **Define management actions** – for locations or areas where water quality standards are not being met or are at risk.

Following the identification of areas where water quality standards are not being met, the water quality management plan can provide a hierarchy of risks which threaten the identified values. The management plan can also specify the management interventions to be taken to address the likely causes of those threats. For example, a program of investment in treatment of sewage and wastewater may be required, together with maintaining river flows to prevent stagnation, anaerobic decay or fish kills, or to protect critical human water needs. Management interventions can include any of the tools and principles outlined in the “Pollution Management” section later in this User Guide.

4.10 Using risk management to support the situation assessment

The International Standard on risk management (ISO 31000) defines risk as “the effect of uncertainty upon objectives”. A thorough and robust risk assessment processes will help to map the key risks to people and environments within the river basin and help identify which ones should be prioritised (for e.g., high likelihood and catastrophic consequences). Using the Standard process, a multidisciplinary group of experts will identify hazards, assess the likelihood of the hazard occurring, assess the consequence, then use likelihood and consequence to rate risks as high, medium or low. The next step is to focus on the medium- and high-rated risks and identify measures that will mitigate the risk. The post-mitigation risk is then assessed, to identify where the greatest benefit can be achieved.

Once these high priority issues have been identified within each state/region of the river basin, and across the river basin, management options can be considered. Options analysis (e.g. multi-criteria, benefit-cost), including the triple bottom line (economic, environmental and social considerations), is essential to employ at this stage, again, with full engagement of stakeholders to inform the options development, and analysis process.

5 Stage 4: Strategies and planning

5.1 Key messages

1. Clear objectives are necessary and agreement on these should be aimed for, recognising that negotiation of objectives with multiple stakeholders will be required in order to achieve the basin vision. Measurable and achievable targets are needed to support the objectives.
2. Basin strategies are designed to achieve the basin objectives and vision over the long term.
3. The lifetime of the plan should be long enough to provide security and stability to water users and managers, but it should be reviewed frequently enough to support adaptive management.
4. Commitment to genuine long-term and inclusive stakeholder engagement is required to accommodate different interests and perspectives.
5. Assess which strategies and tools will best achieve the basin objectives. These strategies may include system flows and sustainable limits to extraction, demand management, supply management.
6. The “system needs” strategy specifies what flow regime is needed to sustain the river and water-dependent ecosystems, sets an overall limit to extraction and establishes the share between system needs and users.
7. Establish shares between states or other major units (for example irrigation schemes). The river basin plan may also allocate water between users or this may occur through state instruments that are linked to the river basin plan.
8. Establishing the system needs, the limit to extraction and the major water shares are significant decisions. It is important not to underestimate the time needed for engagement, listening to stakeholders, considering technical analysis of benefits and impact of options to different stakeholders and the health of the river system, together with maintaining political support for a clear decision framework.
9. The demand and supply management strategies outline how other needs (industrial, agricultural, domestic) will be met within the constraints of the water available in the system and the water needed to keep the system healthy. Strategies may also be required for water scarcity, operational management and water quality.
10. Engagement and decision-making to select and refine the strategies is best informed by modelling of different scenarios and options using the tools discussed in the Situation Assessment chapter. Scenarios and options analysis need to be undertaken in a consultative manner, integrating and considering long-term visions and targets. Alternative climate scenarios need to be a key element of the assessment and options and strategies to manage under potential future climates need to be considered.
11. Economic, social, cultural and environmental considerations need to be part of scenario building, testing and analysis. There needs to be analysis of the effectiveness of each option for achieving objectives and targets, together with an understanding of the costs and the distribution of benefits.
12. A clear decision-making process and governance framework should be established to select implementation options, with engagement and input from community stakeholders.

The core of decisions in water planning is to identify which strategies and tools will contribute to achieving the objectives and vision. These strategies and tools may involve policy measures, regulatory tools (e.g. limits), development of works, or engagement and communication to achieve behaviour change. A range of strategies and tools are discussed here as examples. The best strategy for each river basin plan, will depend on the objectives sought and the situation assessment in that basin.

This stage involves developing, assessing and prioritising strategies for achieving the plan's long-term objectives and addressing the key issues identified in the situation assessment.

The strategies are designed to achieve the basin objectives, and therefore the basin vision, over the long term. Through consultative processes, the following are generally developed for each sub-strategy (Pegram et al., 2013):

- management objectives as time-based targets to achieve the vision and long-term objectives
- management measures as high-level descriptions of the interventions to be undertaken
- institutional arrangements for implementing the management measures
- broad tools and approaches for achieving the management objectives.

Ideally, the basin plan should provide strategies for all the major issues for the river, in one integrated plan. If separate plans exist for different issues (e.g. a water quality plan or an allocation plan may exist separately for simplicity or for legislative or governance reasons), then clear links should be provided to trigger integrated consideration where needed.

The following aspects need to be outlined in the overall basin plan:

- the purpose of adopting the basin strategy
- tools to be adopted to give effect to the strategy
- links to legislative instruments supporting the adopted tools
- attribution of roles and responsibilities for implementation of adopted tools
- the methods of compliance to ensure roles and responsibilities are being met
- timeline for strategy implementation
- interlinkages with other strategies and tools to be adopted by the plan.

This Chapter outlines some of the fundamental features of developing basin strategies and decision-making based on the benefits and impacts of different options against objectives and for the different stakeholders (Figure 10). Note that the development of the strategies may be iterative, and each strategy may have links to other strategies. Drought and flood strategies are not included in the diagram, but are also key elements of river basin planning.

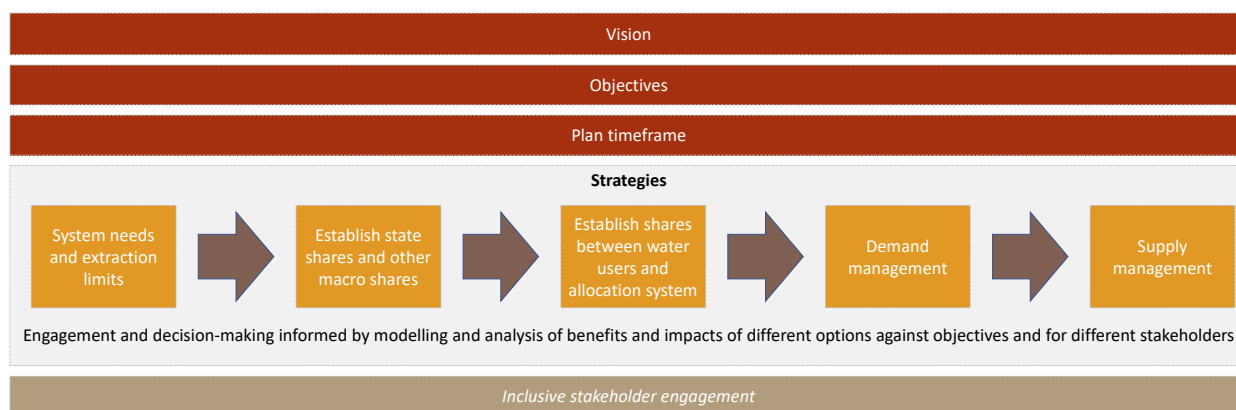


Figure 10. Developing basin strategies

5.2 Timespan of the River Basin Plan

The lifetime of the plan should be long enough to provide security and stability to water users and managers. It should be reviewed frequently enough to support adaptive management, although it may be appropriate for the legislation to set some limits to how much change can occur in each term of the plan.² For example, terms of 5, 10 or 15 years are common.

In the case of legislative plans, the plan may be perpetual, but it is important to provide for mandatory reviews on a five- or ten-year cycle. For example, the Murray-Darling Basin Plan is perpetual legislation, but with a 10-yearly review cycle.

5.3 Basin strategies

The enabling legislation and institutional arrangements are likely to mandate some types of strategies for the river basin plan, at a high level or principles level. The detail of the most appropriate strategies, instruments, measures and actions should be worked out as part of the process of developing the river basin plan. This will require ongoing community and stakeholder engagement, informed by the situation assessment, modelling and other analysis, to inform choices between options that will each give a different balance of benefits and impacts between sustainability needs and the different stakeholders.

The development and implementation of strategies normally includes (Pegram et al., 2013):

1. identifying options and assessing their contribution to achieving the developed objectives
2. evaluating and ranking the options against clear and agreed technical, financial, social, ecological, economic and institutional criteria
3. consulting relevant stakeholders to solicit diverse perspectives and preferences
4. selecting the most feasible option/s
5. identifying clear accountability to determine who is to implement what and by when, as well as how these actions will be funded.

The list of basin strategies presented below comprises those commonly adopted for basin planning across the world. For each strategy, the objectives, a set of broad principles and an example set of tools are provided. Whilst the objectives and principles should be common across different planning applications, the tools adopted to give effect to the principles and objectives will be different and must suit the local context.

² In this context the term “adaptive management” is used to mean a structured, iterative process of robust decision-making in the face of uncertainty, with an aim to review and improve over time based on monitoring and evaluation.

Key strategies for a basin plan which aims to allocate water, enhance sustainability and efficiency of water use, and ensure access to water resources are:

- **Establish system needs and sustainable limits on extraction** – Identify the minimum requirements to sustain the river system, water-dependent processes (such as water quality, sediment processes and wetland systems), critical human needs for communities and industries dependent on the river system and provide volumes and flows (trade-offs may need to be negotiated through the enabling arrangements, governance and institutional arrangements).
- **Distribution of the water users share between states and between water users** – Once the system needs are agreed and a limit to extraction defined, a basis for establishing shares between states and other major units (such as irrigation schemes) needs to be established. Subsequently, there will need a framework and strategies for allocation water access to individual users. This framework is likely to interact with tools and strategies for demand and supply management.
- **Demand management** – Manage water demand and maximise water use efficiency in urban, industrial and agricultural sectors.
- **Supply management** – Manage, and where sustainable increase, the water supply available to the public, industry and agriculture.

The three strategies are interlinked and must be coordinated. The “system needs” strategy specifies what flow regime is needed to sustain the river and allocates water between users to limit extraction. The demand and supply management strategies outline how other needs (industrial, agricultural, domestic etc.) will be met within the constraints of the water available in the system.

In addition to the allocation- and water use-related strategies listed above, there are often two basin plan strategies which focus on responses to events in the basin. These are:

- **Managing competition for water resources under scarcity** – develop agreements and provide rules for how water is shared when it becomes scarce, priorities of use, emergency response mechanisms for acute water shortages, tiered response plans for extreme events. Note that this links closely to the critical human needs component of system needs.
- **Water quality management strategies** – Set water quality targets for the basin, outline strategies and activities to reach the targets and develop monitoring programs to measure the achievement of targets.

It is important to recognise that the decisions involved in establishing system needs and sustainable limits for river basin plans involve much more than technical and scientific input (critical though this is). Similarly, the decisions on shares between states and/or between major irrigation areas or other major industries will be much more than technical decisions.

These are significant decisions where, in order to support economic and environmental sustainability, choices will need to be made that will have benefits and impacts across different groups in society. For this reason, the choices need to be built on careful engagement and negotiation with affected groups, with a key role for governments in considering the right balance for the future. It is important not to underestimate the time needed for engagement, listening to stakeholders, considering technical analysis of benefits and impact of options to different stakeholders and the health of the river system, together with maintaining political support for a clear decision framework. The enabling legislation can provide high-level guidance on key principles to guide these choices and the right balance. The first two chapters of this Guide consider governance and engagement in more detail.

Case study 15 provides an example of development of long-term strategies for water resources management at the state scale.

Case study 15: Maharashtra Integrated Water Resources Strategy (2019)

Maharashtra state has recently won the best state award in ‘National Water Awards, 2018’ for managing water resources effectively. The national awards are the symbol of healthy competition among the states for efficient water management. ‘Integrated State Water Plan’ is one of the key initiatives Maharashtra state has taken up recently. Under Water policy 2003, Maharashtra state has become the first state in India to have an Independent Regulatory Authority for the water sector. Maharashtra Water Resources Authority (MWRRA) Act 2005 is a product of Maharashtra Water Sector Improvement Project (MWSIP) 2005 which is developed to provide institutional governance and enactment to water management (MERI, 2019).

Under the legislative authority of MWRRA, ‘Integrated State Water Plan’ (ISWP) has been prepared to manage water resources, especially river basins by establishing River Basin Agencies (RBAs), State Water Board (SWB) and State Water Council (SWC). A working group of seven chief engineers was formed in early 2017 to prepare the plan which will be published in mid-2019. The ISWP report contains three volumes, the first volume covers 6 primary basins, second covers 69 sub-basins, and the third volume covers interactive maps and surveys. Under the ISWP, Godavari basin plan was compiled in the year 2017 as a pilot project and basin plans for Krishna, Godavari, Narmada, Tapi Mahanadi, and West Flowing Rivers have been approved in 2018. ISWP plan considers both, surface water and groundwater and provides water balance, accounting, and action plans for each basin. ISWP constructs a cohesive picture of water resources by taking in consideration of both, water supply and demand, and socio-economic and legal aspects (MERI, 2019).

5.4 System needs and sustainable limits on extraction

The “system needs” strategy specifies what flow regime is needed to sustain the river and water-dependent ecosystems and sets an overall limit to extraction. This provides the basis to establish the shares between system needs and water users. Distribution of the water users share between states and between water users is discussed below.

System flows are the minimum flow requirements that are essential for non-consumptive purposes such as environmental and cultural purposes and in-stream production needs (e.g. fisheries), as well as for extraction for critical human water needs for drinking and domestic food production. A system flow may take the form of a minimum flow or may be as complex as the definition of specific flow regimes.

Key principles for system need and sustainable limits on extraction include:

- Define a system flow regime that enables water to be delivered, supports water quality, and supports environmental, cultural and other needs.
- Establish an agreed hierarchy of uses so that in times of scarcity, water can be allocated to the most critical water needs.
- Develop a mechanism for allocating water between system needs and water users – the mechanism needs to be responsive to seasonal, monthly and decadal changes in climate.
- Develop a regulatory framework to enforce the defined system flow regime and allocation mechanisms, since this provides stability and security for economic development.
- Enable adaptability while providing clear and predictable rules for how water is made available to users, how users manage their access to water, and how water is distributed between users.

Methods for defining system needs and sustainable limits vary widely depending on the underlying focus. However, usually a combination of the following approaches is required if the solution is to be sustainable:

- **Value-based approaches** which use values-based objectives to frame modelling. This involves consultation on cultural, social, economic and environmental values, needs and benefits, followed by the determination of flow/volume requirements from the resulting policy principles and objectives.
- **Supply-focused** tools use modelling to drive optimisation of supply against an agreed series of requirements using historical climate and flow data.
- **Economic** tools focus on assessing utility enabling assessment of which options and industry demand scenarios deliver the best utility, measured in terms of various economic statistics.
- **Environmental** tools establish environmental objectives and the flows needed to meet those objectives. Common environmental methods include the Building Block Method and holistic approaches (King *et al.* 2000; Tharme, 2003).

5.5 Distribution of the extraction share between states and between water users

Once the system needs are agreed and a limit to extraction defined, a basis for establishing shares between states and other major units (such as irrigation schemes / industry) needs to be established. The states or irrigation schemes or other users will then need a framework and strategies for allocating water access to individual users. This framework is likely to interact with tools and strategies for demand and supply management (discussed further below).

Establishing shares between states (or other significant administrative units) is an inevitably political process that will require patient consideration of all parties' needs. National legislation can provide important principles. Leadership at national and state level is required, together with respectful professional interaction by water resources professionals and officials working at state and national level. Each party will need to listen to the needs of the other parties. As in any negotiation, each party will need to yield something and recognise that all parties will need to get some of what they want (but no party can get everything they want). For conflict and dispute to be resolved, upstream states and downstream states will need to accept that each must get a share. The principles of Australia's River Murray state shares agreement have survived for over a century on this basis, even while political debates continue.

An allocation mechanism needs to be established to ensure that, within the limits established by system needs, water users (agricultural, industry, domestic) have access to the available water resource. The framework to allocate water between users may be part of the river basin plan or this may occur through state instruments that are linked to the river basin plan.

Examples of allocation mechanisms are described below:

- **Water rights or permits** establish a legal framework for water access. They specify the quantity of water available to a particular user, as well as the source, timing, reliability of supply, type of use and duration of access (Richter, 2016).
- **A water allocation plan** sets out the rules for managing the abstraction of water from a river or aquifer to ensure that system needs and other users' needs are met, while being responsive to seasonal or climatic variation in the availability of water.

- **Groundwater extraction permit systems** track and control the use of groundwater through a system of permit requirements. In India, the legislative basis for the permit system could be included in existing state groundwater laws or incorporated into the draft national Model Bill for the Conservation, Protection, Regulation and Management of Groundwater which aims to restore and protect groundwater security in rural and urban areas, and makes provisions for groundwater protection zones and groundwater security plans.

In basins with sufficient water and adequate distribution systems, the establishment of allocations may be a simple process. However, in many basins in India, water is scarce and there is not sufficient volume and/or access to water for the system and all water users. In these cases, demand and supply strategies are needed to assist water users to access sufficient water for their needs within the constraints of the adopted allocation mechanism.

Case studies 16 and 17 provide Indian examples of water resources management strategies at a local level in Maharashtra and for a groundwater management area in Telangana.

Case study 16: Groundwater management in India – Hiware Bazar, Maharashtra, India

Hiware Bazar is a small village in the Ahmednagar district of Maharashtra state. The village is renowned for its water management initiatives and irrigation efficiency action plans with which the village was able to supply water needs through severe droughts. The geographic conditions have a primary role, as the weathered zone (a superficial layer above the water table) ranges to 15m below ground level and is made up of basalt which provides restricted access to additional groundwater flow. Since the late 1970s, farmers have been experiencing severe droughts, which forced them to use more and more groundwater. The over-use of bore wells for agricultural irrigation, especially for sugarcane production, reduced groundwater levels (Garduño et al., 2011).

In order to tackle the drought and resulting depletion of groundwater, the village council prepared an integrated water resource management plan for five years. In 2002, the village-scale crop-water budget was proposed, which assisted farmers to determine the irrigation productivity of their land in dry seasons. The council also asked farmers to reduce the cultivable area and use water-efficient crops for dry seasons. The monitoring and evaluation plan suggests that such proactive actions are showing positive results in terms of groundwater level at Hiware Bazar, compared with surrounding villages.

The water resource plan introduced rainwater harvesting, quarrying trenches and building percolation tanks, which all aided a recovery in groundwater levels. At present, 32 ‘dug-wells’ in the village provide a limited but efficient water supply for irrigation in dry years (Garduño et al., 2011). Although groundwater management of Hiware Bazar is at the village scale, it is an example of the principles of demand and supply management necessary for river basin planning.

Case study 17: User-centred aquifer level plan for groundwater management plan pilot in Telangana state

Telangana state is located on the Deccan Plateau, covering an area of 112,077 km². The state consists of a semi-arid area with groundwater contributing 75% of total water supply for irrigation. Groundwater extraction for drinking water, agriculture, and industrial purposes has led to severe depletion of groundwater levels.

The GroundWater Department (GWD) of Telangana state decided to promote users' participation in groundwater management through a pilot program. The program has been implemented in the Chandur and Marriguda Mandals of Nalgonda district under a Water Sector Improvement Project. The pilot started with community consultations, education campaigns, and social impact assessments. Senior officials from the state ministry and World Bank visited villages, often to motivate and show support for the movement. The movement helped to form 13 council level organisations, which led to formation of the 'Aquifer Recharge Committee'. This committee is now recognised as the 'Groundwater Management Association' (GMA).

The GMA prepared a groundwater management action plan to develop crop and water budgets for farmers. As part of the action plan, 23 check dams with recharge shafts have been sanctioned. After successful implementation of the pilot, GWD has decided to build 181 recharge wells in 65 villages over 5 districts (Madhnure, 2018).

5.6 Demand management

The objective is to provide a range of incentives and tools for water users to manage their water use most effectively and efficiently, within their share, in response to variations in water availability. Demand management is about giving users the tools to decide how they use the water available to them. Many of these tools will also link to other strategies in the river basin plan.

Key principles for demand management include:

- There is a limit to how much water can be extracted for consumptive use while maintaining the health and productivity of the water source recognising climatic and seasonal variability
- Within this limit, each state and each water user has access to a share of the available water
- The more control a water user has over how and when they use their share, the more likely they are to use water efficiently and conservatively
- Demand is best managed at the scale appropriate to users. For instance, there is considerable opportunity for voluntary cooperation by water users (e.g. timesharing of pumping bores, rostering of pumping from surface water) at a local scale
- Water is a highly valuable resource and there is increasing demand for water for competing needs. The priority for supply needs to be determined
- Reduce demand for water wherever possible and maximise water use efficiency
- Recognise that there is a cost for implementing demand management.

There is a range of tools available for demand management, from policy and economic tools to incentivise users to manage their water demand, to technologies that assist in making the use of water more efficient. Some example demand management tools are described below.

- Voluntary cooperative systems occur when a number of users of a common resource voluntarily agree to manage their water demands. For example, on small watercourses or aquifers, users may voluntarily agree to roster their pumping to avoid a sudden depletion of the water source. Case study 18 provides a local level example provided from a village in Maharashtra.
- Identify options that recognise there is a variable and finite limit to water at the appropriate scale
- Establish incentives and mechanisms for optimising water availability and use. This is often done for large river systems where water is captured, stored and released. The advantage of this approach is that users can be clear on the range of water allocations they will receive, and plan accordingly. For example, in many river systems in Australia where water is stored in major public dams, water users have their own 'water account' and can manage their own water risk by withdrawing water or saving water from one year to the next, much like a bank account. Case study 19 provides an example of incentives from Maharashtra.
- Water pricing encourages efficient use of water by placing a price on water that reflects the cost of extraction and distribution. This approach is challenging in India due to the low incomes of many agricultural and urban users, water for fulfilling human rights obligations, and the absence of supportive institutional and technical frameworks (Saleth, 2011)
- Water markets encourage water to be used for its highest value by enabling the trading of water allocations (or rights). Water trading can only take place where sound and transparent governance mechanisms are put in place, a limit on water take has been established (a cap), and an agreed upon allocation system has been established, supported by quality data collection and management (including metering). More information is provided in case study 20 below.
- Water saving technologies include improved irrigation systems, reduction of leakages, domestic water savings measures and changes to industrial processes. These approaches are already well adopted in India. In recognition of the importance of improving water use efficiency, in 2014 the CWC released Guidelines for Improving Water Use Efficiency in Irrigation, Domestic and Industrial Sectors. This document outlines the existing and projected water use for each of the three sectors, and then outlines policy and technological approaches for increasing water use efficiency for each sector (CWC, 2014).

Case studies 18, 19, 20 and 21 provide examples of demand management from India and Australia.

Case study 18: Implementing demand side strategies in India – Water Bank in Hiware Bazar, Maharashtra, India

To achieve water sustainability outcomes, it is essential to shift the focus from water supply to water demand management. Hiware Bazar receives on an average 315 mm rainfall annually. The council prepared its own water budget under the principle of a water 'bank'. The water budget only permits the extraction of a set amount of water, equivalent to annual rainfall, while keeping 5% of that as a reserve (IDFC Foundation, 2012).

The water budget considers drinking water as the first priority, allocating 50 LPCD (Litres Per Capita Demand) and 30 LPCD for livestock. In the drought year of 2011, only 200 mm of rainfall occurred. Thus, all the villagers mutually decided to reduce the rabi cultivable crop area and not to grow any summer crops. As per the regulation, only 1 acre of rabi crop was permitted per private well. In addition, to meet water demand, villagers were asked to grow vegetables which required less water, instead of wheat which requires a lot of water. The council also banned bore wells entirely for irrigation, allowing only two bore wells per house for drinking water. Access to open well water was kept under restriction (IDFC Foundation, 2012).

Case Study 19: Group Farming initiative in Maharashtra state

The Maharashtra state government has offered to provide financial incentives of up to 50 lakh rupees to farmers, for encouraging group farming to reduce water demand and double the farm income. The group farming model depicts that at least 20 farmers from each village should come together to pool 100 acres of agricultural land together. The state government provided financial and logistical support along with crop pattern and scientific farm practices to encourage a doubling of crop production. The primary objective behind the group farming model is to minimise losses incurred by small farmers having area less than 2 hectares (The Indian express 2017).

Case study 20: Water markets

Water markets encourage water to be used for its highest value by enabling the trading of water allocations (or rights). Water trading can only take place where sound and transparent governance mechanisms are in place, a limit on water take has been established (a cap), and an agreed upon allocation system has been established, supported by quality data collection and management (including metering). Water trading is not an appropriate system to use without these necessary conditions being satisfied.

In Australia, water markets have enabled water to be “reallocated” to high value uses and to maximise overall economic value of agriculture even during droughts. However, there are diverse views about water markets and they are seen by some to have negative consequences in moving water-dependent economic activity away from some areas dependent on water-related industries for employment.

The actual form of the water market can vary. For example, in Australia water markets function like a stock exchange with willing sellers advertising their water for sale or loan on an internet bulletin board at a specified price (Richter, 2016).

Existing water markets in India are informal, and generally limited to local water trading between adjacent farmers. It is most common for groundwater, where water sellers are large farmers with deep wells and high capacity pumps, and most buyers are small and often poorer farmers. This means that the sale of water often does not lead to any reduction in water use by the sellers, and the power imbalance typically leads to weak bargaining positions for buyers (Maestu, 2012). Without the above mentioned governance, including compliance structures being put in place and proven to function over a period of time, water trading would not be a viable option for India.

Case study 21: Demand management tools used in the Murray-Darling Basin

Australia has developed a range of tools for demand management:

- a system of entitlements of varying security, predictability and reliability
- carryover of unused water allocations from one year to the next
- voluntary methods, such as rostering of pumping schedules amongst groups of water users
- allowing access to a proportion of entitlement, depending on water availability
- the ability to trade, creating a market that allows industry to modify who has access to water when, depending on their needs (& ability to pay)
- a cap or limit on water extraction for the basin, a river valley or a water source
- urban water and some irrigation areas have instituted demand management by pricing water for partial or full cost-recovery, with consideration of capacity to pay
- water restrictions during time of severe water shortages
- education programs.

5.7 Supply management

The objective is to develop supply management strategies that improve reliability of access to water, while maintaining the health and productivity of the water source.

Key principles for supply management include:

- Maximise water availability for productive uses (e.g. agriculture, industry) within the extractive share of the available water resources, while maintaining the health and productive capacity of the water source
- Ensure that water users have as much control as is feasible to meet their water needs with reliable access within their share of the resource and within the context of seasonal and other variability in water resources
- Supply management requires a recognition that continuing to construct major new infrastructure may be associated with diminishing economic returns, and that benefits can come from maximising the efficiency of pre-existing water supply infrastructure, for example by linking existing dams through pipeline networks
- Supply management is best approached at the most appropriate scale that depends on the water source and the different uses. For example, the adoption of alternative water supply options – e.g. water recycling, rainwater harvesting – provides opportunities to expand the amount of water available for water users at an appropriate scale.

Case study 22 provides an example of both supply and demand management from Gujarat.

Case study 22: Implementing supply and demand management strategies in India – Water and Sanitation Management Organisation, Gujarat, India

The Gujarat state in the western part of India only contains 2.28% of water resources and 6.39% of the geographical area with respect to the overall country's proportion. Since independence Gujarat state has witnessed severe droughts leading to extreme water scarcity. In order to tackle the water supply during times of scarcity of water resources, the State launched a new water governance model, the Water and Sanitation Management Organisation (WASMO) (Gupta, 2011). The model implements both supply and demand management strategies.

WASMO implemented village-wide capacity building and training sessions for empowering the local community to build water conservation (supply) projects. Along with that, technological initiatives such as inter-basin water transfer (supply), drip irrigation (demand), micro water harvesting (supply), and state-wide water grid (supply) were introduced. Inter-basin water allocation through the Sardar Sarovar project will irrigate nearly 2 million ha of land, increasing the agricultural production by nearly 9 million tons per year and providing water supply to 8,215 villages and 135 cities. Under the micro-water harvesting, Sardar Patel Participatory Conservation Project (SPPWCP) was introduced to build 353,937 check dams and village ponds to assist the majority of rural population in Gujarat. The association with 'Gujarat Green Revolution Company (GCRC) Ltd' proved to be vital for irrigation, transforming most of the agricultural land to drip irrigation (demand management). GCRC offered 50% straight subsidy and only asked for 5% of total investment by arranging a loan for remaining 45% amount. Due to financial assistance, 100,000 ha of land was converted to drip irrigation, producing high-value crops (Gupta, 2011).

There are a range of tools available for supply management. Some examples are described below:

- **Development and management of infrastructure** allows for water to be stored for later use, meaning that it is available as needed by water users. Many of India's rivers are already highly regulated by water storage. For example, the Krishna Basin has approximately 650 dams. This high degree of regulation means that supply can be managed to deliver volumes as required by different users. The dams regulate water for irrigation (590 dams), hydropower (five dams) mixed irrigation/ hydropower (47 dams), mixed irrigation/ hydropower/ water storage (one dam), mixed irrigation/ water storage (four dams) and urban water supply (four dams) (India-WRIS, 2015)
- **Water recycling** involves treating wastewater so that it can be reused for the same purpose or used again for a new purpose. The risks to water security from climate change and over exploitation of water resources can actually build a pressure on government to develop new sources for water supply that is fit for purpose. For instance, treatment of wastewater (sewage or stormwater) to an acceptable standard for a range of uses is already a feasible scenario in many circumstances. International experience would suggest the primary challenge to these approaches is community acceptance around treated water use. In addition, strict regulation is required on treatment standards, to avoid pollution of drinking water. There have been global experiences around the treated water as a source for potable or other domestic purposes by simply addressing the stigma associated with name, treated or recycled water. In Singapore, the treated water was introduced as 'new water', campaigned by a leading celebrity (Furlong et. al, 2019)
- **Rainwater harvesting** involves the collection of water from roofs or other non-permeable surfaces for storage and use. By collecting water in a decentralised way, the need for large storage dams can be reduced and water can be supplied for domestic and small-scale uses
- **Managed aquifer recharge** involves intentionally recharging water to aquifers for later extraction. By using an alternative water storage approach, the need for large storage dams can be limited whilst reducing evaporation and still guaranteeing supply to water users.

5.8 Managing competition for water resources under scarcity and drought

Managing water shortage and competition for scarce water has both a strategic long-term planning side and a short-term implementation and operational perspective (see the following chapter).

The strategic side of managing water scarcity, involves developing a coherent set of strategies and plans to reduce the risk and impact of drought. The full set of drought management strategies may be included in the basin plan, or the basin plan may clearly outline the requirements, principles, responsibilities and schedule for developing a drought management plan. The process of developing the river basin plan and engaging with stakeholders, should aim to achieve enduring agreements and rules for how water is shared in general and when it becomes scarce. This may involve principles, volume thresholds or percentage shares, for example between states or between irrigation districts and cities. Another important consideration is to set enduring rules about priority of access to water during shortage, as an integrated component of the system needs strategy. Development of these kind of strategies needs to consider likely alternative climate scenarios, so that the benefits and impacts of different approaches can be assessed. The enabling legislation for river basin planning can include guidance on priorities, including ensuring that critical human water needs are provided for.

A drought management plan needs to ensure that drought responses are developed long before a drought takes place. The drought plan will include clear objectives and hierarchies of operation to prepare a response to drought, using structural (e.g. storage infrastructure, water efficiency improvements) and non-structural approaches (e.g. limiting water access depending on water availability, water markets, public water saving campaigns). This can apply to both supply and demand management.

Even if a full drought plan is not provided within a basin plan, the basin plan can still be an important document in confirming social priorities, which usually favour urban water supply and electricity generation water requirements ahead of agricultural and industrial requirements. There may be priority differences even within a sector – for example, priorities may favour permanent plantings over annual crops or favour food crops over other crops. As part of water allocations, the basin plan will often nominate priority water users, and how many years of storage should be retained for priority users, before water is allocated and released for other users. In addition, the plan should confirm where environmental water requirements sit in the list of priorities.

A key challenge in developing a drought plan is understanding the intensity and frequency of droughts for a given basin. A common approach is to gauge the duration and intensity of the worst drought in the historical record, and to retain sufficient water to provide for supply of essential needs through such a drought. Drought planning however should consider the potential impacts of climate change and the historical record is unlikely to include the full range of possible drought and flood sequences likely with climate change.

Another key issue for consideration in a drought plan is the need to retain enough water to enable the transmission of water for essential purposes – i.e. the need to allow for evaporation and transmission losses to groundwater during dry times.

Implementation (see Stage 5) will require the basin plan to include strategies and principles for emergency response mechanisms and to develop tiered response plans for extreme events. These may need to identify clear thresholds for what constitutes “extreme” or “emergency” – for example when storages fall below a certain level or inflows have been below a certain level for a number of months or years.

In Australia’s River Murray, and across the Murray-Darling Basin after implementation of the Basin Plan, there are very specific rules providing clarity of water sharing and priority under extreme drought. The rules provide for tiers of response: Tier one is ‘normal’ conditions with average or above average inflows, Tier two is triggered when inflows fall below average for a specified length of time and planning then begins for drought operations, Tier three is triggered when inflows fall significantly below average for a specified extended period and is when full drought operations are in place. Under these conditions, deliveries of water along the river may need to be bulked together (“pulsed”) to avoid incurring unsustainable transmission losses. In addition, under tiers two and three there will be a greater emphasis in supplying the higher priority categories of use, at the expense of the lower priority categories. Case study 23 provides more examples of frameworks to respond to drought and water scarcity in the Murray-Darling Basin in Australia.

Australia’s urban water suppliers prepare and operate drought management plans. When water storage drops below an identified level, the water authority introduces water restrictions, such as restrictions on watering gardens. Where water is metered, charges increase when household water use goes above an identified level. In addition, the drought management plan may require industrial users to reduce water use.

Larger agricultural businesses in Australia manage their own water risk. As annual allocations reduce, the water market means that access to more water can be bought- but the price will rise as water becomes more scarce. Irrigated agriculture business are therefore motivated to find water efficiencies and to plan their crop planting with a view to likely water availability in the year ahead.

In the context of the great number of smaller irrigated farms in India, river basin plans and other water management programs could incorporate a number of measures to assist drought management by smaller farmers. For example, regular updates to farmers on water availability for the year ahead and education programs on water efficiency and water efficient crops.

Case study 23: Strategies used in the Murray-Darling Basin to respond to water scarcity

The Murray-Darling Basin Agreement establishes water sharing arrangements between the three states of New South Wales (NSW), Victoria and South Australia. In a simplified summary, NSW and Victoria share inflows to the River Murray, while South Australia is guaranteed an annual flow at its (downstream) border. These arrangements have endured more or less unchanged since they were agreed between 1914 and 1917. State officials and Ministers meet periodically to discuss implementation and provide direction to the River Murray Manager (now the Murray-Darling Basin Authority, previously the Murray-Darling Basin Commission and originally the River Murray Commission).

Since 2012, the Murray-Darling Basin Agreement and the Basin Plan have included arrangements for “Critical Human Water Needs”. These provide an arrangement of three “tiers”, whereby increasing water shortage, at defined trigger levels, will trigger escalation of management arrangements to a higher level. This is necessary on the River Murray, because South Australia’s capital city, Adelaide, and several other centres have a strong reliance on water supply from the River Murray. Given the length of the Murray and the distance of over a thousand of river kilometres from the headwater storages to South Australia, provision must be made for significant storage of ‘conveyance water’ as well as the urban water supply, in order to allow for high losses during extended dry weather.

Similar tiered response arrangements are also used for “extreme events” and emergency response plans to address critical human water supply at the state and regional level across the basin.

5.9 Groundwater management and connected surface water resources

For groundwater management (e.g. in alluvial aquifers), a river basin plan can provide rules to address the over-use or pollution of groundwater resources. This could include i) exclusion of new bores within a certain distance of existing bores; or ii) time limiting of pumping to prevent exacerbation of cones of depletion and the pollution of aquifers by drawing in poor quality water from other strata. Both river and groundwater management strategies will need to consider the likely connections between surface water and alluvial groundwater. For example, when flows in the river are low, there may be a tendency to extract more groundwater. If there is a strong connection, this may further deplete river levels and compound falling groundwater levels.

5.10 Flood management planning

Approaches for flood management may include: i) non-structural (planning and land management) – e.g. floodplain zoning, emergency responses (ii) non-structural (river operations), e.g. dam management rules; or iii) structural – e.g. reservoirs, levees and weirs designed specifically for the prevention or mitigation of flood damage.

For structural approaches, to ensure that infrastructure is managed to reduce flooding risk, a flood management plan needs to provide provisions for a clear hierarchy of objectives and an operational manual for each dam and weir in the basin. The hierarchy of objectives clearly outlines and ranks the objectives of each infrastructure. The hierarchy is normally: i) ensure the structural integrity of the dam is maintained; ii) prevent unnecessary flooding of towns downstream; iii) prevent flooding of agricultural land; and iv) maximise the amount of water retained in storage through active management of air space. For operators of dams and weirs, an operational manual provides clear guidance on actions to take during flood emergencies.

For non-structural approaches, a flood management plan needs to outline the legal situation and provide guidance on issues such as land-use regulations (relocation out of floodplains and catchment management), awareness campaigns, flood warning systems and flood emergency preparedness plans.

Responses to these events may be governed by the river basin plan, or the plan may outline the requirements for subsidiary instruments, such as operations manuals, that are required to be consistent with the principles and rules of the plan.

As an example, there are five key operational areas that are often addressed within a basin plan:

1. flood management plans (for example case study 24)
2. drought management plans (including responses to extreme water shortages)
3. identified options for managing variability in water supply and demand
4. identified approaches to pollution events and pollution prevention
5. managing groundwater depletion and contamination.

Case study 24: Flood management strategy in India

The Government of India formed the Brahmaputra Board under the Brahmaputra Board Act, 1980, under the former Ministry of Water Resources, River Development, and Ganga Rejuvenation. The jurisdiction of the Board covers the entire Brahmaputra basin, along with all the riparian states in north-east India.

The functions of board include preparing flood management strategies and a masterplan to control floods in the basin. The Brahmaputra Board has implemented several flood control and anti-erosion schemes in the basin. The Board conducts non-structural measures such as survey, floodplain mapping, flood forecasting and prepares detailed project reports (DPR) for structural measures such as construction of embankments, dams and reservoirs. Several restoration and protection projects are ongoing, along with drainage development schemes (Brahmaputra Board 2017).

Water quality management strategies

Establishing a water quality planning and management framework has been discussed previously, in the Situation Assessment Stage.

Water quality management requires the development of a coherent set of strategies and plans to safeguard the water quality within a river or aquifer. The full set of water quality strategies and plans may be included in the basin plan, or alternatively the basin plan may clearly outline the requirements, principles, responsibilities and schedule for developing a water quality plan. It is important that the strategies align closely with those in the overall river basin plan but may need specific focus for higher priority issues (e.g. improving drinking water quality).

Key principles for water quality management strategies (discussed in more detail in Stage 3- Situation Assessment) include:

- Establish waterway values and uses in a river basin
- Identify the minimum water quality standards
- Establish monitoring programs
- Define management actions – for locations or areas where water quality standards are not being met or are at risk.

Following the identification of areas where water quality targets are not being met, the water quality management plan can provide a hierarchy of risks which threaten the identified values. The management plan can also specify the management interventions to be taken to address the likely causes of those threats. Management interventions can include any of the tools and principles outlined in the “Pollution Management” section below.

Set water quality targets for the basin, outline strategies and activities to reach the targets and develop monitoring programs to measure the achievement of targets.

Catchment Management and Riparian Management strategies

The best practice approach would be to consider riparian stability and catchment management as part of river basin planning. The impact of both on water quality and water flow should be considered at the planning stage and mitigation actions included in the river basin plan. Similarly, the impact of water use, flow management and water delivery on riparian condition should be considered at the planning stage and mitigation actions included in the plan.

Catchment and riparian management are often carried out separately to water management in Australia. This is perhaps one of the areas Australia could improve. On the River Murray, however, an active riparian restoration program is being carried out in conjunction with river operations, by the MDBA, NSW and Victoria.

5.11 Pollution management

A river basin plan can also provide for the operation of dams and weirs to assist the mitigation of pollution events. This would take the form of a pollution mitigation plan describing the responses to pollution events of different types and different levels of severity. Pollution mitigation could occur by dilution or dispersal of pollutants through flow releases, or by withholding flows to prevent dispersal. The appropriate response will depend on the circumstances and will be outlined in the pollution mitigation plan. Catchment and land management is also critical to good river basin planning and outcomes.

Historically, all cultures of the world have had to contend with waste and pollution. Australian states started a major effort to clean waterways in the late 1960s, with establishment of legislation and pollution control organisations. Today these have developed into state Environment Protection Authorities (EPAs) and Australia is now seeing the benefits of 5 decades of pollution prevention and clean-up of historical pollution.

In India, rapid urbanisation has contributed to deteriorated quality of rivers. In particular, discharge of stormwater runoff, industrial wastewater and untreated sewage into the rivers have resulted in poor in-river water quality which in turn impacts on water users. Stormwater runoff with high organic matter, solid waste dumping, immersion of idols after the religious festivals, clothes washing and bathing directly in the river are also prominent and on-going issues in India. Deforestation and non-sustainable agricultural practices also result in rapid soil erosion and in turn large sediment load influx into rivers.

In India most of the river basins include expanding urban cities. Pune and Hyderabad, two of the major cities with dense population are situated on the banks of Krishna river. Along with traditional end of pipe treatment approaches, diffuse pollution approaches such as integrated urban water management and water sensitive urban design tend to assist river basin management by reducing the pollutants and can also provide recycled water for alternative use (for example see case study 25).

The objective is to ensure that the pollution of waters is prevented as far as practicable. The idea is that the broad end of the triangle is the preferred approach. Only after those measure have proven unfeasible does effort move towards the narrower end, for a minority of activities.

The key principles for pollution reduction:

- Avoid or reduce pollution at source
- Capture pollution on site and/or prevent entry to waterways and groundwater
- Reuse and recycle wastes and wastewater
- Treat wastewater to end-use standards
- Discharge wastewater to waterways only when unavoidable and considering values and uses of the waterways / groundwater
- Apply best practice compliance and regulation principles.



Figure 11. Pollution reduction hierarchy

Case study 25: Pollution management in India

The proposed new capital city of Andhra Pradesh state, Amaravati, is situated on the banks of the Krishna River. The master plan of the city depicts the pollution management strategies through the city's stormwater and wastewater management plans. The masterplan has drawn on the global best practices for stormwater and wastewater management.

The plan includes a decentralised approach towards wastewater management by designing 12 treatment plants all over the city and 1 effluent treatment plan. The portion of treated water will be used for recycling purpose such as urban cooling, washing and remaining treated water will be discharged to the Krishna river. Similarly, for stormwater management, the masterplan incorporates water sensitive urban designs such as grass swales, green roofs, detention ponds. These urban designs will catch and store the rainfall runoff and treat at source. The buildings have a mandatory requirement to build rainwater tanks for water harvesting and reuse. Thus, the city, if constructed, would extract less water from the Krishna river and also improve water quality (APCRDA, 2017).

6 Stage 5: Implementation

6.1 Key messages

1. Implementation involves giving effect to the activities and strategies outlined in the river basin plan.
2. Clear actions for implementation are needed and responsibilities need to be clearly allocated. A key enabling role is provided by overarching river basin planning legislation and by establishing the basin plan in legislation once it is agreed, including regulatory arrangements to assure compliance in implementation.
3. A clear decision-making process and governance framework should be established setting out responsibilities, budget and accountability for implementation and review. This often involves the establishment in legislation of a river basin organisation to provide oversight, but it will also require establishment and continuation of cooperative and productive working arrangements between the state water resource management organisations across the river basin.
4. Engagement and input from community stakeholders continues to be a central requirement during implementation.
5. Operational management involves the practical implementation of a range of river basin plan strategies, including: system needs, extraction limits and shares, flood management; drought management; options for managing variability in water supply and demand; identified approaches to pollution events; managing groundwater depletion and contamination.
6. After the river basin plan has been established, the key to ensuring implementation continues is to establish clear accountability for actions and regular reporting of implementation progress to the river basin organisation, to governments and to the stakeholders.
7. Compliance mechanisms established in the river basin planning legislation at national and state level, need to have clear responsibilities and obligations assigned. Responsibility for regulatory compliance and enforcement must be clear and decision-making on enforcement is best allocated to an independent body. Best practice regulation and compliance is fit for purpose – it is contextual and culturally appropriate.

Implementation involves carrying out and giving effect to the activities outlined in the basin plan.

Implementation of the strategies and activities outlined in the river basin plan may involve a wide range of stakeholders and requires clear institutional leadership to ensure that the various parties are meeting the tasks assigned to them. A river basin organisation is often established to provide plan oversight. A key enabling role is provided by overarching river basin planning legislation and by establishing the basin plan in legislation once it is agreed, including regulatory arrangements to assure compliance in implementation.

A clear decision-making process and governance framework should be established setting out responsibilities, budget and accountability for implementation and review. This often involves the establishment, in legislation, of a river basin organisation to provide oversight, but it will also require establishment and continuation of cooperative and productive working arrangements between the state water resource management organisations across the river basin.

This phase may take place over years or decades, depending on the time frame of the plan and periods set for plan revisions. The lifetime of the plan should be long enough to provide security and stability to water users and managers, but it should be reviewed frequently enough to support adaptive management.

After the river basin plan has been established, the key to ensuring implementation continues is to establish clear accountability for actions and regular reporting of implementation progress to the river basin organisation, to governments and to the stakeholders.

In Australia, successful implementation of water management and river basin plans has required adequate resourcing, institutional arrangements, accountability and reporting, as well as ongoing engagement with community and stakeholders. In Australia, the Murray-Darling Basin Plan and various state legislation or policy arrangements require periodic reporting and/or auditing of implementation status. Case study 26 provides further information on implementation of the Murray-Darling Basin Plan.

Case study 26: Implementation of the Murray-Darling Basin Plan in Australia

In the Murray-Darling Basin, the Basin Plan itself provides a limited amount of detail on implementation. Instead it requires the development of Water Resources Plans which outline how a particular area (there are 36 areas across the basin) will manage water resources under state legislation, to be consistent with the basin plan and enforce the Sustainable Diversion Limit set by the plan. This arrangement enables detailed decisions to be made under state legislation at the regional catchment scale, while meeting requirements set for the Basin as a whole. To provide oversight to the Water Resources Plans and ensure they are consistent with the Basin Plan, they must be submitted to the Murray-Darling Basin Authority and accredited by the Australian Minister for Water.

In addition to the state Water Resources Plans, implementation requirements, commitments, timeframes and milestones for the Murray-Darling Basin Plan are detailed in Intergovernmental Agreements and Implementation Agreements between the national government, the states and the Murray-Darling Basin Authority. These are published and progress reports against them are considered periodically by meetings of the Australian Prime Minister and the state government Premiers (the Council of Australian Governments).

6.2 Operational management

The objective is to develop strategies for day-to-day management of water resources in a basin, and to prepare and respond to events such as droughts, floods and pollution incidents.

Key principles for operational management include:

- Preparations for flood, drought and pollution responses need to be undertaken long before these events occur, as part of developing basin strategies
- Both structural and “soft” approaches (e.g. land use planning) need to be considered
- Hierarchies of objectives need to be set, in consultation, to enable clear and transparent responses to events.

6.3 Regulation, compliance and enforcement

Compliance mechanisms established in the river basin planning legislation at national and state level, need to have clear responsibilities and obligations assigned. Responsibility for regulatory compliance and enforcement must be clear and decision-making on enforcement is best allocated to an independent body, separate from political considerations. Enforcement measures need to be seen to be fair and equitable and proportionate to the significance of the breach of legislation. Clear rules, fairly and equitably enforced, can actually underpin a successful water dependent economy and community.

Best practice regulation is fit for purpose – it is contextual and culturally appropriate. It utilises scarce resources effectively and draws on appropriate education and incentives to support actors to comply with the river basin planning, while maintaining a clear, independent and unambiguous enforcement of the rules. There is a significant body of literature and experience on best practice regulation (e.g. Sparrow 2000). ‘Responsive regulation’ (Ayres and Braithwaite, 1992) has been used by many regulators across a range of sectors as a way of managing scarce resources available for enforcement and compliance, and to manage different actors’ attitudes towards compliance (Figure 12). Initially, the responsive regulatory model uses cooperative and informative mechanisms to respond to non-compliance. If someone repeatedly fails to comply with standards, deliberately or wilfully breaks the rules and/or the breach causes a significant impact, they will be classified as being associated with a higher “risk level”, and further action will be required, moving towards the narrow end of the triangle in Figure 12.

Importantly, education about the rules and how to comply, will only work if it is clear that breaking the rules will result in enforcement action. High profile and publicised enforcement on these activities is critical to the success of education and other regulatory and compliance activities. Water is a valuable commodity and without robust and public enforcement, with significant penalties for offenders, the incentive to break the rules will remain. Case study 27 provides an example from Australia’s Murray-Darling Basin of the need to maintain compliance and enforcement.

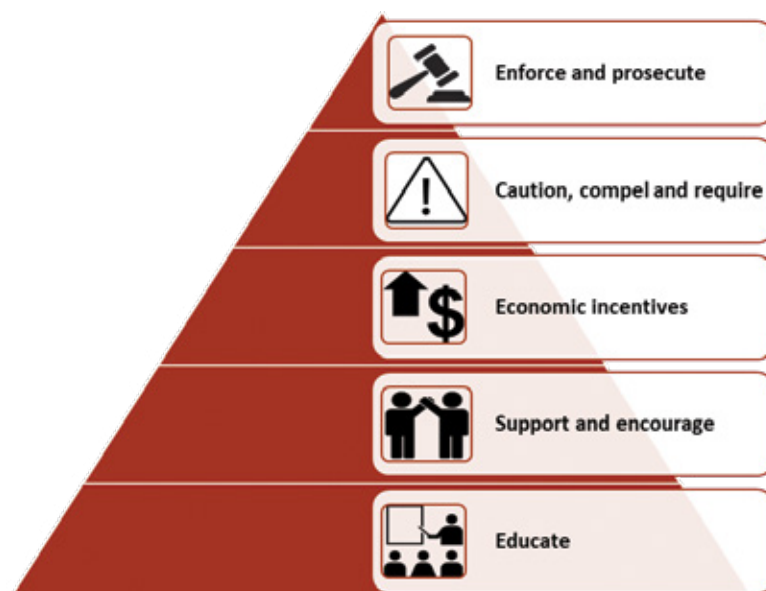


Figure 12. Compliance triangle – illustrating ‘responsive regulation’

Case study 27: Compliance challenges in Australia, and how they have been addressed

The MDBA sets compliance priorities for each water year (July – June) based on a horizon scan and a detailed risk assessment of Basin Plan non-compliance for each of the MDBA's key compliance areas, as set out in the MDBA's Compliance and Enforcement Policy (MDBA, 2019).

In 2017 it was revealed through investigation by Australian journalists that there were serious shortcomings at that time in the state of New South Wales (NSW) water management compliance and enforcement system. This included allegations of large-scale water users tampering with water meters, and that certain irrigators had pumped water from the river system in periods when pumping was not permitted, or in quantities greatly in excess of their entitlements. Community outrage about these compliance shortfalls was high, because of the impact on downstream users and on government investment in environmental water. The high level of community concern drove an independent investigation which delivered a report to the NSW Government in late 2017. The investigation was supported by strong and broad-based stakeholder support (including from other water users) for firm and rapid action to fix the compliance and enforcement system. As a result of the legislation, a new independent NSW Natural Resources Access Regulator was introduced, and individual staff members involved in facilitating the acts of non-compliance were managed through public service processes (NSW Department of Industry, 2017).

7 Stage 6: Monitoring, evaluation, reporting and learning

7.1 Key messages

1. Establish clear basin plan logic, objectives, outcomes and targets that drive clear policy action and clear evaluation.
2. Identify indicators that are relevant, evidence-based, inclusive and cost-effective, and that relate to how the river basin plan takes effect. Special consideration needs to be given to monitoring who benefits, where and how, and any unintended consequences of implementation.
3. Monitoring of compliance is a key factor for successful implementation, including metering of water extraction and regular assessment against the system needs and diversion limits established by the river basin plan strategies.
4. Monitoring, evaluation and reporting must be transparent on implementation status, which organisations are responsible, on progress towards outcomes and be clear on the expected response times needed to achieve outcomes.
5. It is useful to use and link to the indicators of the Sustainable Development Goals (SDGs) in order to align MERL frameworks with the SDGs, and to support the achievement of the SDGs at the national and global levels, where these are relevant to the Plan.
6. Pay attention to reporting and adaptive management during implementation.
7. Describe a clear data sharing and data management arrangement to ensure that all relevant data is collected, reviewed and made available
8. When the Plan expiry date approaches, the monitoring data of the indicators and achievement of Plan objectives needs to be evaluated, and a review of the Plan initiated to consider how the Plan could be improved to better achieve objectives and the vision. The review then re-starts the cycle of Plan redevelopment and implementation.

A key element of successful river basin planning is to establish clear monitoring and reporting framework for the purposes of assuring compliance, accountability about progress of implementation and evaluation of plan objectives, outcomes and targets prior to review and remaking of the Plan.

A Monitoring, Evaluation, Reporting and Learning (MERL) framework is used to track the implementation and outcomes of the basin plan and should feed back into basin assessments and plan revisions as needed. The framework needs to be an integrated part of river basin planning from initiation onwards. Right from when objectives and targets have been identified, the planners should ask “how will we know if we are successful?” and “how will this be measured?”

A key element of answering the question, “how will we know if we are successful?” is to develop a “map” or diagram of how the plan is expected to work – how the actions in the plan will take effect to achieve the objectives over time. This diagram is often called a “program logic”, a “theory of change” or a conceptual model. The diagram is helpful not only in framing MERL, but also in refining the design of the river basin plan itself, since the logic may reveal a need to refine the framing of objectives and targets, or a need to include additional actions if those objectives are to be achieved.

Therefore, the first step of setting up the MERL program is to identify a clear logic or model of how the actions in the plan are expected to take effect, and the intermediate outcomes along the way to achieving the objectives. Based on this logic, key indicators are identified to assess whether outcomes are being achieved or are responding in the expected way. Importantly river basin planning indicators should not be limited to hydrological indicators; they will also include implementation, coordination, social, cultural, economic and environmental outcomes.

The next step in building the MERL component of the plan is to identify suitable indicators of implementation and indicators of the expected changes in the river system, as well as progress towards the environmental and social and economic outcomes. For each of these indicators, the timeframe of responses should be identified. Monitoring can be extremely expensive, and many programs have found that having a large amount of data does not necessarily provide clarity regarding whether a program, plan or policy has been successful or is on track. The key is to identify indicators that are relevant, evidence-based, and cost-effective, in order to assess how the river basin plan takes effect. For example, qualitative information about water user responses may be more relevant than numerical datasets for some questions about implementation success.

Once implementation is underway, it remains important to pay attention to reporting and adaptive management. Simple and clear communication is essential but reporting needs to avoid being too simplistic so that nuances are not lost. At another level, rational, evidence-based evaluation requires a level of rigour and detailed analysis that is likely to mean more lengthy technical evaluation documents that underpin communications to a broader community audience.

Monitoring of compliance is a key factor for successful implementation, including metering of water extraction. Regular monitoring and assessment against the system needs and diversion limits established by the river basin plan is important both to ensure implementation and accountability, and to provide information for the review of the Plan, to assess the performance of these strategies against the objectives of the Plan. This is also an important part of delivering on the engagement and negotiations invested by governments and stakeholders in development of the Plan. Without monitoring of compliance and monitoring of implementation, it is difficult to be sure if the Plan is being implemented consistently, equitably and fairly. This will then likely impact on whether the objectives can be achieved and on stakeholder support. Reporting should be frequent and timely enough to inform the many interested parties across the basin to enable investors and implementers to gauge the success of implementation and to inform revision and refinement over time (learning and adaptive management). The content of the reporting (and therefore the selection of indicators for which data is collected) should be focused on supporting these purposes. For example, providing information about water storage levels to users can influence water use behaviour in a cost-effective manner. Naturally, the exact focus will vary between river basins. This is because different river basins will have different objectives, outcomes, targets and actions.

In summary, key elements of an MERL plan that should be described in the basin plan:

- Objectives, outcomes and purpose – a clear description of objectives, outcomes and purpose of the plan
- Program logic – a framework or conceptual model of how the actions and tools in the plan will take effect to achieve the outcomes, including intermediate outcomes that will show progress towards the longer-term outcomes
- Key evaluation questions – questions that are likely to be asked by government, community and industry about progress and results of the plan. This should include looking at how different parts of society are impacted by interventions and ensure that gender norms are considered so evaluative questions are not gender blind. Questions such as “who has benefited and how” will be useful

- Identification of indicators and data collection processes – identification of indicators of actions, and intermediate and longer-term outcomes that will help answer the likely questions
- Identification of targets – a description of measures of success at different intervals – annually, 5 years and 10 years
- Reporting requirements – definitions of frequency, mediums and responsibilities for reporting to provide information on actions carried out, intermediate and longer-term outcomes, to governments and to stakeholders
- Links to adaptive management – descriptions of clear links between the reporting and accountability, and descriptions of adaptive management (learning from implementation) and reviews for future planning cycles.

7.2 Data sharing and information management arrangements

During basin plan development, a large amount of data and information will have been collected including historical hydro-meteorological data, modelling results, ecological information and social and economic information. In addition, during plan implementation new datasets and information will be collected including hydro-meteorological monitoring, results of plan monitoring and updated climate change projections. Basin planners and other water users in the basin need access to this data to assess the success of the basin plan, or to plan their water use. The plan therefore needs to describe a clear data sharing and data management arrangement to ensure that all relevant data is collected, reviewed and made available.

Key elements of a data sharing and data management arrangement that need to be described in the plan include:

- Characterisation of data and information collected and being collected
- Description of the infrastructure adopted to manage the data and information
- Quality assurance processes
- Roles and responsibilities for collection, review, storage and accessing data and information
- Data requirements for implementation, accountability and operational management
- Data requirements for compliance
- Capacity building requirements
- How the data sharing and data management arrangement will be financed
- Public availability and reporting of data
- Reporting and evaluation against indicators of Plan performance
- Data requirements for evaluation, learning and plan review.

Case study 28 outlines the arrangements for MERL in the Murray-Darling Basin in Australia.

Case study 28: Monitoring, Evaluation, Reporting and Learning in the Murray-Darling Basin

The Murray-Darling Basin Plan includes a Chapter outlining a Monitoring and Evaluation Plan.

The Chapter outlines the role of the Murray-Darling Basin Authority to report annually on the effectiveness of the Basin Plan and to evaluate the Basin Plan every 5 years. The Chapter also outlines reporting requirements for Basin States, the Commonwealth Environmental Water Holder and the national government Department responsible for the Water Act.

The reporting requirements include activity reporting and reporting on monitoring of environmental, social and economic outcomes. These reports provide information to enable the Authority to undertake its overall evaluations and reports. These activities are coordinated through a Monitoring and Evaluation Working Group involving the Authority, the Basin States and national government agencies.

The Basin Plan Monitoring and Evaluation Plan provides a framework and responsibilities, but it is sufficient to provide clarity, transparency and accountability.

From the Basin Plan Annual Report 2017-2018 (MDBA 2019):

This report brings together progress made by Basin jurisdictions to implement the Basin Plan in 2017–18, and the outcomes from this work. It draws on information in the annual implementation reports prepared by Basin jurisdictions, the MDBA and Commonwealth Environmental Water Office. These reports are provided to the MDBA after the completion of the financial year and are published on the MDBA website.

This Basin Plan Annual Report is a key mechanism through which transparency and accountability for Basin Plan implementation and outcomes is provided, which is especially important given the scale and complexity of this major national reform. Through open and transparent reporting, the goal is to build trust among Basin communities in the agencies responsible for implementation and confidence that the intended outcomes of the reform are being achieved.

In 2017, the MDBA published an evaluation report of progress towards Basin Plan objectives and targets (MDBA 2017).

When the Plan expiry date approaches, an evaluation needs to take place that builds on the ongoing interpretation of the monitoring data of the indicators and ongoing evaluation of the achievement of Plan objectives. A review of the Plan needs to be initiated to consider how the Plan could be improved to better achieve objectives and the vision. The review then re-starts the cycle of Plan redevelopment, review of the governance arrangements and implementation.

This process of ‘adaptive management’ needs to respond to what has been learnt, critically evaluate gaps in implementation or objectives not achieved, as well as respond to changed circumstances (for example changed climate, population, industry, water quality and improved science and knowledge about environmental requirements).

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Annex A. Checklist for River Basin Planning

Stage	Key considerations	Key outcomes
1. Initiation, governance and visioning	<ul style="list-style-type: none"> • Build a network of support including across States • Establish a framework for decision making • Determine responsibilities of relevant institutions • Identify potential funding – Government, multilateral development banks • Develop vision and objectives in consultation with stakeholders 	<ul style="list-style-type: none"> • Enabling policy and regulatory framework established • Enabling legislation established • Network of support for river basin planning established • Long term basin vision and objectives developed with community and stakeholders
2. Inclusive community engagement	<ul style="list-style-type: none"> • Identify all stakeholders, users and other groups with a legitimate interest • Stakeholders to be included <ul style="list-style-type: none"> ◦ Community – water users, farmers, fishers, indigenous groups, gender equality and inclusion groups, environment and conservation groups ◦ Government – water utilities, central and state departments and ministries (water, agriculture, energy, pollution control, development) ◦ Business – hydropower, irrigators, agribusiness, navigation, manufacturing ◦ Knowledge sector – universities and institutions 	<ul style="list-style-type: none"> ◦ All relevant stakeholders involved in the planning process
3. Situation assessment	<ul style="list-style-type: none"> • Collect data and undertake modelling • Identify system needs • Determine yields • Determine urban and industry needs • Identify immediate and future data needs • Identify social, economic and environmental benefits from river flows and water extraction 	<ul style="list-style-type: none"> • Foundation information established • Information available to stakeholders • Models developed that assist river basin plan decision-making • Present and future water supply and demands quantified • Issues of common concern identified • Risks assessed

Stage	Key considerations	Key outcomes
4. Strategies and planning	<ul style="list-style-type: none"> Specify the flow regime needed to sustain river health and non-consumptive purposes, including cultural and in-stream production needs (e.g. fisheries), as well as for extraction for critical human water needs for drinking and domestic food production Set an overall limit to extraction. This provides the basis to establish the shares between system needs and water users. This framework is likely to interact with tools and strategies for demand and supply management 	<ul style="list-style-type: none"> Develop strategy for system needs and flow requirements Sustainable limits on extraction established Shares established between states and other major units (such as irrigation schemes / industry)
	<ul style="list-style-type: none"> Plan to provide a range of incentives and tools for water users to manage their water use most effectively and efficiently in response to variations in water availability. The more control a water user has over how and when they use their share, the more likely they are to use water efficiently and conservatively. This may include: <ul style="list-style-type: none"> Water conservation initiatives including education and extension Implement system of water user entitlements, allocations, licences or individual water accounts Rostering or time-sharing diversions Water use restrictions Water pricing and water trade 	<ul style="list-style-type: none"> Developed strategy for demand management
	<ul style="list-style-type: none"> Plan to improve reliability of access to assist water users to meet their water requirements while maintaining the health and productivity of the water source. This may include: <ul style="list-style-type: none"> Water conservation initiatives including education and extension Recycling and reuse Rainwater harvesting Channel seepage control Managed aquifer recharge New water infrastructure 	<ul style="list-style-type: none"> Developed strategy for supply management

Stage	Key considerations	Key outcomes
4. Strategies and planning	<ul style="list-style-type: none"> Plan to provide for day-to-day management to prepare and respond to events such as droughts, floods and pollution incidents. This may include: <ul style="list-style-type: none"> Flood operational plans Drought response and priorities for supply Establish system for pollution control 	<ul style="list-style-type: none"> Developed strategy for operational management <ul style="list-style-type: none"> Flood Drought Water quality
5. Implementation	<ul style="list-style-type: none"> Identify immediate actions and time frames Identify clear accountabilities, timeframes and governance Develop operational procedures and responses that implement the operational strategy Responsibility for regulatory compliance and enforcement must be clear 	<ul style="list-style-type: none"> Actions identified to address issues of common concern in line with the basin strategies Relevant institutions have clearly identified governance, responsibility for actions and review, budget and plans for ongoing engagement with stakeholders Progress on the action plan is assessed and reported regularly
6. Monitoring, evaluation, reporting and learning	<ul style="list-style-type: none"> Measurement against targets Development of reporting arrangements Transparency on status of implementation and progress towards outcomes Feedback loops to adaptively manage water resources 	<ul style="list-style-type: none"> Measured success of the plan against established targets Relevant information is available to evaluate progress, report to the community and review or revise the plan



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The Australian Water Partnership is an Australian Government international cooperation initiative helping developing countries in the Indo-Pacific region, and beyond, work towards the sustainable management of their water resources.

