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SUMMARY

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Conservation | Sustainability | Climate Change

Strategic basin allocation planning

Developed in partnership with the General Institute of Water Resources & Hydropower Planning, Ministry of Water Resources, People's Republic of China

About this summary

This document summarises the findings of a collaborative effort between WWF, the General Institute of Water Resources & Hydropower Planning (GIWP), Ministry of Water Resources, People's Republic of China and a number of leading international experts from the UK, South Africa, Australia and the US. The effort was originally conceived to review and disseminate modern approaches to water management in challenging environments, and provide new insights into strategic planning and risk management of water resources.

This paper focuses on basin water allocation planning and is one in a series of three covering (i) strategic basin allocation planning (ii) strategic basin planning, and (iii) strategic flood risk management. A series of books on these three topics, encompassing both a major international review and a summation of world best practice in these fields, will be published in August 2012, in both English and Chinese.

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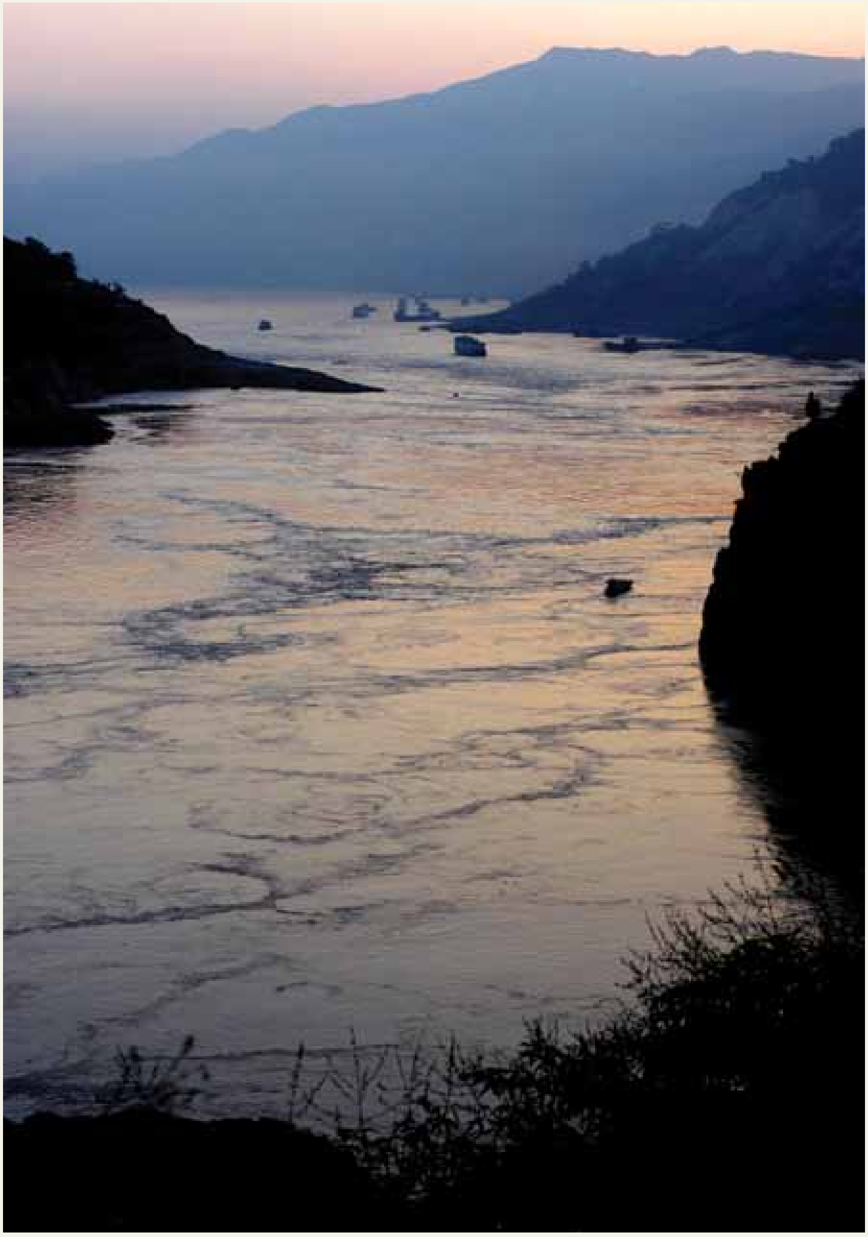
INTRODUCTION

As water scarcity has increased globally, water allocation plans and agreements have taken on increasing significance in resolving international, regional, and local conflicts over access to water.

While objectives and approaches have evolved over time, ultimately water resources allocation has fundamentally remained the process of determining (i) how much water is available for human use and (ii) how that water should be shared amongst competing users. This document considers modern approaches to dealing with these issues at the basin scale, particularly through the allocation of water amongst administrative regions – such as how water is divided amongst countries or provinces.



HISTORY OF BASIN ALLOCATION PLANNING

The development of water resources, irrigated agriculture and the growth of civilizations have been closely linked throughout history. Thus the first civilizations provide the earliest examples of water allocation practices, including those in Egypt, Babylon, and China.

Over time, approaches to allocating water have evolved and water allocation planning has gradually developed from early systems aimed at equitable use of water along irrigation systems, through managing diversions along river reaches, to managing basins – including the way water is shared between administrative regions.

Through the 1900s, and now into the 21st Century, relatively simple basin allocation plans and agreements have progressively been replaced by more complex documents, in efforts to address conflicts over water in a way that maximises economic, social and environmental benefits. Approaches like that of the 1922 Colorado River Compact – which grants the lower states a fixed annual volume of water – have given way to plans that define the relative shares of different riparian states, based on mean annual flows, such as those in the Yellow River and Pakistan's Indus Water Accord. More recent allocation plans, such as those governing the Lerma Chapala (Mexico), the Inkomati (South Africa) and the Murray-Darling (Australia) basins, have adopted sophisticated means of assessing the available water resources and defining how that water will be shared amongst different regions and users.

Plans vs. Agreements

The process for, and end result of, water allocation planning will vary greatly with the context. Within unitary political systems, or river basins entirely within a single jurisdiction, the powers to undertaken planning and make a plan may rest with a single authority. In such cases, planning is commonly undertaken within a legal framework, and results in a water allocation "plan". In international rivers, or rivers that cross multiple states within a federal system, water allocation may rely on a cooperative approach between the parties, and will often culminate in a water allocation "agreement". This document primarily focuses on the development of water allocation plans, but many of the concepts and principles are equally relevant to allocation agreements.

Figure 1: Examples of basin water allocation plans and agreements from the past 120 years

1890

Cauvery River Agreement (1892)

1910

River Murray Agreement (1915)
Colorado River Compact (1922)
Cauvery River Agreement (1924)
Nile Basin Treaty (1929)

1930

Spanish National Hydraulic Plan (1933)
U.S. Mexico Water Treaty (1944)
Upper Colorado River. Basin Compact (1948)

MODERN APPROACHES TO ALLOCATION

A number of related challenges that developed towards the end of the 20th Century have led to a significant evolution in basin allocation planning. These challenges have included (i) the growth in water abstractions, (ii) basin 'closure' and the lack of availability of more infrastructure sites, (iii) growth and change in the economy, leading to a wider variety of water users with different water demands, (iv) the decline of freshwater ecosystems and the loss of river system functions, and, in recent times (v) climate change.

In response to these and other challenges, modern basin allocation planning now focuses more on optimising the use of existing supplies through significant economic, social and environmental analysis and the assessment of trade-offs between competing users. This is coupled with a shift away from the traditional emphasis on the construction of new infrastructure to meet rising demand, and instead the adoption of demand management measures. Plans may include or be based on scenarios projecting how water use may respond to climate change, shifting economies, water pricing incentives, and options to share the benefits of water use rather than on sharing the water itself.

These new approaches to water planning are characterised by:

- Sophisticated, risk-based environmental flow assessments: in recognition of the importance of the flow regime for maintaining freshwater ecosystems and the services and functions that rivers provide to human communities.
- A better understanding of the value of water and the requirements of water users: in recognition of the central – and often limiting – role that water plays in the economy and the diverse range of water users and their differing needs.
- Greater flexibility as needs and objectives change: in recognition of the significant uncertainty associated with changes in climate, economies, demographics and the need for water allocation systems to respond to these changes.

1950 — India-Pakistan Indus Waters Treaty (1961)

1970 — Yellow River Water Allocation Plan (1987)

1990 — Pakistan (Provincial) Indus Water Accord (1991)
Lerma Chapala Agreement (1991)
Revised Murray Darling Agreement (1992) and Cap (1995)
Yellow River Annual Regulation Scheme (1997)
Lerma Chapala Agreement (2004)

Draft Murray Darling Basin Plan (2011)

2010

Water allocation process

The allocation process typically culminates with the granting of water entitlements to individual abstractors. The process can though involve defining and allocating water at a variety of administrative and geographic levels: including at a national, basin, sub-basin, or regional level.

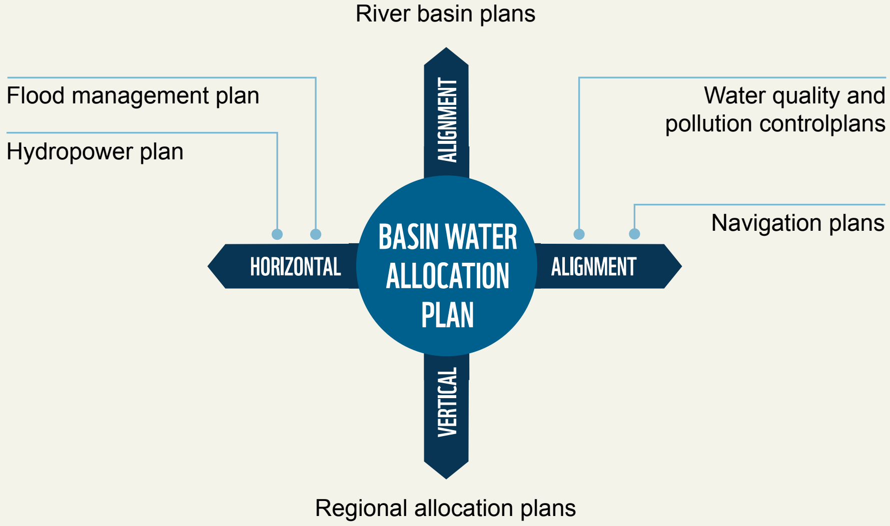


Figure 2: The relationship between basin allocation plans and other water-related plans.

It can also be necessary to allocate water over different timescales: the allocation process commonly involves both granting long-term entitlements to water (for example by reference to a long-term average), as well as an annual or seasonal process, which determines the actual volume of water available at that time to different parties, based on the prevailing conditions.

Finally, the water allocation process must also consider links to other water planning and management processes. A basin allocation plan should be designed to give effect to any overarching river basin plan, and align with other thematic plans, such as those related to hydropower production, flood management, and water quality control. This relationship between the basin water allocation plan and other plans is shown in Figure 2.

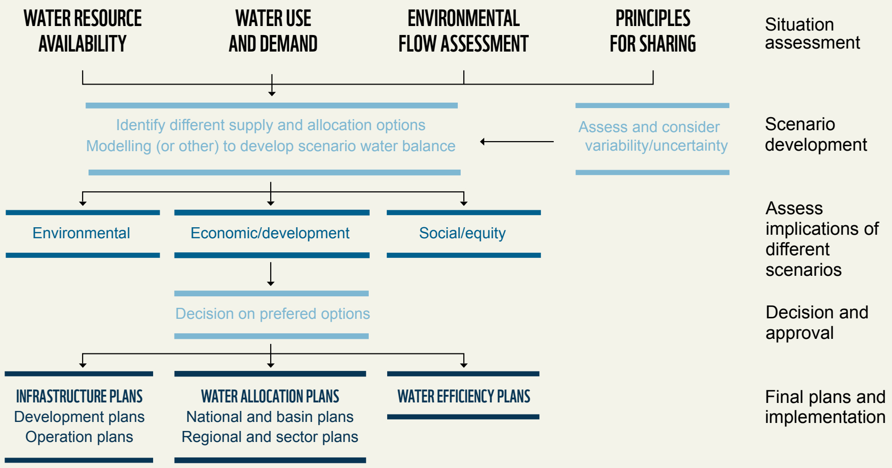
Allocation planning in the Murray-Darling Basin

Approaches to water allocation in Australia's Murray-Darling work basins have evolved significantly over the past century. Early allocation agreements dealt only with the lower reaches of the basin and had a significant focus on navigation. In the 1990s the agreement was varied to cover the entire basin and to place a cap on water use by freezing existing levels of development and abstractions. In 2011, a draft of the first whole-of-basin plan was released. The draft plan is based on detailed hydrological, environmental, and socio-economic assessments, and proposes "sustainable diversion limits" for different subcatchments and regions across the basin. These cover both surface and groundwater abstractions. Where applicable, existing water use will need to be curtailed to comply with the limits set by the plan. The potential social and economic impact of such curtailments has become a major political issue.

Developing a water allocation plan

Establishing a water allocation plan now commonly involves a detailed situation assessment to identify water resource availability, existing water use and expected future demand, and water requirements for environmental purposes. This information is used to develop different allocation scenarios, which can be assessed based on their social, economic, and environmental consequences. An example of this process is shown in Figure 3. The particular approach adopted should be tailored to suit the situation. Notably, the nature of technical assessment that is appropriate can differ greatly depending on the level of water development and water stress in a basin.

Figure 3: A generic water allocation planning process.



Objectives of allocation

Basin water allocation planning is typically undertaken to achieve a series of overarching policy objectives. In many jurisdictions, these objectives include:

- Achieving equity amongst different user groups.
- Protecting key freshwater dependent ecosystems and the services they provide.
- Supporting priorities for social and economic development.
- Balancing supply and demand.

Water allocation in the Yellow River

The 1987 Yellow River Water Allocation Scheme identifies a mean annual flow for the river of 58 billion m³. Of this, 21 billion m³ is reserved to ensure there is sufficient flow to transport the river's high sediment load. The remaining 37 billion m³ is allocated amongst the ten provinces that rely on the river's water resources. The plan also specifies the amount of this water available for agriculture, versus other purposes. These volumes are specified as long-term mean annual flows, and are available to the provincial governments for allocation to regions and users within their jurisdiction.

An annual regulation plan determines the volume available to each province in any given year, based on actual water availability. This plan prescribes monthly and, during peak periods, 10-daily volumes. The plan is given effect through operation of reservoirs, limits on abstractions, and requirements for cross-boundary flows.

Sharing water amongst competing users

Approaches to deciding how common water resources will be shared amongst different administrative regions have included criteria based on:

- Proportionate division, for example based on the physical characteristics of the basin (size, runoff, etc. in each region), or based on population.
- Existing use, for example based on historic use, levels of dependency, or current efficiency and productivity.
- Future use, for example based on growth projections or to align with development planning.

It is common for some of the allocable water to be granted or reserved for priority purposes, prior to water being shared amongst different regional interests. Priority purposes can include water to satisfy environmental requirements, water for domestic purposes, or water required for national or strategic priorities, such as for power supply.

Defining water entitlements

The key operative provisions of a water allocation plan are those that define the entitlements of different water regions or users. The most suitable approach will depend on factors including the local hydrology, the nature and extent of water infrastructure, capacity for monitoring and implementation, and the objectives for sharing water under different seasonal conditions. Water entitlements can be defined in reference to:

- Mean annual or monthly diversions. Example: 1987 Yellow River Water Allocation Scheme.
- Minimum guaranteed volumes. Example: Lerma-Chapala 2004 Allocation Agreement.
- Caps on abstractions. Example: Murray Darling Basin Agreement (1995).
- Requirements for minimum daily, monthly or annual cross-boundary flow requirements. Example: 1922 Colorado River Compact.
- Percentage of available flow. A percentatge of a defined flow over a defined period. Example: Jin River Water Allocation Plan.
- Rights to the water from different rivers or tributaries within a basin. Example: India-Pakistan Indus Water Treaty 1961.

Dealing with variability

Dealing with variability in the seasonal availability of water is one of the defining challenges of water allocation planning. Typically some form of annual allocation process is required to convert long-term entitlements to a defined volume of water, based on the prevailing seasonal conditions. This process often recognises the relative priority of different water users, and can thus ensure that, particularly where less than the full water entitlement is available, different user groups will be affected in different ways (Figure 4). Such approaches recognise the differing capacities of water users to adjust to changes in the volume of water that is available to them, as well as the different social and economic consequences from changes (especially reductions) to water supply.

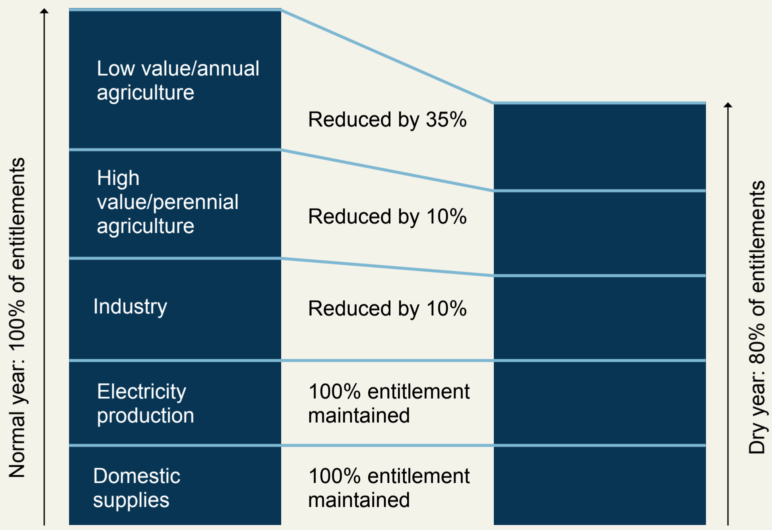


Figure 4: Hypothetical approach to deal with seasonal variability.

Dealing with uncertainty

Current and future changes in both the climate and socio-economic development are characterised by high-levels of uncertainty. Generally, planning in the context of an uncertain future should (i) ensure that decisions do not foreclose future options, (ii) allow responses to unforeseen events, including events that lie outside the historic record, and (iii) establish monitoring systems to observe change.

Water allocation plans and regional water shares need to be sufficiently robust to be able to cope with multiple future scenarios, including changes in water availability and water demands. Approaches can include:

- Adopting a precautionary approach to allocating water, including being conservative in assessing available water and allocating it amongst regions and users.
- Incorporating mechanisms for annual sharing that recognise that the nature of variability may itself change over time.
- Ensuring contingencies exist for changes in circumstances, such as through contingency allocations.
- Establishing mechanisms to allow for water to be reallocated.
- Ensuring environmental flows are protected under a range of scenarios.

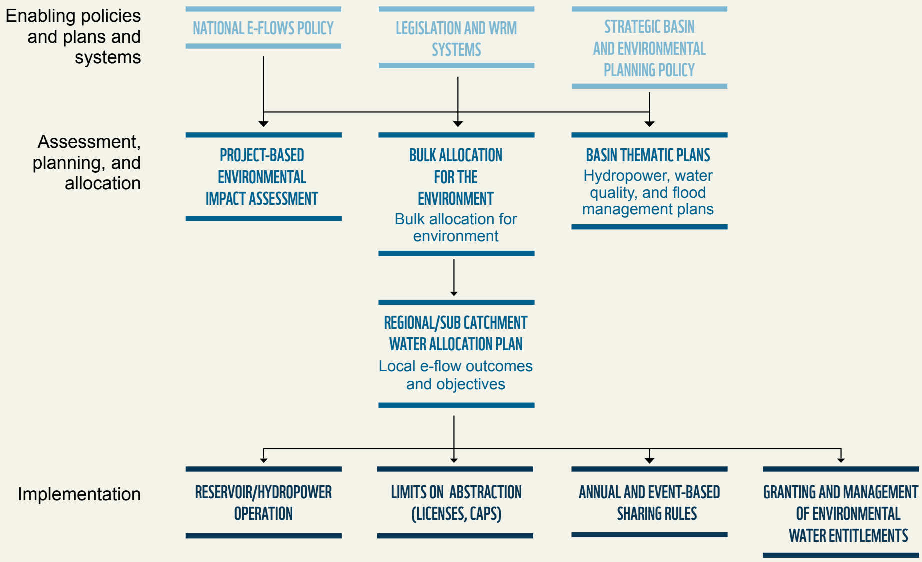
Environmental flows

Globally, water use has resulted in major reductions in annual river flows and changes in the size, timing and frequency of different flow events in many river basins around the world, leading to significant declines in river health. To counter these impacts, determining environmental flow requirements is now seen as fundamental to the water allocation planning process and should involve:

- Identifying the assets and river functions that are of value to society
- Determining the flows – in terms of size, timing, frequency, and duration – required to maintain those assets and functions

At its core, water allocation involves a trade-off between environmental and human needs. Such trade-offs should maximise human and ecological outcomes, while ensuring the the implications for the environment (and dependent communities) of changes to the flow regime are well understood. This requires a comprehensive system for assessing and implementing environmental flows, consistent with national and basin plans and priorities (see Figure 5).

Figure 5: Framework for environmental flow assessment and implementation.



Identifying environmental priorities

Identifying the key environmental assets, functions or processes within a basin is central to the environmental flow assessment process. In the 1987 Yellow River Allocation Scheme, the environmental focus was on maintaining sufficient flows for sediment transport, thus maintaining channel form. The 2004 Allocation Agreement for the Lerma-Chapala Basin recognises the maintenance of water in Lake Chapala as a priority, and limits the volumes that can be abstracted by licence holders based on the annual volume of water in the lake. The draft Murray-Darling Basin Plan sets sustainable diversion limits based on the water required to protect 2,422 key environmental assets (and to maintain four key ecosystems function, which relate to the provision of habitat and the transport of nutrients, organic matter, and sediment).

GOLDEN RULES OF BASIN WATER ALLOCATION PLANNING

Based on international experience, ten "golden rules" of basin water allocation planning have been identified.

1. In basins where water is becoming stressed, it is important to link allocation planning to broader social and economic development planning. Allocation decisions on trade-offs between the demands for water from different regions or economic sectors need to be made with an understanding of future development objectives.
2. Successful basin allocation processes depend on the existence of adequate institutional capacity, both to develop a plan, as well as for monitoring and compliance activities.
3. The degree of complexity in an allocation plan should reflect the complexity and challenges in the basin, as well as the information available and the capacity of relevant institutions.
4. Considerable care is required in defining the amount of water available for allocation. Once water has been (over)allocated, it is economically, financially, socially, and politically difficult to reduce or alter allocations.
5. Environmental water needs provide a foundation on which basin allocation planning should be built. Environmental water is crucial to maintain key system functions on which many services depend, and need to be incorporated at the heart of allocation planning. These requirements should be included even where information is limited.
6. The water needs of certain priority purposes should be met before water is allocated among other users. This can include social, environmental and strategic priorities.
7. In stressed basins, water efficiency assessments and objectives should be developed within or alongside the allocation plan, with allocations made based on an understanding of the relative efficiency of different water users.
8. Allocation plans need to have a clear and equitable approach for addressing variability between years. Depending on the situation, more or less sophisticated approaches are available for doing this, ranging from simple rules for dividing deficits or surplus, through to complex methods based on monthly water resource modelling.
9. Allocation plans need to incorporate flexibility in recognition of uncertainty over the medium to long term in respect of changing climate and economic and social circumstances.
10. A clear process is required for converting regional water shares into local and individual water entitlements, and for clearly defining annual allocations.

The world's freshwater in numbers

100% RECYCLED

64B

64 billion M³ increased demand for water each year to meet the needs of the growing world population

300

new freshwater fish species are discovered every year

47%

percentage of the world population predicted to be living in areas of high water stress by 2030

300%

growth in water abstractions over the last 50 years

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