Water Resources Allocation
Sharing Risks and Opportunities

Chapter 2

A framework for water allocation

This chapter sets out an analytical framework for water allocation regimes as a basis for examining how they function in a range of countries and how they can be improved. It highlights how water is a complex resource, with distinctive features as an economic good, often with a unique legal status. It identifies the key components of an allocation regime and the policy levers that can be used to improve their performance. Finally, the framework links the elements of allocation regimes with the policy objectives of economic efficiency, environmental sustainability, and social equity.

Key messages

- Water allocation is, in essence, a means to manage the risk of shortage and to adjudicate between competing uses via a **combination of policies, laws, and mechanisms**. The risk of shortage is dynamic, in both the short and the long-term. Hence, a well-designed allocation should have two key characteristics: it should be **robust** by performing well under both typical and extreme conditions and demonstrate **adaptive efficiency** with the capacity to adjust to changing conditions at least cost over time.
- Water is a complex resource with **distinctive features as an economic good**, displaying the characteristics of public or private goods in different settings. The public or private good nature of water depends on *how* and *where* water is used or, more precisely, valued (for either use or non-use purposes).
- Water resources usually enjoy a **distinctive legal status**, often managed under the Public Trust doctrine. Access to the resource is often subject to **usage rights** (or "water entitlements"), rather than outright ownership (with the exception of groundwater resources in certain countries).
- **Nested allocation arrangements** can allow for tailoring the design of allocation arrangements to specific settings.

The allocation of water resources determines who is allowed to abstract water, how much can be taken and when, how much must be returned (of what quality), and the conditions associated with use. "Allocation regimes" consist of a collection of public policies, mechanisms, legal and economic arrangements, as well as informal conventional practices. This chapter sets out an analytical framework for allocation regimes that can be used as a basis for examining how allocation regimes currently function in a range of countries and to identify opportunities for improvement. It first highlights the general policy objectives that allocation regimes usually aim to achieve. It then reviews the particular characteristics of water resources as an economic good and the legal arrangements that determine access to the resource. While transboundary allocation is not a focus of this report, some considerations are discussed. Finally, the chapter sets out a framework that links policy objectives to the various components of allocation regimes, to provide a reference against which current approaches can be examined and the levers for improving regimes can be identified.

Policy objectives of allocation regimes

Water allocation is, in essence, a means to manage the risk of shortage and to adjudicate between competing uses. Water systems are inherently variable. The availability of water resources varies in time (seasonal, inter- and intra-decadal variability) and space as a result of the natural water cycle. These features are reinforced and exacerbated by climate change (OECD, 2013a). Freshwater supply conditions can change quickly. It is not uncommon for a region that has been in the midst of a serious drought to find itself suddenly in the midst of a flood.[1]

The risk of shortage is dynamic, in both the short-run and the long-term. Hence, a well-designed allocation regime should have two key characteristics: it should be robust by performing well under both average and extreme conditions and demonstrate adaptivity with the capacity to adjust to changing conditions at least cost over time. Adaptive efficiency addresses the least cost path to maximise social welfare over the long term in the context of complex resources, unpredictability, feedback effects and path dependencies (Marshall, 2005).

Water users need to understand that water supply involves short-term and long-term risks. Neither the average amount of water that can be supplied nor the minimum amount of water that can be supplied from a natural source can be guaranteed. Failure to make the nature of these risks clear can result in over-investment in water-dependent enterprises and calls for compensation when entitlements need to be reduced in order to avoid compromising water quality and other environmental outcomes.

Various water users will have different levels of risk aversion and different risk preferences. For instance, it is critical to avoid any shortage in water availability for cooling nuclear power plants, as the consequences are unacceptably high. However, farmers growing low value annual crops may be willing to forego water use during times of scarcity, especially if they can recover greater value from trading their water entitlements to higher value uses than they can by using the water. Various water users also have different capacities to manage the risk of freshwater shortage, by improving efficiency, relying on alternative water sources, or adjusting the timing of their water use. In principle, to reflect varying risk preferences and capacity, water uses should have flexibility to manage their risk of shortage.

In managing the risk of shortage, water allocation regimes should aim to maximise value individuals and society obtains from water resources in terms of economic, environmental and social outcomes. To achieve this, three generic principles can be used as a guide: economic efficiency, environmental sustainability, and social equity. Well-designed allocation regimes should manage the risk of shortage without compromising the effectiveness of arrangements needed to ensure full control of flood, water quality and other water management tasks.

From the perspective of economic efficiency, two issues should be considered. The first relates to determining an efficient level of water supply that balances the marginal costs of increasing supply or improving its reliability (e.g. through new sources of water, such as wastewater re-use, desalination, inter-basin transfers, or developing storage and distribution infrastructure) with the marginal benefits of doing so. This "supply side" approach has often been a response to increasing pressure on water resources, although it is not always efficient from an economic point of view when greater net benefits can be reaped from improving demand side management. The second issue relates to how existing water resources are allocated among various purposes (including *in situ* uses). Box 2.1 discusses allocative efficiency from a theoretical and practical perspective.

In addition to allocative efficiency, promoting the technical efficiency of resource use is another important dimension. The allocation regime should be designed in a way that encourages efficient water use and promotes innovation to increase the value derived from water use. This requires an allocation regime that provides incentives for efficient resource use and removes perverse incentives for inefficient use.

Appropriate abstraction charges, which reflect at least the full cost of providing access to water resources are an important feature of allocation regimes. In practice, abstraction charges tend to be administrative fees and are not based on the economic value of the water abstracted (Hanemann, 2006). Because water prices have historically been far below efficient levels, increases have the potential to contribute to improving the problem of water shortage (Olmstead, 2010). At the minimum, abstraction charges would provide an incentive to eliminate the most inefficient uses. In addition to allocative efficiency and encouraging efficient resource use, the transaction costs of the overall regime should remain as low as practicable.

Environmental sustainability is a second generic objective of allocation regimes. As pressures on water resources grow, the availability of water to maintain environmental value is increasingly strained. Allocation regimes should have hydrological integrity as well as allocate sufficient water to meet environmental needs, referred to as "environmental flows". The Brisbane Declaration (2007) defines environmental flows as the "*quantity, timing and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihood and well-being that depend on these ecosystems*".

In practice, environmental flow requirements can be estimated in a number of different ways, ranging from simple rules of thumbs, to sophisticated, data intensive approaches. Poff et al. (2009) have developed a framework, the ecological limits of hydrologic alteration (ELOHA), for assessing environmental flow needs for many streams and rivers simultaneously to foster development and implementation of environmental flow standards at the regional scale. In order to apply the ELOHA framework, stakeholders and decision-makers need to explicitly evaluate "acceptable risk" as a balance between the

Box 2.1. **Improving allocative efficiency for water resources: A theoretical and practical perspective**

From a theoretical perspective, an allocation would be considered "Pareto optimal" (or "Pareto efficient") in the case where further reallocation among users cannot make anyone better off without making at least one person worse off. A change in the allocation of resources among users (which may include some compensation to offset any loss of welfare of users due to foregoing use of the resource, even if the transfers are not actually made*) that makes at least one person better off, without making at least one person worse off is considered a "potential Pareto improvement". The relative efficiency of alternative allocations can be viewed with respect to this criterion, by determining whether an alternative allocation situation provides a "potential Pareto improvement".

From a practical perspective, achieving this "optimal" allocation for water resources is problematic for numerous reasons. Water is not one single commodity, but instead a complex, multi-dimensional resource (both legally and hydrologically) (Olmstead, 2010). It is also difficult to estimate the marginal benefit (use and non-use values) of water resources in various settings. For example, what is the value of additional water left in-stream to support a freshwater ecosystem? The value obtained from water resources depends on when and where it is used (or not used). In addition, the marginal benefits of some uses (e.g. drinking water, for national security purposes such as flood protection or cooling nuclear plants) can far exceed the financial cost of supplying water for others (e.g. irrigation) (see Briscoe, 1996), complicating attempts to use marginal cost pricing as an allocation mechanism.

While there are practical limitations to achieving "optimal" water resource allocation, improving the efficiency of allocation is an achievable and valuable goal. It is possible to make changes in allocation regimes to make at least one person better off, without making anyone worse off. One way to do this is to limit changes to those that increase the value of the water entitlements held. Another is to offer compensation to those who would become worse off as a result of a change in water allocation. When considering this option, it is important to begin by assessing the *status quo* in the absence of reform, which can provide a baseline to guide action.

* The Kaldor-Hicks compensation principle states that if transfers (of compensation) could be made to achieve unanimity (in terms of social preferences) on a particular choice, then the choice is socially desirable, *even if the transfers are not actually made* (Kolstad, 2000).

Source: Kolstad (2000); Olmstead (2010); Briscoe (1996).

perceived value of the ecological goals and the economic costs involved, taking into account the scientific uncertainties between ecological responses and flow alteration (Poff et al., 2009).

Along with economic efficiency and environmental sustainability considerations, the equity of dimension of an allocation regime is also important. Equity is subject to interpretation in varying contexts. In the context of water resources allocation, it can relate to equity among various groups (e.g. among water users, between current water users and new entrants, among social groups). It can also be understood in terms of outcomes as well as in terms of processes.

Equity in process is important to ensure that existing and potential water users are treated fairly. Equity also requires that changes in allocation arrangements should fully consider the distributional impacts of these changes. However, the use of water allocation to achieve income and other distributional objectives in OECD countries needs careful consideration. In practice, it is an inefficient means of dealing with income inequality and policy objectives related to supporting farmers' livelihoods or achieving food security. There are proven approaches to address affordability issues to ensure that all households have sufficient access to drinking water for their needs. There are also numerous alternatives to support farmers' livelihoods.

Table 2.1 summarises these general policy objectives that can be used to guide the design of allocation regimes. These various (sometimes conflicting or competing) objectives need to be balanced, which requires addressing trade-offs between them. How this is done in a specific context will be strongly influenced by historic circumstances that have shaped existing allocation arrangements, the relative weight given to certain policy objectives over others, and the prevailing political orientation. In practice, water allocation arrangements are often put in place to serve other policy objectives outside of the water domain *per se*, such as food or energy security. For example, countries that are highly dependent on hydropower for their energy supply, such as Brazil, place a high priority on managing water flows and allocation for energy. Serving the needs of other water users is subservient to this objective. These decisions can be informed by economic valuation, but will also be strongly influenced by a process of negotiation among various groups, such as water using sectors, various regions, historic users and new entrants.

Table 2.1. **General policy objectives of water allocation regimes**

Economic efficiency	Environmental sustainability	Social equity
• Allocative efficiency (allocating water to higher value uses). • Efficiency in water use. • Efficient allocation of risk of shortage. • Efficient level of investment in augmenting water supplies and water dependent activities. • Incentives for innovation and investment. • Administrative efficiency.	• Hydrological integrity of the system. • Adequate environmental flows to support ecosystem services. • Adequate environmental flows to support key freshwater species.	• Equity among water users (or groups of users) and between existing users and new entrants. • Equity in the process of allocation and re-allocation. • Fair distribution of costs and benefits of the allocation regime. • Equitable sharing of risk of shortage. • Equity between generations (ensuring sustainable use of the resource) or community groups, including Indigenous people. • Perceived fairness of the allocation regime.

Water: A resource with public and private good characteristics

Water resources exhibit a number of particular characteristics that make them unlike many other economic goods and natural resources. These distinctive features (summarised in Box 2.2) merit consideration in the design of allocation regimes and can explain, in part, the distinctive legal and economic arrangements underpinning them.

The complexity of water as a resource is reflected in its distinctive features as an economic good often with a particular legal status (Hanemann, 2006; Griffin et al., 2013; Barraqué, 2013; Whittington et al., 2013). These features are critical for understanding how the combination of instruments and mechanisms that make up allocation regimes can be designed to meet policy objectives. As argued by Ostrom (2003), the attributes of the goods allocated, along with the rules used for their allocation affect the incentives that users face.

Water resources display both public good and private good characteristics in different settings. Samuelson (1954) made the distinction between private goods, which "*can be parcelled out among different individuals*" and public goods, "*which all enjoy in common in the sense that each individual's consumption of such a good leads to no subtraction from any other*

Box 2.2. **Water's distinctive features**

The proposition that water is an "economic good" is often the subject of heated debate. Between the opposing views that water is an economic good like any other and that water is sacred and cannot be considered a commodity, Hanemann (2006) argues for a position somewhere between these extremes. First, he acknowledges that water is *perceived* to be different from other essential goods (e.g. shelter, food) and the arousal of passionate debate speaks for itself. Second, water has some *economic* features that make is distinctive *as an economic commodity*. Unlike many other economic goods, water is both a private good and a public good. Water also has a number of specific features that bear on its consumption, value, price and so on.

- *The mobility of water:* water flows, evaporates and seeps into the ground. There are also opportunities for sequential use and re-use (although there is often a reduction in the quality or change in location). This makes tracking water flows costly and sometimes difficult. As a result, it is often hard or impractical to enforce excludability (a requirement for private goods).
- *The variability of water:* the supply of and demand for water varies spatially, temporally and often in terms of quality. This generates the challenge of matching supply and demand, which typically requires infrastructure to facilitate storage, inter-basin transfers. It also affects the legal and institutional arrangements for the use of water. For example the intermittent demand for agricultural water is conducive to collective sharing of right of access (as opposed to individual ownership of a property right), as irrigators may, depending on the crops cultivated, draw water from a common resources at different times.
- *The cost of water supply:* water is expensive to transport, relative to its value per unit (as compared to other commodities, such as petroleum or electricity). Water supply is also exceptionally capital-intensive and capital assets used in water supply are an extreme type of fixed, non-malleable, long-lived capital. For many types of water supply and sanitation infrastructure, there are significant economies of scale. There is generally an unusually large gap between short- and long-run marginal costs in water supply. These factors help to explain the significant degree of public provision of water supply.
- *The price of water:* the price paid by most users represents the physical supply costs and not the scarcity value of the resource itself. Water is often under-priced and charges tend to reflect past supply costs, rather than future replacement costs. Although under-pricing is not unique to water, it is a persistent and ubiquitous feature.
- *Essentialness:* water is both an essential final good (as *no* amount of any *other* final good can compensate for having a zero level of consumption) and an essential input to certain production processes (as *no* production is possible when this input is lacking).
- *The heterogeneity of water:* besides just quantity, water's location, timing, quality and variability influence its value. For a given user, one unit of water is not necessarily the same as another unit if it is available in a different location, at a different time, of a different quality or a different probability of availability. As a differentiated commodity, there is no single demand function for water use.
- *The benefits of water use:* there are a number of ways in which a marginal increase in access to water could result in benefits, either directly or indirectly. Yet, the relationship between water and increased productivity is a complex one. In some cases, water may be a necessary, but not a sufficient condition for economic growth. The relationship may even be more complicated, as *multiple* causal pathways between water and growth may exist.

Source: Based on Hanemann (2006).

individual's consumption of that good". This definition focusses on non-rivalry (consumption of the good by one person does not diminish the ability to consume by others) as the distinguishing feature. "Pure" public goods also exhibit non-excludability (the inability to exclude access to the resource). Excludability is mainly determined by the specific characteristics of the resource, the legal framework used to define the ownership of the resource and entitlements to use it, and the mechanisms in place to measure abstraction and enforce the allocation regime. It is basically about the capacity to prevent certain people from using the resource at an acceptable cost.

The public or private good characteristics of water depend on *how* and *where* water is used or, more precisely, valued (for either use or non-use purposes). Water resource use displays varying degrees of rivalry and exclusivity in different settings. The degree of rivalry varies for different types of uses. This mainly concerns the distinction between consumptive versus non-consumptive uses. This is basically about whether one person's enjoyment of the resource diminishes the possibility of enjoyment by others. For instance, drinking water supply to households is rivally consumed relative to others accessing the public water supply in that area. Irrigation use is rivally consumed relative to alternative uses in the area (via evapotranspiration, water embodied in crops), while the remainder is runoff, which is typically altered in terms of quality and location and is not readily available for others to use (Griffin et al., 2013). In such a situation one person's consumption subtracts from the resource available for others to consume.

In-stream uses of water such as navigation, recreation, or the maintenance of environmental flows to support freshwater ecosystems are examples of public good uses of water, which may be non-rivally and non-exclusively enjoyed (Griffin et al., 2013; Hanemann, 2006).[2] In other words, these types of uses are freely accessible to all and their enjoyment by one user does not impinge on the enjoyment by other users. However, even these uses tend to be non-rival only within their use category, as in-stream use is rival with the out-of stream uses to which this water could be alternatively applied in its locale (Griffin et al., 2013). Table 2.2 summarises these examples of various uses of water resources.

Table 2.2. **Water as a public and private good**

	Rivalry	
	Low – High	
Excludability		
High	**Club good** • Recreational use in a water bodies where access can be restricted, such as a private lake.	**Private good** • Water body exclusively on private land. • Drinking water consumed by households. • Irrigation system which allows for exclusion. • Rainwater captured on private land.
–		
Low	**Pure public good** • In-stream uses, such as: navigation, environmental flows supporting ecosystem services, recreational uses in a public setting, such as bathing, boating, etc.	**Common pool resources** • Shared aquifer. • Water provided through a distribution system in an irrigation district (where users cannot be excluded).

Source: Based on Griffin et al. (2013); Hanemann (2006).

Excludability, in the case of water resources, is mainly determined by the specific characteristics of the resource itself and the legal and policy framework in place to limit access to it. For example, a water body fully contained on private land with well-enforced property rights exhibits excludability, because other potential users can be preventing from using it. However, a groundwater aquifer that can be freely accessed by multiple users does not. This is an example of a common pool resource; characterised by high exclusion costs and where one person's consumption subtracts from the total available (Ostrom, 2003).

The distinction between public and private characteristics of various uses of water resources is an important consideration for allocation for two key reasons. Firstly, the valuation of public and private goods is fundamentally different: for private goods, the marginal value will be that of a single user (allocated efficiently, it will be the user with the highest and best use), while the marginal value placed on a public good is that of many people who can enjoy the good simultaneously. This basic distinction regarding valuation is one of the reasons why the non-market benefits of environmental protection can outweigh the use benefits associated with diverted use (Hanemann, 2006). Olmstead (2010) reviewed the substantial literature on the marginal value of surface water left in-stream for recreation, wetlands restoration, and other in-stream activities. For example, in the United States, the marginal value for fishing was found to be greater than the marginal value for irrigation in 51 of 67 river basins with significant irrigation, but values were highest in the Southwest, where the effects on fishing of marginal changes in stream flow were the greatest (Olmstead, 2010).

Secondly, since water resources display both private and public good characteristics in different settings, nested allocation arrangements can be appropriate to tailor the design of allocation arrangements to specific settings. For example, administrative allocation can be used to determine the repartition between *in situ* and diverted uses. Once this repartition has been made, market-based allocation can be used where appropriate to allocate water among a specific user group, such as irrigators. This reflects what often occurs in practice. The allocation between environmental flow requirements (along with other *in situ* uses) and water available for diverted uses (irrigation, industry, domestic use, etc.) nearly always occurred administratively, via regulation. In practice, most (but not all) market-based allocation arrangements allow for trade among a specific user group, such as irrigators.

Legal status of water and claims to use water

The characterisation of water as an economic good and the ownership institutions of water resources are two distinct matters. Public ownership of water does not mean that water is necessarily a public good (Griffin et al., 2013). In the same vein, common-pool resources are not necessarily associated with common-property regime, *or with any other particular type of property regime* (Ostrom, 2003). However, the public good nature of water *in situ* has had a decisive influence on the legal status of water (Hanemann, 2006).

Water law has been influenced by a number of legal traditions over the centuries that still have repercussions for its use today. Common-law traditions developed a body of legal doctrine specifying strong property rights in flowing water attached to riparian possession and limited rights to surface and underground waters. Water doctrine was also influenced by Roman law and Roman-derived civil-law concepts of common goods and the natural rights of ownership (Getzler, 2004). Customary rights to water use, with roots in traditional land tenure practices, are typically based on long standing non-state law, custom and traditions (Le Quesne et al., 2007). As documented by Ostrom (1992), a typical case of customary rights is that of communal rights, in which water is allocated by a community via community leaders or a bargaining process to individual users. Table 2.3 summarises different generic types of ownership systems, with an example of application to water

Table 2.3. **Types of property ownership systems**

Type of ownership system	General description	Example of application to water resources
Open access	No defined users or owners. There is no incentive for any one user to protect the resource unless all the users protect it.	Instances where no informal or formal control on access to water resources exists.
Common property[1]	A management group has the right to exclude non-member. Non-members have a duty to abide by the exclusion. Co-owners comprise the management group and have rights and duties with respect to the use of resources.	Collectively owned ground or surface water resources, with entitlements to use the water proscribed to individuals by the management group responsible. Communal rights.
State property	Individuals have a duty to observe the rules of resource use determined by the controlling agency. For state ownership to work efficiently, the state must be able to monitor the use of resources, establish rules acceptable to individuals and communities, and enforce those rules.	Publicly owned ground or surface water resources, with entitlements to use the water proscribed by the public authority responsible.
Private property	Individuals have the right to undertake "socially acceptable" uses, and the duty to refrain from "unacceptable" uses. Others have the duty to respect individual rights. This is likely to conserve the resource since the owner would be able to receive the benefits of conservation. However, markets will still be unable to account for externalities.	Privately owned groundwater resources, or surface water resources contained on private land.

1. Getzler (2004) asserts: "The communitarian theory of the self-regulating commons is not in tension with the conventional economic theory of property but is a special case. The conventional theory postulates that parties move out of common pooling into privatised property regimes in situations where trust and stinting cannot be generated between self-interested parties (see Libecap, 1989). The commons theory locates instances where self-regulated pools become possible through the constraints of rational self-interest buttressed by culture or repeat transacting; privatisation is then unnecessary or even sub-optimal."

Source: Based on Pearce and Özdemiroglu (1997) for the categories of ownership systems and general descriptions.

resources. This is not a comprehensive list of ownership and management arrangements for water resources. Cases also exist whereby the ownership of water resource is not explicitly defined, but the government manages the resource and usage rights.

Flowing waters are often treated as common to all, *res communis omnium*, and are not capable of being owned (Hanemann, 2006) or as *res nullius* ("ownerless property"). Water is thus often the subject of *usufructuary rights*, which allow for the right of use of a resource or property and the enjoyment of benefits from that use. These rights of use are typically subject to a number of conditions, including "reasonable" or "beneficial" use doctrine and limited to a pre-determined duration. The reasonable use doctrine allows an upstream user to interfere with the stream to a certain (vaguely defined) extent, without requiring bargains to be struck with all affected users downstream (Getzler, 2004).

There are several ways in which these rights of use can be defined. In this report, we refer to them as "water entitlements".[3] The conditions applied to them can vary considerably from case to case. Common instances include *riparian entitlements*, under which all landowners whose property adjoins a body of water have the right to make reasonable use of it and often requires that the use does not interfere with other riparians' use of the resource. Water entitlements based on *prior appropriation* results in a continuum of senior right holders to junior rights holders. Appropriative entitlements are assigned in order of application of a quantity of water for a beneficial use. Those applications submitted earlier will be more senior to those submitted later ("first in time, first in line"). Water is then allocated according to seniority. In an extreme drought, even "senior" entitlement holders may not receive their allocation. In a mild drought, all but the most junior entitlement holders may receive full allocations. This system means that more junior users bear a greater risk of water shortage, while more senior users are relatively more insulated from such risk.

Water entitlements can also be "*unbundled*", or separated, from land titles. Water users hold an entitlement to abstract and use water from a specified resource pool, independently of ownership of land. The entitlement holder is then given a specific "allocation" of water to abstract within a specified time period in a manner that is in accordance with pre-specified conditions. The separation of water entitlements from specific allocations within a season provides a mechanism to combine flexibility within the system to adjust to changing conditions (by varying the allocations within a given season according to the available resource pool) with security for water entitlement holders (by maintaining the overall entitlement over time).

In many instances, several laws may be in place, which generate contradictory or competing claims on water resources. For example, statutory water law and customary water law may co-exist, with varying levels of actual implementation on the ground. This "pluralism" of water law can be further exacerbated by water laws in contradiction with land laws, or environmental laws, resulting in unclear and competing water law systems in a given context and expected management problems (Le Quesne et al., 2007).

Transboundary considerations[4]

In transboundary river basins, each riparian State is entitled (and limited) to an equitable and reasonable share of beneficial uses of transboundary waters (Wouters et al., 2005). The key principles of international water law – equitable and reasonable use of transboundary water and the obligation not to cause significant harm – provide guidance for allocating water, as well as for the development and use of river basins. There are no universally accepted criteria for allocating transboundary waters or their benefits. Each transboundary basin has its own particularities. Arrangements or agreements reached with regard to certain basins cannot be automatically applied to other transboudary basins. The principles of international water law need to be interpreted in the context of each basin's unique setting.

Allocating water between riparian countries can be highly challenging, especially if the water management practices as well as the main water needs in the riparian countries differ, for example with regard to seasonal discharges as it is commonly the case for water use for agriculture and hydropower. A broader understanding of the benefits of water use can lead to more creative arrangements. Some agreements acknowledge existing uses and some specify a minimum cross-border flow to downstream riparians to ensure the availability of a certain proportion of water resources for the downstream riparian countries. Some agreements also specify the obligation to maintain a minimum environmental flow, such as in the Agreement between the Government of the Russian Federation and the Government of Mongolia on the Protection and Use of Transboundary Waters of 1995.

International guidelines and conventions on freshwater set out principles and rules, which can be helpful in guiding decisions about the use of transboundary waters. The Helsinki Rules on the Uses of the Waters of International Rivers,[5] adopted by the International Law Association in 1966, is a pioneering example of such a guideline. Although the guideline is not enforceable, it preceded and informed the establishment of international conventions on freshwater, namely the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki Convention, 1992) and the Convention on the Law of the Non-Navigational Uses of International Watercourses (UN Watercourses Convention, 1997). Although not all OECD member countries are parties to them, some of the provisions of these conventions have provided the basis for a number of bilateral and multilateral agreements on transboundary waters.

In negotiating agreements on water allocation, hydrographical arguments (shares of the States' territories contributing to flow formation) and the securing of existing uses or needs (irrigable land, population or the requirements of a specific project) are commonly referred to (see e.g. Wolf, 1999). Agreements with clauses for water allocation have commonly been negotiated in conjunction with a boundary delineation, a division of boundary waters or an agreement over future river development. In response to declining groundwater tables resulting from heavy abstraction, an arrangement was concluded in 1977 between France and Switzerland on the Genevese aquifer defining an abstraction cap and a level up to which abstraction is free of charge.[6] Under the Arrangement, the Swiss constructed and have operated an artificial recharge installation and the costs of construction and operation were agreed to be shared by the parties (Mechlem, 2012). This illustration shows how investments for mutual benefit may facilitate agreement on water allocation.

Institutional arrangements at a transboundary level that allow for flexible responses to changing circumstances can be useful, such as through continued co-operation in technical subsidiary bodies (UNECE, 2009). As the availability of water resources varies over time due to climate change, shifting hydrological conditions, land use and land cover change, as well as development, agreements on transboundary waters may also need to adjust in response to these changes in order to effectively manage risk (see example in Box 2.3). Because such agreements are difficult to renegotiate and tend to last for decades, it is better to define water allocation at the transboundary level in a flexible manner considering supply and demand balance.

Policy instruments and mechanisms for water allocation

The complex and distinctive features of water resources as an economic good and its particular legal status mean that allocation regimes are often complex combinations of various laws, policies, and mechanisms. This section identifies the main policy instruments and mechanisms used to allocate water and describes their constituent parts. The robustness and adaptive efficiency of an allocation regime can be improved by unbundling the various elements and using separate instruments to pursue various objectives (Box 2.4). However, unbundling should not undermine the effective management of the system as a whole. Thus, even if separate instruments are used to manage particular objectives, there is still a need for a comprehensive view of how the various elements interact to achieve policy objectives.

The elements of an allocation regime can be divided into "system level" elements and "user level" elements (Young, 2013). System level elements include those issues that are most efficiently and equitably dealt with at the scale of a water resource (be it at the basin, catchment, river, stream or aquifer level). Typically they take the form of conditions expressed in water law, water sharing plans and other similar policy instruments that determine how system wide decisions are taken and by whom. Those that apply to all water resources may be set out in regional and national legislation. System level

Box 2.3. **Improving responsiveness to variability and hydrological extremes in transboundary allocation: The Albufeira Convention**

In river basins where water is scarce or its availability variable, defining water allocations between the riparian countries in terms of an annual allocation may not be sufficient for managing variability. The distribution between seasons is important for several types of water use, including agriculture and hydropower. The Albufeira Convention provides a good example of shifting from allocations based on annual flow to shorter time periods, to better enable adjustment to variability and extremes.

The Convention on Co-operation for the Protection and Sustainable Use of the Waters of Portuguese-Spanish River Basins (Albufeira Convention, 1998)* was revised in 2008 to guarantee a good status of water bodies and to meet the current and future demands, including responding to floods and droughts. The Albufeira Convention regulates the transboundary waters in the shared basins between Spain and Portugal: the Miño/Minho, Lima/Limia, Douro, Tejo/Tajo and Guadiana Rivers.

The original Convention defined the absolute amount of water that should be received by the downstream riparian State. The annual flow regime defined in the Convention operated well for many years and good collaboration helped the riparian countries to overcome difficult situations. Nevertheless, the exceptional drought period that affected the Douro, Tejo and Guadiana basins from 2004 to 2005 demonstrated the potential impacts of water scarcity. The amendment of 2008 involved disaggregating the annual flow regime into shorter time periods. This new regime determines a quarterly (Minho, Douro, and Guadiana), weekly (Douro and Tejo) and daily (Guadiana) discharge flow, depending on the rainfall conditions in each basin (Otterman and Koeppel, 2014). At times of extremely low rainfall (below specific thresholds), the defined flow regime might not apply, but water should be managed in such a way as to ensure its priority uses.

Operating and controlling such a jointly-defined flow regime requires good monitoring capacities and infrastructure, as well as flow regulation, to be in place. Some of the Spanish-Portuguese rivers have significant storage capacity, notably the Guadiana River (UNECE, 2011), so the natural discharge can be complemented with releases from the Spanish reservoirs. Well-functioning information exchange is a prerequisite for an effective, co-ordinated response to hydrological extremes that brings mutual benefits.

* "Convenio sobre cooperación para la protección y el aprovechamiento sostenible de las aguas de las cuencas hidrográficas hispano-portuguesas", Albufeira, 30 November 1998. Available at: *www.boe.es/boe/dias/2000/02/12/pdfs/A06703-06712.pdf*.

Source: Otterman and Koeppel (2014); UNECE (2011).

elements range from identifying the availability of water resources, to the legal status of the resource, to mechanisms for monitoring and enforcement. Table 2.4 provides a summary of the various system level elements of allocation regimes and provides a brief description of each. Boxes 2.5 and 2.6 provide specific examples of how certain countries deal with two of these system level elements, the assessment of water resources and dealing with in-stream flows.

User level elements of a water allocation regime are those aspects that are most efficiently and equitably dealt with by specifying the arrangements that apply to an individual (or collective) abstractor. Typically, these take the form of arrangements specified in entitlements, permits and licenses. These are summarised in Table 2.5.

Box 2.4. **Advantages of "unbundling" to encourage innovation and investment**

Throughout much of the world, entitlements to abstract water are typically bundled together with controls on use and other arrangements, which can decrease flexibility and can discourage innovation. For example, time-bound duration of water entitlements (often 5-10 years) can reduce incentives for long term investment and innovation of water-intensive activities. Water entitlements are often granted with a limited duration to allow for revision of the conditions on the entitlement and an opportunity to deny renewal if needed. However, from the perspective of the water user, this can generate uncertainty. One option to address this is to issue entitlements in perpetuity, yet ensure that they remain subject to specific conditions. This can only be achieved if entitlements are unbundled from other elements of the allocation regime.

Unbundling involves the replacement of a single licensing instrument with a suite of instruments, each designed to address a specific issue, at the appropriate scale. The can bring considerable advantages. Consistent with the Tinbergen Rule that stipulates that for each and every policy target there needs to be at least one policy instrument, separate instruments for allocation should be used for independent objectives. For example:

- Water sharing plans can be used to define abstraction limits for each water body.
- Water entitlements can be used to specify each user's priority share in a water resource as well as those people who have a direct interest (or claim) in that entitlement.
- Allocations can be used to determine the amount of water that an entitlement holder can be granted permission to abstract within a specified time period in a manner that is in accordance with pre-specified conditions.
- A set of "approvals" (such as abstraction approvals, works approvals and land use approvals), or instruments to specify conditions of use, can be used to monitor water take, control local impacts, and adjust for return flows.

The result is a combination of arrangements that enables clear signals to be given to all water users without having to be addressed by one centralised office. For example, basin planning can occur at the basin level and using well-defined sharing arrangements and catchment scale arrangements can then be nested inside a basin plan that allows for changes at the basin scale to flow through the system, without the need to adjust the catchment plan. Water entitlements can then be defined for each water body so that allocations in a given season can be made in a way that is consistent with these plans. Then, local administrators can be left to manage the local impacts of water use without the need to worry about broader catchment and basin-wide issues, improving the efficiency and effectiveness of governance arrangements.

In Australia, the unbundling of abstraction licensing arrangements has increased the flexibility of the system and caused a significant increase in the value of water entitlements. For most of the last decade, the internal rate of return from water entitlements remained above 15% per annum (Bjornlund and Rossiter, 2007).

Source: Young (2013).

Table 2.4. **Description of key system level elements of a water allocation regime**

System level elements of an allocation regime	Description
Legal status of the ownership of water resources	Legal definition of the ownership of water resources (e.g. public, private, *res nullius*).
Institutional arrangements for allocation	Authorities and organisations responsible for allocation and their various roles (policy, planning, issuing entitlements, monitoring and enforcement).
Identification of available water resources	Identification of available water resources (surface, ground water as well as treated waste water intended for re-use) based on best available scientific evidence.
Identification of in situ flow requirements/Identification of available ("allocable") resource pool	An explicit definition of *in situ* flow requirements based on various factors, such as requirements for base flow, environmental flows, non-consumptive use, international commitments, inter-annual and intra-annual variability, and climate change. The remaining water would be considered the available resource pool.
Abstraction limit ("cap")	An explicit and enforceable limit on abstraction. It may be defined in absolute, volumetric terms or as a proportion of available resources. The "cap" can be used to ensure water for environmental needs, so it should be designed to reflect natural flow regime dynamics.
Definition of permitted uses not required to hold an entitlement	Definition of those water users and uses that are allowed to access and use water without holding an entitlement.
Definition of "exceptional circumstances"	An explicit definition of circumstances that are considered "exceptional" and may require extraordinary measures. Stakeholders may or may not be involved in the definition of what constitutes "exceptional circumstances".
Sequence of priority uses	A pre-defined sequence of priority uses sets out the priority of access to water according to types of uses or users. It may apply when "exceptional circumstances" are declared or be used to guide the allocation of water entitlements.
Requirements for new entrants or expanded water entitlements	Conditions placed on the acquisition of new water entitlements or requests to expand existing entitlements. Typical examples include the assessment of third party impacts, environmental impact assessments or existing users foregoing use (for instance, in situations where the catchment is closed).
Mechanisms for monitoring and enforcement	Mechanisms such as metering, aerial surveillance or other means of monitoring water abstraction and use as well as clearly defined procedures and sanctions for addressing infractions and resolving conflicts.
Appropriate infrastructures	Water infrastructures to allow water to be stored, treated and transported, as needed.

Box 2.5. **Assessment of water resources: Examples from Spain and France**

In Spain, the evaluation of available resources and demands in each water resources system are carried out in the River Basin Management Plans (RBMPs). An inventory of available water resources is produced and existing water uses and demands are identified. Water resources assessment methods have been developed for the whole Spanish territory, as well as simulation water resources models that take into account: conventional and non-conventional water resources, environmental flows, water demands, hydraulic infrastructure, water use priorities and exploitation rules in order to establish water allocations and reserves.

In France, water is generally abundant, although water stress is increasing in some regions and there are periodic episodes of scarcity. In areas of water stress, more detailed assessments of water availability and use are justified. Laws related to water management of water resources are stricter in these areas and the allocation regime is more rigorous.

A mapping exercise has been undertaken to identify ground and surface water stressed areas. This is used to define water apportionment areas, where the water deficit is structural. These zones are the target of recent reforms that aim to restore sustainable abstractable volumes as well as the creation of Single Collective Management Bodies (Organismes Uniques de Gestion Collective, OUGC) to provide an incentive for irrigators to allocate a set volume of water among themselves at catchment level.

Box 2.6. **Options for treatment of in-stream flows within a water allocation regime**

When designing an allocation regime and setting a long-term abstraction limit, it is important to decide whether or not to include some or all entitlements in this limit. The most common approach is to set aside the amount needed for environmental needs, non-consumptive uses, and transfers to other systems (including downstream obligations) as a prior right and then to allocate the remainder to take water for consumptive purposes.

An alternative approach, being tested in Australia, is to assign some water to the environment as an entitlement to a share of all inflows and define this entitlement separately from the arrangements used to ensure that base flows, for example, are maintained. In the Murray-Darling Basin, a Commonwealth Environmental Water Holder has been established and by 2019 is expected to hold around one third of the Basin's water entitlements. Under this new arrangement, it is not possible for the government to allocate water to consumptive users without making a *pro rata* allocation to the Commonwealth Environmental Water Holder.

Australia is moving to this approach in order to put environmental water on the same footing as all other water users. Under this arrangement, allocations are made in proportion to the number of entitlements held in the interests of the environment, no matter how dry or wet it is. As a result, administrators are not able to transfer environmental water to other users.

In the United States, non-governmental groups have been buying water to ensure that the environment is looked after. A well-known example is the Oregon Water Trust, which became a programme of The Freshwater Trust in 2008.

Source: Young (2013).

Table 2.5. **Description of key user level elements of a water allocation regime**

User level elements of an allocation regime	Description
Legal definition of water entitlements	A legal definition of water entitlements that confers the right to use the resource, usually under certain conditions as well as identification of the types of water users that are required to hold an entitlement in order to abstract water. Entitlements may or may not be privately held. They can be granted to individuals or to collective bodies, such as water users' associations, which then distribute water to individual users. The definition usually also determines how an entitlement can be withheld or cancelled.
Abstraction charges	Charges associated with water abstraction. They aim to recover costs and to internalise negative externalities associated with water abstractions. As a proxy, most charges are set administratively and are designed to recover the costs associated with water supply provision.
Specification obligations relating to return flows and discharges in water entitlements	Return flow obligations refer to the requirement to return a portion of the water abstracted to the same or a different water body following use. Discharge requirements relate to the quality requirements (including thermal changes) of discharges.
Duration for water entitlements, accompanied by expectations for renewal	The length of time a water entitlement is granted for. It may be for a given number of years or in perpetuity (often conditional on beneficial use).
Possibility to trade, lease or transfer under appropriate conditions	The ability for water entitlement holders to trade (either permanently or temporarily), lease or transfer entitlements to others.

Among the user level elements, addressing return flows can be particularly challenging. When water becomes scarce, entitlement holders have an incentive to reduce return flows and save the water for themselves. This can undermine the integrity of the allocation regime if the change in the effective rate of consumption is not accounted for. There are generally two approaches to address this issue: i) reducing the abstraction limit as the technical efficiency of water use increases, with the reduction averaged across all entitlement holders equally; or ii) specifying return flow obligations in water entitlements.

Choosing between these options depends on an assessment of administrative costs and preference for stimulating innovation. The first approach rewards first movers in the pursuit of technically more efficient uses of water. The rate of adoption of more efficient irrigation technology should be faster. Those that move first, benefit from access to water that was previously being used by others. The latter approach is more equitable, as changes in the choice of technology made by one person, which increase the technical efficiency of water use, have no impact on the amount of water allocated to all other users, as would the case in the first approach. However, the latter approach is much more expensive to administer as the type of technology used by each person needs to be tracked and accounted for. In some cases, including several parts of the United States, a hybrid approach is taken. No attempt is made to account for changes within a farm, but when an entitlement is transferred to another person the entitlement is adjusted for expected changes in the return flow. Box 2.7 provides an example from South Australia.

Box 2.7. **A pragmatic approach to dealing with return flows: An example from South Australia**

The groundwater entitlement regime used in the South East of South Australia provides a good illustration of mixing pragmatism with the best available science to account for return flows. The regime began simply and has evolved with a considerable degree of pragmatism. In the first instance, each irrigator was given an entitlement to the volume of water needed to grow a standard crop and this was done by issuing irrigation equivalents. This was seen to be fair and no person would be able to change crop type or irrigation practice in a manner that undermined the interests of others.

Each irrigation equivalent entitled its holder to take the water needed to grow one hectare of a "standard crop" efficiently. Rather than controlling land-use tightly, the volume of water needed to grow a standard crop was estimated and a set of look-up tables used to specify how many hectares of any crop this would entitle its holder to irrigate. The focus of this approach was on the net amount of water used. That is, there would be no penalty for using irrigation techniques that resulted in the return of a significant amount of water to an aquifer.

Just over a decade ago, it was decided it was time to transition from this simple area-based abstraction regime to a more elaborate volumetric regime. This change was motivated by the impetus to reward more efficient water use, reap the benefits of fixing over-allocation problems and allow land-use change.

Box 2.7. **A pragmatic approach to dealing with return flows: An example from South Australia** *(cont.)*

Conversion from an area-based to a volumetric abstraction regime took around four years. At the start of this period, all irrigators were required to install meters and provide information on the amount of water they were using. Local researchers collected information on crop water use from the United Nation's Food and Agriculture Organisation (FAO) and supplemented this with data collected from field trials, the best available science on return flows, and data obtained from local farmers. Considerable care was taken to involve irrigators in all aspects of the conversion programme.

During this process, care was taken to ensure that changes in irrigation practice and special crop water needs were fully accounted for. The model developed for volumetric conversion provided a delivery component for drip irrigation of 11% over and above the crop water use. The delivery component for spray irrigation was set at an extra 18%. There was also a delivery supplement for flood irrigation that depended upon soil type which ranged between 54% and 199%. All water used for drip and spray irrigation was assumed to be lost from the aquifer. In the case of flood irrigation, the volume of water in excess of that required to carry out spray irrigation was assumed to return to the source aquifer and was therefore not accounted for as a net loss to the resource.

Towards the end of the conversion programme, it became clear that the level of allocation following volumetric conversion would be unsustainable if fully extracted. As a result, all allocations were then reduced on a *pro rata* basis to bring use within a sustainable level of extraction, in line with Australia's National Water Initiative.

Allocations are now issued on the basis that accounts for net losses from irrigation plus a delivery component. Allocations representing the net amount of water used are tradeable. Delivery volumes associated with returns to the aquifer are not tradeable.

During consultation, in the district of Padthaway, the community developed an approach based on differential reductions in order to ensure final allocation was within sustainable limits (almost 50% reduction in allocation) while still preserving the economic output of the region. All licensees received a minimum tradeable allocation of 3.95 ML/irrigation equivalent, reflecting the almost 50% reduction required (sufficient to drip irrigate vines). Active irrigators received additional volumes based on their history of use in the last three years, therefore protecting the economic output of the region. An upper cap on allocation was set at the maximum volume that would have been issued through the volumetric conversion model or the maximum volume used by the irrigator, whichever was lower (therefore, more efficient irrigators received less, as they did not need the additional volume). Temporary (two years) bridging allocations were available to inefficient irrigators to catch-up with best practice, etc.

Finally, the current plan requires that the numerical model used to assess return flows and net effects on use be re-run every 5 years with updated data. Any further changes required in order to keep use within sustainable limits will apply to all irrigators proportionately. A re-run of the numerical model in 2014 has indicated that no further reductions are required at this time.

Source: Based on DWLBC (2006a); DWLBC (2006b); South East Natural Resources Management Board (2011).

In addition to defining returns flow requirements from a quantitative perspective, the quality requirements (including thermal changes) for discharges need to be addressing. Box 2.8 provides an example from Spain.

Box 2.8. **Water discharge permits: An example from Spain**

In Spain, as a general rule, the granting of a water use licence does not imply the granting of a discharge permit for the water after it has been used and the quality has deteriorated. This wastewater must be returned to the natural environment (rivers or aquifers) under quality conditions prescribed by an administrative authorisation via a discharge permit. These discharge permits are granted for a much shorter period than water use licences. They have to be compatible with the receiving environment and are regulated by a list of "limit concentration values" for the main physical-chemical parameters. They are registered in a "Wastewater Census" and are subject to the payment of a Wastewater Control Fee.

In the case of the main surface water resources, the withdrawal volumes are fixed by the Withdrawal Commission (a management body of the River Basin Authority) according to the users' entitlements and the resource availability for a specific period of time. The Withdrawal Commission is in charge of setting the filling and discharge regime governing the reservoirs and aquifers of the river basin in order to comply with the licensing entitlements of the different users.

To summarise how the various elements of an allocation regime fit together, Figures 2.1 and 2.2 provide an overview of the system level and user level elements, respectively. As indicated above, while unbundling can be used as an option to use separate instruments to pursue various objectives, there is still a need for a comprehensive view of the system as a whole, to ensure that the interaction of the various elements works together to reach overarching objectives.

To understand how these various elements of an allocation regime can either help meet or impede policy objectives, Table 2.6 brings these elements together with the policy aims of economic efficiency, environmental sustainability, and social equity. The presence of a given element within an allocation regime does not necessarily ensure that the specific policy objective will be achieved. However, it is the design of the element that will influence its contribution to stated objectives. The descriptions provided in Table 2.6

Figure 2.1. **System level elements of a water allocation regime**

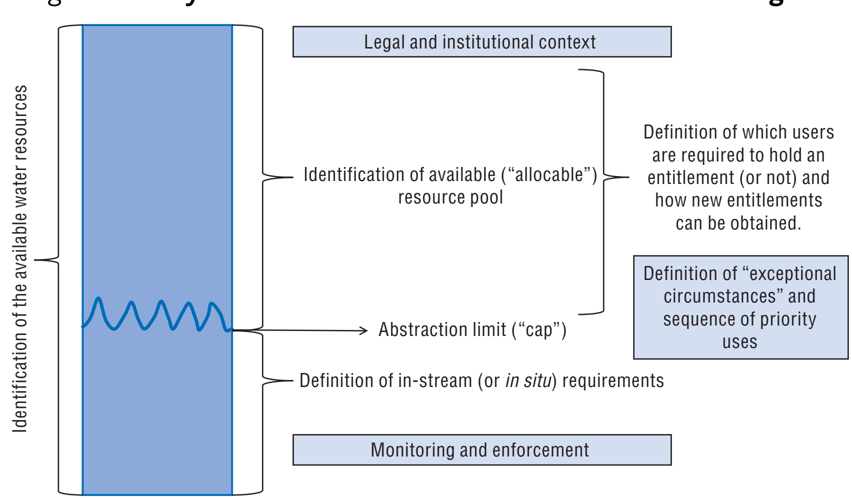

Figure 2.2. **User level elements of a water allocation regime**

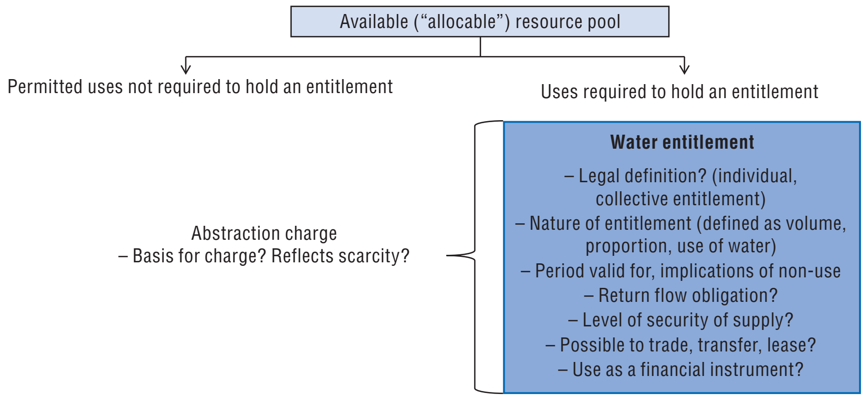

Table 2.6. **Framework for water allocation regimes**

Elements of an allocation regime	Economic efficiency	Environmental sustainability	Social equity
		System level elements	
Legal definition of the ownership of water resources	Allows for clear assignment of entitlements of use.	Confers legal authority to secure water for the public good uses.	Allows for clear assignment of entitlements of use.
Appropriate institutional arrangements for allocation	Ensure that a competent public authority can manage system and user level allocations issues, with clear lines of accountability, while minimising transaction costs.	Ensure that a competent public authority can designate and enforce adequate environmental flows.	Ensure equity in process, through adequate mechanisms for stakeholder engagement.
Identification of available water resources	Allows for efficient augmentation of available resources.	Ensures hydrological integrity and allows for managing system connectivity.	May be used to ensure fair access to adequate resources.
Identification of in situ requirements/definition of available ("allocable") resource pool	Balances use and non-use values of *in situ* activities vs. use value of diverted activities.	Ensures adequate environmental flows.	Balances needs of *in situ* users vs. users of diverted flows.
Abstraction limit ("cap")	Balances cost of closing system with risks of unsustainable use.	Allows for "closing" the resource pool to ensure sustainable functioning.	Balances needs of current water users with future water users.
Definition of permitted uses not required to hold an entitlement	Balances transaction costs associated with managing small scale uses with the cost (risk) of possibly undermining system integrity and foregoing abstraction charges.	Ensures hydrological integrity.	Balances customary, small-scale and subsistence uses with need with the need for system level integrity.
Definition of "exceptional circumstances"/sequence of priority uses	Can be used to ensure that the sequence of priority uses reflects to some extent the marginal value of use.	Can be used to avoiding irreversible damage to vulnerable ecosystems and key species and ensure environmental flows are not simply used as an "adjustment factor" in times of scarcity.	Can be used to ensures that human needs are a priority; Equity in process can be ensured through involvement of stakeholders in the definition of "exceptional circumstances" and the sequence of priority uses.
Requirements for new entrants	Ensures that water can be allocated to higher value uses.	May require an environmental impact assessment to support hydrological integrity.	May require an assessment of third party impacts; can be used to encourage fairness in access between existing users and possible new entrants.
Mechanisms for monitoring and enforcement	Balance transaction costs associated with monitoring and enforcement with costs (risks) imposed by unauthorised use.	Ensure hydrological integrity by ensuring adequate environmental flows.	Ensure common pool resources are used equitably and that use entitlements are respected (amounts are not exceeded) and illegal use discouraged.
Appropriate infrastructures	Ensure that water can be stored, treated and transported to water users as needed.	Ensure that water to serve environmental purposes can be stored, treated and transported to water users as needed.	Ensure that water uses have adequate and fair access to water.

Table 2.6. **Framework for water allocation regimes** *(cont.)*

Elements of an allocation regime	Economic efficiency	Environmental sustainability	Social equity
		User level elements	
Legal definition of water entitlements	Provides incentives for investment and innovation.	When entitlement defined as a proportion of available water, contributes to hydrological integrity and allows for adjustment to changing conditions.	May contribute to equity in processes that determine the conditions applied to water entitlements.
Abstraction charges	Promotes recovery of costs associated with providing freshwater supply, along with the environmental costs of resource use and (possibly) scarcity value.	May be used to reflect the environmental costs of resource use and (possibly) scarcity value in charges appropriate for hydrological conditions.	May be reviewed for potential affordability issues.
Specification of return flows obligations in water entitlements (quantity and quality)	Provides incentives for efficient water use.	Contributes to hydrological integrity and managing the quality of discharges.	Allows for a positive externality to be reaped by more efficient users.
Appropriate duration for water entitlements with clear expectations and transparent process for renewal	Provides an incentive for investment.	Contributes to hydrological integrity.	Contributes to equity in process related to conditions renewals.
Possibility to trade, lease or transfer under appropriate conditions	Encourages allocative efficiency, provide an incentive for efficient water use and innovation.	Allows for water "buy-backs" to occur, which can secure water from existing waters to be reallocated for environmental purposes thereby Increasing flexibility in managing scarcity conditions.	Allows for more flexibility in sharing of risk of shortage.

illustrate how the various elements of an allocation regime can support policy objectives, if they are well-designed. The "health check" set out in Chapter 5 provides policy guidance on how the design of allocation regimes could be improved.

Conclusion

Water is a complex resource, with distinctive features as an economic good and often with a unique legal status. Water resources display varying degrees of rivalry and exclusivity, depending on the type of use (or non-use). Allocation regimes need to consider both public and private good characteristics of water resources since these will bear on how the use (or non-use) of the resource is valued in a particular setting and who reaps the benefits. Nested allocation arrangements can allow for the tailoring of the design of allocation arrangements to specific settings.

Allocation regimes consist of various elements (policies, laws, mechanisms), that, when well-designed, can help to achieve the policy objectives of economic efficiency, environmental sustainability, and social equity. These various and sometimes conflicting or competing objectives need to be balanced, which requires addressing trade-offs between them. The analytical framework set out in this chapter identifies the various elements of an allocation regime and makes an explicit link to the policy objectives that they may influence. This provides a reference against which current regimes can be examined and the levers that are available to improve them. The following chapter will examine the current allocation landscape, as represented by 37 examples of allocation regimes in 27 countries, according to the elements of this framework.

Finally, given the inherent variability of water resources and shifting pressures and social preferences, water allocation regimes also need to be both robust and demonstrate adaptive efficiency. This requires striking a balance between the need for flexibility at the system level and security at the user level, giving both water managers and water users greater capacity to manage risk. Chapter 5 sets out the *"Health Check" for Water Resources Allocation* based on this framework that can support policy makers in their efforts to improve the performance of allocation regimes.

Notes

1. The case of Brisbane, Australia is instructive, as the city has experienced significant problems with both drought and flooding over the past 40 years. The Wivenhoe dam was built to mitigate risks from both floods and drought. In 2008, during a period of prolonged drought, the water level fell to around 17% capacity, leading to a focus on managing water scarcity. However, several months of intense rain in 2010 increased the water level so rapidly, that it resulted in significant flooding throughout the city and surrounding area (OECD, 2013b).
2. Although, to the extent that outdoor recreation on water bodies is excludable, this would be a quasi-private good (Hanemann, 2006).
3. In this report, we define a "water entitlement" as the entitlement to abstract and use water from a specified resource pool as defined in the relevant water plan. In some countries, this may be referred to as "water rights", "water users' rights", "water contracts", an abstraction license or permit.
4. This section is based on a personal communication with Annukka Lipponen and Bo Libert of the UNECE, 30 October 2014.
5. The Helsinki Rules were later superseded in 2004 by the Berlin Rules on Water Resources,
6. This Arrangement and the Convention that replaced it in 2008 remain exceptions.

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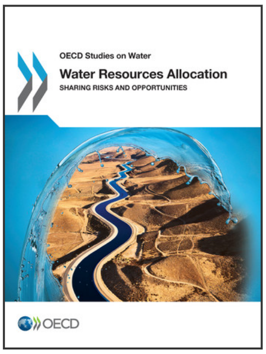

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