**Principles of Integrated Water Resources Management**

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Chapter 5

Water allocation: some general considerations

Pieter van der Zaag

The purpose of the allocation of water to different users is to match or balance the demand for water with its availability. There are various ways how to allocate water. The challenge is to find an optimal allocation that, firstly, adheres to laid-down legal and other regulations, and secondly, satisfies the water demand of all users as much as possible. Or, in the words of Malin Falkenmark and Carl Folke,

> The challenge is to cope with the whole gamut of different considerations needed: water needs, land use needs, terrestrial ecosystems and the goods and services that they provide, and the aquatic ecosystems and their goods and services. Management also involves the linking of upstream and downstream activities in the catchment, and the ethics involved. Reconciliation of conflicts of interest with a solidarity-based balancing of human livelihood interests is to be achieved against unavoidable environmental consequences, defined as hydrosolidarity. (Falkenmark and Folke, 2002, p. 4)

Water allocation is not an issue when water availability far surpasses the demand. In such situations all demands can be satisfied, and in fact there is no need for a regulated allocation of water. In many catchment areas and parts of river basins, however, water availability is frequently less than the demand for it. It is then necessary to find a suitable allocation of the scarce water.

Water allocation is not only concerned with the physical allocation of water. More broadly it is about satisfying conflicting interests depending on water. These may be functions derived from water such as navigation (navigability, minimum water levels), hydropower (head difference), environment (a water regime of water level fluctuation), recreation (availability of water but non-consumptive), etc. These functions are only to a certain extent consumptive, but can be conflictive in their timing and spatial distribution. Also flood protection is a function of the water resources system that is related to the water resources. Flood protection through the construction of storage dams can have a positive impact on water availability for other functions (e.g. hydropower), but can have negative impacts on others (e.g. on the environment).
5.1 Balancing demand and supply

Finding a suitable allocation key for water can be quite complex, since a large number of parameters have to be considered, both on the supply- and the demand-side.

Supply
- The generation of water in a catchment area naturally fluctuates, both within years and between years.
- Water occurs in different forms, which often have different uses. Special reference is made to rainfall and its use as "green water" in agriculture. Green water cannot be allocated in the same way as "blue" water occurring in rivers and aquifers. Yet, dryland agriculture and other types of land use do influence the partitioning of rainfall into groundwater recharge, surface runoff and soil moisture (i.e. evaporation and transpiration), and hence their availability.

Demand
- The demand for water fluctuates, but normally much less than its generation. For many types of uses, water demand increases when water availability decreases, such as during the dry season.
- Many water uses are (partially) consumptive, meaning that the water abstracted will not return to the water system in the form of "blue water"; consumptive water use typically converts blue or green water into water vapour, which in this form cannot be allocated to other users.
- Water uses that are non-consumptive allow others to use the water afterwards. Recreational water uses are a typical example. However, some non-consumptive uses alter the time when this water becomes available for other users. A typical example is water used for the generation of hydropower: electricity is needed also during the wet season, and thus water has to be released from dams for this purpose, when demand for it from other sectors may be low. As a result, this water used for electricity generation is unavailable to these potential uses when they need it. The environment is another (partially) non-consumptive user of water; its requirements are frequently out of sync with the needs of other users. (That is precisely why these environmental water requirements are now increasingly being recognised.)
- Many uses of water generate return flows, which, in principle, are available for other uses. However, return flows normally have a lower quality than the water originally abstracted. This may severely limit their re-use. Sometimes the quality of return flows is a hazard to public health and the environment.
- Different types of water use require different levels of assurance. For arable (non-perennial) irrigated crops, levels of assurance of 80% (i.e. a chance of failure in one out of five years) may be acceptable. For urban water supply assurance levels of 96% or higher are the norm (failing in one out of 25 years).
The legal framework

In many countries water is considered a public good. Here the water is owned by the citizens of a country, and the government manages this public good on their behalf. Laws and regulations will therefore provide the rules pertaining to the use of this public resource.

Box 5.1: From a public to a private good

In countries where water is considered a public good, water allocation may be viewed as the process of converting a public good into a private one. An irrigator, for instance, will apply the water to his/her privately owned crop. The crop will consume a large part of the water, converting it into water vapour and increasing its yield. The irrigator derives direct and private benefit from using a public good, but in so doing s/he denies another person the opportunity to use that water and deriving similar private benefits.

Balancing supply and demand must be done within the established legal framework. A country's water law and subsidiary government regulations will prescribe many aspects of water allocation. Amongst these are:

- The law will prescribe the types of water use that are regulated and therefore require some kind of permit, concession, right etc.; and the types of water use that are not regulated and do not require permission. The use of water for primary purposes often does not require a permit or water right, just as the direct use of rainwater.
- A water permit or water right typically defines which water (groundwater, surface water) can be diverted, where (point of abstraction), and for which purpose (e.g. irrigation of x ha of land). A permit or right specifies certain conditions under which water use is permitted. A typical condition is that the permit or right is limited in that it does not permit the use of water that infringes on similar rights of others. Another condition frequently specified is that the water should be used beneficially and not be wasted, and that return flows should adhere to certain quality standards.
- The law often stipulates the hierarchy of different types of water use; distinguishing between, for instance, primary use, environmental use, industrial use, agricultural use, water for hydropower etc. In most countries water use for primary purposes has priority over any other type of water use. Some countries also specify a hierarchy of the remaining uses, whereby the most important economic use in that country normally receives a high priority of use. In other countries all uses of water other than for primary (and sometimes environmental) purposes have equal standing. In times of water shortage the amount of water allocated to all non-primary uses will be decreased proportionally, so that all these user share the shortage equally.

The law may provide more detailed stipulations with a direct bearing on the allocation of water. The law may stipulate, for instance, that the allocation of water should be equitable. In some countries, in contrast, the law directs that junior rights may not affect senior rights.

In most cases, however, the legal framework does not provide a detailed "recipe" of how the water should be allocated. The water manager will therefore have to interpret the more general principles as laid down in the law, and translate these into operational rules for day-today allocation decisions. In many countries the water manager may not even do this without consulting all relevant stakeholders.
Box 5.2 provides an example of two different water allocation systems. The first is the allocation system based on “prior appropriation”, also known as the “prior date system”, which was the allocation system for non-primary water in Zimbabwe prior to 1999. The second allocation system is known as the proportional system, which has now replaced the prior date system in Zimbabwe.

**Box 5.2: Water allocation principles in Zimbabwe**

As in many other Southern Africa countries, Zimbabwe has recently restructured the water sector and has enacted a new Water Act. This box briefly outlines the allocation principles enshrined in the now defunct 1976 Water Act before considering those outlined in the new 1998 Water Act.

Under the 1976 Water Act use of water for primary requirements did not need a right. All other uses, except the abstraction of groundwater, required a water right. The allocation of these righted waters was based on the prior appropriation doctrine, also known as the prior date system. The granting of water rights was the exclusive function of the Administrative Court sitting as the Water Court. The right would only be granted if water was available and if it could be ascertained that the water would be put to beneficial use. The right granted was dependent on the date on which application for the right was made. The date determined the applicant's priority in the use of the water applied for. This meant that holders of senior rights could satisfy their rights without having to consider junior rights ('first in time, first in right'). The priority date thus defined the right holder's place in the “water queue”. Water rights were 'real' rights registered under the title of the property to which they related and were granted in perpetuity.

In December 1998 a new Water Act was adopted. The new Act introduces a number of important innovations. Water is to be managed on a catchment basis. The overall mandate for management is placed upon the newly established Catchment Councils made up of all stakeholders. All existing water rights have to be converted to water permits that are valid for a limited period of time (twenty years). The prior date system upon which these rights were based (first in time, first in right) was abolished.

From now on it is the Catchment Councils who issue water permits. They do so with regard for the need to achieve an equitable distribution of the available water resources; the needs of each applicant; and the likely economic and social benefits of the proposed use. The Councils have power to revise, reallocate or reapportion the permits in order to ensure the equitable distribution and use of the available water.

The 1998 Water Act does not precisely prescribe the new allocation system that should replace the prior date system. However, a proportional allocation system has been adopted that replaces the prior date system. The proportional allocation system has been defined ‘as the apportionment of either underground or surface water according to proportions of permitted volumes of abstraction for direct use or storage of a single permit over the total volume of all permits within a realistic sphere of influence’ (DWD, 2000).

**The value of water**

The various uses of water in the different sectors of an economy add value to these sectors. Some sectors may use little water but contribute significantly to the gross national product (GNP) of an economy. Other sectors may use a lot of water but contribute relatively little to that economy. Table 2.1 (chapter 2) gives the contribution of the various sectors of the Namibian economy to its Gross National Product, and the amount of water each sector uses. Industry and commerce uses less than 3% of all water used in Namibia, but contribute 42% to the Namibian economy. In contrast, irrigated agriculture uses 43% of all water used, but contributes only 3% to the economy.
Care should be taken to interpret the above data. For instance, it is well known that the agricultural sector typically has a high multiplier effect in the economy, since many activities in other sectors of the economy depend on agricultural output, or provide important input services (Rogers, 1998). The "real" value added by water may thus be underestimated by the type of data given in the table.

Box 5.3 provides some data on the added value of (irrigation) water for the production of maize in Zimbabwe.

**Box 5.3: The value of water for maize in Zimbabwe (see also Figure 5.1)**

For selected plots in Nyanyadzi irrigation scheme, Pazvakawambwa and van der Zaag (2000) found that one additional m$^3$ of water (irrigation + rainfall) supplied to the maize crop (rainfed with supplementary irrigation) gave an added yield of 1.5 kg of maize m$^{-3}$ ($r^2 = 0.81$). Assuming a maize price of 0.10 US$ kg$^{-1}$, it follows that the marginal value of water (rainfall + irrigation) is 0.15 US$ m^{-3}$.

Yields were also correlated with net total irrigation water ($Inet$ in mm). The following mathematical relationship was found:

\[ Y = 1,450 + 19 \times Inet \quad \text{(correlation coefficient} \ r^2 = 0.71) \]

The constant of 1,450 kg ha$^{-1}$ indicates the yields obtainable for a rainfed crop without irrigation. The marginal productivity of net summer supplementary irrigation water was 19 kg ha$^{-1}$ mm$^{-1}$, or 1.9 kg m$^{-3}$. This means that 1 m$^3$ of supplementary irrigation water will produce an additional 1.9 kg of maize, which is valued at US$ 0.19. The marginal value of supplementary irrigation for maize in Nyanyadzi is therefore 0.19 US$ m^{-3}$.

![Figure 5.1: Relationship between water use and yield for maize, Nyanyadzi, Zimbabwe](image)

(a) total net water use and yield  
(b) net irrigation water and yield

The added value of some uses of water is very difficult, if not impossible, to measure. Consider for instance the domestic use of water: how to quantify the value of an adequate water supply to this sector?

The damage to an economy by water shortage may be immense. It is well known, for instance, that a positive correlation exists between the Zimbabwe stock exchange index and rainfall in Zimbabwe. The drought of 1991/92 had a huge negative impact on the Zimbabwean economy (see Box 2.1 in chapter 2). Conversely, floods, though often
beneficial, can sometimes be devastating (Box 5.4).

**Box 5.4: The floods of February 2000** (Brito, 2002)

Heavy rains, which started in early February 2000, flooded parts of Mozambique’s southern provinces. The Save, Limpopo, Incomati and Umbeluzi rivers, which have their head-waters in Zimbabwe, Botswana, South Africa and Swaziland, reached their highest-ever recorded levels in early March, and many riparian communities were submerged for weeks. 699 people died, 95 disappeared, and one million people required some form of emergency assistance.

Large sections of the major road connecting Maputo to the north were demolished. Bridges along the Limpopo flood plain and the railroad were damaged. About 20,000 cattle drowned and 140,000 hectares of crops were destroyed, with the largest irrigation scheme in the country (25,000 ha, along the Limpopo) seriously damaged. Health centres as well as water supply and sanitation infrastructure in many towns and villages suffered extensive damage, exposing one million people to water-borne diseases such as cholera, malaria and diarrhoea.

The destruction caused by the floods is estimated at US$ 600 million. Mozambique’s economic growth went down from 10% in 1999 to 2% in 2000.

**Scales and boundary conditions**

Any allocation decision potentially has third party effects: it may affect those not immediately involved in the allocation process, either beneficially or detrimentally. A special case, and a very important one, is where downstream users are affected that are located outside the jurisdiction of a given water allocation institution.

An allocation process that does not encompass the entire river basin runs the risk of being affected by upstream uses and in turn impacting on downstream uses. Since most river basins are simply too large in extent, and often shared by more than one country, the water allocation processes is normally fragmented into catchment areas which form part of the larger basin. In such cases the allocation process must include boundary conditions; i.e. a specification of water requirements at the inlet and at the outlet of the catchment area under consideration. Even a most downstream catchment area, with its downstream boundary being an estuary, will have to set such boundary conditions so as to minimise salt intrusion, and/or ensure the health of the estuary for environmental, social and/or economic purposes (e.g. for mangrove forests and prawn fisheries).

Boundary conditions are especially important in river basins that are shared by more than one country. If an upstream water allocation institution does not consider the requirements of the downstream country, it may even affect the bilateral relations of the two neighbouring countries.

It would be advisable to formalise such boundary conditions in writing and to get them endorsed by all water allocation institutions involved; in a similar manner as how claims of individual water users are formalised in water permits or rights.

The water allocation process should ideally consider both the detailed allocation decisions between individual water users at the local level, as well as the "big picture" allocation decisions covering the entire river basin. Obviously, these different spatial scales require different levels of accuracy and specificity. But they are both required, since decisions at these different spatial scales affect each other. In practice, the
decision-making process has been iterative, with an initial focus on the smaller spatial scales, especially in heavily committed parts of a basin. With the steadily increasing pressures on our water resources, the interconnectedness between the various parts of the basin have become apparent in many river systems. This has inevitably led to widening the scope of the water allocation process also to the largest spatial scale.

It should be noted that an obligation to surrender a certain amount of water to a downstream area or country does not necessarily imply that all this water is "lost" by the upstream catchment. If this catchment also has to provide for instream environmental water requirements within its area of jurisdiction, the water that has to be surrendered to a downstream area could first serve these environmental requirements (or at least the non-consumptive part of it).

The question remains: how much water should an upstream catchment area leave in the river for downstream users? There is no general answer to this question, and should be subject to agreements with the stakeholders involved (between sub-catchment areas along one tributary or between riparian states). The UN Convention on the Law of the Non-navigational Uses of international Watercourses gives guidance with respect to the parameters to be considered, but their relative weight should be agreed upon in any specific case (see section 5.3 below).

Figure 5.2: Water use and water development plans at various levels in a basin
5.2 Issues in water allocation

In this section some important issues directly related to water allocation are briefly discussed. These issues typically cannot be solved overnight. Any actor involved in water allocation, however, must be aware of them. These issues are: key allocation concepts, uncertainty, efficiency and equity.

(a) Defining key concepts

Key concepts used in a country's water allocation system must be very precisely and clearly defined, and be known and understood by the water users. Such key concepts may include: the ownership of water, water use, primary use, equity, efficiency, and the precise rights and obligations conferred with a water permit.

A particularly important issue is the definition of water use, since this basically defines the point where water converts from a public to a private good. Lack of clarity about where exactly this conversion occurs will create confusion, which will directly impact on the effectiveness of the water allocation process. For instance, if a permit holder has lawfully stored water in his/her dam, has this water already been used and hence is owned by the permit holder, or not yet?

Box 5.5: Water use

The South African Water Act defines water use as taking and storing water, activities which reduce stream flow, waste discharges and disposals, controlled activities (declared activities which impact detrimentally on a water resource), altering a watercourse, removing underground water for certain purposes, and recreation.

(b) Uncertainty

Generally speaking, if a user does not know how much water he or she is entitled to, and how much water is likely to be available at a future time, he or she tends to over-use or hoard water often at considerable losses.

The allocation of water over different uses should therefore aim to effectively deal with uncertainty and increase the predictability of water available to the various uses. Increased predictability is an important condition that will allow users to use water more efficiently. Even a better understanding of how unpredictable water availability is will improve a user's ability to deal with this.

Two types of uncertainty may be distinguished: physical uncertainty and institutional uncertainty.

Physical uncertainty

Physical uncertainty does not so much refer to the stochastic nature of hydrological processes (which is normally quite well understood), but more to the impact of human activities on the hydrological cycle. At the global level, human-induced climate change
is a possibility and may have wide-ranging effects, but the specific effects are not yet well understood. At a smaller spatial scale, the effects of land use change on the availability of blue water are difficult to predict. Will a more efficient use of soil moisture for rainfed crop production indeed translate into decreased blue water flows? A bit more straightforward is the link between groundwater and surface water abstraction; but still it is difficult to predict the precise effect of groundwater abstraction in a given location on the surface water availability somewhere downstream.

The physical uncertainties mentioned here must be acknowledged. If a proper understanding of such processes is lacking, in the first instance conservative estimates should be made on possible impacts of certain interventions. The water management agency should then put in place a programme of data collection meant to gradually improve the understanding of these dynamic processes.

Institutional uncertainty
A different type of uncertainty is created by the institutions that are involved in water allocation. If the manner in which such institutions allocate water is unknown to the users or ill-understood by them, or seen as haphazard, then users may distrust the allocation process. They will receive the wrong (perverse) incentives to, for instance, overstate their water requirements, hoard water or even over-use it.

The institutional system of water allocation should therefore be predictable to users. All users should know the principles and procedures guiding the allocation of water. Moreover, the allocation process must treat all users in the same way. It must also be transparent, and information on permits granted or permits refused must be freely accessible, not only to all water users, but to the wider public as well. A fair and transparent allocation process will enhance the individual users' trust in the process, and will increase their confidence in the worth of their permits/rights to use water. Trust in the allocation process will enhance users' willingness to invest in water related infrastructure, and desist from "free-rider behaviour" in times of water scarcity.

(c) Efficiency and equity

It could be argued that Postel's three Es (Equity, Efficiency and Ecological integrity) should form the pillars of any water management activity. Since water allocation is a major water management activity, following this line of argument the three Es should also inform water allocation decisions. Suppose now that the environmental/ecological water requirements are adequately taken care of, by assigning to the environment rights to sufficient water with an acceptable ecological regime. Then two Es remain, i.e. equity and efficiency.

Some people believe that there is a trade-off between the principles of equity and efficiency; i.e. a more efficient allocation system may ignore certain issues of equity, and vice versa, a more equitable allocation system may be less efficient. This is not necessarily true for all situations. Here some tentative definitions are given, and some implications for water allocation briefly explored.

Equity
Equity can be defined as affording everyone a fair and equal opportunity in the
utilisation of the resource according to one’s needs. Equitable access does not necessarily mean access to equal quantities but rather equal opportunity to access water (WRMS, 1999). Equity deals with the distribution of wealth or resources among sectors or individuals of society.

Efficiency
Different definitions of efficiency can be used, depending on one's objective. The reason why efficiency is important is that water is a finite and often scarce resource. Generally, efficiency measures how much one can do with one unit of water. Economic efficiency would then measure the benefits derived from a unit volume of water used. Water use efficiency measures the amount of water actually consumed for a given use.

At a more abstract level, efficiency can also indicate to what extent the ensemble of technical, legal, institutional, economic and other measures induce efficient use of the scarce water. For instance, certain legal and institutional arrangements may enhance people's willingness to privately invest in water infrastructure, or induce them to waste less water, or pollute less. This will eventually lead to increased water use efficiency as well as increased economic efficiency.

This wider definition of efficiency calls for pricing arrangements that ensure cost recovery of water services. This will not only give the correct signal to water users, namely that water is valuable and should not be wasted, but will also lead to the sustainability of infrastructure and institutions. The wider definition of efficiency also calls for suitable legal arrangements that provide users with sufficient security of water tenure, such that they are willing to invest in water-related infrastructure.

[Note: We prefer this wider definition above a narrow economic interpretation. Such an interpretation usually states that the marginal benefit from the use of the resource should be equal across use sectors; if not, society would benefit more by allocating more water to the sector where the benefits will be highest (the so-called Pareto optimum). In our view, such a Pareto optimum is not likely to exist, since different uses of water require different levels of assurances. See below.]

Trade-offs
The principle of economic efficiency is often translated into proper pricing of water services. This may obviously jeopardise the equity principle, in that poorer households may not be able to buy such a service. The fact that poorer households are thus denied access to a basic amount of water may however be extremely costly to society, in terms of disease, ill health etc. From a societal perspective it may therefore be highly efficient to provide all households with a very cheap (subsidised) lifeline quantity of water, and to make up the financial shortfall through cross-subsidies. In this manner win-win combinations of efficiency and equity in water allocation systems may be achieved.

(d) Water losses
Reducing water losses often has a high priority in attempting to balance demand with supply. However, water losses should always be carefully and precisely defined. This is because it depends on the scale and the boundaries whether water is considered a loss or not. At the global scale no water is ever lost.
In many situations, and especially in irrigated agriculture, a reduction of water losses may not free up all the "saved" water. Even "real" water losses, such as when water is released from a dam through the river bed for a downstream user, may provide an important service; namely recharge of aquifers, water for the environment etc. Once such services are recognised and formalised into permits (or in a "Reserve", as done in South Africa), the water manager may sometimes be able to find interesting win-win solutions. In other cases, of course, this may not be possible.

Analysing water losses should therefore always:
- clarify the scale and boundaries at which the analysis is done;
- consider both the consumptive and non-consumptive parts of the water use;
- consider any other type of use (including the environment) that may benefit from the water "lost".

**Water allocation between sectors** (Savenije and Van der Zaag, 2002)

As was noted earlier, some types of water use add more value than others. The classic case is the different values attained in the agricultural and urban sectors: the value attained in urban sectors is typically an order of magnitude higher than in agriculture (Briscoe, 1996).\(^2\) If water is currently used in the agricultural sector, the opportunity cost, i.e. the value of the best alternative use, may be 10 times higher, subject of course of "location and the hydraulic connections possible between users" (Briscoe, 1996). Thus a shift towards the higher value use is often promoted.

Whereas the opportunity cost of water for domestic water use may be highest, the moment availability is higher than demand, the opportunity cost of the water will fall to the next best type of use. It is just not possible to consume all the water at the highest value use. The proper opportunity cost for irrigation water may therefore be only half, or less, than the best alternative use (Rogers et al., 1997).

Even then, we should realise that water for irrigation requires a lower level of assurance of supply than, for instance, water for urban and industrial use: the same storage dam supplying irrigation water at 80 % reliability (failing one in five years), yields much less water for urban water supplied at 96 % reliability (failing one in 25 years). Figure 5.3 demonstrates this for a river system in Zimbabwe with a hydrological regime typical for many other rivers in semi-arid environments. Here the dam yielding a certain flow at 80% reliability can only provide between 50% and 65% of that flow at 96% reliability, depending on the level of flow regulation, as defined by the reservoir constant (the ratio of reservoir volume to mean annual runoff).

\(^2\) However, in economies with many industries depending on the agricultural sector, the multiplier effect of agricultural production is high, and therefore the value added by water may be under-estimated when only using farm-gate prices of agricultural produce (Rogers, 1998).
The effective opportunity cost of water used for irrigation should therefore again decrease. The resulting opportunity cost is thus only a fraction of what some neo-classical economists claim it to be.

Figure 5.4 illustrates the variation of supply and demand in an imaginary case. It shows that, in general, primary (domestic) and industrial demands, with the highest ability and willingness to pay, require a high reliability of supply, which is normally achieved through relatively large storage provision. Also environmental demands are not the most demanding on the resource. Agricultural water requirements tend to be much higher, fluctuate strongly but also accept a lower reliability of supply.

The emerging picture, then, is fairly straightforward and common sense: the sectors with highest value water uses should have access to water. In many countries these sectors require only 20-50% of average water availability, and these demands can easily be satisfied in all but the driest years. In most years much more water will be available, and this water should be used beneficially, for instance for irrigation. There is therefore no need for permanent transfers from agriculture to other sectors, except in the most heavily committed catchment areas of the world. What is needed is a legal and institutional context that allows temporary transfers of water between agriculture and urban areas in extremely dry years. No market is required to cater for such exceptional situations. A simple legal provision would suffice, through which irrigators would be forced to surrender stored water for the benefit of urban centres against fair compensation of (all) benefits forgone.
In those heavily committed catchment areas where permanent transfers of water out of the agricultural sector are required, normally voluntarily negotiated solutions can be agreed, provided the laws allow this to happen. Rosegrant and Gazmuri (1996: 276-77) report a case of a factory financing the construction of a water-saving drip irrigation system for an irrigation scheme, thereby obtaining the right to use the water thus saved.

(f) Do higher value uses of water need to have priority over lower value uses?

Do higher value uses of water need to have priority over lower value uses? No, not necessarily. Higher value uses (such as urban water use) often have the potential to mobilise sufficient financial resources to secure a reliable supply. Higher value uses often require higher levels of reliability, meaning larger dams, and hence much larger investments, compared with lower value uses (e.g. irrigation). Often, the higher value uses are able to mobilise even these higher investment requirements. In such cases, it is not necessary to give higher value uses priority over lower value uses. The obvious economic advantage to society of not giving priority to various non-primary uses, is, that sectors have to fend for themselves, and will not, in all but the most extreme droughts, damage each other. As observed earlier, in extreme cases of drought, transfers between sectors will have to be against fair compensation.

5.3 Water allocation in international river basins

(Savenije and Van der Zaag 2000)

Principles underpinning the sharing of transboundary waters evolved quite separately from national water allocation systems. With the “Helsinki rules on the uses of the waters of international rivers” the ILA in 1966 codified the principle that “Each basin State is entitled, within its territory, to a reasonable and equitable share in the beneficial uses of the waters of an international drainage basin.” There was insufficient support within the United Nations to adopt the Helsinki Rules as UN law. This was because many countries with well-developed water systems wanted their current water uses explicitly defended. To counter-balance the equity principle, the obligation not to cause significant harm was formulated (Article 7 of the UN Convention).

The question is frequently asked: which comes first, the right to equitable and reasonable use or the obligation not to cause significant harm? Those riparian states with a stake in the status quo tend to stress the importance of the latter principle (which appears to recognise established uses however inequitable these may be), while those riparians who lagged behind in water development tend to use the former principle to claim waters already used by ‘more developed’ riparians. The differential application of both principles should, however, be considered a false dilemma. Both principles apply concurrently and represent, as it were, two sides of the same coin. They convey the basic tenet that riparians have rights and duties in the uses of water resources, in line with the second principle of the Rio Declaration:

“States have, in accordance with the Charter of the United Nations and the
principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and development policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.” (UNCED, 1992: 9)

Both principles imply that also downstream countries would need to seek a declaration of no-objection from upstream riparian countries when planning large-scale water development projects. In this context the current World Bank policy that only require upstream countries to seek a declaration of no-objection from downstream riparians (Subedi, 2003) is inadequate. Some authors have argued that the principle of equity is key to water allocation (Wouters, 1997; Wolf, 1999), which was also the premise of the 1966 Helsinki Rules (McCaffrey 1993). The principle of reasonable and equitable use (Article 5 of the UN Convention), however, is defined in general terms. To establish what is an ‘equitable share’, the UN Convention in Article 6 directs riparian countries to consider a wide variety of aspects (Box 5.6).

**Box 5.6: Article 6 of the UN Convention: Factors relevant to equitable and reasonable utilization (UN, 1997)**

1. Utilization of an international watercourse in an equitable and reasonable manner within the meaning of article 5 requires taking into account all relevant factors and circumstances, including:
   (a) Geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character;
   (b) The social and economic needs of the watercourse States concerned;
   (c) The population dependent on the watercourse in each watercourse State;
   (d) The effects of the use or uses of the watercourses in one watercourse State on other watercourse States;
   (e) Existing and potential uses of the watercourse;
   (f) Conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect;
   (g) The availability of alternatives, of comparable value, to a particular planned or existing use.

2. In the application of article 5 or paragraph 1 of this article, watercourse States concerned shall, when the need arises, enter into consultations in a spirit of cooperation.

3. The weight to be given to each factor is to be determined by its importance in comparison with that of other relevant factors. In determining what is a reasonable and equitable use, all relevant factors are to be considered together and a conclusion reached on the basis of the whole.

Van der Zaag et al. (2002) attempt to define measurable criteria on the basis of which water resources can be allocated to the riparian countries in an equitable manner. Such measurable criteria may facilitate negotiations between riparian countries that are in conflict over the issue. A key parameter for establishing an equitable share is the number of people living in the various parts of the basin. In addition, not only the availability of “blue” water should be considered, but also the availability of “green” water. Two important variables have been identified over which the riparian countries could reach consensus:

1. the value of green water relative to blue water;
2. the fraction of reserved water, which is defined as the basic entitlement of each riparian country.
5.4 Conclusion

There is not one single best way to balance water demand with water availability. This balancing act is region, country, basin and catchment-specific. It is also clear that the balancing act will often involve a process of decision-making where difficult compromises have to be made. Another course module (water resources analysis and planning) provides tools to assist with these decision processes. In all cases, the water allocation process requires a sound quantitative understanding of both water availability and water demand. This will be further elaborated in other course modules.

5.5 Exercise

5.1 In a similar but more detailed manner as Pallett (see chapter 2), Lange (1997) calculated the contribution of water by sector to the economy of Namibia:

<table>
<thead>
<tr>
<th>Economic contribution of water by Sector in Namibia, 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sector</td>
</tr>
<tr>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Agriculture</td>
</tr>
<tr>
<td>Commercial agriculture</td>
</tr>
<tr>
<td>Communal agriculture</td>
</tr>
<tr>
<td>Mining</td>
</tr>
<tr>
<td>Diamond mining</td>
</tr>
<tr>
<td>Other mining</td>
</tr>
<tr>
<td>Manufacturing</td>
</tr>
<tr>
<td>Fish processing</td>
</tr>
<tr>
<td>Other manufacturing</td>
</tr>
<tr>
<td>Services</td>
</tr>
<tr>
<td>Hotels/Restaurants (Tourism)</td>
</tr>
<tr>
<td>Transportation</td>
</tr>
<tr>
<td>Other services</td>
</tr>
<tr>
<td>Households</td>
</tr>
<tr>
<td>Rural</td>
</tr>
<tr>
<td>Urban</td>
</tr>
<tr>
<td>Government</td>
</tr>
</tbody>
</table>

5.1a On the basis of the data provided, define an appropriate indicator for the “value added” by water.

5.1b Calculate for each sector this indicator.

5.1c Compare the sectors. What do you observe?

5.1d Should Namibia decrease water use in certain sectors and allocate it to other sectors?

5.1e What would be required to effectuate such re-allocation?
5.6 References


