Chapter 9

Managing competition for water and the pressure on ecosystems

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Key messages

- Competition for water and shortcomings in managing it to meet the needs of society and the environment call for enhanced societal responses through improved management, better legislation and more effective and transparent allocation mechanisms.
- Challenges include wise planning for water resources, evaluation of availability and needs in watersheds, possible reallocation or storage expansion in existing reservoirs, more emphasis on water demand management, better balance between equity and efficiency in water use, inadequate legislative and institutional frameworks and the rising financial burden of ageing infrastructure.
- Water management choices should emerge from informed consultation and negotiation on the costs and benefits of all options after considering basin interconnectedness, relationships between land and water resources, and the consistency and coherence of decisions with other government policies.

Competition for water exists at all levels and is forecast to increase with demands for water in almost all countries. In 2030, 47% of world population will be living in areas of high water stress.[1] Water management around the world is deficient in performance, efficiency and equity. Water use efficiency, pollution mitigation and implementation of environmental measures fall short in most sectors. Access to basic water services – for drinking, sanitation and food production – remains insufficient across developing regions, and more than 5 billion people – 67% of the world population – may still be without access to adequate sanitation in 2030.[2]

Increased competition for water and shortcomings in its management to meet the needs of society and the environment call for enhanced societal responses through improved water management. Challenges include wise planning for water resources; evaluation of availability and needs in watersheds; possible needs for reallocation or additional storage; the need to balance equity, efficiency and ecosystem services in water use; the inadequacy of legislative and institutional frameworks and the increasing financial burden of ageing infrastructure. Substantial efforts are needed in regulation, mitigation and management, primarily through community consultation and cross-sectoral policy involving the private sector.

Type, extent and effect of competition for water

Competition among uses and users is increasing in almost all countries, as are the links connecting them, calling for more effective negotiation and allocation mechanisms.

Basin closure and interconnectedness

Abstraction of water has approached and in some cases exceeded the threshold of renewability of water resources in many river basins, leading to widespread damage to ecosystems. Demand for water is often highest when availability is lowest, and water shortages and conflicts have increased accordingly. This trend has been paralleled by degradation in the quality of surface water and groundwater from the combined effluents of cities, industries and agricultural activities. This has exacerbated economic water scarcity by rendering water unfit for certain uses and has harmed human and ecosystem health.

Hydrology, ecology and society are all connected. Water resources are increasingly diverted, controlled and used as countries develop. Water flowing out of sub-basins is often committed to other downstream uses, including several often overlooked functions: flushing-out sediments, diluting polluted water, controlling salinity intrusion and sustaining estuarine and coastal ecosystems. As water in a basin is increasingly allocated and river discharges fall short of meeting such commitments some or all of the time, basins (or sub-basins) are said to be closing or closed.[3] Water no longer flows out from the basin – as is happening in the Jordan River (box 9.1).

Perturbations of the hydrologic cycle in one location may affect another. This is most clearly illustrated by the common upstream-downstream effect, but can take diverse, often less visible, forms. Figure 9.1 provides examples of the water quantity, quality, timing and sediment load of upstream-downstream impacts.

Water also connects aquatic ecosystems. Relationships among land, water and biota are complex, and cross-impacts may not be evident immediately. Groundwater abstraction generally reduces flows from underground aquifers back to the surface, drying up springs and wetlands. In Azraq, Jordan, for example, groundwater use for cities and agriculture has resulted in the desiccation of a Ramsar-designated wetland associated with high biodiversity and migratory birds. Dams, through their impacts on flood-pulse regimes, have altered complex ecosystems that were providing valuable services and supporting livelihoods (such as fisheries, receding agriculture, pastures, reeds and medicinal plants). Examples include the Senegal Valley and the Hadejia-Jama'are plains in northern Nigeria.[4]

Competition and conflict for water

Conflicts about water can occur at all scales. Local-level conflicts are commonplace in irrigation systems, where farmers vie for limited resources. In Northern Thailand, for example, low flows in the dry season are diverted by upland farmers to irrigate their orchards, where use of pesticides sometimes leads to the pollution of streams. Conflicts also occur at the scale of large national river basins (multistate Indian rivers such as the Cauvery and the Krishna) or transnational river basins (the Jordan and the Nile). While conflict resolution mechanisms and adequate modes of governance will differ with scale, the

Conflicts around water can occur at all scales

Box 9.1 The closure of the lower Jordan River basin

The lower Jordan River, downstream of Lake Tiberias, flows through the Jordan rift valley before emptying into the Dead Sea. Because of Israel's redirection of the upper course, the river now receives water mostly from the Yarmouk River, a tributary originating in Syria, and from a few lateral wadis that incise the two mountain ranges that run parallel to the valley on each side. Most of the population and cities, together with the bulk of the country's rain-fed agriculture and increasing groundwater-based irrigation, are concentrated in these highlands. In the east bank of the valley some 23,000 hectares of irrigated land have been developed as a result of diversion of the Yarmouk and side wadis.

The lower Jordan River basin has undergone a drastic squeeze, with 83% of its flow consumed before it reaches the Dead Sea because of diversions in Israel and Syria, 45,000 hectares of irrigated land, mushrooming cities swollen by waves of refugees from Palestine and Iraq and immigrants from the Gulf countries, and the new Wehdah Dam reservoir on the Yarmouk River.

The consequences of this squeeze are broad, and some are dire:

- Limited (though still desirable) scope for efficiency improvement.
- Increased recycling and use of treated wastewater for irrigation.
- Reallocation of water from the valley (irrigation) to the highlands (cities).
- Environmental degradation (overdraft of aquifers in the Azraq oasis and a declining Dead Sea that now receives less than 250 million cubic metres of water).
- A surge in costly supply augmentation projects aimed at tapping distant aquifers, transferring water from the Red Sea to the Dead Sea or desalinating saline water.
- Increased irregularity and uncertainty in water supply for irrigation in the valley, the residual user.
- A more politicized and contested water policy, with costs and benefits apportioned across social and ethnic groups and subregions, yielding different levels of power.

Source: Courcier, Venot, and Molle 2005.

Figure 9.1 **Examples of hydrologic interactions in river basins – upstream-downstream impacts**

Variable \ Upstream / Downstream				
Quantity	Upstream diversion scheme on downstream irrigation area	Water harvesting (or small tanks) on a downstream dam	Cities on irrigation wells (out-pumping)	Wells on qanats[a]; deep wells on shallow wells
Quality	Cities or industries on irrigated agriculture	Diffuse pollution of agriculture on city supplies	Cities on groundwater used in pumping irrigation (contaminating)	Diffuse agricultural pollution on village groundwater-based water supply
Timing	Hydropower generation on large irrigation schemes or fisheries	Small tanks on onset of wet season flows (delays) and on biological cues	Hydropower generation on wetland ecosystems	Water harvesting on runoff/flood and downstream groundwater recharge (reduced)
Sediment load	Large-scale deforestation on reservoirs	Overgrazing, or erosion in smallholder agriculture on reservoir (siltation)	Dam retaining silt on fertilization of downstream floodplains	Diffuse deforestation on silt load and delta fanning

a. Qanat is an ancient system of tunnels and wells built to capture water in a mountain and channel it to a lower level.
Source: Based on Molle 2008.

Point, large-scale user or intervention

Diffuse, scattered users or interventions.

nested nature of these scales also means that the modes of governance will have to be consistent and interrelated.

Sectoral conflicts. Sectoral conflicts oppose users from different sectors (domestic, hydropower, irrigation, industries, recreation and so on), including ecosystems, whose sustainability depends on environmental flows. These conflicts are both economic (the return per cubic metre differs greatly across these uses) and political (the social importance and the political clout of each sector also varies). Box 9.2 illustrates the case of conflict between agriculture and industry in Orissa, India.

Perhaps the most common conflict is between agriculture and cities. Half the world lives in cities – and this share is increasing – while agriculture is generally the largest user of water. Moving water from agriculture to uses with higher economic value is frequently proposed, for several reasons. Agriculture gets by far the largest share of diverted water resources and also consumes the most water through plant evapotranspiration. Cities are also thirsty. The value-added of water in non-agricultural sectors is usually far higher than in agriculture. This apparent misallocation is often attributed to government failure to allocate water rationally.[5]

Box 9.2 **Conflict between agriculture and industry over water in Orissa, India**

The Hirakud Dam in Orissa, India, was the first multipurpose dam to become operational after India's independence in 1947. Built across the Mahanadi River, it is the longest and largest earthen dam in the world, and its reservoir is the largest artificial lake in Asia. The dam helps control floods in the Mahanadi, provides irrigation to 155,600 hectares of land and generates up to 307.5 megawatts of electricity through its two power plants. Thanks to irrigation provided by the dam, Sambalpur District is referred to as the rice bowl of Orissa.

With new state development policies based on industrialization, the reservoir started supplying water to industrial plants pumping from the reservoir. In 2006 the state government signed memorandums of understanding with 17 companies to provide them water from the reservoir. Meanwhile, 50 years after the dam's construction, many downstream areas had yet to receive irrigation water, and tension was building between reservoir authorities on one side and local governments and farmers associations on the other on water releases from the dam. In June 2006, 25,000 farmers, fearing that diversion of water could deprive more than 20,000 hectares of irrigation water, formed an 18 kilometre-long human chain near Sambalpur to protest the provision of water to industries. Five months later, in November 2007, 30,000 farmers gathered at the reservoir to protest. This large turnout surprised even the protest organizers and demonstrated the desperation of farmers over their water supply. Both events were covered by the media. Under pressure by the opposition party, Orissa's chief minister assured farmers' representatives that not a single drop of the farmers' share would be diverted to industries and announced a 20 billion rupees package for canal repair work in the Hirakud area.

Source: Thierry Facon, Food and Agriculture Organization of the United Nations, Bangkok regional office, adapted from *Kalinga Times* 2007 and South Asia Network on Dams, Rivers and People 2006.

Another common intersectoral conflict is between hydropower and other sectors, especially agriculture and fisheries. Because the energy production of hydropower plants follows consumer demand, the dams may release water when downstream irrigators do not need it. Real-time management of stored water can result in better outcomes because it enables water to be released when needed for multiple users. Dams may also harm fisheries by impeding fish migration and reducing productivity by altering the water regime. Famous conflicts have occurred on the Columbia River, in the northwestern United States, where intensive river damming has affected salmon and other species. Some dams have been decommissioned to restore ecosystem connectivity. Conflict is looming between dams planned or under construction in the Mekong River basin and the river-abundant fisheries. It is feared that the cumulative effects of these dams, notably those planned on the mainstream river, will have a deleterious impact on Tonle Sap, Cambodia's great lake, and on the fisheries that provide 60% of the basin population's protein intake.

Dams, irrigation schemes and cities consume water or change flow pathways. The poor and the environment, the residual user, bear a disproportionate share of the negative consequences. Massive upstream diversions have typically affected downstream lakes or deltas, such as in the Colorado and the Indus basins (box 9.3; see also figure 10.2 in chapter 10 and box 11.1 in chapter 11). Diversion of the lower Ganges River by the Farraka Dam damaged the ecology of the Sunderbands wetlands, and the project for interlinking northern and southern rivers in India could dramatically compound these impacts on the Ganges-Brahmaputra delta. Excess use of groundwater in many large coastal cities (such as Chennai, Jakarta, Lima and Tel Aviv) has led to the depletion of local aquifers and allowed seawater to intrude and salinize the aquifers.

Meeting water needs during dry seasons and ensuring security of supply require water storage. Climate change will intensify climate irregularity, so that more storage will be needed to ensure the same level of security. More water will have to be kept in reservoirs as reserves for dry spells, leaving less water for use on average. And this increased need for storage is occurring at a time when pressure from users is forcing water managers to take risks and reduce carryover stocks. In many regions of the world the need for more storage is not taken into account, resulting in a growing frequency of local crises during extreme drought.

Integrated management of reservoirs in a river basin is a realistic solution. Part 4 illustrates possible responses and approaches.

Transboundary competition. When a river or aquifer crosses a political boundary and there is competition between sectors or countries, problems become more complex

Box 9.3 Competition for water and downstream impacts in the Indus River basin

Degradation of the Indus delta environment, in the downstream reaches of the Indus River basin, has a long and complex history. Gradual increases in irrigation demands and cultivated areas throughout the basin, punctuated by years of drought and the construction of reservoirs, have resulted in progressive reductions in freshwater flows to the delta over the last 40 years and contention over water diversions.

This environmental degradation is widely acknowledged as stemming from both local threats, such as unsustainable fisheries exploitation and industrial and urban pollution from nearby Karachi, and external threats related to competition for upstream irrigation diversions and storage water management (ineffective drainage, low irrigation efficiency and inadequate farming practices, and reduced freshwater flows).

The poor are bearing the brunt of the consequences, including water-logging and increased salinization of land, aquifers and surface water as reduced freshwater flows are unable to prevent seawater intrusion and land erosion, and reductions in their livelihood assets and opportunities as a result of declining fisheries, deteriorating grazing grounds and reduced agricultural outputs and related revenues. Drinking water shortages have led to an increase in water-related diseases, forcing households to purchase water from tankers at great expense and women and children to spend more time fetching water from sources farther away.

Source: Brugère and Facon 2007.

Box 9.4 Fisheries and hydropower competing in the Mekong River basin

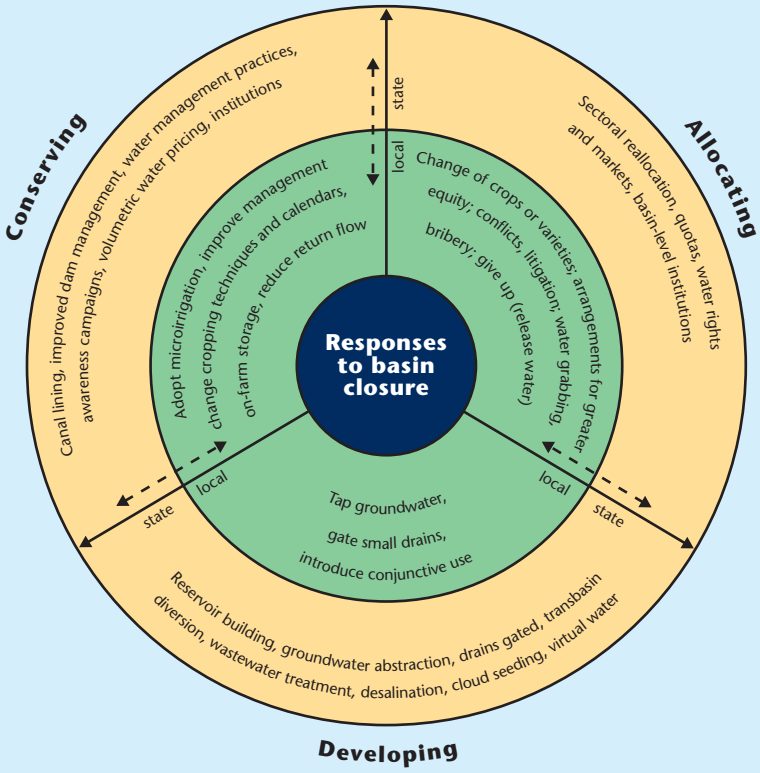
After years of being undisturbed by humans, the Mekong River basin has undergone rapid change in recent years. Populations have been displaced by dams in Thailand, and there has been protracted conflict over the impact of the Pak Mun Dam on fisheries. In Cambodia the loss of lives due to the release of water from dams on the upper Se San in Viet Nam have stirred public awareness of the social and environmental costs of conventional infrastructure development.

A major challenge for the basin is to design hydropower facilities with minimum impact on fisheries. Mekong fisheries account for 17% of the world freshwater fish catch, and numerous studies have shown the importance of fish to the diets and incomes of populations in the basin.

Recent announcements of bilateral agreements between Lao PDR and Thailand and between Lao PDR and Viet Nam for dams on the main stem of the river together with numerous private contracts agreed by Cambodia, Lao PDR and Viet Nam (mostly with companies in China and South-East Asia) have raised concerns about whether these new projects will benefit from the lessons learned from past mistakes. The marginalization of regional international players (such as the Asian Development Bank, the Mekong River Commission and the World Bank), the lack of transparency of the planning processes and the abruptness of official declarations about the signed agreements have left little room for discussion of the economic soundness and impacts of the projects. The central concern remains the fate of fisheries as new dams are planned on the main stream, an issue on which specialists at the Mekong River Commission, the World Fish Centre and elsewhere have issued severe warnings.

Source: Molle, Foran, and Käkönen forthcoming; Mekong River Commission 2008.

Figure 9.2 **Three types of response to water scarcity and competition**



Source: Based on Comprehensive Assessment of Water Management in Agriculture 2007.

and can lead to conflict. The Mekong River basin has been an exception, with concerns around water arising only recently. Partly because of conflicts unrelated to water the river has long-remained undisturbed, but dam development to meet the growing need for energy in most of the riparian countries is putting other downstream uses at risk – particularly fisheries (box 9.4).

Despite competing demands and conflict, however, there is little historic evidence that water itself has led to international warfare or that a war over water would make strategic, hydrographic or economic sense.[6] At the international level water appears to provide reasons for transboundary cooperation rather than war, often preventing instead of causing escalation.[7] Many multilateral treaties on freshwater resources have stressed multiple objectives – economic development, joint management and water quality – rather than just water quantity and hydropower (see appendix 2).[8] The way Mexico and the United States resolved their dispute over the allocation of water from the Rio Grande River, which included a cost-sharing arrangement for water conservation measures, offers interesting lessons for the peaceful resolution of water disputes (see box 15.22 in chapter 15). A recent shift in emphasis from water sharing to benefit sharing promises greater transboundary cooperation.

Managing competition through supply and demand management and reallocation

There are many shortcomings in how water is managed today in a context of increased scarcity: low efficiency, environmental degradation, and inequity. Despite some improvements competition is increasing and water use efficiency remains low in most sectors. But the answer is not just more efficient allocation mechanisms and more emphasis on greater yields and productivity, because these alone may lead to further losses in equity and environmental sustainability. Rather, a combination of supply and demand management measures is needed.

Three common responses to competition

The responses to increased competition for water are supply augmentation, conservation and reallocation (figure 9.2). The most conventional response is to develop new resources. For the state this typically means building new reservoirs or desalination plants or interbasin transfer. For users this means more wells or farm ponds or gating drains to store water. Conserving water includes increasing the efficiency of use by reducing losses. Changes in allocation, to ease competition or to maximize water use, are based on economic, social, environmental or other criteria. Augmentation is a supply management strategy, while conservation and reallocation are demand management strategies, roughly defined as 'doing better with what we have'.[9]

Supply augmentation is typically constrained by the availability of storage sites, the social and environmental costs and the rising financial cost of water. With needs outstripping available stocks in many basins, transfers between basins have become more frequent. Amman, Athens, Bangkok, Kathmandu, Los Angeles and Mexico City are procuring water further afield. The massive transfer of water now under way in China (from the Yangtze River to the Yellow River) is being emulated in Brazil, India, Jordan and Thailand. While this trend is likely to continue, its potential will gradually be exhausted and its costs will spiral upwards. Other small-scale options, such as farm ponds in Asia or wells, have also been widely developed. Desalination is an option in specific locations (islands and coastal cities), but its cost is likely to remain high (though it is declining) and its

Box 9.5 The untapped potential of marginal-quality water

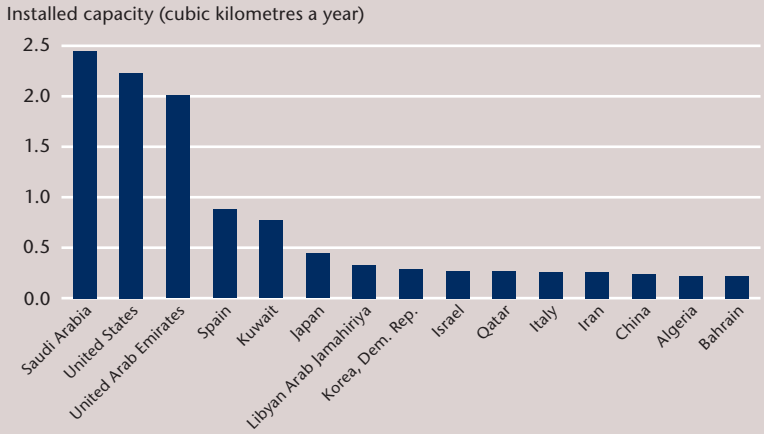
Non-conventional water resources, especially marginal-quality water (urban wastewater, agricultural drainage water and saline surface water or groundwater), are an important source of water that is still undervalued.

Urban wastewater use in agriculture remains limited, except in a few countries with very meagre water resources (40% of uses in the Gaza Strip, 15% in Israel and 16% in Egypt with the reuse of drainage water). Elsewhere, even where water is scarce, wastewater use accounts for less than 4% of all uses (2.3% in Cyprus, 2.2% in Syria, 1.1% in Spain and 1.0% in Tunisia). The use of urban wastewater – treated or not – is growing, particularly for farming around cities, often because higher quality water resources are not available.

Desalination based on brackish water sources (48%) and seawater (52%) is increasingly affordable as a result of new membrane technology ($0.60-$0.80 per cubic metre). It is used mostly for drinking water (24%) and industrial supplies (9%) in countries that have reached the limits of their renewable water resources (such as Cyprus, Israel, Malta and Saudi Arabia; figure 1). Little is used for agriculture (1%), but its use for high-value crops in greenhouses is gradually increasing. Desalination accounted for only 0.4% of water use in 2004 (nearly 14 cubic kilometres a year; figure 2), but production should double by 2025.

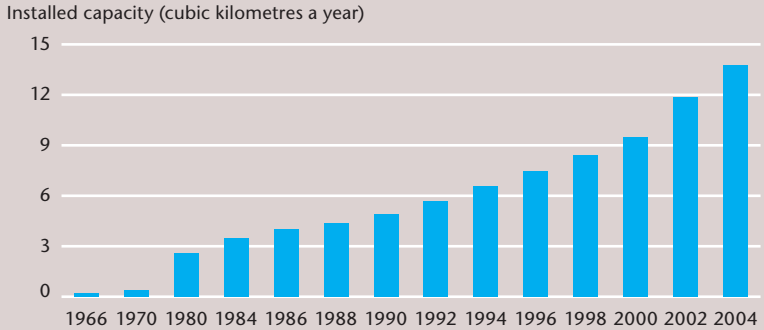
Source: Blue Plan, MAP, and UNEP 2007.

Figure 1 Desalination capacity in selected countries, 2002



Source: Based on Maurel 2006.

Figure 2 Rapid growth of global installed capacity for desalination, 1966-2004



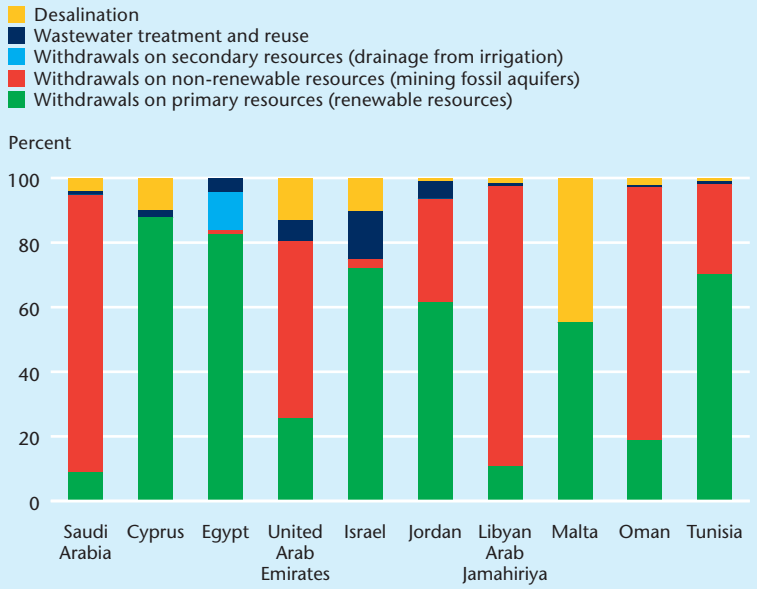
Source: Based on Maurel 2006.

use limited to urban supply. Other non-conventional sources of supply include wastewater, secondary sources (such as treated irrigation drainage) and the mining of fossil (non-renewable) aquifers (box 9.5). Figure 9.3 shows the relative importance of these sources in selected Middle East and Mediterranean region countries.

Because of reuse of water in basins and users' adjustments to scarcity, fully developed basins or aquifers tend to have much less 'slack' than is often thought, and the potential for net water savings at the basin level is often overstated. When limits are reached and improved efficiency and demand management possibilities are exhausted, there are often no win-win solutions to meet additional demands. Rather, resources must be reallocated from one source to another. These demand management options are discussed in more detail in the following section.

Countries rarely resort to all three options at once unless pressure over the resource is severe, as in Tunisia (see chapter 15).

Figure 9.3 Importance of non-conventional sources of water for selected Middle East and Mediterranean region countries, 2000-06



Source: FAO-AQUASTAT; Benoit and Comeau 2005.

Large improvements are expected from demand management, with savings in water, energy and money through increased efficiency

Mechanisms are needed to make optimal choices along the spectrum of options. Optimal choices should emerge from informed processes of consultation and negotiation that assess the costs and benefits of all options, while considering basin interconnectedness, relationships between land and water resources and environmental sustainability. Decisions should be coherent with other government policies.

Scope for improving demand management

Large improvements are expected from demand management, with savings in water, energy and money through increased efficiency. Among the strategies that have contributed to improved water demand management are:

- *Technological improvements.* These include reducing leakage in urban networks, changing equipment and shifting to micro-irrigation, biotechnology and other water-conserving agricultural techniques. Attention must be directed to impacts on flow pathways to properly assess overall water savings (see chapter 3).

- *Management approaches.* Examples include cropping-pattern change, water reuse through sequential uses in irrigation schemes or urban processes, reuse in closed-loop systems (industry and energy sectors) and reallocation across sectors.

- *Economic incentives.* Using water pricing, taxes and fees for demand management and allocation of water has proved effective in domestic and industrial sectors, but these measures are not a workable option for most irrigation schemes in developing countries.[10] Payment for environmental services has been found to be a useful economic restraint in some cases (see chapters 4 and 14).

- *Legal and regulatory approaches.* 'Polluter pays' and 'user pays' principles have reduced both water use and pollution in industry, and participatory management has increased user participation by controlling individual water demands (see chapter 4).

Urban distribution networks and irrigation schemes lose large amounts of water through leakage and percolation. Among the 23 countries of the Mediterranean Action Plan, in a region where water stakes are high, an estimated 25% of water is lost in urban networks and 20% in irrigation canals (map 9.1). Realistically, only part of the water lost can effectively be recovered technically and at a reasonable cost. Cities such as Rabat and Tunis have cut their losses to 10%.[11] Even when the water is returned to the water system, these losses and leakages constitute a failure of the supply infrastructure as they result in significant financial costs (for producing drinking water and pumping and transporting water) and additional environmental and health risks. Technology (canal lining, micro-irrigation) can often solve part of the problem, but a large part of the losses are due to management or regulatory flaws.

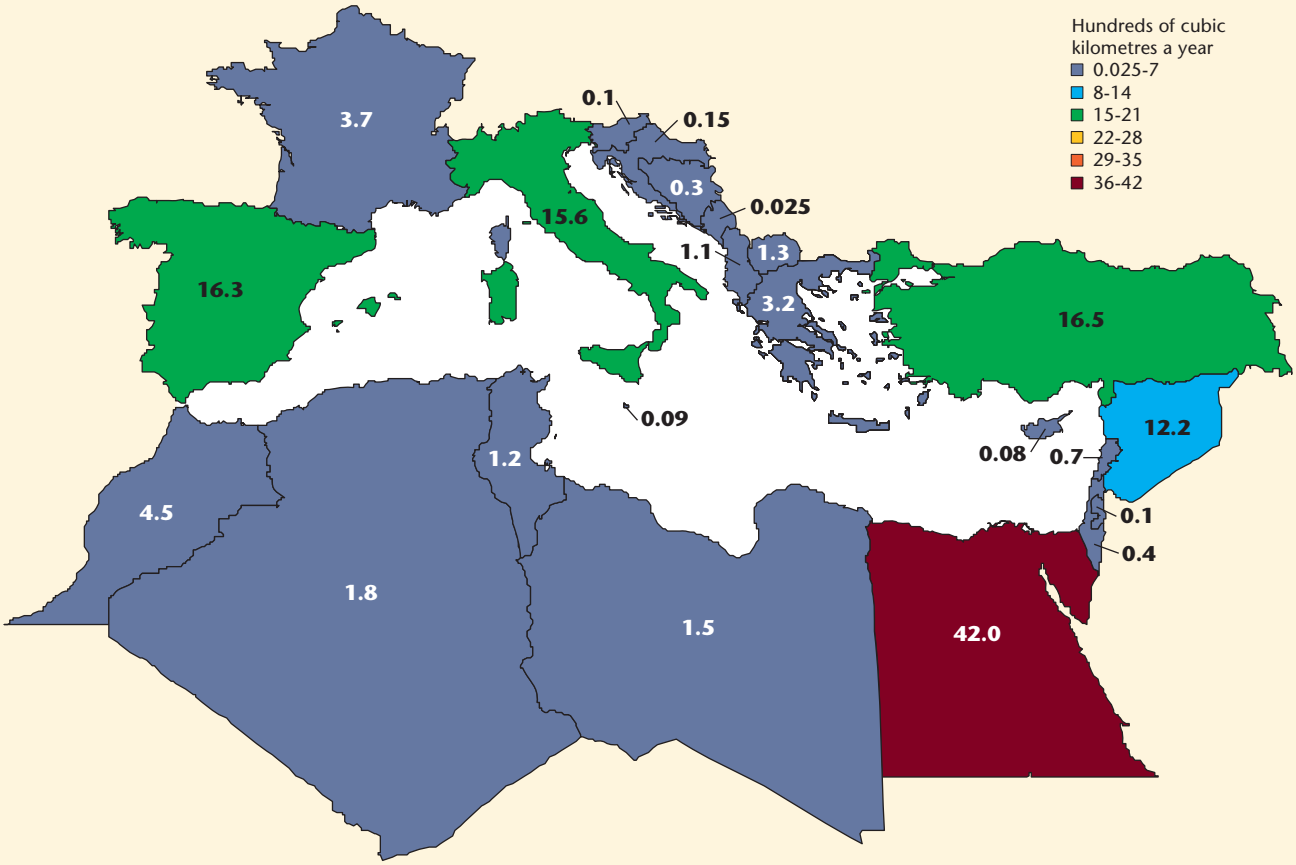
While irrigation losses and inefficiency appear high, with only a third of the water supplied reaching plant roots, most of the losses become return flows, which are tapped by other users elsewhere in the basin or serve important environmental functions. There may be little water to be saved in fully developed basins, and conservation interventions can often end up as reallocation.[12]

Localized irrigation (micro-irrigation), for example, has a limited impact on water depleted by evapotranspiration in the fields and chiefly reduces return flows. Thus water 'saved' by upstream irrigators can come at the expense of downstream users, allowing upstream irrigators to expand their cultivation. This may be desirable from the perspective of the upstream farmer, but the result is increased water depletion.

Price-based regulation was emphasized in the 1990s for limiting water use, but its benefits have failed to materialize, most notably in the irrigation sector.[13] Water can also be saved by changing behaviours – through awareness campaigns, quotas or water pricing (box 9.6).

In the industrial sector a combination of subsidies, higher water prices and environmental regulations have encouraged industries to improve processes and reduce withdrawals (see chapter 7). It is hard to get a consolidated picture of how industries manage water worldwide, but there are global indications that the business community is devoting growing attention to water management,[14] as a result of increased efforts to improve water management. Industries can realize major savings in natural and financial resources by raising awareness through environmental audits and by investing modest amounts. In agricultural and emerging market economies the scope for progress through clean processes is even greater, since production processes are generally well below world standards. Multi-national

Map 9.1 **Difference between water withdrawn and water effectively used in Mediterranean region countries, all uses, 2000-05**



Source: Jean Margat, adapted from Benoit and Comeau 2005; Blue Plan, MAP, and UNEP 2007.

companies can play a key role. In some countries public intervention through subsidies or more stringent enforcement are necessary. The international competitiveness of companies in the global market is enhanced by a commitment to best environmental practices, which reduce pollution and improve the efficiency of water use.

At the national level a growing number of companies are introducing clean production processes – often for pollution reduction – that result in substantial water savings. These efforts are supported by various UN programmes (United Nations Environment Programme, United Nations Industrial Development Organization) through a network of cleaner production centres in 27 countries.

Chapters 14 and 15 present several examples of approaches to demand management.

Reallocation, efficiency and equity issues

Water, like any resource, when it is scarce or requires scarce resources to supply

Box 9.6 **Signs of progress in urban areas: examples in Asia and Australia**

Water withdrawals increased in Asia and Australia in all sectors until the 1980s, when withdrawals for agriculture declined and growth in overall water withdrawals slowed. There is still considerable potential for improvement. Some recent efforts have been stimulated by the United Nations Economic and Social Commission for Asia and the Pacific, which has promoted the concept of eco-efficiency of water use and water infrastructure development, and by complementary research.

Implementation of demand management measures has been uneven across the region, but interest in improving water use efficiency is growing in many countries. Singapore has reduced urban domestic water demand from 176 litres per person a day in 1994 to 157 litres in 2007 as a result of additional and targeted public expenditure for improved demand management.

In Bangkok and Manila leak detection programmes have lowered estimated unaccounted-for water and allowed postponing the development of new infrastructure. Effluent charges have been an important instrument for stimulating efficient water uses in households and commercial establishments.

In 2008 Sydney Water in Australia began providing homes in the Hoxton Park area with two water supplies – recycled water and drinking water (dual reticulation). Recycled water is to be used for gardens and other outdoor needs, toilet flushing and potentially as cold water in washing machines and for certain non-residential purposes. The recycled water taps, pipes and plumbing are coloured purple to distinguish recycled water from drinking water.

Source: www.sydneywater.com.au; UNESCAP 1997, 2004; Kiang 2008.

Once basic human and environmental water needs have been met, the remainder should ideally go to where water has the highest value to society

it, rises in economic value. Once basic human and environmental water needs have been met, the remainder should ideally go to where water has the highest value to society. Since much water is used for productive or 'lifestyle' purposes, it is appropriate to apply economic criteria to its allocation. But water pricing alone will not produce the necessary reallocation, since prices in many sectors do not reflect underlying economic values, and there are many cases of market or service failure. In several Eastern European countries price increases resulted in reductions in urban water consumption to half the level of two decades ago.[15] Flow reductions can lead to secondary water quality problems in supply networks (increase of water residence time), odour problems in sewerage systems and added burdens at wastewater treatment plants, which become hydraulically underloaded and have to treat much denser raw wastewater than before.

Reallocation from lower- to higher-value uses can be achieved by enabling the traditional markets as well as by applying administrative measures, creating water markets or trading water rights. In each case society should set appropriate limits on transfers to protect third parties, the environment and wider social interest. Subject to these conditions, competition for water can be healthy.

In countries that recognize water trading rights, many cities have met their growing water needs by purchasing farms or properties with water rights and taking over the rights. Some non-governmental organizations 'compete' on behalf of the environment by purchasing the rights to a certain volume of water in a river or lake, which they then leave in the water body. These are examples of one-off transactions. But in certain regions (Chile, parts of Australia, some western states of the United States) the conditions have been created for regular water trading (see box 4.2 in chapter 4). There, water markets are commonly used by farmers wanting supplementary water for valuable crops during drought conditions or by cities to create reserves in anticipation of impending droughts. Prices set in these markets signal the marginal values of water in these different uses, which are usually much higher than average values.[16]

These 'efficiency' criteria need to be reconciled with society's desire for equity (the satisfaction of basic needs) and environmental sustainability. Such balancing of water needs can be achieved by a combination of administrative allocation, tariff structures with adequate provisions to protect the poor and other relevant measures. There is a role for subsidies in water services, but they should be carefully targeted to specific functions. Poor people and other disadvantaged groups without sustainable access to safe water and adequate sanitation are usually willing to pay within their means for reliable access to service because improving access (through standpipes or household connections) yields large financial dividends.

The Comprehensive Assessment of Water Management in Agriculture argues for reforms to enable more efficient use of water.[17] Policy-makers need to recognize the incentives and resource constraints confronting small farmers, but it would be a mistake to assume that farmers do not respond to market incentives (food prices have an impact on cropping patterns). Farmers will invest in inputs and irrigation technology (meaning higher water costs) if they believe that they will achieve higher returns. There is no reason for efficiency, equity and environmental sustainability to be out of alignment in that case.

Notes

1. OECD 2008.
2. OECD 2008.
3. Molle, Wester, and Hirsch 2007.
4. Barreteau, Bousquet, and Attonaty 2001; Barbier and Thompson 1998; Neiland et al. 2000.
5. Molle and Berkoff 2005.
6. Wolf, Yoffe, and Giordano 2003; Gleick 2008.
7. van der Molen and Hildering 2005.
8. Wolf, Yoffe, and Giordano 2003.
9. Winpenny 1994.
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11. Blue Plan, MAP, and UNEP 2007.
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