WATER THINK TANK
MÉDITERRANÉE

MEASURING
DISTRIBUTING
PRESERVING

WATER DEMAND MANAGEMENT
IN THE MEDITERRANEAN

PRINCE ALBERT II OF MONACO FOUNDATION

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United Nations Institute for Training and Research

Plan Bleu

International Office for Water

Fondation VEOLIA

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WATER DEMAND MANAGEMENT

IN THE MEDITERRANEAN

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THE WATER THINK TANK

IN FEW WORDS

The *Water Think Tank Méditerranée* (WTT) initiative was launched by the Prince Albert II of Monaco Foundation during the 5th World Water Forum in Istanbul in March 2009, in partnership with the United Nations Institute for Training and Research (UNITAR), the Plan Bleu, the International Office for Water and Veolia Environnement. This initiative follows on from a round table organised by the Prince Albert II of Monaco Foundation, UNITAR and Veolia Environnement, during the Zaragoza Water Expo in 2008, on the theme of integrated water resource management and the role of local authorities.

Urban development lies at the root of many challenges concerning water management throughout the countries of the Mediterranean region. Each local environment is distinguished by specific constraints, often accentuated by the effects of climate change: shortage, deterioration of the quality of natural resources, the state of access networks to water and sanitation services, conflicts of use... These complex problems require clear choices to ensure the sustainable development of the Mediterranean region. Such issues also affect the implementation of solidarity mechanisms in various forms and at various levels.

The *Water Think Tank Méditerranée* fosters dialogue in order to promote sustainable and integrated water resource management within the Mediterranean region. In order to carry out this task successfully, the WTT endeavours to take on board the views of all the public and private stakeholders involved in water management and implements tools for exchange and cooperation thanks to the production, capitalisation and sharing of knowledge. Several initiatives concerning the water sector exist in the Mediterranean area, bringing into play mechanisms for political, financial, scientific and technical cooperation.

The main aim of the *Water Think Tank Méditerranée* is to identify and promote governance mechanisms that will contribute towards efficient coordination between the various levels of management, especially that of the catchment areas and local authorities. This involves examining the conditions required to ensure the sustainability of drinking water and sanitation services in Mediterranean cities, based on concrete case studies to ensure equitable water access.

The project follows on from previous work carried out by *the Water Think Tank*, which gave rise to the publication of two water governance reports, one focused on conflicts of use and the other on water regulation in large cities. This new report offers an overview of the main issues and solutions available for managing water demand in the Mediterranean. This work is based on actual case studies conducted by the partners of the Water Think Tank to ensure that the diversity of local situations that exist within the Mediterranean basin are taken into account.

HSH PRINCE ALBERT II OF MONACO

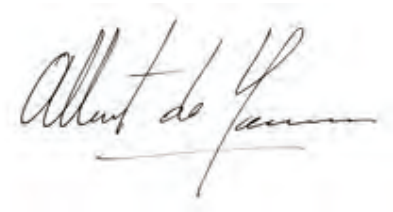
"The Mediterranean Basin is home to an extraordinary cultural, biological and geological diversity, among others. Historically, these complementarities and the trading relationships they gave rise to have spawned an unusually creative way of thinking. The spirit of discovery and sharing knowledge between peoples have shaped the cities and shores of a civilisation founded above all on the sea and fresh water.

I wanted to launch the *Water Think Tank* Méditerranée at the fifth World Water Forum in 2009, which was held in Istanbul, a city that symbolises the intermingling of Mediterranean identities and whose destiny is intimately tied to water.

Often scarce and always fragile, these resources are now subject to enormous anthropic pressure. Our efforts to protect the resource are coming up against population growth, urban development and increased tourism, in a century when the already noticeable effects of climate change are likely to become more marked: the current overuse of fresh water resources is aggravated by the progressive rise in sea levels, which facilitates saltwater intrusion in the groundwater, and by the deterioration of wetlands which play a vital role in ecosystem regulation. Adapting to these changes is a key, pressing issue for the Mediterranean, demanding a genuine ecological transition and, in particular, an optimised approach to water management.

The dialogue initiated by the *Water Think Tank* Méditerranée has since brought together water sector experts, practitioners and decision-makers from many countries around the Mediterranean. The initial work fuelled thinking about the methods of organisation, funding and innovation applicable to water. We have now also completed an analysis of the levers of action available to us for water demand management. Demand that is both diverse and complex – to satisfy vital human needs, our production and consumption choices, and of course, the water requirements of the natural environment itself, which we ignore at our peril.

This third report is the result of two years of research into the effectiveness of the water demand management measures implemented in the Mediterranean. These measures reflect choices made by society and this publication defines the issues at stake, reminds us of the methods of analysis currently used and their limitations, and outlines the potential benefits of a genuine and now essential ecological transition for the Mediterranean."



INTERVIEW
KEY OBSERVER

MRS CHARAFAT AFAILAL
Delegate Minister in charge of Water
Kingdom of Morocco

More than ever, water is a crucial factor in the economic and political stability of the countries surrounding the Mediterranean. Our region, suffering as it does from limited water resources and the effects of climate change, faces huge challenges.

Morocco, like other countries in the region, has a varied climate characterised by vast differences in rainfall patterns from one season and area to another. Against this backdrop, and to support its development, Morocco embarked many years ago on a large-scale hydraulic infrastructure programme to control and harness conventional water resources, which has enabled it to make drinking water supply more secure, develop irrigation, satisfy the water requirements of industry and tourism, protect property and people from major flooding and generate hydroelectric energy.

This policy has however reached its limits, due in particular to the scarcity of the resource and the pressure caused by accelerated urbanisation and industrial and tourism development, which has led to overuse of underground water resources, a deterioration in water quality and a worsening of extreme weather due to climate change.

It is obvious that we still face significant challenges. To build on our achievements and face up to these challenges, Morocco has revised its water policy, combining water demand management and water resource valorisation and preservation with supply management and development.

Following the example of other Mediterranean countries, we have made water demand management (WDM) one of the mainstays of our National Water Plan (PNE), which will soon be put before the Supreme Council for Water and Climate (CSEC). This plan constitutes a frame of reference for the nation's water policy and will form the basis of a more coherent, integrated and sustainable approach to water resource management and use to be in place by 2030.

The water demand management actions recommended by the Moroccan National Water Plan are mainly concerned with developing more water-efficient irrigation practices and making the networks supplying water for irrigation, drinking water and industrial and tourist purposes more efficient. They also call for more efficient use of the water resources harnessed through the hydro-agricultural development of dam-controlled areas and promoting wastewater reuse. All these actions will be accompanied by government and financial measures as well as public awareness and information programmes.

Water demand management, which has been made more prominent in the Mediterranean Water Strategy, is therefore a priority for the countries in the Mediterranean Basin, including Morocco. And it is now clear that, for this exercise to be successful and to ensure that the Mediterranean region develops sustainably, the nations involved must unify their efforts and learn from experience, drawing on innovation and research carried out throughout the Mediterranean Basin as part of a strong dynamic of cooperation across the region.

1 Measuring

A VITAL ASSESSMENT

OF RESOURCES AND NEEDS

"From intuition to precise measurement for informed decisions"

RESOURCES VERSUS NEEDS: A DIFFICULT EQUATION

Appropriate water management calls for precise knowledge of the resources and how they are changing, but above all it requires us to anticipate needs. While physical measurements enable us to determine the volume of water available and necessary to identify the optimum balance point between supply and demand, additional socioeconomic measures are vital to evaluate the marginal utility of all stakeholders and the real value of the resource for the community.

This usage value reflects the benefits directly associated with water consumption, to which a number of less perceptible factors must be added: indirect usage value (derivative of environmental functions), option value (which represents the opportunity to use the resource in the future), existence value and legacy value, which relates to the satisfaction of being able to pass on healthy, productive ecosystems to future generations.

WATER RESOURCE INVENTORY

While water is on the whole a scarce resource in the Mediterranean, the situation varies widely from one area and one season to another. Detailed knowledge of water resources is essential, in spite of the difficulty of observing hydrological processes on the ground. Calculating the water budget provides an overall picture of the reserves available. Understanding phenomena such as precipitation, evaporation, evapotranspiration (water lost through a combination of evaporation and plant transpiration), infiltration, runoff and percolation enables us to estimate the quantity of water available and predict the consequences of a particular climatic or meteorological event. The water budget must also include a qualitative element to establish connections between the types of resource and the standard of water quality required according to use (agricultural, industrial, domestic or tourist).

DEMOGRAPHY AS A CONSTRAINT

With more than 24,000 inhabitants per km², Cairo is one of the most densely populated cities in the Mediterranean. It is also one of the driest, with just 26 mm of rainfall per year!

The issue of population is central to water management in the context of water stress specifically: population growth naturally leads to higher levels of domestic consumption, but also increases economic activity and the amount of food that has to be produced to feed the population. All these requirements have to be quantified in order to allocate resources appropriately in both quantity and quality.

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In practice, measuring these parameters enables us to establish a baseline which serves as a point of comparison to evaluate management policies and monitor the ongoing situation. Beyond a simple evaluation of the systems in place, the aim is to continuously make them more efficient and tailored to the local situation.

Nowadays, the pursuit of more and more precise and frequent measurements is made easier by digital technology. The progressive introduction of remote water meter reading and the deployment of smart meters offer interesting prospects for real-time data transmission to manage demand more effectively and limit or even avoid losses. On a larger scale, technical advances are being made in the agricultural sector with remote irrigation management systems for example. New smartphone apps enable farmers to monitor the volume of water used on individual fields, precisely measure water use efficiency and ultimately compare growing methods.

More broadly, the design of demographic, meteorological, climatic, geological and other models lends credibility to forward planning exercises to define water demand management measures, and are useful in planning long-term initiatives. Such solutions must admittedly be handled with caution, since they are based on probabilistic models that interpret possible but uncertain developments and must be regularly updated. The content can nonetheless be used as an educational resource to raise awareness.

INSTALLING INDIVIDUAL METERS IN TUNIS – A MEASURE THAT BENEFITS THE ECONOMY

With a view to improving service, the Tunisian national water company SONEDE, particularly in the capital Tunis, has encouraged the development of individually metered water supply connections. The ability to monitor their water use has enabled some households to reduce consumption by as much as 30–40%, one the one hand by helping them to become aware of how much they are using and on the other hand making it easier to detect and report leaks. A win-win strategy – for users (reduction in water bill), the operator (less unbilled water) and the environment (resource preservation).

VIRTUAL WATER: ANOTHER WAY TO MEASURE DEMAND IN THE MEDITERRANEAN

How much water is needed to produce a ton of cereals? And for a kilo of meat? The answer lies in the notion of 'virtual water', which attempts to quantify the amount of water actually used or lost through evapotranspiration in agricultural production. A country's total water requirements determine its 'water footprint', which equates to its domestic consumption plus its virtual water imports and minus its virtual water exports. The idea is to take into account in a region's water budget the impact of its imports (foodstuffs, etc.) on its water resources, which can for example exceed its requirements for irrigation.

As a region, the Mediterranean is a large-scale virtual water importer, but the situation varies widely from one country to another: France, for example, is a major exporter while Libya is at the other end of the spectrum, importing 2,800 cubic metres per head of the population each year. A real dichotomy can be observed between the north shore on one side and the south and east shores on the other.

Taking the concept of virtual water into account in water management strategies enables a better appreciation of water demand at the overall basin level, without masking the local disparities. So far, however, this interesting concept has not really been transposed into a working economic system. Common rules have not yet been established, neither for calculating volumes (i.e. the amount of water required in a product's source country versus the destination country) nor for determining the value of the water contained in these products, an essential factor for inclusion in other economic analysis tools (cost-benefit analysis for example).

DOMINIQUE ROJAT
Agence Française de Développement

"Water is an element essential to life, a scarce resource, a common good to be preserved and a commodity which involves cost to make it available and which is valorised in production processes. According to economic theory, price setting in a free market should in theory lead to equilibrium between supply and demand and ensure optimum allocation of goods for all purposes. In the case of water, this view is questioned on several fronts: first of all, we cannot rely on the market alone to satisfy vital needs. Also, the market does not function perfectly: there are externalities (pollution, competition over access to groundwater reserves), the protection of public goods like drainage basins has to be financed, and the size of the networks creates natural monopolies where competition loses its virtuous nature; and lastly, the unequal distribution of resources combined with high transport costs does not favour the functioning of a generalised market. Public intervention is therefore required to allocate water resources for different uses, guarantee water quality, fund large-scale infrastructure projects and regulate private sector involvement in distributing and selling the resource to users. Water rates fulfill various objectives concerned with recovering costs, ensuring social equity and preserving the resource. Economic thinking, particularly the marginal approach, sees benefit in scaling down investment aimed at reducing infrastructure leaks and setting up tiered rate structures to encourage domestic users to reduce their water consumption. It also, in theory, allows for rates based on the valorisation of water in the commercial sectors (industry and tourism), as well as the application of the polluter pays principle. In the agricultural sector, it often involves government subsidy, compensation for the sector's contribution to environmental and social objectives (such as employment in rural areas). Subsidies are also granted for adopting irrigation techniques that use water economically. In all cases, these economic instruments must be coordinated with the different sector policies (energy, agriculture, tourism, etc.) likely to influence water use. In the future, the economic approach offers prospects for the application of innovative instruments or others not yet widely used in the Mediterranean, such as payments for environmental services and water rights markets."

Debate

FROM DESCRIPTIVE TO PREDICTIVE MODELS

While reliable models for describing past climate changes exist, predicting future changes is less certain. Different models – meteorological for short-range forecasting and climatic for long-range forecasting – yield often contradictory results. However, being able to predict rainfall and, more generally, how the climate is likely to change in the future would make it easier to manage water resources.

This difficulty in predicting the weather with certainty, even a few weeks in advance, is due to the chaotic nature of our weather systems, and the famous 'butterfly effect', such that a minor variation in atmospheric conditions (for example, the fluttering of a butterfly's wings) can lead to unpredictable results in the future. We talk of the 'sensitive dependence on initial conditions'. Because it is impossible to measure atmospheric conditions at every point on the earth simultaneously, there is always a degree of uncertainty in choosing the parameters used in calculations, which can greatly influence the forecasts.

On this basis, how far can we trust these models and the conclusions reached? Even though advances in technology allow for increasingly precise physical measurements that minimise the uncertainty associated with the initial conditions (and therefore the forecasting errors), how do we integrate the results from models that we know to be imperfect in political decision-making?

KEY FIGURES

150 L/day

average consumption per head of the population in the Mediterranean

236 mm/year

average precipitation in Sfax (Tunisia), less than 10 mm per month between May and August

523

population of Mediterranean countries by 2025 (60% in countries on the south shore).

Water requirement in Spain (hm3/yr):

Domestic: 4.667
Industrial: 1.647
Irrigation: 24.094


Distributing

THE COMPLEXITY OF NEGOTIATING WATER RIGHTS

"In the absence of a decision, priorities are determined by need…"

THE ART OF DECISION-MAKING

Fresh water is an essential and yet scarce resource that has to fulfil a multitude of different needs and purposes. This dilemma calls for priorities to be defined. Water use, which varies from one region to another, must at the very least guarantee a minimum level of food self-sufficiency defined by each country, including the volumes required for irrigation. The next decision concerns allocation based on equity within the country; this raises the issue of efficiency, which varies depending on use. When taken into account in decision-making, efficiency is itself difficult to determine precisely with the current economic models, which make negotiation a delicate process because the decisions taken can be contested.

Appropriate economic solutions can nonetheless assist decision-making with regard to allocation: taxes, subsidies and quotas can be used to correct market forces by incorporating externalities (positive or negative) to ensure fairer distribution of water resources. Whether direct or indirect, social or environmental, these externalities are calculated with varying degrees of accuracy.

Communities and authorities shape decision-making processes with regard to water in a way that the market could not do in all cases. As a common resource, it must be managed collectively, based for example on 'institutional arrangements' according to Elinor Ostrom's formula which identifies eight design principles for common pool resource (CPR) management.

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THE BITIT WATER RIGHTS MARKET AND THE MURCIA CONSEJO DE HOMBRES BUENOS: TWO EXAMPLES OF PARTICIPATIVE, TRANSPARENT WATER RESOURCE ALLOCATION

The rural community of Bitit in Morocco has a network of seguia (open irrigation channels) that distribute the water throughout the area. Prior to the start of each growing cycle, the stakeholders in the irrigation network meet to decide how the water is to be shared out and thus minimise conflicts of use. They draw up a list (Jrida) showing the length of irrigation time allocated to each party as well as the location of parcels irrigated throughout the season and the order in which stakeholders will be allowed access to the water. The waqqaf, elected annually before the negotiations start, are responsible for ensuring that the decisions made collectively are respected. Water rights may be transferred between users of the same seguia, a system which in practice encourages those with rights to 2-4 hours' irrigation time to sell their water to those who have more than 4 hours, which in turn leads to an increase in average farm size. This system involves farmers in decision-making with regard to resource distribution and monetisation encourages stakeholders to improve efficiency and minimise waste.

In Murcia in southeast Spain, the objective is the same – minimising conflict – but a different method is used: the Consejo de Hombres Buenos (a people's tribunal made up of seven members representing different geographic areas) has jurisdiction over an assembly of more than 23,000 irrigating landowners. Beyond their judicial role, these tribunals have a pivotal role in the communities, of which they are a visible symbol, and play a key part in the process of passing on knowledge related to water management.

A traditional yet modern approach, allocation by the people here is a sign that water resources are being managed democratically and transparently.

The allocation of water resources has to be planned on different but interdependent scales: distribution at Mediterranean (regional) level is based on the principle of north/south solidarity and international cooperation. At individual country level, it is an issue of social justice and cohesion, while distribution at catchment basin and community level corresponds to each region's water allocation.

Distributing the resource according to demand is a key issue. Distributing the cost is another. The production of drinking water and the distribution and treatment of wastewater require investment and regular maintenance. Deciding who pays for what is a fine balance between legitimacy, efficiency and how much the various categories of users are able to contribute. Regardless of whether certain uses take priority, distributing water resources and the associated cost must take into account the specifics of each region, but also policies specific to the sectors concerned. Water policies must be consistent with overall strategic directions: a policy that supports tourism, for example, is hard to reconcile with stringent restrictions on water use in this sector.

The way water resources are distributed therefore echoes the way economic activity and communities themselves are organised. Negotiating water allocations relies on social factors that lie outside the water sector.

THE DEVELOPMENT OF TOURISM IN THE MEDITERRANEAN PUTS ADDED PRESSURE ON WATER RESOURCES

The pursuit of economic efficiency in water use is not always consistent with social and environmental needs. While supporting irrigation keeps farming going, sectors offering higher added value derive maximum economic benefit from each unit of water used, which can sometimes be essential for financing and/or maintaining a country's infrastructure. Certain regions are therefore forced to give priority to tourism-related uses, as in the case of the Cyclades where water consumption is 5–10 times higher in summer than in winter. Another example is in Cyprus where eight golf courses each consume 1 million cubic metres of water per year, the equivalent of what a town of 12,000 inhabitants uses!

Using water for tourism is somewhat of a double-edged sword: while it is a source of revenue essential to maintaining services all year round, it can lead to a shortage of water for local consumption and overuse of groundwater reserves which can in turn cause saltwater intrusion. In addition, the influx of people generates more wastewater, which is often discharged untreated into the natural environment. These quantitative and qualitative impacts must be taken into account to ensure that water-related issues are at the centre of responsible tourism policies.

WHEN RIVERS TOO NEED WATER

The agricultural, domestic and industrial sectors are not the only consumers of water: nature also has its vital needs. In the case of a watercourse, the notion of environmental flows refers to the minimum flow required to sustain the ecosystems. The needs of the aquatic flora and fauna are taken into account but also the water needed to maintain the appropriate physicochemical conditions to dilute any pollutants. And finally, the state of the banks, too often overlooked in river management, which provide a habitat for a rich and fragile biodiversity.

MOSBAH HELALI
National Water Distribution Utility - SONEDE (Tunisia)

« From an operational point of view, it is essential to have a better understanding of the different uses for water and how they change over time. This approach enables us not only to anticipate needs that will have to be met in the future but also, in the present, identify actions that SONEDE, in conjunction with others in the sector, can take to encourage more efficient use of water resources. The reason we wanted to support the work of the Plan Bleu was to contribute to a more detailed analysis of the various types of water demand (domestic, tourism, industrial, agricultural). A cost-benefit analysis of some twenty water demand management measures implemented in Tunisia identified certain priorities, taking into account the environmental and social externalities of certain actions. With the support of the World Bank and the Plan Bleu, SONEDE hosted a seminar to consider this work and serve as the basis for a decision-support tool which will enable us to share our experience with all the other countries in the Mediterranean Basin. Though the situation may vary from one country to another, given what is at stake, discussion and cooperation at regional level are of vital importance." »

Debate

THE ROLE OF NON-CONVENTIONAL WATER RESOURCES

Non-conventional water resources are being developed more and more in the Mediterranean. Cyprus, Syria, Libya and Egypt recycle practically all their wastewater. Egypt reuses 90% of its agricultural drainage water in irrigated areas. Malta, the Balearic Islands and Israel have embarked on large-scale seawater desalination programmes, a solution that is becoming increasingly energy efficient and therefore less expensive.

These techniques can contribute to the security of water supplies in towns and rural areas, and therefore minimise hydrological tension. Some can involve risks for the environment or human health, and still be less energy efficient than traditional solutions. In this sense, they could be accused of transferring the problems from one limited resource (water) to another (energy) while at the same time contributing to global warming by emitting greenhouse gases. The use of renewable energy by hooking desalination plants up to energy production plants (solar power for example) offer an interesting response to these criticisms.

Finally, these techniques are very much focused on supply, an important element but which does not provide a lasting solution to the problem of overconsumption of water at its source. So how far should we push the development of non-conventional water resources to improve water demand management? Is there not a risk of holding up the development of lifestyles and production methods that use water more responsibly?

KEY FIGURES

64%
percentage of water used for agriculture in the Mediterranean

6%
percentage of Syria's wastewater used for irrigation

5 kWh/m³
energy needed to desalinate seawater by reverse osmosis

300 L/day
average water consumption per tourist in the Mediterranean

30%
Mediterranean tourism as a percentage of global tourism

56 500 hm³
total capacity of Spain's 120 large dams


3
Preserving

ADAPTING DEMAND FOR WATER TO LEVELS THE ENVIRONMENT CAN TOLERATE

"A positive ecosystem: resistant, resilient, replenished"

WATER AND ECOLOGICAL TRANSITION

Developing supply has been the traditional response to increased demand for decades. Nowadays this approach appears to have reached its limits and increasingly comes up against financial constraints and environmental obstacles. Water demand management must reduce the pressure on sensitive areas, of which there are many in the Mediterranean. The measures brought into play could be technical (improving water efficiency), social (raising awareness), financial (economic incentives) or institutional (regulation). The volumes of water saved through such measures should not however be considered as an additional supply to be allocated automatically.

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THE RAMSAR CONVENTION, THE CORNERSTONE OF WETLAND PROTECTION IN THE MEDITERRANEAN

Recognising the importance of conserving and using our wetlands sustainably, all the countries that are signatories to the Ramsar Convention are keen to play a predominant role in regulating these vulnerable ecosystems. In the Mediterranean, more than 650,000 hectares are taken up by wetlands.

Marshes, swamps, lakes, rivers, wet grasslands, peatlands, lagoons, oases, estuaries, deltas, tidal flats, mangroves, fish ponds, salt marshes... All these ecosystems, which serve vital ecological functions, are to some extent shaped by humans. The Ramsar Convention seeks to ensure that new activities do not upset the balance of these environments through overuse of water resources.

THE PROBLEM OF LEAKAGE

Efficiency and the infrastructure leakage index (ILI) are two key indicators for measuring the volume of water lost before it reaches the consumer. They give an indication of the extent of the problem, which is often due to water pipe corrosion, settlement, vibration or deformation in the ground, ageing joints in the mains, fragile mains tapping points, etc. In some Mediterranean towns, the proportion of water lost by these means can be as high as 60%. Extensive diagnostic work has been done to tackle this problem in the Rhône-Alpes region of France, where water losses due to leakage are estimated at 20%.

The measures taken to combat the problem of leakage are:

- Detecting and repairing leaks
- Progressive water main replacement, particularly vulnerable sections (old, exposed, etc.)
- Replacing faulty or inaccurate macro-meters and installing new, more efficient ones to monitor flow and locate leaks as soon as possible.

Demand management must also take into account the needs of the natural environment, often neglected but essential for maintaining the ecosystem services that they provide for human needs. The Mediterranean Action Plan aims precisely to ensure that the basin is developed sustainably. Efficient water demand management is also about promoting responsible ways of living and consuming, whether individual or collective. Without disregarding vital human needs or slowing down economic activity, it is necessary for each of us to be aware of our water footprint in our daily lives, and what compensation really means.

To promote responsible collective use of water resources, economic solutions rely on raising the cost of water to help preserve the natural environment. Payments for environmental services (PES), incentives for setting up community initiatives to minimise pollution or overuse of water resources, aim to lessen impacts and reduce abstraction. Having been tested via pilot projects and now implemented all over the world, these schemes provide a means of remunerating stakeholders whose main activity, be it farming, tourism or industry, helps to keep the environment in balance.

Carrying out cost-benefit analyses (CBA) is a way of assessing the short, medium or long-term positive and negative impacts of a proposed management measure in a particular area. The results of these analyses inform the decisions of the authorities responsible for setting public water policy. Over a hundred water demand management measures have been identified in the Mediterranean, and about twenty, which have been implemented in Tunisia, are based on CBAs carried out by the Plan Bleu. This programme has identified the most efficient and the most effective measures as well as the synergies that could result from combining the two.

Despite their usefulness, these analyses must be interpreted with care and recontextualised. They provide strategic information on regional knowledge, identification of the stakeholders concerned and any inequalities that might be created or reduced. They also provide a means of identifying the main items of income and expenditure, and recording any environmental or social externalities for forward-planning purposes.

IN THE NILE DELTA, PRIORITY IS GIVEN TO IRRIGATION EFFICIENCY

The agricultural sector is the biggest consumer of water in the Mediterranean, accounting for two-thirds of all the water used. To reduce this considerable pressure on the resource without impacting food security, we need to use water more efficiently.

In Egypt, 85% of the water withdrawn from the Nile is used for agricultural purposes, mainly irrigation. A project was developed in a 2,500-hectare area of the Kafr el-Sheikh Governorate and subsequently enlarged to 200,000 hectares throughout the delta. The Integrated Irrigation Improvement and Management Project (IIIMP) aims to improve infrastructure design, make use of technical innovations to reduce costs and consumption, and improve the institutional water management framework. The success of this new approach quickly dispelled the farmers' initial reticence; they reduced their water consumption by 20–30%, while at the same time increasing their revenue by 15%.

EFFECTS OF CLIMATE CHANGE ON WATER IN THE MEDITERRANEAN

The fourth IPCC report determines that climate change exists and is of anthropic origin, i.e. associated with human activities. In the Mediterranean, the consequences of global warming could aggravate the problem of overuse of water resources:

- Lower precipitation levels and drier summers are resulting in longer low-water periods (the time of year when rivers reach their lowest level)
- Rising temperatures are causing an increase in the quantity of water needed for agricultural production
- Rising sea levels associated with melting glaciers increase the risk of saltwater intrusion in the groundwater.

The combination of these phenomena will likely be even more critical for some catchment basins on the south shore of the Mediterranean. In the most vulnerable basins, extensive measures will have to be taken to identify and preserve sensitive environments and their biodiversity.

ANA NIETO ARIAS
Water Resources and Environment Department, EVREN, Spain

"With erratic weather patterns already observed predicted to increase further and the tendency towards global warming, the balance between existing resources and demand for water is becoming increasingly precarious in the Mediterranean. Spain's drainage basins are not spared these pressures.

We can use technology to model the natural runoff for the whole country, precisely map the resources available at different times of the year and estimate the varying levels of demand for water that have to be met. For these models to be useful, they must take into account all forms of demand for water, including some not destined for consumption as such, for example, the needs associated with hydroelectric power generation, shipping and recreational pursuits, and of course the water needs of ecosystems themselves. Modelling is also a means of predicting the effect of a drop in rainfall or increased temperatures at drainage basin level.

The vulnerability of individual basins can also be assessed. Sometimes considered cyclical and sometimes structural, it can lead in the short term to usage restrictions according to priorities defined in integrated management plans and in the longer term to demand management measures, such as revision of rate scales, promotion of more efficient irrigation techniques, a preference for crops that use less water and so on."

Debate

THE DIFFICULTY OF RECONCILING ENVIRONMENTAL AND ECONOMIC CONSIDERATIONS WITH REGARD TO WATER USE

Water resources, in different forms, are used to support economic development be it in the agricultural, industrial or tourist sectors. Already viewed as a scarce and fragile resource, water is not always managed collectively according to models that take long-term environmental considerations into account. Approaching water management from a purely economic standpoint, while it can support essential services in the short term, sometimes leads to environmental damage that accumulates year on year. Take the Aral Sea for example, which has almost completely dried up over the past thirty years, where observations have revealed a discrepancy between human timescales and the duration of natural cycles.

Fortunately, positive examples also exist, showing the economic benefits of sustainable wetland management: the beaches and coastlines awarded the Pavillon Bleu label for sustainable coastal management efforts often gain recognition in the form of increased tourism.

While it is often difficult to find the right balance between economic development and sustainable management, it also depends on political priorities: what kind of regional cooperation initiative can we envisage for the Mediterranean basin to hasten the ecological transition? Perhaps one that does not impede development but which on the contrary relies on the emergence of new economic models?

KEY FIGURES

70%
of wastewater discharged into the Mediterranean every year is untreated

35%
Up to 35% less precipitation in the Rhône-Alpes region by 2065

1971
Ramsar Convention on Wetlands adopted

7 $m^3/km/day$
infrastructure leakage index in Tunisia in 2011 (SONEDE)

25 000
The Mediterranean basin is home to 10% of the world's flowering plants, 25,000 species, half of which are endemic.

10%

25%
of total demand: potential water savings in the Mediterranean by 2025

40%
potential water saving with the change to micro-irrigation

KEY CONCEPTS

Water budget

A means of determining the water input/output differential of a defined hydrologic unit (often a drainage basin) over a given time period. Not to be confused with water balance which is an agronomic concept referring to plant function.

Falkenmark indicator

An index for measuring water stress, i.e. lack of water of sufficient quality to meet human needs. It is defined as the proportion of surface runoff water per year available for human consumption, expressed in cubic metres per person per year. This index defines four levels of water shortage of increasing intensity: zero stress (› 1,700 cubic metres per person), water stress (between 1,000 and 1,700 cubic metres per person), water scarcity (between 500 and 1,000 cubic metres per person) and water crisis (‹ 500 cubic metres per person).

Isohyet

An imaginary line drawn on a weather map connecting points receiving equal amounts of precipitation in a given period.

Piezometric surface

The piezometric surface (also called piezometric head or level) defines the boundary between the saturated and non-saturated zones of an aquifer. Monitoring the piezometric surface is important in determining the amount of groundwater resources available and its fluctuations, particularly in arid environments or in cases of saltwater wedge intrusion, occurring more frequently in coastal areas, which can affect water quality.

Blue and green water

In ecology, blue water refers to water flowing in lakes, rivers, seas and oceans that can seep through into the groundwater. When precipitation falls, the surface runoff contributes to blue water. On the other hand, the water absorbed by the ground and living things (particularly plants) is considered as green water. Blue water is transformed into green water by irrigation, and green water into blue water by ground drainage.

Smart meters

Smart water meters transmit information on water consumption by radio waves to the operator, who then relays it to the water services, which in turn make it available to users. The latter can be notified of leaks by SMS or e-mail and keep track of their water use online.

Marginal utility

In economics, the marginal utility of a good or service is the utility that an economic agent derives from the consumption of one additional unit of that good or service.

Easement (water right)

Historically, an easement was a right granted to a village community to take wood from or graze cattle on seigneurial forest land. Nowadays, it is a legal concept with a broader meaning. For the purposes of this document, a water easement is simply a right to use water, hence the term water right. While the per capita volume of water actually available varies greatly according to the available resources and management models, the principle of universal access to water is widely recognised, including by the United Nations and the Universal Declaration of Human Rights of 1948.

KEY CONCEPTS

Externality

An externality is an external effect created by the activities of an economic agent that impacts positively (benefit or positive externality) or negatively (cost or negative externality) on other agents, for which the latter are not compensated.

Water use efficiency

From an agronomic point of view, water use efficiency refers to the ratio of dry matter produced to the amount of water consumed by the plants by evapotranspiration. It is also sometimes defined as the ratio of additional dry matter produced to the additional quantity of water consumed.

Non-revenue water

Non-revenue water is water that has been produced but which does not reach the consumer (due to leaks, theft or lawful use for which no payment is made). Some of this 'lost' water can be recovered through technical measures and more appropriate management models. It can then be used to meet currently unsatisfied demand, or be saved to reduce overall water consumption and therefore pressure on the environment.

Responsible water use

Responsible water use and water use efficiency are water-saving actions that aim to reduce water consumption and avoid infrastructure leakage.

Treated wastewater

After passing through the treatment plant, wastewater may go through further treatment and be reused, for agricultural purposes for example, instead of being discharged into rivers or the sea

Micro-irrigation

Micro-irrigation, also known as drip irrigation or trickle irrigation, is an irrigation method that delivers water directly to the roots of plants. This innovation saves both water and nitrogen, promotes root development and eliminates many diseases caused by water coming into contact with the leaves. Micro-irrigation is therefore a means of increasing production while at the same time reducing the amount of water consumed.

Acoustic leak detection

This method uses the sound emitted by a leak as a tracer. Because water is denser than air, it carries sound waves much more effectively and it is relatively easy to follow the sound to find its origin and therefore the leak.

Infrastructure leakage index

A means of calculating the volume of water lost through leaks in the drinking water distribution system, by relating them to the network length (excluding connections). It is most often expressed in cubic metres per kilometre per day. The higher the index, the less efficient the distribution infrastructure.

Meteorology and Climatology

These two disciplines, often confused, differ in their practices and objectives:

- Meteorology is the study of atmospheric phenomena (clouds, precipitation, wind, etc.) to understand how they are formed and develop according to atmospheric variables (pressure, temperature, humidity, etc.). Based on physics, in particular fluid mechanics and thermodynamics, meteorology provides a means of short and medium range weather forecasting.
- Climatology is the study of climate, i.e. weather conditions averaged over long periods of time. It is based more on geography and geophysics, and focused as much on the past (paleoclimatology) as on the future (long and very long range forecasting).

LOOKING AHEAD

PR. ANDRÁS SZÖLLÖSI-NAGY
World Water Council
Former Rector of UNESCO-IHE

"It has finally been recognised by the world leaders that water is the key to a sustainable world. It is essential to provide access to enough water of good quality to satisfy vital human needs (for food, health and energy security), but equally important to ensure the proper functioning of our ecosystems. Wetlands are an integral part of our shared heritage and provide irreplaceable water services. The varied arid, semi-arid and temperate landscapes that make up our living environment also underpin the cultural diversity the Mediterranean basin is so rich in.

The way Mediterranean territories are to some extent constructed and organised around water is testament to the ability of human communities to manage their relationship with this vital resource. The transmission of knowledge from one generation to another is echoed in the growing importance of educational initiatives focused on sustainable development. Considering the scale of the challenges our planet faces, the most important thing in the mid to long term is to create awareness as well as to involve and unite civil society, with the appropriate concepts, tools and institutions to manage environmental change through adaptation and proper mitigation. Managing our own demand for water is the first step in a far-reaching process of development towards a more sustainable, responsible approach to living in the coming decades.

The World Water Council in close cooperation with UNESCO's water programmes attempts to foster and guide this important behavioural transition by making this essential concern part of our everyday culture. To bring about the necessary practical improvements, scientific expertise and progress need to go hand-in-hand with cooperation among stakeholders. At the heart of this process, the energies of eco-citizenship generated by communities such as the Water Think Tank Méditerranée are of vital importance."

PARTNERS OF THE WATER THINK TANK

HSH Prince Albert II of Monaco during the 6th World Water Forum in Marseille, march 2012, surrounded by (from left to right) :
Bernard Fautrier, Amal Medani, Josiane Mongellaz, Walter Mazzitti, Jacques Oudin, Brigitte Fouilland, Dominique Héron and Hughes Ravenel

Prince Albert II of Monaco Foundation

PRINCE ALBERT II OF MONACO FOUNDATION

HSH Prince Albert II of Monaco set up his Foundation in June 2006 in order to address our planet's alarming environmental situation.
The Prince Albert II of Monaco Foundation is dedicated to the protection of the environment and the promotion of sustainable development. The Foundation supports initiatives in the fields of research and technological innovation, and activities focused on the social issues at stake.

The Foundation funds projects in three main geographical regions: the Mediterranean Basin, the Polar Regions and the Least Developed Countries. The Foundation concentrates its efforts in three main areas: climate change and renewable energies, biodiversity and water management.

www.fpa2.com

Plan Bleu

Plan Bleu

Plan Bleu is a Regional Activity Centre of the Mediterranean Action Plan, established under the aegis of the United Nations Environment Programme. It serves all the countries bordering the Mediterranean Sea and in the European Union that are contracting parties to the Barcelona Convention (1976). It also works in partnership with the Marseille Center for Mediterranean Integration and the Union for the Mediterranean. Its mission is to produce information and knowledge in order to alert decision-makers and stakeholders to the environmental risks and sustainable development issues facing the Mediterranean, and to forecast future scenarios to guide decision-making processes. As a key resource for development – agricultural development in particular – water has always been a major issue for Plan Bleu.

www.planbleu.org

International Office for Water

For 20 years, IOWater has supported international stakeholders in capacity building and developing a framework for better water management through:

- **Studies, advice and twinnings**
  - Strengthening skills at local, national and international level.
  - Drawing up strategies and supporting policies of good water resource governance and pollution control in the main sectors (water supply and sewerage, industry, energy and agriculture).

- **Professional training**
  - Catalogue-based and tailored training programmes.
  - Assistance with establishing water training centres.

- **Data and information management**
  - Implementing solutions for managing information about water and making it accessible.
  - Standardising data exchange.

IOWater is responsible for the administration of the International Network of Basin Organisations (INBO) and runs EMWIS (Euro-Mediterranean Water Information System).

www.oieau.fr

United Nations Institute for Training and Research

The United Nations Institute for Training and Research (UNITAR) delivers capacity building to thousands of beneficiaries around the world through training and research in the fields of the environment, peace, security and diplomacy, and governance.
Within the Governance Unit, the Local Development Programme (LDP) builds the capacity of local stakeholders towards sustainable development in order to help them meet the many challenges they face at local level.
The Programme is an international platform for knowledge exchange, and for the sharing and dissemination of best practice and innovations implemented by towns and cities. It facilitates partnership building between the public sector, private sector and civil society at local, national and international level.

www.unitar.org

Veolia Foundation

Around the globe, Veolia helps cities and industries to manage, optimize and make the most of their resources. The company provides an array of solutions related to water, energy and materials – with a focus on waste recovery – to promote the transition toward a circular economy. Veolia's 179,000 employees are tasked with contributing directly to the sustainability performance of customers in the public and private sectors, allowing them to pursue development while protecting the environment.

Created in May 2004, the Veolia Foundation supports non-profit community-oriented projects contributing to outreach, workforce development and environmental conservation, in France and internationally. It is unique in that every project that it supports is accompanied by a sponsor, who is a Company employee, and in that it provides the expertise of employee volunteers, joined together in Veoliaforce, in the areas of emergency aid and development.

fondation.veolia.com

Barrage de Sau, Osana, Espagne
Dam of Sau, Osana, Spain