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WATER EFFICIENCY

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More efficient water use in the Mediterranean

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Plan Bleu

Building the Mediterranean future together

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Country codes

Mediterranean countries	Code	Mediterranean countries	Code
Albania	AL	Lebanon	LB
Algeria	DZ	Libya	LY
Bosnia-Herzegovina	BA	Malta	MT
Croatia	HR	Morocco	MA
Cyprus	CY	Palestinian Territories	PS
Egypt	EG	Slovenia	SI
France	FR	Spain	ES
Greece	GR	Syria	SY
Israel	IL	Tunisia	TN
Italy	IT	Turkey	TR

KEY POINTS

Despite some encouraging progress, current water-use efficiencies in the drinking-water and irrigation sectors are far from satisfactory. Over the Mediterranean region as a whole, losses and leaks during conveyance and distribution, combined with inefficiency and waste in both irrigation and domestic use, are estimated to represent nearly 100 km^3 per annum, i.e. 45% of total water demand for these two sectors[1] (220 km^3 per annum).

Total water savings made between 1995 and 2010 are estimated at 22b km^3, whereas the recoverable losses estimated using the assumptions suggested by Plan Bleu in 2005 meant that savings of approximately 56b km^3 by that date and 67 km^3 by 2025 were envisaged. This shows that only 40% of these losses had been recovered by 2010. However, by 2025, Mediterranean countries will have continued to improve efficiency in different areas, thanks to the various national water saving strategies that have been adopted and implemented or that are in the process of being so.

In 2005 (the baseline year), three countries had already achieved the 2025 water-use efficiency goals for the two sectors (drinking water and irrigation), goals that were put forward by Plan Bleu and adopted by Mediterranean countries in the context of the Mediterranean Strategy for Sustainable Development (MSSD, 2005), and also adopted by the draft Mediterranean Water Strategy. Other countries are also set to achieve them by 2025. This is encouraging and in concordance with the initial assumption that these goals are attainable.

In the domestic sector, metering the water volumes that are produced and distributed is a prerequisite to any water-saving programme. It supplies quantitative data to guide water-saving policies and measure their effectiveness. In particular, this involves repairing leaks from water pipes, both on the public distribution networks and at users' homes. This is therefore a recommended measure for producing improvements in efficiency in the domestic sector in the Mediterranean. The water savings can be even greater if this is combined with training and awareness-raising campaigns against wasting water, as demonstrated by several examples from Mediterranean countries.

The advantages of water-saving programmes in the agricultural sector can be seen via their impact on the gross margins of crops and their consequent impact on incomes from agriculture. The advantages of water-saving programmes for irrigators can be assessed by comparing the additional gross margins that they can provide with the amortised cost of the investments which must be made in order to adopt localised irrigation.

Improving the efficiency of water use in the agricultural sector by implementing modern irrigation systems opens opportunities for some Mediterranean countries to "uncouple" growth in total water demand from growth in population and gross domestic product (GDP), provided that this is accompanied by "vertical expansion" in agriculture, i.e. an increase in productivity by increasing the yields per m^3 of water used and per hectare of land under cultivation.

While the question of pricing remains a highly sensitive issue in all Mediterranean countries, it is one of the priorities of water-demand management (WDM) strategies. Indeed, it is necessary to gradually cover costs – the EU Water Framework Directive requires full cost recovery for water services – while ensuring social equity. Price reforms have led to reductions in water consumption where consumption is price sensitive. The main conditions for this involve pricing levels and structures, and the existence of alternatives to previous behaviours.

Frequently, the unit cost of water saved by water-demand management is lower than the unit cost of "newly mobilised" water, which itself is lower than the unit cost of reusing treated effluents or of desalination. However, this cost difference should not prevent the development of treatment and reuse of wastewater or the production of desalinated water in a context of increasing water shortages, demographic growth and uncertainties associated with climate change.

The search for data for this water-efficiency assessment report has brought to light the inadequacy, irrelevance and unreliability of a large part of the data and statistics collected from departments and companies responsible for water supply. Efficient and sparing management of water resources requires the implementation, in each sector, of systems for the regular collection of technical and economic data on water production, extraction, distribution and consumption. This data must be based on common indicators used by the various operators and their staff. In regard to information concerning water, institutions in the sector prioritise technical data and statistics. The economic data needed to assess the costs and efficiency of water services is not systematically collected and made available.

The difficulties in obtaining an indicator of water efficiency for the industrial sector lie in the absence of comprehensive overall statistics regarding the volumes of water extracted, used and recycled by various industries, which would mean that an efficiency rate could be estimated for this sector.

1 Total demand for drinking water and irrigation only.

FOREWORD

Plan Bleu has been commissioned by all Mediterranean countries to monitor implementation of the Mediterranean Strategy for Sustainable Development (MSSD), including its "water" section. In 2008, it launched a programme regarding water-use efficiency, with the goals of:

- Improving collection of the basic data required for calculating the efficiency figure (an MSSD priority indicator),
- Providing countries with technical support for producing this indicator,
- Assessing the progress made by each country in terms of water savings,
- Identifying the priority actions to be implemented to improve water-use efficiency, in particular in the framework of national sustainable-development strategies.

Eight countries volunteered to produce national reports on these subjects: Bosnia-Herzegovina, Cyprus, Lebanon, Malta, Morocco, Syria, Tunisia and Turkey. These national reports were presented during a meeting which was held on 5 November 2008 at Plan Bleu in Sophia-Antipolis. This day meant that all participants could exchange their experiences and share the good practices developed in each country.

Following these discussions, Plan Bleu launched additional studies, on the basis of the latest data available on the state of this resource and on changes in water demand, and on the basis of the water-use efficiency reports produced by these eight Mediterranean countries. These studies will investigate the feasibility of the regional water-saving goal for 2025 which was adopted in the framework of the MSSD and, if necessary, this goal will be adjusted. Plan Bleu then suggests studying the relevance of the goal, using an economic analysis based on cost-benefit analyses of various options regarding water management.

Euphrate River and Halabiyya fortress (in the background) from the Zalabiyya Citadel
Source: http://www.deroutes.com/AV8/syrie8.htm

WATER-USE EFFICIENCY
in the Mediterranean

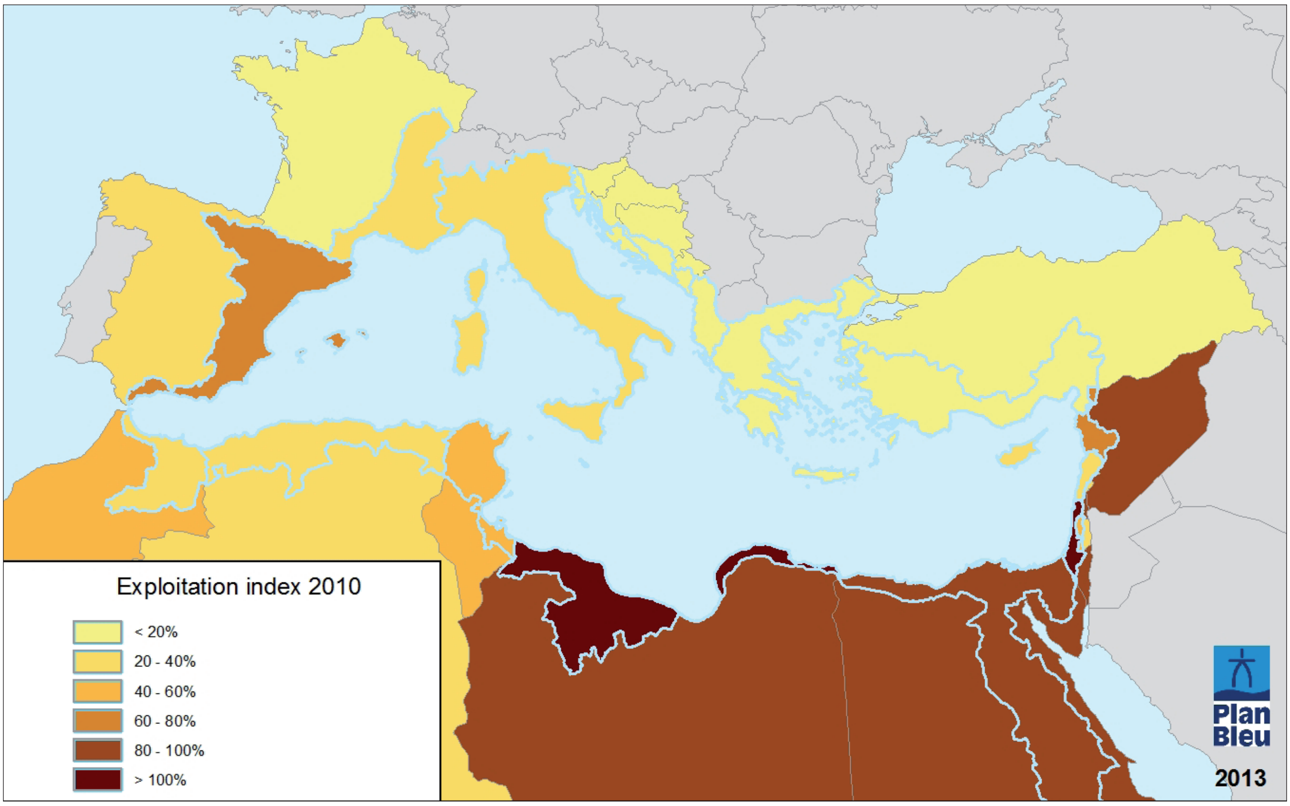
In Mediterranean countries, water resources are limited and unevenly distributed in space and time, with Southern Mediterranean countries having only 10% of total water resources. Nearly 180 million people live under water-stress conditions with availability below 1,000 m^3 per capita per annum, including 60 million living under water-shortage conditions (less than 500 m^3 per capita per annum). Twenty million people in the Mediterranean region do not have adequate access to drinking water, in particular in Southern and Eastern Mediterranean countries (SEMCs).

WATER-DEMAND MANAGEMENT: AN IMPORTANT POLICY ISSUE IN THE MEDITERRANEAN

In this context of increasing shortages in part of the region (see *Figure 1*) and given demographic growth, uncertainties associated with climate change and socio-economic changes, it seems clear that more economical, more sustainable and more equitable management of water is necessary to meet the needs of populations and for development, now and in the future.

Increasing the offer has been the traditional response to increases in demand. In 1997, based on the observation that increasing the offer had reached (or would reach) its limits and would run up

Figure 1. Water exploitation index for natural renewable sources at Mediterranean country and catchment basin levels (2005-2010)



Source: Plan Bleu, 2013

against increasing socio-economic or ecological obstacles in nearly all Mediterranean countries, the Mediterranean Commission for Sustainable Development concluded that water-demand management (WDM) was "the method that permits the greatest progress for Mediterranean water policy".

WDM, which includes all measures that aim to increase technical, socio-economic, institutional and environmental efficiency in the various uses of water, has emerged over the last ten years as a key issue in Mediterranean water management.

Various workshops organised by Plan Bleu at the regional level (Fréjus in 1997, Fiuggi in 2002, Zaragoza in 2007) have led to gradual recognition that WDM is a priority method for contributing to the achievement of the two goals at the centre of the idea of sustainable development: firstly, changing non-viable consumption and production patterns and, secondly, protecting and sustainably managing natural resources with a view to socio-economic development. The workshops provided a forum to discuss the means of implementing WDM policies and showed that the greatest progress would be obtained from a combination of tools (such as strategies, pricing and subsidies, and institutional structures) implemented gradually and continually.

Integrated management of water resources and demand has been adopted as the first priority area of action in the Mediterranean Strategy for Sustainable Development, which was adopted in 2005 by all Mediterranean countries and the EU. In this common "framework" strategy, one of the main goals regarding water management is the strengthening of WDM policies (*see Appendix*).

This Strategy has the following main goals:

- Strengthening WDM policies to stabilise demand, by reducing losses and improper use, and increasing the added value created per m^3 of water used;
- Integrating management of catchment basins, including surface water and groundwater, ecosystems and de-pollution targets;
- Ensuring access to drinking water and sanitation to achieve the "Millennium Development Goals";
- Promoting participation, partnerships and cooperation.

The Union for the Mediterranean (UfM) has been launched with the aims of making a significant contribution to the initiative for the de-pollution of the Mediterranean Sea, strengthening existing plans for cooperation and developing a potential for action that forefronts sustainable management of the environment. In this framework, water is an essential resource to be protected and managed.

In this context, during the Euro-Mediterranean Ministerial Conference on Water (Dead Sea, Jordan, 22 December 2008), the Ministers adopted the guidelines of a joint long-term Mediterranean Water Strategy (MWS), with the priority themes of adapting to climate change, WDM, non-conventional water resources, water governance and funding. The MWS could therefore be an opportunity to deal more effectively with the region's water issues.

This Mediterranean Water Strategy draft is to set a figure for a regional water-saving goal for 2025 and examine the most appropriate means of achieving it. It should also highlight the need to develop economic approaches and cost-benefit analyses for various water-management options, including the short- and long-term environmental and social impacts.

The current challenge: accelerating integration of WDM into water, environment and development policies

The recommendations of the Zaragoza regional workshop "Water-demand management in the Mediterranean, progress and policies" (2007) stressed the need to make WDM a national strategic priority, to ensure its promotion and to coordinate its outworking, monitoring and assessment in the policies of various sectors, in particular agriculture, energy, tourism, environment and land-use planning.

Currently, the challenge is to accelerate integration of WDM into water, environment and development policies and, where necessary, to help countries draw up or improve their national sustainable-development strategy and their "water efficiency plans", adopted in principle at the Johannesburg Summit.

Indeed, while the water demand[2] of Mediterranean countries – which is equal to the sum of extractions and non-conventional production (such as desalination and wastewater reuse) – should increase by about 50 km^3 per annum by 2025 to reach nearly 330 km^3 per annum, losses associated with transport, leaks and improper use of the resource could exceed 100 km^3 per annum (Plan Bleu's current-trend scenario). This shows the importance of better demand management.

The future: what efficiency-improvement goals for the Mediterranean?

The challenge: achieve the regional goals for improving efficiency…

Plan Bleu, in its report "*The Blue Plan's Environment and Development Outlook*" (2005) attempted to assess the scale of losses and "improper uses" of water in each sector and to estimate the recoverable losses per sector and per sub-region in the Mediterranean basin, on the basis of assumptions which are certainly ambitious but nevertheless achievable. The data which follows only concerns the drinking water and irrigation sectors (*see Table 1*), due to a lack of available data for the industrial sector in most countries. The possible savings have been estimated at nearly a quarter of water demand, i.e. 56 km^3 out of a water demand (including drinking water and irrigation) of 220 km^3 across all Mediterranean countries in 2005. The scarcity of available statistics means that this estimate must be treated with caution. It does, however, indicate the order of magnitude of possible progress with regard to purely physical water-use efficiency. In 2025, the potential saving would be around 67 km^3 per annum, based on a water demand of 260 km^3 per annum from Plan Bleu's baseline scenario for 2005 (see *Figure 2*).

2 Here, water demand for drinking water, irrigation and industry.

Table 1. Estimates of recoverable losses (in km^3 per annum) per sub-region in 2005 (based on regional goals being met)

Mediterranean sub-regions (whole countries)	Drinking water	Irrigation	Total
	Assumptions for water-use efficiency improvements		
	Network efficiency raised to 85% and end-user efficiency raised to 90%	Network efficiency raised to 90% and plot efficiency raised to 80%	
Northern	4.6	18.2	22.8
Eastern	1.8	11.4	13.2
Southern	1.6	18.4	20.0
Total	8.0	48.0	56.0

Source: J. Margat, M. Blinda, Plan Bleu, 2005

Note: This concerns "recoverable losses" exclusively from the standpoint of available techniques, without considering social resistance or difficulties.

The potential for savings is therefore far from negligible. Quantitatively, the main opportunity concerns irrigated agriculture, which includes a wide variety of situations. In the Northern Mediterranean countries, this mainly concerns losses on large networks, while in Southern and Eastern Mediterranean countries (SEMCs) plot-irrigation practices are also involved. The possible savings in the agricultural sector are six times greater in volume than those in the domestic sector. Improvements to drinking water supply efficiency would only provide a modest fraction of the total, but this is the easiest to achieve in the medium term in Southern and Northern Mediterranean countries.

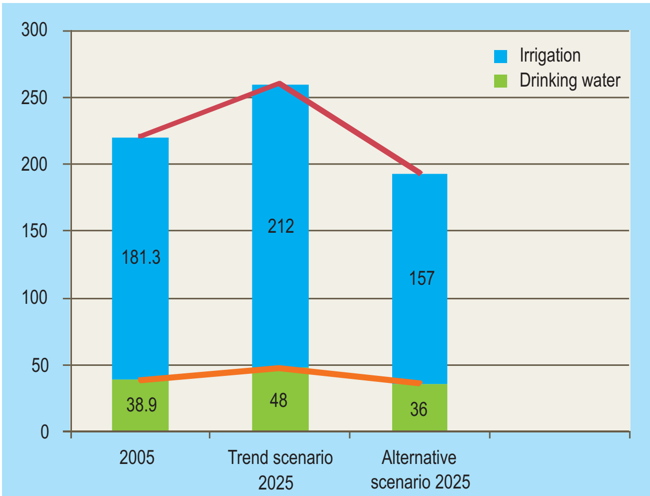
… goals which should be set by each Mediterranean country

The MSSD is a "framework" strategy to encourage the production of national sustainable-development strategies and sector strategies. Each country is responsible for setting its own goals with regard to improving efficiencies. Efficiency plans, the principle of which was adopted at the Johannesburg Summit, can be implemented at various scales: countries, catchment basins, towns or irrigation zones.

Certain Northern Mediterranean countries, along with certain Southern ones, have started to ensure more efficient water management as recommended at the Johannesburg Summit. They have made use of the various measures at their disposal to make progress in WDM or wish to develop these measures further. These include technical, legal, regulatory, institutional and economic measures, along with planning, coordination, training and awareness raising.

The EU has launched a water initiative whose Mediterranean component represents a framework for cooperation to contribute to achieving the Millennium Development Goals, especially in SEMCs.

Figure 2. Per-sector water demand in the Mediterranean: anticipated savings by 2025



Source: Plan Bleu, 2005

IS WATER-USE EFFICIENCY IMPROVING IN THE MEDITERRANEAN?

Method for calculating the water-use efficiency index

Countries still seem to be finding the total water efficiency index, and its per-sector components, difficult to produce. For this reason, Plan Bleu has included in its programme efforts to improve, in each country, the collection and validation of the basic data needed for per-sector (drinking water, agriculture and industry) and total-efficiency calculations, and to provide technical support to countries to improve the collection of this data and the production of indicators.

Priority indicators in the "Water" section of the Mediterranean Strategy for Sustainable Development

Five priority indicators have been adopted to regularly monitor the progress made by countries with regard to water management in the context of the MSSD:

N°	Indicator	Code
1	Index of water efficiency (total and by sector)	WAT_P01
2	Water demand (total and by sector), and compared to the GDP (total and by sector)	WAT_P02
3	Exploitation index of renewable natural resources	WAT_P03
4	Share of the population with access to an improved water source (total, urban, rural)	WAT_P04
5	Share of the population with access to an improved sanitation system (total, urban, rural)	WAT_P05

Index of water efficiency (total and by sector)

Definition of the index (adopted as part of the MSSD)

This index is used to monitor the water-saving performance achieved via demand management by reducing losses[3] and waste during transport and use. It sub-divides into per-sector efficiencies: drinking water, agriculture and industry.

1. Per-sector efficiencies

a. Drinking-water distribution efficiency

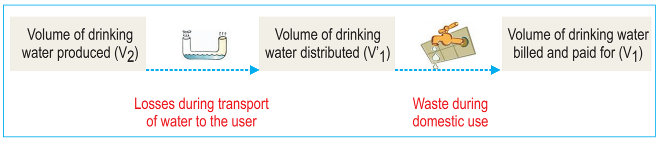
This is the fraction of drinking water produced and distributed that is paid for by users (*Cf. diagram 1*):

$$E_{pot} = V_1 / V_2 \text{ where}$$

- V_1 = volume of drinking water billed and paid for by users in km^3 per annum
- V_2 = total volume of drinking water produced and distributed in km^3 per annum (drinking water demand)

The index measures both the physical efficiency of the drinking-water distribution networks (loss rates or efficiency) and the economic efficiency, i.e. the ability of network managers to recover costs from users.

Diagram 1. Distribution-consumption path for drinking water



b. Irrigation-water efficiency

The physical efficiency of irrigation water is equal to the efficiency of the irrigation-water conveyance and distribution networks multiplied by the plot efficiency (*Cf. diagram 2*):

$$E_{irr} = E_1 \times E_2, \text{ where}$$

- E_1 = the efficiency of the irrigation-water conveyance and distribution networks, upstream of the agricultural plots, measured as the ratio between the volume of water actually distributed to the plots (V_3) and the total volume of water allocated to irrigation (V_4) upstream of the networks, which includes the losses in the networks (i.e. V_4 = irrigation-water demand):

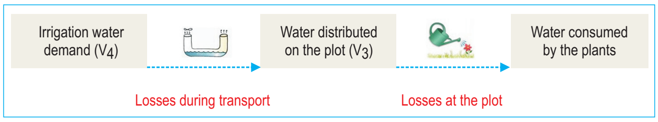
$$E_1 = V_3 / V_4$$

- E_2 = plot-irrigation efficiency, defined as the sum of the (plot) efficiencies of each irrigation method (surface irrigation, sprinkler irrigation, micro-irrigation and other methods), weighted according to the respective proportions of the various methods in each country and estimated as the ratio between the quantity of water actually consumed by the plants and the quantity of water brought to the plot:

$$E_2 = \sum_1^n \frac{S_m \times E_m}{S}$$

- n: number of irrigation methods used
- S_m: surface area irrigated using method *m*
- E_m: efficiency of method *m*
- S: total surface area irrigated in the country (all methods combined)

Diagram 2. Distribution-consumption path for agricultural water



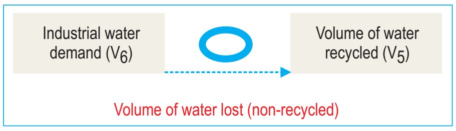
c. Industrial-water efficiency

This is the fraction of industrial water that is recycled (recycling index):

$$E_{ind} = V_5 / V_6$$

- V_5 = volume recycled water (km^3 per annum)
- V_6 = volume of raw water used in the industrial processes, which is equal to the volume newly entering an industrial facility + the volume of water recycled (km^3 per annum)

Diagram 3. Distribution-consumption path for industrial water



2. Total efficiency

The total physical efficiency of water use is defined as the sum of the ratios of the quantities of water used in each sector (demand less losses) to the demand of this sector, weighted by the fraction of total demand used by each sector (drinking water, irrigation and industry).

$$E = \frac{(Epot \times Dpot + Eirr \times Dirr + Eind \times Dind)}{D}$$

- D_{pot}: domestic demand (drinking water), D_{irr}: irrigation-water demand, D_{ind} : industrial-water demand,
- D: total water demand

Water demand is defined as the sum of the volumes of water mobilised (excluding "green water"[4] and "virtual water"[5]) to satisfy the various uses, including the volumes lost during production,

3 The analysis is confined to physical efficiencies, the easiest to quantify, i.e. the ratio between the quantity of water produced for use and the quantity actually used. The difference is generally defined as "losses".

4 Green water is rainwater used directly by plants from the soil.

5 Virtual water corresponds to the volume of water consumed during the production of goods (which is not the same as the water content of these goods). It is usually expressed in litres of water per kilogramme. For example, in Italy, approximately 2,400 litres of water are required to produce 1 kg of wheat, 2,500 litres for 1 kg of rice, and 21,000 litres for 1kg of beef. This is called virtual water because the water consumed is generally not found in the finished products.

conveyance, distribution and use; it corresponds to the sum of the volumes of water extracted and non-conventional production (wastewater reuse and desalination), all reduced by any exports.

Unit

Percentage (%)

Caveats

The economic efficiency of drinking water depends on the billing method (flat-rate or metered) and can be incorrect in the event of faulty metering.

The actual plot-irrigation efficiency (E_2) is difficult to measure in the field, given the difficulties in assessing the quantity of water consumed by plants and the large number of plots. Each country has its own estimates of the average efficiency of the various systems, based on pilot sites. This efficiency therefore tends to reflect the distribution of irrigation water according to the major irrigation methods nationally. The theoretical average efficiency is estimated at between 40% and 60% for gravity-fed surface irrigation, 70% to 80% for sprinkler irrigation and 80% to 90% for localised irrigation.

How the data for calculating the efficiency index is produced and collected

The availability of the basic data required for the calculations, and for the production of the various components of the efficiency index, varies between countries and sectors. Some data exists, in particular for the drinking-water and agriculture sectors, although sometimes it is just estimates. However, this data is dispersed between various ministries and departments, meaning that well-organised and well-managed data collection is still needed. This data is not systematically collected and published, and is rarely produced for statistical ends but more commonly for management or project design purposes. In general, the problems in collecting data regarding water are due to the large number of different bodies that are responsible for managing this resource, or that contribute to producing this data. This data-collection problem is also due to the lack of a powerful IT system with clear operating rules that are accepted by all involved. Inadequate funding should also be noted. It is therefore very difficult to ensure regular collection of relevant, reliable data in the technical, economic and environmental spheres, and to make this data continuously available to the various stakeholders. The development of a well-defined system for collecting and distributing this data could be the solution. This would also make the production and publication of data regarding water in general, and the various components of the efficiency index in particular, independent of the interests of operators, managers and contractors. The problems associated with definitions and calculation methods, which need to be harmonised and standardised, could also be highlighted.

Some countries are beginning to implement an increasingly well-organised system for data collection, by inviting the various stakeholders (such as Ministries, National Water Boards and Statistics Offices) to cooperate to produce regular, reliable data (*see Box 1*).

Box 1

The Algerian authorities for the water sector are keen to improve the production, collection and use of technical information and statistical data regarding the development and use of water resources. This concern has led to the decision to create a network of technical information in which data from the databases of bodies such as Direction de l'Hydraulique de la Wilaya (Regional Water Authorities), Agence Nationale des Ressources en Eau (National Water Resources Agency), Agence Nationale des Barrages et des Transferts (National Agency for Dams and Conveyance), Office National de l'Irrigation et du Drainage (National Office for Irrigation and Drainage), Algérienne des Eaux (National Water Board) and Office National de l'Assainissement (National Sanitation Office) are integrated into the regional databases of the Agences de Bassins Hydrographiques (ABH, Catchment Basin Agencies), before being consolidated into per-sector databases at the Ministère des Ressources en Eau (Ministry for Water Resources). This network is defined in Decree 08-326 dated 19 October 2008, pertaining to specification of the organisational structure and operating procedures of the integrated data-management system for water. The first measure to be taken at the Ministry for Water Resources consists of actually implementing the organisational structure and the integrated data-management system, for which the legal basis and outline have been specified since 2008.

Extract from Decree 08-326 dated 19 October 2008

Art.3-The system for integrated data management for water shall be organised as a network that includes the various centralised and decentralised structures of the ministry responsible for water resources, the public bodies operating under its authority and the other stakeholders in the water sector.

Art.4- The management of data concerning water […] shall be structured on three levels:

- *The level of central administration for water resources, which constitutes the hub for the consolidation of data produced by the various structures in the water sector, in particular with a view to establishing per-sector databases and the IT systems required for the production of water-planning tools;*
- *The regional level, comprising the catchment-basin agencies, which harmonises and consolidates the regional databases;*
- *The basic level, comprising all decentralised structures and bodies under the authority of the ministry responsible for water resources and the other stakeholders in the water sector.*

Art.5- Modalities for access to the data shall be specified by an Order from the minister responsible for water resources.

Source: Mohamed Benblidia, 2011

There is not, therefore, a problem in data production as such but rather a lack of organisation and communication between the various stakeholders in the water sector

Monitoring water-use efficiency in the drinking-water and irrigation sectors

Despite some encouraging progress, current water-use efficiencies in the drinking-water and irrigation sectors are far from satisfactory (*see Figure 3*). Losses and leaks during transport, inefficiency and waste in irrigation and domestic use are estimated at around 100 km^3 per annum for Mediterranean countries (*see Table 2*), i.e. approximately 45% of the total water demand for these two sectors[6] (220 km^3 per annum).

Table 2. Extracted water lost in 1995 and from 2005 to 2010 for the drinking-water and irrigation sectors only (km^3/annum)

1995 Sectors of use	Mediterranean sub-regions (whole countries)			Total	
	Northern	Eastern	Southern	km^3/annum	%
Irrigated agriculture	32	24	49	105	84
Municipalities (drinking water)	9	5	5	19	16
Total	41	29	54	124	100
2005-2010 Sectors of use	**Mediterranean sub-regions (whole countries)**			**Total**	
	Northern	Eastern	Southern	km^3/annum	%
Irrigated agriculture	27	24	37	88	86
Municipalities (drinking water)	8	4	2	14	14
Total	35	28	39	102	100

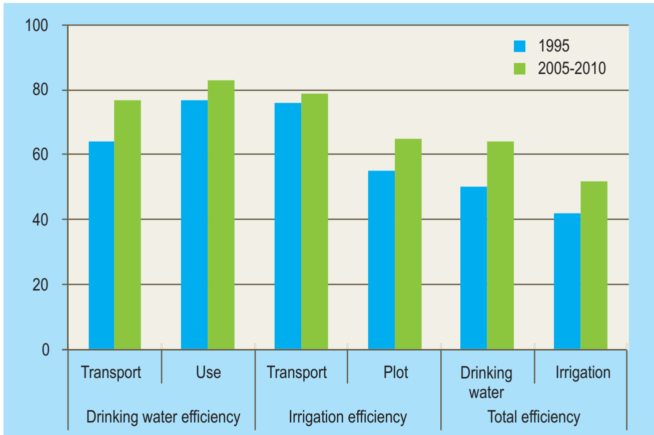
Source: Plan Bleu, Blinda, 2011

This is equivalent to a considerable opportunity for saving water, because at least some of these losses could be recovered via a water-demand management policy.

However, water-use efficiency in the Mediterranean region did see some notable improvements between 1995 and 2010, in particular in Southern and Eastern Mediterranean countries (SEMCs). This progress was strongest in the drinking-water sector with savings of approximately 5 km^3, of which 1 km^3 was in Northern Mediterranean countries and 4 km^3 in SEMCs. This saving represents 27% of losses recorded in 1995. In the agricultural sector, the water saving recorded was of the order of 17 km^3, of which over two-thirds were made in SEMCs (*see Table 3*). This saving represents 16% of the losses recorded in 1995. Further improvements to drinking-water efficiency would only provide a modest fraction of the total savings sought, but this is the easiest to achieve in the medium term in the Southern and Northern Mediterranean countries and the easiest to justify economically given the current price of drinking water.

6 Total demand for drinking water and irrigation only

Figure 3. Water efficiency (total and per-sector) in Mediterranean countries



Source: Plan Bleu, Blinda, 2011

Irrigation water-use efficiency is lower than that for drinking-water supply, which could seem paradoxical, or even contradictory, given the respective potentials for water savings in these two sectors. Implementation of economic instruments to promote a demand management policy for irrigation water remains at an early stage, despite some progress having been made. However, the main quantitative opportunity for savings concerns the agricultural sector. This regards losses on large networks and on plot-irrigation practices, estimated to total 105 km^3 and 88 km^3 in 1995 and 2010 respectively. The savings in the agricultural sector observed over this period represent 78% of the volume of total savings recorded, i.e. nearly four times those of the drinking-water sector. Improving irrigation water-use efficiency is key to effective water-demand management.

Table 3. Estimates of losses recovered in the drinking-water and irrigation sectors between 1995 and 2010 (km^3)

Sectors of use	Mediterranean sub-regions (whole countries)		MED region
	Northern	Southern & Eastern	
Agriculture irriguée	5	12	17
Collectivités (eau potable)	1	4	5
Total	6	16	22

Source: M. Blinda, 2011, estimates based on national sources, Plan Bleu (the figures are rounded).

With regard to overall water-use efficiency (domestic and irrigation combined), almost all countries have shown progress. Thus, the average water-use efficiency for these two sectors rose from 40% to 50% between 1995 and 2010, i.e. an improvement of 10%.

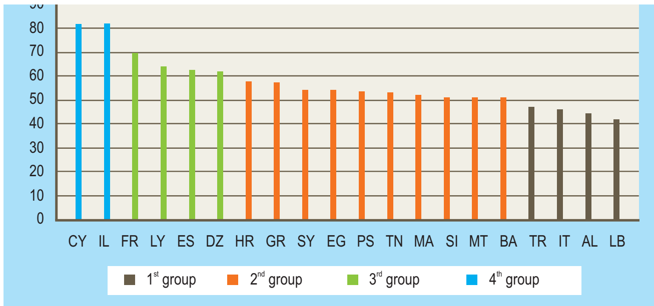
Total water savings made over this period are estimated at 22 km^3 (*see Table 3*), whereas the assumptions suggested by Plan Bleu in 2005 envisaged possible savings of approximately 56 km^3. This shows that 40% of potential savings had been recovered, and that by 2025 Mediterranean countries should have continued to improve efficiency in various areas thanks to the various national water-saving strategies that have been adopted and implemented (or are in the process of being so).

It should be noted that to meet the funding requirements of large rehabilitation and renewal programmes for dilapidated networks, or of installing water-saving irrigation systems, Northern Mediterranean countries have benefited from EU aid (separate from CAP aid), while SEMCs have established public-private partnerships along with bilateral and multilateral cooperation.

Currently, water-use efficiency (for drinking water and irrigation) lies between 40% and 85% in the majority of Mediterranean countries (*see Figure 4*):

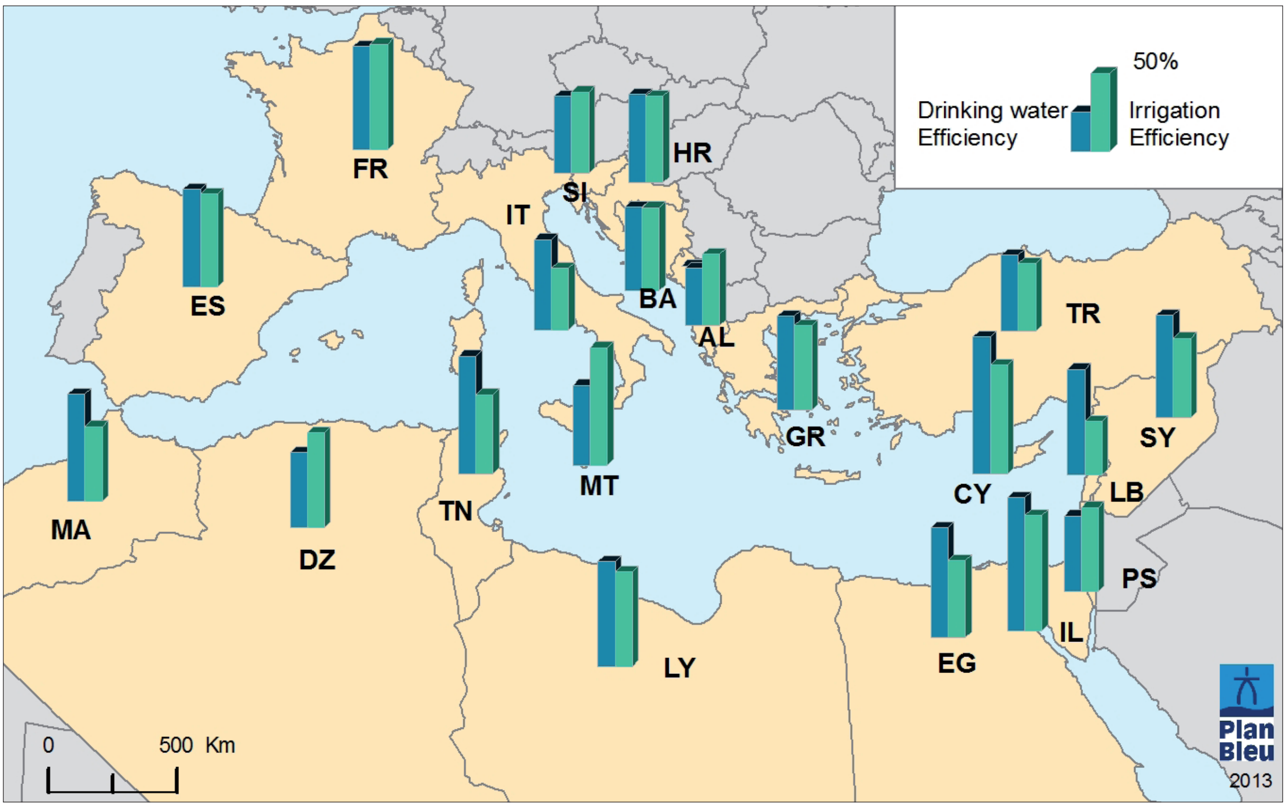
- A first group, comprising Albania, Italy, Lebanon and Turkey, has a total water-use efficiency of between 40% and 50%;
- A second group, comprising Bosnia-Herzegovina, Croatia, Egypt, Greece, Malta, Morocco, Slovenia, Syria, the Palestinian Territories and Tunisia, has a total water-use efficiency of between 51% and 60%;
- A third group, comprising Algeria, France and Libya, has a total water-use efficiency of between 61% and 71%;
- Finally, Cyprus and Israel form a fourth group, with a total-water use efficiency approaching 82%.

Figure 4. Water-use efficiency index for the combined domestic and agricultural sectors in Mediterranean countries (2005-2010)



Source: Plan Bleu, 2011

Figure 5. Per-country water-use efficiency indexes in the drinking-water and irrigation sectors (2005-2010)



Source: Plan Bleu, 2013

By comparing the per-country drinking-water and irrigation-water efficiency indexes (*see Figure 5*), a variety of situations can be observed):

- In some countries, irrigation-water efficiency is substantially lower than drinking-water efficiency: Cyprus, Egypt, Israel, Italy, Morocco, Lebanon, Syria and Tunisia;
- Irrigation-water and drinking-water efficiencies are essentially equal in the following countries: Spain, France, Greece, Libya, Palestinian Territories, Bosnia-Herzegovina, Slovenia, Turkey and Croatia;
- In Albania, Algeria and Malta, irrigation-water efficiency is higher than drinking-water efficiency.

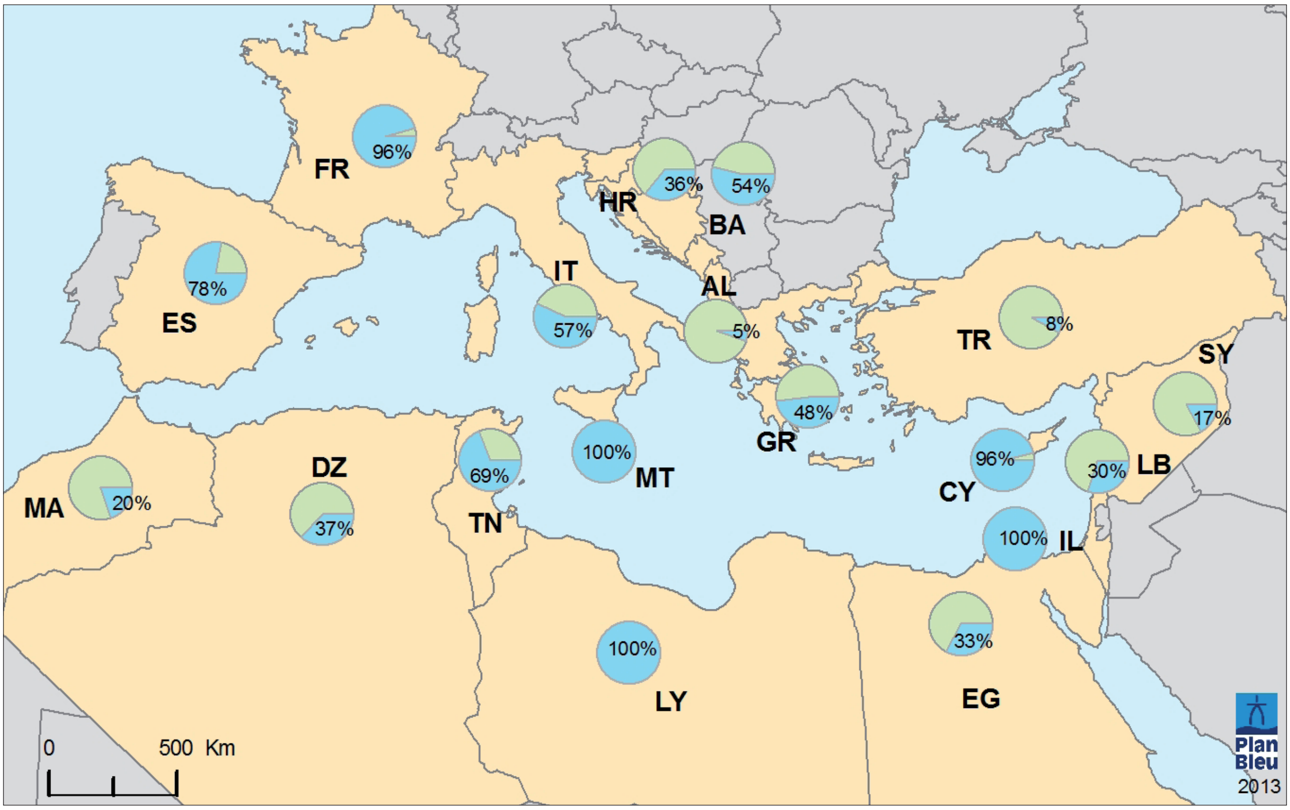
Irrigated surface areas and irrigation-water demand per hectare vary greatly from one Mediterranean country to another. Each year, 182 km^3 of water are used to irrigate approximately 24m hectares (i.e. 20% of agricultural land), which represents an average water demand of 7,500 m^3 per hectare.

The pressure that demand places on water resources depends, among other factors, on the way agriculture is practiced (as this sector is the largest consumer of water), especially for plot irrigation. Losses by evaporation and infiltration are highest under traditional (gravity-fed) surface irrigation. Per-hectare blue-water demand varies greatly between countries, ranging from 1,500 m^3 per annum to 16,000 m^3 per annum, depending on the climatic conditions and the techniques used, i.e. traditional gravity-fed irrigation or more modern sprinkler and drip-feed irrigation. Gravity-fed irrigation still represented 55% of the total irrigated surface area in the Mediterranean in this period, and accounted for nearly four-fifths of total agricultural water extractions.

Significant modernisation work has been performed in recent years by the managers of these networks, with help from States, international cooperation and public-private partnerships, with a view to improving efficiency. Currently, the potential for water savings is still high, in particular in SEMCs, despite the modernisation work already performed on gravity-fed networks and on the equipment used for pressurised (sprinkler and local irrigation) networks. The following map (see *Figure 6*) shows the country-by-country proportion of irrigated surface areas fitted with water-saving devices (sprinkler and drip systems). Along with optimising extraction, better management of flows has produced significant water savings, allowing some irrigated areas to be expanded, and has meant that it has been possible to meet the new technical requirements associated with pressurised irrigation and the appearance of new domestic uses in these areas.

However, it is also important to take into account the need for balanced land and water use, and the indirect services (such as aquifer recharge) provided by gravity-fed networks.

Figure 6. Proportion of irrigated surface areas fitted with water-saving devices



Source: Plan Bleu, Aquastat, 2011

HOW MEDITERRANEAN COUNTRIES currently stand with respect to the components of the water-use efficiency index

METHOD USED AND REFERENCE PROFILES SPECIFIED ON THE BASIS OF THE MEDITERRANEAN EFFICIENCY GOALS

With regard to method, it needs to be shown that multi-criteria analysis can be adapted for use as a decision-making tool for sustainable-development issues. The idea is to show that this method, which is usually applied in the areas of economics and management, is compatible with monitoring the Mediterranean Strategy for Sustainable Development (MSSD). This analysis assesses the convergence of a set of countries towards predefined profiles (examples of good practices).

The proposed method consists of positioning the countries on a graduated scale (in categories) according to reference profiles, on the basis of their performance with respect to the water-use efficiency indicator.This involves comparing countries and assessing their discrepancies regarding progress with respect to the profiles. The specific assessment considered here is designed to bring out the progress made with respect to water-use efficiency. A series of profiles have been defined to provide reference points for progress in sustainable development.

Using as a basis the efficiency-improvement assumptions adopted in Plan Bleu's alterative scenario from 2005 to 2025, the reference points for Profile 1 would be:

- For drinking water: reduce the loss rates to 15% for conveyance and distribution, and 10% for end-user leaks;
- For irrigation: reduce the loss rates to 10% for conveyance and distribution, and 20% for on-plot waste.

As for the reference points for Profile 2, their definition is based on Plan Bleu's observations and on the various national reports for 2005. Indeed, the following observations are based on the summary report concerning management of water shortages in the Mediterranean[7]: drinking-water transport losses are estimated at 30%, losses due to end-user leaks are estimated at 20%, losses during irrigation-water transport are estimated at 20% and on-plot irrigation efficiency is estimated at 60%.

7 Plan Bleu, "*Improving water use efficiency for facing water stress and shortage in the Mediterranean*", Plan Bleu Notes, No.4, October 2006 (English translation April 2008), pp. 3-4

Profile 1 (Plan Bleu's alternative scenario based on water-use efficiency improvements) and Profile 2 (the situation observed in 2005) can therefore be defined as follows[8]:

- **Efficiency profile_1.** ⇨ Drinking-water efficiency = **77%**
- **Efficiency profile_1.** ⇨ Irrigation-water efficiency = **72%**
- **Efficiency profile_2.** ⇨ Drinking-water efficiency = **56%**
- **Efficiency profile_2.** ⇨ Irrigation-water efficiency = **48%**

On the basis of these two profiles, the following three categories have been established for country performance regarding water use:

Category 1 = High efficiency (low losses).

- **Country ∈ Category 1 ⇨ Country efficiency ≥ Efficiency profile_1**

Category 2 = Moderate efficiency (non-negligible losses).

- **Country ∈ Category 2 ⇨ Efficiency profile_2 ≤ Country efficiency < Efficiency profile_1**

Category 3 = Low efficiency (high losses).

- **Country ∈ Category 3 ⇨ Country efficiency < Efficiency Profile_2**

MEDITERRANEAN-COUNTRY PERFORMANCES WITH REGARD TO WATER USE

Current Mediterranean-country performances for drinking water and irrigation water

A classification has been proposed, based on multi-criteria analysis principles. On the basis of their respective situations with respect to water loss rates, countries have been compared to two pre-defined reference profiles and then assigned to one of three pre-defined categories (see *Table 4*).

This classification shows that, for each water-use sector (drinking water and agriculture), only three countries have not yet attained the average efficiency rates of Profile 2 pertaining to the baseline year 2005 (Category 3). However, the goals proposed by Plan Bleu for 2025 (Profile 1), adopted by the Mediterranean countries as part of

8 The index was calculated from the losses observed in 2005 (for Profile 2) and those forecasted in Plan Bleu's alternative scenario (for Profile 1) using the calculation method described on page 9.

the MSSD and retained by the draft Mediterranean Water Strategy, had already been attained in 2005 by at least three countries for each of the drinking water and irrigation sectors (Category 1). This is encouraging and in concordance with the initial assumption that these goals are attainable.

Table 4. Mediterranean-country performances with regard to water use (2005-2010)

2005-2010	Category 1	Category 2	Category 3
Drinking water	Cyprus Israel Tunisia	Egypt Morocco Lebanon France Syria Italy Croatia Bosnia-Herzegovina	Malta Turkey Algeria

2005-2010	Category 1	Category 2	Category 3
Irrigation water	Malta Israel Cyprus France	Algeria Croatia Bosnia-Herzegovina Tunisia Syria Egypt Morocco	Turkey Italy Lebanon

Source: Plan Bleu, 2011

This positioning of Mediterranean countries with respect to reference profiles shows that most countries are found in Category 2 (with moderate water-use efficiency), while three countries are found in Category 3 (with low water-use efficiency) and three others in Category 1 (with high water-use efficiency).

National goals to attain the regional goal: over what timescales?

The various national reports on water-use efficiency reveal encouraging progress, in particular in the drinking-water and irrigation sectors, with a variety of situations (*see Figure 7*). Certain countries have adopted national policies and strategies, and have implemented priority actions to improve sector efficiencies, while specifying national goals and priorities over well-defined timescales. Almost all countries have demonstrated significant progress, as illustrated by the performance indicators that measure the effectiveness of the actions. This involves reducing losses during water transport, promoting water-saving behaviour among users and fitting irrigated areas with water-saving systems.

On the other hand, it is still difficult to quantify the possible gains from a more efficient allocation between the various uses from a socio-economic and environmental standpoint for the Mediterranean as a whole. These gains can only be assessed locally via cost-benefit analyses on the various options, including the cost and benefits of environmental and social externalities. Such analyses have rarely been undertaken, in particular on questions regarding allocation optimisation for different water qualities ("which quality for which water use?"). Certain Mediterranean countries are beginning to make allocation decisions on the basis of an "added value per unit" optimisation criterion. This has encouraged considerable gains in technical or economic water-use efficiency, but the social and environmental impacts are still inadequately taken into account in the decision-making process.

Ranking of Mediterranean countries with regard to water-use efficiency for drinking water and irrigation water in 2025

In 2025, according to country forecasts, the results (*see Table 5*) show that, for the drinking-water sector, no country would be found in Category 3, while eight countries would be found in Category 1, signifying high efficiency, and would have attained the goals proposed by Plan Bleu for this date (Profile 1), which the Mediterranean countries adopted as part of the MSSD. The four other countries studied would be found in Category 2, with moderate efficiency.

For the irrigated agriculture sector, only one country would remain in Category 3, with low efficiency. Five countries would be found in Category 2, with moderate efficiency, and six others in Category 1, with high efficiency. They would thus have achieved the goals proposed by Plan Bleu for 2025 (Profile 1) and adopted by the Mediterranean countries as part of the MSSD.

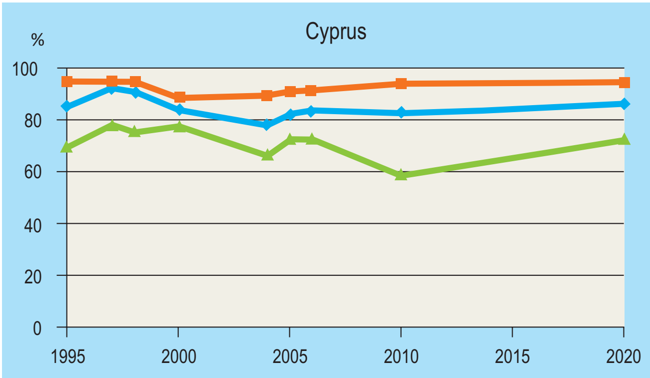
Table 5. Mediterranean-country performances with regard to water use in 2025

2025	Category 1	Category 2	Category 3
Drinking water	Cyprus Syria Israel Egypt France Croatia Tunisia Morocco	Italy Algeria Lebanon Turkey	

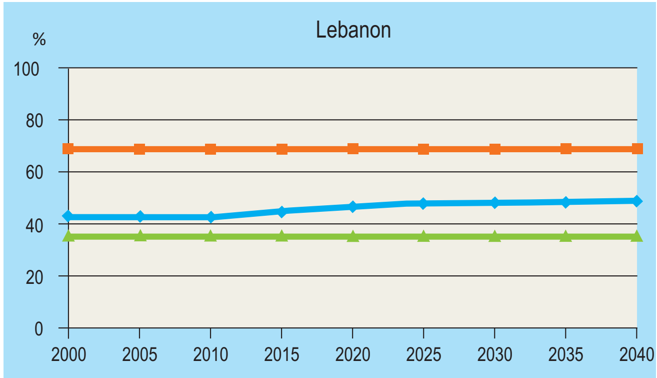
2025	Category 1	Category 2	Category 3
Irrigation water	Algeria Egypt Israel Morocco Cyprus France	Syria Croatia Italy Tunisia Turkey	Lebanon

Source: Plan Bleu, 2011

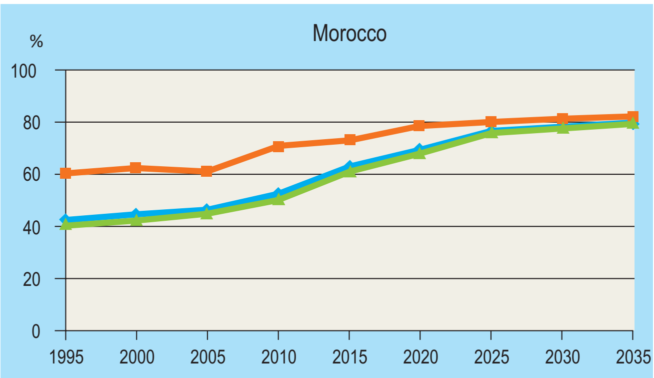
Figure 7. Future (total and per-sector) water-use efficiency projections for certain Mediterranean countries



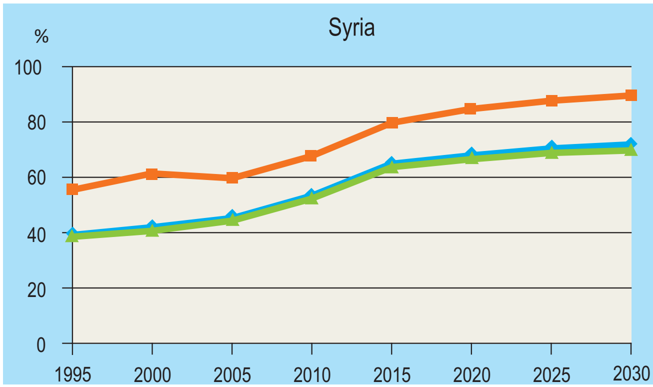
Source: Iacovides, 2008



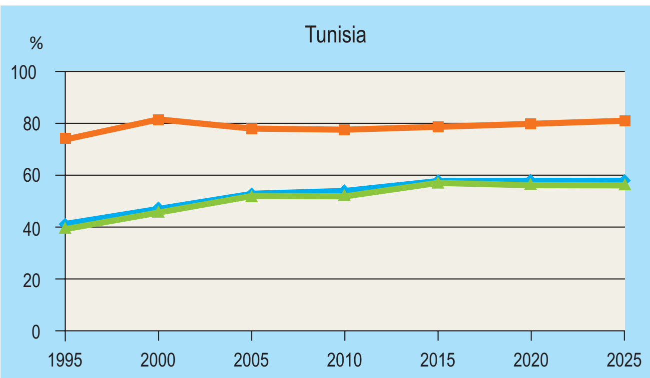
Source: Comair, 2008



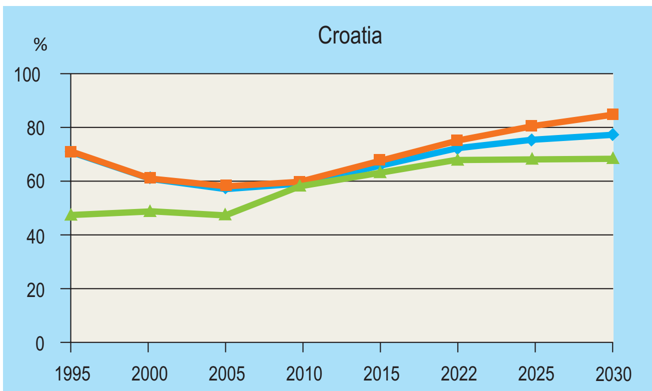
Source: Belghiti, 2008



Source: Al-Azmeh, 2008



Source: Louati, 2008



Source: Devic, 2010

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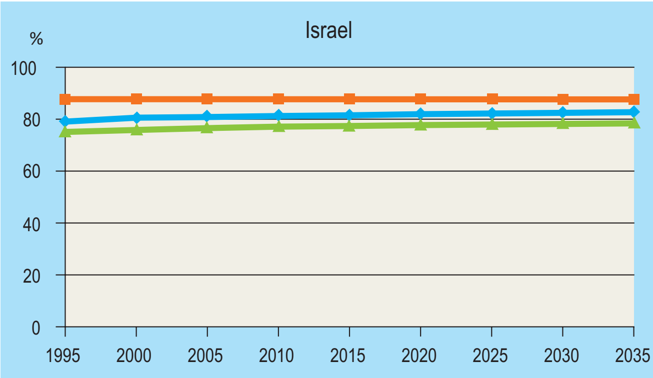
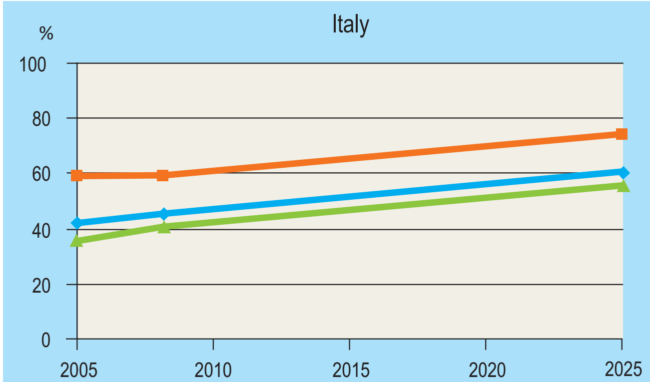
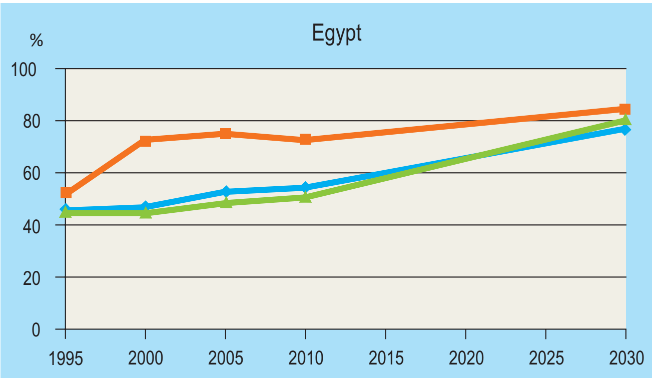
Figure 7. Future (total and per-sector) water-use efficiency projections for certain Mediterranean countries (cont'd)



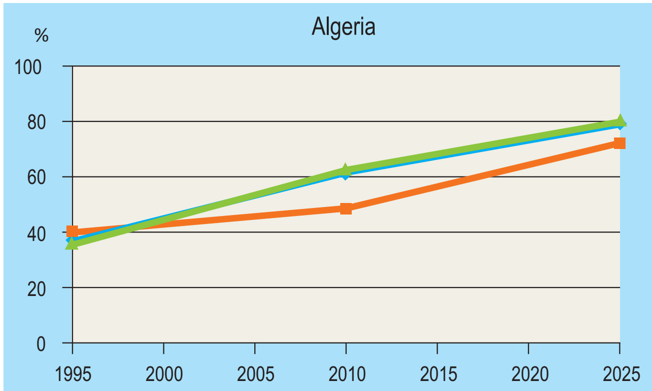
Source: Rejwan, 2011



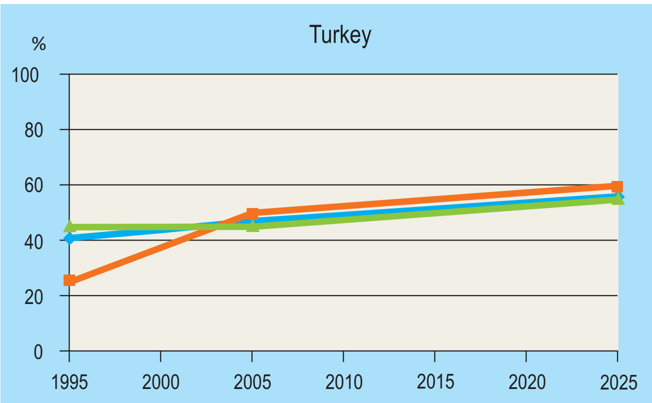
Source: Scardigno, 2010



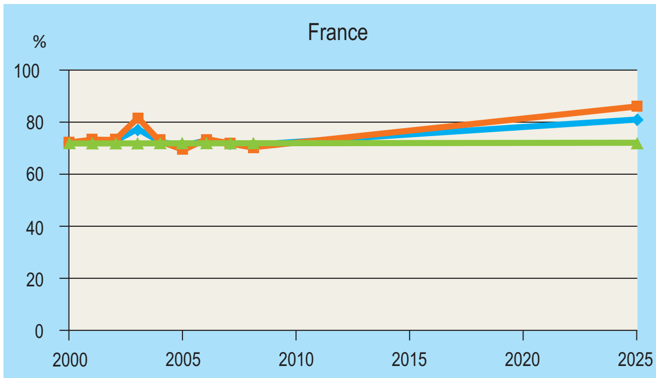
Source: CEDARE, 2010



Source: Benblidia, 2011



Source: Burak, 2008



Source: MEDDTL, 2011

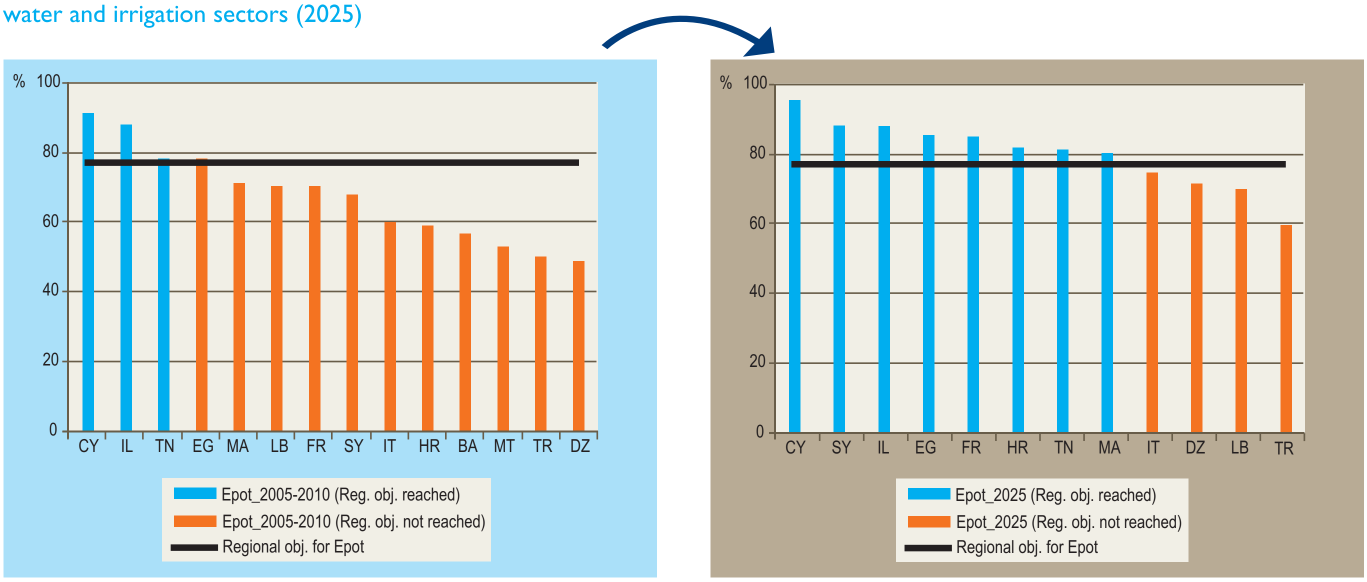
How Mediterranean countries stand with regard to the 2025 regional water-use-efficiency goal for drinking water and irrigation water

The performances of the group of Mediterranean countries which were subject to a test regarding water-use efficiency in the drinking-water and irrigation sectors (see *Figure 8*) are highly encouraging and confirm the initial assumptions, which stated that the regional goal, adopted by the MSSD and retained by the draft MWS, is attainable.

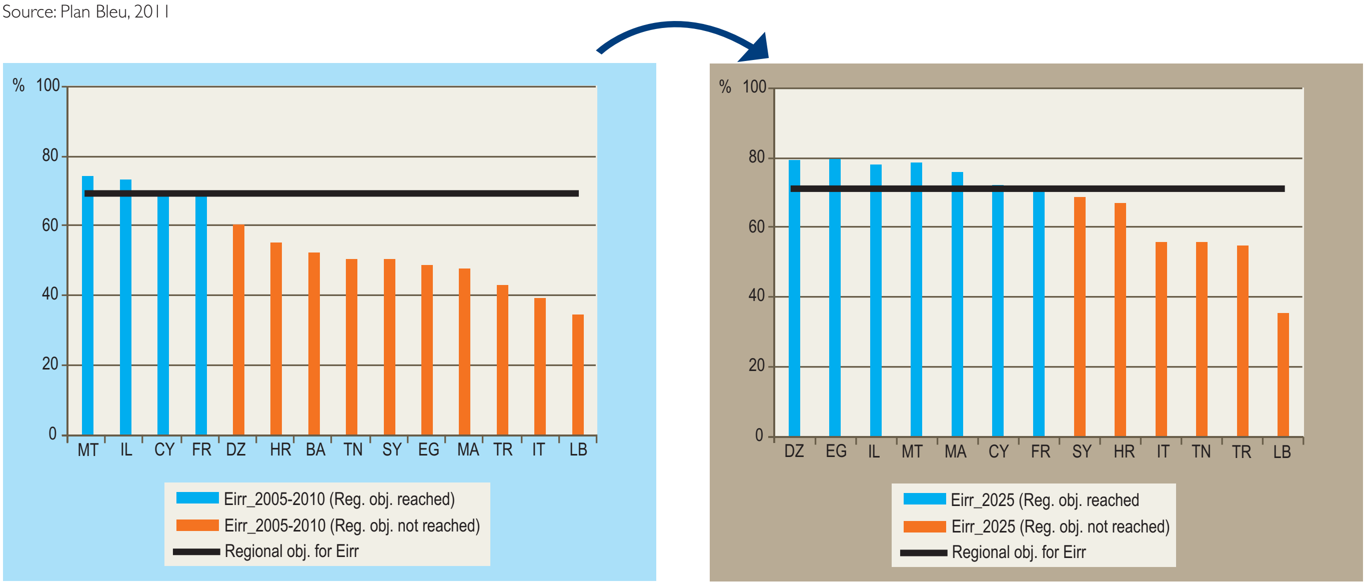
If the progress attained to date is compared with what is to be attained by 2025, following the various national forecasts, it can be deduced that:

- For the drinking-water sector, three countries have already achieved the goal set in the MSSD and eight should have achieved it by 2025. The other countries concerned by this study should only be a few points short of the goal adopted for drinking water (77%): Italy at 2 points short, Algeria at 5 points, Lebanon at 7 points and Turkey at 17 points.

Figure 8. Situation of certain Mediterranean countries (2005-2010) with regard to the water-use efficiency goals for the drinking-water and irrigation sectors (2025)



Source: Plan Bleu, 2011



Source: Plan Bleu, 2011

- For the irrigation sector, four countries have already achieved the goal set in the MSSD and seven should have achieved it by 2025. Two other countries should be just a few points short of this regional goal for irrigation water (72%), namely Syria, at 3 points short, and Croatia, at 4 points short.

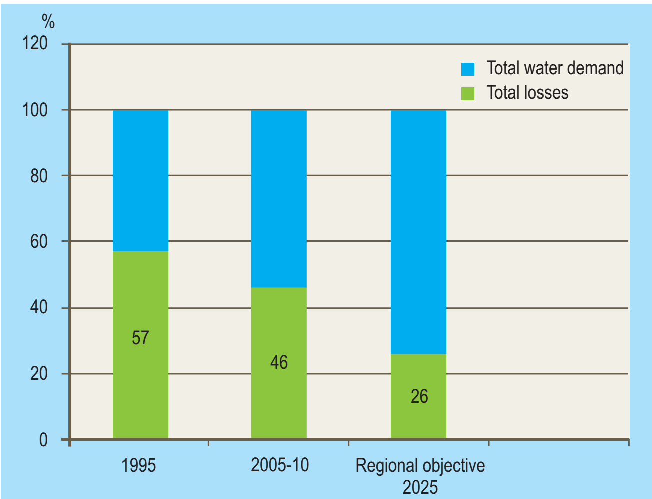
The results of this analysis have served as a basis for determining total-efficiency goals (combining drinking-water and irrigation-water efficiencies but not that of industrial water). By combining the efficiency-improvement assumptions adopted in Plan Bleu's alternative scenario for 2025, Plan Bleu's observations and the various national reports on water-use efficiency for baseline year 2005, the data has been summarised and a value of 74% proposed as a specific total-efficiency goal for 2025, compared with a value of 50% for the average total efficiency for the baseline year 2005. This has led to the establishment of three categories for the performance of countries regarding water use:

- Total efficiency ≥ **74 %** ⇨ High efficiency
- **50 %** ≤ Total efficiency < **74 %** ⇨ Moderate efficiency
- Total efficiency < **50 %** ⇨ Low efficiency

Firstly, it should be noted that there was a considerable reduction in total losses from 1995 to 2010, a reduction which will probably continue given the efforts made to attain the regional goal, which assesses total non-recoverable losses at 26% of the total water demand in 2025 (see *Figure 9*).

By 2025, according to the goals set by the various countries studied, an improvement in total water-use efficiency is expected, with major water savings. The results of this analysis are shown in the form of radar charts, positioning the various countries with regard to their water-use efficiency performance (*see Figure 10*).

Figure 9. Changes in the proportion of losses in total water demands (for the domestic and agricultural sectors combined) for Mediterranean countries between 1995 and 2025



Source: Plan Bleu, 2011

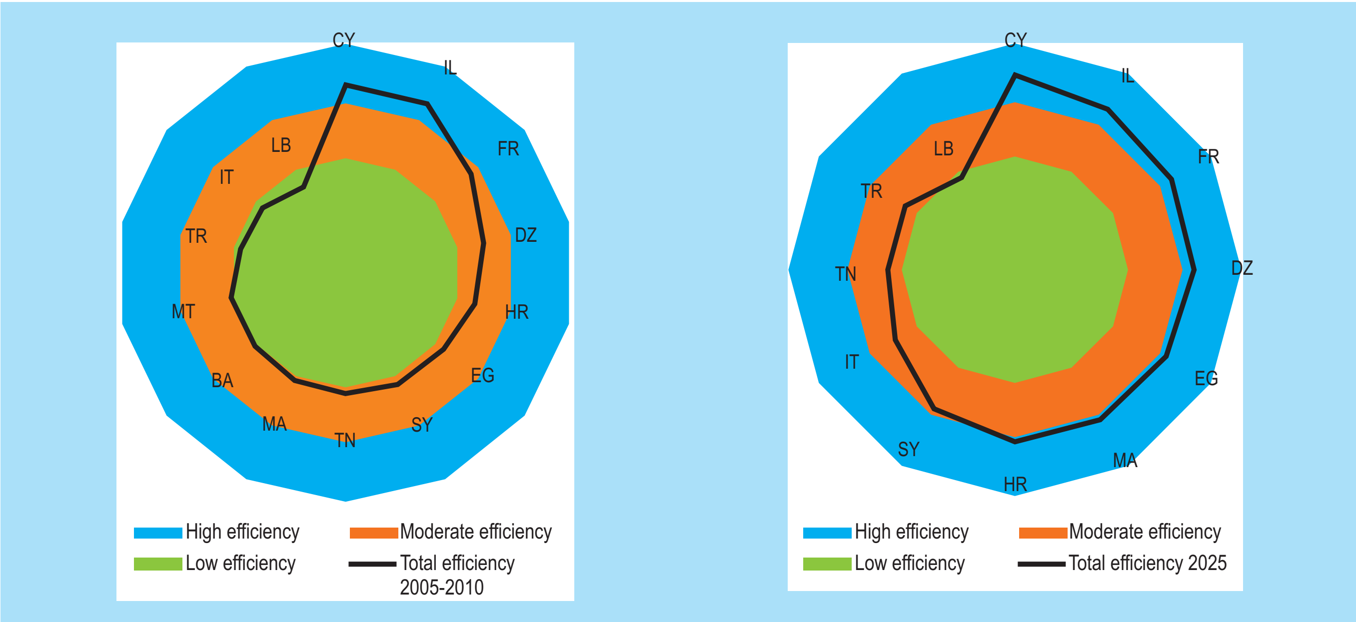
By 2025, among the 10 countries (out of the 14 studied) that have set their goals for total water-use efficiency, five of them should have attained their target, with an efficiency of greater than or equal to 74% and four should be found in Category 2, with a moderate efficiency ranging from 56% to 71%. Only one country would remain in Category 3 (low efficiency).

By 2025, water savings will become increasingly indispensable for all uses of water, in particular in the agricultural sector, as crop irrigation represents 70% of total blue-water demand. The implementation of WDM policies, which promote the setting up of irrigator associations, of awareness-raising campaigns for saving water, of joint management of irrigated areas and of suitable water pricing, while at the same time increasing production, will limit water consumption in the agricultural sector by adopting the following measures in particular:

- Selecting crops on the basis of their water consumption and the climatic conditions: promoting crops with lower water requirements;
- Grouping irrigation plots and implementing a collective irrigation system;
- Selecting suitable equipment to limit water losses;
- Starting irrigation only when necessary, i.e. taking into account soil humidity and climatic conditions;
- Ensuring better water distribution, so that only the plot is watered and not the surrounding paths;
- Checking the equipment to detect water leaks and systematically repairing leaks;
- Rainwater harvesting.

In parallel, a study was performed with a view to identifying any correlation between irrigated surface area and irrigation-water efficiency, combining conveyance and distribution efficiency with plot efficiency. On the basis of the sample of 14 Mediterranean countries studied (i.e. on which there were reports regarding water-use efficiency), a graph showing the trend was drawn. The line of best fit has a positive slope and shows that the higher the proportion of irrigated surface area fitted with water-saving equipment, the higher the water-use efficiency (*see Figure 11*). The line of best fit for the graph of surface area of gravity-fed irrigation against total irrigated surface area also has a positive slope (*see Figure 12*). This is explained by the fact that, in the Mediterranean, gravity-fed irrigation still dominates in terms of surface areas, despite the progress that countries have already made in installing modern irrigation systems.

Figure 10. Mediterranean-country performances regarding water-use efficiency in the domestic and agricultural sectors (in 2005-2010 and 2025)



Source: Plan Bleu, 2011

Figure 11. Correlation between the proportion of irrigated surface area fitted with modern irrigation systems and the irrigation efficiency index in Mediterranean countries (2005)

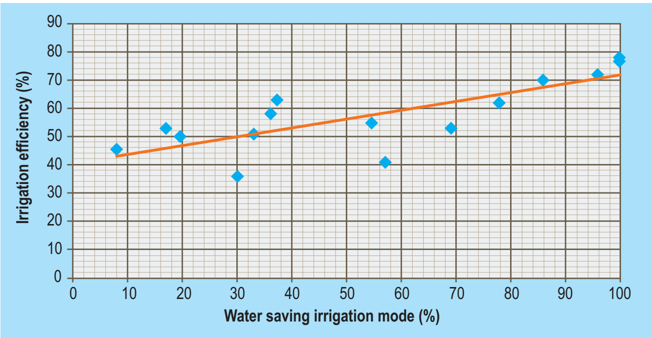
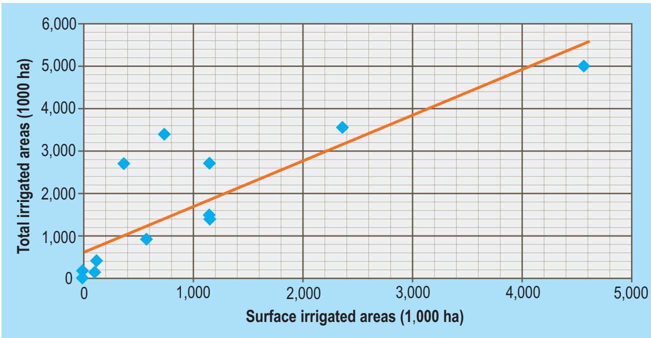


Figure 12. Correlation between total irrigated surface area and gravity-fed irrigation surface area in Mediterranean countries (2005)



Source: Plan Bleu, Blinda, 2011

Note: The sources of basic data used to calculate the water-use efficiency indexes in the various sectors are given in Table 10.

A CONSIDERABLE POTENTIAL for cost savings and for benefits

The economic approach to water management is increasingly important for many reasons. Firstly, as water becomes more scarce, its economic value is rising. Furthermore, economic instruments could be used to optimise the repartition of its use or consumption by the various sectors or users, as such instruments tend to send relevant signals to producers and consumers. The financial viability of water projects is becoming crucial as legal and political restrictions are gradually being imposed on activities that produce deficits.

The use of economic tools is especially effective in water-demand management (WDM). Prices, taxes and subsidies can influence water demand and use, to meet the needs of economic efficiency, social development, social equity and environmental protection. WDM also involves the use of legal incentives, awareness-raising campaigns and educational resources. Specific provisions in sector policies, in particular regarding agriculture, can also promote more efficient use of water resources (Scardigno and Viaggi, 2007).

These various instruments are interdependent and mutually reinforcing. They aim to increase the water-use efficiency and productivity in various sectors (water distribution efficiency within each sector), thus producing higher levels of service and greater economic productivity per unit of water consumed. They also aim to increase the efficiency of water allocation (water distribution efficiency between sectors) by (re)assigning water to applications with better productivity per unit of water consumed. However, in all Mediterranean countries, consideration of price reforms (or of management instruments) is constrained by the need to take into account guaranteed access to drinking water for all and the impact on farmers' incomes.

Economic analyses aim to assess the unit cost of water savings and compare this to the unit cost of water that is newly mobilised or produced. They also give an insight into the financial savings that could be made by implementing WDM policies in comparison with offer-driven management policies.

DRINKING-WATER SECTOR

Domestic consumption (as metered) includes the consumption of households and public services, and often that of light industry, small-scale producers, service industries and tourism facilities that are connected to the public distribution network. In general, household consumption represents that largest share of national drinking-water consumption. For example, in Spain, households account for 70% of urban consumption, light industry and services 24% and public services 6% (L. Khrouf, 2001).

Water demand for domestic use is highly variable from one country to another. It depends on demographics, the state of the supply networks, the household appliances installed and individual consumption, which is itself a function of lifestyle (such as age, marital status, income and education). Drinking water is usually the second largest sector for water demand nationally, following agriculture. However, in certain water-rich countries (such as Eastern Adriatic countries), and on Malta, domestic water-use is the main demand.

According to the 2025 forecast in Plan Bleu's baseline scenario, drinking water should continue to take a major place in total demand, under the combined effects of increasing standard of living, demographic and urban growth, and increasing tourism, at the expense of the energy and industry sectors in Northern Mediterranean countries and at the expense of the agriculture sectors in SEMCs.

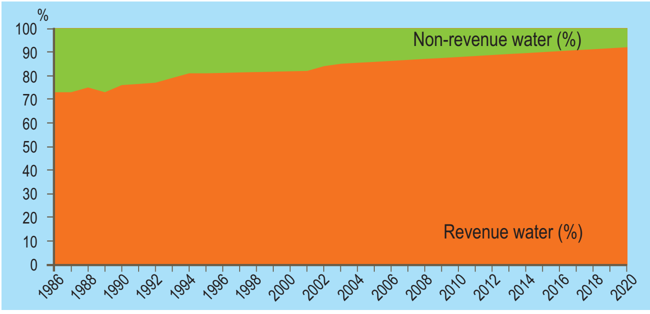
Measures to reduce losses during conveyance and distribution of drinking water

Case study - Cyprus

The domestic-water distribution network of the Water Board of Lemesos, which has existed for over 50 years and supplies 170,000 inhabitants (with 64,000 meters) over an area of 70 km^2, has been the subject of a case study regarding leak management. The annual volume of drinking water distributed by this 795-km-long network is 13.7m m^3 at a cost of €7m.

The efforts made and the importance that the Board has accorded to leak management is reflected in the reduction of the unbilled volumes of water over the years, falling from 27% of total water produced in 1986 to 15% in 2003 (*see Table 6*). These unbilled volumes of water should be reduced to 8% of the total volume produced by 2020 (*see Figure 13*).

Figure 13. Changes in proportion of billed and unbilled water volumes



Source: Lacovides, 2008

Table 6. Breakdown of authorised water consumption and lost volumes in 2003 (Limassol)

Total volume produced (100%)	Authorised consumption (85.74%)	Billed authorised consumption (85.24%)	Billed and measured (85.24%)	Billed water (85.24%)
			Billed and unmeasured (0%)	
		Unbilled authorised consumption (0.50%)	Unbilled and measured (0%)	Unbilled water (14.76%)
			Unbilled and unmeasured (0.50%)	
	Losses (14.26%)	Commercial losses (2.50%)	Unauthorised consumption (0.50%)	
			Metering losses (2.00%)	
		Physical losses (11.76%)	Losses at reservoirs (0.10%)	
			Losses during conveyance and distribution (connections up to customer meters) (11.66%)	

Source: Lacovides, 2008

Case study - Morocco

Régie de Distribution d'Eau et d'Electricité d'Oujda (RADEEO, Oujda's autonomous intercommunal water and power distribution authority) is responsible for the drinking-water and sanitation networks in the city of Oudja (Morocco). It serves a population of 480,000 over an area of 90 km^2, with a connection rate of 99% and a 1,580-km-long network. With regard to sanitation, RADEEO has an individual connection rate of 98%, a 1050-km-long network and a wastewater treatment plant with a daily capacity of 37,000 m^3.

Efforts made by RADEEO to combat leaks and losses in distribution networks have led to an improvement in the efficiency of the drinking-water network. In 2008, for 26.12m m^3 of drinking water mobilised, 13.48m m^3 of billed water and 12.64m m^3 of unbilled water were recorded, i.e. a drinking-water efficiency of approximately 52% (*see Table 7*). Confronted with this situation, RADEEO implemented a water-saving strategy with a programme of priority actions aiming to combat leaks and losses, initially over the period 2009-2015. This programme, with an overall cost of €14m, should lead to a drinking-water efficiency of 68% by 2015 with a cumulative total saving of 15m m^3 of drinking water, which is equivalent to the annual consumption of Oudja city (with a population of 500,000).

Tables 6 and 7 show the breakdown of authorised water consumption and lost volumes. For the city of Lemesos (Cyprus), the unbilled volume was estimated at approximately 15% of the total volume produced, including 12% of physical losses during conveyance and distribution, 2% of metering losses and 1% shared between unmeasured unbilled consumption and unauthorised consumption.

For the city of Oujda (Morocco), the unbilled volume was estimated at approximately 49%, including 39% due to physical losses, 8% due to metering losses, and 1% shared between unmeasured unbilled consumption and unauthorised consumption.

From these two examples, it can be seen that the unbilled portion can be as much as half the total volume produced, mainly represented by physical losses during conveyance and distribution of drinking water.

Case study - Israel

In Israel, for many years drinking water has been conveyed and distributed via a national pipeline that reaches all consumers. During these operations, approximately 10 to 12% of the volume of water is lost. In particular, losses are due to unauthorised consumption (theft), leaks in the pipes and faulty meters. The same average loss rate in water transport applies to all sectors (domestic, tourism, agriculture and industry).

Many challenges remain to be faced to reduce these water losses during transport. One of these challenges is due to the large number (several hundred thousand) of water meters distributed across the national water distribution network. These are mainly read manually, which delays the detection and location of leaks. Nationally, the cost of repairing leaks and installing new pipes is estimated at approximately $570m per annum. Two policies have been implemented to reduce leaks during water conveyance and distribution (*see Box 2*).

Table 7. Breakdown of authorised water consumption and lost volumes in 2008 (Oujda)

Total volume produced (100%)	Authorised consumption (51.60%)	Billed authorised consumption (51.40%)	Billed and measured (51.40%)	Billed water (51,40 %)
			Billed and unmeasured (0%)	
		Unbilled authorised consumption (0.20%)	Unbilled and measured (0.10%)	Unbilled water (48,60 %)
			Unbilled and unmeasured (0.10%)	
	Losses (48.40%)	Commercial losses (9.00%)	Unauthorised consumption (0.80%)	
			Losses at reservoirs (8.20%)	
		Physical losses (39.40%)		

Source : RADEEO, 2011

Box 2

In Israel, water pumping, conveyance and distribution is the responsibility of approximately 50 private and semi-private water companies, which supply water to consumers nationwide. These companies buy water from the State and sell it to consumers. Two measures have been taken to incentivise these companies to reduce water losses in their networks. The first measure specifies a threshold of 8% for the loss-rate of water transported by these companies. This covers losses (such as evaporation) which are considered as inevitable during transport. If the losses during transport exceed 8% of total volume, the companies must pay for this lost water. This strongly incentivises preventing losses during water conveyance and distribution.

The second measure also concerns these water-supply companies. They are authorised to reduce the pressure in pipelines to approximately 3 to 3.5 atmospheres (which is the minimum pressure required to suitably supply fire services). Loss and leak rates can be reduced by more than 5% by lowering the pressure in the pipelines.

Source: Ariel Rejwane, 2011

Other measures adopted include replacing the manual reading of water meters by highly advanced automated reading, which makes the detection and repair of losses and leaks much quicker. Under severe drought conditions, other measures could be applied, such as adding a third pricing band to the ones currently in use. The heaviest users would then pay extremely high prices ($6.95 per m^3).

Rational water use applied to watering public parks

Case study - Israel

In Israel, water losses have also been reduced in public parks, thanks to the use of special taps that require continuous pressure from the user to produce a flow of water. Another measure that has been implemented concerns municipal water consumption, in particular for watering public parks. Exact water consumption rates were not known prior to 2009, because these volumes were not explicitly monitored. The changes consisted firstly of installing individual meters for each park and then specifying the exact surface areas watered for three types of park area, along with their watering requirements, distinguishing between: trees and bushes, flowers and grass (*see Box 3*). These changes have been strictly applied, even for municipalities that had not installed meters, which had to provide an accurate inventory of the surface areas to be watered per type of park area, with estimated water consumption.

Box 3

A water quota for parks has been assigned to each municipality according to the surface area of each type of park area. In 2007, before this change was initiated, municipalities had a quota estimated at 45m m^3 per annum. In 2009, the provision of water to municipalities for parks was governed separately and strictly limited to a quota of 20m m^3. Water consumption was therefore halved between 2007 and 2009. In the years to come, this quota could be slightly increased during wet years, or maintained otherwise.

Source : Ariel Rejwane, 2011

Case study - France

Since 2003, the town of Mérignac has been considering water management in its services, in particular for the watering of public parks. In 2005, this approach was integrated into its Agenda 21 plan for sustainable development.

Two goals were set in terms of savings: water-resources savings on the one hand and financial savings on the other. An action plan for achieving these goals was produced (*see Box 4*).

Box 4

The watering of public parks remains at the heart of water management for a municipality. In Mérignac, differential management of parks has been implemented. Powerful equipment contributes to this: 163 programmable logical controllers coupled with a pluviometer, watering zone monitoring, sector modification and centralised management of two large parks.

The use of alternative resources also helps save water, such as shallow boreholes and use of rainwater for greenhouses (3 tanks with a total capacity of 17 m^3). Furthermore, water saving has now been integrated into park design.

In parallel with these actions, all parks in Mérignac have Ecocert certification (awarded for compliance with organic gardening criteria), to preserve water resources in both quantity and quality.

Since 2002, the water bill has been reduced by 25%. Over 6 years, the town has saved approximately €500,000 for an investment of €50,000. So, saving water can be a profitable investment!

A major publicity campaign has been performed, with water-saving devices handed out so that the municipality sets an example with the hope that individuals will copy it.

Source: Gérard Chausset, Deputy Mayor of Mérignac, 2009

In conclusion, metering the volumes of water produced and distributed is a prerequisite to any programme for saving water. It supplies all the quantitative data needed to direct water-saving policies and to measure their effectiveness. This action aims to fit all water systems with appropriate meters and to closely monitor the networks by installing zone meters, to better direct leak-detection and localisation operations. Once detected, it involves repairing leaks on the public drinking-water distribution networks, on users' property, in particular for group housing (between buildings and in shared areas) or in private housing (between counter and house). Metering water can also serve to limit losses and waste in parks.

These measures are recommended in the Mediterranean region to obtain efficiency improvements in the domestic sector.

Drinking-water pricing

Case study - Tunisia

An economic and financial analysis produced by *Société Nationale d'Exploitation et de Distribution des Eaux* (SONEDE, the Tunisian National Water Distribution Utility) regarding a sector of the capital Tunis, assessed the water savings expected in operating drinking-water networks via the implementation of various actions, namely pipeline rehabilitation and renovation, installing water-saving devices, installing sub-meters and performing awareness-raising campaigns. These measures gave rise to a reduction in water consumption from 3,600 m^3 per annum to 2,700 m^3 per annum, i.e. a water saving of 900 m^3 per annum with an monetary value of 1,800 DT per annum (1DT = €0.51). The cost of the investment was estimated at 7,000 DT and the return-on-investment period estimated at three years and nine months.

Drinking-water pricing remains an effective tool for saving water. The current pricing system in Tunisia is still progressive with both water-use and water-consumption price bands. The distinctions of use fall into three categories: 1) domestic, public, trade and industry, for which there are five consumption bands each with its own tariff, 2) tourism (hotels) with a fixed price of 0.14 DT per m^3, 3) standpipes with a fixed tariff of 0.840 DH per m^3.

For the first category, the initial band is aimed at low-income users of the drinking-water network, whose consumption does not exceed 20 m^3 per quarter, and at populations using public standpipes or drinking-water systems managed by *Groupements d'Intérêt Collectif* (Water Users' Associations). The highest consumption band has quite strong price elasticity[9]. The consumption of this group of users may greatly decrease following successive price rises. This would lead to many of these customers falling into lower consumption bands, which would have a negative financial impact for SONEDE. For the other bands, the results show that price has a statistically significant effect on water demand, which explains the relative slowing of demand observed in recent years.

For tourism use, estimates show that drinking-water demand is highly inelastic with respect to price, but that there is quite significant revenue elasticity[10].

Case study - Algeria

In Algeria, pricing is one of the means used to incentivise users to save water and to reduce losses and waste. The new drinking-water pricing structure set in 2005 (Decree dated 9 January 2005) had this aim. It also corresponds to the principle of covering the real costs of water services via the fees paid by users. Despite the 2005 price increases, the last goal has still not been achieved. Water bills include a fixed part (subscription) and a variable part based on consumption. There are different tariffs for three categories of user: households (with four water-consumption price bands), public services and service industries, and industry and tourism. The basic tariff (social band) is set for the first consumption band (less than or equal to 25 m^3 per quarter). The other tariffs are calculated using this basic tariff and a multiplying factor. For example, the coefficient for industry is 6.5.

Following the 2005 changes, the average tariff for water rose from 24.7 DA/m^3 to 40.5 DA/m^3 (100 DA = €1). For domestic users, the tariff (in the basic band) rose from 21.2 DA/m^3 to 32 DA/m^3. In 2009, the average price paid by the user was around 64 DA/m^3 (including the fees for sanitation services and for water saving and protection). This sale price per m^3 of drinking water should be compared with its production cost, which was estimated at 90 DA/m^3 in 2005 and is probably currently around 125 to 150 DA/m^3 (given the use of seawater desalination). The sale price is the same nationwide, except for the Southern regions where the fees for saving water and combating pollution are 2% of the consumption bill instead of 4%.

Water bills represent a cost of approximately 1% of household income on average (a figure extrapolated from a survey by the National Statistics Office). However, they cost about 1.3% of household income for the lowest-income users, which explains why water prices have not been raised further.

Progress has been made with regard to water savings in drinking-water management (*see Box 5*) and this accounts for an increase in drinking-water efficiency of approximately 10% (drinking-water efficiency has risen from 40% to 50%). However, these improvements are still slow and there certainly remains a great deal to do for effective demand management.

Awareness-raising campaigns to encourage users to save water

Currently, there are water-saving devices on the market for a variety of domestic appliances, such washing machines, taps, showers, dishwashers and flushing systems. Their use can be encouraged by awareness-raising campaigns. Studies have shown that such

9 Price elasticity is defined as the coefficient linking the relative variation of water demand and the relative variation of the price of water. This coefficient is generally negative as when the price increases water demand falls and vice versa.

10 Revenue elasticity is the coefficient linking the percentage change in water demand and the percentage change in income. It measures the impact of a change in a consumer's income on their water demand.

Box 5

Changes in the way urban-water management is organised, which was previously fragmented and highly varied but is now entrusted to a single operator, have enabled more rigorous management, more water-sparing behaviour on the part of users, an increase in financial and technical resources and, especially, significant scope for staff training and development. The formula adopted for water management in Algiers – and more recently in Oran, Annaba and Constantine – of a public-private partnership with specialist multinational companies has already provided positive results regarding reductions in losses and leaks, the organisation and development of metering (installation of new meters), better management of customer service, continuity of water supply to users and, more generally, higher water-use efficiency.

Source: Mohamed Benblidia, 2011

devices can reduce water consumption by up to 35% (30 m^3 per annum per household) for just a small outlay (less than €150 per household), which is saved in less than a year. Furthermore, the installation of such devices can provide significant associated savings in energy. The use of water-saving devices is highly recommended, especially in public buildings. The installation of water-saving devices in households and public buildings depends on the time needed to recover the outlay thanks to the savings made in water and energy bills. This return-on-investment period depends on the price of water and the market price of the devices. It is generally less than 5 months for simple devices such as tap aerators and about 2 years for more substantial devices such as flushing systems. In certain cases, such as where there are water shortages, legislation or subsidies could be used to encourage individuals to invest in water-saving devices or alternative systems.

Significant water savings can also be obtained via educational and awareness-raising campaigns, which usually consist of:

- Informing large consumers and professionals of the benefits of saving water;
- Making water-saving devices known (brochures and kits);
- Raising awareness by direct contact using buses fitted with multimedia display units, brochures and demonstrators for water-saving devices;
- Awareness raising in schools (using educational resources, kits of water-saving devices and brochures, etc.) and training teachers;
- Producing motivating slogans for awareness-raising campaigns;
- Offering advice regarding everyday consumer behaviour;
- Including an awareness-raising letter in bills;
- Supplying consumers with the means to assess and monitor their consumption;
- Explaining the impact of saving water on their water and sanitation bills;
- Explaining the environmental benefits of saving water.

These actions (*see Box 6*) are all the more effective if they bring in technical and administrative assistance to encourage owners to renew faulty equipment or invest in water-saving systems: advice and analysis on the technical viability of the work, help with obtaining microcredit, help with administrative procedures (contracts, subsidies and funding), and checking work performed and new equipment before payment.

Box 6

France

The study concerned a shopping centre which had been fitted with water-saving devices (mixer taps, flow reducers and Toilet Tummys[11]), at an overall estimated cost of €1,591. This operation led to annual water savings on 22%, i.e. 1,677 m^3, with a value of €4,997. The return-on-investment period[12] was therefore just four months.

Source: L. Khrouf, IME, 2001

In 2006, in the context of the implementation of a rational water-use plan in the Agout valley, *Agence Régionale Pour l'Environnement de Midi-Pyrénées* (ARPE, the Midi-Pyrenees regional agency for the environment) and *Syndicat du Bassin de l'Agout* (the Agout Basin Water Board) worked together on a water-saving pilot operation in this catchment basin with the goal of circulating the results at the regional level. Three types of action were performed together, namely: investments (network diagnostics, installing water-saving devices, installing new meters), actions to optimise consumption by encouraging new behaviours, and awareness-raising and publicity campaigns.

The volume of water saved, measured between 2007 and 2009, was estimated at 181,418 m^3, leading to financial savings of approximately €279,722 over the same period.

Source: Jacqueline Alquier, Tarn Senator, 2009

Israel

In 2009, Israeli Water Authority launched a multimedia awareness-raising campaign at the national level. The goal of this campaign was to encourage citizens to reduce their water consumption by highlighting the country's shortage of natural water resources. The awareness-raising campaign was launched in 2008 and continued through 2009 and into 2010, using television, radio, newspapers and the Internet. The campaign successfully reached its target audience, i.e. all citizens, who are now well aware of the urgent need to save water.

The total cost of the campaign, which lasted about a year and a half, was $7.5m. The results showed a 10% reduction in water consumption in 2009 (approximately 76m m^3).

11 A water-saving device for toilets
12 The time required to recover the cost of an investment

Box 6 (cont'd)

The cost-benefit ratio of the media campaign was therefore estimated at €0.10/m^3 at the end of 2009. The effects of the awareness-raising campaign remained after the campaign ended, as per capita domestic consumption rates have continued to fall. The campaign's final cost-benefit ratio (the cost per unit volume of water saved) should therefore be less than $0.10/m^3 and the water savings greater than 76m m^3.

Source: Ariel Rejwan, 2011

Italy

In several Italian regions, significant domestic water savings have been made following the distribution of water-efficient tap adapters. Through collaboration between municipalities, water authorities and chain stores, complete kits of water-saving devices have been supplied to households and public services, either free or at subsidised prices. A publicity and awareness-raising campaign was performed to support distribution of these kits. These initiatives have twin benefits: (i) on the environmental front, they provide energy savings and reductions in carbon emissions, (ii) on the economic front, the provide a reduction in current domestic water consumption of 30 to 50%, leading to a reduction of 20 to 30% in consumers' water bills.

Source Alessandra Scardigno, 2010

Malta

The water-saving programme consists of distributing a set of domestic water-saving devices to each household, on the basis of a publicity and awareness-raising campaign, and pilot/demonstration projects in public buildings. These water-saving devices have been designed to fit onto existing appliances and fittings. This initiative plans to increase the number of beneficiaries by 5% by 2015. The total cost is estimated at €485,000 (with no ongoing costs) over a period of 5 years. This operation has produced significant benefits both on consumers' bills, with €190,000 (€0.37/m^3) of savings, and on the State subsidy for the "social" band of drinking water tariffs. The State has saved approximately €1m (€2.19/m^3). On the environmental front, power consumption and associated carbon emissions have been assessed at 0 kWh and 0 CO_2 emissions respectively.

Source: Manuel Sapiano, 2008

Aid programmes for saving drinking water: the case of France

In 2006, the area covered by the Loire Bretagne water authority had a population of 12 million and a declared irrigated surface area of 454,000 hectares.

In 2006, total extraction (for drinking water and agriculture) during low-water periods was 1,252m m^3, of which 624m m^3 was for drinking water and 628m m^3 for agriculture. During low-water periods extractions for agriculture and drinking water are similar in volume.

Over the period 1997-2006, the gross extractions during low-water periods were as follows:

- Drinking water per capita, 35 to 83 m^3 (average 53 m^3),
- Agricultural water per hectare irrigated, 750 to 3,000 m^3 (average 1,280 m^3).

The Loire-Bretagne Water Agency's eighth and ninth aid programmes for drinking-water savings have generally involved the installation of zone metering to assess measures that contribute to water savings. In contrast, interventions regarding rainwater harvesting are not common and involve localised operations.

In particular, it was been possible to collect data from Vendée Eau (delegates' report and studies from this water board) and from SA HLM Aiguillon Construction (a file supporting the award of a Water Trophy to this company that manages a council estate).

Analyses performed by *Office International de l'Eau* (OIEau, International Office for Water) in France as a whole regarding infrastructure surveys, network diagnostics and assessment of water-management plans have made estimates of the expected benefits in terms of water savings (based on available data[13]) (see *Table 8*).

Table 8. Water savings as a function of % of consumption and in m^3 per € of aid

	Saving as % of consumption		Saving in m^3 per € aid	
	Minimum	Maximum	Minimum.	Maximum
Consumption diagnostics and associated work	2	32	0.1	1.1
Installation of zone metering	8	9	2.1	
Installation of household meters (group housing)	10	28	0.4	0.7
Installation of water-saving meters (group housing)	6	21	-	-
Rainwater harvesting	5	50	0.04	0.5

Source: Loire-Bretagne Water Agency, 2009

The observed ranges are wide, reflecting the diversity of the projects studied. In this respect, the 50% water saving observed on a rainwater harvesting project seems to be a one-off value.

The impact on water consumption is then converted into an impact on extraction by adding to this saving on consumption an amount that corresponds to the mean losses (observed during production and transport of this quantity of water), as specified in the *Schéma Directeur d'Aménagement et Gestion des Eaux* (SDAGE, water-management plan).

13 The available volume measurements are not uniform and may refer to volumes put into the distribution systems, volumes consumed or volumes extracted.

The proportion of extraction saved and the relative efficiency of the various measures can then be estimated at the level of a *département*. At this level, the following measures are most effective:

- Work on social housing, following diagnostics, which can represent a saving of 6 to 7% of extraction and a cost-benefit ratio of 0.05 to 0.03 m^3 per Euro of aid;
- Work on public buildings, following diagnostics, which can represent a saving of 2% of extraction and a cost-benefit ratio of 0.02 to 0.002 m^3 per Euro of aid;
- Installation of zone metering and repairing the leaks detected can represent a saving of 8 to 9% of extraction and a cost-benefit ratio of 0.2 m^3 per Euro of aid at best;
- The other actions represent marginal savings.

In terms of efficiency, it can be concluded that the installation of zone metering and associated work (such as repairing leaks) are the most effective for water savings (*see Box 7*). Next most effective is work on social housing.

Box 7

To combat losses in the water conveyance and distribution networks, Syndicat de Brame (the Brame Water Board), via Fédération des syndicats d'eau potable et d'assainissement du Lot-et-Garonne (the Federation of Lot-et-Garonne Water Boards), has implemented various actions. Initially divided into twenty-four zones, the Brame Water Board is now divided into thirty-eight and could sub-divide further in years to come. This zoning means that leaks can be detected as soon as they occur. This system has considerably reduced losses by looking for them in real time.

The Federation also uses pressure modulation: the pressure is reduced overnight and increased in the day. The end-of-line pressure is always sufficient for users. The Brame Water Board uses three pressure bands: over 8 bar, between 6 and 8 bar, under 6 bar.

The Federation has also taken out a 20-year loan, the only way to fund renovation work. It preferentially uses shallow boreholes rather than extraction from deep aquifers, to avoid degrading the resource for future generations.

Thanks to these various procedures, the Brame Water Board has been able to increase its efficiency, reduce its losses and invert the trend. In 2008, network efficiency was 79.1%, compared with 65.3% in 2002.

For future years, extractions from the Garonne river will be more ecologically and economically beneficial than extractions from the Jurassic aquifer.

Source: Gérard Penidon, General Director of the the Federation of Lot-et-Garonne Water Boards .

IRRIGATION SECTOR

The economic efficiency of irrigation-water use concerns the costs and benefits of water use in agricultural production (including opportunity costs and externalities). It can be expressed in various ways, such as total net benefit per m^3 or per hectare. Unlike the analysis of physical efficiencies (the ratio of water actually used to water extracted), its analysis requires the inclusion of private and social costs and benefits. At the scale of a catchment basin, the economic efficiency is used to maximise net benefits for each use in the basin as a whole. The calculation of physical and economic efficiencies at the basin level is more complex than at the level of an individual irrigator or network manager because issues of water distribution between users, and the contribution of upstream return flows to downstream water availability, must also be taken into account. In the examples that follow, the stress is on plot-irrigation techniques (but not on the characteristics of the crops themselves).

Economic assessments of water-saving projects for irrigation

Case study - Egypt

The costs of efficiency improvements are both cultural and socio-economic. It would also be useful to make decision-makers aware of the cost of inaction, alongside the cost of the action itself.

In Egypt, a project for improving the integrated management of irrigation is based on implementing a water-management system, improving soil productivity, making institutional changes and integrating environmental considerations. The project will be performed over a surface area of 230,000 hectares, i.e. approximately 10% of the total irrigated surface area of the Nile delta and 6.5% of the total irrigated surface area in Egypt. By the end of the project, the water savings should reach approximately 22%, i.e. 838m m^3 per annum.

To assess the opportunity cost[14], the economic return rate (ERR) and the net added value (NAV) have been estimated with and without the project. With no economic value assigned to water savings, the project would have a ERR of 20.5% and a NAV of 12%, estimated at approximately $141m (in US dollars). If water is assigned an economic value equivalent to its residual value from the situation without the project ($0.08/$m^3$), which could now be considered as an opportunity cost for water, the ERR of the project would be 30.4% and the NAV $379m.

The data that follows served as a basis for these calculations: the average cost of developing localised irrigation is $800/ha for orchards and $1,200/ha for market gardening; irrigation costs using mobile sprinklers are approximately $800/ha and irrigation costs using fixed sprinklers approximately $1,800/ha.

14 The opportunity cost (or option cost) designates the loss of alternative goods renounced when a choice is made, i.e. when the available resources are allocated to a particular use to the detriment of other choices. It is the cost of an item estimated in terms of the opportunities missed, in other words the value of the best alternative option not taken

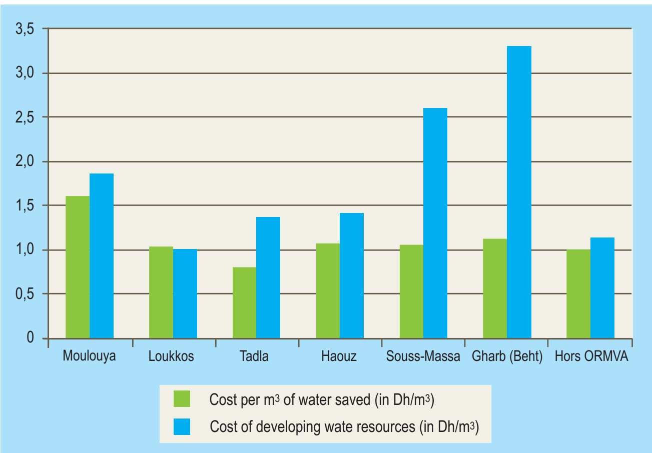
Case study - Morocco

In 2001, the Ministry of Agriculture developed a water-saving programme based on encouraging the adoption of water-saving irrigation techniques on individual farms. This programme aims to convert 115,000 hectares of orchards and market gardens to localised irrigation over 5 years, providing water savings of nearly 360m m^3 by the end. The economic benefits of this programme can be assessed using indicators that report both the water savings of this investment opportunity for the benefit of the nation, and the benefits produced by this programme for the farmers encouraged to invest in local-irrigation techniques.

To assess the opportunity to invest in water savings compared with alternative solutions for developing new water resources, the investment costs required for water savings, such as the investment requirements for the planned programme, were compared with those required to mobilise additional water resources. The costs of mobilising new water resources were estimated via the development costs of new water resources per catchment basin.

From the standpoint of the investment opportunity to be agreed by the nation, the results of this analysis show an advantage in favour of water saving for all programme areas, with the exception of the Loukkos river basin where the cost of mobilising new water resources is similar to the cost of saving water (see *Figure 14*, 11Dh = €1).

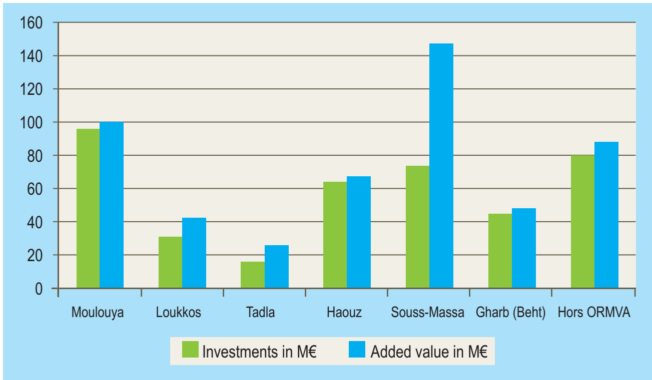
Figure 14. Comparison of the cost per m³ of water saved with the cost of mobilising new water resources



Source: Belghiti, 2008

The advantages of the water-saving programme for farmers can be assessed via the impact of water savings on the gross margin for crops and consequently on their incomes. A measure of the economic benefit of water savings for farmers is given by the additional gross margins resulting from water-saving programmes compared with the amortised cost of the investments that must be made in order to adopt localised irrigation (see *Figure 15*).

Figure 15. Additional added values compared with investment costs



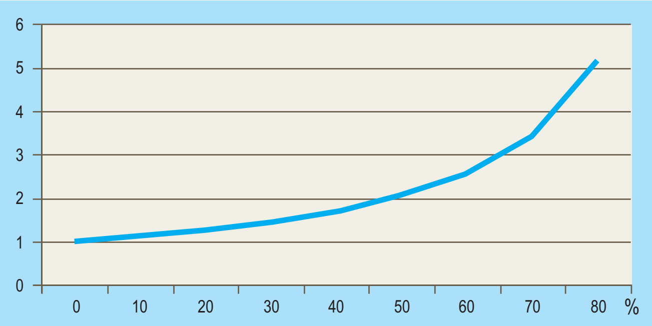
Source: Belghiti, 2008

The average additional gross margins per hectare from the programme are 6,000 Dh/ha/annum and 4,600 Dh/ha/annum for orchards and market gardening respectively. In the event of the whole of the investment costs for conversion to localised irrigation being borne by the farmer, the additional added values barely cover the loan repayments on the investments made. This explains why these projects are not attractive to farmers unless accompanied by significant State-provided financial incentives. Its financial help remains indispensable, as the State aims to develop irrigation to expand the irrigated surface area and make better use of existing water resources. The State is also keen to ensure permanent food security for the country and to promote increased productivity. For these reasons, State subsidies for water savings in the agricultural sector are crucial (see *Figure 16*), especially for small farms where the financial benefits of the investments made are not certain, leading to a tendency to maintain traditional irrigation. Aware of the relative scarcity of water resources, the Moroccan government has implemented a policy that aims to rationalise its use. The surface areas under localised irrigation have been continually rising for a decade and should rise sharply under *Plan Maroc Vert*, the State's current programme for agriculture (see *Figure 17*). This subsidy programme plans to cover all the costs of converting to micro-irrigation for farms smaller than five hectares and for small-farmer groupings.

The goal set by the programme *Plan Maroc Vert* (2008) is to eventually produce a GDP of 100bn Dh per annum, via inducements and subsidies to farmers to convert from gravity-fed surface irrigation to localised irrigation, increasing the surface areas under localised irrigation from the current 154,000 hectares to 692,000 hectares by 2020 (Morocco, 2012).

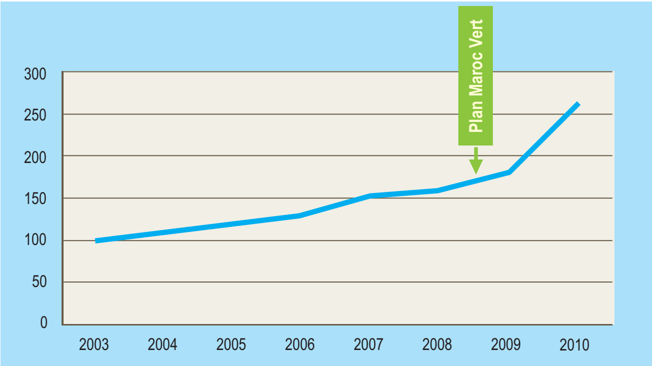
This ratio of gross margin (additional added value) to annual repayment costs can vary from 1, in the complete absence of State subsidies, where farmers would barely cover their loan costs, to 5 in the event of an 80% subsidy, which would produce large profits for farmers.

Figure 16. Changes in the ratio (gross margin/annual repayment costs) as a function of the % of State subsidy for conversion to localised irrigation systems



Source: Blinda, Belghiti, 2011

Figure 17. Development over time of surface area under localised irrigation (x1,000 ha)



Source: Moroccan Ministry of Agriculture and Marine Fisheries, 2010

Case study - Tunisia

A system for monitoring and assessing water savings, and a field survey performed on certain technical and economic development indicators, have provided a mid-term assessment of the National Water Saving Programme and confirmed its effectiveness and economic benefits at the farm level.

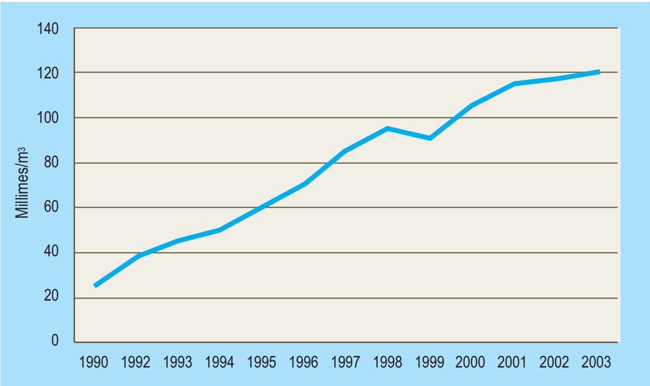
The results of the assessment confirm the strong dynamism of the various stakeholders in development, which has led to a large increase in the surface areas fitted with water-saving systems. Awareness-raising programmes, using various methods of mass communication and popularisation have strongly contributed to irrigation-water saving. This more rational use of irrigation water has led to better profitability on farms and a consequent better appreciation of the value of water.

By converting to an efficient irrigation system, using an appropriate technology package, farmers obtain additional profits that can more than double what they obtained under traditional irrigation. Nationally, the additional profits are 97% for market gardening and 35% for orchards. Without taking subsidies into account, the rate of return on investments for water-saving equipment (or the coverage of additional costs by additional benefits) was 350% for market gardening, 325% for fruit orchards and 109% for field crops, an average of 278% nationwide.

The return on water-saving investments would be achieved from the second year, specifically 1.5 years for market gardening and 2 for fruit orchards, with an average of 1.7. Taking into account both the investment made by the farmer and State subsidies, the return-on-investment period is reduced to one year for all the crops studied.

Work on irrigation-water pricing has been underway over the last decade, under the three considerations of pricing transparency, flexibility (regionalised pricing, variations depending on the use of irrigated areas) and national food-security goals. The total increase in prices was approximately 400% between 1990 and 2003 (see *Figure 18*) and served to recover a major share of the increase in operating and maintenance costs for water systems. Thus, the rate of cost coverage rose from 57% to 90% in the same period. This continual increase in prices has not been made without difficulty, given the reluctance of irrigators to pay more, but certain actions taken alongside it, such as preferential pricing for lower-added-value cereal and fodder crops (50% discount on normal prices), the easing of price controls on irrigated products and awareness-raising among irrigators regarding saving water on the plots, have overcome this reluctance.

Figure 18. Change over time in the average price of irrigation water



Source A. Hamdane, 2007

The impact of the current irrigation-water price policy has been assessed by a recent report on the water sector in Tunisia (see *Box 8*). Estimates of the price elasticity of demand[15] have provided an indication of the relative effectiveness of the water policies applied in the various regions of the country.

15 Demand elasticity is an economic concept that measures the sensitivity of demand to changes in price (price elasticity). Price elasticity is therefore defined as the coefficient linking the relative variation of water demand and the relative variation of the price of water. This coefficient is generally negative as when the price increases the water demand reduces and vice versa.

Box 8

The report concludes that the price elasticity of demand is relatively inelastic. However, the price elasticities of demand in the South and North-West are much higher than average, indicating that a change in the price of water in these regions would lead to a relatively significant change in irrigation-water use compared with other regions. These regions are distinct because irrigators there tend to grow low-added-value crops.

In the report, an agro-economic model was used to estimate the medium-term impact of increasing fees by 15% annually. The results of this analysis showed large differences in the way farms would react. In the North-West and the South, where the demand is relatively elastic, a significant reduction in water demand was observed, whereas in the Centre-West and North-East, regions of high-added-value crops (orchards, market gardening and greenhouses), the demand remains relatively inelastic and so less reduction is observed.

Source: Abdelkader Hamdane, 2007

Policies and measures to incentivise irrigation-water saving

Case study - Israel

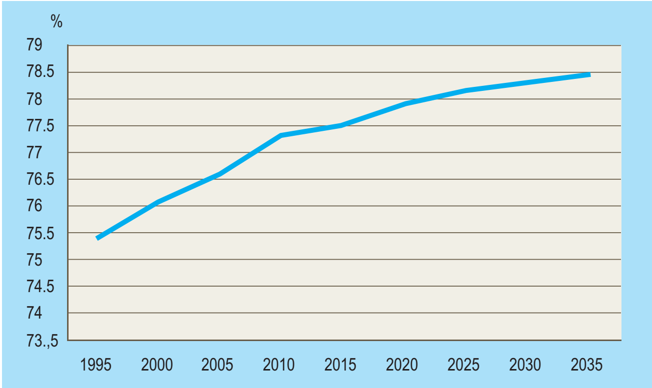
The Israeli government has implemented a National Investment Fund to support research and development programmes for new techniques to improve water-use efficiency in the agricultural sector. This fund also finances drainage projects and regional water-conservation projects, and it offers farmers free training on the latest technologies.

Technological improvements include the use of sprinkler and drip irrigation with computerised control systems that provide the precise water needs directly to the roots of the plants. Israeli research has also led to the development of crop strains that require minimal water supply and/or that can flourish with brackish water rather than fresh water. Research and Development (R&D) has been a major driving force for improving water-use efficiency (*see Figure 19*). This key strategy has optimised the effectiveness of R&D and inaugurated strong collaboration between researchers, farmers and industry in the agriculture sector. The active involvement of farmers should be noted, they provide comments and assessments at each stage of the process.

Case study – Impact of the Common Agricultural Policy

The European Commission has identified agriculture as a priority sector in which measures to combat water shortages must be taken. It has presented a set of policy measures to increase water savings, underlining the need to improve funding for water efficiency in existing sector policies.

Figure 19. Improvements in water-use efficiency in the agricultural sector



Source: A. Rejwan, 2011

Ideas that have been put forward include land-use planning, water pricing, water meters, the promotion of water-saving devices and practices, education and the development of information and communication campaigns to raise public awareness.

Reform of the EU's Common Agricultural Policy (CAP) has greatly increased the level of agricultural production in Europe, thanks to the implementation of tools that guarantee farmers' incomes, support those affected by the rural exodus and promote the modernisation of farming (*see Box 9*).

Box 9

In the agricultural sector, subsidies for the modernisation of irrigation equipment and the maintenance of water distribution networks have been implemented both in rural development and in protection and management plans. In the Common Agricultural Policy, water-resource management is considered to be one of the main challenges for agriculture in the EU. Water savings and water-use efficiency are considered as the main strategies to be adopted. Furthermore, subsidies for investments in on-farm wastewater treatment are also planned.

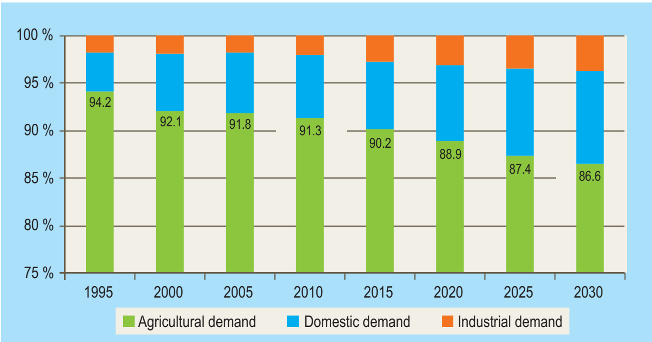
Source: Alessandra Scardigno, 2010

Case study - Syria

The Syrian Arab Republic's water strategy, adopted in 2003, has distinctly opted to reduce irrigation-water demand over that of the drinking-water and industrial sectors. This strategic decision is explained by the water shortages already experienced in certain catchment basins in the country and the continual increase in drinking-water and industrial-water demands, due to demographic growth and socio-economic development. Implementation of this measure is mainly based on tools for rationalising irrigation practices.

In particular, the aim is to reduce irrigation demand from 18,565 km^3 per annum in 2005 to 13,260 km^3 per annum by 2030 (see *Figure 20*).

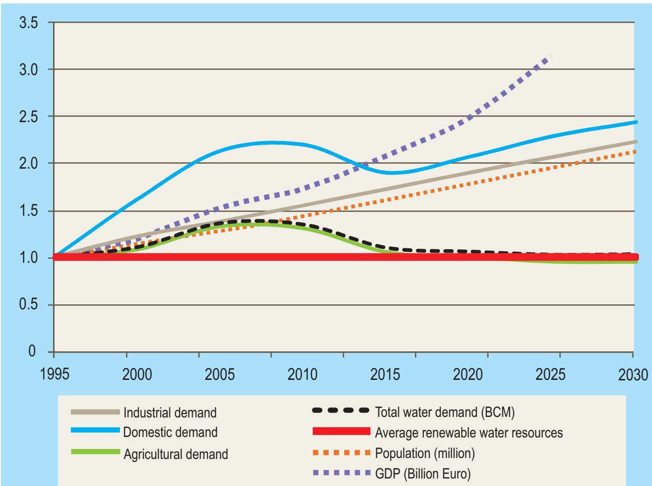
Figure 20. Reducing irrigation demand in favour of other sectors



Source: Al-Azmeh, 2008

Improving water-use efficiency, in particular in agriculture via the national programme for conversion to modern irrigation, highlights future trends (*see Figure 21*) which show that the Syrian Arab Republic has the possibility of "uncoupling" growth in total water demand from growth in population and gross domestic product (GDP), providing that this growth is accompanied by "vertical expansion" in agriculture, namely productivity increases by increasing yields per m^3 of water used and per hectare cultivated. Indeed, the results of national research and pilot projects in this area have been quite encouraging. Conversion to water-saving (sprinkler and drip) irrigation methods not only leads to high savings in water volume but also to higher per-hectare yields, which will produce additional added value leading to improvements in farmers' incomes and in GDP in general.

Figure 21. Uncoupling growth in total water demand from demographic and economic growth



Source: Al-Azmeh, 2008

Without this demand-management policy and improvements in water-use efficiency, the country could face a severe water crisis in the near future. The country's economic growth is dependent on these water savings.

Irrigation-water pricing: the case of Algeria

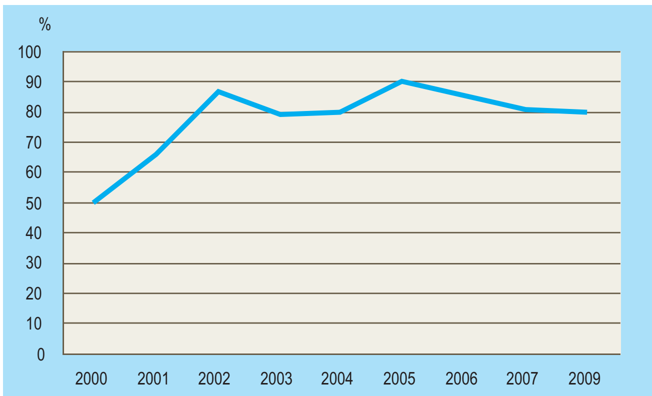
Irrigation-water pricing is set for farms that use facilities managed by the public authorities. This mainly involves large farms and irrigation schemes, and small-scale irrigation zones, fitted out by or for the State, whose management is devolved to associations or irrigator cooperatives. There are no specific fees for private farms fed by private facilities installed by their owners (such as wells, boreholes and river intakes).

The pricing structure for agricultural water and the corresponding tariffs were set in 1998 (Decree 98-156). These provisions were modified by two other decrees in 2005 (Decree 05-14 dated 9 January 2005) and 2007 (Decree 07-270). These last two decrees specify pricing zones and an increase in baseline tariffs.

According to these decrees, the price of agricultural water covers the fees and charges for the operation and maintenance of irrigation and sanitation/drainage works and infrastructure, and contributes to funding investments for their renewal and extension. The management of large farms has been gradually improving with renovation work on the networks which have reduced conveyance and distribution losses (*see Figure 22*).

However, for almost all areas, the pricing levels set by decree are far from meeting the requirement for covering costs. The report on agricultural-water pricing, produced by the BRL-BNEDER group for the Water-Resources Ministry in 2005, has already highlighted this and suggested price reassessments that have not yet been implemented.

Figure 22. Improvements in irrigation-water transport efficiency on large irrigation schemes



Source: Mohamed Benblidia, 2011

The payments due from the user for the supply or extraction of water are calculated using a two-part formula on the basis of the maximum flowrate subscribed to (fixed part) and the volume actually consumed (variable part). Currently, the fixed part varies between 250 and 400 DA per litre per second per hectare, depending on the pricing zone, while the variable part is calculated on the basis of 2.5 DA per m^3 consumed (100 DA = €1).

The price of agricultural water remains very low and has no impact on reducing extraction. The results in terms of reduction in losses and in water savings have not yet been equal to the policy recommendations expressed in legislation and regulations, in particular in the Water Act.

Aid programmes for irrigation-water saving: the case of France

At the level of the whole area covered by the Loire-Bretagne Water Agency, the need for agricultural water is decreasing due to a decrease in irrigated surface areas.

In the context of the eighth and ninth aid programmes for irrigation-water savings, the efficiency ranges given below were established on the basis of case studies for water retainment systems and a computer model for the agri-environmental measure (AEM). The small number of case studies used means that these figures should be used with care, as they correspond more to orders of magnitude for comparison than to precise measurements (see *Table 9*).

The eighth aid programme for irrigation-water saving (2003-2006) showed that agricultural extractions were tending to increase while the irrigated surface area decreased. This increase was masked by a favourable climate. In terms of efficiency, the AEM amortised over 5 years would be the best.

An analysis was performed to assess if Agency aid was suitable and proportional to the potential water savings for the various uses. It showed that €8.6m had been committed by the Agency for water savings during the eighth programme and that €4.1m had been spent during the first year of the ninth programme.

Table 9. Water savings as a function of % of consumption and in m^3 per € of aid

	Saving as % of consumption		Saving in m^3 per € aid	
	Minimum	Maximum	Minimum	Maximum
Water retainment systems	25	30	0,5	1,55
AEM amortised over 5 years	25	100	1,5	6
AEM amortised over 10 years	10	28	0,6	1,9

Source: Loire-Bretagne Water Agency, 2009

Between the eighth programme and the beginning of the ninth programme (2007), the proportion of aid assigned to drinking water reduced from 56% to 39%. This reduction was to the profit of agricultural use, which obtained 46% of the aid at the beginning of the ninth programme, compared with 37% for the whole of the eighth programme, and to the profit of industrial use which doubled its share of aid, from 7 to 15% of aid distributed (see *Figure 23*).

To the extent that these conclusions only concern a small number of actions, the changes must be confirmed following the ninth programme if they are to be considered significant. Indeed, it is possible that a "start-up" effect is skewing the analysis due to the different performance rhythms of different programmes from one use to another.

Furthermore, to the extent that Agency credits for water savings are struggling to be fully spent, it should be specified that these figures have more to do with the question of the attractiveness of the aid to stakeholders in the various uses than the desire of the agency to accord to each use a certain proportion of the total amount.

Figure 23. Distribution of total Agency aid accorded under the eighth programme and at the beginning of the ninth programme

Source: Loire-Bretagne Water Agency, 2009

Even though it benefited from €1.9m of aid in just the first year of the ninth programme, agricultural use benefits from support below its potential for savings. Between 56 and 59% of achievable savings are to be found in agricultural use, while agriculture only receives 46% of the aid distributed for water savings. Conversely, drinking water and industry receive aid in a proportion greater than their potential water savings.

This observation has been attenuated by the redistribution of aid between drinking water and agriculture that occurred at the beginning of the ninth programme. The effort given to drinking water has reduced to approach its potential for savings, while support for agriculture has increased. The proportion of aid given to industry strongly increased between the eighth programme and the beginning of the ninth programme, exceeding its potential for savings.

COST-BENEFIT ANALYSES FOR WATER-DEMAND MANAGEMENT PROJECTS

Case study - Israel

The economic analyses given in this section aim to assess the unit cost of water savings and compare this to the unit cost of additional water mobilisation or production. They should also give an insight into the financial savings that could be made by implementing water-demand management policies – in comparison with offer-driven management policies. They could also serve as a basis for improving cross-sector water efficiency. Indeed, the possible gains from more effective allocation of resources between the various uses and sectors of the economy (i.e. domestic, tourism, agriculture and industry) can only be assessed locally, depending on the hydro-geological context and the value of the goods produced, using cost-benefit analyses for the various options (*see Box 10*).

Box 10

In response to the droughts and water shortages of recent years in Israel, numerous policies have been adopted, aimed at increasing the efficiency of water use and mobilising alternative water sources. These measures include water-demand management (WDM), the reuse of treated domestic wastewater for irrigation and the large-scale production of water by desalination. These three measures aim for sustainable water use in Israel.

Thus, although the cost-benefit ratio (cost per cubic metre of water saved or produced) of the WDM campaign is much lower ($0.10/m^3) than the ratio for wastewater reuse, itself lower than the costs of desalination, these cost differences will not prevent wastewater treatment and reuse or the production of desalinated water.

The cost of transporting treated wastewater from the treatment plants to the various agricultural plots and the natural environment is €0.23/m^3, to which must be added the cost of wastewater treatment and other costs, leading

Box 10 (cont'd)

to a total cost of $1.52/m^3. The cost of desalination itself is $0.54/m^3. This must be added to construction and transport costs estimated at $1.44/m^3, for an overall cost of $1.98/m^3.

This difference in the cost-benefit ratios should not prevent wastewater treatment and reuse, or the production of desalinated water. Ensuring adequate water supply is a priority for the State of Israel, as the available natural resources are currently insufficient to face up to demographic growth, despite effective WDM measures and the reuse of treated wastewater that have already been implemented. Desalination is a significant and growing alternative source in Israel. Although it is not a means to improve water-use efficiency, it is an extremely effective measure for reducing the high pressure on natural drinking-water resources. Currently, several large-scale desalination plants supply a total of 307m m^3 (approximately 40% of national domestic water needs). With the addition of several more desalination plants, production of desalinated water is planned to supply approximately 62.5% and 70% of domestic water demand in 2015 and 2025 respectively. These three initiatives represent an essential contribution to water management in Israel.

With regard to water pricing, a significant reform of the pricing system is currently underway. This reform should mean that, by 2016, water prices should better reflect the real cost of water in all sectors of production and supply. The price of water in the domestic, commercial and industrial sectors will increase by 40 to 50% and average prices in the agriculture sector should increase by over 60%. The Israeli government estimates the total investments required for the water sector to average €1.03bn per annum. These investments, planned in the water production process, mainly concern increasing the production of desalinated water, more strictly applying standards for wastewater treatment for safe reuse and internalising negative externalities. These price increases could lead to a corresponding reduction in water demand.

Over the coming decades, the goal for the domestic sector will be to maintain water consumption at less than or equal to 100 m^3 per capita per annum.

Source: IWA, 2011

Case study - France

Strong demographic growth in the Languedoc-Roussillon region is causing increasing pressure on water resources. Forecasting shows that, by 2020, chronic deficit situations risk multiplying, especially in Hérault *département*.

In this context, public decision makers have studied various projects that aim to mobilise new water resources. They have also asked questions concerning the potential offered by water-saving measures and the economic rate of return for these measures.

To answer these questions, *Bureau de Recherches Géologiques et Minières* (BRGM, the French geological survey), the Rhone-Mediterranean and Corsica Water Agency, the Languedoc-Roussillon region and the Hérault General Council have worked together to produce an economic analysis of the various water management strategies over an area covering more than 300 municipalities located in Hérault, Gard and Aude *départements*.

The analysis shows that 50% of extraction is used for drinking-water supply. Demographic projections, and calculations of the associated water needs, suggest that resources will be overexploited, whence the need to stabilise or reduce these extractions to achieve the goal of a good ecological status, in compliance with the EU Water Framework Directive.

In the face of this double challenge of hosting an increasing population while achieving a good ecological status for water resources, several questions can be asked:

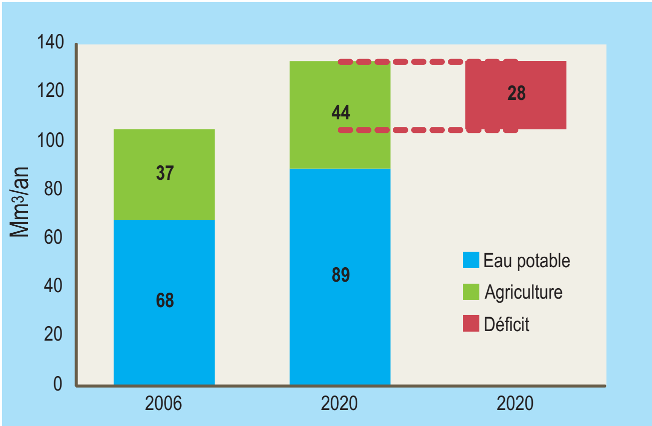
- How can long-term trends in water needs be predicted?
- Will water-saving measures help meet this double challenge?
- What would be the costs of WDM measures compared with the mobilisation of new resources?

To answer these questions, the drinking water needs of the area studied have been estimated, taking into account expected demographic changes, the distribution of the population in the area (in association with road infrastructure projects) and the various types of housing built (such as group or individual, and with or without garden and pool).

For 2020, the current-trend scenario used in the analysis shows that drinking-water extraction will increase by 13m m^3 per annum. In total, taking into account the water needs for agriculture and the protection of aquatic environments, and the reduction in available resources associated with climate change, a deficit of around 28m m^3 per annum is to be expected by 2020 (see *Figure 24*).

It will probably be necessary to mobilise new resources to make up this deficit. In particular, the analysis assessed the volumes that could be substituted or brought in using methods such as inter-basin transfers, drawing on the reserves of existing dams, exploiting new aquifers, desalination plants, wastewater treatment and reuse, or the rehabilitation of contaminated sources.

Figure 24. Deficit in water extraction for the area studied[16] using the current-trend scenario for 2020



Source: Jean-Daniel Rinaudo, Laure Maton, BRGM, 2009

The analysis also assessed actions aiming to manage demand, such as:

- Locating and repairing leaks on drinking-water distribution networks or in group housing (i.e. between buildings that are not managed by municipalities);
- Installing water-saving devices widely (in hotels, campsites, public buildings and households);
- Increasing rainwater-harvesting capacities (in private houses with gardens and in public buildings);
- Implementing special tariffs for peak periods, to encourage households to change their watering practices.

The results show that a significant volume of water could be saved across the 300 municipalities in the area studied. The three most effective water-saving measures could save over 9m m^3 per annum, which is a third of the expected deficit by 2020 (*see Figure 25*).

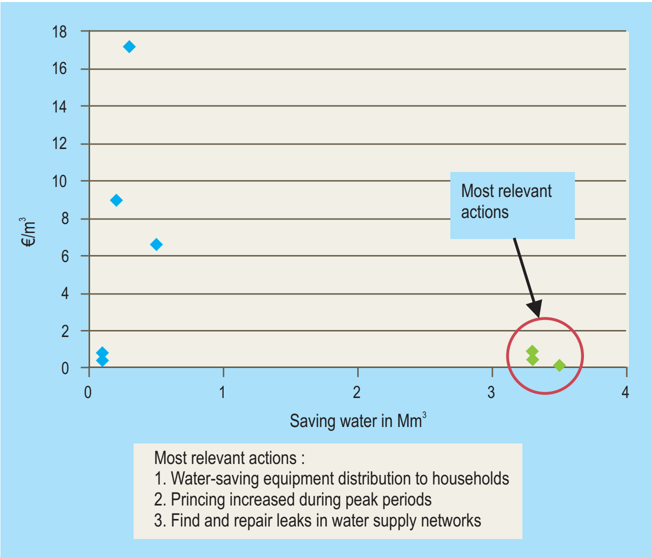
The cost of implementing these actions has also been estimated for the 300 municipalities, then compared with the volume saved, which allows the measures to the listed in order of cost-benefit ratio (cost per m^3 saved). This unit cost can also be compared with the unit cost of measures that aim to mobilise new resources (such as new aquifers, inter-basin transfers and desalination). In this calculation, the volume of water saved was estimated both over the year and for the peak period (July-September).

Certain actions, such as rainwater harvesting on private properties, are not very relevant from a purely economic standpoint.

The most beneficial measure from a cost-benefit standpoint seems to be the free distribution of water-saving devices to households, which would save 3.5m m^3 per annum. Similarly, special tariffs in the peak period (higher prices in summer than in winter), along with locating and repairing leaks, have significant economic potential, given that they would save 3m m^3 per annum (*see Figure 26*).

16 An area of over 300 municipalities located in Hérault, Gard and Aude *départements*.

Figure 25. The most effective water-saving measures



Source: Jean-Daniel Rinaudo, Laure Maton, BRGM, 2009

The analysis also shows that the cost-benefit ratio for a particular measure (such as improving the efficiency of drinking-water networks) can vary strongly from one municipality to another. Municipalities with growing populations would be favoured, which could present a risk for municipalities with declining populations who would see their fixed costs increase.

To maximise the effectiveness of the leak-locating policy, it should be applied to municipalities by listing them in order of their individually-calculated cost-benefit ratios. The analysis shows that the implementation of this measure on the top 5 municipalities would save 250,000 m³ in the peak period. To save double this volume, the measure would need to be applied to the next 12 municipalities on the ordered cost-benefit ratio list.

Finally, the analysis highlights the fact that water-saving measures could prevent the need for investments which would have been made necessary by demographic growth, as the decrease in per-capita consumption compensates for the increased number of customers. This preliminary results will next be expanded by taking into account a larger range of measures for saving drinking water.

Figure 26. Cost-benefit ratios for various WDM measures and for measures that aim to mobilise new water resources

Mobilisation of new ressources	**€/m³**	**Water-demand management**
	0.15	Distribution of water saving equipment to households
	005 - 0.85	Detecting and repairing leaks on drinking-water networks
	0.42	Increasing prices in the peak period
	0.42	Fitting water-saving devices in hotels up to 2 stars
Mobilisation of 3m m³ from Salagou dam	0.43	
Rehabilitation of polluted aquifers	0.67	
Modernising gravity-fed irrigation networks	0.71	
	0.82	Fitting water saving devices in 3-star hotels
Extraction from the Rhône Section 1	1.14	
Extraction from the Rhône Sections 1+2+3	1.79	
Desalination plant with a capacity of 15,000 m³/j	2.06	
	6.6	Reducing leaks in group housing
	8.96	Household rainwater harvesting (500 l)
	17.2	Household rainwater harvesting (9 m³ vessel)

Source: Jean-Daniel Rinaudo, Laure Maton, BRGM, 2009

CONCLUSION

The assumptions adopted in Plan Bleu's alternative scenario for improving water-use efficiencies in the various sectors by 2025 at the regional level, have been adopted by Mediterranean countries as "desirable goals". These goals, which have also been adopted by the draft Mediterranean Water Strategy, are based on the components of the total water-use efficiency index and can be integrated into a single target, namely achieving a total water-use efficiency of 74% in the Mediterranean. This figure is "attainable" because it is based on certain countries' actual performances. However, while water-demand management is an increasingly common concern, it has so far only rarely been converted into quantified targets in official national water-planning documents.

For both the domestic and agricultural sectors, analysis of national reports shows that water-demand management measures are often effective and can save significant quantities of water. This is the case for measures that aim to improve network efficiency and for the installation of water-saving devices in homes.

In the agricultural sector, water-demand management measures are in the economic interest of irrigators, as they can help secure, and even increase, the water supply to plants. Significant annual volumes can be freed up by reducing losses in distribution networks and by modernising on-plot irrigation techniques.

The difficulties in obtaining an indicator of water efficiency for the industrial sector lie in the absence of comprehensive overall statistics regarding the volumes of water extracted, used and recycled by various industries (which would mean an efficiency rate could be estimated for this sector).

For water-demand management tools to be implemented they should be acceptable to society. To be acceptable, (i) they must not be in conflict with other national goals, (ii) they must be compatible with the income constraints of the various users and (iii) their implementation must not be more costly than the benefits produced (in particular in terms of water savings).

There must be price elasticity of demand for pricing-based systems to be effective in a context of resource scarcity. Metering or estimation of volumes consumed is the basis of volume management and is an important prerequisite to the implementation of an incentivising pricing system.

Social policies to help the poorest should be implemented when the increase in water prices could deprive them of access to drinking water or food security.

The search for data for this water-efficiency assessment report has brought to light the inadequacy, irrelevance and unreliability of a large part of the data and statistics collected from departments and companies responsible for water supply. Efficient and sparing management of water resources requires the implementation in each sector of systems for the systematic collection of technical and economic data on water production, extraction, distribution and consumption. This data must be based on common indicators used by the various operators and their staff.

It should be noted that, with regard to information concerning water, institutions in the sector prioritise technical data and statistics. The economic data needed to assess the costs and efficiency of water services is not systematically collected.

Implementation of policies for improving the efficiency of water use must be gradual, via indispensable reforms which clearly inscribe the goal of water-demand management into all policies – in particular agricultural policy – and which generate the means for its implementation, with the production of efficiency plans and sustainable systems for covering costs. In this context, regional cooperation can play an important role via transferring know-how, strengthening abilities, exchanging experience, sharing good practices and funding projects, especially in SEMCs. Public-private partnerships will also have a positive effect regarding recourse to economic instruments (such as subsidies and pricing) and techniques (such as rehabilitating water-transport networks and leak detection), allowing optimal allocation of available resources.

A "common language" is required to pursue and improve work on water-use efficiency. This implies improving systems for collecting data, which are not just for academic purposes but are key tools to help in decision-making. Research into the use of non-conventional resources must not be neglected either.

The costs of efficiency improvements are both cultural and socio-economic. It would also be useful to make decision-makers aware of the cost of inaction, along with the cost of the action. More complete and systematic knowledge of the cost of implementing water-saving programmes, and of the full cost of supplying water services, is needed to properly measure the advantages of water-demand management policies.

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Table 10. Sources of data on water-use efficiency

Country	Reference documents
Albania	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/ WRI 2005/AQUASTAT 2005
Algeria	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/WRI 2005/ONS-EUROSTAT Compendium 2006/ Rapport national sur l'efficience d'utilisation de l'eau en Algérie, 2011
Bosnia-Herzegovina	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/Statisticki Yearbook 2001/ J. Margat, rapport PAM 158, 2004/ Rapport national Saragosse 2007/ Rapport national Sophia Antipolis 2008
Croatia	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/Statike information 2002/ National study on water efficiency in Croatia, 2010
Cyprus	FAO-AQUASTAT 1997/Eurostat, Statist-. Service-Environmental Statist 2000/Etude IME, Lkhrouf, 2001/ Rapport national Saragosse 2007/ Rapport national Sophia Antipolis 2008
Egypt	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/ EUROSTAT Compendiums 2003 et 2006/ J. Margat, rapport PAM 158, 2004/:WRI 2005/ FAO 2005/ Water use efficiency & Economic approach of water demand management in the Mediterranean, case of Egypt, 2011
France	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/IFEN 2006 (RNDE)
Greece	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/ WRI 2005/ AQUASTAT 2005
Israel	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/ Water Commission 2002/WRI 2005/ Rapport national Saragosse 2007/ The State of Israel: National Water Efficiency Report, 2011
Italy	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/WRI 2005 / « Stato dell Ambiente 2001 » (minst dell Ambiente et della Tutela del Territoris, 2001) / A. Massaruto « Agricult. Water Ressources & Water Policies in Italy » 2001 / Rapport national Saragosse 2007/ Water use efficiency & Economic approach of water demand management, Italy's report, 2010
Lebanon	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/WRI 2005/ AQUASTAT 2005/ Rapport national Sophia Antipolis 2008
Libya	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/ WRI 2005/ FAO 2005
Malta	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/EUROSTAT-Environm Statistic 2006 / Rapport national Saragosse 2007/ Water use efficiency in Malta, 2008
Morocco	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/ Rapport national Saragosse 2007/ Rapport national Sophia Antipolis 2008
Slovenia	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/EUROSTAT 2006
Spain	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/EUROSTAT 2006 / Rapport national Saragosse 2007
Syria	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/WRI 2005/ AQUASTAT 2005/ Rapport national Saragosse 2007/ Rapport national Sophia Antipolis 2008
Tunisia	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/WRI 2005/ EUROSTAT Compendium 2006/ Rapport national Saragosse 2007/ Rapport national Sophia Antipolis 2008
Turkey	FAO-AQUASTAT 1997/Etude IME, Lkhrouf, 2001/ Turk Stat-EUROSTAT 2006/ WRI 2005/ Rapport national Saragosse 2007/ Rapport national Sophia Antipolis 2008

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EXTRACT FROM THE MEDITERRANEAN STRATEGY FOR SUSTAINABLE DEVELOPMENT CONCERNING THE INTEGRATED MANAGEMENT OF WATER RESOURCES AND DEMAND

Water is a scarce and fragile resource that is unequally distributed in time and space, and climate change is expected to lead to more irregular and lower volumes of rainfall. The shortage of water, due to irregular rainfall and aridity, is a major constraint for agriculture. Irrigation is the largest consumer of water. The number of people in the region with access to less than 1000 m^3 of water a year is currently 108 million and may reach 165 million by 2025. Certain countries are facing a critical situation.

National strategies have favoured supply-side policies through the construction of dams and boreholes. However, many dams in Southern and Eastern Mediterranean countries (SEMCs) will lose most of their storage capacity because they are becoming silted up and few countries will still be able to exploit them in the long term. Aquifers, many of which consist of non-renewable fossil water, are being over-exploited or irreversibly degraded by saline intrusion. Hydrological systems are deteriorating as a result of the degradation and over-exploitation of catchment areas and the disappearance of wetlands. The management of cross-border water resources is a potential source of conflict.

Many or most Mediterranean countries are faced with several water-related issues: how to sustainably manage their scarce water resources, how to secure access to safe drinking water for population groups who do not yet have it, and how to accustom individual consumers to practices which save water. The first challenge requires water-demand management policies to reduce loss and misuse, the development of more added value through improving water-use efficiency in irrigation, industry and urban areas, and the meeting of economic and social needs at reduced cost. It also requires the integrated management of catchment areas and wetland ecosystems and an increase in water supply, particularly through the development of non-conventional sources of water.

The second challenge requires the achievement of the Millennium Development Goals (MDGs) concerning access to safe drinking water and sanitation. The third necessitates the strengthening of partnerships with local water users and water management bodies and awareness-raising campaigns on how to save water.

Certain Northern Mediterranean countries, along with some Southern ones, have started to ensure more efficient water management as recommended at the Johannesburg Summit. The EU has launched a water initiative whose Mediterranean component represents a framework for cooperation to contribute to achieving the MDGs, especially in SEMCs.

Goals

- Stabilise water demand by reducing water losses and waste (a reduction in demand in the Northern Mediterranean countries and controlled increases in the SEMCs), and increase the added value per cubic metre of water used.
- Promote the integrated management of catchment basins, including surface water and groundwater, ecosystems and de-pollution targets.
- Achieve the Millennium Development Goals concerning access to safe drinking water and sanitation.
- Promote participation, partnership, active cooperation and solidarity for the sustainable management of water, at the local and national levels.

Guidelines and actions

Regional Cooperation

1. Promote the Mediterranean component of the EU Water Initiative as one of the means of achieving the MDGs and the goals of the Johannesburg Plan of Implementation. Strengthen synergies with donors in support of investment, and with other regional cooperation frameworks.

Water-demand management

2. Set precise overall and per-sector efficiency goals in national strategies. Reorient water policies to integrate water-demand management into agriculture policies and into those of other sectors. Encourage demand-side approaches with the aim of improving water use efficiency, reducing unnecessary losses, implementing water-saving techniques in irrigation and involving industry, tourism and municipalities in avoiding wasting water.
3. Implement appropriate fiscal and pricing systems and encourage investment in water-demand management and the development of financial mechanisms for internalising external costs and expected benefits from water-saving measures.

Integrated water-resource management

4. Encourage the establishment of appropriate bodies and organisations for integrated catchment-basin management (covering surface water, groundwater and ecosystems), in qualitative and quantitative terms. Strengthen international commitments undertaken for the management of transboundary water resources.

5. Preserve and increase water resources through soil and water conservation measures, agricultural and forestry practices, small-scale irrigation, run-off management and spate irrigation, along with the mobilization of non-conventional sources of water, as well as the recycling of urban and industrial wastewaters and stormwater, taking into account quality standards.
6. Strengthen regulatory and other instruments, where appropriate, to reduce the over-exploitation of groundwater and non-renewable water sources and promote the artificial replenishment of aquifers, where necessary.
7. Protect aquatic ecosystems and restore their regulating role.

Access to water and sanitation

8. Support investment to halve, by 2015, the proportion of the population without access to safe drinking water and sanitation, pursuant to the MDGs.
9. Strengthen regulations, where appropriate, and promote investment in wastewater treatment systems to prevent and reduce pollution from urban and industrial sources.

Water management governance

10. Promote schemes for integrated participatory management of water resources, including partnerships with local authorities, the private sector and NGOs.
11. Take action to educate users about the need to save water, and to protect its quality.

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