Improving water use efficiency for facing water stress and shortage in the Mediterranean

Note prepared by Gaëlle Thivet and Mohammed Blinda

Plan Bleu
Regional Activity Centre

Sophia Antipolis
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Water resources in the countries around the Mediterranean are limited and unequally distributed in both space and time- the countries to the South account for a mere 13 % of the total. The Mediterranean is home to 60% of the world's « water poor » (disposing of less than 1000 m^3/inhab/yr) and in this day and age, twenty million Mediterranean have no access to drinking water, particularly in the countries to the South and East.

In many areas resources are already over-exploited, and with the population to the South and East increasing along with tourism, industry and irrigated land, so the growth in water demand will continue to surge.

Against a backdrop of increasing shortages in part of the region, and given the uncertainties linked to climate change, the Blue Plan's work is highlighting the pressing need to adapt water management policies, to better manage the various uses, and to save and use resources in the best possible way in order to meet population and development needs both today and in the future.

I. Water demand management: a major political issue in the Mediterranean

At the heart of Mediterranean water management for the past ten years

For the past ten years or so, water demand management (WDM), which comprises all measures intended to enhance the technical, social, economic, institutional and environmental efficiency of the various water uses, has been emerging as an issue central to water management in the Mediterranean.

Based on recognition of the fact that simply increasing supply, which had always been the traditional response to increased demand, had already (or was about to) reach its limits, and was running up against growing social, economic and ecological obstacles in virtually all the riparian countries, back in 1997 the Mediterranean Commission on Sustainable Development concluded that WDM was "the route for achieving the most significant progress in Mediterranean water policies", given its potential for improving efficiency.

Various workshops held at regional level (Frejus in 1997, Fiuggi in 2002, Zaragoza in 2007) led to water demand management gradually becoming recognised as a priority route towards achieving two of the objectives central to the sustainable development concept: moving on from non-viable modes of consumption and production on the one hand, and the protection and sustainable management of natural resources for the purpose of social and economic development on the other. They provided an opportunity to discuss the tools for implementing water demand management policies and showed how the most significant progress had been achieved through the progressive and consistent implementation of combinations of various tools (strategies, pricing and subsidies, institutional organisation).

The integrated management of water resources and demand was selected as the Mediterranean Strategy for Sustainable Development's first priority action area, adopted by all the riparian countries and the European Community in 2005. Within this common "framework" strategy, one of the main objectives related to water management (cf. annex 1) is to build up WDM policies in order to stabilise demand through limiting loss and misuse and to increase the added value created per m^3 of water used (i.e. enhancing efficiency).

The current issue: speedier integration of water demand management into water, environmental and development policy

The recommendations which emerged from the workshop on « Water demand management in the Mediterranean, progress and policy » (2007) which was recently held in Zaragoza for political decision makers, stress how important it is for WDM to be ranked as a national strategic priority, to promote it and coordinate its roll-out, follow-up and evaluation under the various sectoral policies, agricultural, energy, tourist, environmental and land planning in particular.

The issue at stake today thus entails speeding up the integration of WDM into water, environmental and development policy and, where appropriate, assisting countries in drawing up or improving their national sustainable development strategies and « efficiency plans » (or plans for the rational use of water resources), the principle of which was adopted at the Johannesburg Summit.

Indeed, whilst water demand in Mediterranean countries- equating to the sum of water used and non-conventional water production (desalination, reuse) - is set to increase by some 50 km^3 by 2025 to reach almost 330 km^3/yr, in other words a level which is hardly compatible with renewable resources, losses related to transport, leaks and misuse of the resource could well exceed 100 km^3/yr (Blue Plan scenario). Hence the importance of improved demand management.

II. Is water use becoming more efficient in the Mediterranean?

The water efficiency index, constituting one of the 5 priority indicators of follow-up of the "water" chapter of the Mediterranean Strategy for Sustainable Development, allows following the efforts carried out by the countries in terms of water savings through demand management, by reducing losses and wasteful use during transport and distribution. It covers total and sectoral efficiency (drinking water, agriculture and industry) (i.e. Appendix 2):

- Drinking water efficiency corresponds to the share of drinking water produced, distributed, and paid by consumers. The indicator measures both the physical efficiency of drinking water distribution networks (loss rates or yield) and economic efficiency, e.g., the capacity of network managers to cover costs through consumer payments.
- Physical irrigation water efficiency is the product of i) network for irrigation water transport and distribution" efficiency upstream of the agricultural plots ii) by plot efficiency
- Water industrial efficiency corresponds to the share of the recycled industrial water volume (recycling index)
- Total water use physical efficiency is defined as the sum of used water quantity ratios per sector (demand-losses) over sector demand, weighed by the share of sectoral requirements (drinking water, irrigation and industry).

The following table provides an efficiency estimate for drinking and irrigation water as well as overall efficiency for the various Mediterranean countries for 1995 and 2005 (data currently being validated):

	Drinking water efficiency		Irrigation efficiency		Total efficiency	
	1995	2005	1995	2005	1995	2005
Albania	38	38	41	48	40	45
Algeria	40	50	36	36	37	40
Pal. Terr	45	50	56	56	52	54
Bosnia-Herz.	32	40	63	63	53	57
Cyprus	65	67	66	90	66	84
Croatia	54	54	45	54	54	54
Egypt	40	60	38	38	38	39
Spain	56	65	42	62	44	62
France	56	69	70	70	61	69
Greece	62	62	56	56	57	57
Israel	79	90	77	75	77	81
Italy	58	69	39	39	45	47
Lebanon	52	52	46	46	48	48
Libya	70	70	63	63	64	64
Malta	34	53	70	78	42	64
Morocco	52	71	34	48	35	50
Montenegro	50	50			50	50
Slovenia	51	51	45	54	51	51
Syria	60	64	37	55	39	56
Tunisia	55	68	36	58	38	59
Turkey	25	54	45	45	41	46

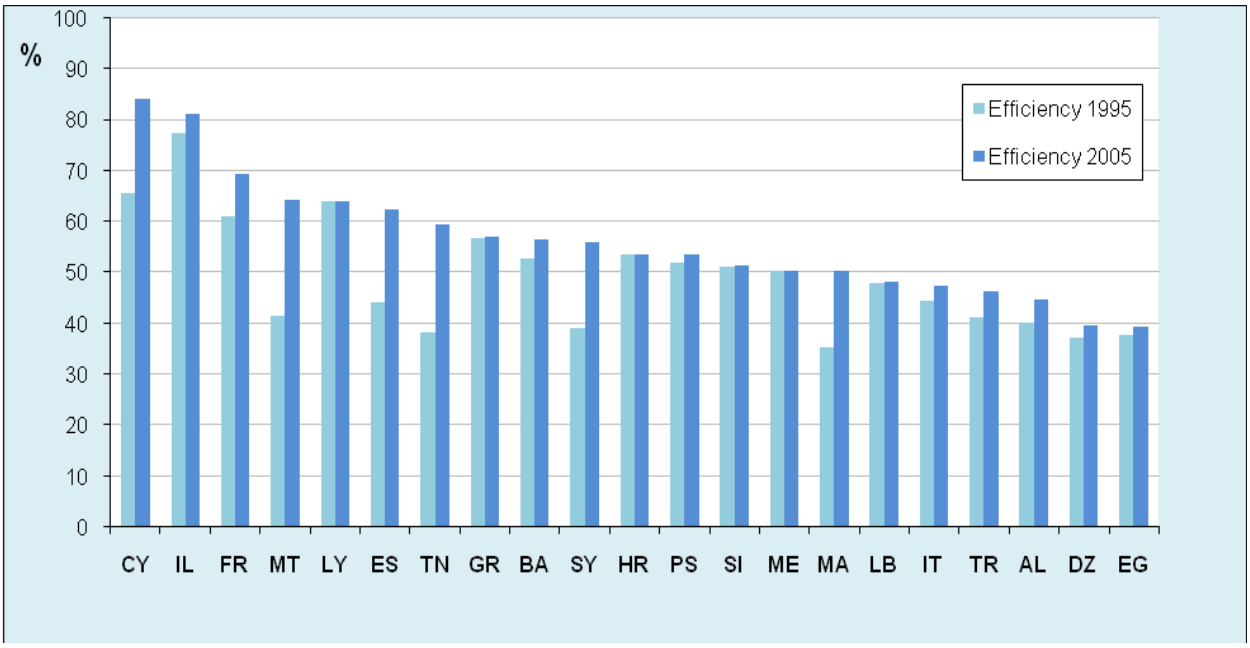
Diverse sources. Data currently being validated by countries.

In 2005, total water use efficiency is believed to have been between 50 and 85% in the majority of Mediterranean countries:

- Albania, Algeria, Bosnia-Herzegovina, Croatia, Egypt, Greece, Italy, Lebanon, Morocco, Montenegro, Palestinian Territories, Slovenia, Syria, Tunisia and Turkey are believed to have had 40-60% total water efficiency;
- France, Libya, Malta and Spain are believed to have had 60-75% total water efficiency;

- Cyprus and Israel are believed to have had total water use efficiency close to 84 and 81% respectively.

Between 1995 and 2005 virtually all countries achieved encouraging progress in terms of their efficiency in the various water use sectors.

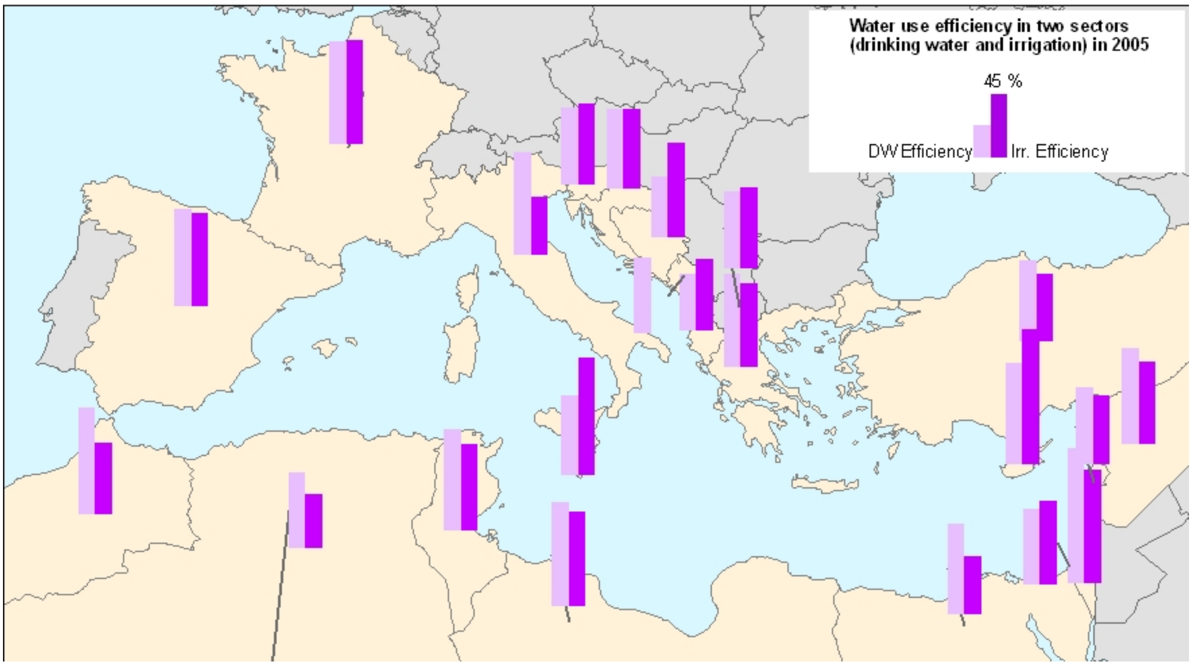


Total water use efficiency index in Mediterranean countries (1995-2005)

Source: Plan Bleu (Data currently being validated)

When the efficiency indexes for drinking water and water for irrigation purposes are compared per country, however, (in 2005), several situations emerge:

- In some countries, water efficiency in irrigation is much lower than for drinking water: Algeria, Egypt, Israel, Italy and Morocco.
- Water efficiency for drinking and irrigation water is more-or-less equal in the following countries: Croatia, France, Greece, Lebanon, Libya, Palestinian Territories and Spain.
- Albania, Bosnia-Herzegovina, Cyprus and Malta have greater irrigation than drinking water efficiency.



Water use efficiency in two sectors (drinking water and irrigation) in 2005

Source: Plan Bleu (Data currently being validated)

Efficiency is still difficult to measure

It is often still difficult for countries to establish their total water efficiency index and its sectoral components.
In situ measurements of actual average plot irrigation efficiency (E2) are more complex, in view of the difficulty in precisely assessing volumes consumed by plants, and in view of the high number of plots. Each country has national estimates of the average efficiency of all systems, based on pilot experiments. The value of E2 in fact highlights the distribution of irrigation per major modes of irrigation at national level (theoretical average efficiency estimated from 40 to 60 % for surface irrigation from 70 to 80 % for sprinkler irrigation and from 80 to 90 % for localized irrigation).

The economic efficiency of drinking water is dependent on invoicing modes (subscription, meters) and meter malfunction can yield biased results.

To this end, the Blue Plan's work programme includes furthering within each country the collection and validation of the basic data needed to calculate sectoral (drinking water, agriculture, and industry) and total efficiency, as well as providing the countries with methodological support to improve their collection of this basic data and production of indicators.

III. The future: what efficiency improvement objectives exist in the Mediterranean?

The issue: to save almost a quarter of water demand

In its report entitled « *Mediterranean: the Blue Plan's environment and development outlook* » (2005), the Blue Plan endeavoured to evaluate the extent of water loss and «misuse » for each sector (losses which artificially inflate water demand in the various national planning documents) and on the basis of a set of ambitious albeit "feasible" hypotheses to estimate recoverable losses per sector and per Mediterranean basin sub-region. Potential achievable savings were thus estimated at around a quarter of current water demand, in other words 70 km^3 for a total demand of 281 km^3 for the Mediterranean countries as a whole in 2000. In 2025 it would be about 86 km^3/yr (for total water demand of some 330 km^3/yr).

Mediterranean basin Sub-region (countries)	**Drinking water**	**Irrigation**	**Industries**	**Total**
	Efficiencies improvement hypotheses			
	Networks efficiency raised to 85% and users efficiency raised to 90%	Networks efficiency raised to 90% and plot efficiency raised to 80%	Recycling generalized to 50%	
North	4,4	15,7	9,5	29,6
East	1,8	12,2	2,2	16,2
South	2,5	17,9	4,1	24,5
Total	**8,7**	**45,8**	**15,8**	**70,3**

Recoverable losses estimation per Mediterranean basin sub-region in 2000
Source: Blue Plan & J. Margat

Note: These losses are « recoverable» purely in terms of the techniques available, notwithstanding social difficulties and resistance.

Potential available savings are therefore by no means negligible in the Mediterranean. The main quantitative source lies in irrigated farming, where situations vary enormously. To the North, the losses stem from major networks, whilst to the South and East, plot-by-plot irrigation practices also come into play. In volume terms, potential savings in farming are five times higher than in the domestic sector. As for industry, it can make an effective contribution through recycling, as has been demonstrated by the French industrial experience. The drinking water sector would only release a tiny fraction of the total; it is, however, the most straightforward to mobilise to the South and North in the medium term, as well as the easiest to justify in economic terms, given the current cost of water.

Regional objectives for improving efficiency…

The efficiency improvement hypotheses in the Blue Plan's alternative scenario (presented in the fore-going table) were adopted by the Mediterranean riparian countries as « desirable objectives » for improving physical water efficiency at regional level and by 2025 (Mediterranean Strategy for Sustainable Development, 2005) :

- Drinking water in municipalities: reduce losses rates stemming from distribution to 15% and leakages from users to 10%;
- Irrigation: reduce losses rates stemming from transport and distribution to 10% and raise irrigation efficiency by plot to 80% ;
- Industry: extend recycling to 50%.

… to be rolled out by each Mediterranean state

The MSSD is a « framework » strategy which can inspire national sustainable development and sectoral strategies (or help in their updating). It is, however, up to each individual country to set its own efficiency improvement objectives. Efficiency plans (or plans for the rational use of water resources), the principle of which was adopted at the Johannesburg Summit, can be drawn up and implemented at various levels (country, watershed, expanse of water, city or irrigated area).

However, although concerns about water demand management are becoming ever more widespread, this issue is rarely reflected in terms of targeted and quantified objectives in official national water planning documents. Indeed, only a handful of Mediterranean countries have to date set national targets for improving efficiency (sectoral and total) and the dates for reaching them.

Moreover, for the Mediterranean as a whole, it is still difficult to quantify the potential gains to be achieved through more efficient distribution between the various uses (improving « inter-sectoral efficiency »), from three points of view- economic, social and environmental. These gains can only be evaluated locally by "cost-benefit" studies into different options, including the cost and benefit of environmental and social externalities. This type of study is rarely undertaken, particularly on optimisation and allocation according to various qualities. Some Mediterranean countries are starting to make their allocation choices using optimisation criteria such as « more added value per drop ». This has prompted considerable gains in technical efficiency or water savings, but these decisions still take very little account of the social and environmental impact.

In order to support Mediterranean countries in drawing up « efficiency plans », in its future work the Blue Plan intends to:

- Further the collection of information on national efficiency improvement objectives (both sectoral and total);
- Invite those countries which have not yet done so to set their own efficiency improvement objectives and the deadlines for reaching them;
- Invite the countries to establish priority actions to be introduced in order to improve sectoral and total efficiency (according to the objectives set) and to evaluate their cost.

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The challenge of water demand management is not only limited to physical savings. It also means improved economic and social enhancement of mobilized resources and the coverage of water requirements of ecosystems. In Northern Rim countries, rather better endowed with water and where demand is falling, resource quality is prevalent, on a par with the interest in maintaining or restoring ecosystems, generating lesser water supply costs. In the South and East, where countries are facing both the squeeze from limited water resources and the rapidly increasing demand, quantitative aspects are still the main issue.

The transition from the baseline scenario to a sustainable development scenario (described in the report « *Mediterranean: the Blue Plan's environment and development outlook* », 2005) can only be gradual, carried by the indispensable policy reforms posting clear integrated water resource management objectives in all policies – particularly in agricultural ones – and generating the means for implementation, based on the development of sustainable efficiency plans and financial mechanisms.

In this context, both the financing of investments in drinking water supply and sanitation infrastructures (in the South and East) and the recourse to economic instruments such as subsidies and pricing to optimize allocation of available resources, appear crucial for the future. The same applies to strengthening management capability, particularly at local level.

Sources :

Plan Bleu (2005). *Mediterranean: the Blue Plan's environment and development outlook*, edited by Guillaume Benoit & Aline Comeau. EARTHSCAN Editions. Chapter « Water », pp. 71-108. www.planbleu.org

Margat, J., Plan Bleu (2004). *L'eau des Méditerranéens: situation et perspectives.* Athens. MAP Technical Report Series no 158. www.unepmap.gr

FAO (2000). *Agriculture: toward 2015/2030*, Global perspective studies unit, April

FAO-AQUASTAT

National reports (2007) « Water demand management, progress & policies » presented at Saragossa regional workshop (Bosnia-Herzegovina, Cyprus, Egypt, Spain, France, Israel, Italy, Malta, Morocco, Syria, Tunisia, Turkey)

Appendix 1

Extract of the Mediterranean Strategy for Sustainable Development related to integrated water resources and demand management

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 persons in the region with fewer than 1000 cubic metres 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 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 conflicts.

Many or most Mediterranean countries are faced with several water-related issues: how to manage their scarce water resources sustainably; 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 greater efficiency in irrigation and in the use of water in 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 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.

Some countries in both the North and the South have began to undertake more efficient water management, as called for by the Johannesburg Summit. The EU has launched a water initiative, the Mediterranean component of which represents a cooperation framework conducive to the attainment of the MDGs in the region.

Objectives

- Stabilize water demand through the reduction of water losses and the wasteful use of water (a reduction in demand in the North and controlled increases in the South and the East) and increase the added value per cubic metre of water used.
- Promote the integrated management of watersheds, including surface and groundwater; and eco-systems, and foster depollution objectives.
- 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 local and national level.

Orientations and actions

Regional Cooperation

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

Water demand management

2. Determine precise global and sectoral efficiency goals in national strategies. Reorient water policies to integrate water demand management in agriculture and other sectoral policies and 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 cities in controlling waste water.
3. Establish appropriate fiscal and pricing systems and encourage investment in demand-side management and the development of financial mechanisms for the internalization of external costs and the expected benefits from water-saving measures.

Integrated water resource management

4. Encourage the establishment of appropriate bodies and organizations for integrated watershed, management (surface, groundwater resource 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 and spate irrigation and the mobilization of non-conventional sources of water, as well as the recycling of urban and industrial wastewaters and drainage water, 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 groundwater, 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 the 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 protect its quality.

Appendix 2

Descriptive sheet of water efficiency index (total and per sector)

Priority indicator of MSSD (WAT_P01)

Strategic Objective:

To stabilize water demand: reduction in the North and controlled increase in the South and East. To reduce losses and misuse by defining efficiency targets in all sectors. To create more added value through more efficient use of water for irrigation, cities and industry, and to satisfy economic and social requirements at lower costs.

Rationale:

Water volumes lost and "misused" in all sectors are such that they artificially increase water demand in Mediterranean countries. Thus, at the scale of Mediterranean catchment's areas, the "feasible savings potential" has been appraised to be at 24% of current demand.

Definition:

This indicator measures progress in water savings through demand management, by reducing losses and waste during transport. It covers total and sectoral Efficiency (drinking water, agriculture and industry):

1) Sectoral Efficiencies

a) Drinking Water Efficiency

This is the share of drinking water produced, distributed1, and paid by consumers.

Epot = V1 / V2 where

- V1 = drinking water volume invoiced and paid by consumer
- V2 = total drinking water volume produced and distributed

The indicator measures both the physical efficiency of drinking water distribution networks (loss rates or yield) and economic efficiency, e.g., the capacity of network managers to cover costs through consumer payments.

b) Irrigation Water Efficiency

The physical efficiency of irrigation water is the product of "network for irrigation water transport and distribution" efficiency by plot efficiency:

Eirr = E1xE2

[1] In the sense of networks upstream from losses.

- E1: efficiency of irrigation water transport and distribution networks, upstream from agricultural plots, measured as the ratio between water volumes actually distributed to plots and the total volume of water for irrigation, upstream of networks, including losses in networks ;

- E2: plot irrigation efficiency is defined as the sum of efficiencies (per plot) of all irrigation methods (surface irrigation, sprinkler irrigation, micro-irrigation, others), weighted by the respective proportions of all local methods and estimated as the ratio between water volumes actually consumed by plants and volumes delivered to plots.

$$E2 = \sum_{1}^{n} \frac{Sm \times Em}{S}$$

- n : number of irrigation methods used:
- Sm: surfaces irrigated using method : m
- Em: method efficiency: m
- S : total local irrigated surface according different methods

c) Industrial Water Efficiency

The volume of recycled industrial water (recycling index)

$$\mathbf{E_{ind} = V1 / V2}$$

- V1 = Recycled water volumes
- V2 = Gross volume consumed for industrial processes which is equal to the volume incoming for the first-time to the industrial plant + recycled volume.

2) Total Efficiency

Total physical efficiency of water consumption is defined as the sum of used water quantity ratios per sector (demand-losses) over sector demand, weighted by the share of sectoral requirements (drinking water, irrigation and industry)

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

Water demand is defined as the sum of water volumes dedicated to satisfying needs (excluding « green » water and « virtual » water), including volumes lost in production, transport and consumption. This corresponds to the sum of water volumes abstracted, non-traditional water production (desalination and imports), and water reuse, minus export volumes.

Unit

Percentage

Objective and/or targeted values:

To achieve the 2025 physical efficiency levels recommended by the alternative scenario of the Plan Bleu:

- Drinking water in communities : restore levels of distribution losses to 15%;
- Industry recycling generalized at 50%;
- Irrigation: restore levels of transport losses to 10% and maintain high physical efficiency at 80%.

Or to achieve national total physical efficiency objectives.

Methodological Indications:

When network measurement tools are available (meters, satellite imaging), the efficiency of the irrigation network (E1) can be estimated by management structures. Efficiency is network-specific. However, national average efficiency could be assessed by computing individual network averages, weighted by volumes distributed yearly.

In situ measurements of actual average plot irrigation efficiency (E2) are more complex, in view of the difficulty in precisely assessing volumes consumed by plants, and in view of the high number of plots. The value of E2 will be estimated. Each country has national estimates of the average efficiency of all systems, based on pilot experiments. The value of E2 in fact highlights the distribution of irrigation per major modes of irrigation at national level.

As an initial approximation, and in the absence of precise data on the actual efficiency of the modes of irrigation, the indicator may be computed on the basis of theoretical average efficiency estimated from 40% to 60% for surface irrigation, from70% to 80%for sprinkler irrigation and from 80% to 90% for localised irrigation.

$$\mathbf{E2 = (S1 \times 0{,}50 + S2 \times 0{,}75 + S3 \times 0{,}85)/S}$$

- S1 : surface irrigation and similar;
- S2 : land irrigated by sprinkler
- S3 : land irrigated with the localised irrigation method
- S : total country surface irrigated for all modes of irrigation

Geographical scope:

NATIONAL LEVEL	CATCHMENT AREAS	MEDITERRANEAN COASTAL ZONES (NUTS 3)	COASTAL ZONES	MEDITERRANEAN SITES	MARINE ZONES
YES	YES	-	-	-	-

References:

- L'eau des méditerranéens : situation et perspectives, Jean Margat, PNUE, PAM, Plan Bleu, 2004
- « A Sustainable Future for the MEDITERRANEAN : The Blue Plan's Environment & Development Outlook», Plan Bleu, 2005
- http://www.veoliawater.com/services/industrial-customers/applications/re-use/

International Data Sources:

FAO-Aquastat http://www.fao.org/ag/agl/aglw/aquastat/dbase/index.stm

Precaution for use:

In some cases, and due to the diversity in data sources for one country, or due to heterogeneous definitions, total water demand can be different from the sum of demand in various sectors.

The economic efficiency of drinking water is dependent on invoicing modes (subscription, meters) and meter malfunction can yield biased results.