Sustainable solutions for water in the Mediterranean: managing scarcity and improving quality

Priority 1: "Improving water demand management"

Report relating to target n°1 (MED 1-1)

---

1. Heading of target MED 1.1

By 2015, each Mediterranean country has set its own national objectives for water use efficiency in the various using sectors and for water allocation between the different uses (productive and environmental) and defined (implemented) "efficiency plans" for achieving their short-, medium- and long-term objectives.

Remarks :

- The target is established at national level. However, the solutions to be implemented and commitments to be made to reach this target involve all stakeholders at the various territorial levels (governments, local and regional authorities, water authorities, professionals, etc.).
- National water efficiency targets should be mainstreamed into water policy or the various sectoral strategies. It is difficult to design targets in isolation.

2. Target context and issues

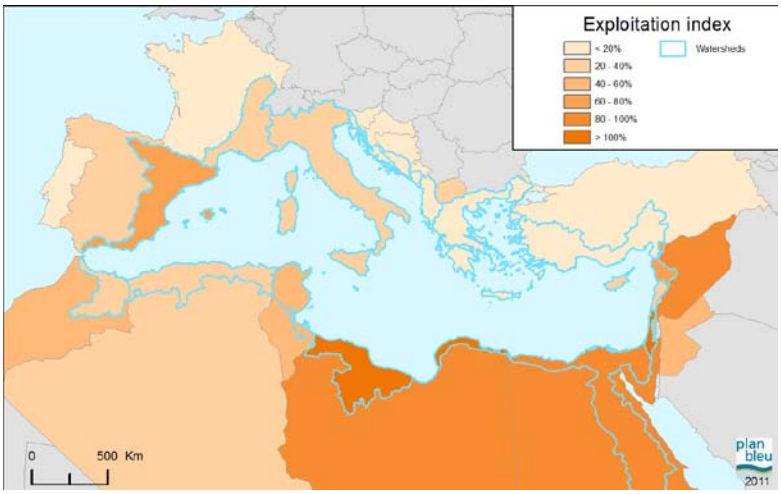
2.1 Scenarios for bringing water scarcity onto the political agenda and promoting water demand management in the Mediterranean

In the Mediterranean, water resources are very unevenly distributed over both space and time. Water shortage and drought situations are frequent, and have a particular impact in Southern and Eastern countries. The number of people living in countries in situations of water scarcity, with less than 1000 m^3/capita/year of renewable water resources, could reach 250 million inhabitants in 2025, 80 million of whom would be facing extreme shortage conditions with less than 500 m^3/capita/year.

Water demand across all Mediterranean countries doubled in the second half of the 20th century to reach 280 km^3/year in 2007. It may increase by a further 20% by 2025, essentially in the Southern and Eastern countries. Agriculture accounts for nearly 65% of this total water demand. In spite of some encouraging progress in terms of water use efficiency, losses during water transport and use are estimated at almost 40% of the total water demand, or more than 100 km^3/year for the Mediterranean as a whole.

In some countries (Egypt, Israel, Jordan, Libya, Malta, Syria and the Palestinian territories), water withdrawals approach or even exceed the limit threshold of renewable resources (figure 1). Water demand is increasingly met by an unsustainable water production relying on fossil water withdrawals and over-exploitation of renewable water. The prevailing national strategies still focus on extending water supply and pursuing abstraction, using and constantly deteriorating natural resources, posing a serious threat to the long-term.

Figure 1: Exploitation index of renewable water resources in individual countries and catchment areas (2005-2010)



Source: Plan Bleu

Nota: Indices close to or higher than 80% indicate already high tensions on water resources; ratios between 60 and 80% are signs of a high risk of medium-term structural tensions; and ratios between 20 and 60% point to local or conjectural tension.

Within a context of increasing shortage in parts of the region and in view of the uncertainties brought about by climate change, it is even more pressing to adapt water management policies, to better manage the different water uses and to ensure a more efficient and effective use of resources, if present and future needs of populations, hydrosystems and development are to be satisfied.

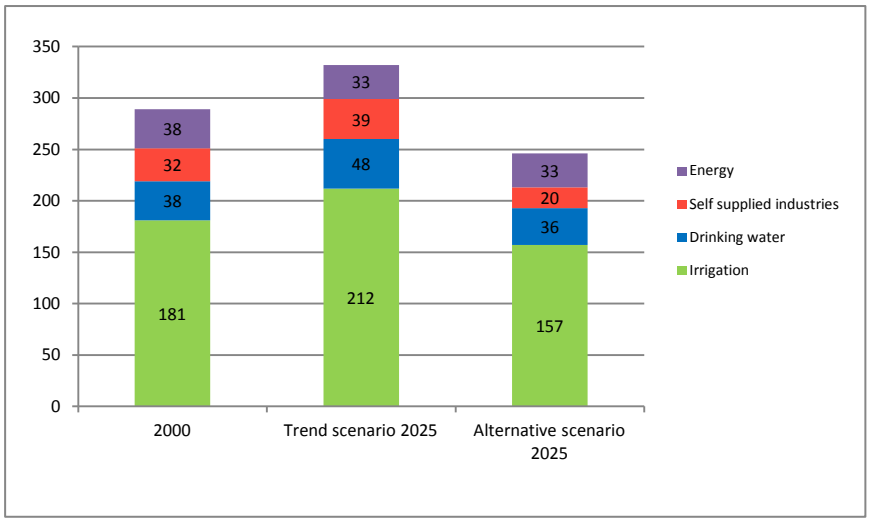
The works carried out by Plan Bleu, a centre for systematic and prospective studies on the environment and development in the Mediterranean operating in the framework of regional cooperation (the Mediterranean Action Plan), have in this sense helped to highlight on the one hand, the increasing imbalance between water supply and water demand, and on the other, the savings that could be achieved by reducing losses and inappropriate uses. Potential water savings have been estimated at almost a quarter of the total water demand by 2025 (figure 2). Agriculture is a crucial area for freeing up significant amounts of water. As the leading sector for « blue »[1] water consumption, irrigated agriculture represents the greatest potential for savings by volume, with over 65 % of total potential water savings identified in the Mediterranean.

More rigorous management of demand in certain countries or regions could, for example, help to cope with the expected increase in demand, at least over the next 15 to 20 years.

The works carried out have also underlined the necessity of developing cost-benefit and cost-effectiveness-type economic approaches, incorporating short- and long-term environmental and social impacts, in order to compare different water management options and assess the economic and financial benefits of water demand management (WDM) measures.

[1] « Blue » water is the water flowing through rivers to the sea, in lakes, held in underground aquifers, distributed through pipes, etc.

Figure 2: Water demands per using sectors at Mediterranean scale, trend and alternative scenarios (km³/year)



Source: Plan Bleu, 2007

Inset 1: Water demand management (WDM)

WDM is defined as a set of technical, political, institutional, economic, training, awareness-raising and communications tools, designed to encourage more efficient use of existing water supply before seeking to increase supply levels. It therefore encompasses measures designed to improve water use efficiency[2] in the various usage sectors (intra-sectoral efficiency), but also water allocation between uses, taking account of both productive and environmental uses (inter-sectoral efficiency).

2.2 A regional political commitment to address water shortage

Based on these future-oriented analyses and in the wake of various regional WDM workshops (Fréjus 1997, Fiuggi 2002[3]), integrated water resource and demand management was chosen as the main priority action area for the Mediterranean Strategy for Sustainable Development (MSSD) adopted in 2005 by all Mediterranean rim countries and the European Community. One of the main objectives in relation to water management is consolidating WDM policies to stabilise demand by 2025, based on reducing levels of loss and inappropriate use and increasing the value added per cubic metre of water used, i.e. increased efficiency. The MSSD is a "framework strategy", which can be used as the basis for developing or updating national sustainable development strategies, "efficiency plans" (or plans for the rational use of water resources, the principle of which was adopted at the Johannesburg Summit in 2002) and sector-specific strategies, on the understanding that individual countries are responsible for establishing their own objectives. Efficiency plans may be drafted and implemented at various levels (country, catchment basin, aquifer, city, irrigation area, industry…). However, although WDM is becoming an increasingly widespread concern amongst Mediterranean countries, it is still rarely expressed in terms of targeted, quantified objectives.

In addition, since the mid 90s the focus of political cooperation on water-related issues between the European Union and Mediterranean countries has tended to be shortage and drought. A working party on water scarcity and shortage was set up as part of the joint Process between the

[2] Used in the English sense of the term, translated as "rendement" in French. It is based on achieving a specific result using a minimum level of resources.
[3] A third regional workshop on progress with WDM was held in Zaragoza in 2007.

Mediterranean component of the European Water Initiative- Med EUWI- and the Water Framework Directive (2004-2009) with the aim of encouraging greater pooling of knowledge and techniques and the exchange of experience between Mediterranean and European countries. Its work highlighted the significance of WDM measures.

Since 2009, the Marseille Centre for Mediterranean Integration (CMI) « Environment and water » cluster has also been spotlighting WDM through its programme on « the economic approach to water demand management » led by the French Development Agency (AFD) in conjunction with Plan Bleu.

Finally, WDM should constitute a priority within the national Strategies for adapting to climate change adopted by the Mediterranean countries. Indeed, WDM measures are key aspects of adaptation strategies, particularly by dint of forestalling the effects of climate change and switching/ reorganising uses and activities.

A regional objective of 25% water savings by 2025 has been adopted within the framework of the Barcelona Convention, taking 2005 as its baseline. The aim of this target (MED 1.1) is to achieve this regional objective.

3. Target action plan and commitments

3.1 Target action plan: stages and milestones

Three stages are proposed for the action plan:

- By late 2013, each Mediterranean country will have assessed current water use efficiency in the various usage sectors as well as feasible progress to be made in water savings,
- By 2014, each Mediterranean country will have set its own national water use efficiency objectives for the various sectors of use and water allocation between uses (productive and environmental),
- By 2015, each Mediterranean country will have defined (started the implementation) action plans towards achieving these objectives in the short, medium and long term.

3.2 Commitments

Examples of commitments made or to be made by:

3.2.1 Political stakeholders

Targets for improving water efficiency at Mediterranean level

The integrated management of water resources and demand constitutes the prime priority action area of the MSSD adopted in 2005 by the Contracting Parties to the Barcelona Convention. One of the main objectives relating to water management is to consolidate WDM policies in order to stabilise demand by curbing losses and increasing the value added per m^3 of water used (or to improve efficiency in hydraulic and economic terms). The « desirable targets » established towards improving physical water efficiency at regional level up to 2025 are as follows:

- For the domestic sector: reducing loss rates in distribution to 15% and user-level leakage to 10%;
- For irrigation: reducing loss rates in water transportation and distribution to 10% and raising plot irrigation efficiency to 80%;
- For the industrial sector: achieving 50% recycling.

These targets should contribute to achieving the regional objective of 25% water savings by 2025.

At Mediterranean country level:

- Water efficiency improvement targets:
  - ✓ In Morocco, the « Plan Maroc Vert » adopted in 2008 includes a National Irrigation Water-Saving Programme with the objective to convert almost 500 000 ha to localised irrigation by 2020, which will make it possible to save 1 billion m3 per year by 2020. Moreover, the National Water Strategy (elaborated in 2009) includes an ambitious water demand management programme for drinking, touristic and industrial water: networks' efficiency shoud be improved to reach about 80% (national average) by 2020 against 71% for the current situation; it also includes incentives for water-saving technologies and a review of the tariff system, as well as the implementation of audit systems for big consumers (industries, infrastructures for tourism) (cf. solution presented in annex 2);
  - ✓ In Jordan, the National Water Strategy shows ambitious objectives for 2025, among them: reducing physical losses for drinking water from 43% to 25%, reducing withdrawals from superficial aquifers, increasing tow-fold the reuse of wastewater (from 125 to 250 MCM);
  - ✓ In Tunisia, a country which has been involved in water demand management strategies for a long time, the updating of the National water strategy -by 2050- has been initiated (cf. solution presented in annex 2).
  - ✓ Syria: irrigation water efficiency index assessed on the basis of the National Development Plan and the National Programme for Converting to Modern Irrigation: 69% in 2025 and 70.1% in 2030;
  - ✓ Cyprus: target to improve urban water system efficiency (particularly through system rehabilitation) established by the Strategic Development Plan (2007-2013); prospects for improving drinking water efficiency to reach 95% in 2020;
- Commitments made/to be made to curb and control water abstraction…

Targets to improve water efficiency set by local authorities

3.2.2 Donors

A qualitative analysis of recent intervention strategies and policies applied by the leading bilateral and multilateral sponsors active in the Mediterranean (United States, Germany, Japan, France, European Commission, European Investment Bank, World Bank) highlighted the fact that these strategies increasingly focused on support for WDM-stimulating integrated water resource management[4], even though the bulk of financing continued to concentrate on drinking water provision, sanitation and sewage treatment in response to the Millennium Development Goals (Corm, 2007).

[4] For example: incentives towards efficient resource use, introduction of water-saving crop methods, tariff reforms, curbing leakage and waste in local communities, etc.

Inset 2: Extract from the AFD's (French Development Agency) 2010-2012 Water and Sanitation sectoral intervention framework for the MENA region

Water resource management: moving from words to acts, supporting the drawing up of « financiable » global operational strategies.

Striking a balance between water supply and demand involves drawing on new resources, along the following four lines: i) improving agricultural as well as urban usage efficiency, ii) promoting integrated water management, achieving optimal allocation through consultation between uses, iii) drawing on non-conventional resources: reuse of wastewater, desalination and i) water transfers when the previous levers have proven their limits.

Sponsors such as the AFD tend to be sought for the last two of these four thrusts, with their significant investment needs. The AFD now intends to adopt a global approach covering all of them. Whilst the optimisation of resource management through better control of demand is often encouraged, the difficulty currently consists of transposing words into « financiable » AFD operational strategies. Agricultural, energy and water management policy must also be "decompartmentalised", whilst accepting the constraints of political action. To achieve this, the AFD will help shape global strategies upstream. This is partly the aim of the Marseille Centre for Mediterranean Integration's « water » programme, led by the AFD and the Plan Bleu.

It should, however, be stressed that sponsors provide support for approaches and projects comprising part of a global water management strategy shaped by the beneficiary country itself, depending on the national context. As such, it is first and foremost up to the country itself to establish WDM as a national priority to ensure that sponsors can support WDM strategies and approaches.

The interest in developing decentralised cooperation regarding WDM (allowing examples of good practices to be circulated to local levels) should also be underlined.

3.2.3 Other institutions (international organisations, NGOs…), private sector

The private sector will be called upon to play an important role as a provider of services and equipment needed to save water, for the solutions to be implemented at the level of water services or irrigated areas.

Non-governmental organisations, and especially those working to protect nature and the environment, have a role to play in raising awareness on the issues around overconsumption of water and in informing users and bodies responsible for water management of better solutions for handling demand. One awareness-raising method that could be promoted is to determine and publish a production "water footprint" on different scales (by country, catchment area, etc.), depending on the interest shown by national or regional authorities and lending institutions in the Mediterranean basin (cf. solutions proposed in annex 2 by WWF and Mohammed VI Foundation).

4. Solutions

4.1 Tools towards enhanced water demand management

Various studies, assessments and regional workshops[5] have revealed the genuine progress made over the past fifteen years or so regarding the inclusion of WDM in water policy and some

[5] National reports on « Monitoring the progress and promotion of water demand management policy » drawn up by a dozen or so countries in preparation for the 3rd workshop on WDM in the Mediterranean (UNEP-MAP-Plan Bleu,

sectoral policies. Increasing numbers of Mediterranean countries, often amongst those with the least water (such as Israel, Malta, Cyprus, Spain, Tunisia, Morocco, Jordan…), have started to move down this path. They have adopted official national WDM strategies combining legislative and regulatory, technical, economic and institutional instruments and mobilising stakeholders, or are intending to further develop these tools. A degree of devolution of water management to units such as catchment basins, increasing user participation and the redefinition of the role of the State are all helping to drive the emergence of such strategies.

Figure 3 (annex 1) uses the case of the farming sector to show various water demand management tools implemented in Mediterranean countries. A more detailed (albeit non-exhaustive) presentation of the technical measures for improving water efficiency, regulatory and economic instruments and consultation and planning tools is provided hereafter.

4.1.1 Technical measures to improve water efficiency

In the agriculture sector:

- Improving channel hydraulics (dynamic regulation and automatic facility management…),
- Rehabilitation and modernisation of old irrigated systems,
- Improving the efficiency of plot irrigation techniques (sprinkler and localised irrigation, enhanced or modernised gravity irrigation),
- Reducing the vulnerability of current agronomic models and crop systems: improving cultivated or grazed species (selecting « water-saving » or drought-tolerant varieties), review of inter-crop and crop behaviour (strategies intended to reduce evaporation loss), crop choice and rotation optimisation, etc.,
- Use of supplementary irrigation (crop irrigation in case of rainfall shortage), switching from the concept of maximum yield to one of optimum yield,
- Use of irrigation planning and guidance tools,
- Installation of water meters for surface water and groundwater: meters for specific areas (division into sectors, leakage search…) and individual meters (to evaluate the volumes effectively distributed and correct the non-revenue water problem…),
- Reuse of treated sewage as a means of saving higher quality resources.

Examples (solutions presented in annex 2): The role of water user associations in Morocco; The national irrigation water saving programme (PNEEI) in Morocco.

In the domestic, tourism and industrial sectors:

- Improving the efficiency of water supply systems: network diagnosis and leak detection and repair operations, replacement of infrastructure according to the principle of economic preference, analysing the opportunity cost of conducting detection and repair campaigns; pressure management, water meters…

  Examples (solutions presented in annex 2): Improvement in urban networks efficiency in Algiers (Algeria), Aqaba (Jordan), Bethleem (Palestinian territories) and Oujda (Morocco).

- Improving use efficiency amongst domestic (including local authorities) and tourist users: installation of water efficient systems (flow modulators and water-saving household appliances), development of systems for the reuse of grey water for purposes not requiring drinking water, rainwater collection, etc.

  Examples (solutions presented in annex 2): IDARA Project - Instituting Water Demand Management in Jordan; Technical demonstration of local water management in Tunisia;

2007), national studies (14) on water efficiency drawn up between 2008 and 2011 at the Plan Bleu's invitation (http://www.planbleu.org/publications/eau.html).

In the industrial sector: improving network management and control, improving procedure control, equipment modification, technology switch, on-site water recycling and reuse, etc. The use of environmental management tools and voluntary-based operational management assistance tools may facilitate the design and ranking of WDM measures.

Example (solution presented in annex 2): Water-saving program of OCP in Morocco (Office Chérifien des Phosphates).

4.1.2 Legislative and regulatory instruments

The use of legislative and regulatory instruments may play a crucial role in limiting and effectively controlling surface and groundwater abstraction in order to curb/compensate for resource over-exploitation. Appropriate measures for assessing water abstraction per type of use will have to be drawn up and introduced for this purpose.

Examples of measures already implemented or to be developed:

- Abstraction declaration/authorisation system
- Mandatory metering of abstracted volume (beyond certain abstraction thresholds and depending on the type of abstraction)
- Equipment standards and approval for activities
- Temporary restrictions relating to hydro-climatic variations
- Water police responsible for control and reporting of offenders
- Water rights
- Arbitration systems…

Examples (solutions presented in annex 2): Highland Water Forum and groundwater bylaws enforcement in Jordan; Integrated management and the Aquifer framework agreement in Souss Massa river basin (Morocco).

4.1.3 Enhanced use of economic instruments

Scant application of economic instruments

Economic instruments (pricing, quotas, subsidies, taxation…) can be instrumental in ensuring the more efficient allocation of resources at sectoral and inter-sectoral level, improving access to water for the poorest members of society and taking environmental concerns on board. They may prompt behavioural change amongst the various users whilst also contributing to the essential financing of water management.

However, whilst often seen as the preferred tool for integrated water management, relatively little use has been made of them in the Mediterranean to date, particularly in the farming sector. Of the range of economic instruments available, the various forms of pricing (flat-rate, by volume, combined…) are by far the most widely used in that the main objective continues to be recovering the cost of supplying water to the user. The European Union's Water Framework Directive (WFD) promotes in particular the significant role to be played by pricing in cost recovery. This is reflected in all Mediterranean countries. The remaining instruments, such as quotas or subsidies, are much less widespread or used in conjunction with pricing.

Nowadays in certain countries, however, tariff systems are also expected to act as an incentive towards balanced resource management whilst (in the farming sector) efforts continue towards intensifying irrigated agriculture for national ends relating to food security or ensuring balanced budgets for infrastructure managers.

Irrigation water:

In terms of the outcome, the cost recovery objective- however limited- is rarely reached. Most countries in which agricultural water is free or where pricing provides only a minor incentive (flat-rate systems) do not apply weighty price increase or tariff change policies. However, pricing in the interests of saving more water, such as volume-based systems requiring the introduction of metering, may be installed in newly irrigated areas (Spain, Greece, Lebanon). Some countries with volume-based pricing are planning programmed price increases (Morocco, Tunisia). Others (Cyprus, Lebanon, Israel…) are intending to increase on an occasional basis to enhance the recovery of water costs.

Example (solution presented in annex 2): Pricing, irrigation water cost recovery and water demand management in the agriculture sector in Tunisia.

Drinking water:

As for irrigation water, the degree to which water savings are encouraged through drinking water pricing depends partly on the tariff structure (flat-rate, uniform, incremental, combined uniform, combined incremental) and partly on price level. The greatest incentive is provided by systems combining highly progressive incremental pricing with a high starting price (Israel, Turkey). The pricing applied in some countries, however, (Egypt, Jordan) whilst volume-based in increments provides relatively little incentive given the low starting price and limited increments from stage to stage. The application of a seasonal rate (Spain) can also help encourage water savings at crucial times.

Amending the tariff structure helps encourage water savings and is reflected in i) the readiness to switch from flat-rate pricing to a combined or proportional system (France[6]), ii) more stages where an incremental system already existed (Tunisia, Greece, Morocco).

There is a general trend towards increasing the cost of water for the user with a view to recovering a growing share of the real cost of drinking water provision and sanitation (EU countries, Spain, Morocco, Tunisia, Egypt…). This trend towards recovering more of the cost- and therefore higher water prices- is set to continue. Driven in particular by the WFD, the growing inclusion of environmental concerns in prices (scarce resources, treatment…) is likely to further consolidate this trend. Besides cleaning up, some countries are also introducing pollution or resource fees, driving up the price of drinking water and encouraging savings whilst providing for the financing of clean-up activities or the development of new resources.

Example (solution presented in annex 2): Drinking water cost recovery in the Palestinian territories (*"Using prepaid meter as a way to enhance the water service's quality").*

Tools to be used with caution and in conjunction with other instruments

Whilst greater use of economic instruments can provide for better WDM, certain conditions must be present if they are to operate correctly and be accepted by society. Such instruments must in particular:

- Take account of other policies or national aspirations regarding, for example, land use planning or curbing food dependency,
- Be compatible with the income of the various users[7].

[6] The 2006 law on aquatic environments stipulates that systematic account must be taken of volumes consumed when water bills are drawn upl. The latter comprise a section for drinking water and another for wastewater collection and/or treatment where such a service exists.

[7] Depending on the country this could take the form of free water for farmers, lower than necessary price increases, the introduction of a specific price structure with water saving bonuses, use of the quota system, the introduction of social pricing for drinking water. In Morocco, for example, price increases for agricultural water were staggered over time to ensure that increases did not outstrip technical progress in agriculture.

The correct functioning of economic instruments is thus dependent on many conditions. The first of these is the definition of a clear objective, a consistent framework and the essential combination with other instruments. Pricing in particular cannot in isolation prompt users to save water, as price awareness tends to be rather low. Additional flanking measures are required:

- Incentives: awareness-raising campaigns about saving water, installation of individual meters, subsidies for using water-saving apparatus. These financial incentives to save water should be sustainable and guarantee the implementation of action plans to improve water use efficiency;

  Examples (solutions presented in annex 2): Training and awareness-raising for drinking water savings, the examples of Tunisia and Cyprus.

- Authoritarian demand control measures (mentioned in point 4.1.2): usage restrictions to address temporary crises or structural shortage, organisation of « water shifts » when there is too little water to meet requirements, seasonal bans on certain types of non-priority consumption (gardens, swimming pools, etc.).

An innovative solution: payments for ecosystem services

Payment for Ecosystem Services (PES) is an offsetting tool used by beneficiaries of services provided by nature to recognise the value of these services and contribute to their preservation, creating a virtuous circle in which natural resources improve the quality of life of local communities.

PES can be an integrated water resources management tool that is effective both from an environmental perspective (by encouraging the water requirements of ecosystems to be taken into account) and an economic perspective, as well as being fair from a social justice standpoint.

Example (solution presented in annex 2): The development of payments for ecosystem services (PES) in Sebou Basin, Morocco.

4.1.4 Consultation and planning tools for joint objectives

Consultation and planning tools for defining joint objectives embraced by all stakeholders constitute useful levers for fostering enhanced WDM in the various sectors of water use, but also between sectors. These tools should be developed at various levels: national, regional and local.

At local level, decentralised management units based on a catchment basin or aquifer, for example, provide the appropriate institutional framework by encouraging subsidiarity. Basin agencies may constitute choice political mediation bodies in water management where they enjoy strong user acceptance as a result of their ability to listen, awareness of social needs, independence, transparency and control authority. User associations- of irrigators, for example- also act as consultation fora for defining and applying highly effective rules in support of WDM.

Numerous practical experiences bear witness to the importance of involving users in joint resource management. The weak performance of the water police in most Mediterranean countries as a result of limited means and the persistence of unlawful practices are encouraging a move towards more local and often more effective self-regulation based on jointly agreed management approaches. The aquifer or river contracts and even water development and management schemes for major catchment basins being developed in the Mediterranean show the real significance of such approaches (inset 3).

Examples (solutions presented in annex 2): Understanding, negotiating and sharing to reduce water demand and ensure balanced distribution of resources between uses and hydrosystems in

the Rhone-Mediterranean river basin (France); Ecosystems conservation in Morocco, the example of the Nador Lagoon (Morocco).

Inset 3: The advantage of approaches involving concertation with users

In France, implementation of the 1992 water law has led to the drafting of a water development and management master plan (SDAGE) for each catchment basin, setting out the focus of management and planning for a period of between 10 and 15 years. In the sub-catchment basins, the water development and management plan (SAGE) supported by local structures is the tool used to manage and protect uses and the resource. In conjunction with the river contract, the Drôme river SAGE initiated in 1992 and involving all water users has led to the introduction of a global mechanism limiting demand for agricultural water throughout the basin by freezing irrigated areas, input of water from the Rhône downstream, compliance with an objective flow rate and the growth of a real time flow measurement network to inform managers.

Source: Faby & al. (2007)

Local management capacity cannot be improved, however, unless its legitimacy and decision-taking powers are consolidated in legal and financial terms, at the same time increasing the criminal and financial liability of its leaders and the transparency of its transactions. This also implies a clear separation between control and management functions.

Moreover, whilst new modeling tools and information and communication technology may help improve water demand management at catchment basin level or within an irrigated area, its effectiveness also largely depends on the implementation of endogenous, participation-based processes needed to construct innovatory water management tools.

Example (solution presented in annex 2): STRATEAU: a modeling and decision-making tool for water management strategies at territorial level.

4.2 Economic evaluation of WDM in the Mediterranean

The economic assessment suggests that WDM measures are cost-effective and make for improved allocation of scant financial resources when compared, for example, with dam construction, water transfers or desalination in numerous studies conducted within the Mediterranean and more generally in regions facing water shortage.

Comparative, measure by measure analysis of the unitary economic results[8]

In the drinking water sector:

- The most effective solutions consist of reducing supply network leakage where initial network yield is low.
- The installation of water-saving apparatus is an effective solution for both user and manager once demand for connection to a constant-sized network is increasing. Water saving potential is enormous at domestic level but difficult to achieve compared with supply networks.

In the irrigation sector:

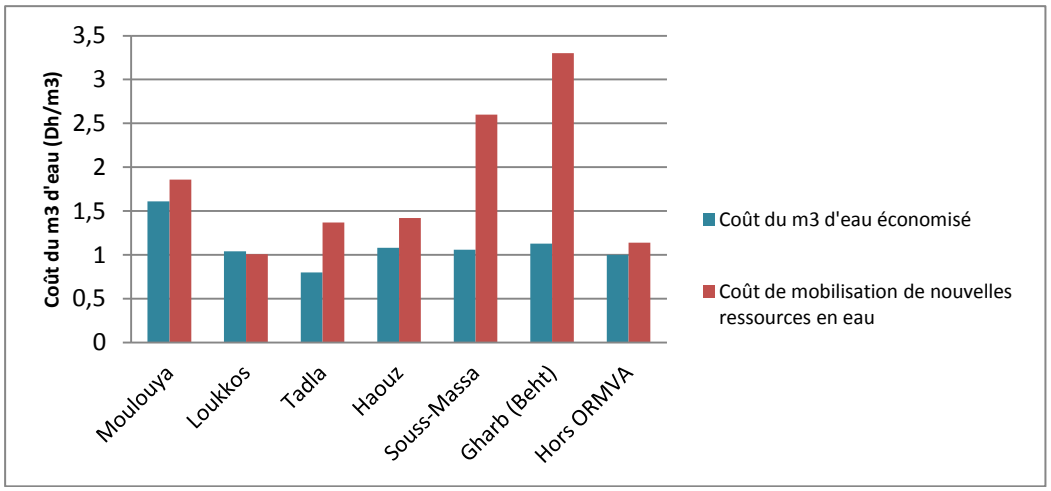
- At network level, optimising the workings of existing supply channels (drip or pressure) would appear to offer as cost-effective a solution as changing collective channels (switching from drip to pressure). Moreover, significant volumes can be saved by renovating networks or making them watertight: they may represent 30 % of abstractions.

[8] This is a presentation of the main results of an analysis of some ten case studies located in France, Morocco, Tunisia, Greece, Spain and Jordan (Fernandez & al., Plan Bleu, 2010).

- The effectiveness of measures to improve hydraulic efficiency throughout the collective network and at plot level largely depends on the initial hydraulic yield of networks and/or irrigation techniques.

Case studies also reveal major spatial variability in cost-effectiveness ratios, particularly in the case of conversion to localised irrigation techniques. In Morocco, the cost per m^3 of water saved by converting plantations and allotments to local irrigation also varies from one region to another, as does the cost of developing new water resources (figure 4).

Figure 4. Comparison between the cost per m^3 of water saved (by converting to localised irrigation) and the cost of mobilising new resources in Morocco



Source : Belghiti (2008)

WDM measures may be economically attractive to the irrigator as they secure water input, improve water use efficiency and even lead to an increase in the volume allotted to agriculture where water is a limiting factor. Thus they do not release water for other uses or the environment. Redistributing water towards other uses requires the introduction of contractual or coercive incentives which can make water rights more flexible.

According to a multi-use perspective:

- Solutions intended to render the use of water from dams more flexible may prove effective.
- Solutions intended to limit diffuse pollution are effective.
- Supply-increasing solutions such as transfers or seawater desalination are the least effective.

Global project analysis

Besides providing a measure by measure assessment, the studies also assess the cost-effectiveness ratios of various combinations of measures as a function of achieving a given volume of available water, intended either to ease pressure on the environment or to meet new human needs.

According to the case studies, besides being the most cost-effective measures, reducing network leakage and installing water-saving apparatus may also go a long way towards meeting future demand for drinking water.

Project feasibility studies should also take account of several aspects:

- Major spatial and temporal variability (seasonal variability in the supply/demand ratio with peak periods) in the efficiency of some measures,
- Only measures with a negative ratio are likely to be spontaneously implemented since they represent a net profit for the clearly identified beneficiary of the measure. Measures with a

low but positive ratio, on the other hand, usually require collective financing (public, international), particularly those involving indivisible investments with high fixed costs.

Examples (solution presented in annex 2): Cost-effectiveness analysis for WDM measures in the Guadalquivir river basin (Spain); Economic analysis and WDM policies & strategies matrix, EW2 program (AFD/Plan Bleu) implemented in the framework of the Marseilles Centre for Mediterranean integration (CMI); The Water footprint approach (inset 4).

Inset 4: The water footprint approach

Production water footprints provide a measurement of water use on a national scale, and serve as an indicator for the level of water consumption associated with human activity. They include the amount of green water (rainfall) and blue water (water in hydrosystems) used in the production of agricultural products (in the main), and grey (polluted) water generated by agricultural, domestic and industrial uses.

Calculating the water footprint could also be used to measure "virtual water" exports and imports between two countries as a function of trade volumes between these two countries (cf. Target report MED 1.2).

Source: WWF (2011)

4.3 Examples of implementation or innovation around the Mediterranean

The existing or innovative solutions collected in the framework of the preparatory process for the 6th World Water Forum are presented in annex 2, by territorial levels (users, water services, river basin, national or regional levels). Focused and local solutions are presented in the previous chapters. Solutions relying on national policies and strategies are also highlighted.

Examples (solution presented in annex 2): The Water demand management Unit in Jordan; National water strategies in Morocco and Tunisia.

These solutions, implemented and by different kinds of actors, are based on a combination of WDM measures (mentioned in previous sections). The selected examples illustrate WDM improvements in the various water use sectors (intra-sectoral efficiency), and between sectors (inter-sectoral efficiency, issue of resource sharing between uses).

4.4 Lessons, leverage and conditions for WDM implementation

The Mediterranean experience with managing water shortage and demand allows certain lessons to be drawn, particularly regarding leverage and conditions for WDM implementation. They can be summed up as follows:

- Ensure strong political leverage and support at the highest level of State in order to provide the coherent strategic framework required to coordinate action and to provide lasting, sustainable commitment,
- Be familiar with/assess current and future water demand (social, economic, environmental), in order to define the priority sources of water savings or those most « profitably » exploited,
- Conduct for this purpose future studies exercises at the appropriate territorial levels, with particular focus on the water/agriculture relationship.
- Promote and implement WDM within the various sectoral policies (agriculture, energy, industry, trade, tourism…) which are crucial in many countries,
- Territorialise WDM implementation to better understand the determinants, factors limiting water uses and hydro-social cycles in a given area,

- Draw on a combination of WDM tools appropriate to each situation and country; attach particular importance to training and awareness-raising for professionals and water users to promote better understanding of WDM stakes and potential benefits,
- Develop recourse to cost-benefit or cost-effectiveness analyses, comparing several water management options (measures intended to increase water supply and WDM measures), internalising as far as possible the cost of the social and environmental impact of the various options,
- Design action plans which also allow new resources to be mobilised in order to optimise the water supply/demand approach, combining « technical »-type approaches focusing on technique and supply infrastructure with « societal » approaches,
- Promote a cross-cutting vision and the use of instruments to align environmental, water and sectoral policies at national and local level.

5. Recommendations for follow-up

The monitoring of the implementation of the target action plan, compliance with the commitments made by the various stakeholders (governments, local authorities, sponsors…) and the application of « promising » solutions should be based on the definition and regular filling in of indicators.

As far as possible, priority will be given to the use of already existing indicators (at regional, national and territorial level) such as:

- The Mediterranean Strategy for Sustainable Development's monitoring indicators: water efficiency index (total and per sector), water demand (total and per sector) and water demand compared with GDP (total and per sector), renewable resource exploitation index,
- The indicators for monitoring national water efficiency improvement objectives defined by some Mediterranean countries,
- Indicators for monitoring water efficiency improvement objectives defined at catchment basin or conurbation level, etc.

Further indicators specific to this target objective could also be defined.

The implementation of « solutions » (WDM tools) could be monitored on the basis of a matrix listing the various solutions and assessing the degree of implementation according to different criteria (see detail in annex 3):

Solution (WDM tool)	Already existing	Planned	Result	Comments (constraints)	Criticality/ issue	Economic analysis
Agriculture sector						
Enhanced hydraulic efficiency of channels						
Enhanced efficiency of irrigation techniques						
Etc.						
Domestic sector						
(…)						
Industrial sector						
(…)						
Allocation between uses						
(…)						

6. Conclusion

Discussions and experience in water demand management and processes for regional co-operation on the environment and development in the Mediterranean may interest many other areas of the world given:

- the anticipated impacts of climate change which will increase water shortage and drought problems in many regions,
- the overexploitation of groundwater resources which is becoming a major international problem,
- the increasing awareness of the necessity and importance of greener growth which first aims to reduce losses and inefficient use before tapping into new resources,
- the food crises which are increasingly associated with structural problems and becoming more international in scope, requiring better management of all our resources and ecosystems.

Water demand management aims to encourage better use of water before increasing supply and thus contribute to resolving the imbalance between water supply and demand. As such it is a major response to these various challenges. It involves practical action to improve, and even transform, production and consumption modes across the various water use sectors. It requires a change in practice and behaviour and a policy shift away from infrastructure projects to accountability of stakeholders. It should be highlighted that in the agricultural sector, the notion of rational water use should not only apply to irrigation, but should be extended to all rainfed agriculture, the sector which uses the largest proportion of water resources (cf. target MED 1.2).

In order to limit their dependence on "unsustainable" water abstraction, some countries are also committing to developing non-conventional water production such as the reuse of treated wastewater and desalination of seawater and brackish water (cf. targets MED 2.1 and MED 2.2). The development of these non-conventional freshwater production methods will nevertheless be determined by the relative changes in their cost - especially energy costs – and their technical feasibility in comparison with abstraction of natural resources. It also depends on issues of the environment, health and public acceptance.

Water demand management involves a combination of tools and political will. Economic instruments are one of the tools available and can, in particular, make a significant contribution to more efficient allocation of water resources in different sectors and across sectors and to improving access to water and taking into account environmental concerns. They can encourage behavioural change on the part of the various users and also contribute to the funding that is essential for water management. Consultation and planning tools to define shared objectives for all stakeholders are also key factors for encouraging better water demand management in the various water use sectors, but also between sectors, on the different territorial levels (national, regional and local).

Economic assessment also suggests that water demand management measures are often cost-effective and that they provide a better allocation of scarce financial resources when compared, for example, with the construction of dams, water transfer or with desalination in regions that are facing water shortages. The economic assessment of ecosystem services – e.g. wetlands – can also be extremely useful to ensure that meeting the water requirements of ecosystems is recognised as a priority. This underlines the importance of developing the use of cost-benefit or cost-efficiency analyses that compare several water management options (supply-side measures and water demand management measures), by internalising the cost of the social and environmental impacts of the different options to the greatest possible extent. These analyses are real decision-making aids.

Water demand management requires progressive approaches that are tailored to each local situation with increased involvement of users and improved awareness of these issues among policymakers. However, the realisation of this almost "cultural" change and its extension to other Mediterranean countries, and other regions of the world, first and foremost requires support from the highest levels of Government in order to provide a cohesive strategic framework. This is essential for the co-ordination of actions and an ongoing long-term commitment.

For water demand management to become fully effective in managing tensions over water, it now seems crucial to move out of the world of water and promote tools which influence sectoral policies, while also stimulating economic and social development within countries. This means moving from technical efficiency to economic and social efficiency, and from efficiency within sectors to efficiency across sectors. This supposes promoting a cross-sectoral vision and the use of instruments that align water policies and sectoral, environmental and planning policies at both a national and local level.

Annex 1: Various tools for managing demand for agricultural water implemented in the Mediterranean

Institutional framework

Consistent strategic framework

essential for the coordination of action and lasting, sustainable commitment

Technical tools

- Improving channel hydraulics
- Improving the efficiency of irrigation techniques
- Reducing the vulnerability of agronomic models and crop systems
  - ✓ Improvement of cultivated species
  - ✓ Review of intercrop and crop behaviour
  - ✓ Crop choice and optimisation of rotation
- Use of top-up irrigation
- Irrigation planning and guidance tools

Economic instruments to encourage water savings

- Pricing
- Quotas
- Financial assistance (subsidies, soft loans)
- Fees
- Uncoupling of CAP aid
- Agro-environmental measures
- Environmental cross-compliance

Regulatory and abstraction control instruments

- Declaration system/ abstraction authorisation
- Temporary restrictions relating to hydro-climatic variations
- Mandatory metering of abstracted volumes (beyond certain thresholds and depending on the type of abstraction)
- Water Police responsible for checking and reporting on offenders

Planning and consultation tools

- Decentralised management units (basin agencies)
- User associations, irrigator associations
- NICT (software to support water management in an irrigated area)

Training and awareness-raising tools

- Awareness-raising campaigns for farmers and the general public
- Agricultural extension
- Training of professionals, technicians and agricultural engineers

Annex 2: Existing and innovative solutions collected in the framework of the preparation for the 6th World Water Forum

Type of solution	Title of the solution	Contributor	Associated targets
At the user level			
Awareness raising and education for water savings	Water demand management at user level regarding water saving behaviors in Cyprus	I.A.CO Ltd (Environment & Water consultants)	
	Education and awareness raising for drinking water savings - The example of Tunisia	SONEDE	
Water saving devices and systems	IDARA project: Instituting Water Demand Management in Jordan	Ministry of Water and Irrigation	
Recycling grey and black waters, rainwater harvesting	Technical demonstration of local water management in Tunisia	Centre of Water Research and Technologies Tunis	Med 2.1 and 2.2
Agricultural practices, water management at plot level	Management of irrigated schemes : the role of water user associations in Sebou, Morocco	Union des fédérations des AUEA	Med 1.2
Industrial process optimization	Water program of OCP, Morocco	Office Chérifien des Phosphates (OCP)	Med 2.1
At the water services level			
Renovation and modernisation of irrigation systems (pressurized systems)	The national irrigation water saving programme (PNEEI) in Morocco	Ministry in charge of agriculture, Morocco	Med 1.2 Th 2.2
Improvement in urban networks efficiency	PPP for improving water services' efficiency in Algiers (Algeria)	Suez Envt / SEAAL	Th CS 1.2
	Reducing water losses in Oujda (Morocco)	RADEEO	
	Analysis, planning and verification of WDM techniques in Aqaba (Jordan)	Aqaba Water	
	Improve water service quality in Bethlehem area	WSSA, Palestinian Water Authority	
Pricing and cost recovery	Pricing, irrigation water cost recovery and agricultural water demand management in Tunisia	Hamdane A. (consultant)	Med 1.2
	Using prepaid meter as a way to enhance the water service's quality in Jenin Governorate (Palestinian Territories)	JSCJWV (Service for Jenin West Villages) & PWA	
At the territorial level			
Concerted and common management, regulation for groundwater overexploitation control	Highland Water Forum and groundwater bylaws enforcement in Jordan	Ministry of Water and Irrigation	
	Integrated management in the Souss Massa river basin in Morocco	Souss Massa river basin Water Agency	

Management of intersectoral transfers	National strategy for reallocation and wastewater reuse in Jordan	Ministry of Water and Irrigation	Med 2.1
Planning and consultation tools to improve inter-sectoral water management and to take into account water needs for ecosystems	Understanding, negotiating and sharing to reduce water demand and ensure balanced distribution of resources between uses and hydrosystems	Rhone-Mediterranean and Corsica Water Agency	Med 3.2
	Ecosystems conservation in Morocco, the example of the Nador Lagoon	Fondation Mohammed VI	
Modeling tools (assessment of water demand and supply)	STRATEAU: a modeling and decision-making tool for water management strategies at territorial level	French Water Embassy	
Cost-efficiency analyses for WDM at the watershed level	Cost-effectiveness analysis for WDM measures in the Guadalquivir river basin (Spain)	Guadalquivir Hydrographic Conf.	
Payements for ecosystem services	The example of Sebou river basin in Morocco	WWF	
Improving rainwater management (soil and water conservation etc.)	Improving rainwater management n a context of water scarcity The example of Tunisia	Hamdane A. (consultant)	Med 1.2
At the national level			
Reinforcement of the institutional framework for WDM, combination of measures progressively and continuously implemented	Water Demand Management Unit in Jordan	Ministry of Water and Irrigation	Med 3.1
	Water demand management: a priority in the national strategy for water in Morocco	Ministère de l'énergie, des mines, de l'eau et de l'environnement - Dpt eau	Med 3.1
	National Strategy for Water by 2050 in Tunisia Enhancement of participatory management in Tunisia	Ministry in charge of agriculture, Tunisia	Med 3.1
Tariff, tax and trade policies	Pricing, equalization		
	Solution to increase the added value per m3 of water and decrease the water footprint via international trade	WWF	Th 3.2 Med 2.1
At the regional level			
Sharing best practices, benchmarking	Economic analysis for water demand management Strategies, Works carried out in the framework of the Marseilles Center for Mediterranean integration (CMI) activities	AFD and Plan Bleu, in the framework of the CMI water programme	
The Mediterranean wetlands observatory	The Mediterranean wetlands observatory: a solution for addressing the disappearance of wetlands in the Mediterranean	Tour du Valat	Th 1.5

Annex 3: Example of matrix for monitoring the implementation of « solutions » (water demand management tools)

Solutions in the agriculture sector (WDM tools)	In place	Target	Result	Comment/constraint	Criticality/issue	Economical analysis
Technical tools						
Hydraulic efficiency (conveyance, irrigation scheme)						
On farm irrigation efficiency						
Crop mix						
Irrigation schedule						
Crop and seed selection						
Agronomic improvements: soil, greenhouse, hydroponics						
Surface irrigation metering						
Wells metering						
Groundwater monitoring						
Legal/institutional tools						
Declaration system / abstraction permit						
Equipment standards / activity approval						
Mandatory metering						
Enforcement means / fining system						
Temporary restrictions relating to hydro-climatic variations						
Aquifer contract (contrat de nappe)						
Water rights						
Arbitration system						
Economic tools						
Tariff (volume, block-tariffs, flat-rate per ha, per crop type, season...)						
Quota (surface, crop, season, etc.)						
Farm subsidy (+ Agro-environmental measures)						
Charges (abstraction/pollution)						
Transfer (capital investment irrigation schemes)						
Water rights exchange						
Export subsidy						
Import duty						
Agriculture/land management policy						
Cross-compliance (éco-conditionnalité)						
Communication/concertation						
Water users associations						
Awareness-raising, extension						
Training						

Solutions in the domestic sector (WDM tools)	In place	Target	Result	Comment/constraint	Criticality/issue	Economical analysis
Technical tools						
Wells metering						
Groundwater monitoring						
Hydraulic efficiency (conveyance)						
Distribution network efficiency						
Pressure management						
Physical loss reduction						
Asset management						
District metering						
Individual connection versus water points						
Customer metering						
On house water management						
Water-saving customer equipment						
Water harvesting (house level/city level)						
Legal/institutional tools						
Declaration system / abstraction permit						
Equipment standards / activity approval						
Mandatory metering						
Enforcement means/ fining system						
Temporary restrictions relating to hydro-climatic variations						
Output-based aid (OBA) water services						
Economic tools						
Tariff (flat-rate, uniform or block-tariffs)						
Quota (conveyance)						
Water services subsidy						
Transfer (capital investment)						
Communication/concertation						
Awareness-raising						
Extension						
Training of water services operators						

Solutions for improving intersectorial efficiency (reallocation) (WDM tools)	In place	Target	Result	Comment/constraint	Criticality/issue	Economical analysis
Technical tools						
Water transfer at basin level						
Water transfer inter governorates						
Wastewater reuse (domestic to agriculture or industry)						
Multi-uses structures						
Peak factor (seasonal…)						
Legal/institutional tools						
Priorisation of uses						
Quantification per sector						
Quantification per governorate						
Private public partnership / project finance						
Economic tools						
Tariff (?)						
Quota (?)						
Water services subsidy						
Transfer (capital investment)						
Communication/concertation						
Awareness-raising						
Extension						
Training of water services operators						

<u>Annex 4</u>: Members of the Target & Solutions Group
for the priority on "Water demand management" (targets MED 1.1 & MED 1.2)

Coordinating organizations

Plan Bleu 15, rue Beethoven - Sophia Antipolis 06560 Valbonne, France Tel : (+33) (0)4 92 38 71 30 Fax : (+33) (0)4 92 38 71 31 Email : planbleu@planbleu.org	**Agence française de développement (AFD)** 5, Rue Roland Barthes 75598 Paris Cedex 12, France Tel : (+33) (0)1 53 44 31 31 Fax : (+33) (0)1 44 87 99 39 Email : site@afd.fr

Coordinators

Ms Gaëlle THIVET Plan Bleu Tel : (+33) (0)4 91 55 48 18 Email : gthivet@planbleu.org	Mr Frédéric MAUREL AFD / Water and sanitation division Tel : (+33) (0)1 53 44 40 24 Email : maurelf@afd.fr

Members of the Target & Solutions Group

Mr Philippe GUETTIER Ministry for ecology, sustainable development, transport and housing, France Email : philippe.guettier@developpement-durable.gouv.fr	Mr Abdelkader BENOMAR Ministère de l'énergie, des mines, de l'eau et de l'environnement, Maroc Email : benomar@water.gov.ma
Mr Luc HERROUIN Rhone-Mediterranean & Corsica Water Agency, France Email : luc.herrouin@eaurmc.fr	Mr Mohend MAHOUCHE WWF France Email : mmahouche@wwf.fr