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Conceptual Frame for Rational Use of Water Resources in the Mediterranean

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Abstract. Many countries in the Mediterranean region are located in the arid to semi arid regions of the world that are known to have limited water resources and suffer increasing water scarcity. Sustainable management of these resources will become increasingly complex in the future as climate change is expected to increase the frequency and intensity of drought and water shortages. There is an increasing concern about the effective and efficient use of water for agriculture, and water conservation in general. The promotion of effective water use and on-farm water management are identified as important contribution to management strategies to address problems of water scarcity and to promote intensive agriculture on environmentally sound grounds. The conceptual frame of rational water use is based on research papers and discussions during the second MELIA project workshop and on papers uploaded on the Melia website. Most of the contributing partners focussed on the solutions to local and regional issues for rational use of water resources. They have also identified instruments and measures that could be employed to contribute to the rational use of water, mainly in the agricultural sector.

Keywords. Water resources – Water availability – Water supply – Water use – Water management – Water policies – Water conservation – Water use efficiency

Cadre conceptuel pour une utilisation rationnelle des ressources en eau dans le basin Méditerranéen

Résumé. *De nombreux pays de la région méditerranéenne sont situés dans des zones arides et semi arides du monde avec des ressources en eau limitées et une pénurie d'eau croissante. La gestion durable de ces ressources deviendra plus complexe et difficile dans l'avenir à cause des changements climatiques qui augmentent la fréquence et l'intensité des sécheresses et de la pénurie d'eau. Il y'a une préoccupation croissante actuellement au sujet de l'utilisation efficace et efficiente de l'eau en agriculture et la préservation des ressources en eau en général. La promotion de l'utilisation rationnelle de l'eau et la gestion des eaux agricoles ont été identifiées comme des contributions importantes à la stratégie de gestion des ressources en eau, nécessaires pour résoudre les problèmes de pénurie d'eau dans les pays méditerranéens. Le cadre conceptuel de l'utilisation rationnelle de l'eau est basé sur des documents de recherche présentés au second MELIA Workshop et/ou téléchargés sur le site Web du projet Melia. La plupart des partenaires et d'autres membres du projet MELIA ont mis en évidence les solutions locales et régionales pour l'utilisation rationnelle des ressources en eau. Ils ont également identifié les raisons et les mesures qui pourraient être prises pour contribuer à l'utilisation rationnelle de l'eau principalement dans le secteur agricole.*

Mots-clés. *Ressources en eau – Eau disponible – Pénurie d'eau – Approvisionnement en eau – Politique – Economie – Préservation de l'eau – Utilisation de l'eau – Efficacité d'utilisation*

I – Introduction

In the Mediterranean water resources are limited, fragile and very unevenly distributed over space and time. During the second half of the 20th century, water demand has increased twofold, reaching 280 km^3 /year in 2005. Agriculture consumes 64 % of total water demand: 45 % in the north and 82 % in the south and east. In numerous Mediterranean countries, water use is

approaching the limit level of available resources. Momentary or structural water shortages are being observed. The number of '*water poor'* Mediterranean people, living in countries with less than 1,000 m^3 of water per person per year, extends to 180 million, 60 million of whom face shortage conditions with less than 500 m^3/capita/year. Twenty million Mediterranean people are still deprived of access to drinking water, particularly in the south and east (Plan Bleu, 2011).

Within the MELIA project, a debate and dialogue on the perspectives for rational use of water resources in the Mediterranean region was carried out to assess and promote schemes of water saving, or optimal water use and water conservation for different sectors (urban, industrial and agricultural). Important savings can be achieved in agriculture through a better use of both technical and economical tools, as well as institutional and human resources. Water saving can also be achieved in both drinking water and industry, but the most beneficial saving in terms of volume would be in irrigated agriculture.

The paper is based on research papers presented at the second MELIA project workshop and on papers uploaded on the Melia website (Karaa *et al.,* 2010; Mazahreh *et al.*, 2005, Munla, 2007; Dudeen, 2009; Abdin and Gaafar, 2009; Chimonidou *et al.*, 2009; Rana *et al.*, 2009; Omrani and Ouessar, 2010). We would like to thank all MELIA partners for their contributions. Most of the contributing partners focussed on the solutions to local and regional issues for rational use of water resources. They have also identified instruments and measures that could be employed to contribute to the rational use of water, mainly in the agricultural sector. After elaborating the issue of water scarcity in the region, we will present a number of lists of, among others, measures and instruments that are expected to contribute to developing the framework of rational water use for the Mediterranean.

II – Water scarcity in the Mediterranean countries

The Mediterranean is one of the regions to be affected most by climate change, facing water problems such as scarcity, pollution, conservation, sanitation and management of resources. Water is a scarce commodity in most Mediterranean countries and its availability is declining to a critical level.

Shelef and Azov (1996) list the following features and characteristics shared by Mediterranean countries:

- Warm, sunny and dry during a relatively long summer and a relatively long rainy season during autumn, winter and early spring.
- A general shortage of water, at least in certain regions of the respective countries.
- A threat of pollution of groundwater and surface water, due to the lack of dilution, dispersion and flushing out, which is a consequence of the general shortage of water.
- Ideal circumstances for intensive agriculture to grow crops that need a warm and dry climate. This results in the export of agricultural products to countries with a colder climate. In most regions irrigation is needed to sustain this intensive agriculture during the dry summer, however, in some countries irrigation is required almost all year.
- The occurrence of droughts, frequent or occasional, depending on the region. Droughts lasting several years occurred in the Middle East and southern Europe in the past two decades.
- Tourism is one of the most important economical branches. Tourism provided countries with hard currency (the economy in certain countries largely depends on this). Tourism requires high standards of sanitation, drinking water and food, and, furthermore, clean beaches and water to swim in.

- Relative susceptibility to disease outbreaks and even epidemics due to the sanitary conditions, the warm climate, the relatively high proportion of disease carriers and locally endemic diseases.
- Relative shortage of funds for both capital investments and operating costs in the municipal public sector.

We add the following features:

- Rapid population growth and significant rising of consumptive demands, especially as a result of migration from rural to urban areas.
- Trans-boundary water dependencies and challenging questions of overlapping political and administrative boundaries affecting shared water bodies.

According to Abdin and Gaafar (2009) other important factors contribute to the deteriorating water situation in most Mediterranean countries. These driving forces can be categorized in four subgroups: social forces (poverty, inequity, cropping patterns and consumer behaviour), physical variables, economic forces and political forces (for instance irrigation water subsidies).

In the Mediterranean region nearly 70% of the available water resources is allocated to agriculture. In the arid and semi-arid countries of the region agricultural water use accounts for as much as 80% of the consumed water. In the Northern countries this can be about 50% of the total available resources (Hamdy and Lacirignola, 1997). According to De Wrachien (2003), more than 16 million hectares are irrigated. As water resources in the eastern and southern Mediterranean are decreasing, they are expected to be the main limiting factors for agricultural development, particularly in the period 2000 – 2025. The water needed for irrigation is scarce and finding land suitable for irrigation is becoming more difficult (De Wrachien, 2001).

As said before, significant water savings are possible if better use is made of existing human and natural capacities. Therefore, governments have made great efforts, and have invested heavily, to improve water resources management through the application of new technologies in urban and agricultural areas. Such investments are intended to reduce water losses and to increase water availability at local levels. However, when entire river basins are considered, the issues become more complex (Duqqah *et al.,* 2010)

The situation clearly calls for a review of existing policies. This review should embrace an integrated view and should, regarding water resources, consider both demand management and supply augmentation (Sapiano, 2008).

Demand Management: Regulatory instruments must be formulated in order to adjust, limit or stop water uses or users who are utilizing the resource inefficiently and thus contribute to the degradation of the natural resource base. The underlying aim should be to give priority to the environment and water uses that have the highest social and economic value.

Supply Augmentation: A programme of measures must be developed which should wherever possible encourage incentives for the augmentation of the current water supply both at a local and a regional level.

Many different options exist for augmenting supply and managing demand. A problem-focused approach is therefore needed to ensure that options are selected that are most suitable in the local context.

III – Towards a conceptual frame for sustainable rational use of water resources in the Mediterranean

As a synthesis of debates, contributions, discussions, it was convened that sustainable perspectives on rational use of water resources in the Mediterranean region will be developed by taking into account the following aspects, strategies, tools, measures and so on:

Strategies for basin management improvement Basin management is a policy instrument that takes into account all water resources and all water uses in a basin, together with the physical, social and economic influences on these. To improve basin management by using the concept of sustainable rational water use, we propose:

- ✓ To set up public education and inform the users about their rights as well as their responsibilities.
- ✓ To elaborate guidelines on how to develop public awareness.
- ✓ To improve communication amongst stakeholders.
- ✓ To prepare users for the new concepts of ***"****Rational Water Use"* and the environmental dimension.
- ✓ To improve the water use of irrigation in the engineering and technical context.
- ✓ To make the farmers aware that they have to pay for water, though this is often complicated as some farmers think: *" if rain water is free, why must we pay for the water we use?"*
- ✓ To improve irrigation techniques (drip irrigation, sprinkler), use alternative sources of water such as treated wastewater or drainage water in irrigation, etc.
- ✓ To promote agronomic research and application of results such as:
    - selecting crop varieties with high yield per unit of water;
    - switching to less water intensive crops;
    - sequencing crops to maximize output under conditions of soil and water salinity;
    - selecting drought resilient crops where necessary;
    - introducing water efficient crop varieties.
- ✓ To look for a strategy in the whole Mediterranean for preserving water in agriculture
- ✓ To look for new sustainable technologies, regulations, cooperation between different stakeholders in water management.
- ✓ To increase farmers' awareness in water resource management and encouraging participatory approach.
- ✓ To finance and establish pilot projects for collective irrigation, especially in ground water resources.
- ✓ To get benefits from the investment projects that support national projects for irrigation modernization.
- ✓ To finance the rehabilitation of government irrigation projects with easy and grace period loans.
- ✓ To build capacity in the field of designing, operation, and maintenance in addition to preparing trainers to promote strategies for modernizing and managements of irrigation projects.
- ✓ To develop national standard specifications for all irrigation equipment.

- ✓ To develop industrial and research labs, and contribute to establishing labs to monitor the quality of produced irrigation equipment.
- ✓ To construct additional water works, such as new dams and expand irrigation networks.

Technical, economic, social and environmental aspects

- ✓ Special attention to water value as a pillar of water policy.
- ✓ More extension is required to reach end-users.
- ✓ Consensus is needed on indicators to assess water use and water scarcity.
- ✓ Special attention to the social dimension as well as the economic in water use.
- ✓ Assessment of the balance between private and public intervention in water sector.
- ✓ Emphasis on better bridge between research and extension.
- ✓ Fostering awareness of decision makers on real challenges in water resources management.
- ✓ Further studies on integration of water pricing and water affordability.
- ✓ Establishing water user organizations for increasing farmer involvement in the management and collection of water fees.
- ✓ Reducing irrigation subsidies and/or introducing conservation-oriented pricing.

Sustainable technological solutions for water treatment recycling and reuse

- ✓ Select the technology that best fits the local conditions and be aware that technologies successful somewhere are not necessarily successful somewhere else.
- ✓ Reuse of drainage water and treated wastewater in agriculture.
- ✓ Desalination of brackish and sea water.
- ✓ Enable all actors to be involved in experimental platforms development. Scientists and administrators have to work together.
- ✓ Promote the broad dissemination of successful scientific results to the public, end-users and all concerned agents (Translate scientific outputs into common language).
- ✓ Promote participatory approaches in decision making.
- ✓ Increase training opportunities for technical and non-technical staff.
- ✓ Enhance public awareness on a regular basis, not an ad-hoc basis. Institutional and economic support is needed.
- ✓ Create lobby groups to ensure that policy makers properly understand the problem and adopt the appropriate means.
- ✓ Use unconventional channels to convey the message to as wide audience as possible (e.g., use football teams, actors, etc.)
- ✓ Show the consequences of not taking any action.
- ✓ Develop a communication strategy with media involvement.
- ✓ Strengthen training and extension services to disseminate efficient technologies.

Efficiency and equity in water policies

- ✓ Water policies must be developed in an integrated fashion with other policies.
- ✓ All national policies should be revisited from time to time.
- ✓ Align national water policies with WFD principles rather than simply adopt WFD in a mechanical manner.
- ✓ No single national policy can be developed without the full participation of end-users after they have developed the required capacity through various tools such as extension services, training and others.
- ✓ National policies should follow a bottom-up participatory process to guarantee confidence, engagement and commitments of the end-users.
- ✓ Models should play an important role in supporting decision making processes, just us other technological tools do.
- ✓ Taking appropriate decisions is not simple, due to the different inter-connected aspects and the complexity of the issues. Decision Support Systems (DSS) and models can help the decision making process through iterative learning cycles.
- ✓ Indicators as well the results of DSS should support the development of a sustainable management plan.
- ✓ International technical cooperation needs political agreements and consensus on common objectives. This is specifically so for IWRM in the Mediterranean Region.
- ✓ Technical cooperation among countries needs legislation to identify rights, roles, and levels of cooperation regarding different water resources.
- ✓ Increased penalties for water miss-users or those who cause waste in different fields.
- ✓ Strengthening of “the polluter pays” principal.
- ✓ Encouragement of participation both at the low level through water users associations in old and new irrigated areas; as well as at the higher level of the distribution canal through the formation of the water federations.
- ✓ Harvesting local water runoff and floodwater to increase water supplies for dry land agriculture (construction of rainwater cisterns and ponds).
- ✓ Reducing evaporative water loss by cropping in closed environment (greenhouses). This method is economic with land and water use, avoids soil salinization and produces high yields of exportable crops.
- ✓ Considering the use of brackish water for irrigation of salinity tolerant crops.
- ✓ Saving freshwater by switching to irrigation with treated wastewater.
- ✓ Shifting from high demand water crops to low demand water crops.

Developing tools for water quality-quantity monitoring for management of water resources

- ✓ Remote sensing is a complementary tool which can reduce the amount and costs of field measurements for integrated water management. However, ground truth data is required for validation.
- ✓ Active remote sensing (i.e. Radar and Interferometer are additional remote sensing tools for assessment of water quality and non traditional water resources. Developing computer models and computation of indices are used as indicators for water quality and water balance.

- ✓ Additional research should be established to enhance water use efficiency within farmers' parcels.

Improve knowledge sharing among practitioners

- ✓ Enable their participation in different scientific events as well as in the experimental work.
- ✓ Build their theoretical capacity to enable them to combine theory with practice
- ✓ Report on success and failure stories that they witness and lessons learnt.
- ✓ Provide communication venues.
- ✓ Enable exchange of expertise (remove barriers such as lack of funds, language, etc.)

IV – Conclusion

The enormous importance of water for the social and economic development of mankind and the conservation of our natural environment requires the mobilization of all of us, to take the necessary steps for the sustainable development of our natural resources and the raising of public awareness on the rational use of this precious commodity of nature.

However, it should be pointed out that water scarcity, due to growing demands coupled with the marked decline of rainfall attributed to climatic changes worldwide, makes the rational use of water and the reduction of wastage imperative. The more water we save today, the greater our chances are to have water in the future.

The improvement of strategies for basin management taking into account the technical, economic, social and environmental aspects, the use of sustainable technological solutions for water treatment recycling and reuse, the efficiency and equity in water policies, developing tools for water quality-quantity monitoring and the improvement of knowledge sharing among practitioners would be the key actions towards a sustainable rational use of water resources.

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