

Water demand management in the Mediterranean, progress and policies

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PAPER

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*An initiative towards water saving and sustainable
demand irrigation management in the Mediterranean*

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by

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Abstract

In most arid and semi arid countries of the Mediterranean, it is well recognized that appropriate approaches towards sustainable solutions to the increasingly water problems the majority of those countries are now facing lies in reducing water losses, and increasing water use efficiency and crop water productivity in the agriculture sector the one receiving more than 80% of the available water resources, but, unfortunately with water losses exceeding the 50% and with on farm water management generally below the 40% and thereby there is a high potentiality for water saving in this field to supply the increasingly water demands in the other sectoral water uses.

Aware of this, for more than 15 years the Mediterranean agronomic institute of Bari has focused its activities on integrated demand water management in the agriculture sector to increase the water saving potentiality in the irrigation sector.

The gathered information, the research findings and the know-how obtained through networking activities, research programmes and bilateral and multilateral cooperation projects during the course of these years was translated in an ample Regional Action Programme on Water Resources Management (RAP-WRM). The programme started in 1998 and lasted for five years within the frame work of the EU-DGI activities, and was realized in tight cooperation with many scientific institutions and involved many irrigation experts and researchers from most countries of the Mediterranean.

This work aims to synthesize main considerations and objectives of RAP-WRM programme as well as to present the outputs and results achieved during this realization.

Introduction

The complex dimension of the Mediterranean freshwater resources, their fragility and scarcity have received considerable attention as a primary political, technical and scientific issue in many occasions during the last decade (Dublin, 1992; Rio, 1992; the Hague, 2000) and also recently during the Johannesburg World Conference on sustainable Development in August 2002 and 3rd World Water Forum

held in Kyoto in March 2003 and the International Conference on Water, Land and Food Security in Arid and Semi-Arid Regions, Bari-Italy, 2005. All these conferences and meetings have emphasized that the water perspectives in the Mediterranean region are concerned by two fundamental issues: the continuously growing water demand, on one hand, and the chronic water scarcity and expanding problems of pollution, on the other one. Both these issues are interrelated into the complex water functions and affected by unfavourable regional climatic conditions and other environmental and socio-economic factors having frequently triggering effects.

Today, in most Mediterranean countries suffering the water shortages, at the heart of the question of whether a water crisis can be averted or whether water can be made productive. Increasing the productivity of water is central to producing food, to fighting poverty, to reducing competition for water and to ensuring that there is enough water for the nature. The more we produce with less water and/or with the same amount of water, the less the need for infrastructure development, the less the conflicts among the sectorial water uses, the greater the local food security and the more water for agricultural, household and industrial uses, and the more remain in nature. However, achieving the greater water productivity needed to resolve water shortages problems through water saving management will not happen automatically.

There is a great need to find appropriate ways and proper tools for water saving and to achieve greater efficiency in all water sectors and in particular the irrigation one where efficient water use is very poor below the 45%. But finding such ways will require that a wider range of alternative approaches to be developed, tested and implemented.

In this regard significant challenges remain in the areas of technological, managerial and policy innovation and adaptation, human resources development, information transfer and social environmental considerations.

Indeed, those are the key issues of the philosophical approach focusing on agricultural sector in the RAP – WRM programme. The new in this programme is that its final goal is to increase the water supply to compensate the notable shortfalls in the available water resources to meet the increasing water demand, not through the oriented supply management approach, but by adopting the oriented demand management one.

Water planning and management: the need for a new approach

The traditional hardware approach – Increasing water supply

Traditionally, solutions were fully focusing on the supply-side, relying on an ever-larger number of dams, reservoirs and aqueducts to capture and store ever-larger fractions of freshwater run-off. Such approach is now criticized for environmental, economic and social reasons. Basic human needs for water still remain unmet and it is becoming harder and harder to find new water resources, or even to maintain the existing ones to supply croplands.

Under such traditional approach, water-planning efforts usually did not include a detailed analysis of how water is actually used. Equally, there was no clear identification of the common goals for water development to seek agreement on principles to resolve conflicts over water. In addition, little attention has been paid to protecting natural ecosystems from which water supplies have been withdrawn. Those are growing calls, beside others including high costs of construction, tight budgets, deep environmental concerns, pushing towards changing the way we are following in planning and managing our water resources.

The alternative is to change the traditional approach in managing and planning our water resources towards *the soft path approach* fundamentally based on demand water management to meet the needs of growing population without requiring major new constructions or new large scale water transfer from one region to the other. This approach is focussing on and exploring the efficiency to implement options for managing demand and reallocate water among users to reduce projected gaps and meet future needs (Gelick, 1993; 2001; RMI, 2002 and Hamdy, 2005).

RAP-WRM : considerations and issues

There is no doubt that water problems in most countries of the Mediterranean are increasing. The ways towards solving them are, theoretically, very well known but, practically, most of the solutions remain vastly unimplemented because water policies and water management strategies, particularly in the agricultural sector, are not favouring the solutions both to the actual and the perspective water problems. Changes are needed in the way we are using and managing the water resources which implies effective cooperation and greater involvement of the scientific institutions and experts from the region to decide on the approaches to be followed to face the drastic shortages in the available water resources which is hitting severely the sustainable development in most developing countries in the region.

This was the overall objective of the RAP-WRM project which was developed in view of the following major considerations:

- water scarcity is one of the major limiting factors of agricultural, economic and social development in the arid and semi-arid regions of the Mediterranean;
- an increasing number of developing countries of the Mediterranean are approaching full utilization of their available water resources which means that no room is left to increase the supply, as inevitable consequence of the amplified conflicts among sectorial water users;
- the quantity of freshwater resources available to agriculture is diminishing while the use of lower quality water is increasing;
- future perspectives to meet agricultural and human demand for water will increasingly depend upon non-structural solutions and a completely new approach for water planning and management, by increasing the efficiency with which water is allocated among different users (Hamdy, 2003);
- future water problems could not be mediated by extra water transfer from other regions which are already fully employed, but by structural interventions on the water demand side with strong application of an integrated water management policies which favour water conservation and saving practices and the use and recycling of non-conventional water resources;
- the dominant fact that will be strongly evident over the next few decades in the structural imbalance between the constantly increasing demand for water to meet the needs and the limited natural available water supply (Fig.1)



Fig. 1 - Water Resources Dilemma in the Mediterranean Region.

- It is expected that within the next 25 years there will be a progressive increase in water demand by nearly 50% in the year 2025 with respect to the actual demand values (1990) (Fig. 2). The crucial question is how to provide such enormous increase in the water demand.

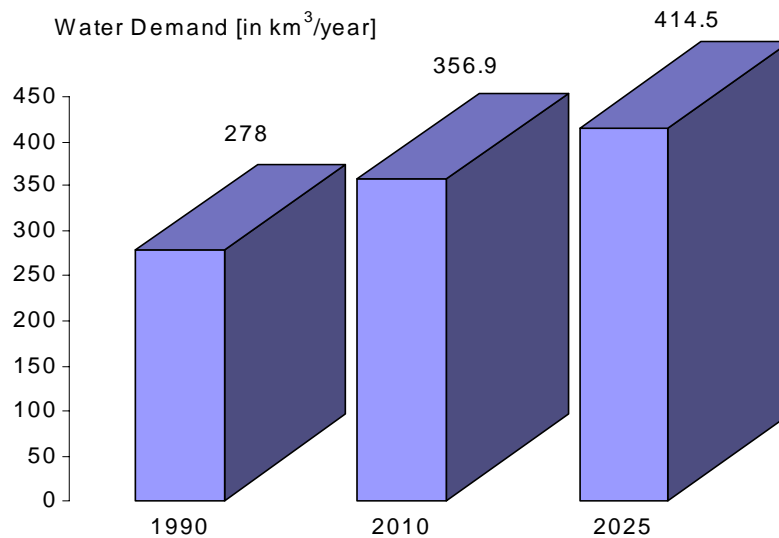


Fig. 2.
Actual water demand (in 1990) and foreseen water demand for 2010 and 2025, in km³/year.

- In the developing countries in the Mediterranean we are greatly suffering big shortages in the water managers who are capable not only to evaluate the problem, but, to find the reasonable solutions; those with good understanding the connection between water and ecological health and the links between the health of natural ecosystem and human well-being to integrate ecological and human water needs in a comprehensive way. The capacity building in the water sector in the region is still poor.

RAP-WRM: objectives, issues and major activities

In view of the previous highlighted considerations, the RAP-WRM was developed aiming to improve the institutional capacity building, the human resources development and regional cooperation and exchange of experiences in the field of water resources use and management in the agricultural sector emphasizing technical, social and economic aspects through the following major issues (Fig. 3):

- water use efficiency at farm scale;
- design, performance evaluation and management of collective irrigation systems;
- use of non-conventional water resources in agriculture;
- participatory irrigation management (PIM); and
- economic aspects of water mobilization and use.

RAP "Water Resources Management"

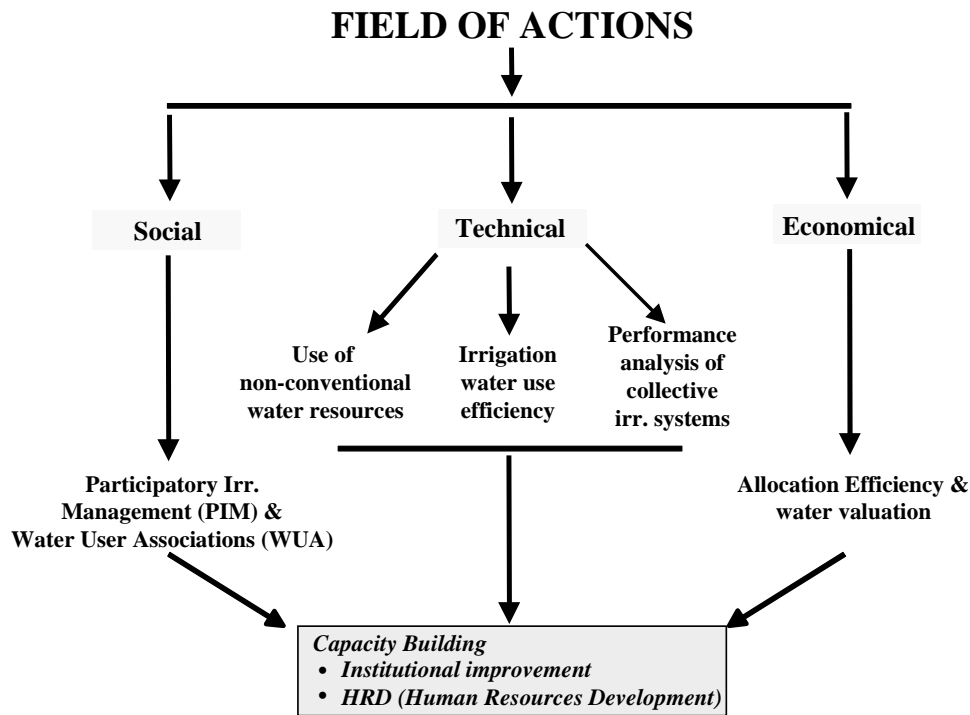


Fig. 3. Field of actions of RAP-WRM

The strengthening of regional co-operation and exchange of experiences between the Southern and Northern rim of the Mediterranean have been carried out through the following activities:

- training (advanced short courses and MSc. Mobility program);
- promotion of research (networking and demonstration research projects);
- workshops and courses for decision makers (in PIM, economic aspects of water mobilization and use and gender issues) and
- logistic support – information technology development and transfer in Southern Mediterranean countries.

RAP-WRM: implementation phases

The programme covered 10 Southern Mediterranean countries (Algeria, Cyprus, Egypt, Jordan, Lebanon, Malta, Morocco, Syria, Tunisia and Turkey).

The programme included the following two phases:

the first, which lasted for two years where major work was developed through the three collaborative networks: Water Use Efficiency (WUE-Net); Collective Irrigation

System (CIS-Net) and Non-Conventional Water Resources Management (NWRM-Net). The Networks activities have resulted in numerous publications, organizations of conferences and workshops as well as the realization of several research projects. The gathered know-how, the conclusions and recommendations of such running activities all emphasized clearly that within all the water sectors, agriculture is the one with the highest potentiality for water saving as water losses are enormous in this field.

In this sector, even where efforts to improve water use efficiency have begun, great potential still exists for reducing water losses without sacrificing economic productivity or personal welfare. There is a great potential for improving the water efficiency and increase crop water productivity with which we produce food. However, to achieve such goals, major improvements are still required in water resources use and irrigation technology and management. In the region, to cope with increased waters scarcity, significant changes have to be done in: *how water is managed? What needs have to be changed? What are the improvement required?*

Those are the issues translated into actions to be experimentally implemented on the ground in *the second phase* of the project, exactly formulated in the research project WASIA (Water Saving in Irrigated Agriculture).

The main objective of the WASIA Research Project is to develop a conceptual framework for water saving in irrigated agriculture of the Mediterranean region through the integration of the activities which represent major topics of the three collaborative “Water Resources Management” networks. The overall scheme of integration of activities concerning to the three research lines of the collaborative research network is presented in Fig. 4, which demonstrate the different layers of interaction for each research team.

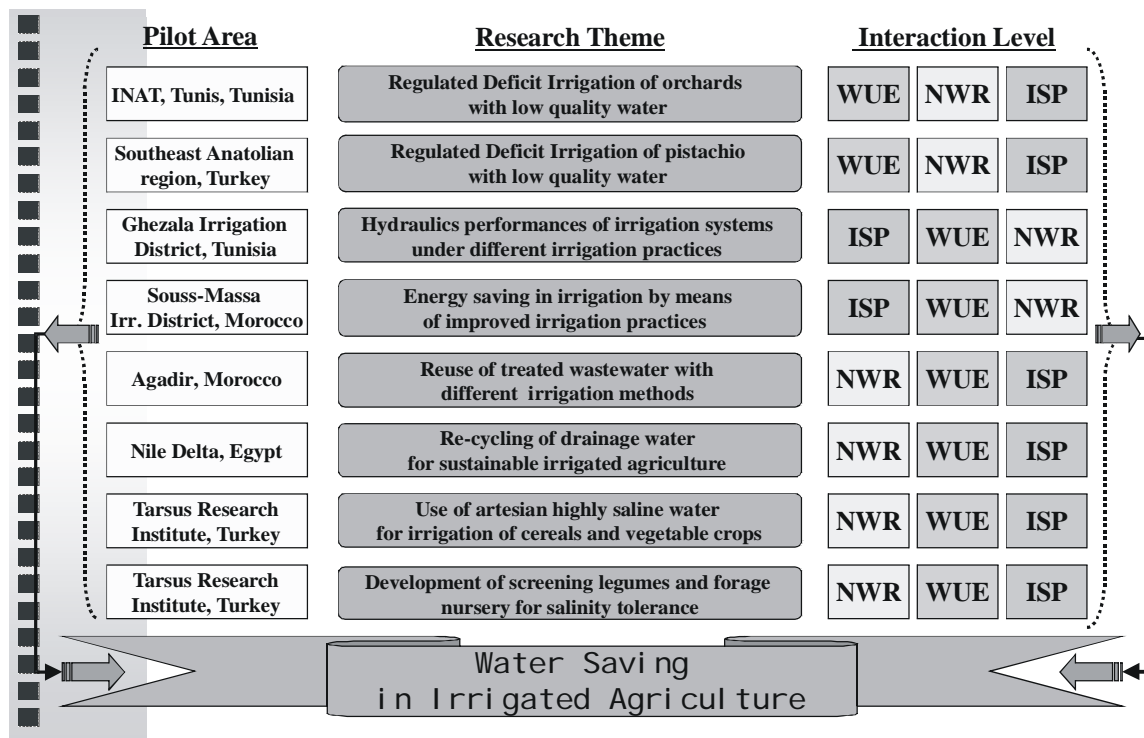


Fig. 4 – Research Layout and level of networks interaction

The implementation of the project as such integrated approach has allowed for the creation of a conceptual framework which takes into consideration different aspects of water saving in irrigated agriculture of the Mediterranean region.

RAP-WRM: outputs and results

The Regional Action Programme on Water Resources Management, represents one of the biggest activities ever carried out by the Mediterranean Agronomic Institute of Bari, Italy. Thirty national institutions and universities from 10 beneficiaries countries, 7 Italian partners and 5 international organisations have been involved directly in the programme along with about 1026 participants from the Mediterranean countries, where the majority -around the 80%- were from the 10 Mediterranean countries, the beneficiaries of the RAP.

Educational, training and capacity building aspects

The activities within the RAP-WRM have produced 19 short-term courses, tens of experimental works with the development of more than 65 MSc. Theses

covering the major issues included into the cooperative irrigation network to validate and decide on both tools and approaches through which water losses is diminished and water saving is increased in the agriculture sector. Such educational and training programmes improved the institutional capacity building, the human resources being with a relatively high calibre capable not only in identifying the problems, but also in finding the appropriate sustainable solutions.

The relatively high number, over 400 experts and managers, trained under such programme created a well-trained and updated human resource network speaking one language and working in harmony, exchanging their know-how and experiences to set up the appropriate national water policies and strategies those to safeguard and provide the sustainability in the use and the management of water resources on the regional level.

Information and Communication Technology (ICT)

This is one of the issues received greater interest in all the programme steps from the beginning till the end. This was realized through the implementation of an internet-based information system to promote exchange and dissemination of scientific and technical information in the Mediterranean region. This have been achieved through providing the needed scientific equipments (web server, internet work stations, info.net work), beside hardware and software, for upgrading and enhancing the ICT, particularly in the scientific centres lacking such tools for proper networking collaboration fundamentally depending on a well-developed scientific data-bank information.

The other major activity in this field was the development of the RAP-WRM website in both English and French language [url:http://www.iamb.it/par/](http://www.iamb.it/par/).

The RAP-WRM web is the project's general container of all detailed information and documentation sources. It played an important role in not only the exchange of data among the partners in the RAP but also in disseminating the information among all the stakeholders involved in the water sector in the region. Indeed, the web page acted as a gateway where information are passing to the partners, beside its utility, on one hand, as an aid to the decision-makers and, on the other one, as a guide source facilitating and updating the knowledge of both academic and scientific staff. The website is under continuous updating and innovation which ranked it to be the most complete, updated and scientific data bank

and to be considered as a realistic guide source providing the needed information related to water sector, in general, and irrigated agriculture, in particular, in the Mediterranean.

Research Activities – WASIA Project

The Deliverables

The research project WASIA has contributed in the integration of the collaborative research network activities under one umbrella at different sites in the Mediterranean region which has resulted in an increased exchange of research findings and available information, development of new data-bases, different research techniques and application of updated technologies. Such outcomes, along with wide experiences and ample information available at the institutions involved in the research program, all certainly resulted in increasing the competence of decision makers and research staff in the developing countries of the Mediterranean as well as helping in the set up of comprehensive strategies for water saving in irrigated agriculture. The networking activities and the research findings suggested certain approaches and tools to be translated into actions in order to improve water saving in the agriculture sector concerning the following issues:

- *Water managing: managing water scarcity*

A basic distinction can be drawn between supply-management oriented approaches and demand management ones: the difference between the two approaches is sometimes exaggerated, but, indeed, some solution overlap the two categories. In the region and, particularly, for the countries suffering from water scarcity, the water management approach to be recommended is the one that integrates the supply oriented management with the demand oriented one for managing water scarcity (Fig.5).

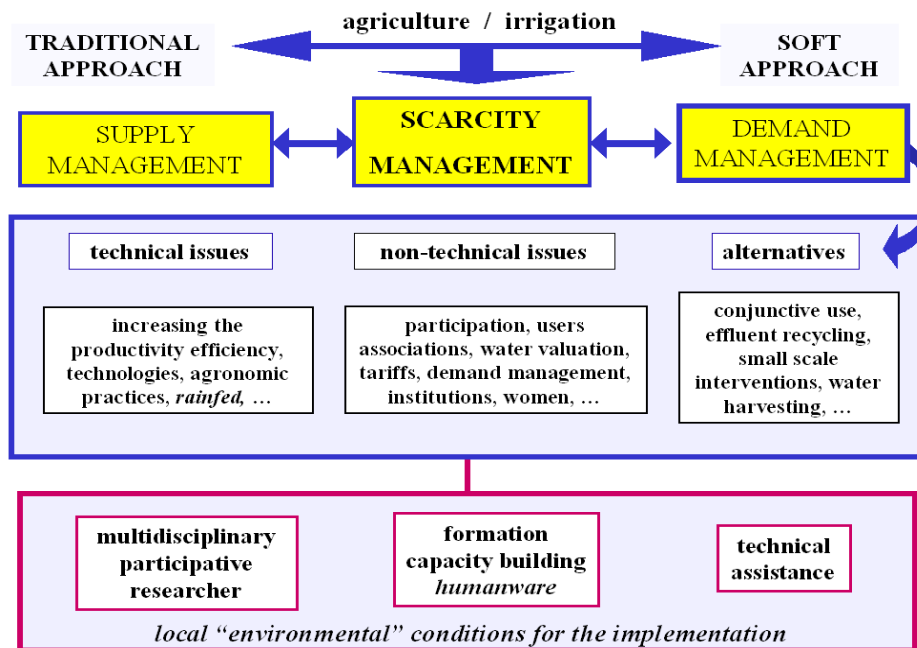


Fig. 5: Managing water scarcity: major issues

- *Water Saving – Major techniques*

For water saving, among the technical issues to be ranked as a priority in the region is the non-structural water development with its several techniques leading to the increase in crop water productivity, i.e. producing more with less water, reducing water losses and thereby lowering the water demand in the agricultural activities, and automatically increasing the foreseen water supply needed to increase the rate of irrigated agriculture without the need for any further irrigation infrastructure. This could be achieved through improvements in water use efficiency –or preferably- “water productivity”.

- *Water Use Efficiency improvement*

The research findings give the tendency that vast improvements in water use efficiency could be easily achieved since large losses occur in distribution systems as water moves through leaking pipes and unlined adequate. This is frequently the case due to faulty or old equipment and poorly designed or maintained irrigation system (Hamdy and Lacirignola, 1999, 2005). So the question is: *how to cope the challenges facing the irrigation sector in the region for efficiency improvement being with very poor values not exceeding the 45%?* Hamdy, 2001 and Hamdy et al., 2002 gave the example that: assuming a typical situation where 80% of total water use is for agriculture, a 10% increase in the

efficiency of irrigation would provide 50% more water for municipal and industrial use. This illustrates clearly the considerable potential for water saving in the irrigation sector through improving the efficient water use in this sector. The more is our capacity in reducing the water losses and increasing water use efficiency, the greater is the water saving in the agricultural sector (Fig. 6) (Hamdy, 2003).

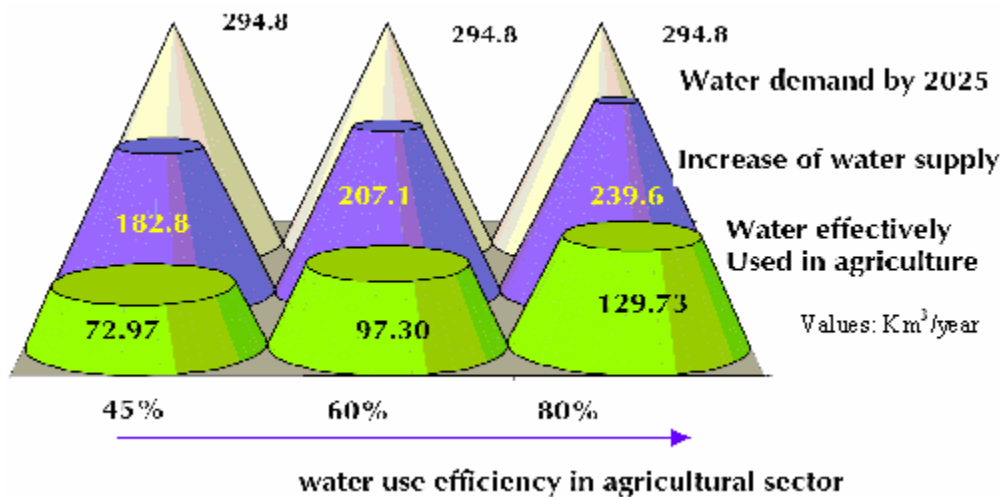


fig. 6. possible water saving in agriculture sector.

The RAP-WRM activities were not limited to specific area, but the work covered several areas and, in particular, those highly related to improving irrigation water use efficiency and increasing water saving, including:

- elaborating the concept of demand management into implemented policies, programmes and actions;
- managing water demand through efficient pricing, cost recovery and regulatory measures and related education and training;
- ensuring widespread user participation and the shift from centralized public water management approach to the decentralized one where the water users are the main actors; and
- adopting improved water efficient technologies and improving the water efficiency in producing food by changing cropping patterns towards less water demanding crops, by reducing wasteful application of water by cutting field to plate losses (Hamdy, 1996).

Increasing water productivity

This is one of the issues where most activities during the running of the RAP-WRM project concentrated on. Evidently, achieving greater water productivity to resolve the water crisis is feasible in the developing countries of the region, where water productivity is far below potential. According to the cooperative networking survey, taking the cereal grains, as an example, the range in water productivity in dry biomass produced is between 0.2 and 1.5 kilogram per cubic meter (IWMI, 2000). If a country's demand for grains grows by 50%, one way to match this rise is to increase water productivity by 50% (Hamdy et al., 2000).

How to achieve such increase in the water productivity? This was intensively searched in the WASIA research programme. The research findings pointed out that the key principles for improving water productivity at field farm and basin level, which apply regardless of whether the crop is grown under rain-fed or irrigated conditions, are: (i) increase the marketable yield of the crop per each unit of water transpired; (ii) reduce all outflows (e.g. drainage, seepage and percolation), including evaporative outflows other than the crop stomatal transpiration; and (iii) increase the effective use of rainfall, stored water and water of marginal quality.

The first principle relates to the need to increase crop yields or values. The second one aims at decreasing all "losses" except crop transpiration. The third principle aims at making use of alternative water resources. The second and third principles should be considered parts of basin-wide integrated water resources management (IWRM) for water productivity improvement.

These three principles apply at all scales, from plant to field and agro-ecological levels. However, options and practices associated with these principles require different approaches and technologies at different spatial scales.

Within each of these broad strategies, more detailed measures can be identified. The choice of strategies for increasing water productivity will be guided by economic and social factors. Existing water rights will often constrain choices, especially when there are options of reallocation. In such cases, the basis of water rights may need to be reconsidered. Local availability of water will be an important consideration dictating an improvement strategy. In choosing among various strategies, cost-effectiveness is a central consideration.

RAP-WRM and deliverables achieved

The deliverables of the project include many important tools which were missing in the most of developing countries in the region (e.g. guidelines for deficit irrigation strategies, guidelines for optimal use of treated wastewater, saline water and drainage water in irrigation, new databases on water demand, software packages, geo-referenced databases, etc.). Moreover, at some sites (Morocco, Egypt and Tunisia), the experiments were carried out in cooperation with the farmer's associations and also at the private farms which is of particular importance because it facilitates the transfer of the research findings to the direct water users and contributes to the implementation of new management strategies on the ground.

In addition to those deliverables, the programme highlighted the following concluding remarks:

- the way to water saving and whenever possible to its re-use, is still open. From a purely technical point of view, important water saving are possible if one thinks that under realistic conditions water efficiency can vary from about 25% to 75%, depending on the cases, the modes and the equipment, understanding that moving from the former to the latter value means to triple the irrigation surface at equal water use efficiency. With the technologies and methods available today, agriculture could cut its water demand by 10 to 15% (Abu-Zeid and Hamdy, 2003, 2006);
- water saving is a complex practice. First, one should consider not only crop requirements and the pedological environment but, also, the fact that quite often water saving techniques are labor-capital and energy-intensive. One must also consider new environment concerns and social problems related to the frequently low education level of farmers;
- the sound and efficient use of water for irrigation with better water saving will require:
 - deep scientific and technical knowledge which is far from perfect at the present time. However, some clear modules are available;
 - a more systematic and permanent monitoring and collection of un-based data at a reasonable cost;
 - closer participation and collaboration of the technical group and the involvement of farmers in the implementation of the programme for

determining water charges where great equilibrium and flexibility are necessary;

- for the majority of the Mediterranean countries there is a high opportunity for saving significant volumes of the water losses, totally around 130.0 km³/year, particularly in the irrigation sector where the most beneficial water saving could be achieved. For instance, the studies carried by Bari Institute (Hamdy, 2003) in the irrigation sector, the reduction in the transport losses by nearly 50% and the improvement of irrigation efficiency from 40-50% to 80% could provide water saving of nearly 52 km³/year corresponding to more than 40% of the total actual water losses in the region and giving additional supply of nearly 20% of the actual demand. The fact that these figures are indicative ones, but, they quantify the potential gains achievable from the irrigation sector through demand water management and the implementation of the soft non-constructing approaches;
- capacity building in the Mediterranean should be expanded and improved and interdisciplinary training of water experts should be promoted and should not only be concentrated on the technical aspects, but it should equally strengthen both the financial, managerial and the administrative side;
- networking activities indicated that in several countries of the region, water policies are subjected to a dramatic shift from the supply augmentation policies to the demand management ones. The challenge is not only to seek new supplies of water, but also to increase the productivity and efficiency of existing water resources and those to be developed in the near future. However, what to be stressed here is that the water resources problems need to be approached without preconceptions. Not all the problems can be solved with infrastructure and at the same time, in environments with minimal infrastructures, all the problems cannot be addressed through better management. A balance need to be struck between stakeholders, donors and financial institutions analysing the needs and developing the investment plans to meet the requirements of both

management and water resources development targets for partnership and development.

Finally, judging the Regional Action Programme (RAP) -Water Resources Management (WRM)- Water Saving in Irrigated Agriculture (WASIA) it is to be highlighted that the programme is not confined to itself, but it should be seen as an opportunity to add durable values to the overall training, research and cooperation among the Mediterranean countries towards water saving and sustainable demand irrigation management. As an initiative it is to be considered as an Euro-Mediterranean space open regional programme.

The achievements outputs and the research findings all should be fully considered and to be taken as fundamental basis to set up new programmes including the proper actions needed to be implemented on the ground.

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