

# WATER SCARCITY MANAGEMENT IN THE ARAB WORLD: OPTIONS AND TOOLS

## GESTION DE LA PENURIE D'EAU DANS LE MONDE ARABE : OPTIONS ET OUTILS

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### ABSTRACT

*In most arid and semi arid countries of the Arab world water scarcity is rapidly affecting the countries' development. The common problems are imbalances between water availability and water demand, degradation of surface and ground water quality and inter-sectoral competition for water. Furthermore; droughts have also been adversely affecting these countries, often with devastating consequences.*

*In water stressed regions, agriculture consumes nearly 80% of the available and useable fresh water resources. Under water stress conditions, the agricultural sector will be strongly affected, bringing most countries in enormous difficulties to achieve their food security.*

*Under the current water crisis, the countries of the region have to find answers to the following questions: How to meet the increasing water demand under the prevailing limited fragile water supply? What are the appropriate measures/practices that should be adopted to meet the increasing water shortages? And how to implement, on the ground, the actions for water resources management and what these actions should be?*

*In this paper such emerging questions will be fully examined and discussed in order to face and attenuate the current water crisis.*

**Key words:** water management, water use and coping with water scarcity.

### RESUME

*Dans la plupart des pays arabes arides et semi arides, la pénurie d'eau affecte rapidement le développement de ces pays. Les problèmes communs sont des déséquilibres entre la*

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*disponibilité de l'eau et la demande en eau, la dégradation de la qualité de l'eau de surface et de l'eau souterraine, et la concurrence intersectorielle pour l'eau. En outre, les sécheresses affectent aussi défavorablement ces pays, et souvent donnent lieu aux conséquences dévastatrices.*

*Dans les régions à stress hydrique, l'agriculture consomme presque 80 % des ressources en eau douce disponibles. Dans les conditions de stress hydrique, le secteur agricole sera fortement affecté, apportant d'énormes difficultés à la plupart des pays dans la réalisation de leur but de sécurité alimentaire.*

*Dans le cadre de la crise actuelle de l'eau, les pays de la région doivent rechercher les réponses aux questions suivantes : Comment satisfaire la demande croissante en eau dans le cadre de l'approvisionnement en eau limité? Quelles sont les mesures/pratiques appropriées qui devraient être adoptées pour faire face aux manques croissants d'eau? Et comment mettre en oeuvre sur le terrain, les activités de la gestion des ressources en eau et quelles seront ces activités?*

*Ce rapport étudiera et discutera telles questions émergentes pour faire face à la crise actuelle de l'eau et prendre des mesures pour atténuer cette crise.*

**Mots clés :** *Gestion de l'eau, usage d'eau, faire face à la pénurie d'eau.*

## 1. INTRODUCTION

The Arab World is facing one of the severest water scarcities in the world. Most of the Arab region lies in the arid and semiarid zone. Rainfall is low, variable and unpredictable in most of the area. Within the Arab countries, most of the possible water resources have already been developed and are now using almost all the water that can be drawn. Several Arab countries are suffering from water deficiency and others are heading that way.

In the region as a whole, especially for agricultural requirements, water shortage presents a challenge of the first order. As a result of water deficit, there is a food deficit, the region is one of the largest food importers and the forecast indicates that the region will remain in great food deficit for some time to come.

The local agriculture sector is no longer able to produce sufficient food. The perspectives are not promising, despite the fact that agriculture is by far the largest user of water in the Arab countries: amounting to nearly 90 percent of all available water resources. Today, in those countries, the question is: can the water crisis be averted? Can water be made more productive? Can we produce more with less water or at least more with the same amount of water? This is what will be discussed in this paper.

## 2. WATER USE PERSPECTIVES

Figure 1 shows the estimated water availability in the countries of the Arab world from 2003 to 2050. The average water availability is expected to decrease from 1051 m<sup>3</sup>/person/year in 2003 to 674 m<sup>3</sup>/person/year in 2025 and then, will drop to 476 m<sup>3</sup>/person/year by 2050. This

means that by the middle of this century the whole region, with the exception of Mauritania and Iraq, will experience chronic water stress with water availability below 1000 m<sup>3</sup>/person/year. By 2050 the majority of the countries will experience absolute water stress, with a water availability of less than 500 m<sup>3</sup>/person/year. Moreover, in many countries of the region, water availability will be only few hundreds of m<sup>3</sup> per person annually.

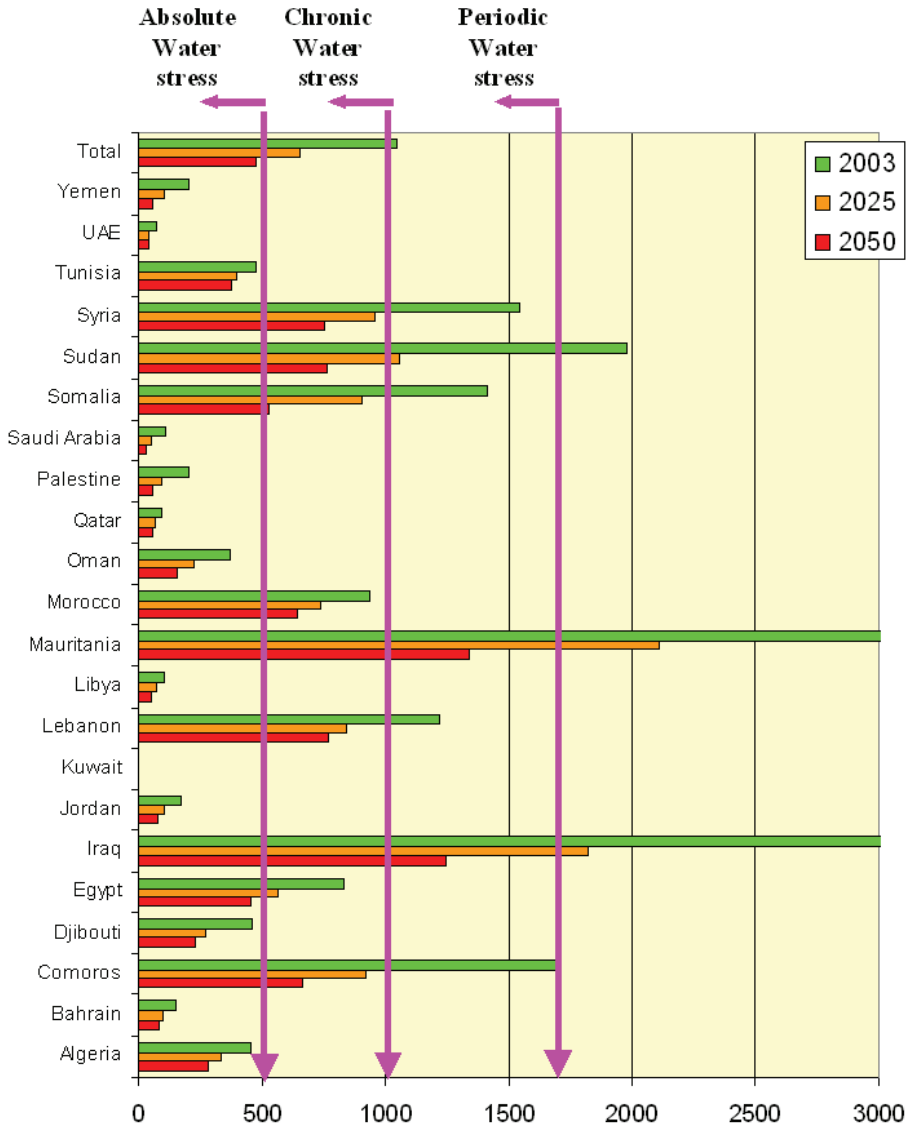


Fig. 1. Water resources availability trend in the Arab world (2003-2050)

### 3. WATER DEMAND TREND IN THE ARAB WORLD

Figure 2 demonstrates the non-sustainability of the future water resources. This poses the question on the possible ways to meet this ample water demand at places where most of

technically available resources are already exhausted. For most countries of the region, meeting the increasingly water demand should be realized through structural interventions on the water demand side with strong application of modern integrated water management policies which favour water conservation and saving practices and the use of non-conventional resources.

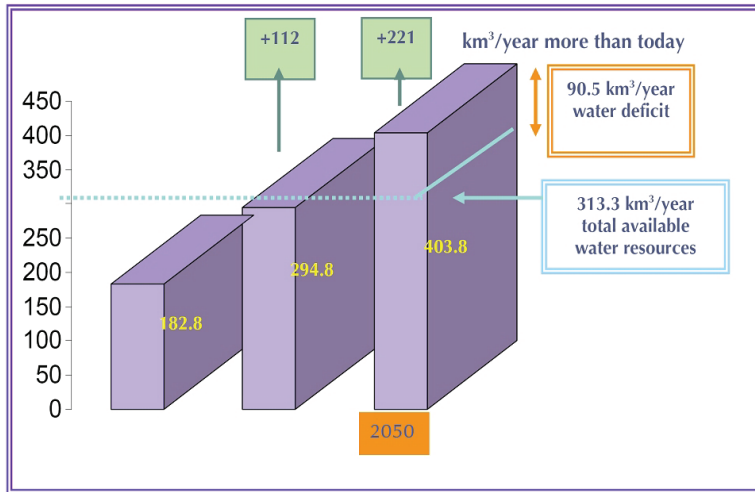


Fig. 2. Water demand trend in the Arab world (2003-2050).

Source: Elaboration CIHEAM/IAMB on FAO, 2003; Gleick, 2003, PRB, 2003

#### 4. SECTORIAL WATER USE IN THE ARAB REGION

It is estimated that about 3155 billion m<sup>3</sup> (bcm) of water are used annually for agriculture (about 14,000 m<sup>3</sup> per hectare) for a total irrigated area of about 11 million hectares, giving a rise in total irrigation withdrawals up 240 bcm (Fig. 3).

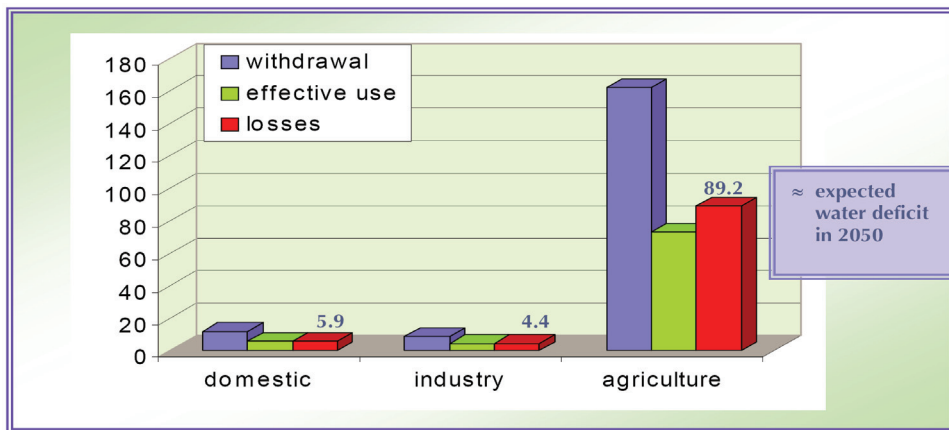


Fig. 3. Sectorial water use (km<sup>3</sup>/year) in the Arab world.

Source: Elaboration CIHEAM/IAMB on FAO, 2003; Gleick, 2003, PRB, 2003

In general, for the majority of Arab countries, a large part of water extracted appears not to be used effectively. The efficiency of use is far from being satisfactory in all sectors and is particularly evident in the irrigation sector (Fig. 3).

The overall efficiency of most irrigation systems is only about 45%, due to considerable losses in water supply and distribution networks and in on-field water application practices. Water losses in the irrigation sector amount to 89.2 km<sup>3</sup>/year, which would almost completely cover the water deficit expected in 2050. However, together with the water losses of the domestic and industrial sectors, the losses would reach approximately 100 km<sup>3</sup>/year. The data obtained so far confirm that major water losses occur in the agricultural sector and this is the reason why the major efforts on water saving should be focused on irrigated agriculture (Hamdy et al., 2002B).

## 5. SOLUTIONS TO COPE WITH WATER SCARCITY IN THE ARAB WORLD

In order to cope with water scarcity in the Arab world, a set of solutions can be considered to allow a sustainable water resources management. However, putting these solutions into actions comes second to the combination of the following three crucial issues: (Hamdy, 1997):

- political power should show suitable goodwill in protecting the water resources;
- an adequate mobilization of the financial means, and
- the presence of technicians and scientists having the required ability for implementing the proposed solutions.

In the majority of the Arab countries, the increase in water demand faced with limited water supply on one hand, and the arising water scarcity problems on the other hand, require response to such acute water shortages with immediate actions and plans with appropriate changes in the way those countries are using and managing the water resources.

In this regard, the question to be asked is: *what do we mean by changes in both water use and management?*

The changes do not imply to stop increasing water supply through the traditional water approach. Some new dams, aqueducts, rainfall and runoff harvesting, and water infrastructures will certainly be built, particularly in those Arab countries where the basic water requirements for agricultural and human activities have not been met yet. But even in those countries, new approaches should be developed which permit water needs to be met with fewer resources, less ecological disruption and less cost. Future perspectives to meet agricultural and human demand for water will largely depend upon non-structural solutions and a completely new approach for water planning and management. Two approaches should be followed: the first, by increasing the efficiency with which current needs are met, and the second by increasing the efficiency with which water is allocated among different users.

## 6. MANAGING WATER SCARCITY

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 (Fig. 4).

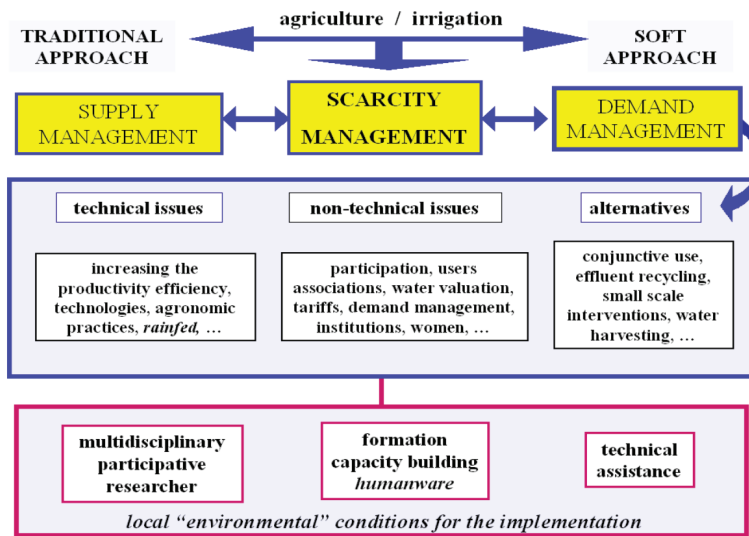


Fig. 4. Managing water scarcity: major issues (Hamdy et al., 2002B)

## 7. ADOPTION OF AN ADEQUATE AGRICULTURAL WATER DEMAND MANAGEMENT

Integrated water demand management is not an easy process, hence, it does not only call for a three level action (Fig. 5), but also to be successfully implemented; it requires management instruments, the establishment of the enabling environmental conditions together with an appropriate updated institutional framework (Fig. 6) (Abu-Zeid and Hamdy, 2004 and Hamdy, 2000, 2003).

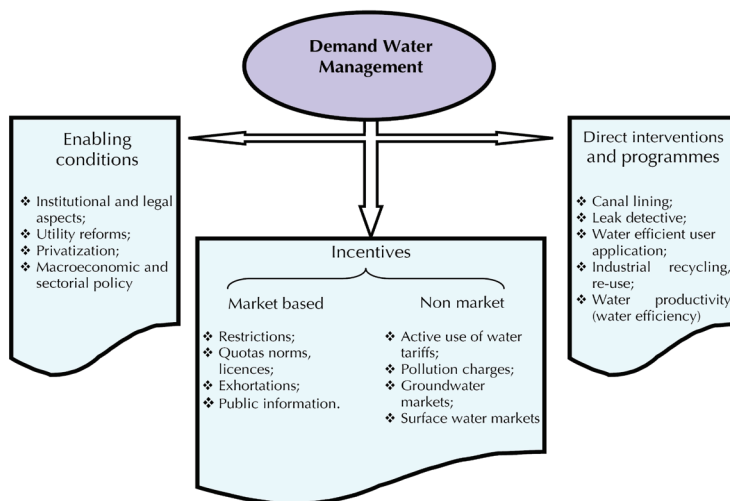


Fig. 5. Demand water management approach: main policy measures.

Source: Abu-Zeid and Hamdy, (2010);

In spite of such complexity, this is the suggested approach we need to follow in managing the water resources to overcome the existing water scarcity and its increasing problems.

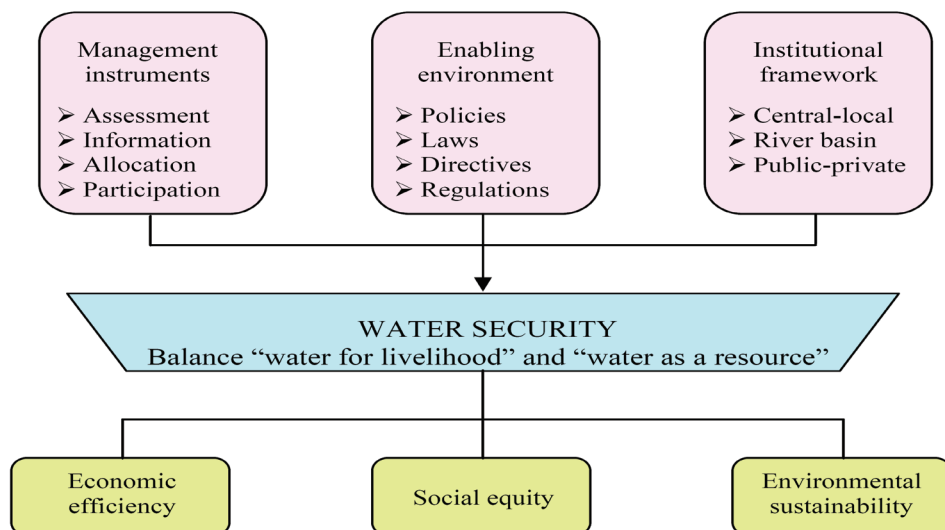


Fig. 6. Demand water management prerequisite and water security balance.

Source: Abu-Zeid and Hamdy, (2010)

In the Arab region, the implementation of proper water management in the agriculture sector seems to be a realistic approach to overcome the aggravating water scarcity problems. This will necessitate the establishment of structure incentives, regulations and restrictions that will help, guide, influence and coordinate the farmers' behaviour for the efficient use of water in irrigation while encouraging innovative saving technologies.

## 8. IMPROVEMENT OF WATER USE EFFICIENCY

In most countries of the region, there is a great potential for improving the water use efficiency in food production, by changing cropping patterns towards less water-demanding crops, by reducing wasteful applications of water, by cutting field-to-fork losses, by changing diets and by the functioning of international markets (Hamdy and Lacirignola, 2001).

From a purely technical point of view, important water savings are possible. If one considers that, under realistic conditions, water efficiency can vary from about 25% to 75% depending on the situation, the modes and the equipment, and realises that moving from 25% to 75% means to triple the irrigated area while using the same amount of water. With the technologies and methods available today, agriculture could easily cut its water demand by 10 to 15%.

However, this will require much greater imagination and flexibility on the part of irrigation policy-makers, managers and planners and there will be a need for technological, managerial and policy innovation and adaptation.

## 9. INCREASING WATER PRODUCTIVITY

Increasing water productivity in agriculture contributes not only to the overall food security equation but also to water security. The key principles for improving water productivity at field, farm and basin level, 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 (Hamdy et al., 2002B).

Increasing the productivity of water and having higher yields using the same amount of water could be achieved through improved varieties, improved soil management practices that save water through reduction in non-productive evaporation or flows to sinks in excess of environmental requirements, and reallocation of water from lower to higher value uses.

## 10. IMPROVEMENT OF IRRIGATION SYSTEMS

For most of the Arab countries, the major physical and technical problems and constraints in irrigation systems are: inefficient water use, shortage of water supply at the source, poor canal regulation, water logging and salinity, poor operation and maintenance, small-scale programs and scarce water resources. Such problems and constraints require a set of common supporting actions, namely the development of adequate data bases, adaptive research, institutional strengthening, human resource development, improvements in socio-economic analysis, environmental protection, technology transfer and infra-structure development.

Many efforts were directed towards the use of modern irrigation techniques, but their implementation is still very limited.

Modern irrigation techniques need to be carefully selected and adapted to the local physical agronomic and socio-economic development, as well as to the technical and managerial skills of local farmers. Upgrading existing irrigation schemes should, in most cases, be preceded by pilot schemes to test alternative design concepts. Costly improved technologies can only be justified if their agronomic and economic potential is fully exploited (Abu-Zeid and Hamdy, 2004).

## 11. SECTORIAL WATER USE AND ALLOCATION EFFICIENCY

In many countries of the region the adoption of the principles of allocation by efficiency, which lead to utilization of water in the economic sectors that bring the best return, is now technically and politically up for bargaining and discussion.

For some countries the possibility of taking water from the existing systems to provide supplies for additional users in other sectors where higher economic and social returns exist is an increasingly important strategy, but it has not yet been implemented in the policies of national governments or water institutions. On the other hand, others consider that new water is the only solution and that the political problems of re-allocation are difficult and therefore the approach of reallocation is not yet a relevant option.



The presence of such controversial water allocation strategies between counties with regard to its water resources to some extent depends on the overall level of economic development of an individual country. The more economically advanced a society becomes, the more it needs to question its water resource policy.

## 12. CONJUNCTIVE USE OF WATER SUPPLIES

The conjunctive water use is one of the approaches to be highly recommended in the Arab countries and particularly in those suffering from acute water shortages.

Yet, in most countries in the region, the conjunctive water use is rarely practiced, or not at all. In order to make the conjunctive use of water fully operational (Hamdy, 2003), it is required that:

- policies and regulation are in place and enforced to ensure that waters of varying quality are used in accordance with approved standards of use.
- scientifically based standards of water use and standards for discharge to water systems are prepared, confirmed and put into effect;
- regulation to enact water use standards is flexible to allow a structured phase-in of the final standards;
- a precise database is established on the availability of each water supply, considering both the quantity, quality, location and seasonal availability in quantity, quality, temporally (when it is available) and spatially (where it is located);
- economical aspect are considered in the planning process when water supplies are linked to potential water uses. It could be more economical to move water of appropriate quality from a more distant source than to use a nearby water supply of higher quality than needed.

## 13. EFFECTIVE WATER GOVERNANCE

In the Arab countries moving towards more effective water governance will require several changes but the process of change should be principally based on (Hamdy and Lacirignola, 2005):

- building as much as possible on existing arrangements,
- capitalizing on opportunities and being realistic,
- opening processes and policy-making with all stakeholders as far as practical,
- establishing effective socio-political and administrative systems and,
- adopting an IWRM approach with transparent and participation processes that address ecological and human needs.

## 14. PROMOTE WIDE USE AND RECYCLING OF NON-CONVENTIONAL WATER RESOURCES

Generally speaking, for most arid and semi-arid countries of the region, re-use of wastewater may have greater impact on future use of water sources than any of the technological solutions

available for increasing water supply; such as water harvesting, weather modification or desalination. To promote wide use of wastewater in agriculture in arid and semi-arid Arab regions, more emphasis should be given to the following (Hamdy and Ragab, 2005):

- find simple, efficient and economic waste water treatment methods,
- modify the irrigation design, techniques and management to cope with the specific characteristics of the effluents, and
- develop rapid analytical methods for routine monitoring of effluent quality, as well as that of irrigation runoff, drainage and groundwater.

Saline water is another potential source of irrigation water and its use in the agriculture sector is becoming an increasingly important issue in the region.

However, currently, the use of these new sources, particularly in irrigation, is not properly conceived due to one or more of the following reasons (Hamdy et al., 1995):

- Lack of national policies and strategies in this area.
- Inadequate commitment by decision-makers.
- Sub-optimal results due to ad hoc planning and management.
- Long-term sustainability is in doubt.
- Major constraints exist in terms of lack of adequate funds for operation and maintenance; inadequate monitoring and evaluation; lack of trained manpower.
- Health and environmentally related issues are not being properly considered.

## 15. DESALINATION

Given the still relatively high costs of desalination varying between US\$ 0.60 and US\$ 1 per M<sup>3</sup> and of conveying desalinated water to consumers, this technology should not be viewed as the solution to the region's complex water problems. Desalination does have a role in the Arab rich oil countries as one option among others to be considered. But for the foreseeable future, economic considerations may warrant limiting its application in Arab region to brackish groundwater and to seawater desalination on a limited scale for municipal purposes in water-scarce towns in coastal areas.

Contrary to the general consensus, it is expected that, in the next few years, the acceptance of desalination technology will be rapidly gaining momentum. The growth in desalination will accelerate due to the rapid advance in technology, the expected decline in the energy cost and the involvement of the private sector in financing. All are indications that this technology will play a major role in the supply side solution, providing greater portions of the water needed to coastal cities and industries, but not for the cultivation of most food crops (Abu-Zeid 1997).

## 16. VALUATION OF WATER AND IRRIGATION WATER CHARGES

The failure in the past to recognize water's economic value and the real cost of water are the primary reasons behind the misuse of water and the major water losses occurring in

agriculture. It is therefore now widely accepted that managing water as an economic good is an important tool to achieve efficient and equitable water use, as well as to encourage the conservation and protection of scarce water resources.

Yet, for many Arab states in the region, it is difficult to reconcile the concept of water as an economic good with the traditional idea of water as a basic necessity and human right. In this regard, action should be directed to the use of non-price measures to encourage consumers to use water more efficiently, including the following (Abu Zeid, 2001):

- Transferring management responsibilities for operations and maintenance to user groups.
- Promoting water rights and markets.

## 17. STRENGTHENING CAPACITY

Capacity building in the Arab region should be expanded and improved and interdisciplinary training of water experts should be promoted. Training should not only be focused on technical aspects but it should equally strengthen both the financial and the administrative side of the institutions involved in the implementation of the irrigation demand water management.

International, national and regional institutions could play a great role using their training programs and research activities in the development of national capacities to sustain the long-term research needs in the water sector. They can also help orienting research to practical and cost-effective solutions that benefit water users and field practitioners. The region needs institutions with high capability to collect, analyse and elaborate information on water resources including environmental and socio-economic information (Chioccioli et al., 1998; Hamdy, 2002).

## 18. CONCLUDING REMARKS AND FUTURE OUTLOOK

Several programs and projects have been realized and others are on the way to solve water problems and to satisfy water needs. Some progress is now felt. The ultimate challenge for all water professionals, decision makers and politicians is to put into practice what we know. It is essential that we translate the ideas, conclusions, and recommendations for action on the ground. Those actions should be translated into programs dealing with the following major issues:

- Integrated water resource management: demand water management, particularly in the agriculture sector as nearly more than 80% of water resources are allocated to irrigation with relatively high losses exceeding 50%. There is a very high potential to save water to satisfy the increasing demand in other water sectorial uses.
- Managing water scarcities should involve new visions for innovative technologies, institutional reforms and reallocation policies, including evaluation of water, enforcement of national and regional laws and other policy interventions that appear likely to result in structural changes or adjustments in the economy.
- Water productivity improvement: more crop per drop. This program should be based on using new technologies to achieve higher water production efficiencies through water conservation technologies, intensive irrigation of high value crops, expanded supplemental irrigation in rain-fed farming zones, and improved irrigation methodology.

- Re-use and recycling of wastewater in the agriculture sector. This is the most reasonable approach to increase the water supply by saving a part of the freshwater already allocated to agriculture, expanding the irrigated area and reducing the food gap in the region and overall to sustain the environment without degradation.
- Capacity Building. Capacity building development programs will improve the function of institutions and human resources for water resource development and management in the region.
- Research in desalination, particularly renewable energy, which provides new water supply at reasonable price.

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