

Over exploitation and pollution increase the cost of water supplies presenting another constraint to expansion of safe water supply services. Limited availability of groundwater and the declining groundwater tables makes development of sources and withdrawals more costly. Deeper boreholes have to be drilled and the pumping costs may rise to practically uneconomical levels. Once contaminated, water requires costly treatment before it can be used for community water supply. Where adequate treatment cannot be afforded, communities rely on insufficiently treated water for their water supply with considerable risk to health.

### **FUTURE CHOICES: The demand management approach**

The supply driven approach has effectively demonstrated its inability to deliver water security to the region. The natural water shortages have been made even worse by historical supply driven water policies and management practices. Accessible water sources are tapped beyond their virtual capacity. Securing additional water sources from across national borders, while achievable, remains costly and carries a great deal of security risks. Turning to the sea for additional water sources is also achievable, but remains costly and within the near future, it will not be affordable to most MENA countries.

Before embarking on development of new costly water sources, a new approach to water resources management in the region is needed. The new approach focuses on manipulating the demands in a serious attempt to match them with the available water resources. Each nation's water resources must be protected, conserved, developed, managed, used, and controlled in ways which ensure efficient, sustainable and beneficial use of water in the public interest.

In the water stressed countries of MENA, every drop of water including wastewater, must count. The water resources and wastewater management policies must come together in addressing the water cycle in a holistic manner within the umbrella of integrated water resources management processes. Water must be used efficiently to reduce the consumptive use of water and wastewater flows. Wastewater flows must be managed effectively to safeguard public health, and protect the freshwaters from pollution. They must be reintegrated safely in the water cycle and accounted for in the water budget of the household, community, industry, and agriculture.

The recommended approach stipulates that new water sources and additional supply facilities will be developed only after exhausting all available possibilities for reducing the demand on water to match the existing supplies. The water deficits can be reduced with a large-scale shift from the supply driven approach to the demand management approach placing the following three groups of functions at the heart of water management policies and practices:

1. Efficient allocation of water amongst the competing groups of users to ensure that water supplies are used wisely, efficiently, in a sustainable manner for the public interest
2. Increasing the efficiency of water use to reduce the consumptive use of water while maintaining the social benefits of water
3. Strengthening environmental protection policies and pollution control to safeguard the quality of the scarce freshwater and safely reintegrate wastewater into the water cycle as a component of the water budget of households, communities, industries, and agriculture.

### **Water allocation for serving the public interest**

The severe competition between the various water user groups (domestic, commercial, industrial, and agricultural) will only get worse. As the population continues to grow, the municipal and domestic

demand on water will continue to rise. Industrial and commercial water demands will also grow due to the changing nature of the region economies from large dependence on agriculture to increasing dependence on the industry, tourism and services. As the water resources are subjected to increasing pressure, all effort must be made to ensure that every drop of water is used wisely and optimally in a socially beneficial manner in the public interest. Water allocation amongst the competing water user groups is the main tool available for ensuring that water is used optimally in the public interest.

Public health protection is the most socially beneficial use of water which serves the public interest. To protect the public health and meet the basic human water needs, the domestic and municipal water demand must be first met and the highest quality water must always be reserved for the domestic municipal water requirements. In times of water crises such as droughts, the domestic water demand is first met at the cost of the other competing demands mainly the agriculture demand.

The industrial and commercial water user groups are viable economic entities capable of adding high economic and social returns (employment for example) on utilizing water. If the water is treated as a commodity and is left to the market forces and subsidies on water are removed, the industrial and commercial water users might afford the real cost of water.

The agriculture, the largest user group, appear to be the user group which has to yield part of its share of the water resources as the pressure mounts. Agriculture is the largest water user with the least water productivity (value added by using water), the contribution to GDP is lowest, and the employment generated from using water is lowest (World Bank, 1996 & Macoun 2000).

## **THE EFFICIENCY SOLUTION**

Using water more efficiently in all applications is the tool to reducing the consumptive water use without reducing the social benefits of water. The enabling solutions for more efficient water use include:

1. Increasing the efficiency of the municipal, agricultural, industrial and commercial water supply and delivery systems
2. Increasing the efficiency of water utilization by all water user groups
3. Eliminating wasteful consumption of water by all water user groups
4. Allocating water to the more productive applications within each water user group,.
5. Matching the water quality with the intended water application and ensuring that water is used at least twice before it is discharged.

### **Efficient municipal water use**

There are many misconceptions surrounding efforts to increase municipal water use efficiency. Water use efficiency exercises are often fragmented and crisis driven. Water utilities often perceive the water efficiency measures as sporadic and low profile public awareness exercises often targeted at the wrong audience.

The demand management approach calls for institutionalizing comprehensive, sustained and long-term water efficiency measures within the management practices of the water suppliers. The demand management approach calls on the water suppliers to play a proactive role and invest not only in improving the efficiency of the water supply systems but also in ensuring that consumers of water are using water efficiently. Investment in municipal water efficiency is of paramount importance in

order to save the best quality and scariest water from wastage and also to spare the millions of dollars necessary to produce it. In Tunisia and Bahrain, significant water savings were realized through the execution of municipal water demand management programmes which combined: increasing supply system efficiency through leakage control and better management; universal metering and pricing; improved customer services; and public education for creating a water conservation culture (Box 1).

The first priority water efficiency measure is reducing water losses in municipal water supply schemes through efficient management of the production, conveyance, storage, and distribution facilities. The system efficiency can be increased to over 80% as the case in Bahrain, Cyprus, UAE and recently in Tunisia (Figure 4). Reducing the water losses in municipal systems defers and may eliminate urgent investment in additional water sources and expansion of the water supply system in addition to safeguarding the water quality in the municipal systems. Improved efficiency of municipal supply systems enhances the public's confidence in their water supply systems and encourages positive behavioral change towards conserving water. In Tunisia sustained leakage control efforts over 4 years period reduced water losses in the system from 24.1% to 14.5% (Box 1). Bahrain's leakage control measures and improved customer services allowed significant manipulation of water demand as also demonstrated in Box 1.

Domestic water metering and pricing are the tools to reduce wasteful water consumption. Water metering increases people's awareness of their water consumption and encourages consciousness. The rising block tariff structures have been used widely and have proven their effectiveness as water conservation tools. While developing water pricing tools, planners must maintain the supply of the basic human needs at an affordable cost to the low income groups within the society and must ensure that water efficiency measures should never harm public health. Water must always be available for meeting the basic human needs at a reasonable and affordable cost.

Indoor and outdoor water efficiency brings direct benefits to the consumers whose spending on water can be reduced. Consumers with limited supplies can stretch their share of water to last for longer duration in order to avoid having to buy transported additional supplies at very high costs. Indoor water use efficiency can be boosted significantly through the use of improved water saving fixtures and appliances such as low volume flush toilets, dual flush toilets, high performance shower heads, showers and facet aerators, and front loading washing machines without inconveniencing the water users. New air-displacement flush toilets, using 1.6 litre per flush, are under development (Moore 2000). The enabling water saving technologies are proven and available and must be made widely reachable. Water utilities must encourage and invest in wider application of these enabling technologies through retrofitting programmes or financial incentives. Legislation, revised building codes, import and manufacturing restrictions, tax incentives are all necessary measures for encouraging availability and wider use of water efficient domestic solutions.

Private and public landscaping and vegetable gardens are the biggest outdoor water users in the region. Solutions for water efficient landscaping are also available. Xeriscaping utilizes native and drought tolerant plants and water efficient designs to create beautiful surroundings with as little water as possible.

## Box 1: Water Demand Management in Tunisia and Bahrain

### TUNISIA saves 66 million cubic meter of water in 4 years through leak detection alone<sup>1</sup>.

Like most EMR countries Tunisia has a very limited water supply and a constantly rising water demand. To cope with water supply shortages crisis, Tunisia began to implement a comprehensive and sustained water demand management programme since 1991. Tunisia water conservation strategy combines the following: Increasing water supply system efficiency and controlling leakage; Universal water metering and pricing for conservation (rising-block-tariff); Public awareness and education to create a water conservation culture.

By 1999, major water saving were made:

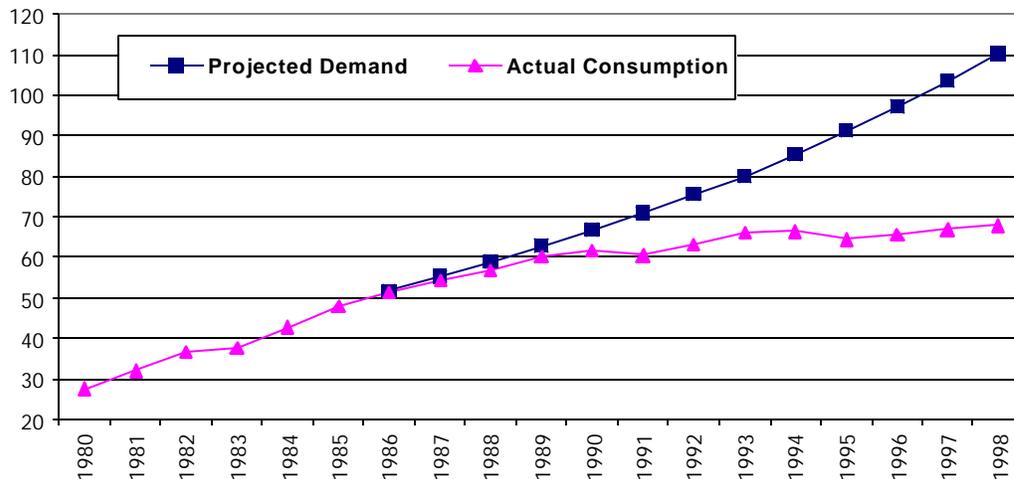
- ? Water losses in the distribution system dropped from 24.1% to 14.5%. The resulting water savings from 1996 to 1999 were 66 million cubic meters equivalent to 20 % of the annual drinking water consumption and the capacity of a medium size dam.
- ? 37% reduction in institutional and public water consumption which dropped from 1248 to 784 m<sup>3</sup>/year/connection
- ? 18% reduction in tourism consumption which dropped from 576 to 472 liters/day/bed
- ? 5% reduction in the average domestic consumption which dropped from 137 to 130 m<sup>3</sup>/year/connection in 1991.

### BAHRAIN defers a major expansion of its water supply system by conserving water<sup>1</sup>.

In 1985, the State of Bahrain predicted that by 1998, the demand on water would rise to 110.28 from 48.16 million gallons per day (mgd) in 1985. The additional 62.12 mgd would have had to be met through building an additional desalination plant. Bahrain embarked on a comprehensive water conservation programme in 1986 and further expanded it in 1992. Bahrain water conservation strategy combined the following: leak control through system rehabilitation and replacement; universal water metering and water pricing for conservation; improved consumer services compounded with public awareness and education

By 1998, the actual water consumption was 42.4 mgd less than predicted. By effectively controlling the demand on water, Bahrain eliminated the need to build a new desalination plant.

### The Impact of Water Demand Management Policies in Bahrain



Source: Limam (2000), Tunis, and Ministry of Electricity and Water – Bahrain (1999)

Enabling technologies are also available for using low quality water for non-potable water applications such as toilet flushing and landscaping to free up the most expensive, scarcest best quality water. Separation and recovery of graywater for toilet flushing or landscaping can readily be done. Brackish or lower quality water aquifers contaminated from onsite sanitation systems can be used for landscaping and toilet flushing. Small wastewater recycling systems at the scale of the household, residential building or neighborhood offer a cost effective and robust means of closing the water loop. The water authorities in Cyprus provide financial incentives and equipment to those households that wish to install graywater systems or drill a borehole for utilizing the low quality shallow aquifers for landscaping and toilet flushing (Kambanellas, 1997 & 1999). In Saudi Arabia, a residential development company reports water savings of 40% in residential buildings equipped with small wastewater recycling systems - closed water loop system (Badruddin, 2000).

The enabling technologies and the water pricing tools must be compounded with behavioral change and a water conscious culture which is influenced partly by people's knowledge of how much water they consume, for what purpose, at what cost and what consequences. The Bahrain customer information services notify the customer of their past consumptions. The pioneering Greater Hermanus water conservation project in South Africa provides the consumers with lots of information on their water consumption pattern and offers them prepaid water option as a tool to change their behavior towards water.

Public education and awareness is of paramount importance. However there are a lot of misconceptions. Water utilities often target the wrong audience with their across the board public awareness exercises and water education campaigns. In many cities in the region the average water consumption of 70 lpcd is common and a significant proportion of the population barely gets the basic water needs while the big consumers continue to wastefully use water. Water efficiency campaigns must be targeted at the right audience and must be closely coordinated with other demand management measures in order to ensure long-term behavioral change..

### **Water efficiency in agriculture**

Agriculture water use efficiency can be improved to grow more with the same water or grow the same amount with less water. Huge volumes of water can be freed up for meeting rising and priority domestic and industrial demands. Losses from the water storage, conveyance and distribution facilities can be reduced by lining water canals, replacing open canals with pipes, lining and covering on farm storage facilities. The irrigation efficiency can be improved significantly by departing from the inefficient flood irrigation methods to drip irrigation. Irrigation management services should be established to guide farmers on when, how, and how much to irrigate. To boost the irrigation efficiency in agriculture, Oman offered incentives and subsidies to encourage farmers to use drip irrigation. The productivity and efficiency of water use in agriculture can be improved by only allowing irrigation of crop and on lands with optimum crop yield per cubic meter of water. Better pricing of irrigation water can provide rational incentives to reduce wasteful irrigation and shift to more productive agriculture practices.

Countries may have to offer import incentives in order to encourage importation of water intensive crops and to discourage their local production. Bans might have to be placed on certain farm lands known for their low yields for every cubic meter of water. It might be necessary for countries with severe water shortages to stop farming of export crops. Exporting one ton of oranges is effectively exporting the 400 cubic meters of water that is needed to grow it. Likewise, importing one ton of bananas is effectively importing the 900 cubic meters of water necessary to produce it.

Crops require varying quality water. Crops which require a very high quality water might have to be replaced with salt tolerant and drought tolerant crops to make use of the brackish water, which in many counties is plentiful. Recycled wastewater is widely used in agriculture. Increasing use of recycled wastewater will become even more necessary in the future as the better quality irrigation water is shifted to municipal and industrial applications.

### ***Water efficiency in the industry***

The total amount of water use in the industry is determined by the mix of products produced, the intensity of water requirements in the production process, and the efficiency of the production processes. To produce more with the available quantity of water, it necessary to examine the mix of products and shift to products requiring less water to produce. Water intensive products can be avoided. Water intensive processes can be replaced with more efficient and less water dependant processes. Industrial wastewater must be recycled and as much as possible and used, together with treated domestic wastewater and other low quality waters, in appropriate applications within the production processes.

The industrial sector is considered a viable economic entity capable of competing for the scarce water supplies in the open market. Industrial water pricing to reflect the real cost of water will encourage conservation and investment in water saving solutions.

### **Environmental Protection, Pollution Control, and Recovery of Water**

As we use water in our homes, buildings, industry, and agriculture, we generate wastewater. The generated wastewater will either end up consuming the scarce freshwater resources if poorly managed or can be brought back into the water budget as a non-conventional water source thus closing the water loop. Pollution control through effective wastewater management is the tool available to water resource managers to protect the scarce water resources and recover water. To maximize wastewater recovery and beneficial use, wastewater management services must be extended at an accelerated rate to the unserved urban and small communities. Robust, efficient, cost effective, affordable and environmentally responsible wastewater management solutions must be identified and employed.

Necessity, investment and promotional efforts over the past two decades led to wide recognition of the importance of wastewater as a potential water source in the region. Yet this potential water source is not fully utilized and it continues to pollute the scarce water resources. The problem lies in the way wastewater is managed and recycling is perceived. For a long time, centralized wastewater systems were the preferred choice of planners and decision makers and the ultimate solution. The standard large, water and capital intensive sewer networks are built to transport domestic wastewater to central treatment. The high cost of centralized systems renders them unaffordable and and their dependence on water as a transportation medium renders them inappropriate in MENA especially for small communities. Experience with centralized systems in MENA is far less than desirable. Sewer networks are overloaded and often suffer from siltation and blockages due to the low water consumption where water supplies are intermittent. Treatment plants, often added years after the