

Review

Overview of the water and wastewater reuse crisis in the Eastern Mediterranean Region

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SUMMARY Many countries of the Eastern Mediterranean region have very limited water resources. The situation will worsen in the future as populations grow and demands rise, and water/wastewater reuse will become imperative. This paper reviews the current situation in the Region as regards water use/reuse and management, and gives suggestions for how to ensure sufficient water resources for the future

Features of the Eastern Mediterranean Region

The Eastern Mediterranean Region (EMR) is one of the poorest regions in the world in terms of water resources. It is also distinguished by its high population growth, accompanied by increased rates of water consumption, which has an adverse influence on water resources [1]. Thus, most groundwater resources in the EMR are at risk of being exhausted through overpumping. With withdrawal exceeding the internally renewable water resources, the resulting water pollution and water scarcity are rapidly becoming a major concern in most countries of the EMR. About 10% of the Region's population lacks safe water, and more than 30% lacks adequate sanitation.

By the year 2025, almost all countries of the Region with the exception of Iraq, Sudan and the Syrian Arab Republic will be unable to satisfy the food needs of their population [2]. Many countries will have to

shift the economy from an agricultural base to industry and services. The high-income countries of the EMR will continue to depend on desalination and other countries will be forced to depend on recycling. Thus reclaimed water will come to provide a substantial part of the available water resources in most EMR countries.

Stresses on the Region's water

The Region's gloomy picture in terms of water is the result of nine interrelated and interacting stress factors.

1. The lack of water to satisfy and sustain life and development in the Region. Demand is rocketing and the available renewable quantity diminishing, as a result of unsustainable extraction and exploitation of non-renewable resources.
2. Deterioration in water quality because of unsafe management and lax enforcement of the laws covering pollution pre-

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vention and control. Pollution is also increasing due to the expansion of industry and agriculture.

3. The low cost of water in the Region, which encourages misuse, exhausts resources and exacerbates water pollution.
4. Geopolitical factors. Many countries depend on the water that flows from other countries (Afghanistan, Egypt, Iraq, Islamic Republic of Iran, Jordan, Lebanon, Pakistan, Somalia, Sudan, Syrian Arab Republic and Tunisia). The amount flowing out depends on many geopolitical factors, and in the absence of agreed international laws and bilateral agreements on shared resources, the problem is intensifying. Many groundwater aquifers are shared between many countries and these too are not managed in a sustainable way. Many of the upstream countries are using their military superiority to control water supplies.
5. Institutional inefficiency is one of the major constraints in managing the water sector. Management of water in the Region is characterized by a lack of laws and inadequate enforcement, political domination of the decision-making process, short-term planning and a pattern of continuous crisis management. Furthermore, seepage of brackish or saline groundwater into the sewerage system and the intrusion of seawater into groundwater add to water stress. Donor agencies may also impose unsustainable and/or unaffordable technologies or projects that take no consideration of long-term integrated planning.
6. There is a shortage of easily available, valid and reliable data and information on water resources in most of the coun-

tries of the Region. Information on water resources and their quality, distribution, coverage, usage, unaccounted for water, leakage, cost, consumption, aquifer capacity and withdrawals, is scarce. The inadequacy of the information can lead to faulty planning and decision-making by both politicians and professionals.

7. There is a further lack of research and local experience. The region is almost completely dependent on countries in the northern hemisphere and in the west for research. There are few surveys or investigations carried out in the Region aimed at solving the Region's water problems. There are Region-specific problems that need to be investigated by institutions and universities located in the Region and more funds need to be allocated to research and development.
8. Inadequate financing exists in most of the countries of the Region, many of which are dependent on subsidies. There is a need to reform the water sector so that it can operate according to the principles of self-sufficiency and cost recovery.
9. The ability of consumers and the community to pay for their water and the level of community participation in planning and investment are both inadequate in the Region.

Wastewater reuse in the Region

Wastewater reuse in the Region can contribute to solving the problem of water quality and quantity, depending on how it is used. Wastewater reuse will play a major role in the agricultural economy, in individual well-being and in the health of society. It will continue to be a first option for aug-

Table 1 Cost of enhancing water resources

Option	Estimated cost (US cents/m ³)
Reducing end-user consumption (recirculation, low-water-use technology and leakage repair)	5-50
Treatment of wastewater for irrigation	30-60
Desalination of brackish water	45-70
Desalination of seawater	100-150
Transporting of water by pipelines	10-1500 ^a
Transporting of water by ship	0.5-1500 ^a
Transporting of water by sea in giant floating water bags (not including costs of terminals, inland transport or purification)	15-35 ^a

^aThe price of the water itself is not included. The cost depends mainly on the distance transported. Adapted/revised from World Bank 1997 [3].

menting water resources in the Region for many years (Table 1) [3].

The total quantity of reused treated wastewater in the EMR is estimated at 1200 million cubic metres per year. The quantity of effluent produced in Egypt in 1999 was about 4.96 million cubic metres, 3.774 of which came from secondary treatment plants and 1.205 from primary treatment plants (S Hossein, RG Youssef, unpublished report, 1999). Tunisia irrigates 3000 hectares with 20 million cubic metres of treated wastewater per year. Jordan produced 71 million cubic metres of treated wastewater in 1998 (M. Al-Najjar, unpublished report, 1999). The amount of wastewater treated constitutes 12% of the water used for irrigation; 15 700 *dunum* (1 hectare = 10 *dunum*) have been irrigated with 15.7 million cubic metres of treated effluent, and the rest blended with surface water for unrestricted use and used to irrigate 91 100 *dunum* mostly in the centre and southern Jordan Valley (M. Al-Najjar, unpublished report, 1999). Egypt, Saudi Ara-

bia and the Syrian Arab Republic are the largest users of treated wastewater in absolute terms, accounting for almost 66% of all the wastewater reused in the Region, with the Syrian Arab Republic alone accounting for almost 31% [4]. However, reuse is haphazard and presents significant health risks, especially where untreated wastewater is used to irrigate vegetables as happens in some EMR countries. To avoid the spread of disease, wastewater should be suitably treated for the type of crop to be irrigated and in accordance with accepted health protection measures.

Appropriateness of treatment processes in the EMR for agricultural use

Most of the treatment plants in the EMR use an activated sludge process, followed in some cases by rapid sand filtration [5]. These techniques were developed to reduce the suspended matter load and oxygen

demand of the discharged reclaimed waters and to reduce eutrophication of the bodies of water; they were not designed to remove pathogenic excreted microorganisms. Their use in the EMR, where excreted infections are endemic and where wastewater is mostly used for agricultural irrigation, is justifiable only in special circumstances.

Alternative treatment processes that are better at achieving low survival/acceptable risk of excreted pathogens in the effluent are now available [6]. There are five wastewater treatment processes that can achieve complete removal of helminth eggs and an adequate reduction in excreted pathogens so that the resulting material is suitable for unrestricted irrigation. These processes are:

- waste stabilization ponds with a detention time of more than 14 days;
- combination of treatment and effluent storage to replace the required detention time;
- conventional secondary sewage treatment with the effluent upgraded in polishing ponds;
- conventional secondary treatment followed by slow sand filtration;
- conventional secondary sewage treatment with effluent disinfected/upgraded by beta or gamma irradiation.

Regulations and guidelines for wastewater reuse in the Region

Most of the standards and government regulations in the EMR were established as country effluent standards to control the quality of discharge. The major difficulty here is that the application of uniform effluent standards can be uneconomical or inappropriate. Moreover, due to the great variation in end uses, the effluent standard

is usually too stringent and environmentally unjustified.

Water reuse standards must protect both public health and the environment, and must be suitable for end reuse objectives and the method of application. It is suggested that the discharge to stream standards be imposed only in cases of indirect reuse, and that they should be based on the total assimilative capacity of the rivers or valleys and on the water quality level for the predominant downstream water reuse. Most of the EMR standards are based on either the US Environmental Protection Agency or WHO guidelines, regardless of the type of end use or the country's disease profile. In practice, most of these standards are not enforced. Some countries with a high level of sanitation-based disease lack proper standards for reuse of wastewater [1].

Key suggestions to ensure water security and quality of life

- Policy-makers and high-ranking professionals in each country should review the water stresses relevant to their country and decide how to overcome them.
- The water sector should not be run on a principle of continuous crisis management.
- Self-destructive mining and overpumping of the ground water should be halted.
- Plan for water use not to exceed the available water resources. Water shortages mean pollution and unsustainable development. Each country should establish water conservation plans for all uses and levels.

- Only high-value agricultural production should be irrigated, and water should be allocated to uses that have the highest value and prevent pollution.
- Incentives should be provided for conservation, and sanctions/penalties imposed for irrational/wasteful water use. Costs should be applied at a realistic level that will prevent uneconomical use/reuse of water.
- Water use activities should be coordinated, plans for water use established and long-terms strategies and investments decided on according to priorities to be agreed with community participation.
- Valuable water resources should not be wasted by discharging reclaimed water into the sea.
- The wastewater reuse project should be designed as an integral part of the overall wastewater network and water resources plan.

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