best option yet the least understood option for water in the coming decades.

Wastewater Treatment and Reuse for Food and Water Security

Naser I Faruqui, Senior Program Specialist
International Development Research Centre

Introduction

This brief discusses wastewater treatment and reuse as a tool for addressing food and water security in the Middle East and North Africa (MENA).

At 2.8%, MENA has one of the highest average population growth rates in the world. Combined with scarce natural water supplies this results in a very low per capita water availability, expected to decline to 725 m3 per capita, per year (pcpy), by 2025, far below the benchmark level of 1000 m3pcpy–used as an indicator of severe water stress. This situation is compounded by the high urbanization rate in MENA, which at 3.2%, is higher than the rate for developing countries as a whole, 2.9%. Overall, within the region, about 80% of fresh water is used in agriculture. Because even with low urban tariffs, the value of water is at least 10 times higher in urban areas than it is in agriculture (Gibbons 1986), water will increasingly be taken out of agriculture and into urban areas. This means that the region will increasingly suffer from twin and related problems of food and water insecurity.

Most nations in the region are already importing virtual water, in the form of food, and will likely have to increase specific imports, such as cereal crops. Despite this, many countries wish to increase fresh water supplies to domestic, and industrial usages, and at the same time, expand irrigated agriculture. For example, Tunisia wishes to increase the area of irrigated agriculture by at least 30,000 hectares (ha), and Egypt, by 880,000 ha. How can these seemingly contradictory objectives be reconciled? The answer is water demand management–more efficient water use within all sectors. One specific component is to increasingly reuse domestic wastewater, for industry, for some municipal purposes, such as flushing toilets and irrigating green spaces, but above all, for agriculture, to offset the fresh water being taken out of this sector.

Benefits

There are several benefits of treated wastewater reuse. First, it preserves the high quality, expensive fresh water for the highest value purposes–primarily for drinking. The cost of secondary-level treatment for domestic wastewater in MENA, an average of $US 0.5/m3, is the cheaper, in most cases much cheaper, than developing new supplies in the region (WB, 2000). Second, collecting and treating wastewater protects existing sources of valuable fresh water, the environment in general, and public health. In fact, wastewater treatment and reuse (WWTR), not only protects valuable fresh water resources, but it can supplement them, through aquifer recharge. If the true, enormous, benefits of environmental and public health protection were correctly factored into economic analyses, wastewater collection, treatment and reuse would be one of the highest priorities for scarce public and development funds. Third, if

managed properly, treated wastewater can sometimes be a superior source for agriculture, than some fresh water sources. It is a constant water source, and nitrogen and phosphorus in the wastewater may result in higher yields than freshwater irrigation, without additional fertilizer application (Papadopoulos, 2000). Research projects in Tunisia and Saudi Arabia have demonstrated that treated effluent had superior non-microbiological chemical characteristics than groundwater, for irrigation. Mainly, the treated wastewater has lower salinity levels (WB, 2000, pg. 8).

Case-Studies

Countries in the region which practice wastewater treatment and reuse include Kuwait, Saudi Arabia, Oman, UAE, and Egypt. However, only Israel and Tunisia, and to a certain extent, Jordan, already practice wastewater treatment and reuse as an integral component of their water management and environmental protection strategies. About eighty percent of Israel's treated wastewater is reused in irrigation. In Tunisia, treated effluent with a total flow of 250 m3/d is used to irrigated about 4500 ha of orchards (citrus, grapes, olives, peaches, pears, apples, pomegranate), fodder, cotton, cereals, golf courses and lawns (Abu-Zeid, 1998). In Jordan, all of the treated wastewater collected from the As-Samra wastewater treated plant is blended with fresh water from the King Talal reservoir and used for unrestricted irrigation downstream in the Jordan Valley.

Problems

The main problem with wastewater reuse is the threat to public health and soil and water, if reuse is not done carefully. While the main impact on health in developing countries from wastewater reuse is from helminthic diseases, microbial pathogens are the second largest threat. The worst case situation is when untreated wastewater is used to irrigate vegetables or salad crops eaten raw. This practice resulted in the cholera outbreak in Amman in 1981. Unfortunately, there are many examples of this on-going practice. For example, due to water scarcity, the irrigation of market vegetables such as eggplant and cucumber with raw wastewater flowing in the Kedron Valley, West Bank (IDRC Trip Report, Naser Faruqui, 1999). Components in wastewater most toxic to some crops include sodium, chloride, and boron (Dayman, 2000). Wastewater can also salinize soils, and the grease in raw wastewater can reduce soil permeability and aeration by clogging pores. Both microbial pathogens and over the longer term, nitrates from wastewater can contaminate shallow aquifers.

These obstacles are very real, but are not insurmountable. In fact, in 1989, the World Health Organization published the Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture (WHO, 1989), to protect public health. These guidelines identify necessary treatment levels depending upon whether the irrigation will be restricted (cereal, industrial, fodder crops or pastures and trees), or unrestricted(irrigation of crops likely to eaten uncooked, sports fields, public parks). Even the most stringent treatment levels in the WHO guidelines can be met by a series of wastewater stabilization ponds. In addition to identifying a combination of treatment and crop restrictions, the WHO guidelines also outline safe waste application methods and control of human exposure, to protect public health. For instances, in most cases, sprinkler irrigation is discouraged, and where fruit trees are irrigated with wastewater, irrigation should cease two weeks before fruit is picked, and

no fruit should be picked off the ground. Crops and soil can be protected by already available information on crops and soil sensitive to wastewater irrigation. Groundwater and surface water can be protected by mapping sensitive areas, such as shallow aquifers used for drinking, and banning wastewater irrigation in those areas.

Given the emphasis that Islam, like other religions, places on cleanliness, there is also a persistent notion within the region that wastewater reuse is against Islam. However, IDRC organized a workshop on water management in Islam in December, 1998. As noted in the book, Water Management in Islam, to be published jointly by IDRC-UNU Press, in October 2000, in 1978, the Council of Leading Islamic Scholars of Saudi Arabia issued a special fatwa "to regulate the rules of treated effluents for different purposes. Wastewater reuse was made permissible for all purposes, including wudu, provided that the wastewater was treated to the required level of purity for its intended use and did not result in any adverse public health effect. Saudi Arabia is currently reusing about 20 percent of its treated wastewater in refineries, for flushing the toilets and for irrigating forage and landscape crops.

Another obstacle is that while in theory, centralized WWTPs can be implemented in cities in MENA, providing that municipalities, national governments, and donors make them a priority, few proven systems exist for rural or peri-urban areas. Within its Urban Agriculture program, meant to offset potential lower food production in rural areas, IDRC is currently developing a network of decentralized, low-cost , natural waste-treatment systems, for reuse on or near on-site. Pilot projects include trickling filters for grey-water reuse in the low-density hilly settlement surrounding Jerusalem, aquatic wetlands using water lettuce or duckweed in the Jordan Valley and Senegal, and low-mechanical content activated sludge in Egypt.

Creation of an Enabling Environment

Governments in MENA can do at least four things to use safe WWTR as one tool to combat food and water insecurity. First, WWTR must form part of an integrated water management strategy, at the basin level, with multi-disciplinary linkages between different sectors such as environment, health, industry, agriculture, and municipal affairs. For instance, the main producer of waste water, municipalities, must interact with the main user, agriculture. Urban/rural planning must be integrated so that industries are not sited in locations where their effluent, often high in dangerous constituents such as heavy metals, will not contaminate water meant for the biggest user, agriculture. Second, it is the duty of governments to facilitate the participation of stakeholders in WWTR projects, including supporting non governmental organizations which help build institutions at the local level. Safe and sustainable decentralized, WWTR projects will never be established without the willing participation of the beneficiaries. Third, there is a need to disseminate existing knowledge about the danger of raw wastewater reuse, safe reuse guidelines, the position of Islam on wastewater reuses. Knowledge of cost effective treatment technologies, crop and soil protection must also be disseminated, and site-specific research carried-out, to fill missing gaps. Finally, to ensure the protection of public health and the environment, governments must regulate and monitor quality of effluent, reuse practices, public health, crop water quality, and soil and groundwater quality.

Conclusions

Domestic WWTR is one tool to address the food and water insecurity facing many countries in MENA. In coming years, in most MENA countries, valuable fresh water will have to be preserved solely for drinking, very high value industrial purposes, and for high value fresh vegetables and salad crops consumed raw. Where feasible, most other crops in arid countries will have to be grown increasingly, and eventually solely, with treated wastewater. The economic, social and environmental benefits of such an approach are clear. To help the gradual and coherent introduction of such a policy, which protects the environment and public health, governments shall have to adapt an Integrated Water Management approach, facilitate public participation, disseminate existing knowledge, and generate new knowledge, and monitor and enforce standards.

WDMRN Home	About WDMRN	News	Program	Documentation	Links

Resources | Research Programs | The Institution | CRDI en français

Last Updated: 10 Apr. 2000