

Friends of Environment and Water (FEW)

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Costs and benefits of wastewater treatment and reuse for irrigation in Wadi Al-Nar/Kidron area

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List of abbreviations

AL	Aerated Lagoon
AS	Activated Sludge
avg.	Average
BOD	Biological Oxygen Demand
CBA	Cost-Benefit Analysis
Dounum	1,000 square meters = (0.1 hectare)
HWE	House of Water and Environment
JD	Jordanian Dinar
km	Kilo Meter
l/c/d	Liters per Capita per day
CM	Cubic Meter
masl	Meters Above Sea Level
MCM	Million Cubic Meter
MENA	Middle East and North Africa
mm	Millimetres
O&M	Operation and Maintenance
PT	Palestinian Territories
PWA	Palestinian Water Authority
SS	Suspended Solids
TD	Tunisian Dinar
TF	Trickling Filter
US\$	United States Dollar

WHO	World Health Organization
WWTP	Wastewater Treatment Plants
AL	Aerated Lagoon

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1 Background

1.1 *Objectives of the study*

The aim of this study is to conduct a cost benefit analysis for irrigation with treated wastewater from Palestinian communities that discharge into Wadi Al-Nar. The specific objectives are:

- To estimate the quantities of wastewater that would be available for irrigation after adequate treatment.
- To select the suitable crops to be irrigated with treated wastewater in the study area.
- To estimate the land areas to be irrigated with the treated wastewater.
- To select proper locations for wastewater treatment plants.
- To select proper wastewater treatment technologies.
- To select suitable sites for irrigation with the treated wastewater.
- To study and compare the financial and economic costs and benefits for the suggested treatment and reuse options.
- To suggest an appropriate tariff system for wastewater treatment and reuse in order to ensure sustainability of the project.

It is worth mentioning that indirect costs and benefits associated with the undertaken wastewater treatment and reuse options were not evaluated due to time and budget limitations. Besides, the sources for most of the data needed is the stakeholders, and the major one (the Palestinian Authority) was under an employees' strike for a long time.

1.2 *Water scarcity and the need for additional water supplies*

The crisis of water scarcity looming on the horizon threatens the stability and security of the Middle East in general and the Israeli-Arab relations in particular. The Palestinian population and economy grow against finite freshwater resources, the annual per capita availability, which was about 2,000 CM in 1980, has fallen to less than 500 CM in 2000; it is predicted to fall to less than 200 CM by 2025; far below the benchmark level of 1,000 CM used as an indicator of severe water stress.

Much of the water crisis is caused by the way water is used. More than 75% of Palestinian withdrawn freshwater is allocated to agriculture and only 25% to municipal and industrial uses, compared with worldwide 69% and 31%, respectively. This implies reallocation of freshwater from agricultural to domestic and industrial uses. It is estimated that a reduction in agricultural water use by 15% would double the water available to households and industry in the region. This would reduce irrigated agriculture in a country that aims to expand it due to social and food security reasons. Moreover, the Palestinian policy-makers avoid inter-sector water transfer, mainly due to internal and external political considerations represented by the fact that Israel dominates the management of the entire water resources. The Palestinian Territories (PT) will increasingly suffer from water scarcity and consequent food insecurity, unless feasible and viable alternatives are provided. This fact has converged national, regional, and international efforts in search for additional and alternative sources of water.

Most attention was turned to desalination of brackish and sea water, inter-basin transfers by pipeline, and import of water by shipment. All of these options are technically feasible, but none is affordable or easy since they are capital and energy intensive (Table 1), many have severe ecological impacts, and all are politically complex (Brooks, 1999). Moreover, these options can solve the quantity dimension of the problem temporarily, but cannot prevent environmental pollution and risks to public health. Therefore, the reuse of treated wastewater is well recognized for having a potentially significant role in alleviating the quantitative and qualitative stress on water resources in the region.

Table 1: Cost comparison of options for enhancing water resources in the MENA region.

Options	Estimated costs (US\$/CM)
Reducing end-user demand (re-circulation, low water-use technologies) and leakage prevention	0.05 – 0.50
Wastewater treatment for irrigation	0.30 – 0.60
Desalination of brackish water	0.45 – 0.70
Desalination of seawater	0.48 – 2.20

Source: World Bank, 1996; Abdulrazzak and Kobeissi, 2002

Treated wastewater is now being considered as a new source of water that can be used for different purposes such as agricultural and aquaculture production, industrial uses, recreational purposes and artificial recharge. Using wastewater for agriculture production will help in

alleviating food shortages and reduce the gap between supply and demand. The increasing concern for reuse of treated wastewater in the PT is accelerating significantly for many reasons:

- Depletion of groundwater resources and growing water scarcity increase demands for additional water supplies.
- Expansion of sewerage system networks.
- High population growth leads to production of large quantities of wastewater which makes its use for agriculture a viable alternative.
- A wide range of technologies now exists to purify wastewater to acceptable levels, increasing the opportunities to reclassify wastewater as a renewable water resource rather than waste.
- Environmental concerns increase, reflected by stricter pollution control measures, leading to larger quantities of wastewater to be treated at high expenses. Reuse is a safe disposal of wastewater which will reduce the environment and health risks. The treatment of wastewater to be used for irrigation is cheaper than that needed for protection of the Environment.
- The nutrients in reclaimed wastewater add attraction for use in agriculture, and consequently reduce use of chemical fertilizers.
- Rainfed farming can be converted into more productive wastewater irrigated agriculture.

Depending on the degree of treatment, reclaimed wastewater is a reliably available resource that may be fit for irrigation, industrial, and municipal uses at relatively low costs.

1.3 Palestinian strategies for reuse of treated wastewater

The Palestinian Water Authority (PWA) is the key regulator of Palestinian water resources. The following strategies that encourage and enforce reuse of treated wastewater are developed by PWA (2003):

- Reuse of treated wastewater must be considered in all treatment schemes.
- Co-operation must be established with different relevant bodies.
- For every reuse project, beneficiaries must be involved in all project phases.

- Flexible reuse plans should be developed to be able to utilize treated wastewater in winter seasons and when the effluent quality drops below the demands.
- Establish planning tools (regulations, standards, guidelines, etc.) for reuse and recharge.
- Discharge to surface water may be considered as an interim action, or if reuse is not feasible.
- Do not allow irrigation of crops eaten raw by treated effluent and adopt appropriate enforcement means.
- For better water quality and reuse efficiency, consider (i) mixing of treated effluent with urban and surface runoff, (ii) artificial recharge of groundwater with treated effluent wherever possible, and (iii) establish surface storage for treated effluent with or without harvested runoff.
- Allow private sector and/or public to manage or share the management of wastewater reuse projects (contract private companies or public associations and co-operative to manage wastewater reuse).
- Develop a program for modifying water use habits to include reuse of treated effluent in urban centers (greening, fountains, urban parks and landscape irrigation forestation, and other areas).



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