



## Land suitability for irrigation with treated wastewater

### Key findings

- Irrigation with treated wastewater can reduce soil fertility and groundwater quality if site-specific soil properties are not considered.
- A high-sensitivity towards soil salinization is the most widespread concern in the Jordan River basin area and currently cannot be overcome by wastewater treatment.
- Lower overall soil suitabilities for irrigation with treated wastewater were identified for the sandy soils of the coastal plain and for the heavy soils of the highlands of the West Bank and the Golan heights.
- The risk of slaking of the upper layer as a result of raindrop splash was found to be generally low to moderate.
- Heavy metal up-take by plants or leaching to the groundwater is highly unlikely in more than 80% of the soils tested, due to their high pH.
- A reduced wettability of soil surfaces from wastewater irrigation occurs mainly in sandy soils.

### Overview and Objectives

In the Middle East available freshwater is expected to decrease alongside a growing population (increased demand) and decreasing natural recharge due to climate change (Briefing 1.3). Freshwater resources are preferentially allocated to domestic and industrial use, while agriculture (relying largely on irrigation) is particularly threatened by water shortages.

Wastewater provides an alternative option, and is already the most important non-conventional water resource in the Jordan River catchment. The use of treated and blended wastewater for irrigated agriculture on the Jordanian side of the Jordan River amounts to about 20% of the natural annual inflow and will exceed this before 2025.

By 2008, after several years of drought, wastewater constituted about half of the water supplied to Jordanian agriculture. In Israel, the contribution of treated wastewater to agricultural irrigation supplies is of a similar proportion, and the rate of reuse of wastewater is close to 75%. Potential wastewater resources in the West Bank are estimated to equal about 50% of the current Palestinian freshwater withdrawal.

Health risks associated with wastewater irrigation can be controlled by treatment technology and regulation of crop selection. However, depending on irrigation technology, effluent quality and site characteristics such as land use, irrigation with wastewater can pose adverse environmental effects, on- and off-site. Potential risks include

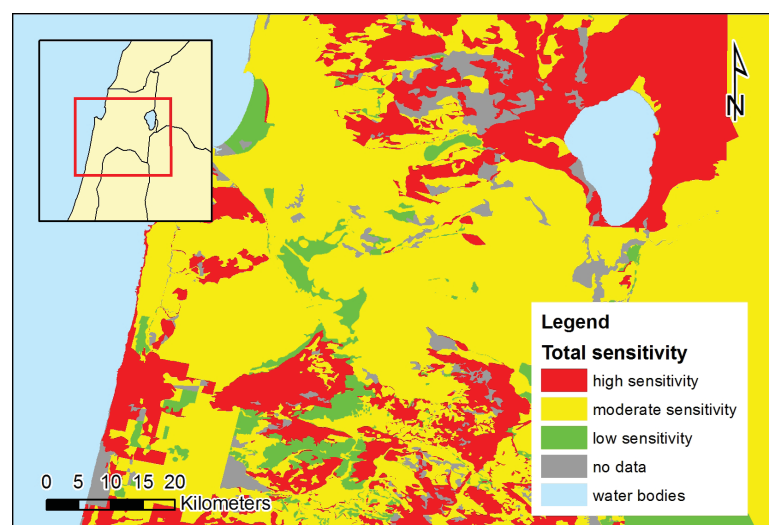


Figure 1: Total soil sensitivity towards treated wastewater irrigation (cutout).

Teams of researchers from Germany, Israel, Jordan and the Palestinian Authority work on how best the hazards posed by global change to the future of the Jordan River basin can be faced and overcome.

[www.glowa-jordan-river.de](http://www.glowa-jordan-river.de)

The GLOWA Jordan River project is part of a larger research initiative launched by the German Federal Ministry of Education and Research under the title "Global Change and the Hydrological Cycle".

<http://nbn-resolving.de/urn:nbn:de:bsz:21-opus-69281>

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soil salinization, structural deterioration of soil, and accumulation and transfer of pollutants. These risks must be controlled in order to prevent the long-term degradation of soil and groundwater resources through irrigation by wastewater.

With the aim of developing long-term sustainable land and water use management strategies, a Geographical Information System (GIS) database of the Jordan River basin showing various soil sensitivities to irrigation with treated wastewater was created and made available for authorities, farmers and scientists within Israel, the West Bank and Gaza, and parts of Jordan. See Figure 1 for a cut-out of the GIS image.

### Research Methods

Our project team compiled data from soil maps and soil analyses to identify the site-specific risks. Land was classified using map units based on the soil's suitability for irrigation with treated wastewater (i.e. high suitability would mean a low sensitivity). As a first step, a soil database was created within a GIS database. This compilation of soil units and their associated chemical and physical soil properties is the first of its kind for this region and forms the base for other practical applications like land-use planning and modeling climate change scenarios.

For the evaluation of land suitability for irrigation with wastewater, six major risks to agriculture were considered:

1. Mobilization of heavy metals
2. Slaking of the upper soil layer
3. Salinization of soils
4. Mobilization of boron
5. Groundwater pollution
6. Hydrophobicity (degree to which water is repelled from a hard surface)

The analysis showed that the most severe risk of irrigation with wastewater in the Jordan River region is that of soil salinization. As current wastewater treatment technologies do not reduce salt content, irrigation with highly saline wastewater may raise soil salinity to the point of reduced productivity, thus posing a serious threat to agricultural production. Salinization is expected to be a major limiting factor for the expansion of the use of treated wastewater, since salt concentrations in soils and groundwater will increase independently of irrigation due to lower precipitation rates and higher temperatures induced by climate change (Briefing 1.3).

Other widespread risks of wastewater use in irrigation are mobilization of boron and groundwater pollution by leaching of non-absorbable substances like nitrates and chloride. These threats can only be overcome by reducing the pollutant load in the wastewater.

### Conclusions

The GIS-based land sensitivity classification for wastewater irrigation has been published and is available for authorities, farmers and scientists (<http://tobias-lib.uni-tuebingen.de/portal/glowa/?la=de>).

The sensitivity maps help to identify areas where irrigation with poor quality wastewater may pose a particularly high environmental risk and should thus be avoided. Mitigating factors include improving treatment technology or using only freshwater resources. On the other hand, areas with a low risk, i.e. with high suitability for irrigation with wastewater, may not require the most sophisticated treatment technology as even lower grade wastewater will not pose serious environmental risks. The information provided by these maps may be applied to determine a sustainable approach to regional land and water resource management by informing wastewater allocation and investment strategies for treatment technologies.



Figure 2: Center Pivot Irrigation System, Israel.

### References

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