## Which facts need to be considered when implementing treated wastewater reuse?

Water demands for irrigation vary seasonally so that a storage system or a combination with other reuse schemes should be planned. Storage capacities need to be dimensioned to be able accommodating about 30 % of the annual effluent.

To select an appropriate treatment method and system the following factors have to be assessed:

- costs of construction, operation and maintenance
- charges for deliverance to the farmers and their acceptance
- land availability, topography, geology, climate and distance to residential and reuse areas

For maximum protection a **multi barrier approach** is suggested:

- wastewater treatment: reduce pathogen concentrations
- crop restrictions: only for processed, cooked or fodder crops
- irrigation method: drip/trickle irrigation instead of sprinkler or furrow irrigation (also advisable to avoid salt related leaf damage and salt accumulation in the root zone)
- scheduling of irrigation: restrictions how long before the harvest reuse water can be applied
- location restrictions: buffer strip to dwellings and to surface water and groundwater infiltration features
- human exposure control: protective clothes, hygiene, washing of harvested produce before sale, cooking of crops, clear signage of reclaimed water, immunisation

**Irrigational reuse should not be permitted in groundwater protection zones 1 and 2.**

## How can we be sure that there is no negative impact on water resources from treated wastewater reuse ?

**For reuse an intensive control of wastewater water quality and investigations of impacts on water resources, health impacts on local population and farmers, quality of the produced food and impacts on soil quality is necessary.**

This requires:

- Drilling of downstream monitoring wells and frequent analyses of raw water quality in downstream water sources used for drinking purposes
- Frequent analyses of the applied reuse water
- Frequent analyses of food safety for human consumption
- Investigation of effect on soil (e.g. salt accumulation)
- Public health surveys

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# Reuse of Treated Wastewater in Agriculture

## Protection of Jeita Spring

Project funded by the German Government

Federal Ministry for Economic Cooperation and Development

## Where is water needed for irrigation and why is there not enough ?

Because of the specific geological conditions, the main agricultural areas in the Mount Lebanon mountain range are located at elevations of between 1000 and 1550 m. They are located on aquitards, i.e. on geological units of low permeability. Water for irrigation at these elevations is needed mainly between June and September. It comes from springs emerging from the Upper Cretaceous limestone aquifer, which is fed mainly by melting snow at elevations between 1800 and 2600 m. Because of the high level of karstification this aquifer dewaters quickly and many springs, such as Labbane fall dry already in August. Therefore much of the needed irrigation water is increasingly stored in large ponds. In the Jeita catchment there are around 1000 such ponds and reservoirs. **Due to the increased need of water from springs for irrigation, less and less water is being allocated for irrigation**. **Therefore the need for unconventional water sources, such as treated wastewater, has risen.**

## What are the differences in treatment if water is intended to be reused in agriculture ?

Discharge of treated domestic wastewater into the environment requires a high level of treatment, often tertiary treatment, where nutrients, nitrogen and phospate are removed and wastewater is disinfected. For reuse of treated wastewater in irrigation it is, however, desired to retain nutrients, nitrate and phosphate. Although disinfection would be desirable because of health concerns for the farmers and local population, especially if spray irrigation is applied, it is often not practiced because of high energy costs. Therefore **wastewater treated for reuse usually carries a high microbiolocial and nutrient load.**

## Where could reuse of treated wastewater be allowed ?

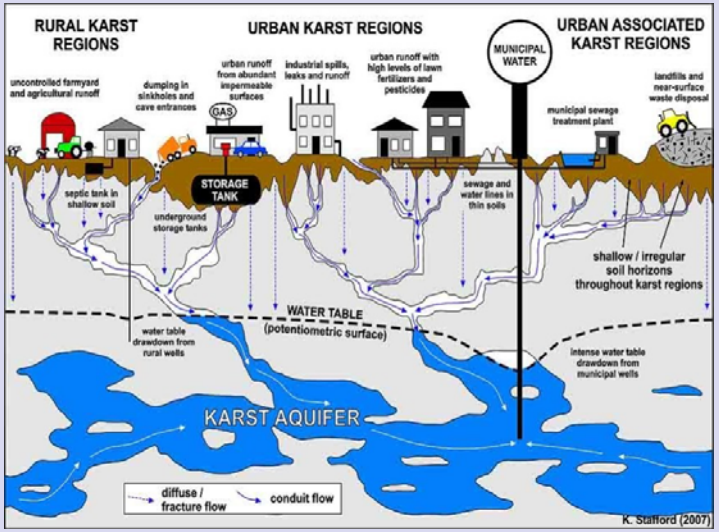
Treated wastewater can only be applied in agriculture if it ensured that it will not infiltrate into groundwater and cause contamination thereof. Under the conditions prevailing in Lebanon it is recommended to **allow the application of treated domestic wastewater reuse for irrigation only in areas where the vulnerability of the aquifer to pollution is low so that treated wastewater would not directly or indirectly infiltrate into the groundwater and cause pollution**. Reuse should primarily take place only on sufficiently thick geological units of low hydraulic permeability, which act as a **hydrogeological barrier**. Moreover treated domestic wastewater reuse depends on the type and characteristics of the soil. If treated domestic wastewater is applied in large quantities, soil salinity may increase and cause a massive reduction in soil fertility.

## A National Standard for Treated Domestic Wastewater Reuse for Irrigation is needed

**A related proposal has been made by the project**.

It recommends :

- Treated wastewater reuse standards should be similar as for discharge into the environment, because karst aquifers are highly vulnerable and contamination can reach drinking water supplies fast
- Not to reuse treated industrial wastewater and treated domestic wastewater containing a large share (> 10%) of industrial or commercial wastewater.
- To use Domestic wastewater reuse classes based on health concerns, hydrogeological and soil characteristics of the area.




- To use groundwater vulnerability maps for the decision if and where to apply reuse.
- To agree with farmers and local population on the option of reuse and sign related agreements

## What would happen if treated wastewater was applied on karstic limestone ?

The intensive karstification of the limestone in the Mount Lebanon mountain range has created interconnected dissolution channels through which infiltrating rainwater reaches the aquifer very fast. Horizontal movement in the aquifer along so-called conduits is even faster (up to 2000 m/h). A contamination, even if taking place several kilometres upstream of a spring used for drinking purposes, may rapidly affect its water quality. Large-scale application of treated wastewater reuse in the Mount Lebanon mountain range therefore potentially bear a high pollution risk. Here only few areas are principally suitable for reuse. The suitability of individual areas has to be investigated in detail before related decisions are taken.

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