

Soils under waste water irrigation

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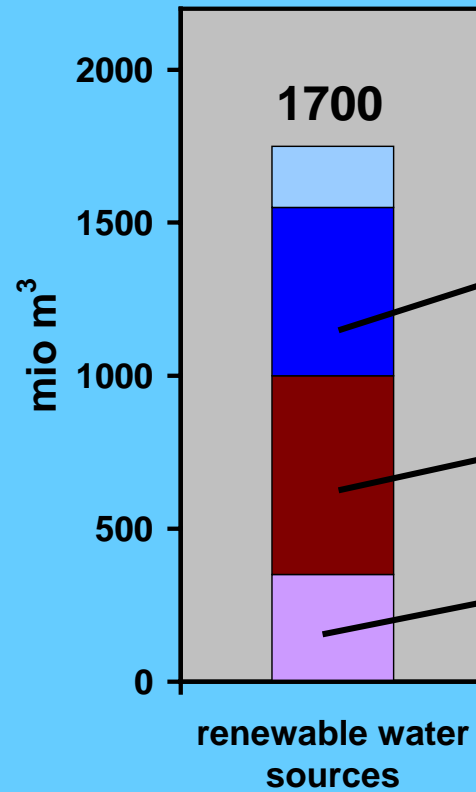


Water sources and water demand in the Jordan River area

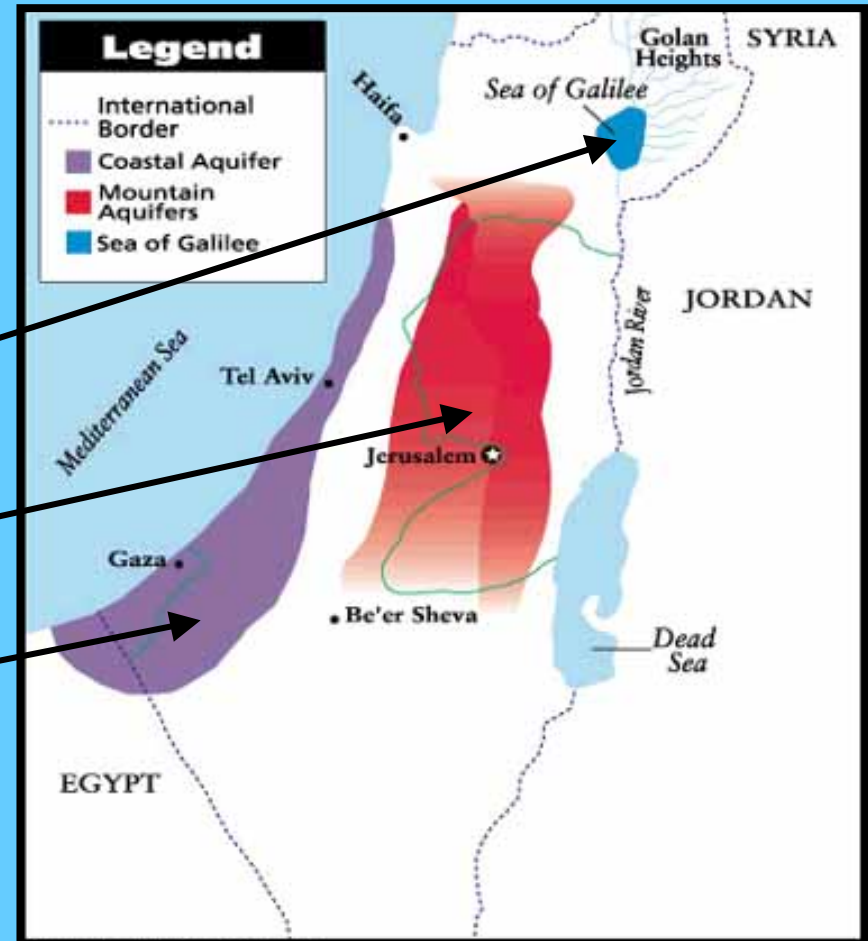


- Freshwater resources are already being overexploited.
- Global climatic change may aggravate this situation by reducing precipitation and increasing evapotranspiration.
- Water demand is expected to increase due to population growth and improved standard of living.
- "Clean" freshwater from ground- and surface waters will be preferentially allocated for use as drinking water and for certain industrial processes.
- For agricultural production, irrigation will increasingly have to rely on marginal waters, such as saline waters or treated wastewater.

Water sources and water use in Israel

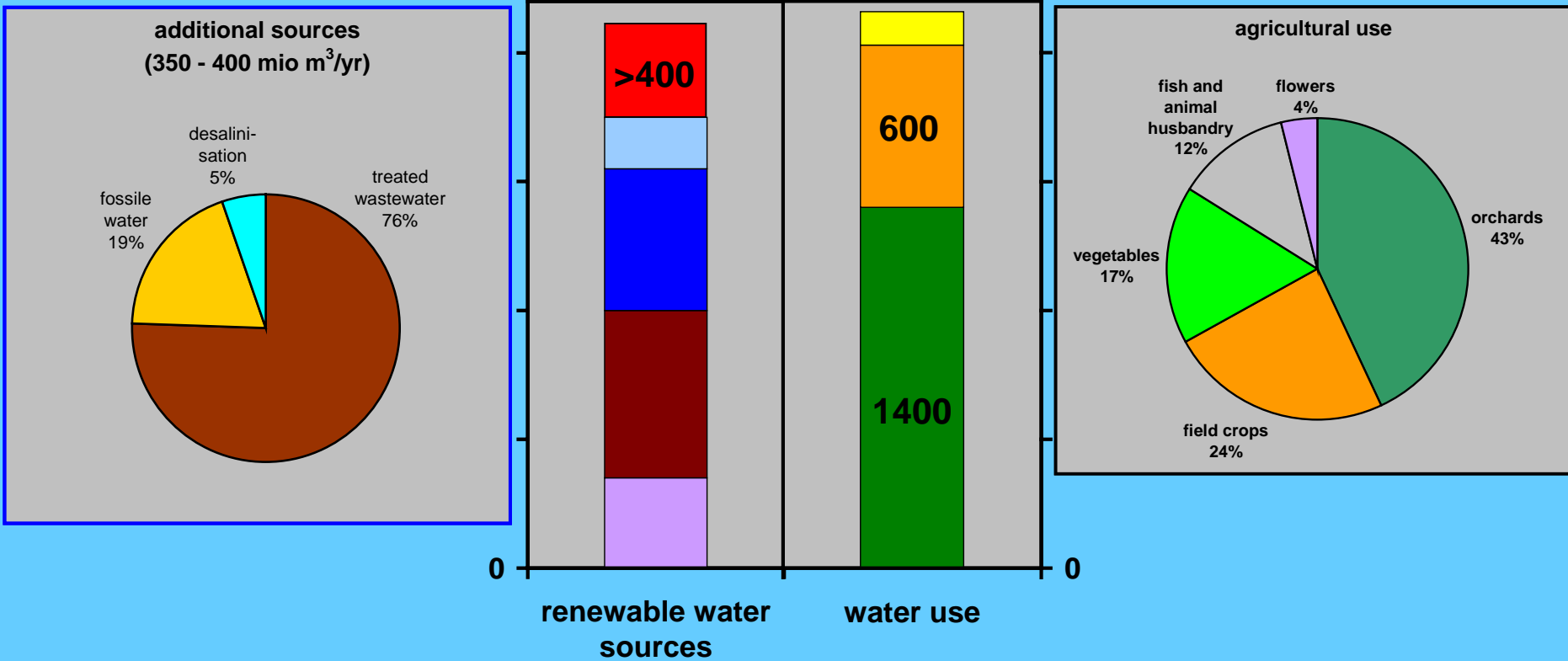


- Other Aquifers and surface waters
- Sea of Galilee
- Mountain Aquifer
- Coastal Aquifer



water sources

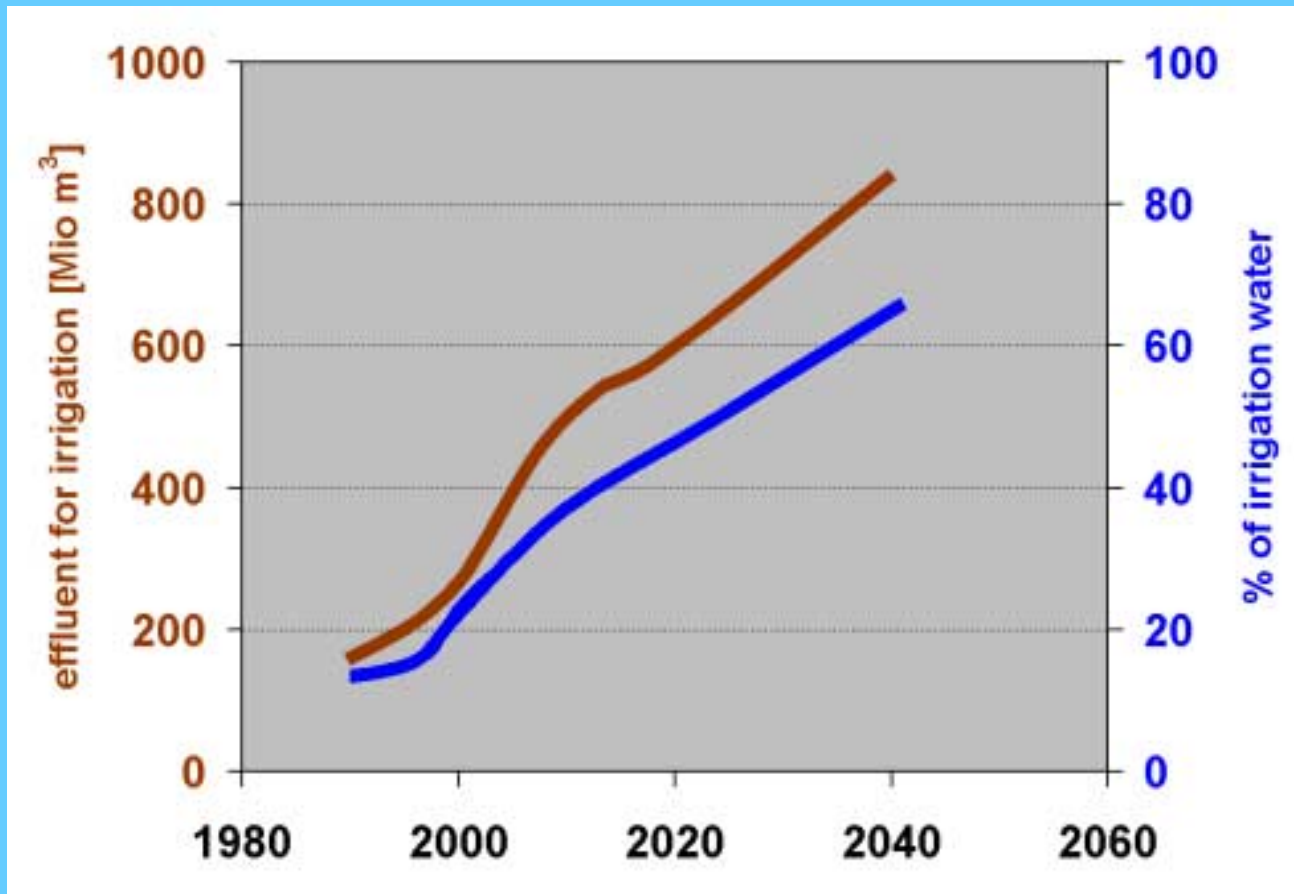
Water sources and water use in Israel



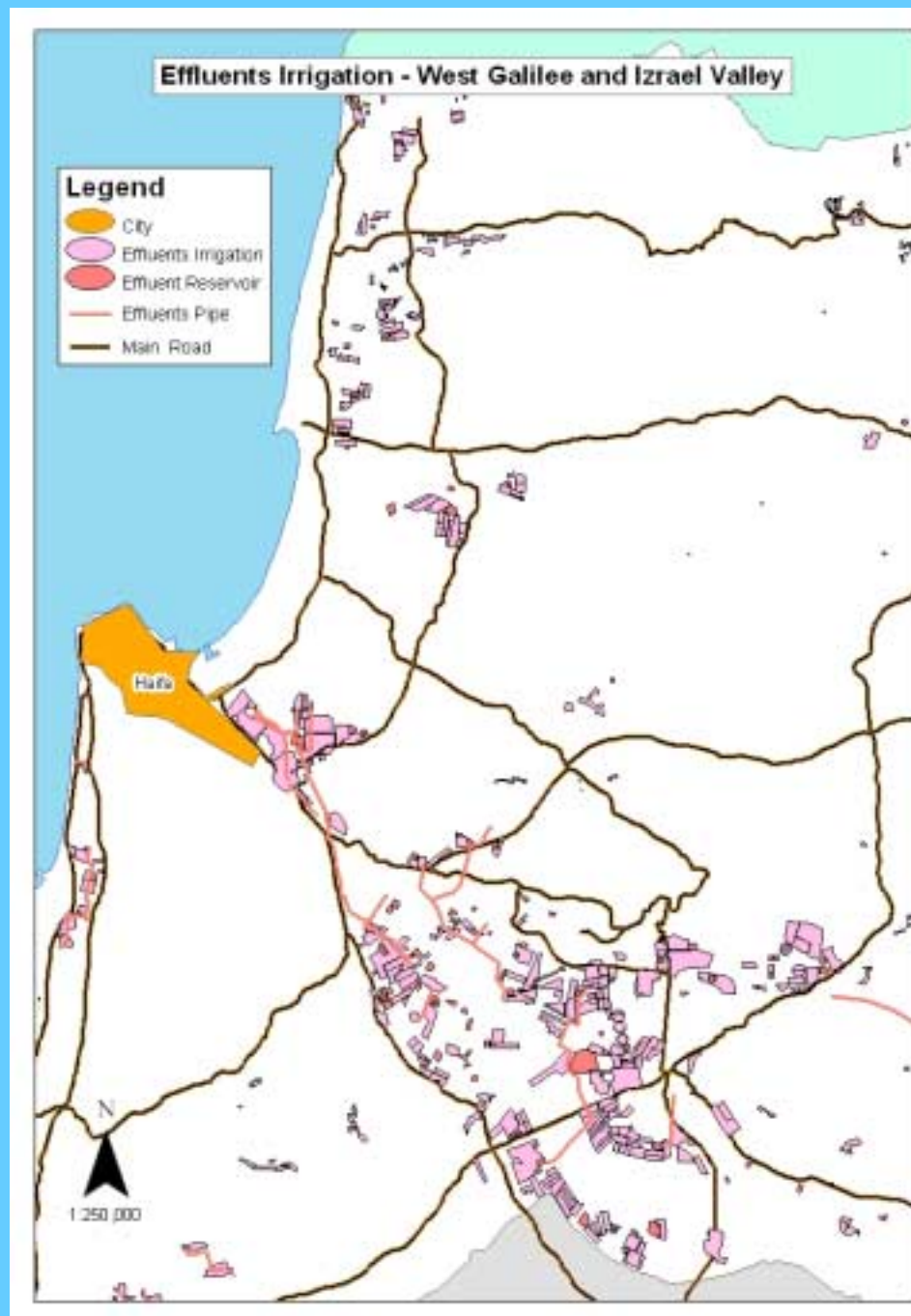
- Other Aquifers and surface waters
- Sea of Galilee
- Mountain Aquifer
- Coastal Aquifer
- industry
- municipal & household
- agriculture

Israel's options for agricultural water demands:

Increase the use of marginal waters, such as treated sewage effluents or brackish waters.



Present and projected use of effluents in Israeli agriculture

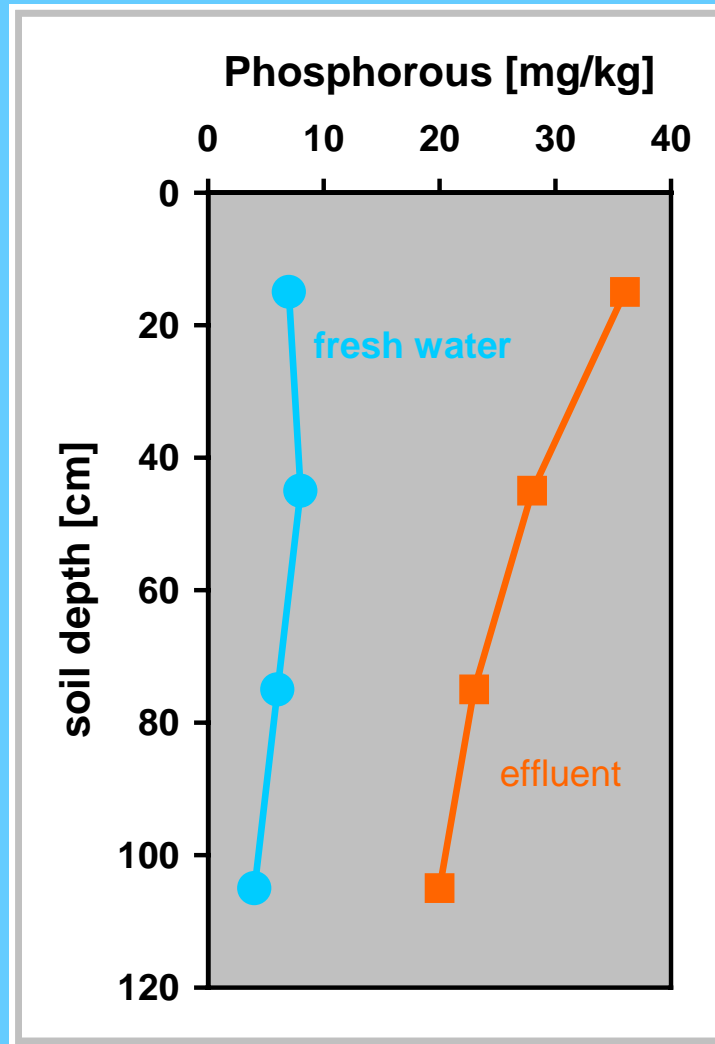


Problems associated with the use of treated wastewater for irrigation

- Microbial pathogens (i.e. coliformes) may contaminate food crops.
- High nutrient loads (esp. N, P) increase the risk of groundwater eutrophication.
- Elevated salt loads can cause soil and groundwater salinisation and affect soil physical properties.
- Elevated inputs of heavy metals, organic pollutants, hormones and antibiotics may enter food chain or groundwater resources.
- Inputs of particulate and dissolved organic matter can affect mobility of contaminants and physical or chemical soil properties.

Effect of effluent irrigation on chemical soil properties:

P-content

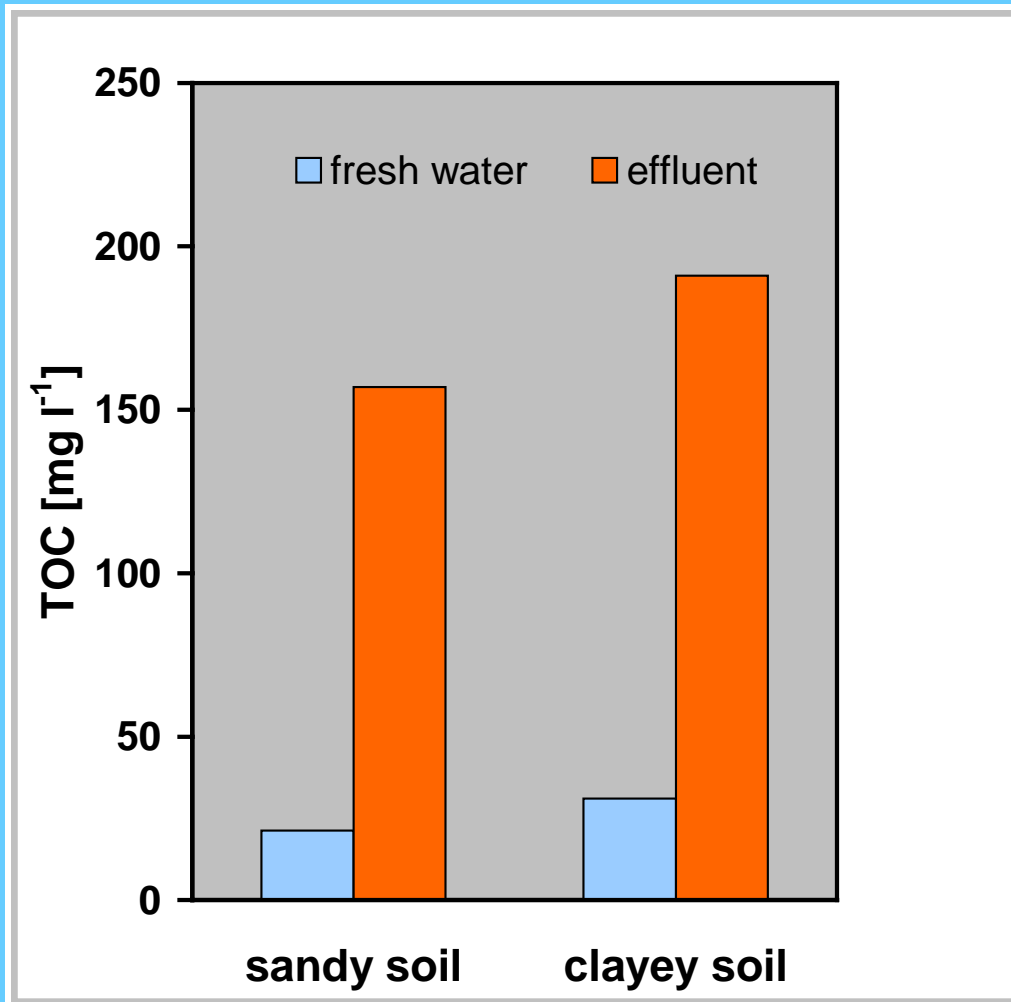


Assouline et al.

P-content in soil increases:

- improved P-availability for crops
- increased risk of groundwater contamination

Effect of effluent irrigation on **TOC output** from two soils in a lysimeter study



TOC output much higher

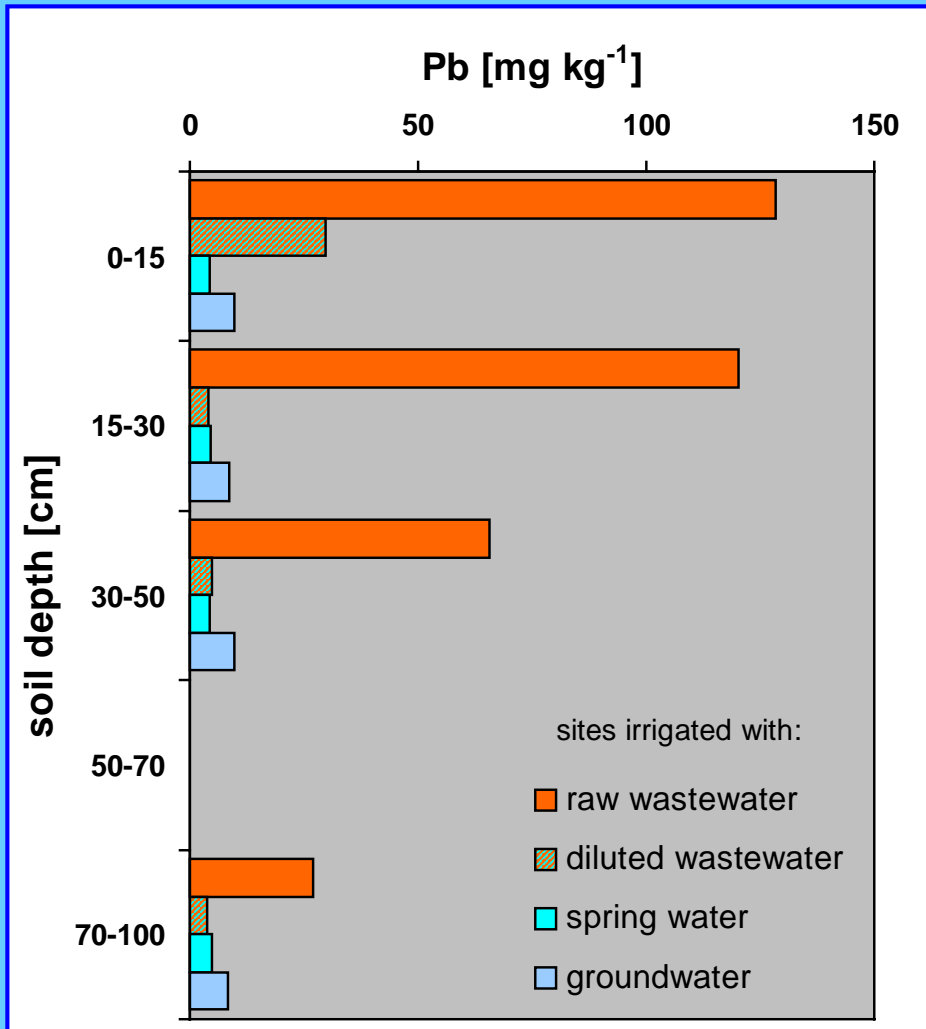
- little sorption or degradation in soil
- increased risk of DOC-associated transport of contaminants

Wastewater:

120-240 mg TOC l⁻¹
(low quality)

Effect of effluent irrigation on chemical soil properties:

Heavy metal concentrations in soils near Nablus

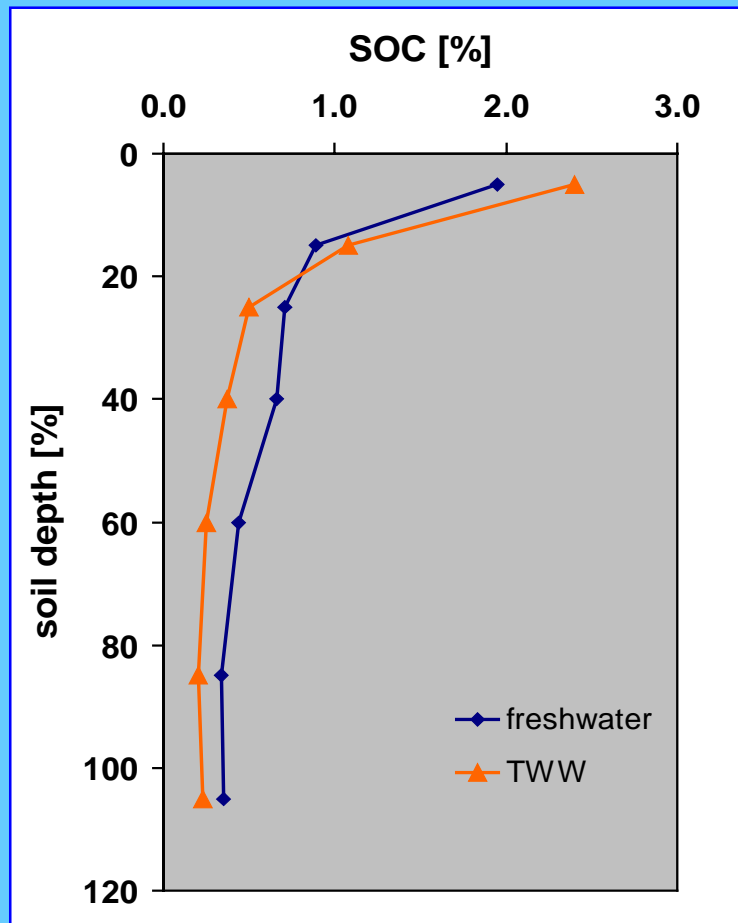


Pb concentrations elevated in soil under raw and diluted wastewater irrigation.

Pb has been translocated to great depth.

➔ high risk of groundwater contamination despite high pH and high clay content of the soil

Effect of effluent irrigation on chemical soil properties: **Soil C-pools**



Ramat Ha'kovesch, Coastal Plain
12 years TWW irrigation

SOC-content in topsoil increases:

→ filtration of particulate organic matter

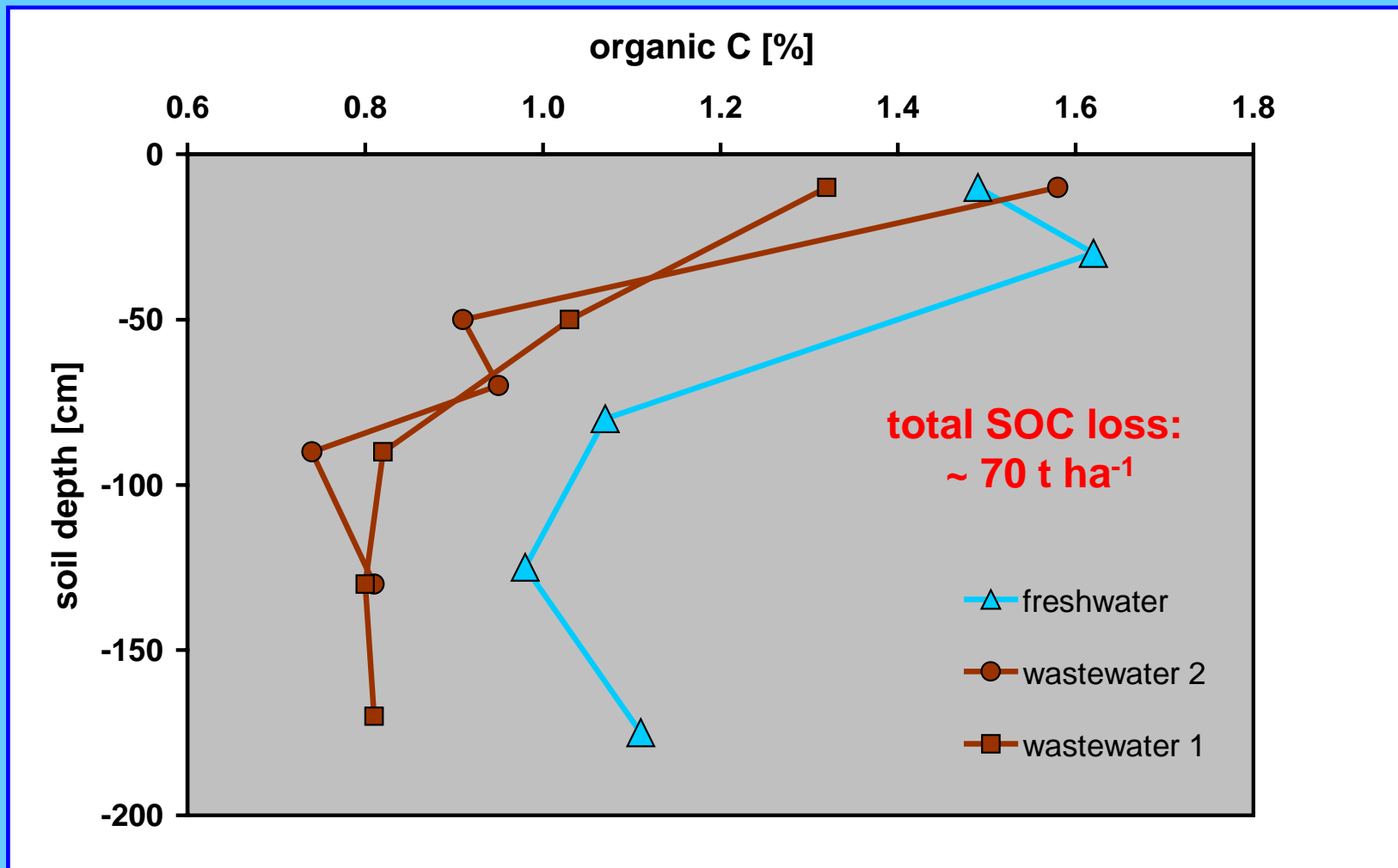
SOC-content in subsoil decreases:

→ loss of SOC due to stimulated microbial activity

Total loss of SOC: 12 t ha⁻¹

Jüschke et al.

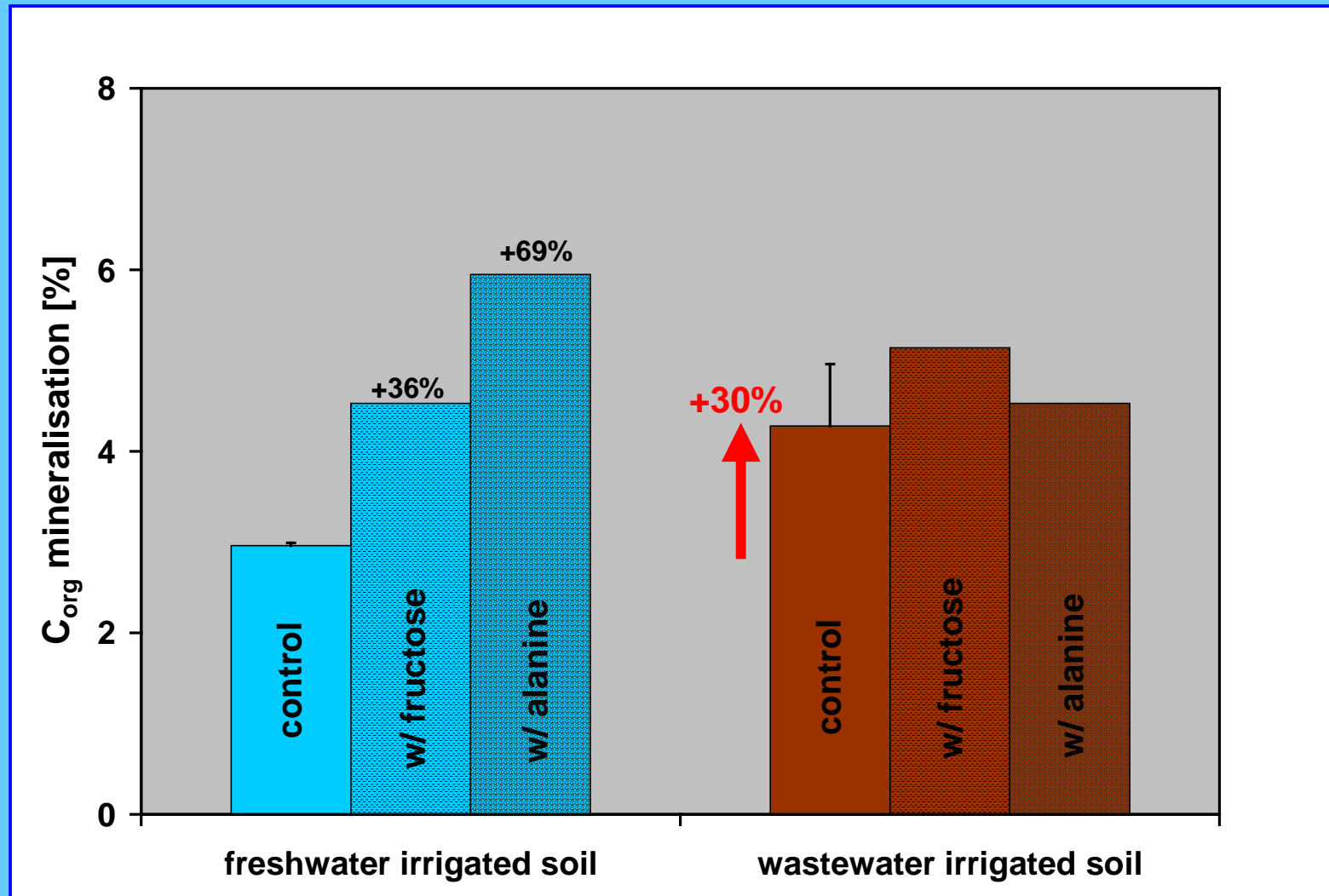
Effects of long-term wastewater irrigation on SOC content (Yagur, 35 years of irrigation)



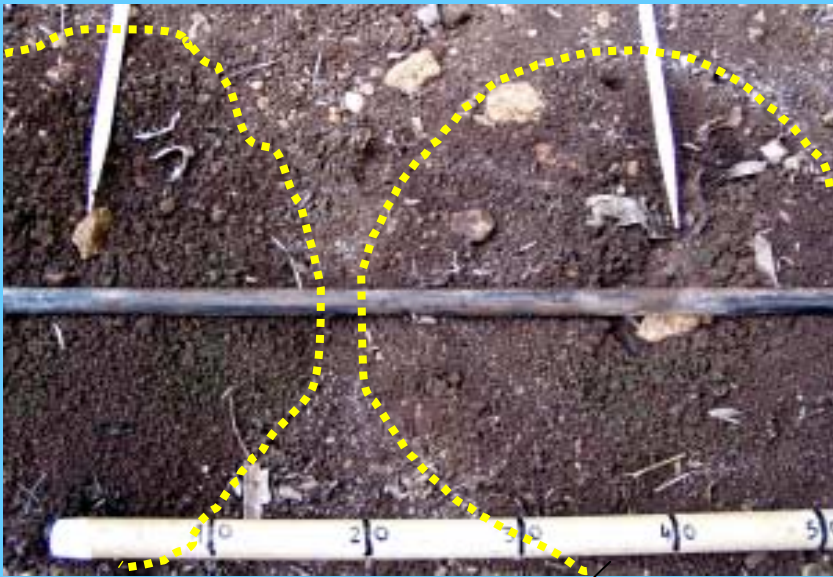
Tarchitzky et al.

Effects of substrate additions on SOC mineralization

(Ramat Hakovesh orchard, 10-20 cm)



Effect of effluent irrigation on physical soil properties: **water repellency**



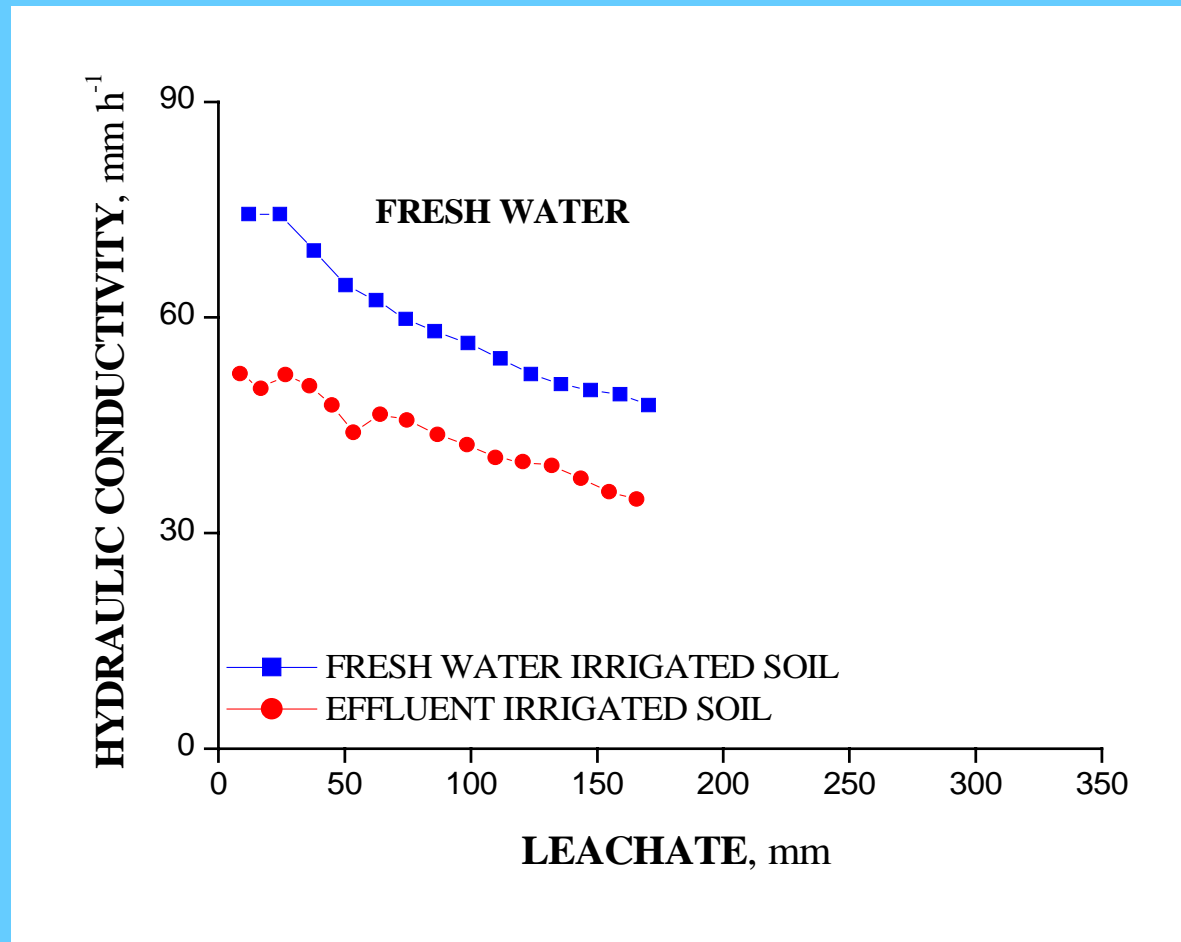
freshwater



TWW

Soil surface hydrophobicity from TWW irrigation increases risk of surface run-off and rapid solute transport along preferential flow pathways.

Effect of effluent irrigation on physical soil properties: hydraulic conductivity



**hydraulic conductivity
decreases**

- ➔ reduced water infiltrability
- ➔ increased risk of soil erosion

Summary and conclusions



- Wastewater irrigation increases soil P-content and may cause accumulation of pollutants if treatment technology is inadequate.
- C-inputs from effluent irrigation can stimulate microbial activity to such an extent, that SOC is mineralized at a higher rate than it is replenished from organic inputs with wastewater.
- A depletion of soil SOC pools at a rate of 1-2 t a⁻¹ can cause long-term negative effects on soil fertility.
Any additional CO₂-release to the atmosphere is undesirable.
- High salt loads in combination with DOC can cause surface hydrophobicity and decreased aggregate stability, which increases the risk of runoff and of downward pollutant transport along preferential flowpaths.
- Elimination of TOC by advanced sewage treatment technology is necessary to avoid these potential detrimental effects on soil and groundwater quality.

Thank you

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Vielen Dank