Urban wastewater reuse for irrigated agriculture in Jordan: soil sustainability, perceptions and management

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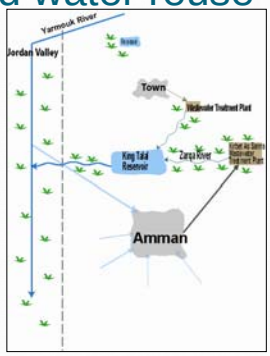
Jordan

How to meet the water deficit

- Develop new resources
- Water demand management
- Reuse water

Water reuse means collecting wastewater that flows into sewers, preferably treating it, then transferring it to land for irrigating crops.

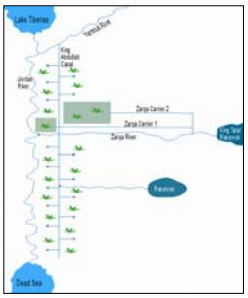
Jordan and water reuse



Jordan and water reuse – Direct reuse

Direct irrigation around water treatment plants e.g. As Samra, Ramtha, Wadi Mousa.

Jordan and water reuse – Indirect reuse



Sustainability of reuse

- How does water reuse affect the **soil**?
- Can and should a **threshold** of use be given based on water quantity and quality inputs, soil conditions, climate, crop and management strategies employed?
- What do farmers **think** about the water, how do they **manage** it?
- What are organisations doing in all this – importance of **policy**?

Methods

- Soil sampling, experimentation and analysis
- Mathematical computer modelling (Hydrus)

Methods

- Semi-structured interviews with Jordanian farmers using the water – Direct and indirect water reusers.
- Semi-structured interviews with governmental, non-governmental, international, research and private organisations involved with water reuse.

Water quality – inputs to the soil

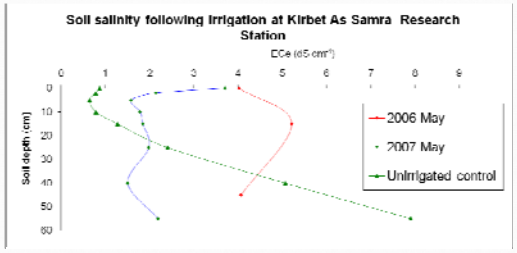
Inputs to the water that will affect the soil sustainability.
Domestic uses, industrial waste, desalination brine …..?

- Biological contaminants
- Very very few heavy metals.
- Plant toxic ions (Na, Cl, B)
- Organic matter and NPK

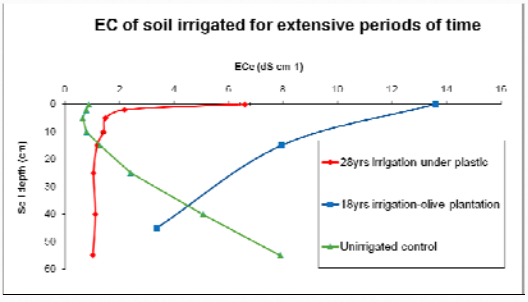
Location	Month and year of sampling	Solutes detected in the water (mg l^{-1})			Additional parameters			
		Chloride (Cl)	Sodium (Na)	Boron (B)	Electrical Conductivity (EC) dS m^{-1}	pH	Sodium Adsorption Ration (SAR)	Total Organic Carbon (TOC) ppm
Kirbet As Samra	Nov 2006	440.05	253.30	1.03	2.04	8.12	5.02	n/a
Kirbet As Samra	May 2007	174.25	265.31	0.84	1.68	7.83	5.83	10.97
Ramtha	Nov 2006	328.63	194.38	0.89	1.41	8.84	3.55	n/a
Ramtha	May 2007	468.89	127.64	0.38	1.58	7.70	3.45	10.73
Deir Alla	May 2007	299.54	173.21	0.55	2.09	7.50	3.45	9.45

Results – soil sustainability

To what extent do solutes accumulate in the soil?



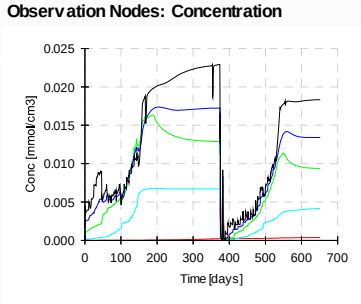
Results – soil sustainability



Modelling

- Hydrus model
- Parameterised with lab and field data and experiments
- Pedo-transfer systems
- Management methods - combination of rainfall and irrigation – do more salts percolate through the profile?

Modelling



Farmer management strategies

Indirect reuse (Jordan Valley)

- Leaching – quantities and timings controlled by water allocation - mainly in JV.
  - Water shortage
  - Mismanagement of resources

Direct reuse

- Nutrients – awareness of fertilisers in the water
- Communication with treatment plant manager

Farmer perceptions

Farmers – direct reuse

"I like the wastewater because before the treatment plant there was no water for supplementary irrigation. I make more money now".

Farmers – indirect reuse

"The water has bad things in it for the plants, there are no good things".

Farmer perceptions

Farmer perceptions

Water reuse is a very sensitive topic – the Saudis still do not import Jordanian produce.

All interviews moved onto:

- Water shortage – this is the biggest issue in the JV. (But not at As Samra – here water is used without care for water scarcity)
- Mismanagement of resources – in the JV.
- Lack of support for agriculture – everywhere.

Management is critical – what do the organisations say?

- Water reuse as a "necessary evil" in a water scarce country
- Essential but not desirable
- A terminology and perception issue??????

Management is critical – what do the organisations say?

- Risks to the soil are important – but less important than risks to human health
- 50% recognised damage to soil as a risk
- None considered the role of water management in mitigating this risk.

Organisation priorities:

- Farmer training
- Monitoring
- Research

Management is critical – what do the organisations say?

- Water allocation and potential conflict between direct and indirect water users.
- Is the water a waste?

Low value commercial crops (fodder, reeds, wood etc) versus high value vegetables

Conclusions

- The soil analysis reveal that the application of "revived" water does alter the soil chemistry.
- The alterations are dependent on the quantity of water applied, rainwater inputs and management methods.
- Very important that lab and field studies are not extrapolated directly to the farm. Must consider farmer's knowledge and management methods.

Conclusions

- As the use of revived water rises the ratio of direct to indirect irrigation will depend on the policy of decision makers and decision making (as a response to policy) by farmers.
- Ensuring soil sustainability is imperative and achievable through water management both on and off the farm.