Benefits and Risks of Using Treated Municipal Wastewater for Agricultural Production

With current population growth rates in the UAE, the estimated treated wastewater quantity will reach around 1,400 MCM by 2030. Its utilization into appropriate and safe reuse can have considerable environmental and economic benefits. ***Top image:*** *Radishes grown under subsurface drip systems with treated wastewater.* ***Lower image:*** *Tomatoes from trials at ICBA showed very encouraging results.*

Thematic Area: Crop Productivity and Diversification

Purpose: Evaluate the impact of using wastewater for irrigation on vegetables and other agricultural production systems

Geographic Scope: United Arab Emirates (UAE)

Timeline: 2013 - 2015

Partners:
- Ministry of Environment and Water (MoEW)
- Dubai Municipality (DM)

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Food and water security is a growing global challenge especially for marginal environments such as the Middle East and North Africa region which receives a mere 1.3% of the world's renewable freshwater but has the highest population growth rate in the world. These factors, along with the projected effects of climate change, have put enormous pressure on agriculture to reduce its share of freshwater use and look for alternative sources to meet the requirements. Treated municipal wastewater is a useful option for farm production systems as it contains organic matter and nutrients which are essential for plant growth. However, its use needs careful handling to mitigate its detrimental effects on soils, crops and human health.

In the United Arab Emirates (UAE), the water supply from the treated municipal wastewater is about 600 MCM (million cubic meters). This is 12 percent of the total water supply and all of it is treated at the tertiary level. Nonetheless, tertiary-level treatment does not completely screen out the presence of bacteria such as total *Colifoirms* and *E. Coli* from the effluent nor does it address the concentration of heavy metals especially copper, iron, zinc and chromium which could pose a safety hazard if high. The International Center for Biosaline Agriculture (ICBA) considers treated wastewater an important alternative water resource, if used properly. This prompted ICBA to launch with its local partners an initiative to evaluate the benefits of reusing treated wastewater for crop growth and possible risks of pathogens and heavy metals on soils and crops.

Activities and Outcomes

ICBA is receiving tertiary-level treated municipal wastewater from the Al Aweer Sewage Treatment Plant of Dubai Municipality to carry experiments at the Center for growing different crops with this water. Vegetables, namely carrots, lettuce, eggplant, tomato, radish, and spinach were grown using two irrigation methods i.e. surface drip and subsurface drip for comparative evaluation. Additionally, experiments with buffel grass, forage, and Salvadora, (a landscaping plant) are in progress as are experiment with Date Palm seedlings of the Lulu variety provided by UAE University.

Throughout the project, field experiments are being carried to

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Six-month old Salvadora persica (miswak) seedlings were planted in November 2013 to evaluate the transportation of pathogens and heavy metals to the plant parts.

assess the impact of treated wastewater irrigation on soil properties and various vegetable, fodder crops, and the Lulu date palms. Anticipated project outcomes include:

> Recommend the suitable treated wastewater quality for vegetables, landscaping, forages and date palm trees;

> Determine the level of concentration of heavy metals and/or pathogens in plant tissue, and advise if it is within safe levels;

> Identify suitable irrigation methods for avoiding environmental/health risks using treated wastewater;

> Assess the level of concentration of heavy metals in the soils (within the root-zone) in the short-term and long-term that affect groundwater and drainage water.

Indicator	Quantity (MCM/Year)
Treated effluent	600
Reused effluent	352
Treated effluent lost	248
Projected wastewater in 2030	1400

Results of two years of field experiments showed that the vegetables produced with treated water were free from *E. coli*, *E. coli* 157 and *Salmonella* and that the concentration of Coliform bacteria was below the detection limit (<10 cfu/g). The concentration of heavy metals such as copper (Cu) and zinc (Zn) in the wastewater treatments was more or less similar to the control treatments. However, slightly higher amounts of iron (Fe) were found in Spinach. Control plots irrigated with fresh water showed the same results. In case of tomato, the concentration of *coliform* exceeded 10 cfu/g for 50% of samples due to insect induced infection on their skin.

The results of the two-year trials are very encouraging. However, these are preliminary findings and need further verification during the next year of field investigations.

Future Directions

Further experiments will be carried out using the tertiary-level treated wastewater for irrigating vegetables, landscaping plants, forage and date palms. ICBA scientists will monitor results and assess any correlation with the use of treated wastewater. Suitability for UAE conditions will be demonstrated and technological interventions will be suggested as needed in order to minimize the negative impacts.

Findings will be published in journals and/or conference papers. The potential impacts of these findings will assist the Ministry of the Environment and Water (MoEW) in creating policy and regulations for the safe use of treated waste water in landscaping and agriculture and in measures to help protect the environment.

The results of this project will ultimately have wider application in the whole Arab region as more and more countries are starting not only to reuse treated wastewater effluent for agricultural production, but are

Data from buffel grass selected for forage evaluation showed that 10 - 11 cuttings can be achieved per year using treated wastewater for irrigation compared to only 3 - 4 cuttings from the control treatments where low-saline water (0.3 dS/m) was used.