Sustainable forest irrigation in arid and semi-arid zones

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A regional project is testing the use of treated wastewater in forestry and agroforestry systems on marginal lands as a way of turning it into a valuable asset for improving livelihoods and food security.

Highly populated arid and semi-arid countries produce large quantities of wastewater, the management of which is a serious concern. In many countries, untreated wastewater is released onto abandoned land, where it creates health and environmental hazards.

If treated, however, wastewater can be an important resource for agroforestry and forestry, helping to produce wood and fuelwood and create windbreaks and shelterbelts for farmers and smallholders, thereby improving food security (Armitage, 1985; FAO, 1989; Braatz and Kandiah, 1996). New wastewater treatment technologies combined with improved drip irrigation systems offer the potential for considerable afforestation in semi-arid and arid zones, which would help to meet people's needs for forest goods and ecosystem services as well as to restore degraded landscapes, combat desertification and mitigate climate change by sequestering carbon.

FAO Forestry and treated wastewater

In recent years there has been an increase in requests from Mediterranean and Near East countries to involve FAO in the development and implementation of projects to use treated wastewater in forestry and agroforestry systems. FAO and the Italian government have responded to such requests with a project[1] to apply new technologies in the production and management of treated wastewater in four North African countries – Algeria, Egypt, Morocco and Tunisia.

Case studies in the sustainable use of treated wastewater

Phytodepuration

Phytodepuration (sometimes called constructed wetlands) is the use of plants – usually grass reeds and rushes – to filter and purify wastewater; the resulting treated water can be used for the irrigation of trees or fodder crops. Phytodepuration systems are cost-effective, affordable and sustainable, especially in rural communities in remote, dry areas which may be unable to sustain the cost of standard-treatment wastewater plants. The Forestry Department of the University of Tuscia, Italy, is testing a small phytodepuration treatment facility at the Brézina Oasis in Algeria. It will use grass reeds and rushes to purify wastewater, which will then be used to irrigate a small forest plantation for the production of bioenergy.

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Local stakeholders review the design of the phytodepuration facility, Brézina Oasis

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The phytodepuration facility at the Brézina Oasis, which is being installed with the support of the University of Tuscia

Ferti-irrigation

Treated wastewater can increase carbon storage in the soil. The University of Basilicata, Italy, has developed a system for retaining organic matter in treated wastewater to be used for the ferti-irrigation (that is, simultaneous fertilization and irrigation) of poor soils in arid areas. It has been used for ten years to irrigate an olive grove and has been shown to decrease energy costs, increase olive yield and improve soil fertilization, and the olives and olive oil are free of dangerous contamination.

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[1] GCP/RAB/013/ITA: Forest restoration in Algeria, Egypt, Morocco and Tunisia using treated wastewater to sustain smallholders' and farmers' livelihoods.

FAO/M. BALDASSO

The planted forest of Serapium grows on desert sand alongside the Suez Canal

At a workshop held in Hammamet, Tunisia, in October 2010 (FAO, 2010), wastewater treatment experts and representatives of the four countries and FAO met to develop a logical framework for a regional project. The workshop also served to establish a network of specialists in the participating countries.

The regional project became operational in March 2012 and is scheduled to be completed in 2013. Its main aim is to create, in each country, demonstration sites for the use of treated wastewater in forestry and agroforestry, with a view to raising awareness about and building capacity in the safe use and good management of treated wastewater.

In **Morocco**, the project will support the establishment of an initial 10 hectares of a future green belt in Marrakech, which will act as a buffer zone between a garbage disposal area and the wastewater plant. The green belt will be planted mostly with palm trees, although 10 percent of the area will be planted with forest species. The area will be ferti-irrigated by wastewater, and most of the organic matter will ultimately be stored in the soil. The establishment of the green belt will require the cooperation of Moroccan and Italian institutions working under the overall umbrella provided by the FAO project. To raise country capacity, the project will help train young scientists in the technology.

In **Algeria**, the project will support the planting and maintenance of a phytodepuration plant in the Brézina Oasis, El Bayadh, established by the University of Tuscia, with the aim of growing a small plantation of tamarix for bioenergy production using treated wastewater. The main aim is to demonstrate the sustainability and affordability of this technique in rural areas. The project will also support the design of a phytodepuration plant in the Taghit Oasis.

In **Egypt**, the project will work in close cooperation with the Ministry of Agriculture and Land Reclamation, the Undersecretariat of Afforestation and the Forestry Department of the University of Alexandria to prepare and implement the first management plan for the planted forest in Serapium, Ismailia, alongside the Suez Canal, which is irrigated with treated wastewater. The aim is to make this forest eligible to obtain credits for its sequestered carbon. The work will be carried out with the support of the University of Munich and the Forestry Faculty of the University of Tuscia and will help build capacity in Egypt in the management of arid-zone planted forests.

In **Tunisia**, the project will support the preparation of two demonstration areas in collaboration with the University of Basilicata and the University of Tuscia. A ferti-irrigation facility will be established near Kerouan, where a very advanced wastewater treatment facility treats water to a level suitable for agriculture. Although the system is sophisticated, however, it has high energy usage; therefore, the ferti-irrigation methodology, which would provide water for tree irrigation and organic matter for the soil, is of considerable interest. In a village in the country's south, the project will support the implementation of a low-cost, low-energy phytodepuration plant to produce water for agroforestry.

More wastewater, less waste

These demonstration projects will enable the transfer of knowledge and technology and help build capacity and raise awareness on wastewater treatment and the use of treated wastewater in agroforestry and forestry systems. Given increasing demand for water and a scarcity of supply, the use of treated wastewater is likely to expand. Forestry and agroforestry approaches can improve farmer livelihoods and turn what was once a problem into an asset. FAO Forestry is already working to support other interested countries, including Jordan, Lebanon, Libya, Pakistan, the Syrian Arab Republic, Argentina and Mexico, to engage in regional collaboration for using treated wastewater in forestry and agroforestry. ◆

References

Armitage, F.B. 1985. *Irrigated forestry in arid and semi-arid lands*. Ottawa, Canada, International Development Research Centre.

Braatz, S. & Kandiah, A. 1996. The use of municipal waste water for forest and tree irrigation, *Unasylva*, 47(185): 45–51.

FAO. 1989. Irrigated forest plantations. *In:* FAO *Arid zone forestry: A guide for field technicians*. Chapter VII. FAO Conservation Guide 20. Rome (also available at: www.fao.org/docrep/T0122E/t0122e0c.htm).

FAO. 2010. International workshop, "Forest restoration in Algeria, Egypt, Morocco and Tunisia using treated waste water to sustain smallholders and farmers livelihoods", Hammamet, Tunisia, 16–17 October 2010. Planted Forests and Trees Working Paper 45/E. Rome. Available at: www.fao.org/docrep/013/am008e/am008e00.pdf. ◆