



Utilization of Treated Wastewater and Sewage Sludge in Forest Ecosystems

Mahmoud Nasr*

Department of Sanitary Engineering, Faculty of Engineering, Alexandria University, Alexandria, Egypt

Exponential population growth, coupled with rapid industrialization and urbanization, has generated an increasing amount of wastewater, which results in health risks and environmental damage. Recently, increased attention has been focused on the practice of wastewater, under strict hygiene regulations, for forest-irrigation purpose. Land application technology, including irrigation, becomes a viable solution when the cost of a typical tertiary treatment process is high. Soil and vegetation act as filters that encourage the entrapment of particulate contaminants from wastewater, and then the treated effluent is allowed to drain through the soil profile (via gravity). Some communities in the arid and semi-arid tropics use sewage, after primary treatment, for the irrigation of woodlots and other species, such as *Casuarina glauca*, *Eucalyptus camaldulensis* and *Tamarix aphylla*. These communities need forest plantations, greenbelts and amenity trees for protection against sandstorms and desiccating winds. Primary treated effluent is rich in mineral nutrients required for plant

growth, where the plant productivity is frequently limited by low levels of the available nutrients. A fast-growing tree plantation can uptake nitrogen and phosphorus species up to 135 and 12 kg/ha per year, respectively. An excess amount of nitrogen is leached to groundwater as nitrate (drinking water standard for nitrate is 10 mg/L). Thus, a balance between the input of nutrient-rich wastewater and the uptake of plant is required for limiting the risks of pollution. Simultaneously, social, cultural and aesthetic aspects make the irrigation of trees by treated sewage a more acceptable option than the irrigation of crops. Additionally, the application of sewage sludge for the purpose of forest fertilization has been successfully implemented under government-controlled forest plantations. However, more research is needed to investigate the feasibility of irrigating forests and tree plantations with treated wastewater, including health factors, environmental considerations, economic benefits and social and aesthetic concerns.

*Corresponding author: Nasr M, Department of Sanitary Engineering, Faculty of Engineering, Alexandria University, 21544, Alexandria, Egypt, Tel: +201006390400; E-mail: mahmmoudsaid@gmail.com

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