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Development of a multi-function software decision support tool for the promotion of the safe reuse of treated urban wastewater

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Abstract

Decision-making in environmental projects can be complex principally due to the inherent existence of trade-offs between socio-political, environmental and economic factors. This is why the MEDAWARE project which is an EU MEDA Water project (ME8/AIDCO/2001/0515/59341-P033) has focused its aims on the development of a software tool able to apply a scoring system for existing wastewater facilities based on the potential safe reuse of the final effluent. The scope of this work is to present the multi-criteria analysis user friendly software that has been developed. The tool is able to guide the responsible authorities to the most efficient solutions in terms of health and safety for the agricultural reuse of the produced effluent as well as to help them undertake actions that can be sustainable. The input data for the specific model are quite simple and can be easily collected (e.g. data concerning the population served by the facility, the possibilities for agricultural reuse of the water in the area, specific requirements or preferences on cultural, economical, technological or social issues), while the outcome is the ranking of the alternative scenarios and the suggestion of specific processes and treatment systems.

Keywords: Urban wastewater; Design of reuse schemes; Decision support tool; Software tool

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1. Introduction

Recycled water can satisfy most water demands, as long as it is adequately treated in order to ensure that the water quality is appropriate for the intended use. In addition to providing a locally controlled water supply, water recycling provides tremendous environmental benefits. By providing an additional source of water, water recycling can help decrease the discharge of treated wastewater into sensitive ecosystems, thus reducing and preventing pollution.

Still, in some countries, the institutional and legal framework is either weak or not existent. In some cases it only refers to international standards (guidelines or laws) for reuse which are very general and most frequently the standards demand very cost intensive solutions [1]. An integrated planning approach is therefore necessary when the reuse of wastewater becomes a management alternative in a water stressed basin. Such an integrated plan involves a number of technological, economical and health aspects besides the legislative framework.

Like any other water source that is not properly treated, health problems could arise from drinking, exposure or consumption of products irrigated with it if this contains disease-causing organisms or other pollutants. This is the reason why every drop of wastewater to be reused has to undergo previously a complete and appropriate treatment depending on the final use. Focusing on agricultural reuse, the options for sustainable reuse projects are related to the quality of the effluent and the level of environmental risk associated with land application for a variety of crops and/or activities.

The Mediterranean basin is characterized by a severe imbalance in water demand versus supply. Agriculture in the Mediterranean countries while offering immense opportunities at the same time is subject to major constraints. Opportunities are given through important comparative advantages in fruits and vegetables and activities related to production and exportation. Constraints stem from the fact that agriculture depends generally on the rain and that there are no supplementary irrigation capacities. The constraints are also related to the size of farms, age of farmers (usually old and illiterate), to the lack of equipment and, in general, to inadequate technological skills (fertilizers, seeds, varieties, quality and sanitary control, etc.). Such shortcomings render Mediterranean countries to be very dependent (these are their comparative disadvantages) on grain production, meat and milk. Significant progress in productivity can be achieved though a better management of water resources and treatment technologies [2].

The design of water treatment and reuse schemes should take into consideration not only technical aspects but also the special characteristics of the area where the reclamation system will be implemented. Social, political, economical, legislative and even meteorological features of the area could be critical to determine the success or failure of the project. The accurate preliminary design and cost estimating tools for wastewater treatment plant construction are extremely important [3–6].

Models based on spreadsheets are commonly used to provide planning or cost estimations, but these models are relatively non-flexible and time consuming when modifications are necessary. On the other hand existing commercial design software tools only rarely do consider wastewater characteristics and economic aspects as inputs, however, they do not take into account other important issues such as materials or equipments availability, personnel qualifications required, final destination of the treated water, etc. [7].

The multi-criteria analysis user friendly software that is presented in this paper, not only takes into consideration technology and cost information for the selection of the most appropriate treatment system, but also considers the weight of other indicators such as land availability and type of soil, type of crops cultivated in the area and their water requirements, meteorological conditions, and legislative requirements. This