SINBAD

Système INtégré de gestion du BAssin pour la réutilisation Des eaux usées pour l'agriculture

(Integrated Wastewater management for wastewater reuse in Agriculture)

Keywords: water afteruse – irrigation – integrated wastewater modeling – pollution abatement – sanitation

ABSTRACT

1. Introduction/Problem Identification

The overall objective of SINBAD is to improve water use efficiency in Algeria by promoting an integrated wastewater management approach and reusing (treated) wastewater in irrigated agriculture. Two pilot areas were selected for the project implementation: the hydrological basin draining to Lake Réghaïa, situated on the Algerian Mediterranean coast, and the city of Constantine in the north-east. To achieve this goal the project has built an integrated mathematical model of the wastewater cycle (sewer networks and Wastewater Treatment Plant - WWTP) of the target areas. Alternative wastewater treatment options are simulated to identify the most cost-effective one that is engineered in the master plan for the wastewater management of the two pilot sites. 2 training sessions were carried out to build the modelling capacities of Algerian experts from the Ministry of Water Resources involved with the operation of the WWTP in Réghaïa and Constantine.

2 couples further development of the results of component 1 with capacity building

2. Analysis/Results and Implications for Policy and/or Research

The early stage of the project is characterized by data gathering and analysis. Population, point and diffuse pollution sources, hydrological data, features and drawings of sewerage and irrigation networks and WWTPs, industrial areas, data on wastewater quality, location of outlets, general data on receiving water bodies (rivers, lake, sea) are inventoried and implemented into a GIS. The existing wastewater management process is analysed using a combination of models to simulate the processes taking place in the wastewater cycle, from the time pollution loads are generated in urban areas or in the watershed, until they enter into the sewer network, processed in the WWTP and discharged into the receiving water bodies (rivers, lake, sea).

Different treatment scenarios are simulated to assess impacts on the environment and human health, cost-effectiveness, requirements in terms of legislation and local stakeholders' institutional and managerial capacities as well as affordability, with the final goal to reuse treated wastewater for agriculture in Constantine and in Réghaïa areas, taking in account the environmental boundary conditions (restoration the degraded lake of Réghaïa. Treatment options include: centralized-combined treatment for municipal and industrial sewage; centralized/decentralized treatment of industrial

sewage; treatment processes for irrigation purposes (i.e. aiming at abating microbiological pollution and TDS and using sludge as fertiliser). A bi-dimensional hydrodynamic model of the lake simulates water quality patterns depending on the efficiency of wastewater treatment works.

The results of the simulations of integrated models support the preparation of the master plan of the best scheme for wastewater management and reuse in agriculture. The master plan embodies: the upgrading of the water quality and quantity monitoring system, the integration and rehabilitation of the sewerage network, the upgrading of the WWTP and a new laboratory for water analysis, the upgrading of the current irrigation system to account for the reuse of treated water. The master plan also evaluates the most suitable irrigation technologies (e.g. drop, furrow, sprinkler, shallow flooding irrigation etc.) depending on specific chemical, biological and physical conditions of water and soil in the two pilot areas (e.g. stability, salinity, nutrient content, microbiological contamination etc.), and types of cultivated crops (e.g. from the perspective of nutrient demand, yields and nutrition values, vulnerability to microbiological contamination etc.). Capital and operational expenditures, estimated revenues, assessment of affordability by customers are included in the financial and economic analysis to support the project viability.

The project has included a capacity building program for the staff of the Algerian Ministry of Water Resources. 2 specific training sessions were carried out, one in Algeria at the Ministry of Water Resources and the other in Italy at SGI's. The training courses addressed the following topics: integrated wastewater management modelling, with special focus on the management of the Constantine and Réghaia wastewater treatment plants, wastewater treatment technologies, modelling of the irrigation networks in Constantine and Réghaia, efficient use of water in agriculture, quality standards, contamination processes and classes of pollutants. Detailed tasks and financial plans to develop sustainable infrastructures are prepared, taking into account cost recovery and operation issues and avoiding unrealistic expectations.

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3. How does the proposed paper advance knowledge of/innovation within the subject?

Holistic assessment of wastewater cycle with integrated modelling. Options for wastewater treatment are analysed and compared to identify the most cost-effective ones for irrigation purposes, pollution abatement, realistic applicability, easy operation and cost recovery.

4. What are the practical applications of the contents of the proposed paper?

Design and implementation of wastewater treatment works able to improve treated wastewater quality for both irrigation purposes and pollution abatement. Know-how transfer of wastewater modelling and technologies to operators and local planners.

5. What is the replicability of the procedures or practices described in the proposed paper?

This methodology can be used in any wastewater management planning. Integrated modeling helps understand the current situation and allows for what-if scenarios studies. Design shall not be limited to technical solution but also include economic and financial viability for actual implementation.