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Water Resources Management for Paros Island, Greece

Flora Konstantopoulou[a], Songsong Liu[b], Lazaros G. Papageorgiou[b] and Petros Gikas[a,*]

[a] *Department of Environmental Engineering, Technical University of Crete, Chania, 73100, Greece*
[b] *Centre for Process Systems Engineering, Department of Chemical Engineering, University College London, London, WC1E 7JE, United Kingdom*

Abstract

Non-conventional water resources, such as desalinated and reclaimed water, should be taken into account for water deficient islands, as natural water resources are not sufficient. The present article proposes a model to calculate the optimal (minimum cost) water and wastewater management infrastructure for the island of Paros, in Cyclades Complex in Greece, taking into account water availability and water demand. The proposed model, takes also into account geographical aspects, the localised water demand (of potable and non-potable quality) and wastewater production, the water and wastewater storage and conveyance systems, and the operating cost of the facilities. The model is based on mixed integer linear programming (MILP) techniques.

Keywords: *integrated water resources management, desalination, wastewater treatment, water reclamation, mixed integer linear programming (MILP)*

1. Introduction

Recently, it is observed an increase in water demand in the islands of the Cyclades, Greece, mainly due to increase in permanent and seasonal population, parallel to increase in per capita water consumption [1]. At the same time the abstention of the inhabitants of the islands from traditional methods of collection and storage of rain water to be used during the summer months, as they expect that the government or the local authorities are obliged to supply the islands with water at subsidized prices.

Several solutions have been proposed for water supply to the water deficient Aegean Islands, including fresh water transportation either from mainland Greece or from large islands with sufficient water resources (especially Rhodes) even if water transportation is a particularly expensive and non-sustainable option [2]. Non-conventional water resources, such as desalinated and reclaimed water, should also be taken into account for water deficient, islands, as natural water resources are non sufficient [1].

It is likely that the optimal solution will be a combination of a number of alternative options. Non-conventional water resources may play an important role in the integrated water management, as water conservation is unlikely that can solve entirely the problem [3], while the massive runoff collection is expensive, time-consuming, and may also demand valuable land if artificial lagoons are to be constructed. Thus, desalinated seawater [4] or brackish water [5] and reclaimed water from wastewater [6] are the alternative options which may be considered. The best solution should take into consideration as much factors as possible and provide safe water for the indented use, at the lowest possible cost.

Although existing technologies are capable of producing potable water from wastewater [7], it may be expensive and may not be acceptable by the public for potable uses. Desalinated and reclaimed water may rather be used in a synergic way. Desalination yields potable quality water, at a relatively high environmental and financial cost [8], while reclaimed water can be used in non-potable urban, industrial and agricultural applications in relation to its qualitative characteristics [9], at production cost significantly lower to that of desalinated water. Reclaimed water is a viable, sustainable, long-term solution to the challenges presented by growing demands for water [10].

Gikas and Tchobanoglous [2] estimated the cost of desalinated and reclaimed water for the islands of the Aegean Sea in Greece, as a function of plant capacity and reclaimed water quality. Reclaimed water storage facilities and distribution network may contribute significantly to the cost of reclaimed water. Published work has indicated that decentralized and satellite strategies in water resources management can be particularly beneficial in achieving optimal management [11]. However, if reclaimed water is to be used, a dual distribution system should be often established [12]. A previous study on water resources management for Paros island has concluded that the optimal water management for the island is a combination of groundwater and desalinated water [13]. However, the use of reclaimed water was not examined by the aforementioned study.

[*] Corresponding author. Tel.: +30 28210 37814
Fax: +9876543210; E-mail: petros.gikas@enveng.tuc.gr

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