Evaluation of water resources management and agronomic scenarios using an integrated modelling system for coastal agricultural watersheds: The case of Almyros Basin, Thessaly, Greece

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Coastal agricultural watersheds face complex problems of water quantity and quality. In many coastal agricultural watersheds, the problems arise from: i) the limited use of surface water, ii) the excessive groundwater abstractions for irrigation, and iii) the over-fertilization practices for crop yield magnification. These complex and interrelated problems may be studied by using an integrated modelling system of surface water and groundwater able to simulate the processes regarding the quantity and quality of water. In this study, water resources management and agronomic scenarios are developed for the evaluation of the quantity and quality of the groundwater system of the semi-arid coastal agricultural Almyros Basin, in Thessaly, Greece. The historical and current unsustainable irrigation and fertilization practices, the groundwater abstractions, and the limited use of surface water reservoirs have caused a large water deficit of the aquifer system, groundwater nitrate contamination and seawater intrusion, resulting in severe degradation of water resources. Land use change and agronomic scenarios, as well as, reservoir operation scenarios, are combined and simulated using an integrated modelling system. The Integrated Modelling System consists of coupled models of: surface hydrology (UTHBAL), groundwater flow (MODFLOW), agronomic practices and nitrate leaching (REPIC, an R-ArcGIS based EPIC model), nitrate transport (MT3DMS), and seawater intrusion (SEAWAT). The models have been calibrated and validated against observations/measurements of various variables, e.g. groundwater table levels, crop yields, nitrate concentrations and chloride concentrations. The feasibility of the simulation of the various scenarios have been, also, evaluated with indices of Crop Water Productivity (CWP), Nitrogen Use Efficiency (NUE) and Economic Water Productivity (EWP).