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Misconceived aquifer structure and hydrodynamics – erratic water resources management: The case of river Pinios estuarine

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Abstract

This paper addresses the critical issue of how wrong can water resources management go if the structure and hydrodynamic evolution of the exploited system is not well known. As a case study the River Pinios estuarine groundwater system in central Greece, is discussed. The study area has a spatial extent of about 80km^2 and a typical estuarine shape. Due to the neotectonic evolution and the eustatic moves, a unique geomorphological environment and a dense hydrological network have been developed. Dominant socioeconomic activity in the region is agriculture and secondarily tourism that is focused only along a narrow strip along the coastal line and occurs only seasonally. Domestic water demands are covered by groundwater abstractions mainly from deeper wells drilled at the margins of the estuarine. Shallow wells in the alluvial sediments of the basin augment irrigation demands that are predominantly catered by surface water from the river Pinios and its tributaries, and to a minor extent several springs that emerge along the marginal fans of the basin. Due to the shallow groundwater levels, a large percentage of irrigation demands is covered by direct osmosis of water from the root zone.

Based on the simplistic understanding of a single aquifer unit that so far prevailed, the aquifer is in a very delicate equilibrium with the surface water bodies with which a hydraulic interaction occurs, whilst its boundary to the sea poses an issue of potential salinization, under careless management scenaria. Based on this conceptualization of the aquifer system, its resources are, subject to pollution from agrochemicals, domestic activities and saline intrusion. In parallel, its vulnerability potential is extremely high due to the shallow groundwater levels and the texture of the vadose zone. On the contrary, recent hydrogeological and geophysical findings, suggest that the aquifer system consists of a phreatic aquifer of relatively limited potential superseded by an aquifer of probably considerably higher potential, which however shows an abrupt change in its hydrochemical characteristics moving from the upstream recharge to the coastal zone. This dramatic change in the structure of the system alone, lead to completely different groundwater resources management options and alternative scenaria. Depending on the main hydrodynamic mechanisms that control evolution of the system and give rise to the water quality phenomena noted, two completely contrasting management models could be deduced. It therefore may be argued that developing a deep understanding of aquifer geometry and deciphering its hydrodynamics may lead to vastly different management options, hence poor knowledge of the system can easily lead to its progressive deterioration or even mining and the establishment of irreversible impacts.

Keywords: groundwater; deltaic plains; hydrodynamics; aquifer system geometry.

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