Assessment and Management of Groundwater Used in Aquacultural Fishponds Based on the Spatial Variability of Groundwater Quality and Quantity

C.-P. Liang (1), C.-S. Jang (2), and S.-W. Wang (3)

(1) Fooyin University, Department of Environmental Engineering and Science, Ta-liao Dist., Kaohsiung City, Taiwan (sc048@mail.fy.edu.tw), (2) Department of Leisure and Recreation Management, Kainan University, Luzhu, Taoyuan 338, Taiwan, (3) Environmental Division, Agriculture Engineering Research Center, Jhongli, Taoyuan 320, Taiwan

Aquaculture is a general landscape in western and southwestern coastal areas, Taiwan. Aquaculture industries frequently require the huge quantity of water resources. However, surface water resources are limited in the regions. Therefore, fishers abundantly pump groundwater to cultivate fish and shellfish, resulting in substantial decreases in groundwater levels and the occurrence of seawater intrusion over several decades. . To reduce adverse effects on fish growth and potential land subsidence due to pumping, this work combined the spatial variability of groundwater quality and quantity parameters to assess zones of suitable groundwater used in aquacultural fishponds in the Pingtung plain, Taiwan. First, according to an aquacultural water quality standard in Taiwan, two pollutants in groundwater - manganese and ammonium-nitrogen - were considered. Sequential indicator simulation (SIS) was adopted to characterize realizations of the pollutants and to probabilistically determine four roles in the groundwater utilization ratio (UR) - $UR < 0.1$ (strictly limited), $0.1 \leq UR < 0.5$ (minor), $0.5 \leq UR < 1$ (major) and $UR = 1$ (completely used). A safe groundwater UR was determined from the two pollutants based on dominant estimated probabilities. Then, SIS also was used to grade transmissivity fields representing the pumping capacity of aquifers. Finally, recommended combinations of different levels of groundwater quality and quantity in fishponds were spatially delineated based on estimated probabilities and provided decision makers with detailed information to wisely select a reliable scheme of groundwater management. The analyzed results indicate that the recommended pumping zones for aquaculture are mainly distributed in the northeastern, southwestern and partial southeastern aquifers. The factor of groundwater quantity is more important than that of groundwater quality for aquaculture in this plain. Therefore, a development and management scheme of groundwater resources in aquacultural fishponds should simultaneously take into account the spatial variability of groundwater quality and quantity parameters.