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Comparative study of irrigation water use and groundwater recharge under various irrigation schemes in an agricultural region, central Taiwan

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The risk of rice production has increased notably due to climate change in Taiwan. To respond to growing agricultural water shortage without affecting normal food production in the future, the application of water-saving irrigation will be a substantial resolution. However, the adoption of water-saving irrigation may result in the reducing of groundwater recharge because continuous flooding in the paddy fields could be regarded as an important source for groundwater recharge. The aim of this study was to evaluate the irrigation water-saving benefit and groundwater recharge deficit when adopting the System of Rice Intensification, known as SRI methodology, in the Choushui River alluvial fan (the largest groundwater pumping and the most important rice-cropping region in central Taiwan). The three-dimensional finite element groundwater model, FEMWATER, was applied to simulate the infiltration process and groundwater recharge under SRI methodology and traditional irrigation schemes including continuous irrigation, and rotational irrigation in two rice-crop periods with hydro-climatic data of 2013. The irrigation water use was then calculated by water balance. The results showed that groundwater recharge amount of SRI methodology was slightly lower than those of traditional irrigation schemes, reduced 3.6% and 1.6% in the first crop period, and reduced 3.2% and 1.6% in the second crop period, compared with continuous irrigation and rotational irrigation, respectively. However, the SRI methodology achieved notably water-saving benefit compared to the disadvantage of reducing the groundwater recharge amount. The field irrigation requirement amount of SRI methodology was significantly lower than those of traditional irrigation schemes, saving 37% and 20% of irrigation water in the first crop period, and saving 53% and 35% in the second crop period, compared with continuous irrigation and rotational irrigation, respectively. Therefore, the amount of groundwater pumping for irrigation water use can be reduced when adopting the SRI methodology in the future. The reducing of groundwater recharge could be supplemented by using 1,500 hectares of fallow paddy fields, located at proximal-fan region, as recharge pools in the wet season. The adoption of water-saving irrigation would be helpful for the relevant government agency to formulate the integral water resource management strategies in this region.
Keywords:Groundwater recharge, SRI, FEMWATER, Field irrigation requirement