Effects of Changes in Agricultural Irrigation Systems on Surface Water Resources – A SWAT-based Study in South India

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Abstract

Under monsoon-driven climate with a strong seasonality in rainfall, agricultural management is closely linked to water resource management. Hydrological modelling is therefore essential for a sustainable agricultural management, especially if changes in land management and irrigation systems are to be evaluated. The major goal of this study is to analyze the effects of increased groundwater use for irrigation on the surface water resources in a meso-scale catchment in Southern India using the Soil and Water Assessment Tool (SWAT). The examined catchment drains an area of about 5300 km2 and is located upstream of the Krishnagiri reservoir in Tamil Nadu, India. The catchment's topography is more or less plain with sporadic Inselberg outcrops from the Archean granite-gneiss bedrock. The dominant soils of the catchment are Nitisols and Luvisols. The climate is influenced by the southwest and northeast monsoon, leading to high rainfall amounts in May and October, while the highest temperatures are observed in April. The annual rainfall is about 1000 mm. The catchment is traditionally used for intensive, mostly irrigation-based agriculture with rice, millet and peanuts as main cash crops. The traditional irrigation system relies on small surface reservoirs for rainwater harvesting. With increasing groundwater use for irrigation, which results from improvements in technical equipment and public power supply, these reservoir systems are losing their relative importance as agricultural water supply and are partly getting silted due to reduced maintenance. We hypothesize that this shift in irrigation systems has a significant effect on surface water resources, especially on surface runoff peaks and on temporal evaporation patterns. Furthermore we try to assess the effect of these changing conditions towards sustainable water resources management. This evaluation will mainly be based on the likely effects on groundwater resources, while especially incorporating an estimation of groundwater recharge rates.