New Agriculturist, **29**(2) : 383–393, 2018 http://biovedjournal.org/

Farm level agro-hydrological simulation using the SWAT model for Manjira sub-basin, India

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Received and Accepted

ABSTRACT : This study aims to simulate hydrological processes at farm and basin scale in the Manjira sub-basin of the Godavari river basin in India. In addition, the study also aims to simulate crop yields in the region at three scales: the scale of the sub-basin, the scale of a watershed and the scale of a farm within the sub-basin. The simulations have been performed using SWAT model. The study focuses on (i) calibration and validation of the model at three levels that is sub-basin, watershed, and farm (ii) sensitivity analysis (iii) best-fit parameter at sub-basin level (iv) model performance analysis (v) reservoir simulation vi) crop yield simulation at farm level for Rabi and Kharif season (vii) water balance study at sub-basin level and (viii) climate change impact analysis by shifting transplanting dates. The results from the SWAT model showed a good fit with observations of streamflow at Saigaon station (NSE and R^2 = 0.86), and at the Singur reservoir (NSE = 0.57, R^2 = 0.60). The paddy yield for farm level simulations has been calibrated/ validated with the observed yields for Rabi and Kharif crops (statistical significance were not found in absence of long term series data of same parent data). While transplantation simulation results showed that five days earlier (when harvest date was fixed) transplantation yielded reduction by 0.15%, while five days later (when harvest date was fixed) resulted in decrement of 3.95% in crop yield. On the other hand, when shifting five days earlier (constant length of growing season) resulted to decrement of 0.15% and five days shift later (constant length of growing season) resulted to decrement by 4.02% in crop yield. Water balance study showed that crucial months are October (low rainfall) and December (nursery preparation time), where scanty rainfall creates negative draft at water balance.

Key Words : The SWAT model, The APEX model, water balance; climate change impact, paddy yield; water use efficiency.