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Unlocking Rice Potentials in Contrasting Wetlands in East Africa

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Abstract

East African wetlands are increasingly considered a major asset to boost domestic rice production towards self-sufficiency as favourable edaphic and hydrological conditions support high production potentials. Hence, the identification of sustainable intensification options is crucial to maintain wetland resilience and ecosystem services. We studied the effects of hydrological condition and nutrient management on rice yields in both an inland valley swamp in Central Uganda and a floodplain wetland in South-West Tanzania between 2014 and 2017. Field experiments were established along hydrological gradients (cross-section of the wetlands), from the poorly-drained riparian, to the moderately-drained valley bottom/middle and the drought-prone fringe zones. Phenology, biomass accumulation and grain yield were monitored under different water and nitrogen management. Experimental data were subsequently used to calibrate and later validate the APSIM-*ORYZA* rice growth model. The study aimed at quantifying prevailing yield gaps and their explanatory causes as well as to test the models capability to simulate complex hydrological conditions and various genotype-by-environment-by-management interactions. Attainable (simulated) rice yields ranged between 5.0 to 7.0 t ha^{-1} in Uganda, and between 8.1 to 9.8 t ha^{-1} in Tanzania. In contrast, actual grain yields under farmer´s management were significantly lower (Tukey $\alpha = 0.05 < 0.001$) and varied between 1.3 and 2.7 t ha^{-1} in Uganda and between 2.6 and 3.2 t ha^{-1} in Tanzania. Consequently, maximum yield gaps amounted to 4.1 and to 5.8 t ha^{-1} in Uganda and Tanzania, respectively. Spatial and temporal differences in soil moisture content differentially affected the grain yield in different hydrological positions in the wetlands. Therefore, daily measured soil moisture data is being used in the model to simulate the water balance and account for the differentiating soil moisture availabilities. The models capability to simulate rice growth and yield under complex hydrological conditions and with the effect of water- and nutrient limitations is being evaluated. Results will help to identify and understand main limiting factors and help developing sustainable cropping systems based on the positioning within the respective wetland.

Keywords: APSIM-ORYZA, *Oryza sativa*, Tanzania, Uganda, wetland, yield gaps

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