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Evaluating Crop Production Potential in a Floodplain Wetland in Tanzania: The Challenge of Soil-Moisture Monitoring

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Abstract

Floodplain wetlands in East Africa are a valuable resource for the cultivation of staple crops, such as rice and vegetables, or for dry season grazing. Information on spatial and temporal water availability for agricultural production is indispensible for land use planning. However, characterisation of complex hydrological processes poses a challenge, especially in data scarce regions.

We quantified soil water availability in the floodplains of the Mkomazi River, situated in the sub-humid lowlands west of the Usambara Mountains, Tanzania. Frequency Domain Reflectometry (FDR) based soil moisture contents, groundwater levels, and climate, were monitored over 2 years at different landscape positions and land use types within the wetland.

Based on the analysis of water sources (river flooding, spring water, ponding of rain water) and land uses, we were able to differentiate five major land use classes within the floodplain: (1) rain fed rice; (2) grazing land; (3) natural vegetation; (4) vegetables and irrigated rice; and (5) upland crops. During the wet season, periods of 4–5 months of soil flooding allow cultivating lowland rice while during the dry season groundwater levels drops below 2 m. The one-dimensional HYDRUS software package was used to simulate seasonal water movement in the soil based on observed soil hydraulic properties and climate. After calibrating the model, simulated soil moisture could be used for filling spatio-temporal gaps in the observed time series of soil moisture. Thus, the water availability for crop production could be evaluated despite the data limitations.

The findings of our research are useful for future work on the agricultural use of floodplain wetlands in the region. Moreover, using HYDRUS for quantifying climate scenarios, they provide the basis for formulating land use recommendations under increasingly variable weather conditions.

Keywords: Calibration, FDR, HYDRUS, model

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