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Enhancing model calibration and validation through participatory engagement

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Abstract

Crop simulation models play an important role in agricultural decision-making by providing insights into crop growth, yield potential, and responses to various management practices and environmental conditions. Enhancing the precision of models is critical for formulating informed decisions aimed at bolstering sustainability and fortifying resilience against the impacts of climate change. This is particularly so given that model effectiveness often hinges on the precision of underlying assumptions and data inputs, which may not always align with the complexities of real-world farming practices. Overcoming this challenge requires bridging the gap between theoretical models and practical realities, which can be achieved through participatory approaches. This study presents insights from participatory engagement with 600 farmers, aimed at refining crop simulation models' calibration and validation processes. Participatory approaches were used for systematic data collection on crop varieties, planting dates, water management and pest management strategies. Farm assessments and field visits provided opportunities for direct observation and validation of farming practices, while participatory rural appraisal techniques facilitated in-depth discussions and data visualisation. The survey period was between 2016–2018 across agroecological zones in Limpopo, South Africa. The Decision Support Tool for Agrotechnology Transfer (DSSAT v4.7), a dynamic crop model, was used to simulate yields of three crops: soybean, sunflower, and groundnut, based on data provided by farmers.

Our calibrated model showed good agreement between reported and simulated yields with calibration efforts, resulting in an average accuracy rate of 75 %. Validation of the calibrated models further demonstrated their efficacy in capturing farmer's management practices. By integrating input data from farmers into model simulations, this research illuminates the transformative potential of participatory approaches within crop modelling research. By adopting inclusive methodologies and integrating farmers' experiential knowledge and localised insights into crop models, we enhance the robustness of the calibration and validation processes, leading to more reliable predictions of crop growth and yield outcomes.

Keywords: participatory approach, agricultural research, DSSAT, food security

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