Simulation Modeling to Predict the Response of Selected Upland Field Crops to Present and Future Climate

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Process-based crop simulation models can predict the climate change impacts on crop production. In Sri Lanka, crop simulation models have been used predominantly for rice. These are tailor-made cropping system models with limited applicability to the agro-environment and crop varieties. Hence, there is a need to develop locally-applicable crop simulation models to predict the growth of important 'Upland Field Crops' grown in Sri Lanka. Accordingly, this work was aimed at developing three crop simulation models to estimate growth and yield of maize, mung bean and tomato and to predict the impacts of long-term climate change on their phenology and productivity. Data required for the model development were obtained from multi-locational field experiments conducted at Rahangala, Kundasale, Maha-illuppallama and Killinochchi representing a range of temperature and rainfall conditions in Sri Lanka. These models were validated using independent data gathered from multi-location field experiments conducted in the present study, and secondary data were obtained from the Department of Agriculture. Accordingly, model predictions on crop phenology (i.e., time required for 50 % flowering), leaf area index and yield showed satisfactory agreement with observed data. Model predictions revealed that the potential shifts in maize and tomato cultivation from warmer lower-elevations to cooler higher-elevations in the future, unless new heat tolerant varieties are introduced. Moreover, increasing future temperatures would increase crop productivity in cooler environments while decreasing productivity in warmer areas. Furthermore, parameters estimated in the present study fill the existing knowledge gaps for modeling phenology, growth and yield of maize, mung bean and tomato. Predictions of this study would be used in policy formulation to increase climate resilience and protect farmers' livelihoods in vulnerable areas.

Keywords: *Maize, Mungbean, Tomato, Phenology, Climate change*