Simulation of Rice Yield Response for Nitrogen Fertilizer Application across Diverse Agro-Climatic Zones in Sri Lanka: An Analysis using Agricultural Production System sIMulator (APSIM)

A.G.S.N. Karunarathne[1]*, J. Weerahewa[1], S.H.N.P De Silva[2]

[1]*Department of Agricultural Economics and Business Management, University of Peradeniya, Peradeniya, 20400, Sri Lanka*
[2]*Department of Crop Science, University of Peradeniya, Peradeniya, 20400, Sri Lanka*
**salanik@agri.pdn.ac.lk*

Rice yields vary significantly across agro-climatic zones (ACZs) in Sri Lanka. Understanding rice yield response to nitrogen (N) across ACZs is crucial for optimizing fertilizer application. This study employs APSIM-ORYZA 7.9 as the crop model to simulate rice yields for varying N applications and uses Mitscherlich-Baule yield response functions in the form of y = a+ b[1- exp (k*N)]. Weather data for 1992-2022, soil characteristics, crop management data, genetic coefficients of widely cultivated rice variety, *Bg* 356, and urea as the N source were used for modelling. APSIM model was already validated in Sri Lanka. The model accuracy was further evaluated with Department of Census and Statistics yield data, using Relative Root Mean Square Error (RRMSE). Rice yields for varying N levels were generated for Dry zone Low country (DL), Intermediate zone Low country (IL), Intermediate zone Mid country (IM), Intermediate zone Up country (IU), Wet zone Low country (WL), Wet zone Mid country (WM), and Wet zone Up country (WU). Since DL exhibits a significant variability in rice yields it was sub-divided into three separate zones namely DL1 (for areas with yield <3600 kg/ha), DL2 (areas with a rice yield of 3600-4300 kg/ha), and DL3 (areas with yield > 4300 kg/ha) Statistical evaluation for model accuracy resulted in RRMSE of 16% and R^2 of 98%. The estimated coefficients of the production function are statistically significant ($P \leq 0.05$). The order of regions concerning the highest to lowest yield response to N application is DL3> DL1> IM> DL2> IL> IU> WL> WM> WU. It Ranges 37.27-21.31 kg of rice per kg of urea. During drought conditions, the order of regions shifted to DL3> IM> DL1> IL> DL2> IU> WL> WM> WU emphasizing the importance of tailored interventions in fertilizer application in Sri Lanka based on its yield response to N.

Keywords: Urea, Modelling, Production Function, Rice