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Estimation of Rice Yield using MODIS NDVI and Multimodel Ensemble Seasonal Hindcasts

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Rice (Oryza sativa L.) is one of the most consumed staple crops which more than half of the world's population has been estimated to subsist primarily on. Even though rice yield estimation can be very important for intervention plans in the rice market, several pre-harvest rice yield estimation methods have often failed to accurately estimate rice yields due to weather variability. The objectives of this study were to develop a rice yield estimation model using Normalized Difference Vegetation Index (NDVI) and meteorological variables and to apply the APEC Climate Center Multimodel Ensemble (APCC MME) seasonal hindcasts to the model to timely provide estimates of rice yields for efficacious intervention plans. The developed model by a multiple regression analysis is Yield = 563.48NDVI – 0.12P9 + 90.99 (where yield is the rice yield in kg (10a)-1 (i.e. 0.01 t ha-1) and P9 is the observed monthly precipitation in September in mm month-1). The goodness-of-fit measures were 0.66, -0.14%, 0.13 t ha-1, and 2.25%, for adjusted R2 (coefficient of determination), Percent bias (PBIAS), Root Mean Square Error (RMSE), and Mean Absolute percentage Error (MAPE), respectively. Overall, the developed model better estimated the model using only NDVI and the 9.15 sampling method. To timely provide rice yield estimates, the applicability of the APCC MME seasonal hindcasts was assessed. A statistical downscaling method using Empirical Orthogonal Function Analysis (EOFA) and Singular Value Decomposition Analysis (SDVA) was used to predict monthly precipitation hindcasts in September required for the developed model. Even though the estimates of rice yield using the predicted monthly precipitation for whole study period were not as good as the estimates using the 9.15 sampling method, the estimates for the two years of 2008 and 2009, when the 9.15 sampling method largely underestimated, were better than those using the 9.15 sampling method. It is concluded that the proposed approach replacing the observed meteorological variables with the predicted variables in the rice yield estimation model can be used to timely provide rice yield estimates that reflect the meteorological conditions for more effective intervention plans in the rice market.