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Comparison of Feedforward Back Propagation and Self-Organizing Map for Prediction of Crop Water Stress Index of Rice

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Abstract : Due to the increase in water scarcity, the crop water stress index (CWSI) is receiving significant attention these days, especially in arid and semiarid regions, for quantifying water stress and effective irrigation scheduling. Nowadays, machine learning techniques such as neural networks are being widely used to determine CWSI. In the present study, the performance of two artificial neural networks, namely, Self-Organizing Maps (SOM) and Feed Forward-Back Propagation Artificial Neural Networks (FF-BP-ANN), are compared while determining the CWSI of rice crop. Irrigation field experiments with varying degrees of irrigation were conducted at the irrigation field laboratory of the Indian Institute of Technology, Roorkee, during the growing season of the rice crop. The CWSI of rice was computed empirically by measuring key meteorological variables (relative humidity, air temperature, wind speed, and canopy temperature) and crop parameters (crop height and root depth). The empirically computed CWSI was compared with SOM and FF-BP-ANN predicted CWSI. The upper and lower CWSI baselines are computed using multiple regression analysis. The regression analysis showed that the lower CWSI baseline for rice is a function of crop height (h), air vapor pressure deficit (AVPD), and wind speed (u), whereas the upper CWSI baseline is a function of crop height (h) and wind speed (u). The performance of SOM and FF-BP-ANN were compared by computing Nash-Sutcliffe efficiency (NSE), index of agreement (d), root mean squared error (RMSE), and coefficient of correlation (R^2). It is found that FF-BP-ANN performs better than SOM while predicting the CWSI of rice crops.

Keywords : artificial neural networks; crop water stress index; canopy temperature, prediction capability
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