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Mapping of Biophysical Parameters of Rice Agriculture System from Hyperspectral Imagery

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Chlorophyll, nitrogen and leaf water content are the most essential parameters for paddy crop growth. Ground hyperspectral observations were collected at canopy level during critical growth period of rice by using hand held Spectroradiometer. Chemical analysis was carried out to quantify the total chlorophyll, nitrogen and leaf water content. By exploiting the in-situ hyperspectral measurements, regression models were established between each of the crop growth parameters and the spectral indices specifically designed for chlorophyll, nitrogen and water stress. Narrow band vegetation index models were developed for mapping these parameters from Hyperion imagery in an agriculture system. It was inferred that the modified simple ratio (SR) and leaf nitrogen concentration (LNC) predictive index models, which followed a linear and nonlinear relationship respectively, produced satisfactory results in predicting rice nitrogen content from hyperspectral imagery. The presently developed model was compared with other models proposed by researchers. It was ascertained that, nitrogen content varied widely from 1-4 percentage and only 2-3 percentage for paddy crop using present modified index models and well-known predicted Tian et al. (2011) model respectively. The modified present LNC index model performed better than the established Tian et al. (2011) model as far as the estimated nitrogen content from Hyperion imagery was concerned. Moreover, within the observed chlorophyll range attained from the rice genotypes cultivated in the studied rice agriculture system, the index models (LNC, OASVI, Gitelson, mSR and MTCI) accomplished satisfactory results in the spatial distribution of rice chlorophyll content from Hyperion imagery. Spatial distribution of total chlorophyll content widely varied from 1.77-5.81 mg/g (LNC), 3.0-13 mg/g (OASVI) and 2.90-5.40 mg/g (MTCI). Following the similar guideline, it was found that normalized difference water index (NDWI) and normalized difference infrared index (NDII) predictive models demonstrated the spatial variability of leaf water content from 40 percentage to 90 percentage in the same rice agriculture system which has a good agreement with observed in-situ leaf water measurements. The spatial information of these parameters will be useful for crop nutrient management and yield forecasting, and will serve as inputs to various crop-forecasting models for developing a precision rice agriculture system.

Key words: Rice agriculture system, nitrogen, chlorophyll, leaf water content, vegetation index