Crop parameter and yield estimation of wheat using satellite data-A case study of western Uttar Pradesh, India.

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ABSTRACT

Potential of satellite imageries to provide spatio-temporal dynamics of crop growth condition as well as crop yield have been explored in several studies. Particularly, attempted in Haryana and Punjab, India and abroad too. In most of the studies, statistical relationship between crop parameters and satellite derived variables holds key to operational agricultural applications. However, information and techniques at regional scale estimation of crop growth parameters and yield of wheat are scarce in western Uttar Pradesh. Hence, the present study was undertaken to quantify crop parameters (LAI and fAPAR) and yield of wheat in intensively irrigated region of western Uttar Pradesh. Spectro-biophysical relationships were established for wheat crop using near real time satellite images (LISS-III and Landsat 7 ETM+) acquired to coincide with an exhaustive ground data collection campaign. Secondly, yield models for wheat were developed based on statistical relationships between field measured yield and either single date VI or spectral profile parameters. Soil line based indices, which minimize soil background effects, were found statistically superior over others to estimate LAI and fAPAR in wheat. SAVI, MSAVI and WDVI were good predictors of LAI and fAPAR in wheat. These indices have shown better relation without a clear saturation at high LAI levels (up to 6). However, there is slight underestimation at high fAPAR values. Other indices (RVI, NDVI and TSAVI) have shown either high intercept bias or less coefficient of determination. LAI from MODIS was underestimated and fAPAR product from MODIS was a good estimate comparable with the high resolution fAPAR image of wheat during the peak vegetative growth stage indicating, vegetation types covering the spatial heterogeneity of one square kilometer area from high resolution have to be aggregated to validate these products. The CLAIR model based estimates of LAI and fAPAR, particularly during the vegetative phase showed good approximation of LAI and fAPAR, but it underestimated them during the reproductive phase. High resolution single date image can be used in the field level yield prediction and pooled yield model improved its performance. MODIS NDVI can be used in yield prediction in large fields and inclusion of temporal NDVI increased the model predicting ability of wheat. Badhwar model fitted well to the spectral profiles of wheat derived from MODIS data in all the tehsils except during the spectral emergence due to the spectral mixing of sugarcane with wheat. Although, MODIS sensor has coarse resolution for field scale crop yield estimation, the results offers a scope for yield estimation with a spatial detail that is better than the traditional district level data.