The Ohio State University

Environmental Science Graduate Program
Student Seminar Series

Integrating Remote Sensing to Improve Grain Yield Estimates for Assessing Within-Field Spatial and Temporal Variability in a Corn-Soybean Rotation

Aman Bhatta

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Abstract

Understanding of within-field spatial and temporal variability of crop yield and the potential drivers for such variability is critical for site-specific crop management (a.k.a precision agriculture) from both economic and environmental perspectives. The objectives of this study are to 1) improve crop yield estimate by integrating remote sensing data , 2) assess the spatial and temporal infield variability in corn and soybean rotated farms, 3) develop management zones based on yield stability, and 4) evaluate the impact of topographic and soil properties on infield variability. To meet these objectives, yield monitor data from three fields (~120 hectares) in corn-soybean rotation between 2016-2019 from the Molly Caren Agriculture Center at London, Ohio were used. In addition to yield, high resolution satellite and manned aircraft-based imagery (0.3 m to 3 m), digital elevation model (DEM) (0.76 m) and bare soil maps were used. Yield data collected from yield monitor were cleaned using Yield Editor software. Topographic variables such as slope, elevation, aspect, roughness, flow direction, TPI, and TRI were calculated using DEM data. Remotely sensed imageries were preprocessed and analyzed, and various vegetation indices such as normalized difference vegetation index (NDVI), saturation index, hue index, color index and red index were calculated. Using high resolution yield maps, temporal and spatial standard deviations (SD) were calculated. Based on SD and average crop yield, areas within a field were classified into four zones (z), with z1 and z2 having consistently higher and lower yield than average yield, respectively; z3 has variable but below average yield, and z4 has variable but above average yield. DEM derived topographic variables were used to assess their impact on yield variability within the four zones. The accuracy of yield spatial distribution was increased on using the imagery with higher resolution and topographic variables were considered important for prediction of yield in all fields. The management zones with high grain productions were associated with low slope and TPI values. The base index, hue index and red index were more effective in prediction of crop grain yield than NDVI and GNDVI. The random forest model using the high-resolution imagery is effective in prediction of yield and development of efficient management zones considering the temporal standard deviation of crop grain yield. Improved understanding on processes underlying spatial and temporal variability of crop yield can help develop management practices for optimal productivity with improved environmental quality.

For more information, contact Ashleigh Bope (Bope.19@osu.edu) or visit https://esgp.osu.edu/