

## **Beyond NDVI: Are FPAR, LAI, GPP, or LST better for estimating crop yields?**

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### **ABSTRACT:**

Many imagery products for potential use in estimating crop yields are generated by the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard the Terra and Aqua earth observing satellites. Most commonly used is the Normalized Difference Vegetation Index (NDVI), but there are higher-level biophysical parameters that may perform better. They include the Fractional Photosynthetically Active Radiation (FPAR), Leaf Area Index (LAI), and Gross Primary Productivity (GPP). Additionally, MODIS collects daytime and nighttime land surface Temperature (LST) and those relationships to crop yields are not well known either.

The purpose of this research was to fully explore all of these MODIS variables and ultimately determine which have the best correlation strength and optimal timing to US (United States) crop yields using NDVI as a benchmark. The MODIS indices investigated each came from 8-day composited products at 1 kilometer resolution having been masked by crop type with robust 30 meter resolution land cover classifications developed by the US Department of Agriculture (USDA). The investigation was undertaken for a total of 10 crops but the three most important in the US – corn, soybeans, and wheat - are focused on. The analyses spanned the major farming areas of the US from 2008-2013 and used annual county-level average crop yield data from the USDA as a historical basis.

Most crops showed strong positive correlations to each of the vegetation related indices in the middle of the growing season, with NDVI performing arguably better than FPAR, LAI, and GPP. Conversely, some crops showed negative correlations to daytime LST mid-summer. Nighttime LST, however, was never correlated to crop yield, regardless of the crop or seasonal timing. Results varied little from Terra to Aqua. The conclusions here can be used to guide which variables, and their seasonal timing, are best used for crop yield modeling efforts.