

**Multi-sensor Fusion to Determine Agricultural Sensitivity to Climate Variability in South  
Asia  
Project Report May – December 2011**

**Project Team:**

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**Project Summary:**

The project uses multiple sources of satellite imagery to examine the sensitivity of agriculture in South Asia to climate variability. South Asia is at the forefront of concerns about future food security. Population growth, continuing rural poverty, water shortages, stagnating yields, and climate change all contribute to these concerns. Despite agricultural intensification over the last several decades, agriculture in the region remains highly sensitive to monsoonal rainfall. Detailed understanding of this climate sensitivity is hampered by the coarse scales of previous studies conducted with data at the level of national and sub-national administrative units.

The project focuses on the sensitivity of cropping intensity (number of crops per year) to variability in rainfall. We are using data from MODIS, Landsat, Quickbird, WorldView, Tropical Rainfall Mapping Mission (TRMM), and other sensors to establish annual estimates of cropping patterns and rainfall anomalies. We are using time series of MODIS Enhanced Vegetation Index (EVI) to identify number of crops and agricultural productivity based on phenological profiles. Higher resolution Landsat, Quickbird and Worldview data in selected locations enable us to quantify landscape heterogeneity at the 250m scale. Other available, district-level, sub-district level non-satellite data and field data on dominant crop type, size of land holdings, yields and indicators of adaptive capacity such as education level and income will enable us to explore factors associated with agricultural sensitivity to climate variability.

The ultimate goal of the project is to enable risk mapping and inform effective approaches for adaptation to climate variability in the region. Data sets on cropping patterns at 250m resolution and aggregated to district level for each year from 2000 to present will be made available to the community of researchers investigating climate impacts on agriculture.

**Progress to date:**

We have selected two focal areas to develop methods and understanding of relationships between cropping intensity and climate variability. These areas have been selected to represent a range of conditions (subsistence to market crops) and to be in places familiar to the investigators where data sources and field logistics are known. The two areas are in north-west India in the state of Gujarat and central India in the state of Madhya Pradesh. To date we have collected field data and assembled MODIS, Landsat, TRMM, Quickbird, and Worldview data for the Gujarat site.

The main emphasis in this reporting period has been on development of an accurate and validated method to determine cropping intensity. We are comparing three methods: MODIS time series analysis, EOF analysis of MODIS data, and Landsat time series. The Quickbird and Worldview data (now available to NASA PIs) has been obtained and we are using these as validation sources. Agricultural census data is another data source for comparison. We have also collected surveys in the field to identify crop type, socioeconomic factors, and farmer's responses about their adaptive capacity.

To compare data sources and algorithms to determine cropping intensity, we are currently conducting an experiment. Preliminary results indicate that Landsat time series provides higher accuracy in mapping cropping intensity than MODIS data, but that MODIS data performs reasonably well. The results from this experiment will enable us to select the most appropriate method to use in other places.

**Plans for coming year:**

In the coming year, we plan to do the following:

- Finalize experiment with methods comparison in two field sites and submit a paper for publication
- Analyze field data from the Gujarat site to determine the attributes of rainfall variability (length of dry spells, total rainfall, variability in rainfall etc) associated with variability in cropping intensity
- Analyze survey results to identify socio-economic characteristics (and access to water) in the Gujarat field site associated with sensitivity of cropping intensity to rainfall variability
- Extend methods and field data collection to second site in Madhya Pradesh

- Begin to extend methods at a larger scale over South Asia

We have hired a post-doc (Pinki Mondal) to work full-time on the project. She has extensive field experience in the second field site as well as extensive remote sensing expertise. Due to other commitments she was able to join the project only beginning in December, 2011.