REMOTELY SENSED CHANGES IN CROP PRODUCTION OVER INDIA

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1. INTRODUCTION

A number of studies based on long-term Normalized Difference Vegetation Index (NDVI) data from the NOAA/AVHRR have documented an increase in terrestrial photosynthesis over extended regions of the globe and a number of driving factors have been invoked to explain this greening. In India the increase in photosynthetic activity corresponds to the expansion of irrigation following the technological innovations brought about by the Green Revolution, providing one of the most spatially extensive examples of large-scale greening induced by land use and land cover changes [1, 2]. In India these land cover changes have resulted in progressive increases in food grain production. However, aggregated agricultural production statistics indicate that the rate of food grain production has recently slowed down. In this paper we provide independent evidence of the agricultural deceleration in India analyzing the interannual variability in long term (1982-2006) record of the Normalized Difference Vegetation Index (NDVI) from the National Oceanic and Atmospheric Administration's Advanced Very High Resolution Radiometer (NOAA/AVHRR) together with climate, land use data.

2. METHODOLOGY

We analyzed the spatio-temporal changes in rates of agricultural production over India using the Global Inventory Modelling and Mapping Studies Group (GIMMS) NDVI data set version G [3] for the period July 1981 to December 2006. Cropland pixels were identified by spatial overlay of a mask from [4]. Annual and seasonal time series in NDVI for 1982 to 2006 were compared to national and state-level food grain production statistics [5] and to rainfall [6] and surface temperature [7] monthly time series.

3. MAIN RESULTS

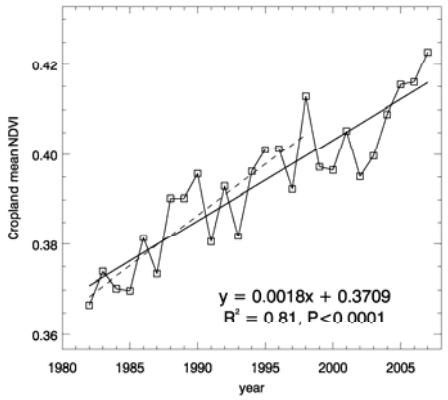

Fig. 1. Time series of mean NDVI over croplands of India

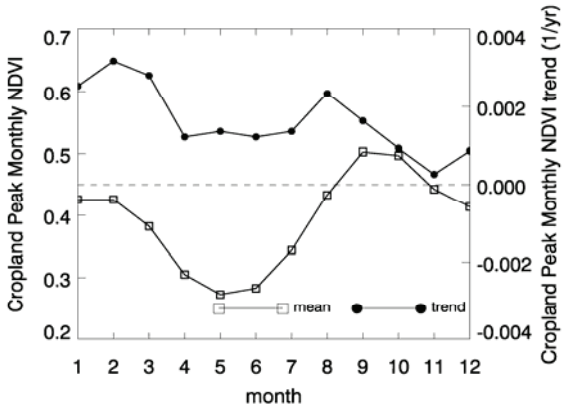

Fig. 2. 1981-2006 average (left axis) and linear trend (right axis) in peak monthly NDVI (left axis) over croplands of India.

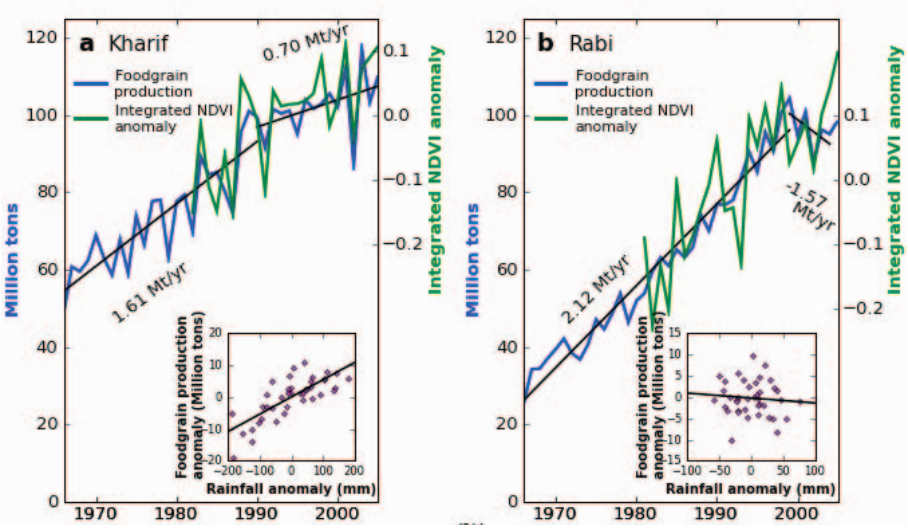

Fig. 3. Food grain production (total production of rice, wheat, coarse cereals, and pulses) during the (a) kharif (summer, rainy) and (b) rabi (winter, dry) seasons in India over the past four decades. Food grain production (Million tons/yr; left axis) and corresponding growth rates are displayed for the period 1966-67 to 2005-06. Also shown are anomalies of seasonally integrated satellite vegetation greenness (iNDVI) over the croplands of India for the kharif and rabi cropping seasons from 1981-82 to 2005-06 (right axis). Food grain production anomalies are uncorrelated to rainfall anomalies (inset).

The interannual variability of the mean NDVI shows a sustained growth over India's cropland up to the late 1990s (Fig. 1). In India there are two main cropping seasons: a summer cropping season (kharif), in which crops take advantage of the monsoon rains, and a winter cropping season (rabi), when water from crops is provided by the

moisture accumulated during the monsoon season, or, increasingly, by irrigation. The trends in peak monthly NDVI (Fig. 2, left axis) indicate that most of the increase in NDVI observed over India's cropland is due to the greening of the dry winter cropping season (Jan-Mar). Anomalies of NDVI integrated over both the kharif (Fig. 3a) and rabi cropping (Fig 3b) capture the interannual variability in food grain production statistics, suggesting that NDVI can be used to map the spatial variability in the deceleration of agricultural production over India in the last decade.

11. REFERENCES

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