On the need for dynamic crop maps as input for efficient simulation of crop productions

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Food security remains a critical global challenge in the face of a growing population and increasing demand for agricultural resources. Water plays a central role in sustaining food production, particularly in regions with limited rainfall where blue water availability is crucial. Reliable estimation of total consumptive crop water use largely depends on knowing the actual crop area within a region. In this regard, accurate estimation of crop growing areas are vital for effectively estimating both crop yields and water use. These maps offer detailed spatial information on crop types and their distribution, enabling precise calculations of water requirements and informed irrigation planning. Here we show how various crops show increasing/decreasing trend of its crop growing area; at district level in India. We also propose a simple methodology for preparation of dynamic crop maps using an available crop map(for a particular year) and reported crop growing areas over a given time period. These dynamic crop maps can be used as input to various crop models.

The common names of various crops used in this study are as follows : Bajra : Pearl Millet; Jowar : Sorghum; Ragi : Finger Millet; Arhar : Pigeon pea.

Trend of crop growing area at district level in India

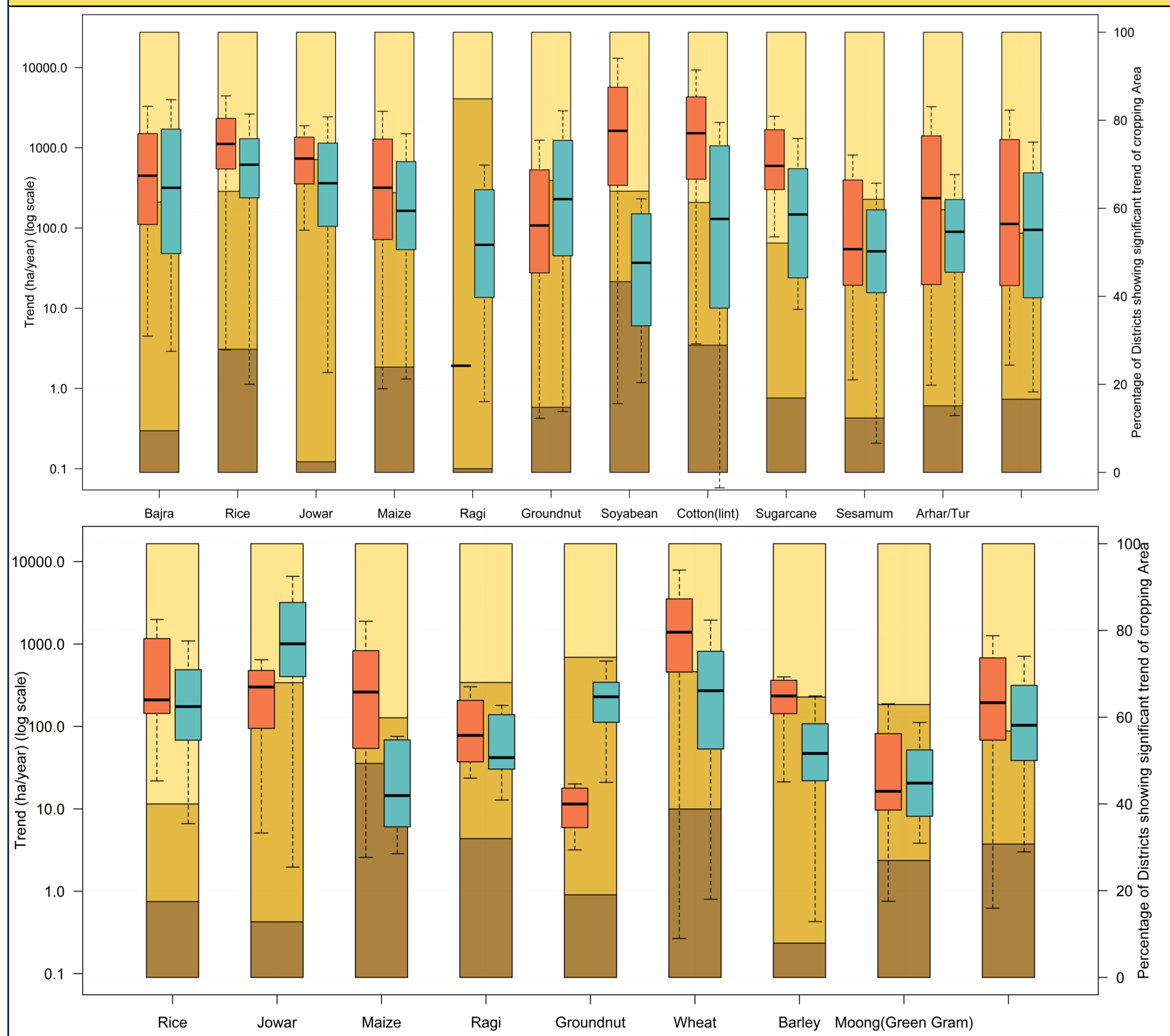


Fig1 : District-wise trends in crop growing area for (a)kharif and (b) rabi crops across India (2001–2019). The 100% stacked bar chart shows the proportion of districts with significantly increasing($p<0.05$), significantly decreasing($p<0.05$) and non-significant trends for each crop, based on districts with at least 12 years of data. The adjoining boxplots illustrate the distribution of trend magnitudes for districts exhibiting significant increases or decreases in cropping area.

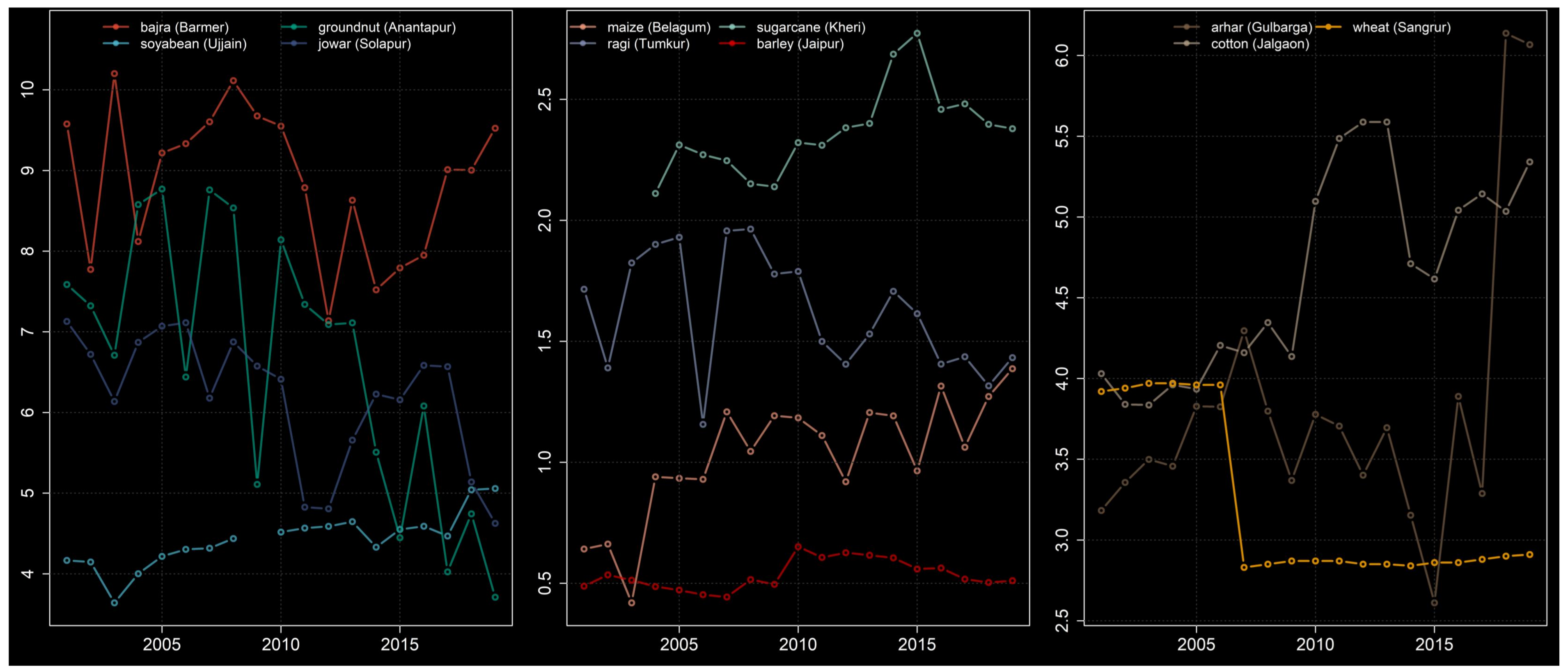
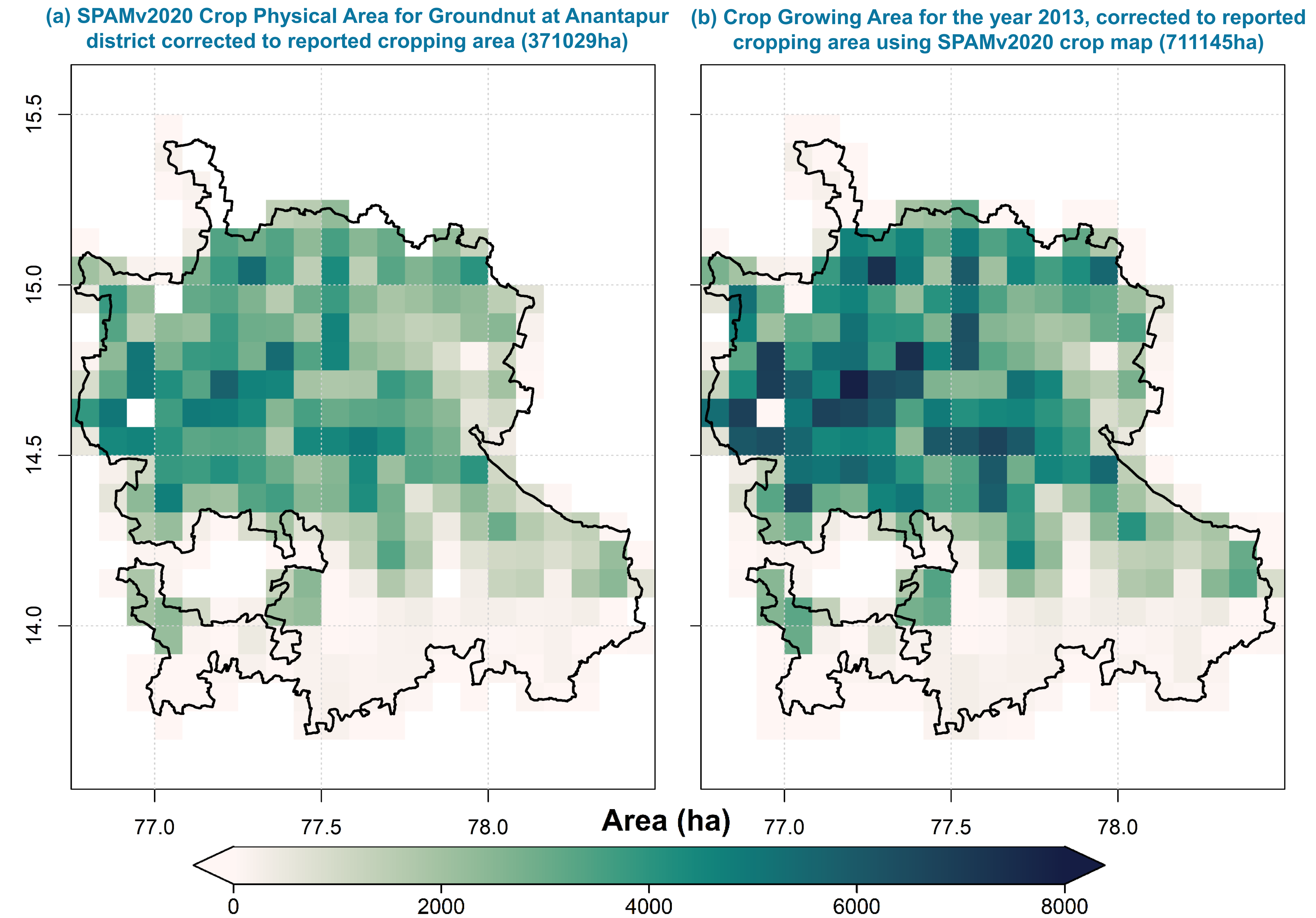


Fig 2: Temporal trends (2001–2019) of crop growing area(hectare) for 12 major crops, shown for the highest-producing district of each crop. The plots highlight interannual variability and long-term changes in cultivation area across key crop-dominant districts

Preparation of dynamic crop maps

The preparation of dynamic crop maps is based on the assumption that the spatial pattern of cropping area (available crop maps) remains constant throughout the study time period. In the below example we use SPAMv2020 crop maps (for the year 2020). The total cropping area of a crop (here groundnut) within the district (Anantapur) is compared to that of the reported crop area(for the year 2020). The difference(if any) is then added/subtracted uniformly each pixel of the crop map to correct SPAM for the year 2020. The same is followed to prepare crop maps for other years. This forms as a simple pre-processing step, for preparation of dynamic crop maps as input into crop models, using a single crop map and reported crop growing area.



Code for the above work is available at https://github.com/mrani307/AOGS2025

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