Drought impact-based forecasting of crop yield in India

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1 Introduction

Droughts are becoming more frequent and severe in India. Addressing the intricate challenges of reliably predicting drought impacts on crop yield in India requires advanced methodologies such as impact-based forecasting due to the complex interplay of climatic variables and vulnerabilities within the system.

What is Impact-based forecasting? [1]

- forecasting impact, not only hazard;
- by establishing impact function that connects hazard (represented by drought indicators) and impacts and accounts for vulnerability factors (that shape the relationship between hazard and impact);
- inputting forecasted drought indicators in impact function and generating forecasted impacts;
- identifying the most vulnerable areas and prioritizing the aid;

[1] Shyrokaya, A., Pappenberger, F., Pechlivanidis, I., Messori, G., Khatami, S., Mazzoleni, M., & Di Baldassarre, G. (2024). Advances and gaps in the science and practice of impact-based forecasting of droughts. WIREs Water 11(2), e1698.

Data for Impact function

Input
Drought indices

VCI * (NDVI) as proxy for crop yield

Output
Crop yield

3

- explored the feasibility of using the remote-sensed vegetation index NDVI [2] (at a 16-day time-step) as a proxy for crop yield impacts;
- derived district-based NDVI values for croplands and computed monthly and yearly *Vegetation Condition Indices (VCI) for various crops across two growing seasons: the Rabi Season (October-May) and the Kharif Monsoon season (June-September)

Correlating Drought indices & VCI (NDVI)

We correlated the monthly VCI with observed drought indicators to investigate whether the variation in VCI can be explained by SPI.
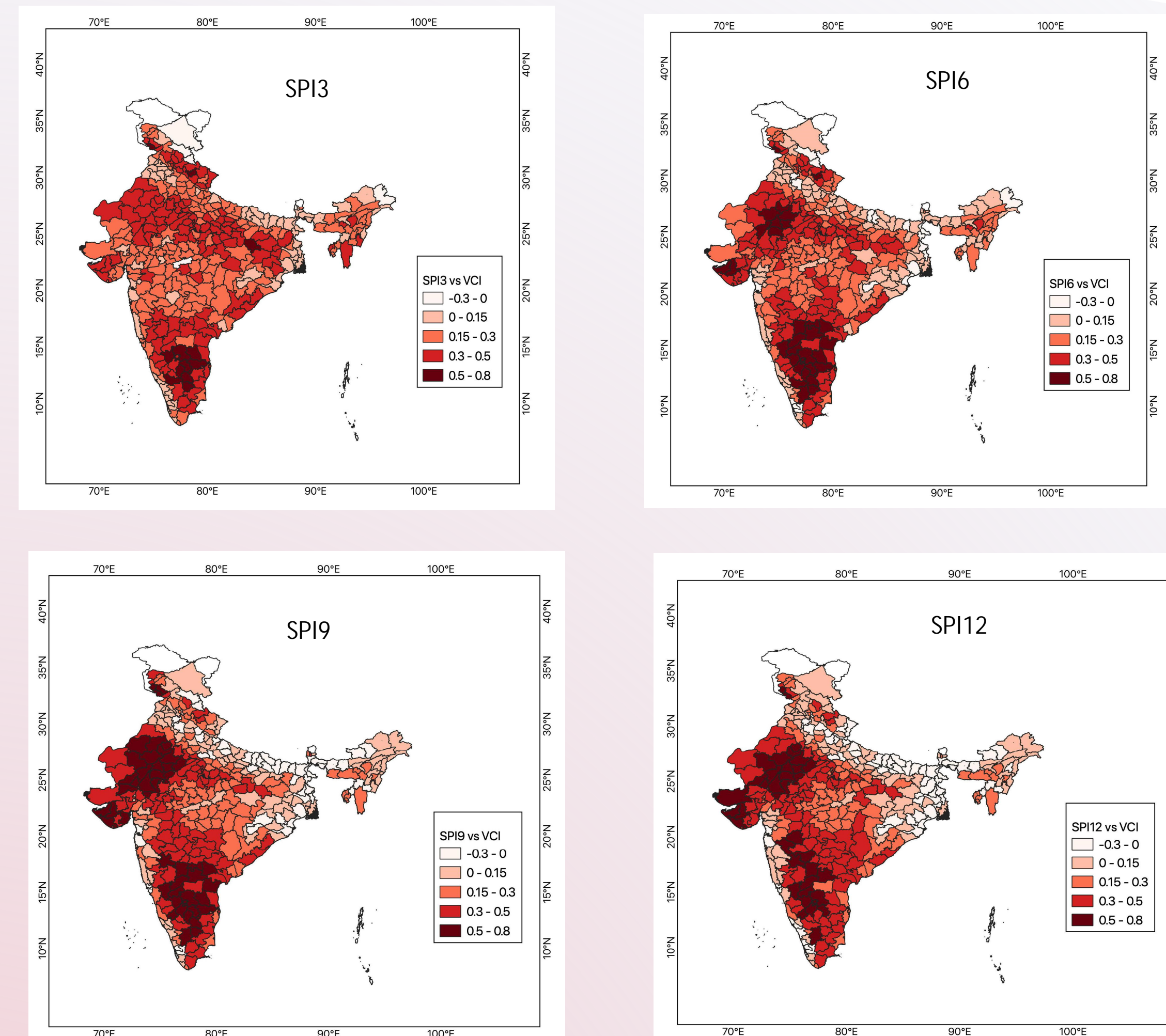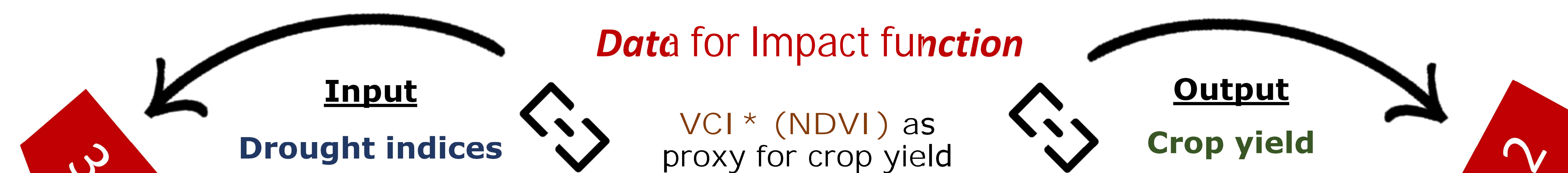

Figure 2. Correlation coefficients between SPI with various accumulation periods and monthly VCIs

2

Correlating VCI (NDVI) & Crop yield

We correlated the yearly VCIs with crop yields for different crops at a district level in India to identify the districts and crop types that can be represented by VCI.
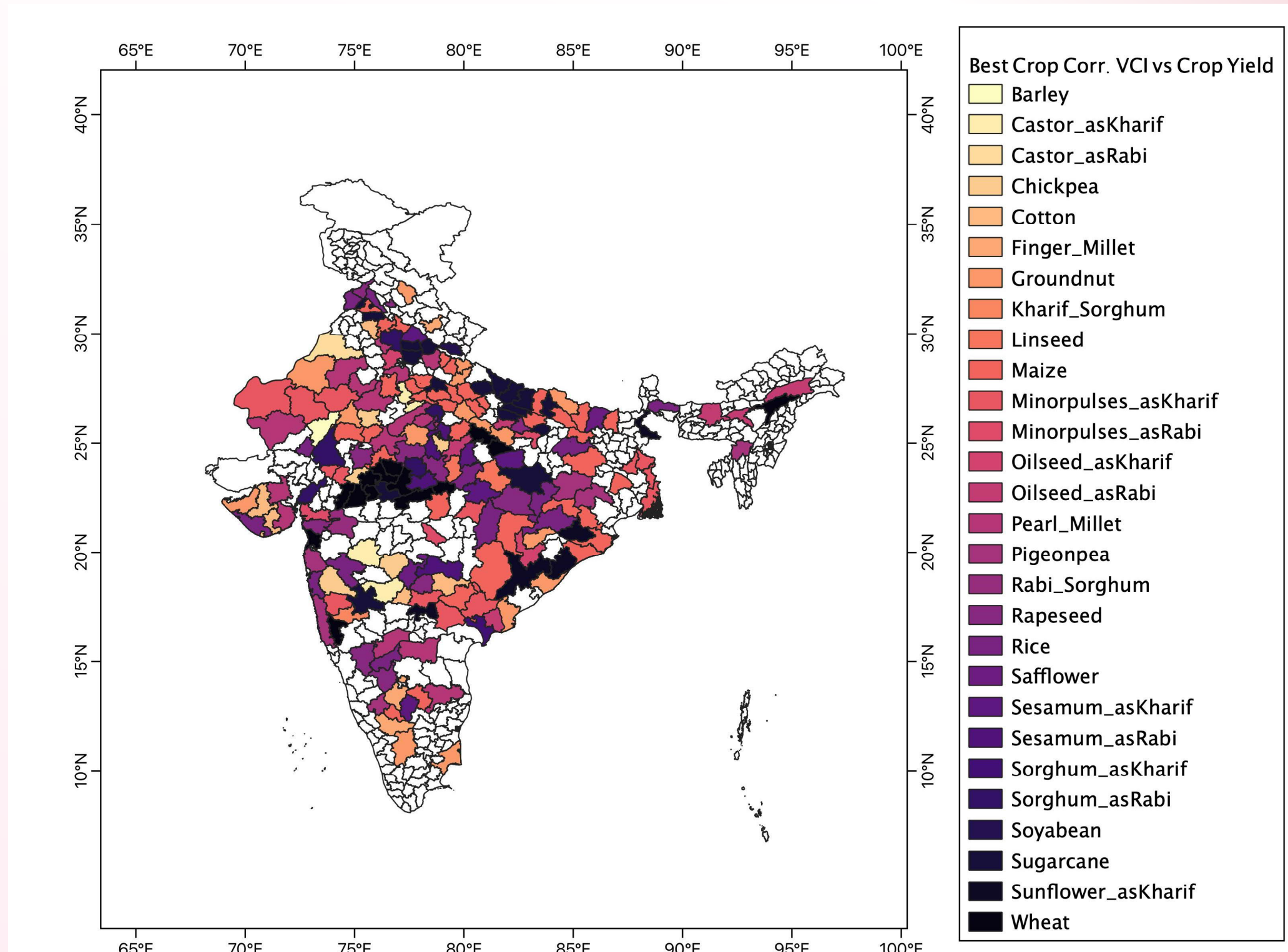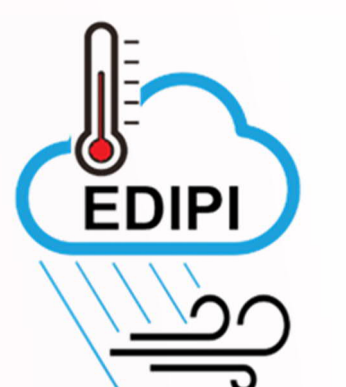

Figure 1. Correlation coefficients between SPI with various accumulation periods and best-correlated crop type per district based on the correlation between yearly crop yield for different crop types and yearly VCIs

4

Building impact function and assessing predictive skill

comparative analysis of various machine-learning algorithms (Random Forest, XGBoost, ANN) to assess their efficacy in predicting crop yield impacts

5

Inputting forecasted drought indicators (SEAS5) in impact function and assessing the skill

assessing predictive skill of the impact function based on forecasted drought indicators

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References: [2] Didan, K.: MOD13A1 MODIS/Terra Vegetation In- dices 16-Day L3 Global 500m SIN Grid V006, NASA EOSDIS Land Processes DAAC [data set], https://doi.org/10.5067/MODIS/MOD13A1.006, 2015b

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