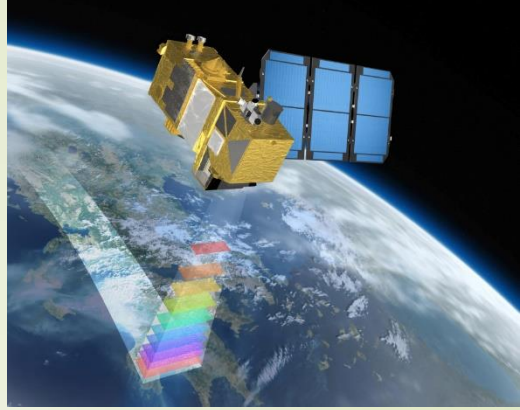
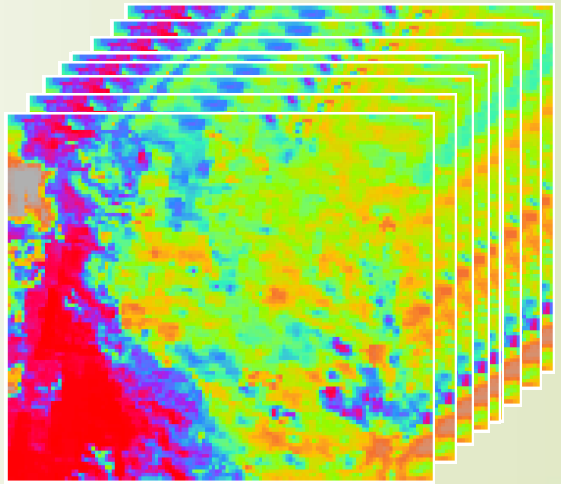
Application of Remote Sensing derived land surface information to enhance implementation of management practices in SWAT





Presented by

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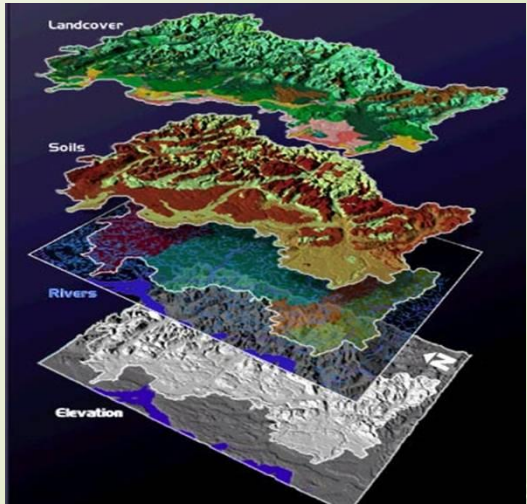


OUTLINE

- BACKGROUND OF THE STUDY
- OBJECTIVE
- OVERALL METHODOGY
- RESULTS AND DISCUSSION
- CONCLUSION
- FUTURE WORK

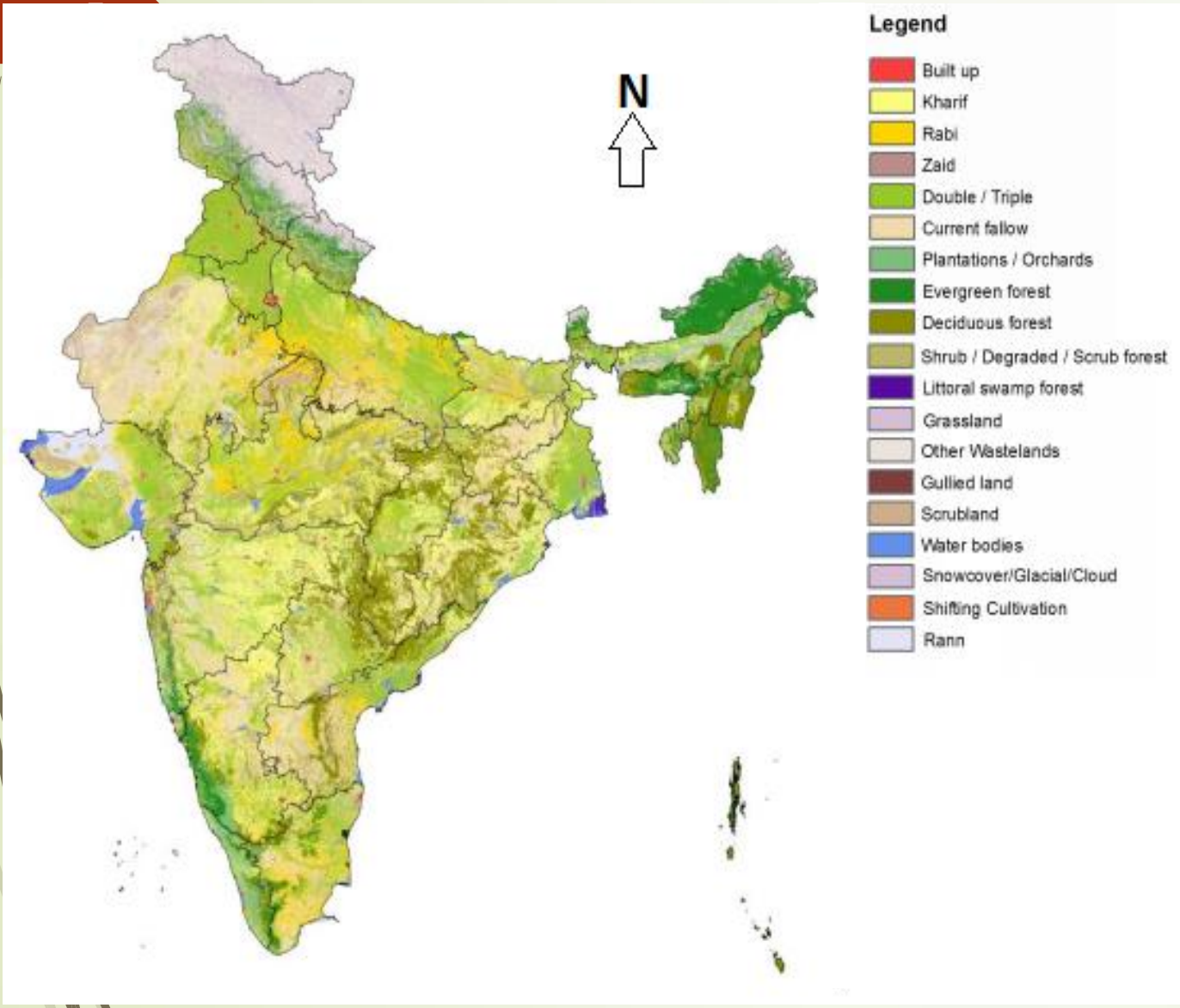
BACKGROUND OF THE STUDY

- Water management and water saving are evolving as crucial factors in the context of sustainable development.
- Distributed hydrological models are widely used for water balance studies.
- The accuracy of estimation of these water balance components are more dependent on the availability of the input data.
- Mainly in agricultural dominated region the land use representation and the crop management practices play a dominant role.

WATER USE IN INDIAN CONTEXT

- India is an agricultural dominated country and 90% water consumption is accounted by agriculture.
- Heterogeneity in landuse and spatio-temporal variability in agricultural practices needs to be addressed in Hydrologic models.
- Accounting these variability in Hydrological models will increase the models performance in simulating the water balance components effectively.
- Conventional methods of acquiring land management related information through field scale surveys, cropping related reports etc., are appropriate for model simulations at a field scale.

LAND USE/LAND COVER MAP



- The LULC map of 2007-08
- The LULC map represents agricultural cultivated areas as season specific classes, namely:

  kharif only, rabi only, zaid only and double/triple cropped areas.

Source: NRSC

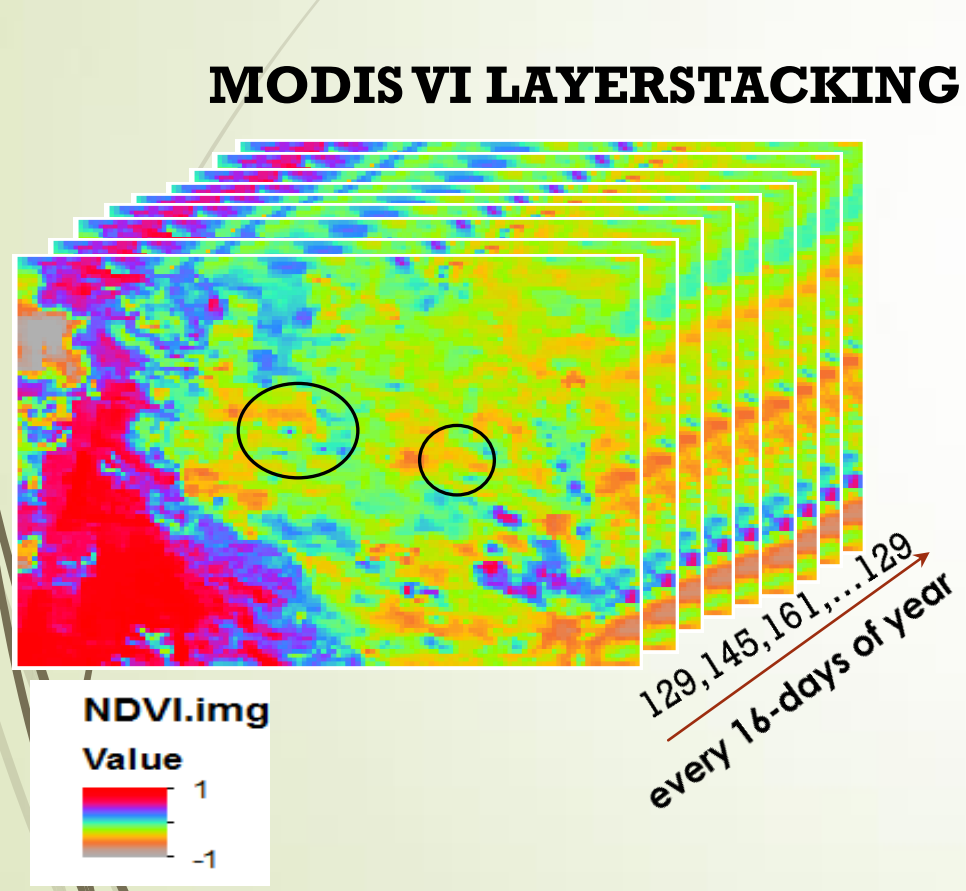
CROPPING SEASONS IN INDIA

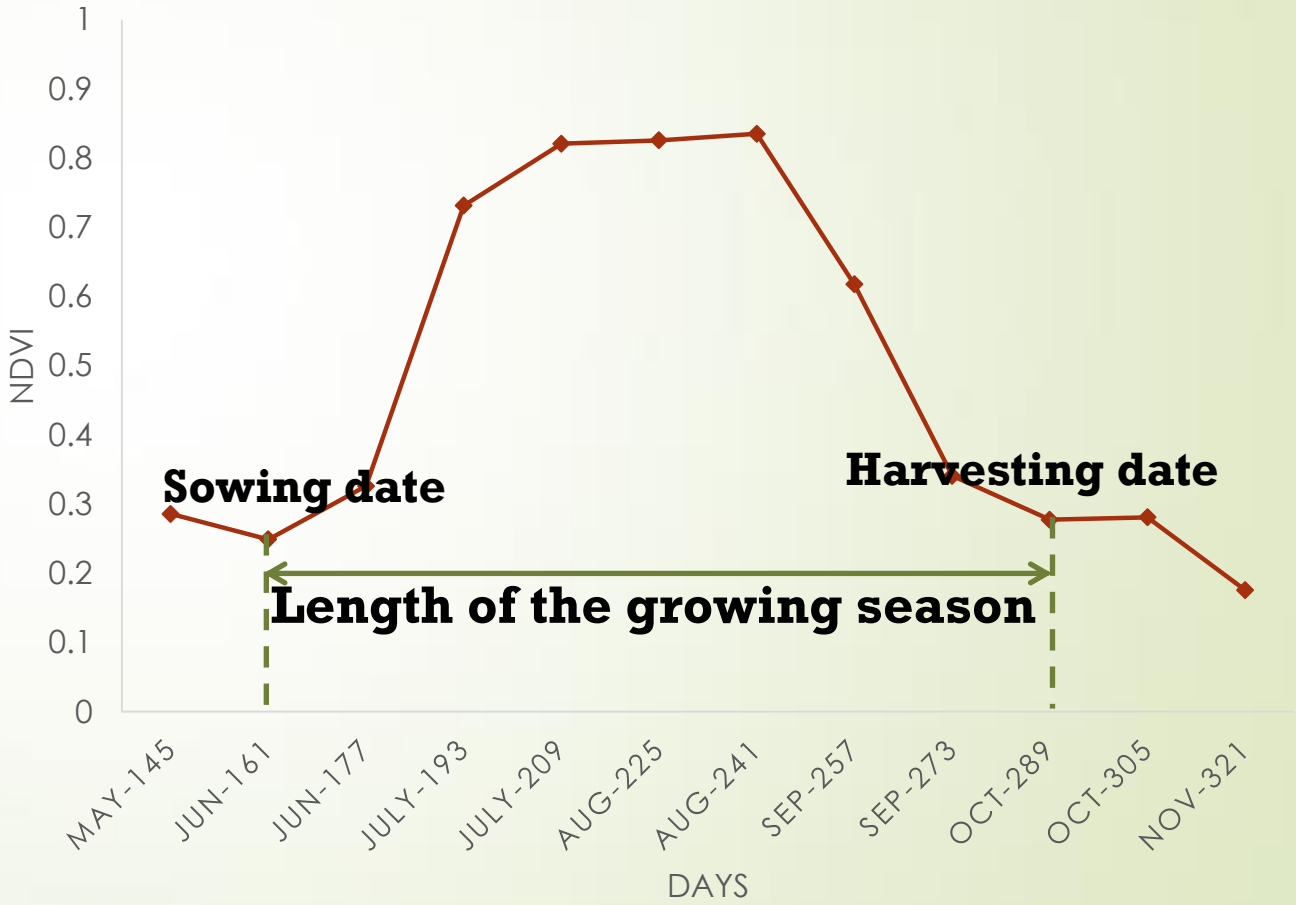
Cropping Season in INDIA	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Kharif													
Rabi													
Zaid													

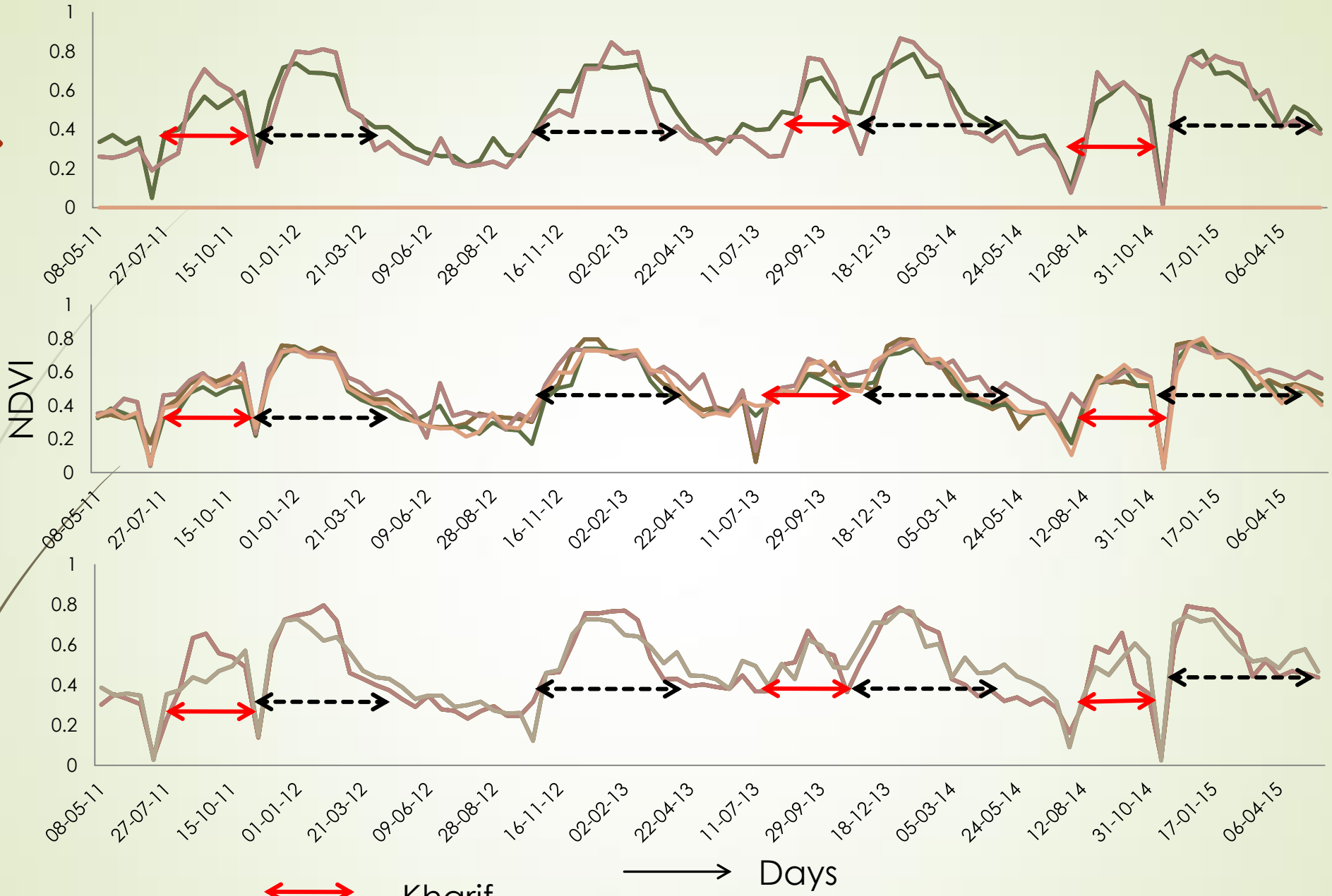
Source: http://nfsm.gov.in/nfmis/RPT/CalenderReport.aspx

CROP PHENOLOGY USING REMOTE SENSING

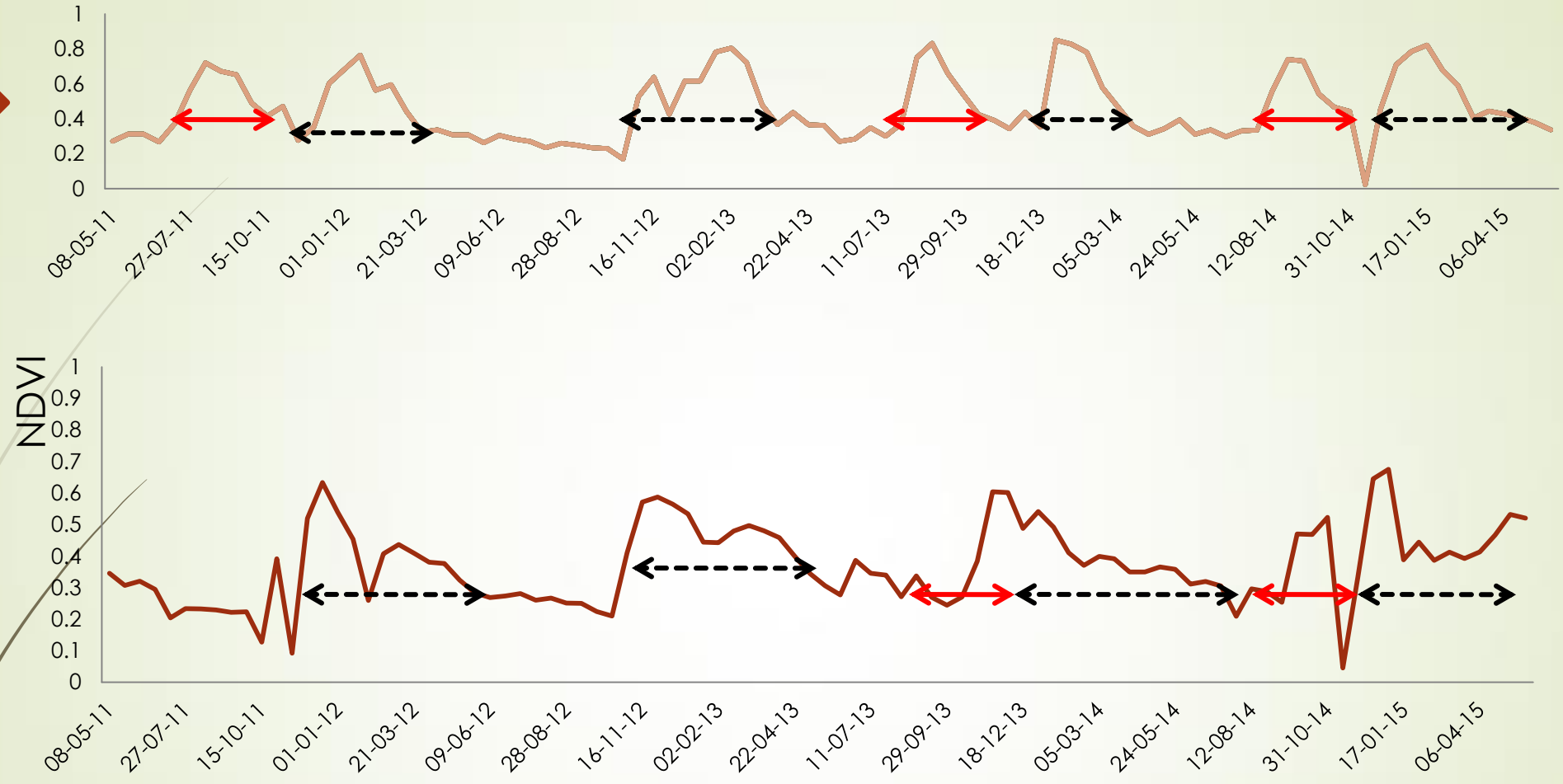
- Times series of MODIS NDVI 16-day composites @ 250m spatial resolution







Upstream - entirely paddy



Kharif

Rabi

Downstream - paddy mixed with perennial

OBJECTIVE

- Developing an automated algorithm to extract the crop phenology parameters from remote sensing data to prepare a crop calendar for the whole nation.
- Improving the parameterization of the agro-hydrological model SWAT by incorporating the crop related information and management practices.

METHODOLOGY

- Build up
- Kharif only
- Rabi only
- Zaid only
- Double / tripple
- Current fallow
- Plantation/orchard
- Evergreen forest
- Deciduous forest
- Scrub/Deg. forest
- Littoral swamp
- Grassland
- Other wasteland
- Gullied
- Scrubland
- Water bodies
- Snow covered
- Shifting Cultivation
- Rann

MODIS VEGETATION INDICES DATA

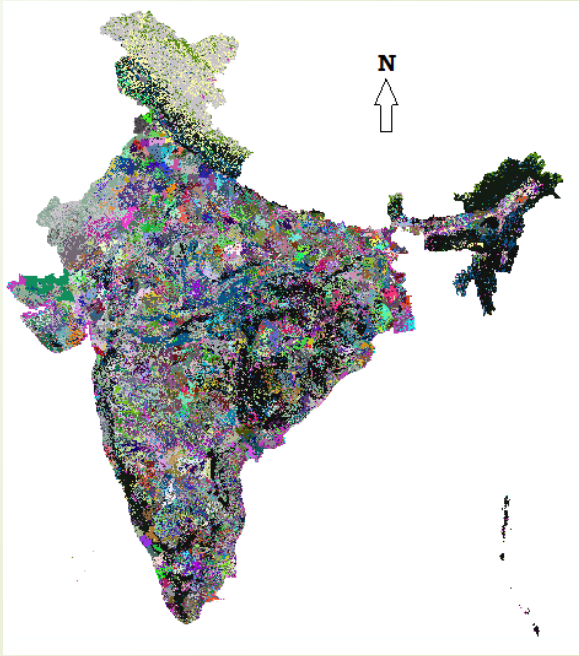
DENOISING NDVI

AUTOMATED ALGORITHM USING DERIVATIVE METHOD

EXTRACTION OF CROP SOWING, HARVESTING DATES & CROP GROWTH LENGTH

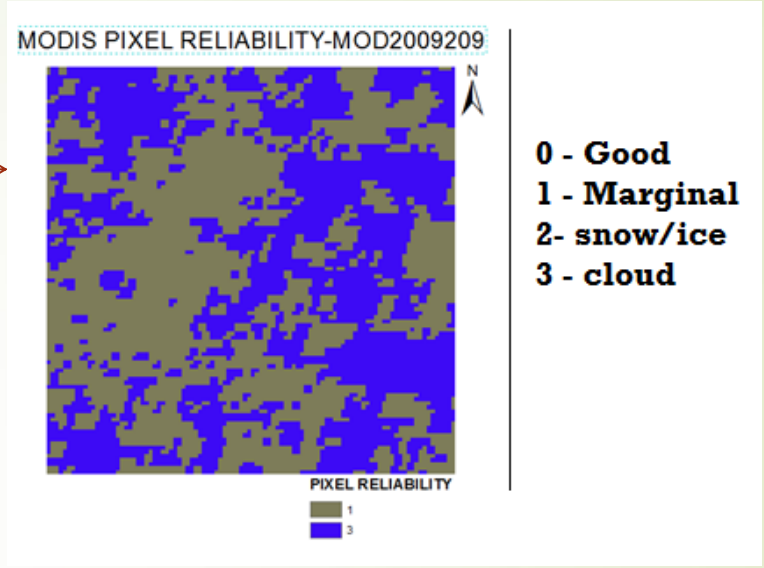
DISTRICT WISE SEASONAL CROP STATISTICS

CROP MAPPING & CROP CALENDAR FOR NATIONAL SCALE



DENOISING OF TIME SERIES DATA

Removal of Cloudy pixels



Masking of agricultural pixels from NRSC LULC data

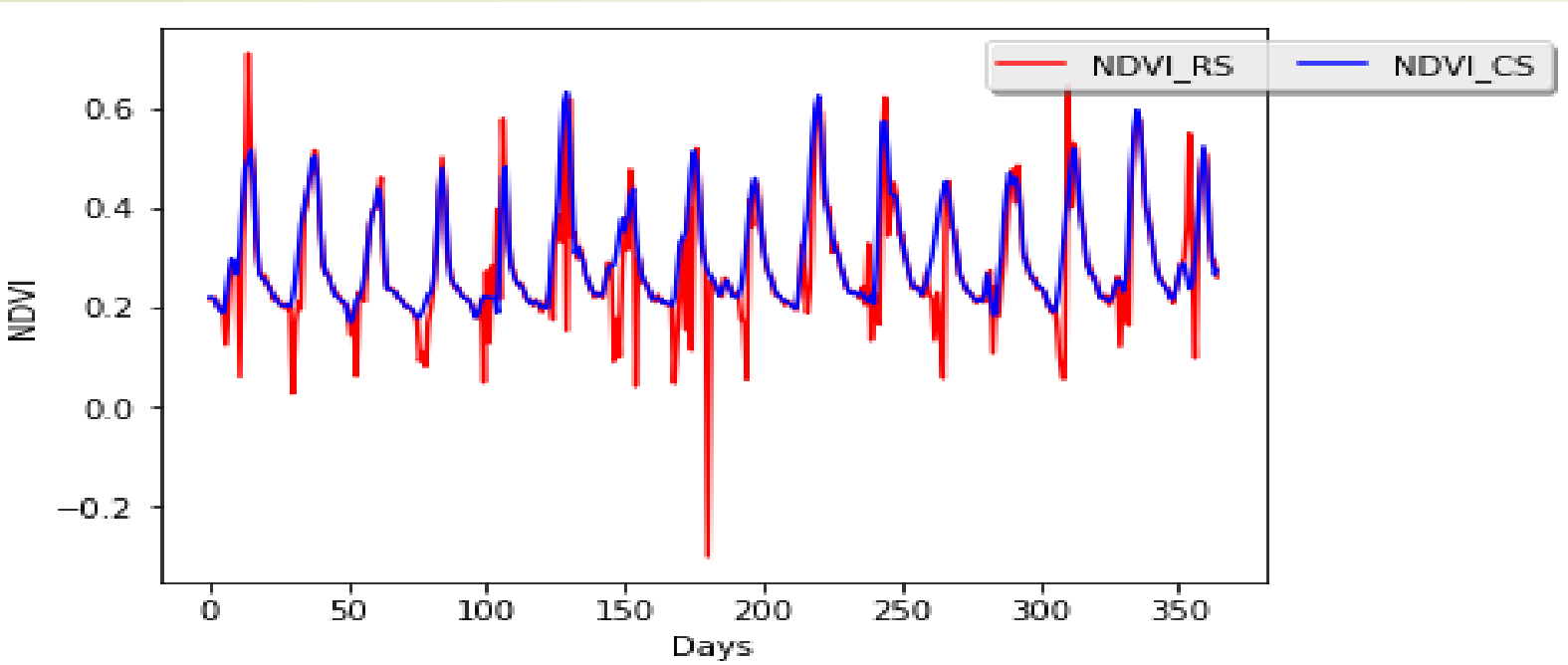
Gap filling

Smoothening of the time series data

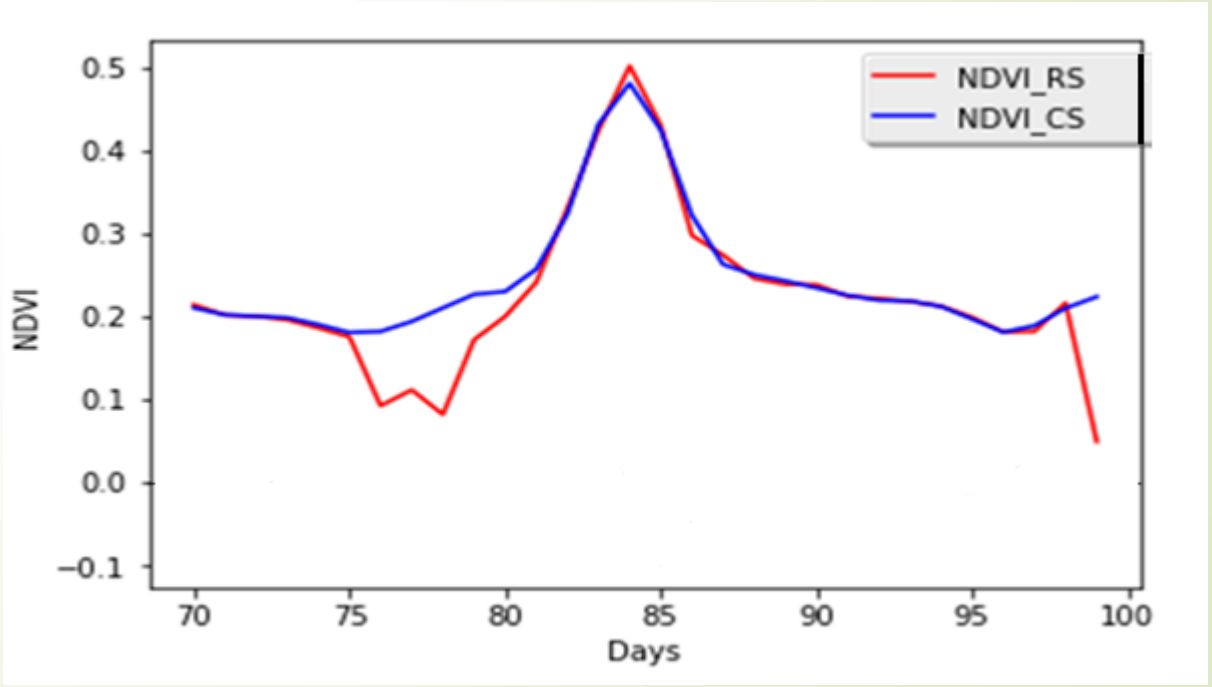
Savitzky-Golay Filter

$$g_i = \sum_{n=n_{-L}}^{n=n_R} c_n f_{i+n}$$

Removal of contaminated pixels



Time series raw NDVI and smoothened NDVI



DERIVATIVE METHOD

The 1st derivative of Lagrangian interpolation,

$$L^1(x) = \sum_{j=0}^{k} y_j \, l_j^1$$

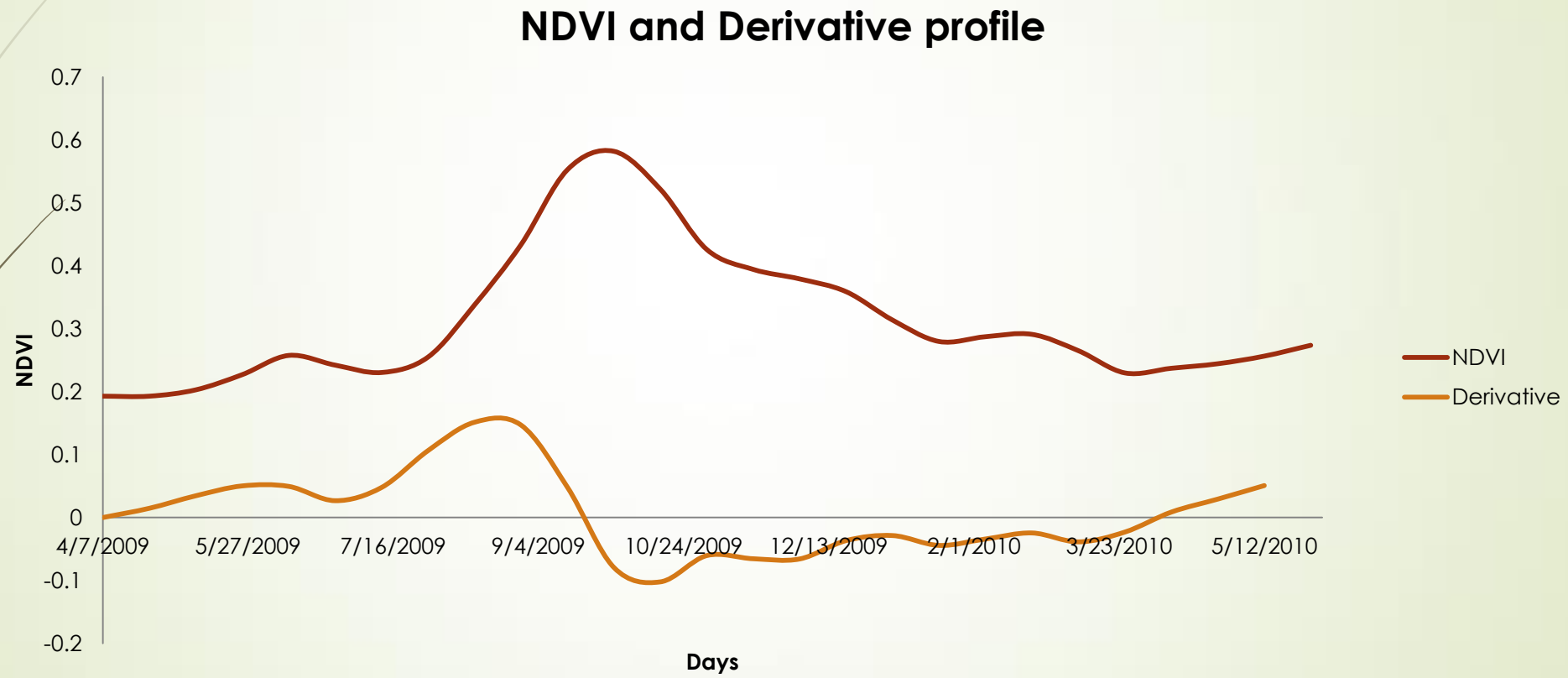
$$l_j^1 = \sum_{i=0, j!=j}^{k} \left[\frac{1}{x_j - x_i} \prod_{m=0, m!=(i,j)}^{k} \frac{x - x_m}{x_j - x_m} \right]$$

Where y represents the NDVI value and x represents the composite day of the year of the i.

The 3-point lagrangian interpolation is used for the study, the 1st derivative at point j along the NDVI time series calculated

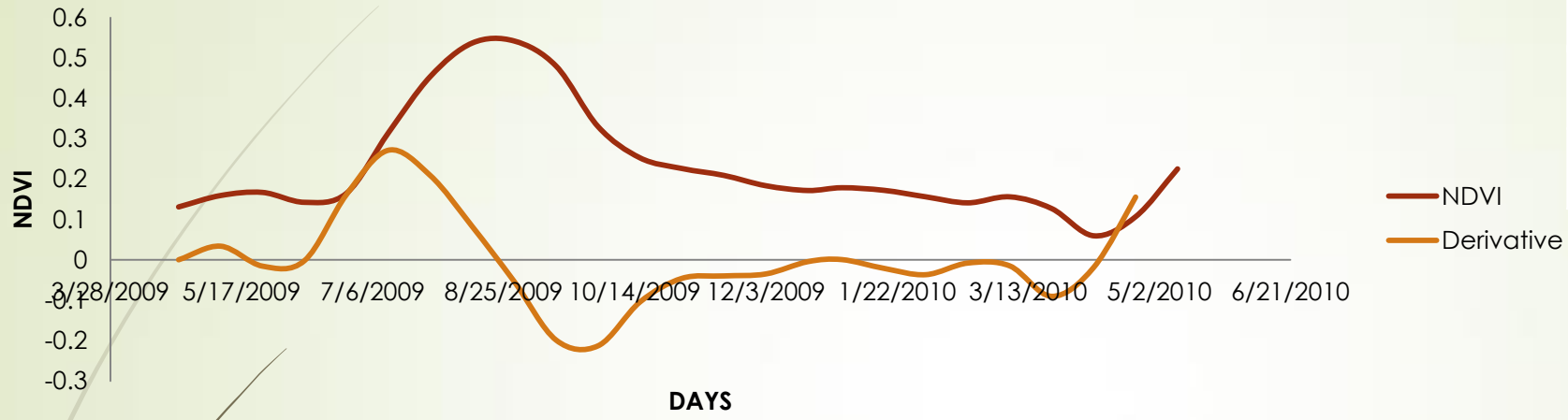
RESULTS AND DISCUSSION

- 2009-10 crop year is selected for the preliminary study.



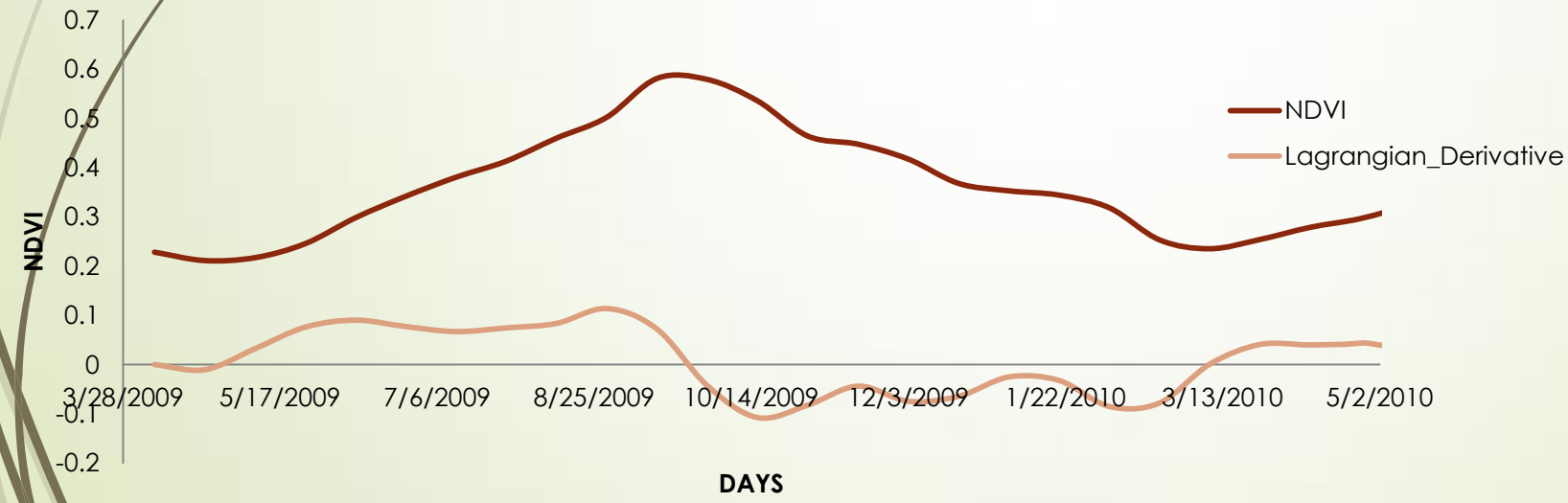
KHARIF SEASON

PADDY PIXEL



Sow_date	Harv date
10/06/2009	14/10/2009
CGP: 120 DAYS	

SUGARCANE

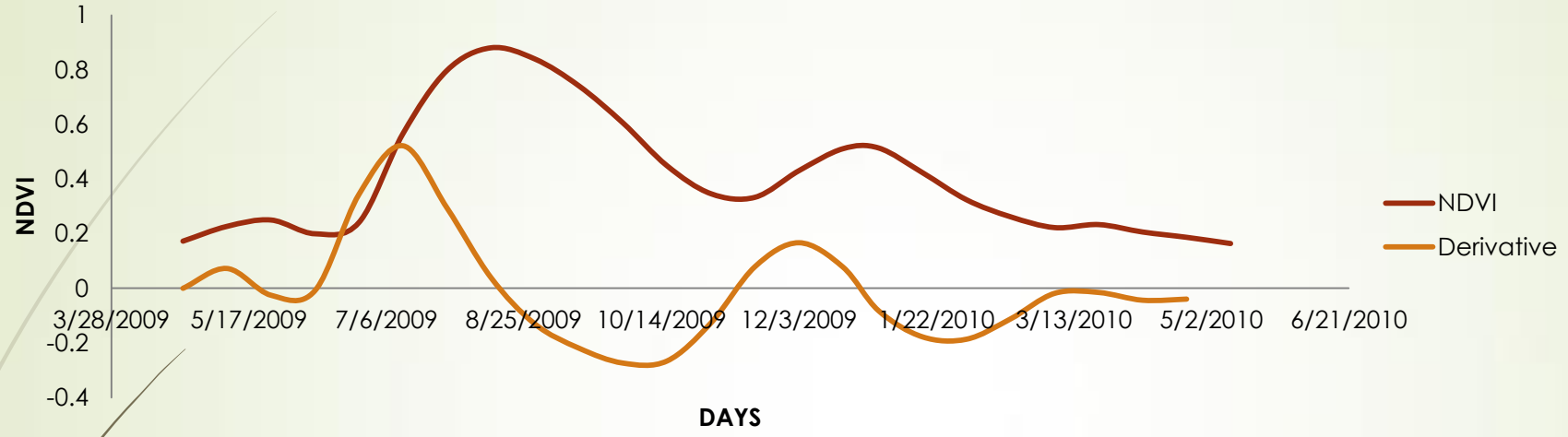


Sow_date	Harv date
31/4/2009	19/12/2009
CGP : 232 DAYS	

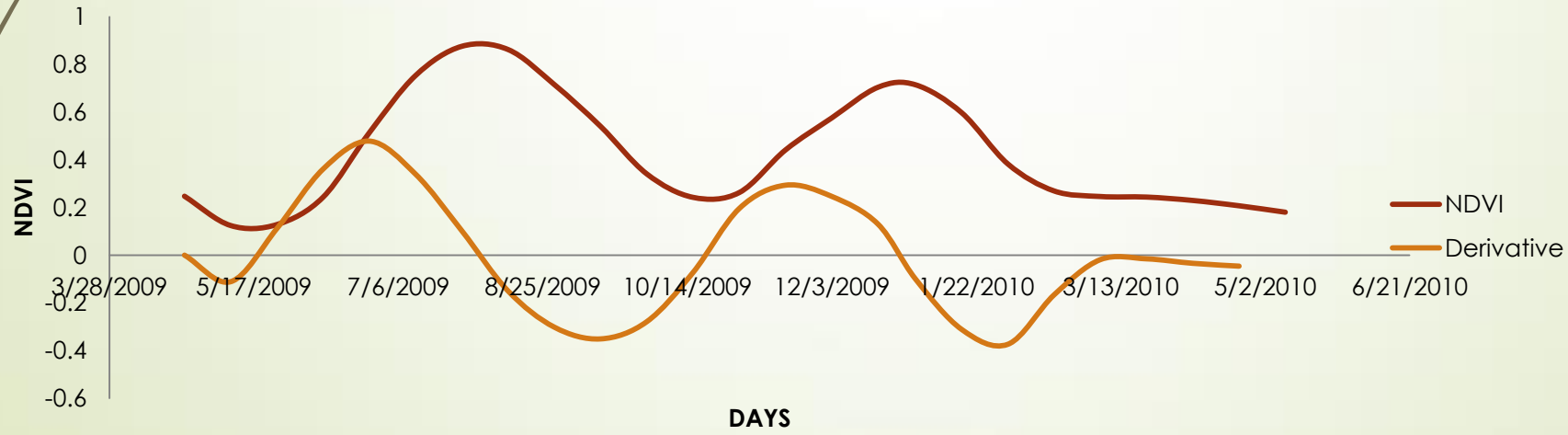
MIXED PIXEL – RICE MIXED WITH PLANTATION

Sow_date	Harv date
15/4/2009	20/01/2010
CGP: 280 DAYS	

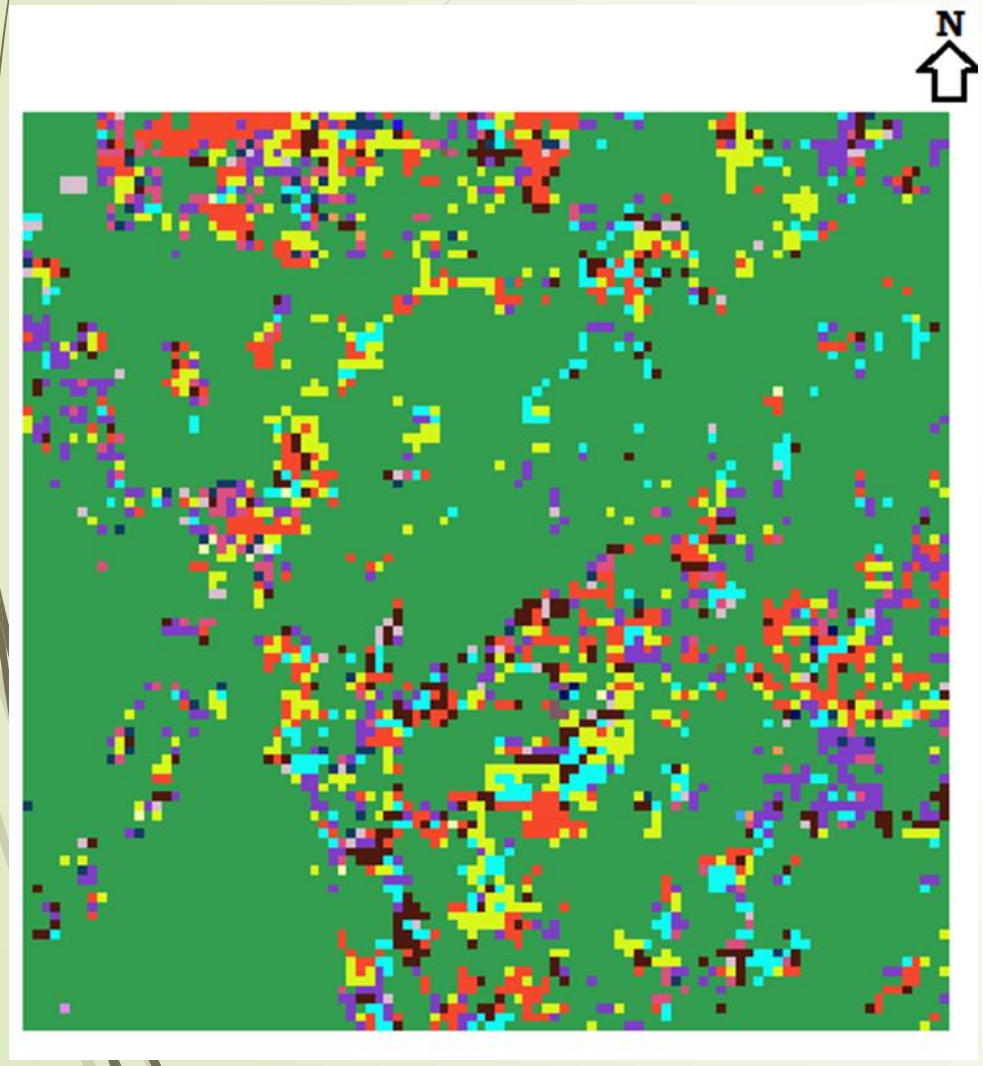
Double crop - Paddy with another crop

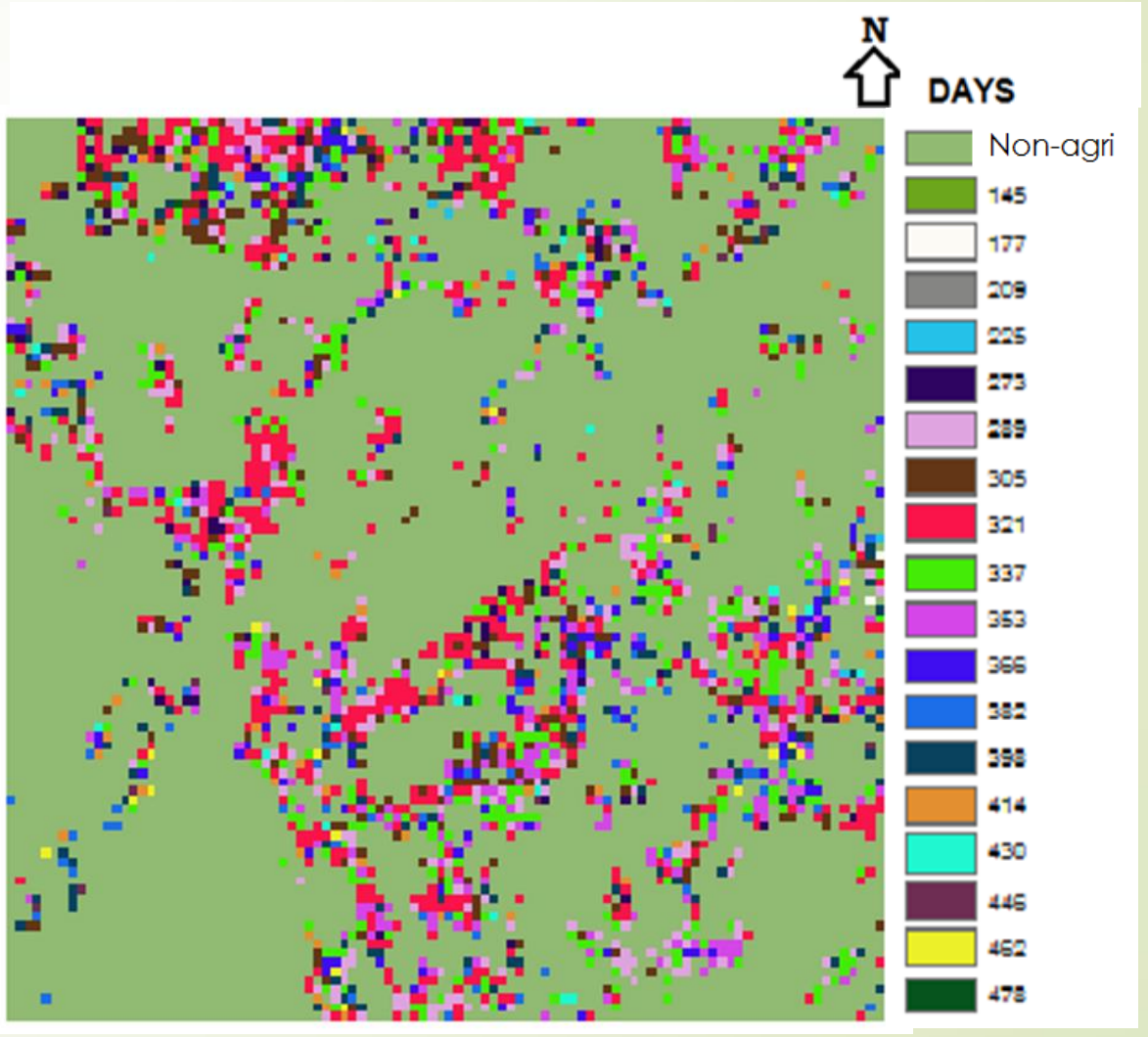


Double crop - Paddy -Paddy



SPATIAL VARIABILITY OF SOWING & HARVESTING DATES





CONCLUSIONS

- The algorithm was effective for pure pixels of single and double crops.
- Exception handling is required for various degrees of mixed pixel.

FUTURE WORK

- The algorithm will be applied for the time series of MODIS composite data from the period of 2000 – till date
- Also, it will be implemented and validated for various seasons and crops across India.
- The crop information extracted using this methodology will be used in SWAT for modelling large river basins.

Thank you