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# DSS for monitoring agro-meteorological and crop conditions in India using remote sensing for agro-advisory services

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# Rationale

#### Smart Agriculture

- Based on informed decisions
  - By policy makers (Federal & State)
  - By stakeholders (Farmers, Researchers, Developmental agencies)
- To fulfil immediate requirements and long term sustainability goal

## **Hypothesis**

Real time monitoring of crop conditions at regional scales as affected by climatic stresses for suggesting contingency measures to stakeholders and likely food situation (Production forecast) to policy makers is one of the broad strategies of climate smart agriculture.

### Remote Sensing technology

- **Range of Spatial / Spectral Resolutions field scale to regional scale**
- Repetitive for regular monitoring
- Indices directly observe crop vigour and crop environment
  - Multiple sources and historical standardized datasets

# The IARI Satellite Ground Station (NICRA)

- First such system in an Agricultural Institute
- Receive direct
  broadcast of remote
  sensing data from
  satellites
- US, European, Chinese and Indian satellite
- Mid China to IndianOcean : Mid Iran toMyanmar
- End-of-pass to level-2 product in less than 10 min











# The System Overview



# METHODOLOGY

# Parameter

Daily Rainfall

- Daily NDVI
- Day Land Surface Temperature (LST)

 Night Land Surface-Temperature (LST)

## Index

- Weekly Standardized
  Precipitation Index (SPI)
  - Fortnightly Crop Condition Index (CCI)
  - Weekly Daytime Temperature Condition Index (TCIday)
  - Weekly Night time Temperature Condition Index (TCInight)



# METHODODLOGY

## Standardized Precipitation Index (SPI)

- Index of rainfall anomaly
- Comparable across regions
  & time scale

Standard Normal Distribution



# METHODODLOGY



# METHODODLOGY

# Temp. Condition Index (TCI)

- Index of surface Temperature
- Separate for Day & Night
- Comparable across regions
  & time scale



Classification of TCI values			
< 20 %	Very Hot		
20 – 40 %	Hot		
40 – 60%	Normal		
60 – 80%	Cool		
> 80%	Very Cool		

# **Suit of Technologies**

## Specification

- Automatized the workflow (C, IDL)
- Map preparation in ArcGIS
- Database: MySQL
- Web programming: PhP
- Web server: Apache tomcat

## Visualization

- Country Level: as periodic & seasonal maps
- District level: Temporal profile of parameters in current season as compared to previous year and average

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Research on Agroecosystem Monitoring & Modelling from Spac Indian Agricultural Research Institute



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The Center for Research on Agroecosystem Monitoring and Modeling from Space (CREAMS) is an interdisciplinary research initiative of the Indian Agricultural Research Institute, New Delhi and coordinated by its Division of Agricultural Physics. It undertakes research and builds capacity in using remote sensing, agro-meteorology and agro-models for qualitative and quantitative assessment of crops and crop environment from field to regional scale in India. Through this portal, CREAMS brings some of the scientific products to the decision makers for taking informed decisions

The initiative is supported financially by in-house project and ICAR funded NICRA project. CREAMS operates its own X & L-band satellite ground station to receive direct broadcast remote sensing images from a range of international satellite constellation. Besides, it has a state-of-art geo-spatial laboratory with high-end computer workstations, large network attached storage and latest image processing/GIS software for archiving and analysis of data







#### Rainfall Monitoring Kharif 2014-15 (periodic)



#### Rainfall Monitoring Kharif 2014-15 (seasonal)



## **Rainfall Monitoring**

#### Kharif season (2013-14)

#### **Standardized Precipitation Index**



CLIMATE-SMART

Agriculture

#### Kharif season (2014-15)



### **Temperature Condition index (day) (Periodic)**

#### Kharif 2014-15



#### Temperature Condition index (day) (Seasonal) Kharif 2014-15



### Temperature Condition index (night) (Periodic) Kharif 2014



### Temperature Condition index (night) (Seasonal) Kharif 2014-15



### Kharif 2014-15

#### **Crop Condition Index (Periodic)**



## Kharif 2014-15 Crop Condition Index (Seasonal)





2015

### Rabi 2013 -14

#### Wheat Seasonal



Districts with wheat crop area more than 10% of Net Sown Area



### Kharif 2014-15

#### **Rice Seasonal**



Districts with rice crop area more than 10% of Net Sown Area





# Situation Highlights

# **Standardized Precipitation Index** (29 Oct 14 - 11 Mar 15) SPI > 2.00 (Extremely wet) 1.50 - 1.99 (Very wet) 1.00 - 1.49 (Moderately wet) -0.99 - 0.99 (Normal) -1.00 - -1.49 (Moderately dry) -1.50 - -1.99 (Severely dry) < -2.00 (Extremely dry) No data © CREAMS/AP/IARI

CLIMATE-SMART Agriculture 2015 Cumulative SPI of Rabi Season (29-Oct-14 to 11-Mar-2015)

Extremely wet/very wet conditions over many parts of North Punjab, foothills of Himachal, southern districts of Haryana, Delhi, few districts of east-central Uttar Pradesh and Marthawada region of Maharashtra.

Moderately wet conditions observed in Hilly districts of Himachal, northern Haryana, Central Uttar Pradesh, Madhya Pradesh and Saurashtra.

Extremely dry/ severely dry conditions were observed over many parts of Tamil Nadu, in few southern districts of Andhra Pradesh and Karnataka,

Rest of the country experienced normal conditions.

# Case of Extreme Rainfall in March 2015



2015

Wheat crop lodged due to untimely thunderstorms

### **Comparing Jalandhar & Shivpuri District Situation**



### **Medium Range Weather Forecast Based Agro-Advisory System**



# Wheat Yield Forecasting – Group of Districts

#### Punjab & Haryana Agro-ecoregions



## The Models and their Performance



# The Forecasts

	Forecast for 2013-2014		Change over previous year	
	Production (M t)	Yield (t/ha)	Production (%)	Yield (%)
Punjab	16.97	4.84	+ 2.2	+ 2.3
Haryana	11.48	4.59	+ 3.0	+ 2.9

First Forecast Used Satellite Data upto 20 March 2014.



# **Summary & Path Ahead**

- It is a prototype system in its initial development /validation phase
- The information generated is both complementary and supplementary to current system with potential for improving the agro-advisories at national scale.
- Some more bio-physical product based indices, esp. those related to canopy and soil moisture to be included
- Generating and hosting pixel level indices maps for visualizing sub-district scale variability
- Working on linking remote sensing inputs into crop simulation model for What-if analysis for advisory and better yield forecasting





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