



Drought and Flood Impact Assessment on Agriculture



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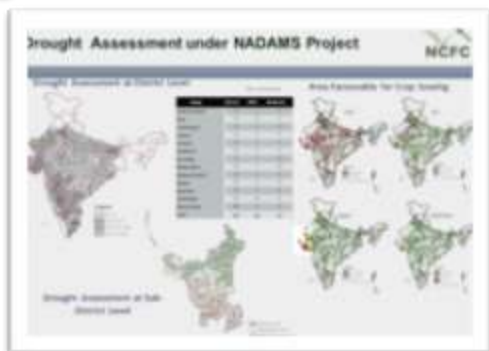
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Established under Dept. of Agrl. & Coop. (MoA), to Institutionalise and Operationalise Applications in Agriculture; Inaugurated on 23rd April, 2012

National/State/District level pre-harvest crop production forecast of Rice (Kharif & Rabi), Wheat, Rapeseed & Mustard, Winter Potato, Cotton, Sugarcane, Rabi Sorghum and Jute (FASAL); Remote Sensing driven CCE, Crop Emergence Area



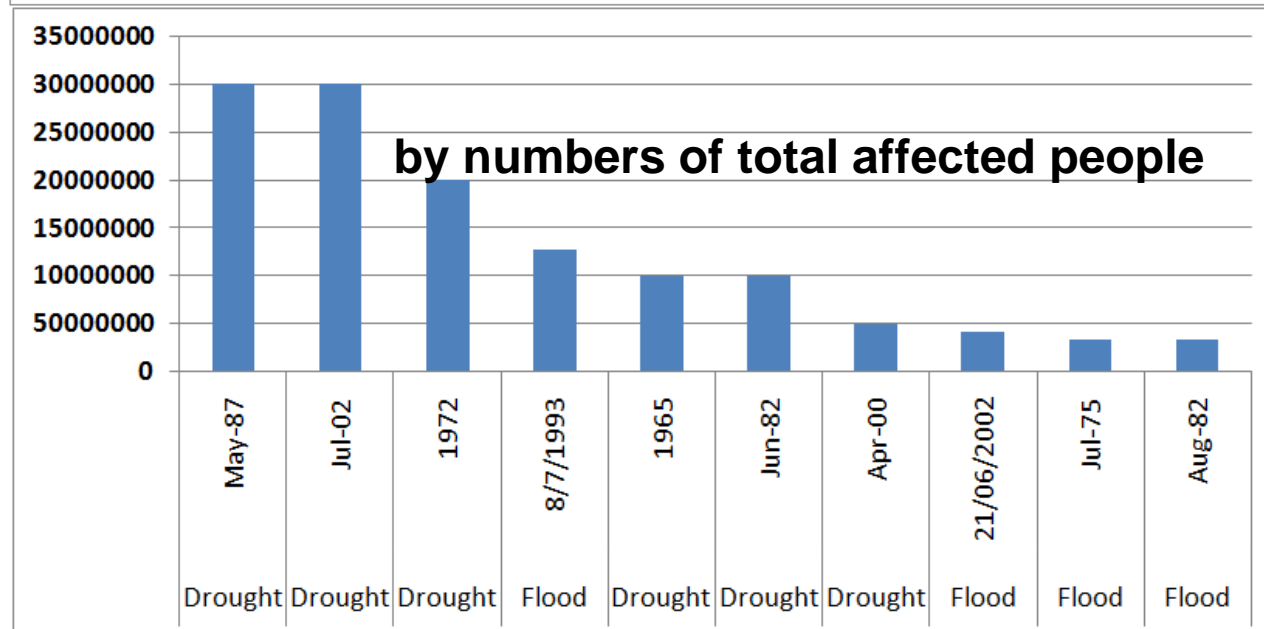
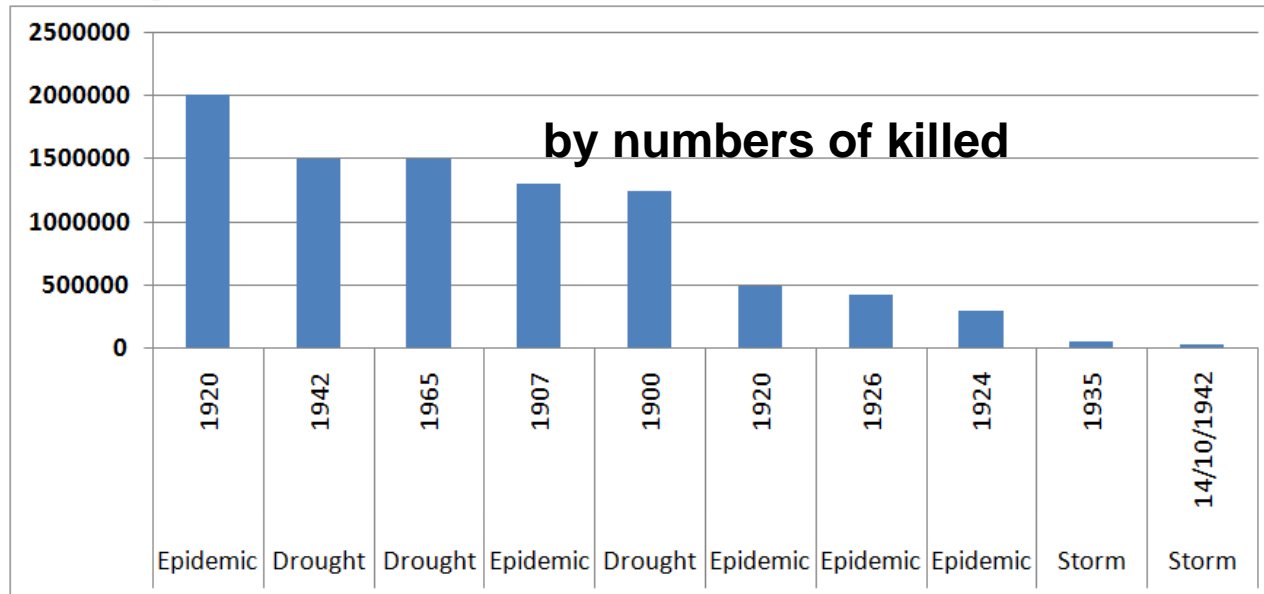
Agricultural Drought Assessment at State/District/Sub-District level for 13 agriculturally dominant states (NADAMS); Rabi Season Crop Alert Districts; Rice Flood Inundation Assessment

Future Programmes: Crop insurance, Soil Health, Horticulture, Sustainable Agriculture, Regional Assessment

Introduction

- Agriculture, in India, is strongly affected by two major hydro-meteorological disasters, namely drought and flood.
- Drought is a perennial feature, 16 per cent of India's total area is drought prone and approximately, 50 million people are annually affected by droughts.
- Over 68-70% of total sown area in India is vulnerable to drought.
- As per report of National Disaster Management Authority (NDMA) 2012, in India about 49.81 Million hectare (15.2% of total geographical area) is flood prone and on an average 10-12 Million hectare is actually affected every year causing a range of miseries.
- Simultaneous occurrence of flood in one and drought in another parts of the country are quite common.
- Assessment of agricultural condition during drought or flood is essential for taking various relief and rehabilitation measures.
- Since both these disasters impact large area, satellite based monitoring is extremely useful.

Top 10 Disasters of India (for the period 1900 to 2014)



(Source: "EM-DAT: The OFDA/CRED International Disaster Database")



Flood Prone Areas in India



(Source: NRSC: India-WRIS)



Agencies involved with Drought Monitoring/ Management in India

- **Ministry of Agriculture:** Overall coordination, Inter-Ministerial Crop Weather Watch Group (CWWG)
- **IMD:** Weather Forecasting, Drought Assessment (AAI, SPI)
- **CWC:** Monitoring Storage situation in Major Reservoirs
- **MNCFC/NRSC:** Space technology based drought assessment (NADAMS)
- **ICAR:** Contingency planning
- **NRAA:** Promoting participatory development process in rainfed regions
- **NIDM:** Capacity Building

- **Aridity Anomaly Index**
- **Standardized Precipitation Index**
- **Palmer Drought Severity Index**
- **Crop Moisture Index**
- **Moisture Adequacy Index**
- **Remote Sensing based Indices**

Using VNIR

- Normalized Difference Vegetation Index
- Vegetation Condition Index

Using SWIR

- Normalized Difference Water Index
- Shortwave Angle Slope Index

Using LST

- Temperature Condition Index
- Crop Water Stress Index.
- Vegetation Index/Temperature Trapezoid



Operational Drought Assessment: NADAMS

'National Agricultural Drought Assessment and Monitoring System (NADAMS)' project, conceptualized and developed by National Remote Sensing Centre (NRSC), ISRO, Department of Space

Provides near real-time information on prevalence, severity level and persistence of agricultural drought at state/ district/sub-district level

Currently, it covers 13 states of India, which are predominantly agriculture based and prone to drought situation.

Monthly report of drought condition is provided to the all concerned agencies in Centre and State under NADAMS.

From the year 2012, the NADAMS project is being implemented by the Mahalanobis National Crop Forecast Centre (MNCFC), Ministry of Agriculture, after the technology was transferred to MNCFC by NRSC.

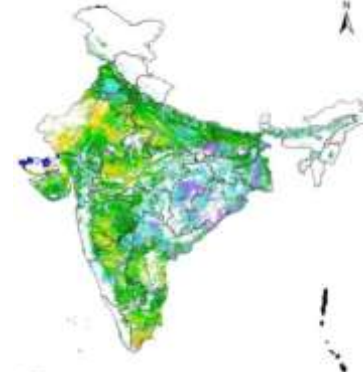
Drought Assessment: Inputs

- Remote Sensing based indices:
 - Normalized Difference Vegetation Index
 - Normalized Difference Water Index
 - Vegetation Condition ,

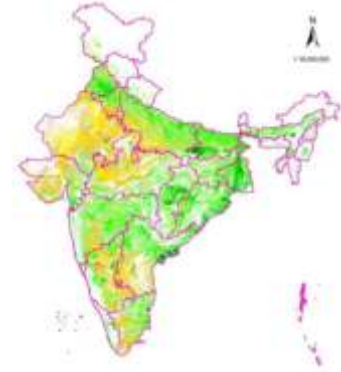
$$VCI = (NDVI_{curr} - NDVI_{min}) / (NDVI_{max} - NDVI_{min})$$

$$VCI = (NDWI_{curr} - NDWI_{min}) / (NDWI_{max} - NDWI_{min})$$
- Area Favourable for Crop Sowing (Satellite based SASI and Soil Moisture Index)
- District level Rainfall Deviation
- Irrigation percentage

NOAA AVHRR NDVI



MODIS NDWI



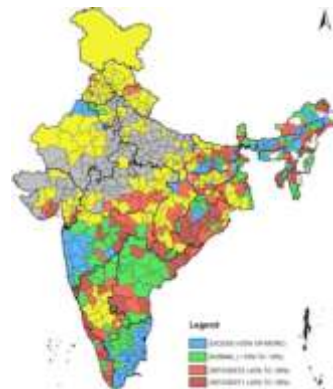
AWiFS NDVI



AWiFS NDVI



Rainfall Data from IMD

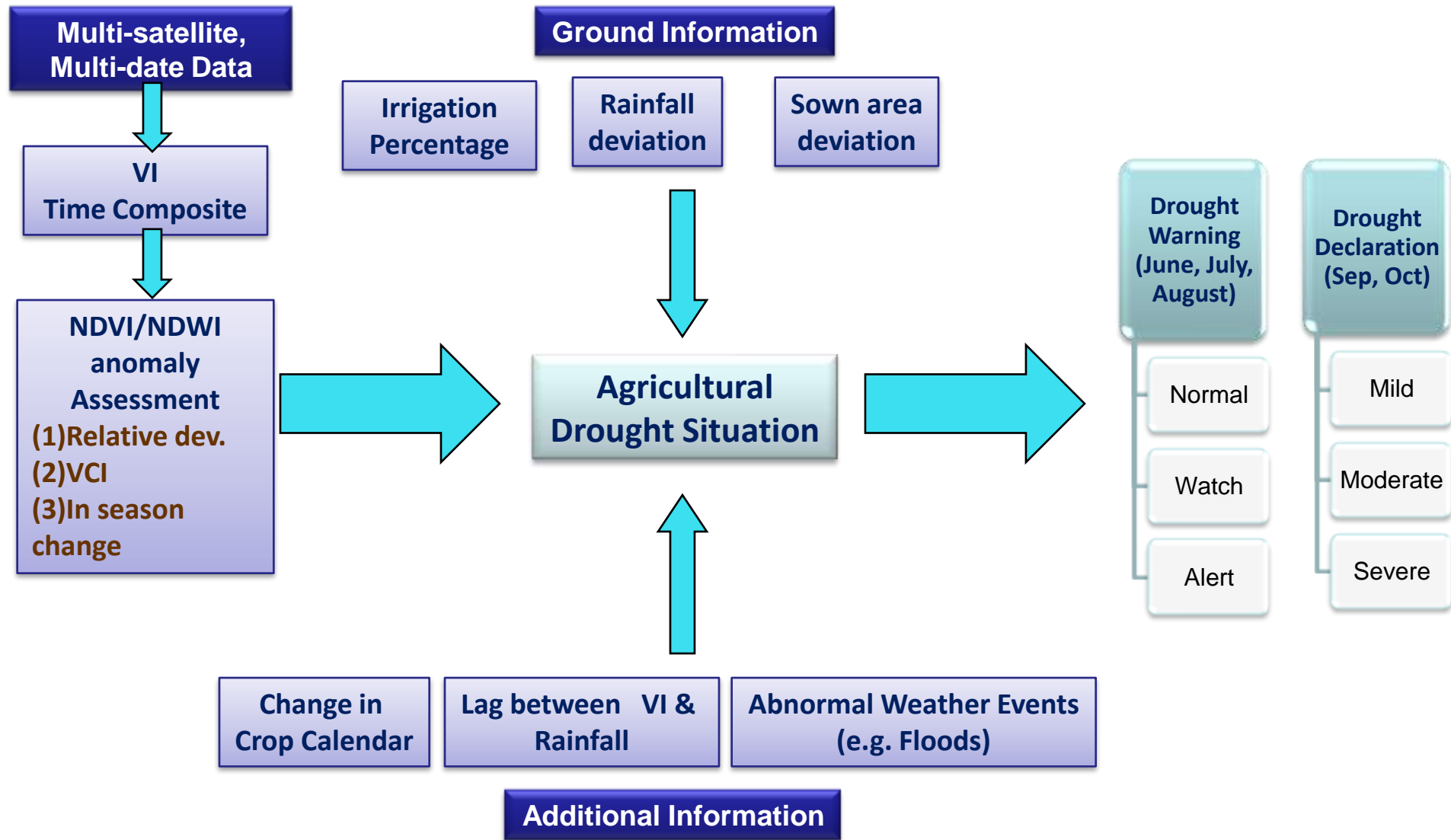


Parameters for Drought Declaration

S.N.	Drought Manual (Government of India)	NADAMS (MNCFC)
1	Rainfall Departures	District/sub-district level weekly rainfall departures
2	Sowing Area Deviation	Estimated Area Favorable for Sowing from Spectral Indices and Sowing Area Data from States
3	Spectral Vegetation Index	VCI of NDVI, NDWI
4	Moisture Adequacy Index	Soil Moisture Index, based on Agromet modelling

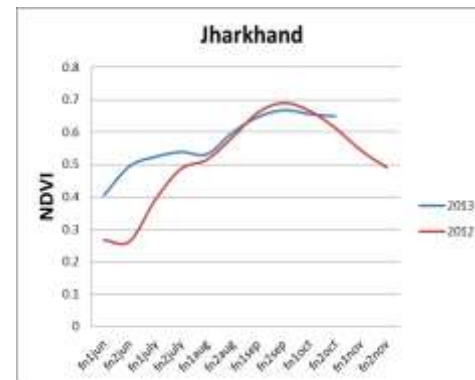
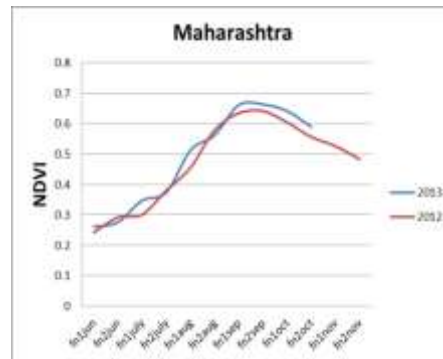
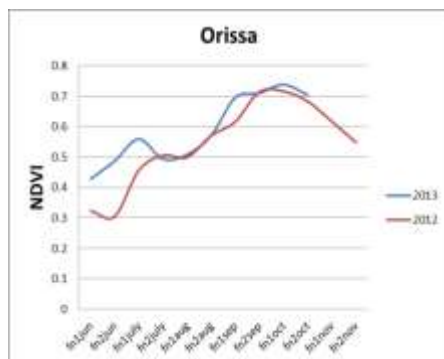
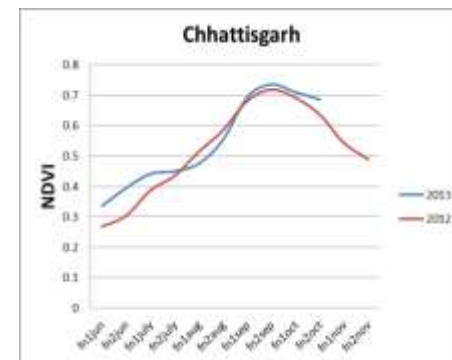
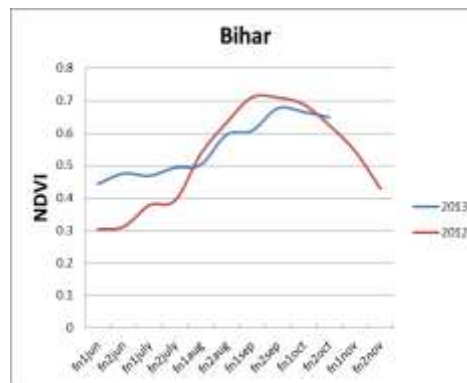
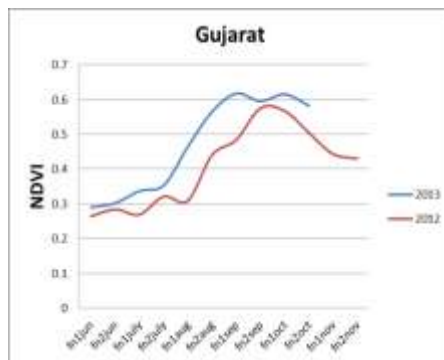
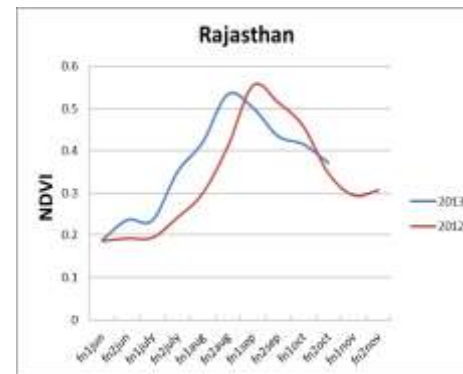
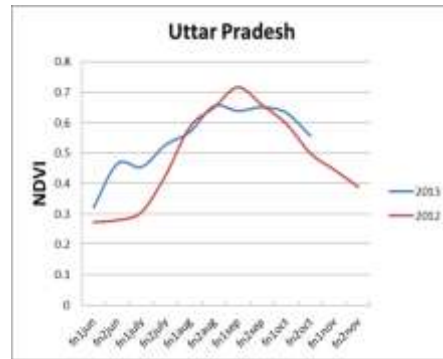
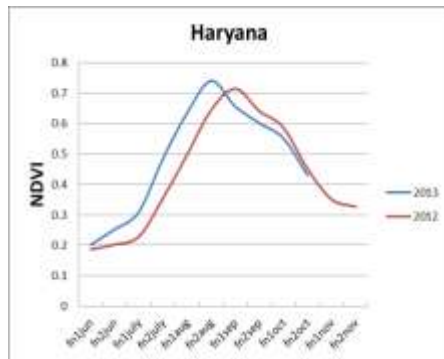


Methodology for Agricultural Drought Assessment





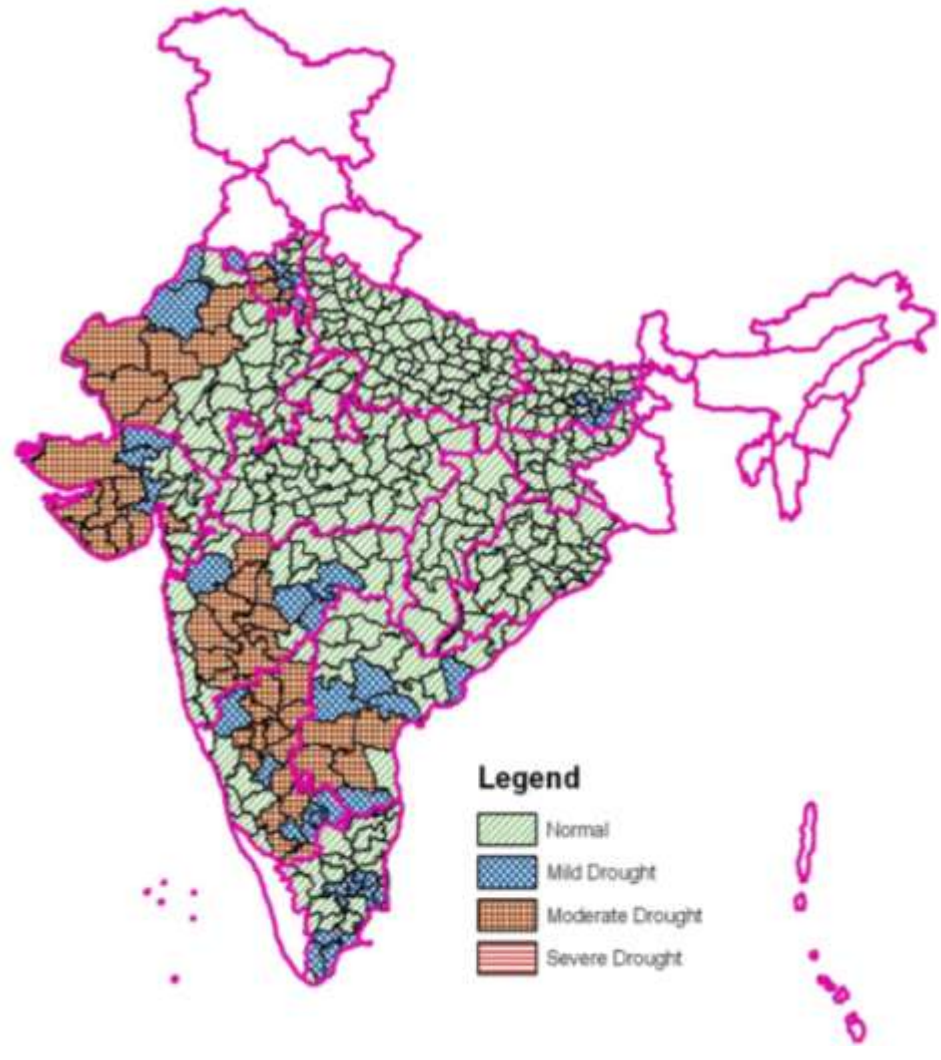
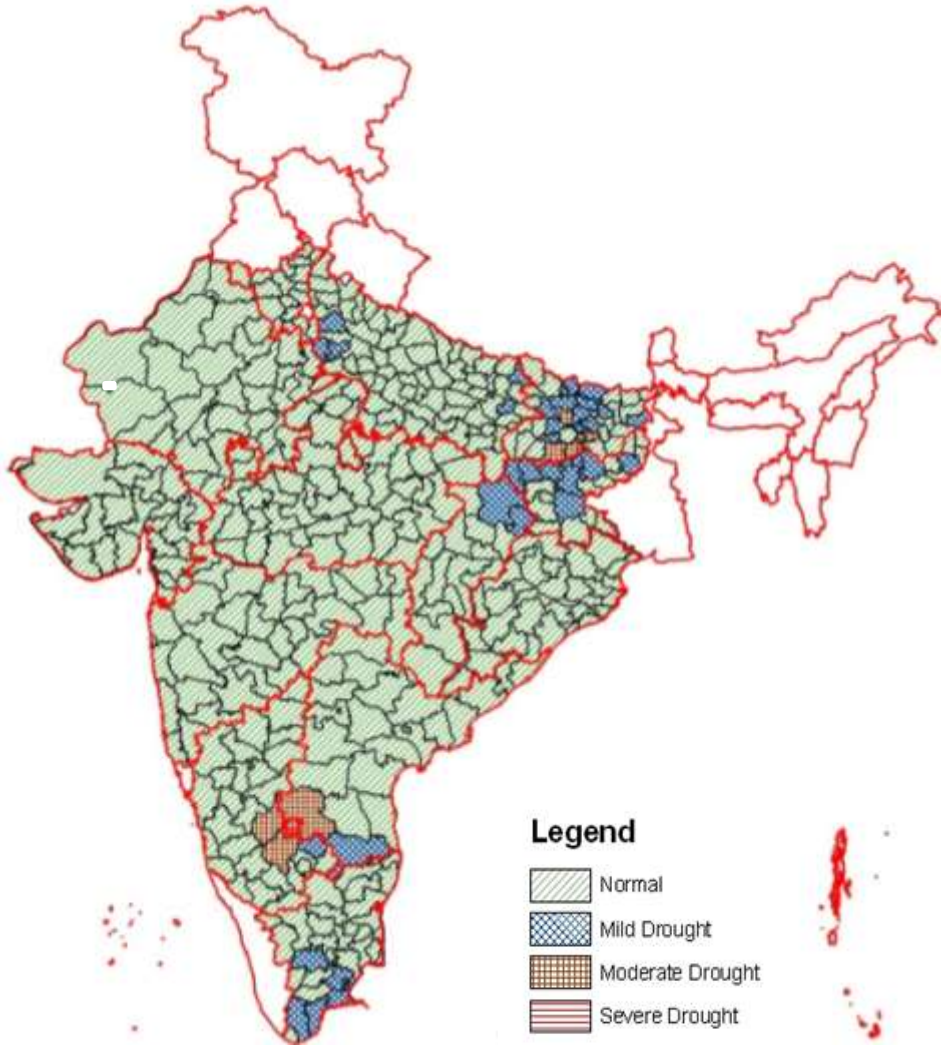
NDVI Profiles



Agricultural Drought Assessment

October 2013

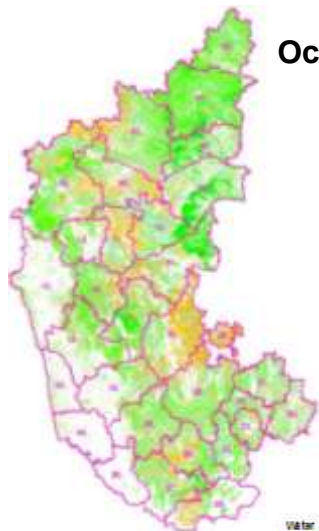
October 2012





Agricultural Drought Assessment - Karnataka

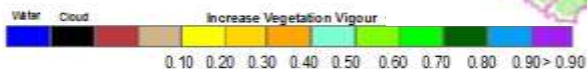
Resourcesat-2 AWiFS based Normalized Difference Vegetation index



October 2013



October 2008



Rainfall up to 30/10/13



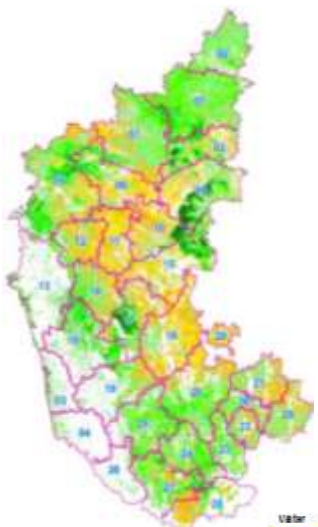
(Source: www.imd.gov.in)

Legend

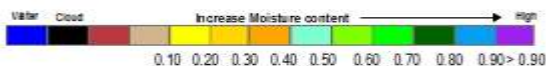
- EXCESS (+20% OR MORE)
- NORMAL (+19% TO -19%)
- DEFICIENT2 (-40% TO -59%)
- DEFICIENT1 (-20% TO -39%)
- SCANTY (-60% TO -99%)
- NO RAIN (-100%)
- NO DATA

October 2013

MODIS based Normalized Difference Water index



October 2010



- | | |
|---------------------|--------------------|
| 01.GULBARGA | 16.CHITRADURGA |
| 02.YADGIR | 17.DAVANGERE |
| 03.UDUPI | 18.SHIMOGA |
| 04.DAKSHINA KANNADA | 19.CHIKIMAGALUR |
| 05.BELGAUM | 20.TUMKUR |
| 06.BAGALKOTE | 21.CHIKABALLAPUR |
| 07.BIJAPUR | 22.BANGALORE URBAN |
| 08.BIDAR | 23.RAMANAGARAM |
| 09.RAICHUR | 24.MANDYA |
| 10.KOPPAL | 25.HASSAN |
| 11.GADAG | 26.KODAGU |
| 12.DHARWAD | 27.MYSORE |
| 13.UTTARA KANNADA | 28.CHAMARAJA NAGAR |
| 14.HAVERI | 29.KOLAR |
| 15.BELLARY | 30.BANGALORE RURAL |

Agricultural drought assessment – October



Legend

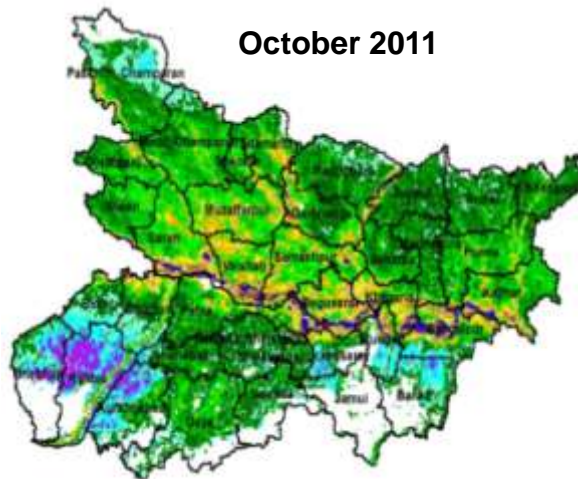
- Normal
- Mild Drought
- Moderate Drought

Agricultural Drought Assessment - Bihar, 2013

AVHRR based Normalized Difference Vegetation index



October 2013

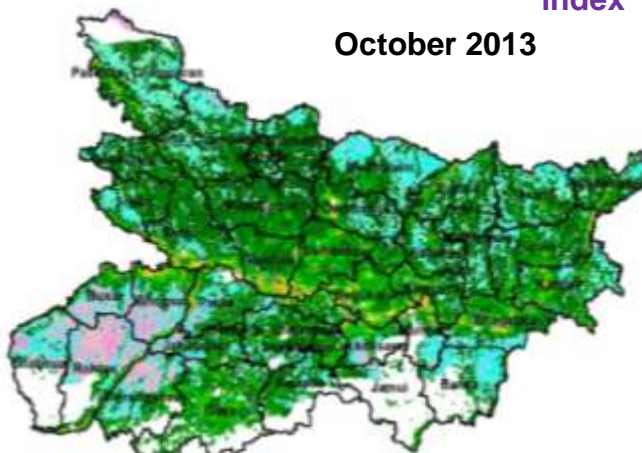


October 2011

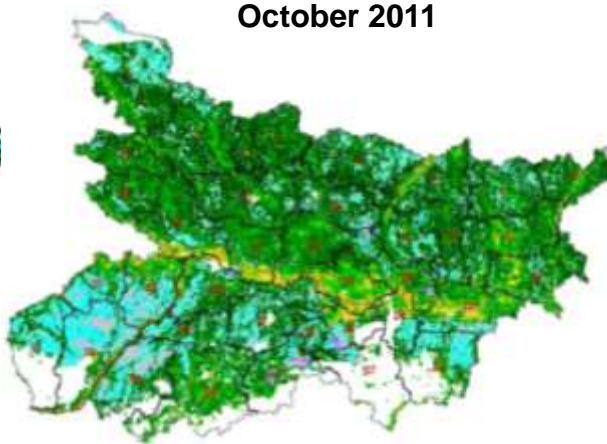


Forest Area

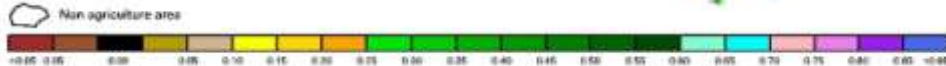
MODIS based Normalized Difference Water index



October 2013



October 2011



Non agriculture areas

Rainfall upto 30/10/13

(Source: www.imd.gov.in)



Legend

- EXCESS (+20% OR MORE)
- NORMAL (+19% TO -19%)
- DEFICIENT1 (-20% TO -39%)
- DEFICIENT2 (-40% TO -59%)
- SCANTY (-60% TO -99%)
- NO RAIN (-100%)
- NO DATA

Agricultural drought assessment – October 2013

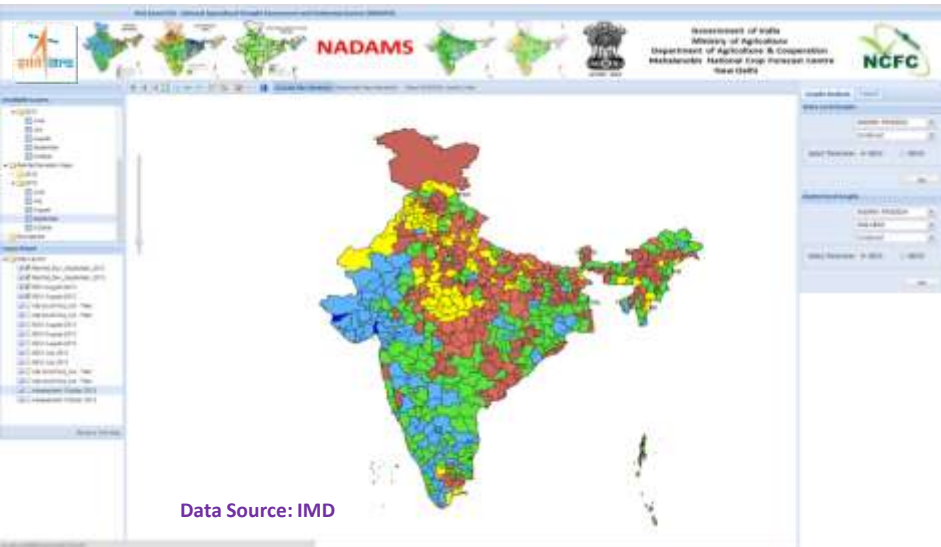
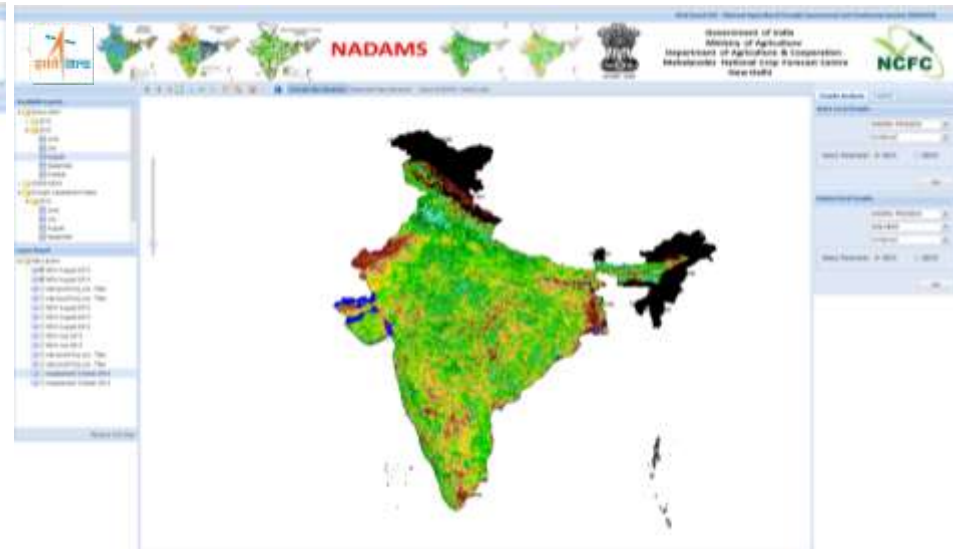
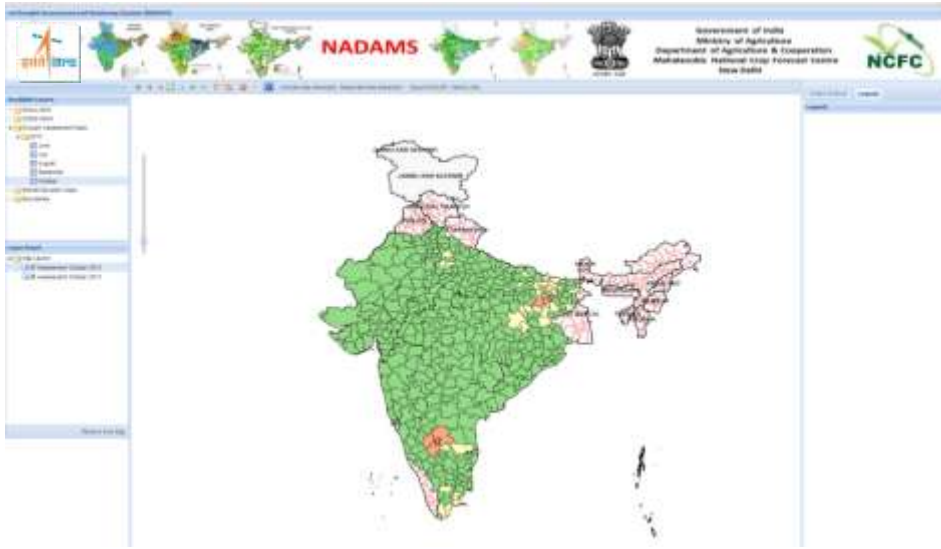


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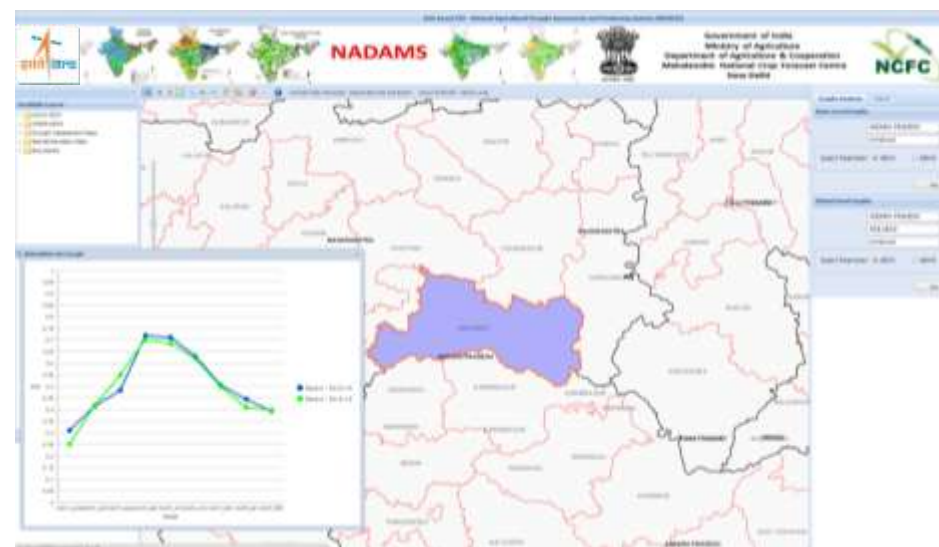
- Normal
- Mild Drought
- Moderate Drought
- Severe Drought



Towards a Drought Portal



Data Source: IMD

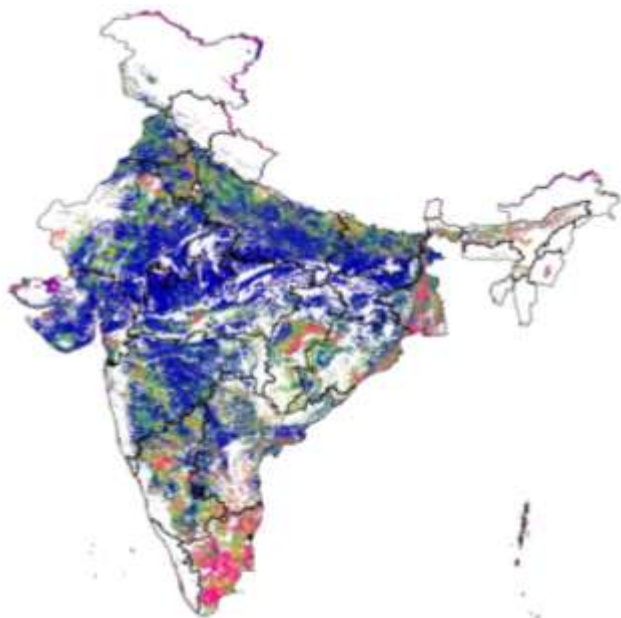


Agricultural Condition (February 2014)

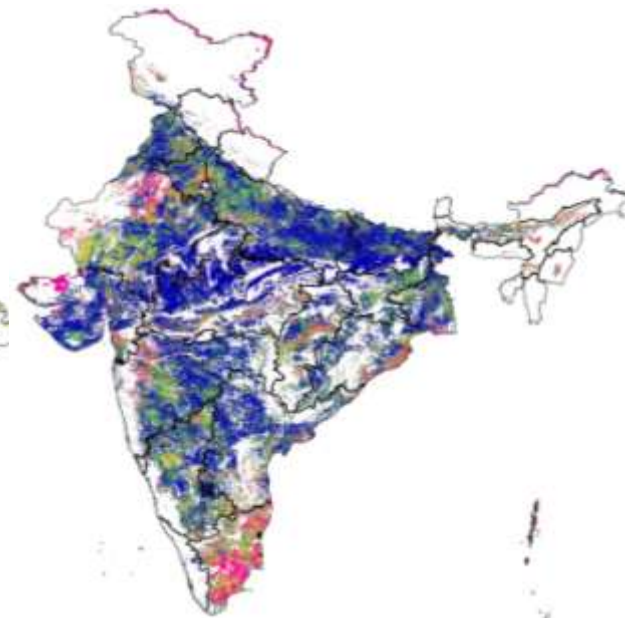
Vegetation & Temperature Condition Index

- Vegetation Condition Index(NDVI) = $100 * (NDVI - NDVI_{min}) / (NDVI_{max} - NDVI_{min})$
- Vegetation Condition Index(NDWI) = $100 * (NDWI - NDWI_{min}) / (NDWI_{max} - NDWI_{min})$
- Temperature Condition Index = $100 * (LST_{max} - LST) / (LST_{max} - LST_{min})$

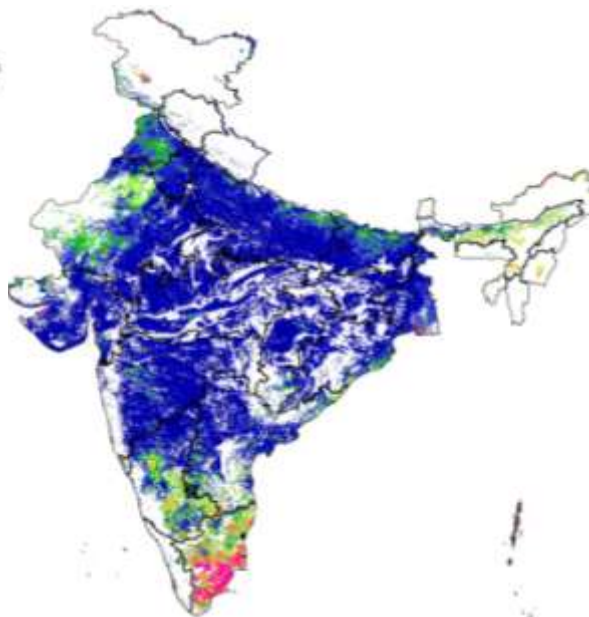
VCI (NDVI) February 2014



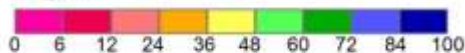
VCI (NDWI) February 2014



TCI February 2014

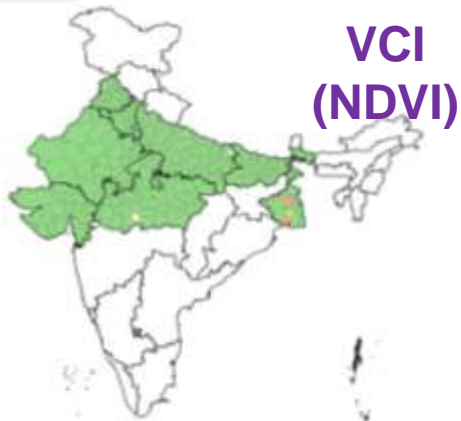


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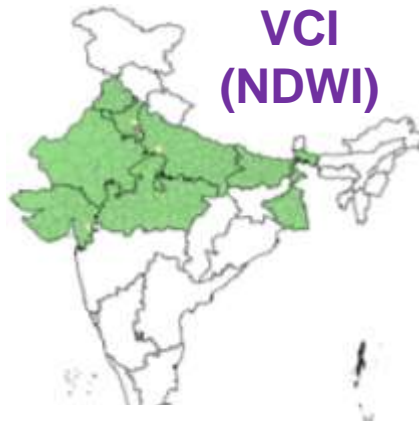


District-level Crop Alert (February 2014)



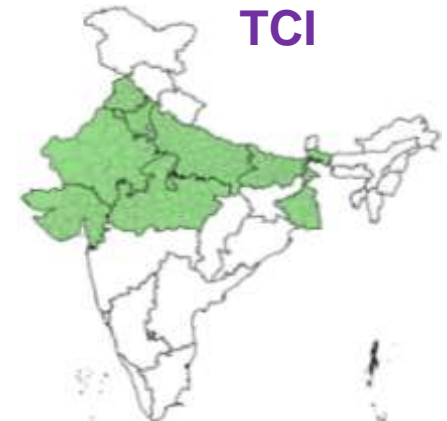
Legend

Normal	VCI > 40
Watch	20 < VCI < 40
Alert	VCI < 20



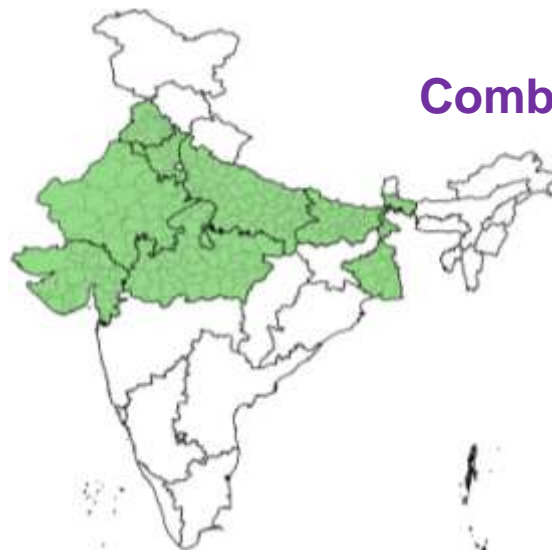
Legend

Normal	VCI > 40
Watch	20 < VCI < 40
Alert	VCI < 20



Legend

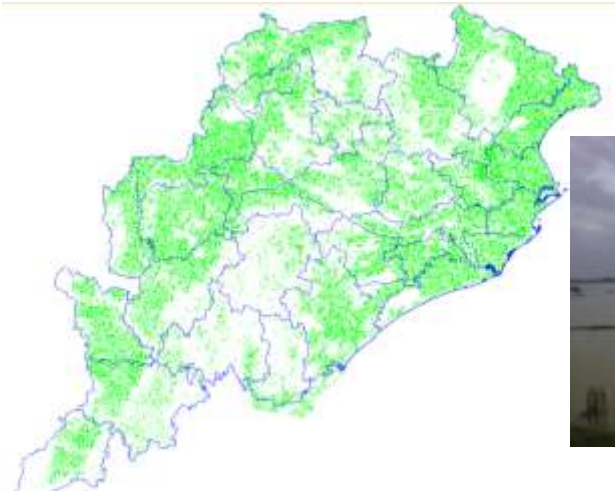
Normal	TCI > 40
Watch	20 < TCI < 40
Alert	TCI < 20



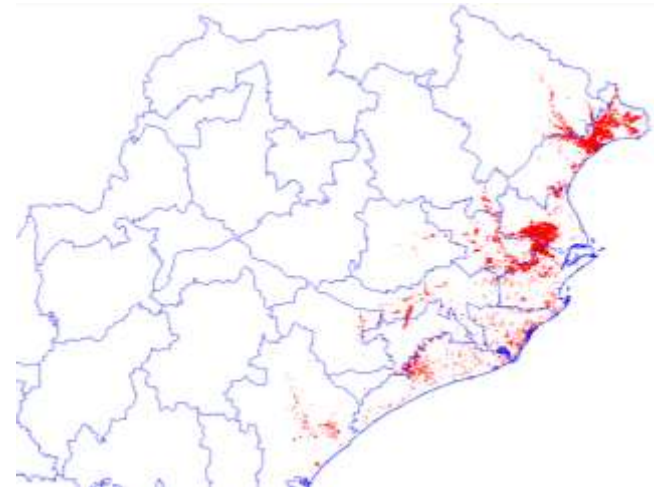
Legend

Normal	
Watch	
Alert	

Odisha Rice-Flood Assessment



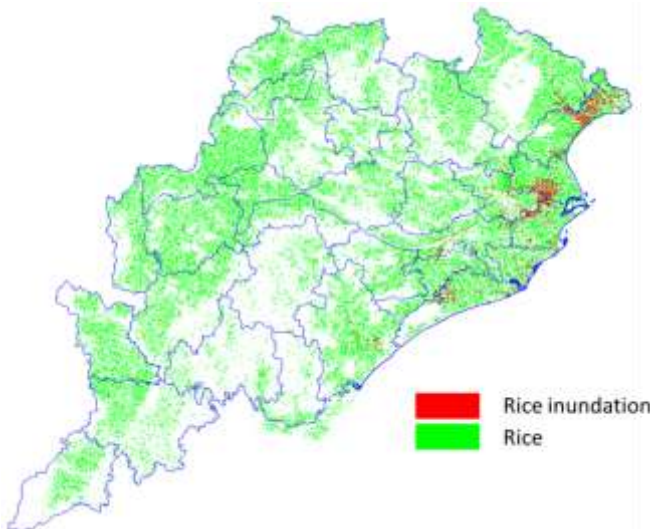
(Rice Map of Odisha from RISAT Data)



(Flood Map of Odisha, upto 17th Oct., ISRO)

An Estimate of District wise Rice Inundation Area (Assessment Upto 17th October, 2013)

District	Rice Inundation Area (ha)
Baleshwar	35791
Bhadrak	20498
Jajpur	16130
Kendrapara	15790
Puri	11315
Cuttack	7176
Jagatsinghpur	7149
Mayurbhanj	6844
Ganjam	4634
Khordha	4119
Nayagarh	1249
Keonjhar	1000
Dhenkanal	682
Others	20
Total	132398



(Rice Flooded Map of Odisha , upto 17th Oct.)

Gap Areas/Requirements

- **Early Warning.**
- **Assessment at higher spatial and better temporal scale.**
- **Comprehensive Drought Monitor.**
- **Quantitative Impact Assessment.**



Parameter Requirement

- Rainfall
- Soil Moisture
- NDVI
- NDWI
- LST
- Vegetation Fraction
- Evapo-transpiration
- Depth and Period of inundation

(All these as Real-time, Calibrated, Long-term products)

Observation Requirement

- Higher frequency of observations (Optical)
 - ~50 m at 1-2 day interval
 - ~250 m daily
 - ~10 m at 10 day Interval
- SAR (15-20 m) at 5-10 day interval
- Observations in Passive Microwave and Thermal: Daily at low resolutions
- *Case for a Disaster Management Constellation? Scope for Small Satellites?*



Thank you.

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