Drought Monitoring in India

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Operational Programmes for Agricultural Assessment

FASAL

- Crop Forecasting
- 8 Major Crops
- District/State/National Level
- SAR & Optical Data

NADAMS

- Drought Assessment
- District/Sub-District Level
- Multiple Satellite Data
- Weather, Crop, Soil Moisture Inputs

CHAMAN

- Horticultural Crops
- 7 Crops in 185 Districts
- Horticultural Developmental Plans
- Precision Farming

KISAN

- Technology for Crop Insurance
- High Resolution Data
- CCE Planning and optimization
- UAVs fro Loss Assessment

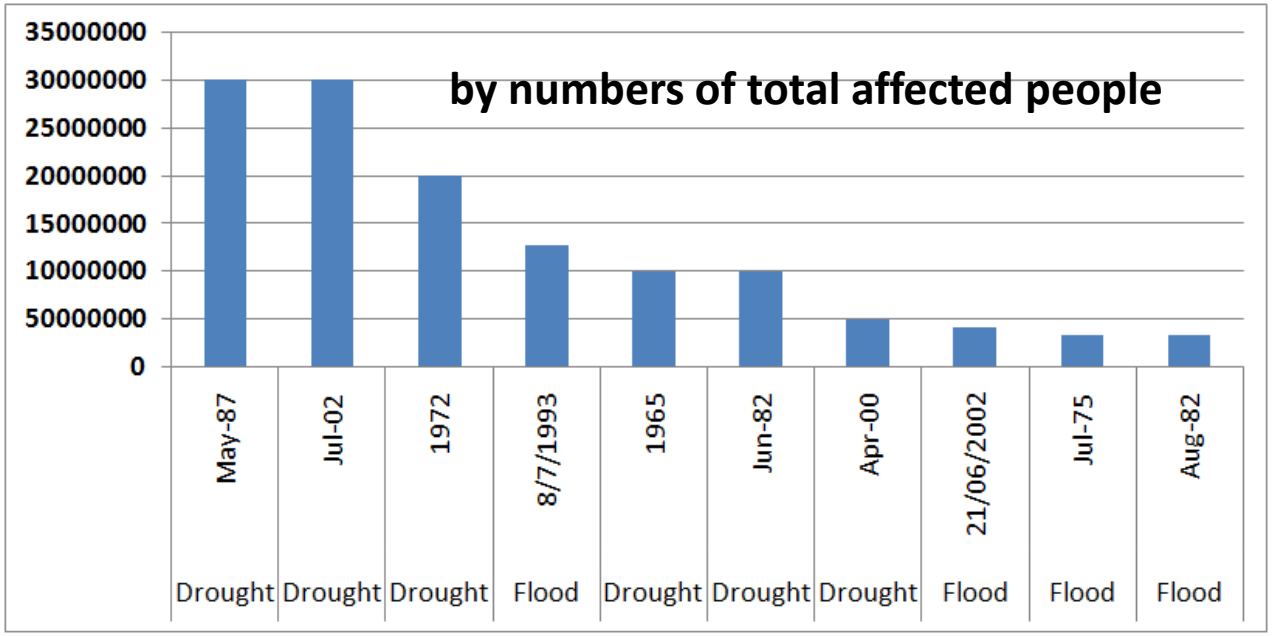
Crop Intensification

- Suitability for Pulses in Post Kharif-Rice Fallow Areas
- 6 Eastern Indian States
- Village level priority assessment for implementation

Droughts in India

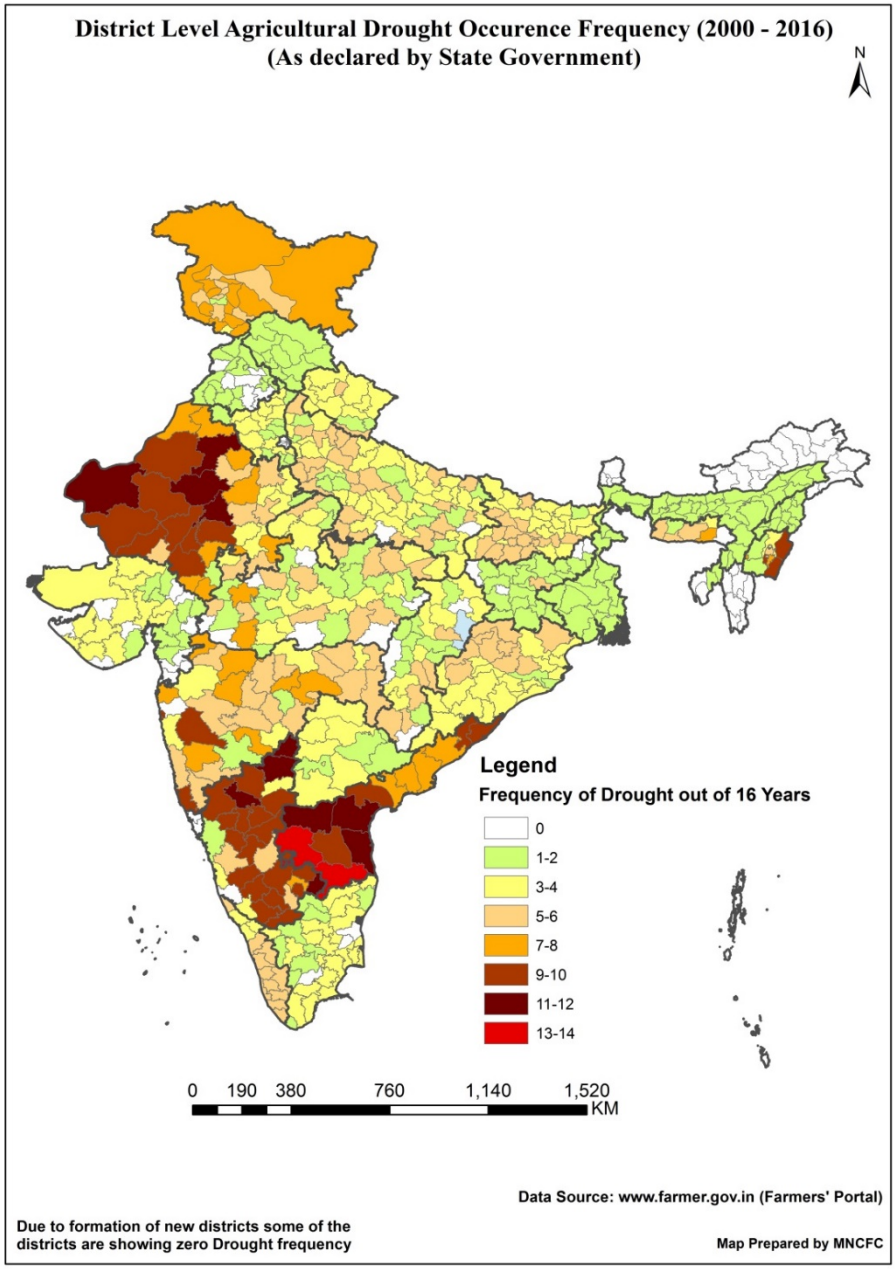
- During 1871–2017, there were 25 major drought years, defined as years with All India Summer Monsoon Rainfall (AISMR) less than one standard deviation below the mean (i.e. anomaly below –10 percent): 1873, 1877, 1899, 1901, 1904, 1905, 1911, 1918, 1920, 1941, 1951, 1965, 1966, 1968, 1972, 1974, 1979, 1982, 1985, 1986, 1987, 2002, 2009, 2014 and 2015. (Source: Drought Manual)

Top 10 Disasters of India (for the period 1900 to 2017)

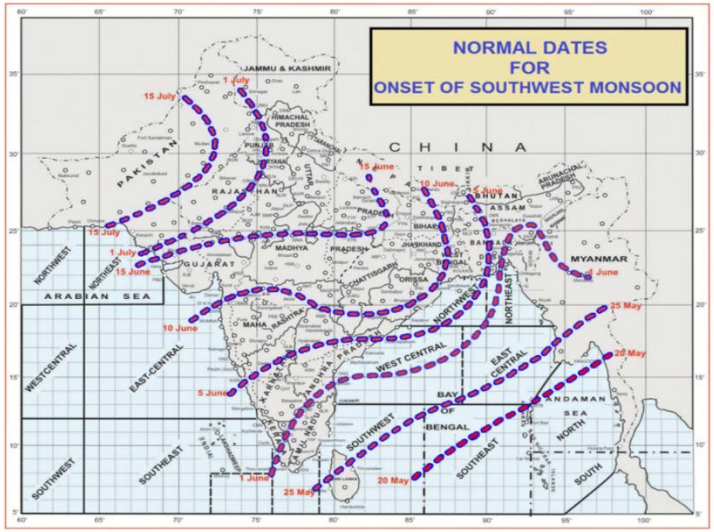


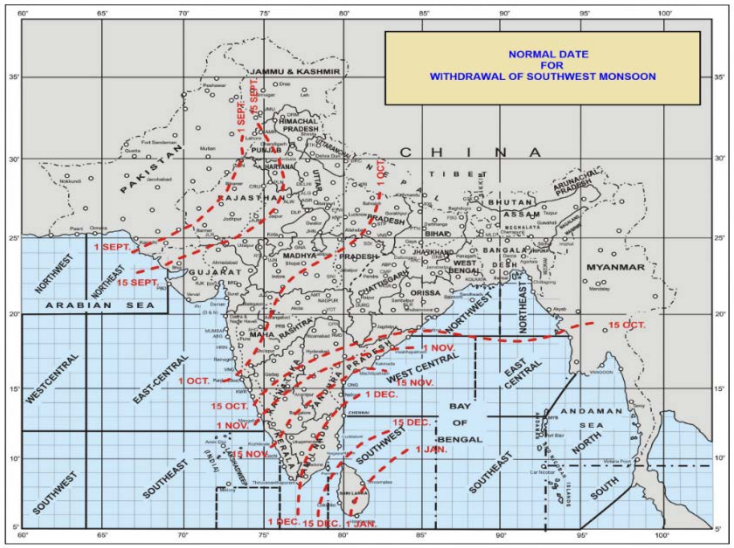
(Source: "EM-DAT: The OFDA/CRED International Disaster Database)

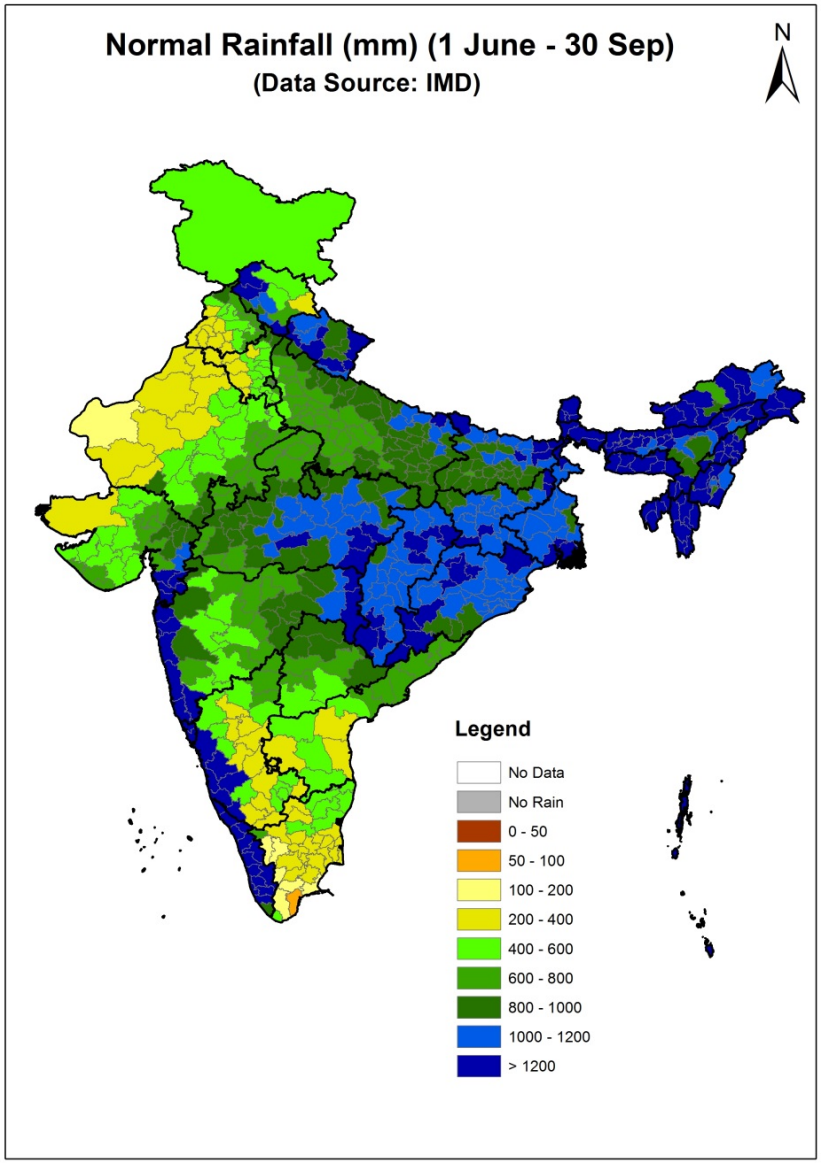
Drought Occurrence Frequency



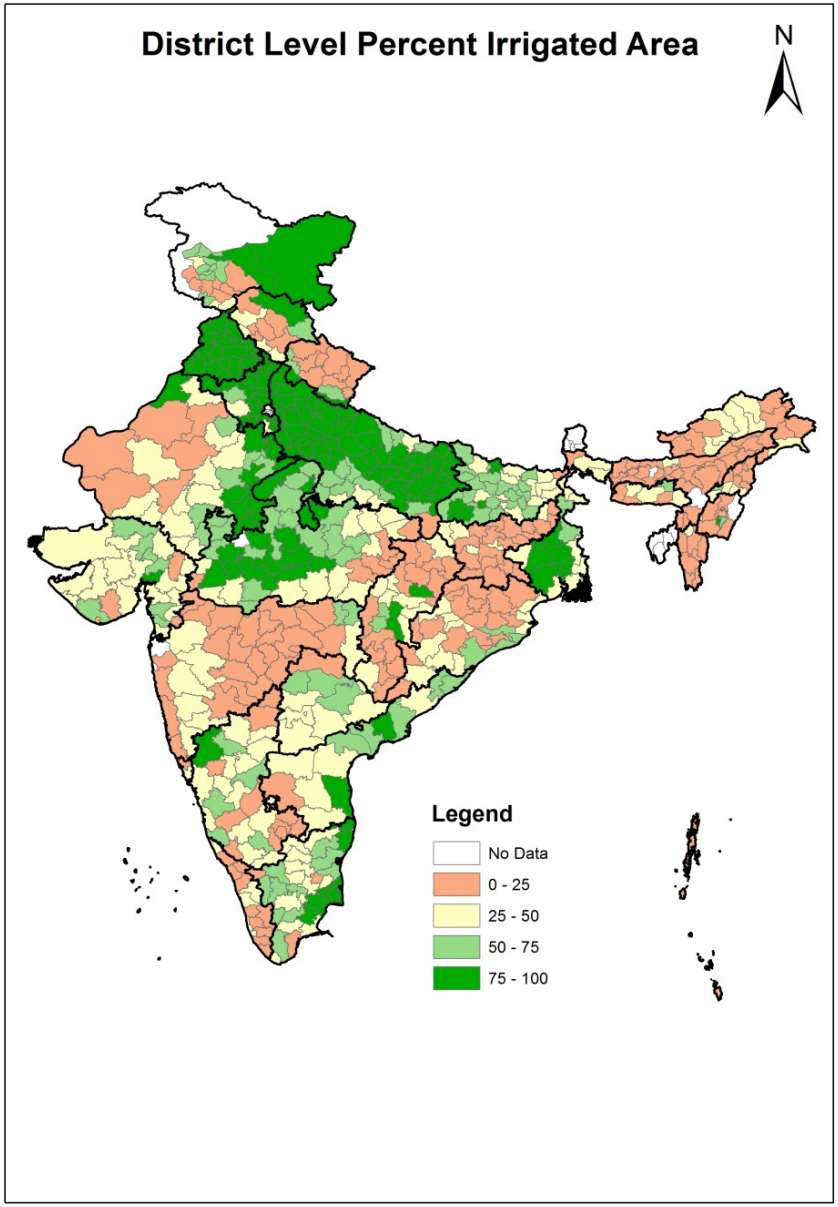
Rainfall Pattern







Irrigation Availability



Central Agencies involved with Drought Monitoring/Management in India

Ministry of Agriculture & Farmers' Welfare

- Overall coordination, Inter-Ministerial Crop Weather Watch Group (CWWG), Leading IMCT for Drought Assessment

India Meteorological Department

- Weather Forecasting, Rainfall Data

Central Water Commission

- Monitoring Storage situation in Major Reservoirs

DAC&FW (MNCFC) and ISRO

- Space technology based drought assessment (NADAMS)

ICAR- CRIDA

- Contingency planning

DOLR/ MOWR/DAC&FW

- PMKSY-Watershed Development-Water Harv. Str. /Irrigation/Water Use efficiency

National Institute of Disaster Management

- Capacity Building

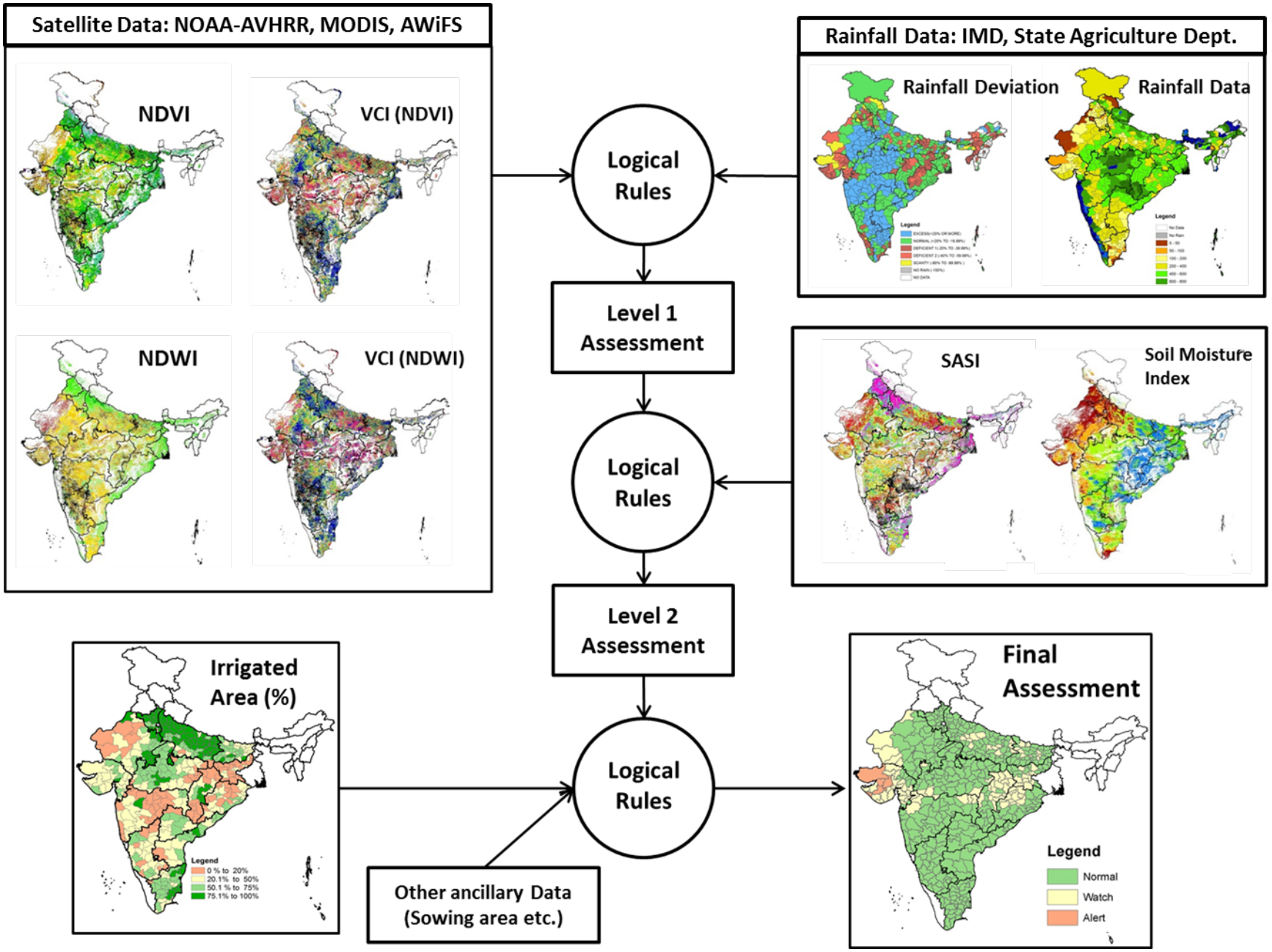
Crop Weather Watch Group

Members	Tasks
Additional Secretary, DAC&FW & Central Drought Relief Commissioner	Chairperson of the Group: overall coordination
Economics & Statistical Advisor, DAC&FW	Report behavior of agro-climatic and market indicators
Agriculture Commissioner	Crop conditions: Availability of Inputs; Contingency Planning
Animal Husbandry Commissioner	Livestock health; Fodder availability
India Meteorological Department	Rainfall forecast and monsoon conditions.
Central Water Commission & Central Ground Water Board	Monitoring data on Important reservoirs / groundwater.
Crop specialists	Report on crop conditions.
Ministry of Power	Availability of power
Indian Council of Agricultural Research	Technical input and contingency planning
National Centre for Medium Range Weather Forecasting	Provide medium-term forecasts
Mahalanobis National Crop Forecast Centre	Agricultural Drought Information

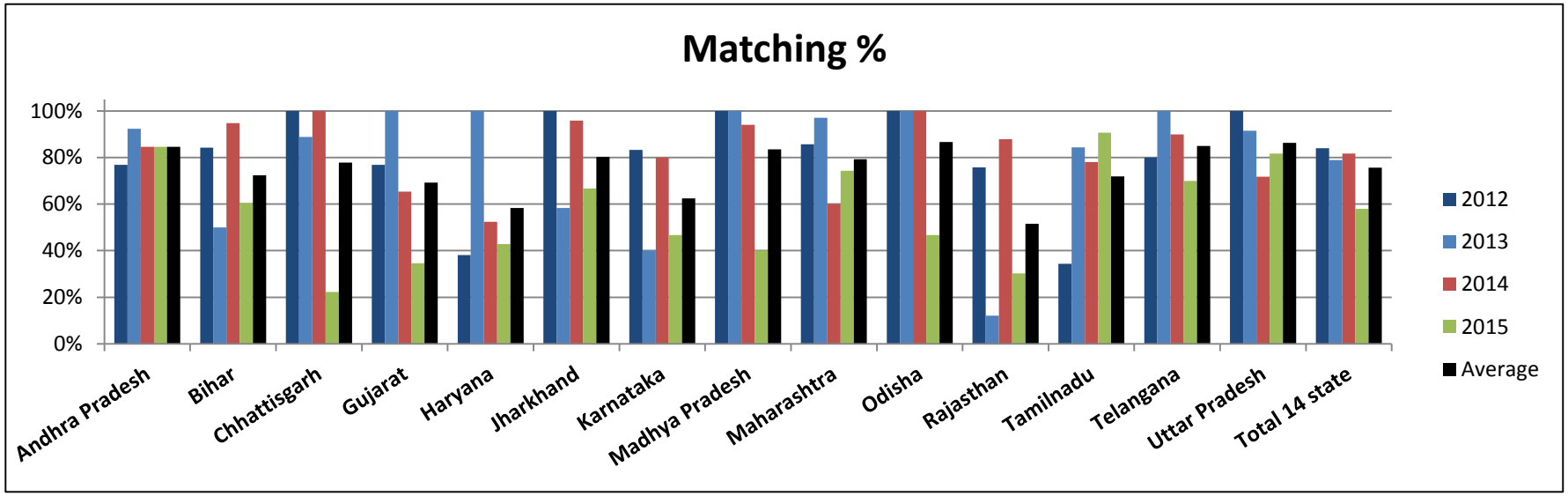
National Agricultural Drought Assessment & Monitoring System (NADAMS)

- *Operational Drought assessment during Kharif using Remote Sensing (Methodology developed by ISRO).*
- *Monthly/fortnightly District/Sub-District level drought assessment for 14 Agriculturally Dominant states of India (6 at Sub District level).*
- *Satellite based indices, Rainfall data, Soil moisture, Ground information on Sowing progression and Irrigation Statistics are used for drought assessment.*
- *Drought Warning (Normal, Watch & Alert) is given in June July & August, while Drought Assessment (Mild, Moderate & Severe) in September & October.*
- *Many states, proactively, use NADAMS assessments for support in Drought Declaration.*

Drought Assessment



Matching between State Declarations and Satellite based Drought Assessment

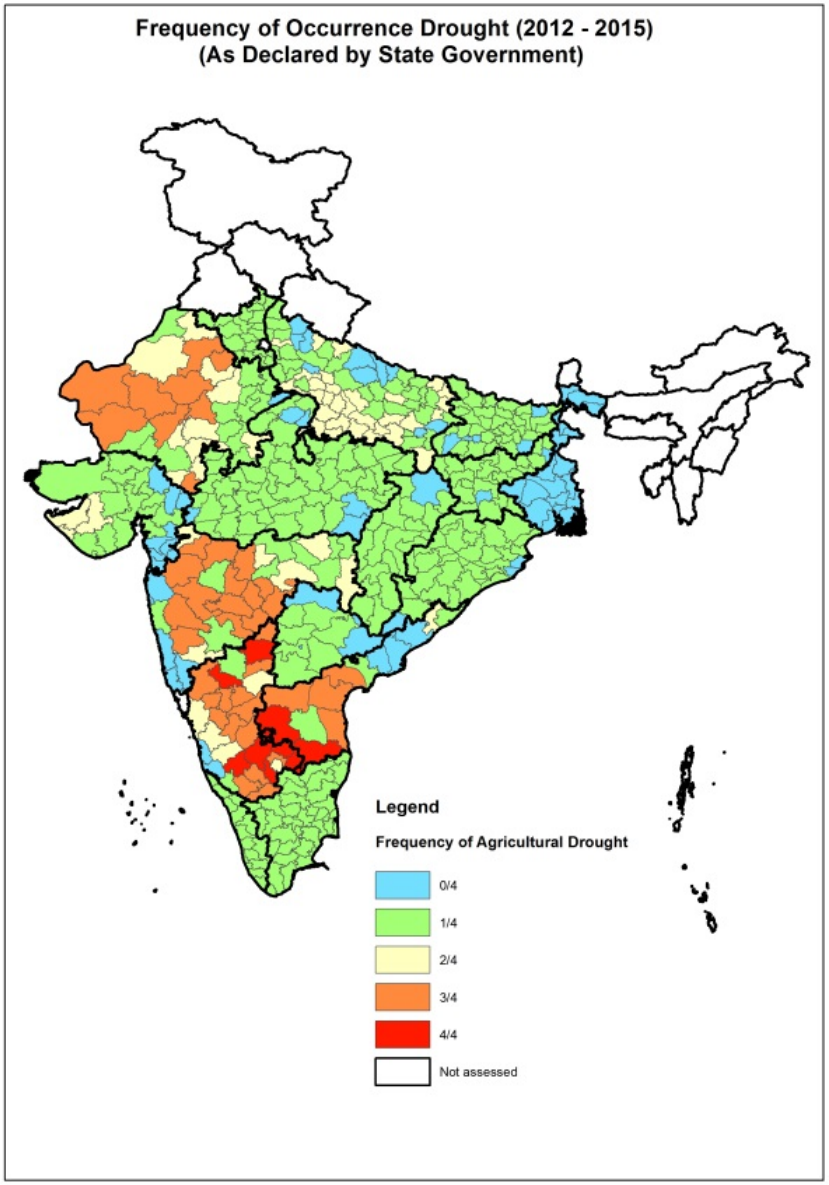


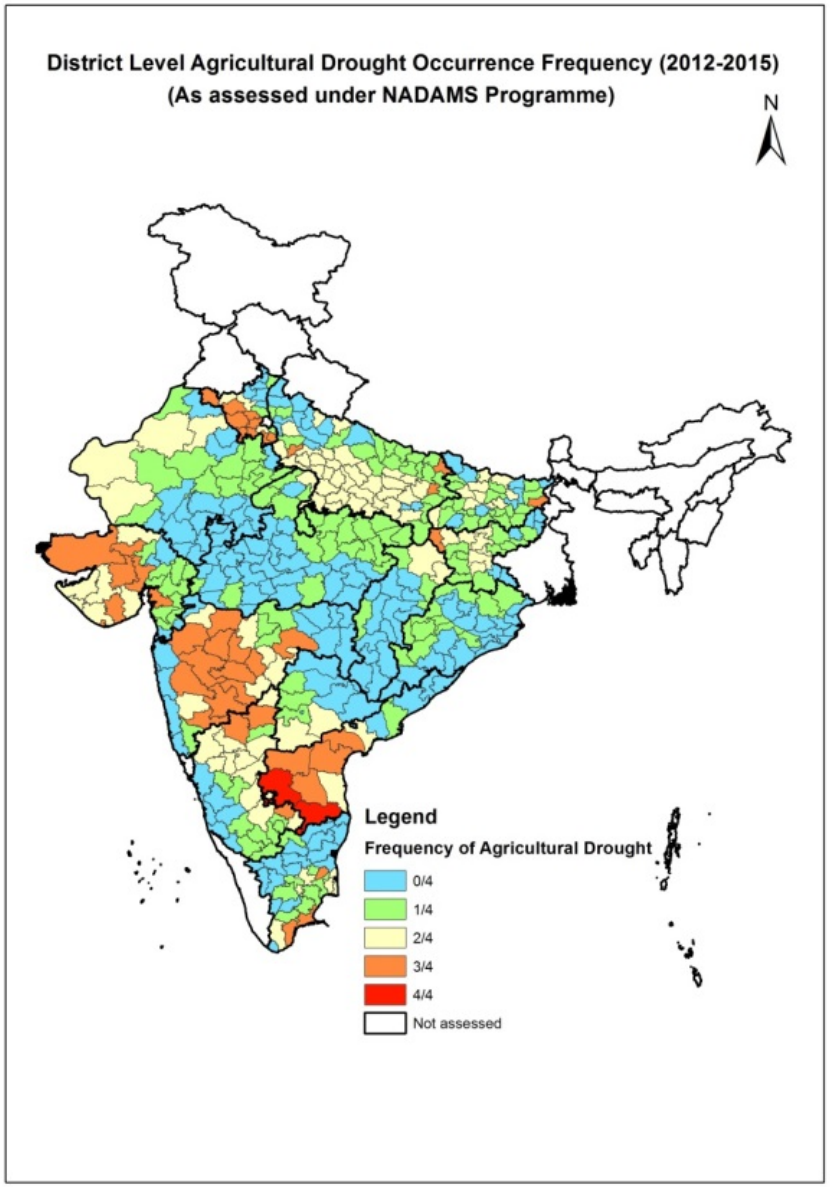
Matching %	No. of Cases
< 50 %	**11 (19.6%)**
50 % -60 %	**4 (7%)**
60 % -70 %	**4 (7%)**
70 %- 80 %	**7 (12.5%)**
80 % -90 %	**11 (19.6%)**
90 % -100 %	**19 (33.9%)**
Total	**56**

Total 14 States , 4 years = 56 Cases

In >66% cases, there is >70% matching

Drought Frequency Maps Comparison





Recognition of NDVI by Supreme Court of India

64. The third and fourth key indicators are NDVI and MAI. In this regard, our attention was invited to a few pages of a monthly Report of

Agricultural Drought Assessment for Bihar for the month of August, 2015. The Report is prepared by the Mahalanobis National Crop Forecast Centre under the Ministry of Agriculture and Farmers Welfare. Reference was made to the NDVI and the Normalized Difference Water Index (NDWI).[24] The Report indicates that till August 2015 the vegetation condition is good in the entire State except in a few districts that is between 0.61 and 0.52 (which is better than in the previous three years).

(Source: Supreme Court WRIT PETITION (CIVIL) NO. 857 OF 2015)

Parameters for Drought Declaration

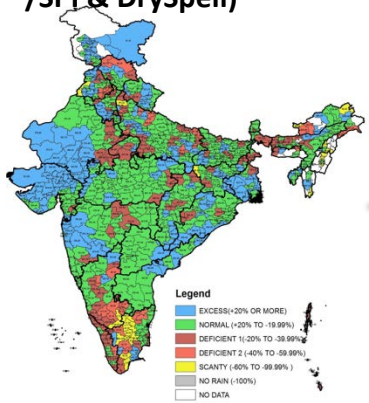
(Drought Manual, 2016)

Levels	Category	Parameters
Trigger 1 (Cause)	Rainfall Based	1. RF Deviation or SPI 2. Dry Spell
Trigger 2 (Impact)	1. Remote Sensing 2. Crop Situation 3. Soil Moisture 4. Hydrological	1. NDVI & NDWI Deviation or VCI 2. Area under sowing 3. PASM or MAI 4. RSI/GWDI/SFDI
Verification	Field Data	GT in 5 sites, each, of 10% of Villages

RF – Rainfall
SPI – Standardized Precipitation Index
NDVI – Normalized Difference Vegetation Index
NDWI –Normalized Difference Wetness Index
PASM – Plant Available Soil Moisture
MAI – Moisture Adequacy Index
RSI – Reservoir Storage Index
GWDI – Ground Water Drought Index
SFDI – Stream Flow Drought Index
GT – Ground Truth

Drought Assessment as per New Drought Manual 2016

Rainfall Data (RFDev /SPI & DrySpell)



Drought Trigger 1

No

Drought Assessment

No Drought

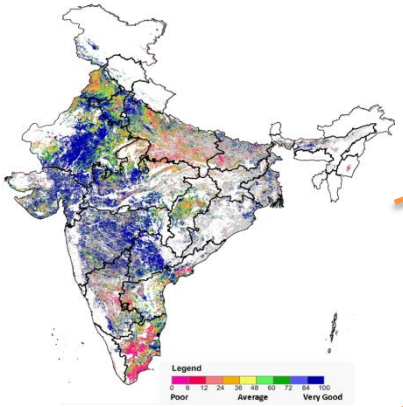
Yes

Socio-Economic Indicators.

Drought Assessment

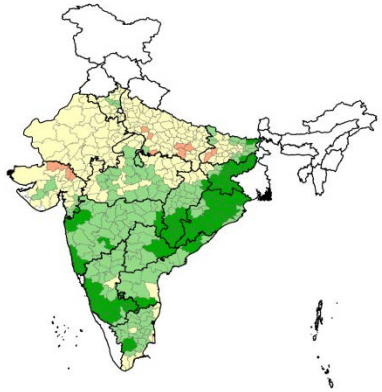
Drought Category (Severe, Moderate, Normal)

Remote Sensing Data

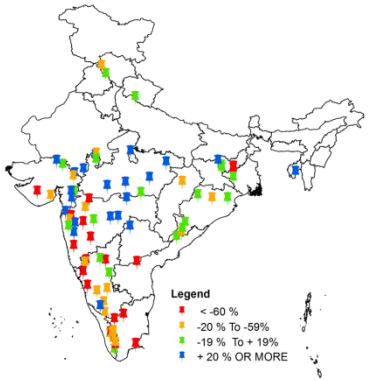


Asses any 3 impact indicators

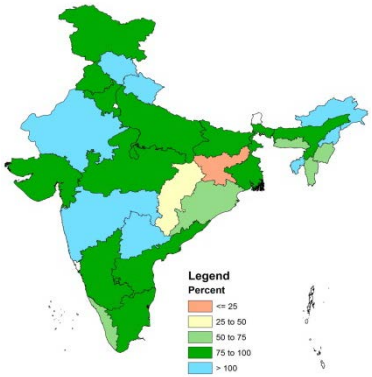
Soil Moisture



Hydrological data



Crop Sown Area



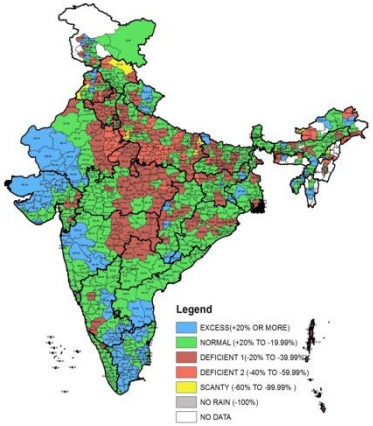
Drought Trigger 2

Yes

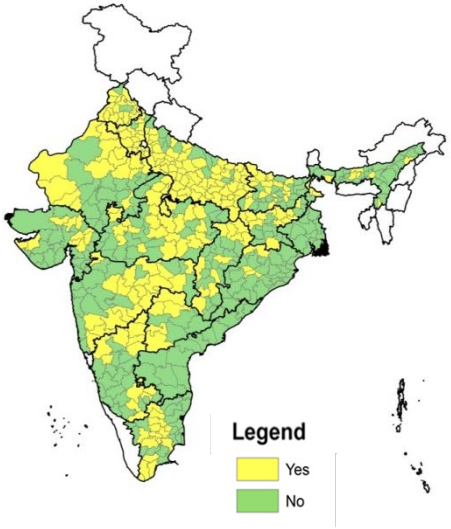
Ground Truthing

Drought Indicator Assessment during Kharif, 2017

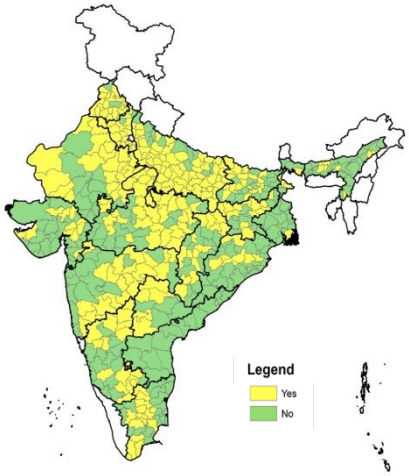
Rainfall deviation



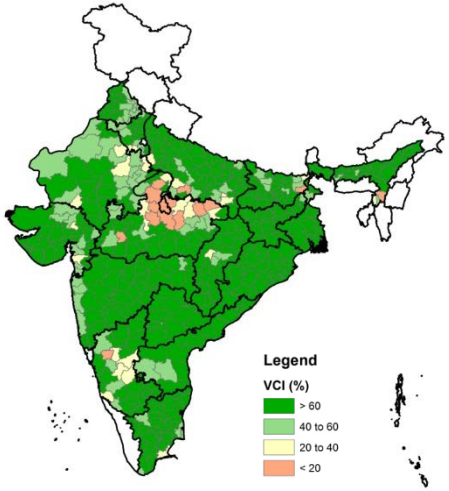
Dry Spell



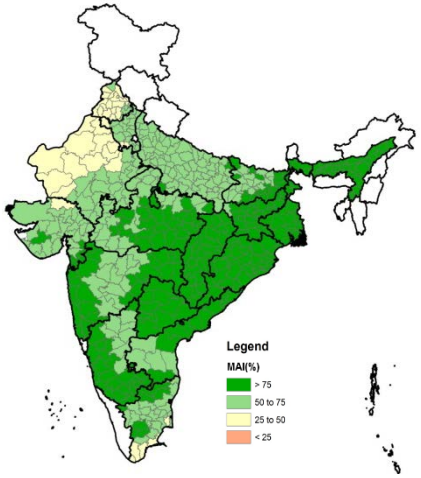
Trigger 1



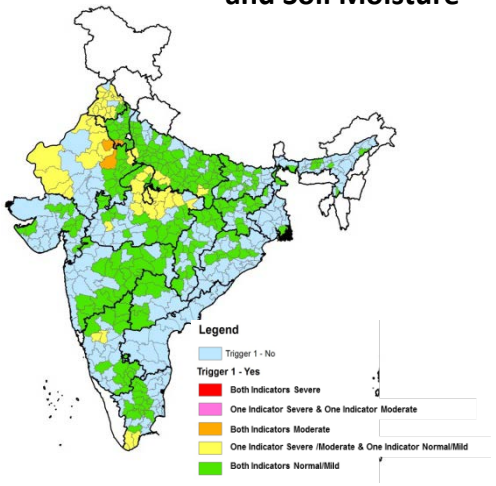
VCI



MAI



Drought Indicator Assessment based on Rainfall, Remote Sensing based and Soil Moisture



Issues

- Getting Cloud free data is a major problem
- Need for long-term, high resolution satellite data for sub district level drought assessment.
- Low vegetation index may not be always due to water stress.
- Crop phenology plays a strong role in VI deviations
- VCI may be affected by cropping pattern change.
- Satellite based soil moisture is of low resolution. Represents mostly surface soil. Affected by vegetation.
- Problems for areas with more non-agriculture vegetation, hilly regions, etc.
- Assessing the effect of consecutive drought is a challenge
- Similarly, Rabi season drought assessment is another difficult issue.

Needs

- Monitoring at dis-aggregated level (Block/GP)
- Early Warning of Droughts
- Composite Indicator: *Integrated, Implementable, Acceptable*
- Vulnerability Assessment – *towards drought mitigation*
- Rabi season drought assessment
- Assessment Climate Change Impacts vis-à-vis drought vulnerability

Satellite Data Requirements

- VNIR-SWIR Data at 50-100 m resolution with daily repeativity
- Thermal data, 100-200 m resolution, with daily repeativity
- Satellite derived soil moisture (combination of passive and active microwave data), 1-2 km resolution, daily/alternate day
- Development of VI products: corrected, long-term, calibrated and real-time with moderate resolution

Conclusions

- Proper assessment, monitoring and early warning of drought is essential, considering its large scale impact, especially for the agrarian economy of India
- Due to complexity nature of drought, multiple parameters need to be used to assess drought.
- Satellite data provides very significant information about drought assessment. It also has been recognized, by the Government, as one of the key parameters for drought assessment.
- There is need for, at least, moderate resolution data with high repeativity in optical (VNIR, SWIR), thermal and microwave (active + passive) domain.

THANK YOU

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