Operational Agricultural Drought Assessment

Government of India
Ministry of Agriculture & Farmers’ Welfare
Department of Agriculture, Cooperation & Farmers’ Welfare
Mahalanobis National Crop Forecast Centre, New Delhi

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Indian Agriculture

Net Area Sown: 141.6 Mha (43%)

Foodgrain production: 252 Mt
- (Kharif: 128 Mt, Rabi: 124 Mt)

Horticulture Production: 281 Mt

Net Irrigated Area: 65.3 Mha (46.4%)

Agrl. Share of GDP(%): 13.9

Employment Opportunity: 54.6%

Average Field size: 1.15 ha
Drought Occurrence Frequency
**Central Agencies involved with Drought Monitoring/ Management in India**

<table>
<thead>
<tr>
<th>Agency</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministry of Agriculture &amp; Farmers’ Welfare</td>
<td>Overall coordination, Inter-Ministerial Crop Weather Watch Group, Leading IMCT for Drought Assessment</td>
</tr>
<tr>
<td>India Meteorological Department</td>
<td>Weather Forecasting, Rainfall Data</td>
</tr>
<tr>
<td>MoWR, RD&amp;GR (CWC, CGWB)</td>
<td>Monitoring Reservoirs and Ground water situation</td>
</tr>
<tr>
<td>Indian Space Research Organization</td>
<td>Space based inputs</td>
</tr>
<tr>
<td>ICAR - CRIDA</td>
<td>Contingency planning</td>
</tr>
<tr>
<td>DOLR/ MOWR/DAC&amp;FW</td>
<td>Agricultural Drought Monitoring: NADAMS Mahalanobis National Crop Forecast Centre, DAC&amp;FW</td>
</tr>
<tr>
<td>Mahalanobis National Crop Forecast Centre, DAC&amp;FW</td>
<td></td>
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</table>
# Crop Weather Watch Group

<table>
<thead>
<tr>
<th>Partners</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Secretary, DAC&amp;FW &amp; Central Drought Relief Commissioner</td>
<td>Chairperson of the Group: overall coordination</td>
</tr>
<tr>
<td>Economics &amp; Statistical Advisor, DAC&amp;FW</td>
<td>Report behavior of agro-climatic and market indicators</td>
</tr>
<tr>
<td>Agriculture Commissioner</td>
<td>Crop conditions: Availability of Inputs; Contingency Planning</td>
</tr>
<tr>
<td>Animal Husbandry Commissioner</td>
<td>Livestock health; Fodder availability</td>
</tr>
<tr>
<td>India Meteorological Department</td>
<td>Rainfall forecast and monsoon conditions.</td>
</tr>
<tr>
<td>Central Water Commission &amp; Central Ground Water Board</td>
<td>Monitoring data on Important reservoirs / groundwater.</td>
</tr>
<tr>
<td>Ministry of Power</td>
<td>Availability of power</td>
</tr>
<tr>
<td>Indian Council of Agricultural Research</td>
<td>Technical input and contingency planning</td>
</tr>
<tr>
<td>National Centre for Medium Range Weather Forecasting</td>
<td>Provide medium-term forecasts</td>
</tr>
<tr>
<td>Mahalanobis National Crop Forecast Centre</td>
<td>Agricultural Drought Information</td>
</tr>
<tr>
<td>Indian Space Research Organisation</td>
<td>Technical inputs on drought parameters</td>
</tr>
</tbody>
</table>
### Parameters for Drought Declaration
(Drought Manual, 2016)

<table>
<thead>
<tr>
<th>Levels</th>
<th>Category</th>
<th>Parameters</th>
</tr>
</thead>
</table>
| 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
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.
Methodology

- Multi-satellite, Multi-date Data
  - VI Time Composite
  - NDVI/NDWI anomaly Assessment
    - (1) Relative dev.
    - (2) VCI
    - (3) In season change

- Ground Information
  - Irrigation Percentage
  - Rainfall Deviation/SPI
  - Sown area deviation

- Agricultural Situation

- Change in Crop Calendar
- Soil Moisture / SASI
- Reservoir Storage

- Agricultural Condition (June, July, August)
  - Normal
  - Watch
  - Alert
  - Moderate
  - Severe

- Drought Assessment (Sep, Oct)
  - Normal
  - Mild
  - Moderate
  - Severe

- Additional Information
NADAMS: Multi-parameter Integrated Approach

Satellite Data: NOAA-AVHRR, MODIS, AWiFS

- NDVI
- VCI (NDVI)

- NDWI
- VCI (NDWI)

Logical Rules

Level 1 Assessment

Rainfall Data: IMD, State Agriculture Dept.

- Rainfall Deviation
- Rainfall Data

Logical Rules

Level 2 Assessment

- SASI
- Soil Moisture Index

Logical Rules

Final Assessment

- Irrigated Area (%)

Other ancillary Data (Sowing area etc.)

Legend
- Normal
- Watch
- Alert
NADAMS: Drought Assessment, 2016
Taluk level crop condition - Ahmadnagar district
Normal year (2010) and Drought year (2015)

September 2010

Karjat Taluk

Shri Gonda Taluk

September 2015
Crop area affected by agricultural drought situation are showing lower NDVI/NDWI compared to normal, in 2012 Kharif in Maharashtra State.
Agricultural Drought situation in Karnataka, Kharif 2016
Usage of Drought Reports

Many States i.e Andhra Pradesh regularly uses MNCFC’s reports for Drought declaration in the State.
### Matching between State Declarations and NADAMS Assessments

<table>
<thead>
<tr>
<th>State</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andhra Pradesh</td>
<td>77%</td>
<td>92%</td>
<td>85%</td>
<td>85%</td>
<td>85%</td>
</tr>
<tr>
<td>Bihar</td>
<td>84%</td>
<td>50%</td>
<td>95%</td>
<td>61%</td>
<td>72%</td>
</tr>
<tr>
<td>Chhattisgarh</td>
<td>100%</td>
<td>89%</td>
<td>100%</td>
<td>22%</td>
<td>78%</td>
</tr>
<tr>
<td>Gujarat</td>
<td>77%</td>
<td>100%</td>
<td>65%</td>
<td>35%</td>
<td>69%</td>
</tr>
<tr>
<td>Haryana</td>
<td>38%</td>
<td>100%</td>
<td>52%</td>
<td>43%</td>
<td>58%</td>
</tr>
<tr>
<td>Jharkhand</td>
<td>100%</td>
<td>58%</td>
<td>96%</td>
<td>67%</td>
<td>80%</td>
</tr>
<tr>
<td>Karnataka</td>
<td>83%</td>
<td>40%</td>
<td>80%</td>
<td>47%</td>
<td>63%</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>100%</td>
<td>100%</td>
<td>94%</td>
<td>40%</td>
<td>84%</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>86%</td>
<td>97%</td>
<td>60%</td>
<td>74%</td>
<td>79%</td>
</tr>
<tr>
<td>Odisha</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>47%</td>
<td>87%</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>76%</td>
<td>12%</td>
<td>88%</td>
<td>30%</td>
<td>52%</td>
</tr>
<tr>
<td>Tamilnadu</td>
<td>34%</td>
<td>84%</td>
<td>78%</td>
<td>91%</td>
<td>72%</td>
</tr>
<tr>
<td>Telangana</td>
<td>80%</td>
<td>100%</td>
<td>90%</td>
<td>70%</td>
<td>85%</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>100%</td>
<td>92%</td>
<td>72%</td>
<td>82%</td>
<td>86%</td>
</tr>
<tr>
<td><strong>Total 14 state</strong></td>
<td><strong>84%</strong></td>
<td><strong>79%</strong></td>
<td><strong>82%</strong></td>
<td><strong>58%</strong></td>
<td><strong>76%</strong></td>
</tr>
</tbody>
</table>

#### Matching %

<table>
<thead>
<tr>
<th>Matching %</th>
<th>No. of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 50 %</td>
<td>11 (19.6%)</td>
</tr>
<tr>
<td>50 % - 60 %</td>
<td>4 (7%)</td>
</tr>
<tr>
<td>60 % - 70 %</td>
<td>4 (7%)</td>
</tr>
<tr>
<td>70 % - 80 %</td>
<td>7 (12.5%)</td>
</tr>
<tr>
<td>80 % - 90 %</td>
<td>11 (19.6%)</td>
</tr>
<tr>
<td>90 % - 100%</td>
<td>19 (33.9%)</td>
</tr>
</tbody>
</table>

**Total 14 States, 4 years = 56 Cases**
Drought frequency Maps Comparison


District Level Agricultural Drought Occurrence Frequency (2012-2015) (As assessed under NADAMS Programme)

Legend
Frequency of Agricultural Drought
- 0/4
- 1/4
- 2/4
- 3/4
- 4/4
- Not assessed
Though the vegetation condition is very good in Northern and central states, there is temperature stress, thereby affecting overall vegetation health.
Future 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
- Development of products (long-term, calibrated and real-time) for drought monitoring
- Assessment Climate Change Impacts vis-à-vis drought vulnerability