AGRICULTURAL DROUGHT ASSESSMENT REPORT

July 2012
Assessment for 13 States

Mahalanobis National Crop Forecast Centre
Department of Agriculture & Cooperation, New Delhi -110 012

National Remote Sensing Centre, ISRO
Department of Space, Hyderabad – 500 625
Agricultural Drought Assessment is essential for taking appropriate remedial measures for improvement of drought situation. Satellite based remote sensing data has been shown to be highly useful for crop condition assessment and drought monitoring. A very successful project called National Agricultural Drought Assessment and Monitoring System (NADAMS) had been developed by National Remote Sensing Centre (NRSC), ISRO, which envisages use of remote sensing and meteorological data for drought assessment of 13 agricultural important states of India. After the technology was transferred to Mahalanobis National Crop Forecast Centre (MNCFC), Department of Agriculture & Cooperation, this is the second report of national level agricultural drought assessment brought by MNCFC, in collaboration with NRSC. This report assesses agricultural situation of the country for the month of July, 2012.

Composite images of coarse resolution NOAA AVHRR data (1 km) was used for 9 states namely, Bihar, Chhattisgarh, Gujarat, Madhya Pradesh, Jharkhand, Orissa, Rajasthan, Uttar Pradesh and Tamil Nadu, while moderate resolution data from MODIS (250 m) was used for 4 states namely, Andhra Pradesh, Karnataka, Haryana and Maharashtra. Crop condition has been assessed using satellite derived Normalized Difference Vegetation Index (NDVI)/Normalized Difference Water Index (NDWI) images. Shortwave Angle Slope Index (SASI) derived from MODIS data has been used to generate Area Favourable for Crop Sowing (AFCS). These satellite derived products have been integrated with Soil Moisture Index (derived using soil water balance approach) and IMD Rainfall data (rainfall deviation, number of dry weeks) for assessment of drought situation in each district of these 13 states.

During July 2012, deficit or scanty rainfall was recorded in many meteorological subdivisions covering the entire states of Tamil Nadu, Karnataka, Rajasthan, Gujarat, Haryana, Bihar and Jharkhand and in the sub-divisions of Madhya Maharashtra, Marathwada and West UP. Delayed monsoon and continuously deficit rainfall till end of July affected the agricultural situation in all these areas. SASI anomaly in July 2012 indicated a large proportion of the agricultural area (>50%) in dry condition in the current season compared to normal monsoon year of 2011 in the states of Bihar, Gujarat, Haryana, Jharkhand, Uttar Pradesh, Tamil Nadu, Karnataka, Madhya Pradesh and Rajasthan. AFCS revealed low favorable area for crop sowing in Kharif 2012. Out of 108 M ha of potential Kharif area of the country, only 87 M ha has been found to be under favorable area. NDVI, an indicator of agricultural vegetation status, is significantly less than normal in most of the states. Multiple indices indicate significant improvement in parts of Maharashtra, Andhra Pradesh, Orissa, Chhattisgarh, Jharkhand, Uttar Pradesh, Madhya Pradesh and Haryana and continued surface dryness and poor vegetation vigor in as many as 267 districts of the 13 states by the end of July. District-wise analysis in 13 states by the end of July indicated “Normal” agricultural situation in 132 districts. The agricultural situation is categorized as “Watch” in 148 districts and as “Alert” in 119 districts.

This current report presents the state level maps of above indices and the agricultural condition. It also presents, in tabular form, district-wise analysis in 13 states by the end of July.
AGRICULTURAL DROUGHT ASSESSMENT REPORT

July, 2012 All India

1.0 Introduction

'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. Agricultural conditions are monitored at state/district level using daily NOAA AVHRR data for 9 states. AWiFS (Advanced Wide Field Sensor) of Resourcesat 2 (56 m resolution) is used for detailed assessment of agricultural drought at district and sub district level in four states. MODIS 250m, 500m derived NDWI, SASI datasets have also been interpreted to complement the assessment. Fortnightly/monthly report of drought condition is provided to the Government 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.

Agricultural drought assessment with multiple indices as indicated below;

- Shortwave Angle Slope Index (SASI)
- Normalized Difference Wetness Index
- Normalized Difference Vegetation Index
- Soil Moisture Index (derived from soil water balance approach)
- IMD Rainfall data – rainfall deviation, number of dry weeks

The present report is a summary of agricultural situation during July 2012 for 13 states and contains satellite derived vegetation index images, rainfall deviations and assessment of agricultural situation.

2.0 Vegetation Index Image

Among the various vegetation indices that are now available, Normalized Difference Vegetation Index (NDVI) is most widely used for operational drought assessment because of its simplicity in calculation, easiness in interpretation and also its ability to partially compensate for the effects of atmosphere, illumination geometry etc. Normalised Difference Vegetation Index (NDVI) is derived from (NIR - Red/NIR + Red) where NIR and Red are the reflected radiation in visible and near infrared channels. Various colours in the NDVI image - Yellow through Green to Red - indicate increasing vegetation vigour. The legend of colour bars
and the vegetation index values are provided along with the vegetation index image. Water, clouds and snow have higher reflectance in the visible region and consequently NDVI assumes negative values for these features. Bare soil and rocks exhibit similar reflectance in both visible and near IR regions and the index values are near zero. The NDVI values for vegetation generally range from 0.1 to 0.6, the higher index values being associated with greater green leaf area and biomass.

3.0 Spatial Vegetation Status

The agricultural crop condition is monitored based on the NDVI information derived from satellite data. The vegetation index images of the country after overlaying the forest area mask and agricultural vegetation condition map for June 2011 and 2010 are shown in Plates.

After precluding the forest area, district wise average vegetation index statistics are generated. The district wise vegetation status during the current season is assessed based on the seasonal NDVI progression.

4.0 Surface Wetness Indicators

Shortwave Infrared (SWIR) band is sensitive to moisture available in soil as well as in crop canopy. In the beginning of the cropping season, soil back ground is dominant hence SWIR is sensitive to soil moisture in the top 1-2 cm. As the crop progresses, SWIR becomes sensitive to leaf moisture content. SWIR band provides only surface wetness information. When the crop is grown-up, SWIR response is only from canopy and not from the underlying soil. NDWI using SWIR can complement NDVI for drought assessment particularly in the beginning of the cropping season. NDWI is derived as under:

\[ \text{NDWI} = \frac{(\text{NIR} - \text{SWIR})}{(\text{NIR} + \text{SWIR})} \]

where Near Infra Red and SWIR are the reflected energy in these two spectral bands. Higher values of NDWI signify more surface wetness.

5.0 Shortwave Angle Slope Index (SASI)

SASI images were generated using 8-day composites of MODIS 500 m images of NIR, SWIR 1 and SWIR 2 bands. SASI is highly sensitive to rainfall and hence indirectly associated with crop sown area. SASI variations in the season which represent dynamics of surface moisture were used for assessing the Area Favourable for Crop Sowing (AFCS) from time to time. General threshold values of SASI specific to soil texture that indicate favorable situation for crop sowings were identified. Based on SASI thresholds, discrimination of the Area Favourable Crop Sowing (AFCS) was done on weekly basis for each state. The AFCS weekly values are useful to assess the intensity of early season/sowing period agricultural drought.
intensity in terms of timeliness in the commencement of sowings, extent of delay or reduction in crop sowings.

6.0 Soil Moisture Index from Soil Water Balance Model

The soil water balance (SWB) model is a convenient way of estimating the soil moisture over a large area with considerable reliability. A simple book keeping – bucket type – water tight model was developed to derive the top 30 cm profile soil moisture. This model considers the initial root depth of 30 cm throughout the season to capture the soil water scenario for crops sown and germinating during any part of the cropping season. The soil water balance in the upper layer is governed by daily values of rainfall, runoff, evapotranspiration (ET) and drainage to the second layer. When the upper layer saturates in excess of Field Capacity (FC) due to rainfall, the excess water percolates to the lower passive root zone and are instantaneously redistributed in that zone. The excess soil water in the passive zone moves out as deep percolation. Since the upper 30 cm is considered for the soil water assessment the lower limit of soil water is the residual water content of the soil as the upper layer is exposed to the atmosphere and subjected to upward flux due to the direct solar radiation. The climatic, soil and crop parameter are the main inputs for the SWB. The daily near real time TRMM 3B42RT spatial rainfall product and the daily global potential evapotranspiration data are used as the rainfall and climatic input, respectively. The soil information was derived from the 1: 0.5 million scale NBSS&LUP soil map. Since this model does not take into account the irrigation applied from various sources, the results of the model should be considered over rainfed areas alone. The Soil Moisture Index (SMI) derived is defined as the proportion of the difference between the current soil moisture and the permanent wilting point to the field capacity and the permanent wilting point. The index values range from 0 to 100 with 0 indicating extreme dry condition and 100 extreme wet conditions.

7.0 Rainfall Status (Data Source: IMD, New Delhi, www.imd.gov.in)

As per IMD, all India average rainfall upto 01 August 2012, was 374 mm against normal of 462 mm with -19% departures from normal. Although, rainfall has increased from June (108 mm), it remained less than normal. There are 20 meteorological subdivisions that have received either scanty or deficit rainfall. Only 16 meteorological subdivisions have received either normal or more than normal rainfall. In 2011, during the corresponding period, only 10 meteorological subdivisions received either deficit or scanty rainfall and the remaining subdivisions received normal or excess rainfall. Rainfall deviations from normal at district level, for different weeks of June and July were depicted in Plates.
8.0 Highlights of Agricultural Situation – July 2012

- Deficit or scanty rainfall was recorded in many meteorological sub-divisions covering the entire states of Tamil Nadu, Karnataka, Rajasthan, Gujarat, Haryana, Bihar and Jharkhand and in the sub-divisions of Madhya Maharashtra, Marathwada and Western UP. Delayed monsoon and continuously deficit rainfall till end of July affected the agricultural situation in all these areas.

- SASI indicates the intensity of surface dryness/wetness condition. High and positive values of SASI during June and July in many parts of Rajasthan, Gujarat, Karnataka, Haryana, Madhya Pradesh, Bihar and Tamil Nadu indicated persistent surface dryness over agricultural areas. SASI anomaly in July 2012 indicated a large proportion of the agricultural area (>50%) in dry condition in the current season compared to normal monsoon year of 2011 in the states of Bihar, Gujarat, Haryana, Jharkhand, Uttar Pradesh, Tamil Nadu, Karnataka, Madhya Pradesh and Rajasthan. Reduced surface wetness revealed by SASI anomalies resulted from deficit and scanty rains in the current season. SASI derived intense surface dryness in all these states reflects either reduction in crop sown area or poor growth of crops.

- More than 50% of agricultural area in Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Madhya Pradesh, Rajasthan, Tamil Nadu and Uttar Pradesh states showed very large negative deviations from normal NDWI, reflecting the intensity and spread of surface dryness over agricultural areas.

- Soil Moisture Index (SMI) derived from spatial soil water balance model, upto 31st July, showed improvement from June in many parts of the country due to progression of monsoon. SMI continues to be lower (<50% of holding capacity) in parts of Andhra Pradesh, Karnataka, Maharashtra, Bihar, Madhya Pradesh, Rajasthan, Gujarat, Haryana and Uttar Pradesh. In these areas, persistent higher values of SMI are yet to be reached for achieving normal crop sown area and crop growth. Comparison of SMI between 2012 and 2011 indicated lower SMI values in 2012 in many parts of the above states.

- The Area Favorable for Crop Sowing (AFCS) has been derived from (1) SASI data integrated with ground data on cropping pattern, soils and irrigation support and (2) Spatial Soil Water Balance model. AFCS reflects the agricultural area with significant surface wetness and hence favorable for crop sowing activity. AFCS revealed very less favorable area for crop sowing in kharif 2012. Out of 108 M ha of potential Kharif area of the country, only 87 M ha has been found to be under favorable area.

- There was a significant increase in AFCS or area sown from 44 M ha in June to 87 M ha in July. The AFCS has increased significantly in July from previous month in Andhra Pradesh, Karnataka, Maharashtra, Orissa, Chhattisgarh, Uttar Pradesh and Madhya Pradesh states.
The unfavorable area for crop sowing is 22 M ha, and is mostly located in Gujarat, Rajasthan and Haryana and in the northern and central Karnataka and in coastal region and Rayalseema regions of Andhra Pradesh indicating the continued unfavorable seasonal conditions in July 2012. About 2.5 M ha of this unfavorable area corresponds to rice crop and is mostly located in Rajasthan, Haryana, Karnataka, Tamil Nadu and Uttar Pradesh states.

NDVI, an indicator of agricultural vegetation status, is significantly less than normal in most of the states – southern parts of Andhra Pradesh, northern Karnataka, Marathwada and Madhya Maharashtra, West Madhya Pradesh, West Gujarat, North Rajasthan, Southern Haryana, East and West Uttar Pradesh and many parts of Bihar. Reduced greenness in the current season is the result of delayed crop sowing and reduced crop area. Even in Maharashtra and Andhra Pradesh states, where the crop sown area is close to normal, NDVI deviations are significant as a result of slow progression of crops. Near normal NDVI indicating more or less normal crop progression is evident in Orissa, Chhattisgarh, Jharkhand and Telangana region of Andhra Pradesh.

Multiple indices involving SMI derived from soil water balance, satellite derived SASI, NDWI and NDVI and their comparisons between 2012 and 2011/2010, IMD rainfall and its derivatives indicate significant improvement in parts of Maharashtra, Andhra Pradesh, Orissa, Chhattisgarh, Jharkhand, Uttar Pradesh, Madhya Pradesh and Haryana and continued surface dryness and poor vegetation vigor in as many as 267 districts of the 13 states covered in the analysis country by the end of July.

There is a significant improvement in the agricultural situation from June to July, in terms of increased crop sown area and near normal crop condition, in some or other parts of every state particularly in the irrigated areas. But the extent of crop sown area and the vigor of already sown crops is significantly less than that of Kharif 2011 or Kharif 2010 in some or other parts of every state particularly in the rainfed areas as indicated below.

District-wise analysis in 13 states by the end of July indicated “Normal” agricultural situation in 132 districts. The agricultural situation is categorized as “Watch” in 148 districts and as “Alert” in 119 districts.

“Alert” category districts are characterised by either delayed sowing time or reduced crop sown area or poor greenness of agricultural vegetation or lack of adequate irrigation infra-structure or all of them. There may not be improvement to the extent of normal agricultural situation in these districts.
- “Watch” category districts are characterised by slightly reduced crop sown area or slightly reduced greenness of crops, with scope for significant improvement in subsequent fortnights.

- The number of districts under “Alert” class has increased to 119 in July from 94 in June, thereby indicating continued intense agricultural drought conditions in Rajasthan, Bihar, Uttar Pradesh and Gujarat, Haryana, Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu states.

**Summary of July 2012 Agricultural Drought Assessment**

<table>
<thead>
<tr>
<th>State</th>
<th>Agricultural drought situationupto July 2012</th>
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| Andhra Pradesh | **Normal (10 districts):** Adilabad, Chittoor, Karimnagar, Khammam, Medak, Nellore, Nizamabad, Rangareddy, Srikakulam and West Godavari  
**Watch (5 districts):** East Godavari, Mahaboobnagar, Vizianagaram, Visakhapatnam and Warangal  
**Alert (7 districts):** Anantpur, Kurnool, Kadapa, Guntur, Krishna, Nalgonda and Prakasam |
| Bihar        | **Normal (5 districts):** Paschim Champaran, Kishanganj, Bhabhua, Rhotas and Aurangabad  
**Watch (20 districts):** Purbi Champaran, Sitamarhi, Madhubani, Muzaffarpur, Katihar, Madhepura, Sheohar, Supaul, Araria, Darbhanga, Gopalganj, Munger, Luckeesarai, Sheikhpura, Nalanda_Sheikhpura, Patna, Bhojpur, Jahanabad, Gaya and Jamui  
**Alert (12 districts):** Purnia, Saharsa, Siwan, Saran, Vaishali, Samastipur, Begusarai, Khagaria, Bhagalpur, Banka, Buxar and Nawada |
| Chhattisgarh | **Normal (13 districts):** Koriya, Surguja, Jashpur, Raigarh, Korba, Bilaspur, Jangir, RAIPUR, Durg, Kawardha, Rajnandgaon, Dhamtari, Kanker, Bastar, Dantewada  
**Watch (2 districts):** Surguja, and Jashpur |
| Gujarat      | **Normal:** Nil  
**Watch (10 districts):** Sabar_Kantha, Dahod, Panchmahal, Anand, Vadodara, Narmada, Bharuch, The_Dangs, Navsari and Valsad  
**Alert (15 districts):** Kachchh, Banas_Kantha, Patan, Mehsana, Kheda, Gandhi_Nagar, Ahmedabad, Surendranagar, Rajkot, Jamnagar, Porbander, Junagadh, Amreli, Bhavnagar and Surat |
| Haryana      | **Normal (7 districts):** Ambala, Kaithal, Karnal, Kurukshetra, Panchkula, Panipat and Yamunanagar  
**Watch (3 districts):** Fatehabad, Rhotak and Sirsa  
**Alert (9 districts):** Bhiwani, Faridabad, Gurgaon, Hisar, Jhajjar, Jind, Mahendragarh, Rewari and Sonipat |
### Jharkhand
**Normal (12 Districts):** Koderma, Gumla, Garhwa, Palamau, Chatra, Jamtara, Pakaur, Dumka, Latehar, West and East Singhbhum and Saraikela Kharsawan  
**Watch (10 Districts):** Giridih, Deoghar, Godda, Sahibganj, Dhanbad, Bokaro, Hazaribagh, Lohardaga, Ranchi and Simdega  
**Alert:** Nil

### Karnataka
**Normal (11 districts):** Bangalore U, Bangalore R, Bidar, Chimalalgur, D. Kannada, Kodagu, Mandya, Mysore, Shimoga, Udupi, U. Kannada  
**Watch (8 districts):** Belgaum, Chamarajangar, Chitrdurga, Davagere, Haveri, Haveri, Kolar and Tumkur  
**Alert (9 districts):** Bagalkot, Bellary, Bijapur, Dharwad, Gadag Gulberga, Yadgir, Koppal and Raichur

### Maharashtra
**Normal (19 districts):** Ratnagiri, Rayagad, Nanded, Sindhudurg, Thane, Latur, Yavatmal, Parbhani, Kolhapur, Wardha, Wasim, Bhandara, Gondia, Amaravati, Hingoli, Akola, Gadchiroli, Nagpur and Chandrapur  
**Watch (4 districts):** Osmanabad, Sangli, Buldana and Satara  
**Alert (10 districts):** Aurangabad, Bid, Jalna, Jalgaon, Dhule, Nashik, Nandurbar, Ahamadnagar, Solapur and Pune

### Madhya Pradesh
**Normal (11 districts):** Katni, Damoh, Jabalpur, Dindori, Mandla, Balaghat, Seoni, Chhindwara, Betul, Hoshangabad and Harda  
**Watch (27 districts):** Morena, Bhind, Datia, Gwalior, Sheopur, Shivpuri, Tikamgarh, Chhatarpur, Panna, Rewa, Sidhi, Shahdol, Vidisha, Bhopal, Raigarh, Shajapur, Ujjain, Ratlam, Mandsaur, Indore, Dewas, Sehore, Raisen, Narsimhapur, East_Nimar,West_Nimar and Badwani  
**Alert (7 districts):** Guna, Satna, Umaria, Sagar, Neemach, Jhabua and Dhar

### Orissa
**Normal (18 districts):** Sundargarh, Jharsuguda, Sambalpur, Angul, Dhenkanal, Kendrapada, Cuttack, Puri, Khurda, Nayagar, Ganjam, Phulbani, Boudh, Sonepur, Bargarh, Nawapara, Kalahandi and Malkangiri  
**Watch: (12 districts):** Mayurbhanj, Keonjhar, Deogar, Jaipur, Balasore, Bhdrak, Jagatsinghpur, Bolangir, Rayagada, Gajapati, Koraput and Nowrangapur  
**Alert:** Nil

### Rajasthan
**Normal:** Nil  
**Watch (8 districts):** Dausa, Karauli, Kota, Baran, Jhawalwar, Banswara, Dungarpur and Dholpur  
**Alert (24 districts):** Ganganagar, Hanumangarh, Bikaner, Churu, Jhunjhunun, Alwar, Bharathpur, Jaipur, Sikar, Nagaur, Jodhpur, Jaisalmer, Barmer, Pali, Ajmer, Tonk, Sawai_Madhopur, Bundi, Bhilwara, Jaisamand, Jalor, Sirohi, Udaipur and Chittaurgarh

### Tamil Nadu
**Normal (8 districts):** Thiruvallur, Chennai, Vellore, Tiruvannamalai, Viluppuram, Nilgiris, Coimbatore and Teni  
**Watch (10 districts):** Kanchipuram, Dharmapuri, Salem, Erode, Dindigul, Karur, Tiruchirapalli, Perambalur, Madurai and Kanniyakumari  
**Alert (12 districts):** Namakkal, Cuddalore, Ariyalur, Nagappattinam, Thiruvarur, Thanjavur, Pudukkottai, Sivaganga, Virudunagar, Ramanathapuram, Tuticorin and
| Uttar Pradesh | Normal (18 districts): Lakhimpur, Sidharthanagar, Shravasti, Gonda, Barabanki, Sitapur, Unnao, Lucknow, Faizabad, Ambedkar_Nagar, Chaudauli, Varanasi, Fatehpur, Kanpur_Urban, Kanpur_Rural, Banda, Chitrakut and Kaushambi |
| Watch (37 districts): Hamirpur, Farrukhabad, Kanauj, Saharanpur, Muzaffarnagar, Bijnor, Meerut, Baghat, Juotiba_Phule_Nagar, Moradabad, Bareilly, Pilibhit, Bahraich, Balrampur, Sant_Kabir_Nagar, Basti, Hardoi, Shahjahanpur, Budaun, Bulandshahr, Etah, Rae_Bareilly, Sultanpur, Azamgarh, Mau, Ballia, Ghazipur, Pratapgarh, Auraiya, Etawah, Mainpuri, Firozabad, Jalaun, Jhansi, Lalitpur, Mahoba and Allahabad |
| Alert (14 districts): Ghaziabad, Rampur, Maharajganj, Kushinagar, Deoria, Gorakhpur, Aligarh, Mathura, Hathras, Jaunpur, Agra, Sant_Ravidas_Nagar, Mirzapur and Sonbhadra |

- Progression of NDVI and NDWI during August needs to be observed, since it is a critical indicator of crop growth.
- Progression of crop sown area particularly in Gujarat, Rajasthan, Haryana, north and central Karnataka, coastal and Rayalseema regions of Andhra Pradesh needs to be observed to assess the impact of drought on crop sowing, as the large proportion of Kharif potential crop area remained unfavourable till end of July 2012.
- Delayed crop sowings in the states of Bihar, Jharkhand, Gujarat, Rajasthan, Madhya Pradesh and in parts of Haryana may result in the reduction of crop yield.
- Poor crop growth in the areas where the extent of crop sown area is near normal such as in parts of Andhra Pradesh, Karnataka, Maharashtra, Orissa and Chhattisgarh may result in the reduction of crop yield.
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Plate 1: Agricultural Drought assessment, July 2012

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<td>Karnataka</td>
<td>11</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>19</td>
<td>4</td>
<td>10</td>
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<tr>
<td>Madhya Pradesh</td>
<td>11</td>
<td>27</td>
<td>7</td>
</tr>
<tr>
<td>Orissa</td>
<td>18</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Rajasthan</td>
<td></td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>8</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>18</td>
<td>37</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>132</td>
<td>156</td>
<td>119</td>
</tr>
</tbody>
</table>
Plate 2: Area Favorable for Crop Sowing (AFCS) derived from SASI and water balance methodology 25th July 2012

<table>
<thead>
<tr>
<th></th>
<th>Kharif Area</th>
<th>AFCS</th>
<th>% Kharif Area</th>
<th>Unfavorable</th>
</tr>
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<tr>
<td>Andhra Pradesh</td>
<td>78</td>
<td>68</td>
<td>87</td>
<td>10</td>
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<tr>
<td>Bihar</td>
<td>37</td>
<td>36</td>
<td>97</td>
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<tr>
<td>Chhattisgarh</td>
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<td>48</td>
<td>101</td>
<td>0</td>
</tr>
<tr>
<td>Gujrat</td>
<td>87</td>
<td>50</td>
<td>57</td>
<td>37</td>
</tr>
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<td>Haryana</td>
<td>28</td>
<td>16</td>
<td>58</td>
<td>12</td>
</tr>
<tr>
<td>Jharkhand</td>
<td>25</td>
<td>24</td>
<td>98</td>
<td>1</td>
</tr>
<tr>
<td>Karnataka</td>
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<td>60</td>
<td>80</td>
<td>15</td>
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<tr>
<td>Madhya Pradesh</td>
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<td>97</td>
<td>93</td>
<td>7</td>
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<td>Maharashtra</td>
<td>140</td>
<td>132</td>
<td>95</td>
<td>8</td>
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<tr>
<td>Orissa</td>
<td>63</td>
<td>61</td>
<td>97</td>
<td>2</td>
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<tr>
<td>Rajasthan</td>
<td>143</td>
<td>44</td>
<td>31</td>
<td>99</td>
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<td>Tamilnadu</td>
<td>24</td>
<td>18</td>
<td>74</td>
<td>6</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>93</td>
<td>87</td>
<td>94</td>
<td>6</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>945</strong></td>
<td><strong>742</strong></td>
<td><strong>79</strong></td>
<td><strong>203</strong></td>
</tr>
<tr>
<td><strong>All India</strong></td>
<td><strong>1086</strong></td>
<td><strong>870</strong></td>
<td><strong>80</strong></td>
<td><strong>216</strong></td>
</tr>
</tbody>
</table>
Plate 3: SASI Anomaly in July 2012

SASI anomaly from previous year – July 2012

SASI deviation from previous year upto 25 July 2012

Legend:
- More wet
- Wet
- No significant change
- Dry
- More dry

States:
- AP
- Assam
- Bih
- Chh
- Guj
- Har
- Jhri
- Kar
- Ker
- MP
- Mah
- Orr
- Pun
- Raj
- TN
- UP
- WB

Total
Plate 4: Soil moisture index derived from water balance methodology, July 2012

Soil Moisture Index of India

As on
15th July 2012

Soil Moisture Index of India

As on
31st July 2012

Soil Moisture Index

Non-Agricultural Area

0

100
Plate 5: Soil moisture index derived from water balance methodology, June 2012
Plate 6: Fortnightly Agricultural area NDVI of NOAA AVHRR (1 km * 1km)
Plate 7: Comparison of Agricultural area NDVI of NOAA AVHRR (1 km * 1km)
Plate 8: Comparison of Agricultural area NDVI of NOAA AVHRR (1 km * 1 km)
Plate 9: MODIS (250 m²) NDWI during July 2012 showing surface moisture status

1ST fortnight
July,12

2ND fortnight
July,12

July,12

1ST fortnight
July,10

2ND fortnight
July,10

July,10
Plate 10: MODIS (250 m$^2$) NDWI during June 2012 showing surface moisture status

1$^{ST}$ fortnight
June, 12

2$^{ND}$ fortnight
June, 12

1$^{ST}$ fortnight
June, 10

2$^{ND}$ fortnight
June, 10

June, 12

June, 10
Plate 11: NDWI and NDVI Deviation Map for July 2012
(derived from MODIS data)
Plate 12: NDWI and NDVI Deviation Map for June 2012
(derived from MODIS data)
Plate 13: Percent Deviation of NDWI and NDVI - July 2012
(derived from MODIS data)
Plate 14: Percent Deviation of NDWI and NDVI - June 2012
(derived from MODIS data)
Plate 15: IMD – Sub-division wise Rainfall

RAINFALL (mm.) FOR THE PERIOD
01.06.2012 TO 01.08.2012

RAINFALL (mm.) FOR THE PERIOD
01.06.2012 TO 27.06.2012

Legend:
- Excess (+20% or more)
- Normal (+15% to -10%)
- Deficient (20% to -55%)
- Scanty (+5% to -95%)
- No Rain (-100%)
- No Data

Notes:
[a] Rainfall figures are based on operational data.
[b] Small figures indicate actual rainfall (mm), while bold figures indicate Normal rainfall (mm).
Percentage Departures of Rainfall are shown in brackets.

Source: www.imd.gov.in
Plate 16: District wise rainfall deviations

Source of rainfall data: www.imd.gov.in
Plate 17: District wise weekly rainfall deviations June and July 2012

(Source of data: www.imd.gov.in)
Plate 18: Number of weeks with less than normal rainfall up to July 2012

Source of rainfall data: www.imd.gov.in
Plate 19: District wise weekly rainfall deviations June and July 2011

Source of data: www.imd.gov.in
Plate 20: District wise weekly rainfall deviations for selected states
June and July 2010

Source of data: www.imd.gov.in
Plate 21: Agricultural Drought Assessment - Andhra Pradesh

MODIS based Normalized Difference Vegetation index

July 2012

July 2010

Source: www.imd.gov.in

Seasonal Rainfall for the week ending 01/08/12

01. AGRAHAZAR 13. MALLI
02. ANANTAPUR 14. ANGU
03. CHITTOOR 15. MELLORE
04. OUDAHAPAH 16. NIZAMABAD
05. EAST GODAVARI 17. PRACHASAM
06. GUNTUR 18. RANGAREDDY
07. HYDERABAD 19. KRKAULAM
08. KARIMNAGAR 20. VISAYAPATHNAM
09. KHYRAMNAGA 21. VIZAYAGARAM
10. KRISHNA 22. WARRANGAL
11. KURNOOL 23. WEST GODAVARI
12. MALLAHINAGAR

Legend
- EXCEEDS 30% OF NORMAL
- NORMAL, 1% TO 10%
- DECREASED, 10% TO 30%
- SCARCE, 60% TO 90%
- NO RAIN, 90%
- DATA NOT AVAILABLE

MODIS based Normalized Difference Water index

Agricultural drought assessment – July 2012
Plate 22: Agricultural Drought Assessment - Bihar

AVHRR based Normalized Difference Vegetation index

MODIS based Normalized Difference Water index

Seasonal Rainfall for the week ending 01/08/12

Agricultural drought assessment – July 2012
Plate 23: Agricultural Drought Assessment - Chhattisgarh

AVHRR based Normalized Difference Vegetation index

MODIS based Normalized Difference Water index

Seasonal Rainfall for the week ending 01/08/12

Agricultural drought assessment – July 2012

Source: www.imd.gov.in
Plate 24: Agricultural Drought Assessment - Gujarat

AVHRR based Normalized Difference Vegetation index

MODIS based Normalized Difference Water index

Seasonal Rainfall for the week ending 01/08/12

Source: www.imd.gov.in
Plate 25: Agricultural Drought Assessment - Haryana

July 2012

July 2010

MODIS based Normalized Difference Vegetation index

MODIS based Normalized Difference Water index

Seasonal Rainfall for the week ending 01/08/12

Source: www.imd.gov.in

Agricultural drought assessment – July 2012
Plate 26: Agricultural Drought Assessment - Jharkhand

AVHRR based Normalized Difference Vegetation index

MODIS based Normalized Difference Water index

Seasonal Rainfall for the week ending 01/08/12

Agricultural drought assessment – July 2012

Source: www.imd.gov.in
Plate 27: Agricultural Drought Assessment - Karnataka

MODIS based Normalized Difference Vegetation index

July 2012

01. GULBARGA
02. YADGIR
03. UDUPI
04. DAKSHINA KARNADA
05. BELGAUM
06. BASALKOTE
07. BIJAPUR
08. BIDAR
09. RAICHUR
10. HOPAL
11. GADAG
12. DHARWAD
13. UTTARA KARNADA
14. HASSAN
15. BELARY

July 2010

01. CHITRADURGA
02. DAVANGERE
03. SHIMOGA
04. CHIKMAGALUR
05. TUMAKUR
06. CHIKBAULAPUR
07. BANGALORE URBAN
08. RAMANAGARAM
09. MANDYA
10. HASSAN
11. KODAGU
12. MYDIRE
13. CHAMARAJA NAGAR
14. KOLLUR
15. DANDA URBAN

Source: www.imd.gov.in
Plate 28: Agricultural Drought Assessment - Madhya Pradesh

**AVHRR based Normalized Difference Vegetation index**

**MODIS based Normalized Difference Water index**

**Seasonal Rainfall for the week ending 01/08/12**

**Agricultural drought assessment – July 2012**

Source: www.imd.gov.in
Plate 29: Agricultural Drought Assessment - Maharashtra

MODIS based Normalized Difference Vegetation index

MODIS based Normalized Difference Water index

Seasonal Rainfall for the week ending 01/08/12

Source: www.imd.gov.in

Agricultural drought assessment – July 2012
Plate 30: Agricultural Drought Assessment - Orissa

AVHRR based Normalized Difference Vegetation index

MODIS based Normalized Difference Water index

Seasonal Rainfall for the week ending 01/08/12

Source: www.imd.gov.in

Agricultural drought assessment – July 2012
Plate 31: Agricultural Drought Assessment - Rajasthan

AVHRR based Normalized Difference Vegetation Index

MODIS based Normalized Difference Water Index

Seasonal Rainfall for the week ending 01/08/12

Source: www.imd.gov.in

Agricultural drought assessment – July 2012
Plate 32: Agricultural Drought Assessment - Tamil Nadu

AVHRR based Normalized Difference Vegetation index

July 2012

July 2011

Seasonal Rainfall for the week ending 01/08/12

Source: www.imd.gov.in

MODIS based Normalized Difference Water index

July 2012

July 2011

Agricultural drought assessment – July 2012

Legend
- Normal
- Watch
- Alert

Source: www.imd.gov.in
Plate 33: Agricultural Drought Assessment - Uttar Pradesh

AVHRR based Normalized Difference Vegetation index

July 2012

July 2011

MODIS based Normalized Difference Water index

July 2012

July 2011

Seasonal Rainfall for the week ending 01/08/12

Agricultural drought assessment – July 2012

Source: www.imd.gov.in