Integrated Seasonal Condition Monitoring System
Andhra Pradesh

Government of Andhra Pradesh
Normalized Difference Vegetation Index
MODIS (250m) Mandal Wise
First Fortnight of September 2017

Vegetation Vigor
- Forest
- Water
- Cloud

0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Andhra Pradesh Space Applications Centre (APSAC)
Planning Department,
Government of Andhra Pradesh
web site: www.apsac.ap.gov.in

Prepared for:
Andhra Pradesh State Disaster Management Authority (APSDMA)
Genious, JR Towers, Kunchanapalli, Guntur, Govt. of Andhra Pradesh
Cumulative Report up to 15th September, 2017

- Seasonal condition is categorised as “Normal” in 591 Mandals as on date 15th September, 2017.
- Seasonal condition is categorised as “Mild” in 66 Mandals as on date 15th September, 2017.
- Seasonal condition is categorised as “Moderate” in 11 Mandals as on date 15th September, 2017.
- Seasonal condition is categorised as “Severe” in 02 Mandals as on date 15th September, 2017.
- Nellore district is excluded in the assessment and considered as "Normal" as it is covered during North-East Monsoon.

Cumulative Seasonal Condition up to 15th September, 2017

Fortnightly seasonal condition of Andhra Pradesh up to 1st fortnight of September, 2017

- Assessment is based on Fourteen year historical and current year satellite and Meteorological data.
- Analysis includes NDVI, NDWI, VCI and Rainfall.

Rainfall up to 15th September 2017

- 89 mandals out of 670 mandals (13.28%) received deficit rainfall. 343 mandals (51.19%) and 238 mandals (35.52%) are under Normal and Excess category up to First fortnight of September, 2017 respectively. (Source: APSDPS, AP).

Agriculture up to 15th September 2017

Up to first fortnight of September 2017, Paddy is at active tillering to panicle initiation stage. Maize is at vegetative to cob formation stage. Jowar, Bajra, Mesta and Redgram crops are at vegetative stage. Greengram, Blackgram, Sesamum crops are at flowering to pod formation stage. Groundnut is at vegetative to flowering and pod formation stage. Cotton is at vegetative to flowering stage. Sugarcane is at cane formation stage. In Kadapa and Kurnool districts water under KC Canal is not yet released (Source: Department of Agriculture, Andhra Pradesh State).
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1. Background and Rationale

APSAC is carrying out remote sensing based crop seasonal condition assessment from Kharif 2012 onwards and the same was used as a key indicator by state government for declaration of drought mandals. In continuation of the project, Andhra Pradesh Space Applications Centre (APSAC) has established a protocol for crop condition assessment that is called as Integrated Seasonal Condition Monitoring System (ISMS). ISMS uses weather observation network of 1169 Automatic Weather Stations (AWS), Rainfall status, Dry spells in addition to the Vegetation Condition Index (VCI) generated from Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI). The assessment is divided in two part, first part is from June to September and grouped into Normal, Watch and Alert situation of each mandal and First part from September to October is grouped into Normal, Mild, Moderate and Severe for confirmation of agriculture seasonal condition.

Integrated Seasonal Condition Monitoring System (ISMS): The objectives of the ISMS are

- Concurrent monitoring of seasonal conditions using remote sensing, extensive weather network data and continuous ground truth.
- Develop an early warning (monitoring) of agriculture seasonal condition using suite of indicators, which will help to increase drought preparedness, and identify and implement appropriate Disaster Risk Reduction (DRR) measures.
- Early Warning to the Districts/Mandals.

The details of the classification of agricultural situation are given in Table.1.

**Table. 1. Classification of Agricultural situation**

<table>
<thead>
<tr>
<th></th>
<th>June-August</th>
<th>September - October</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>• Agricultural situation is normal</td>
<td></td>
</tr>
</tbody>
</table>
| Watch  | • Progress of Agricultural situation is slow  
          • Ample scope for recovery  
          • No external intervention needed |
| Alert  | • Very slow progress of agricultural situation  
          • Need for intervention.  
          • Develop and implement contingency plans to minimise loss |
| Mild stress | • Crops have suffered stress slightly |
| Moderate stress | • Considerable loss in production.  
                     • Take measures to alleviate suffering |
| Severe stress | • High risk Significant reduction in crop yield  
                   • Management measures to provide relief |
2. Data used, Indicators and Methodology

Table 2. Data source and indicators

<table>
<thead>
<tr>
<th>Data source</th>
<th>Product</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODIS (250/500m)</td>
<td>Surface reflectance</td>
<td>NDVI &amp; NDWI</td>
</tr>
<tr>
<td>AWiFS</td>
<td>Surface reflectance</td>
<td>NDVI &amp; NDWI</td>
</tr>
<tr>
<td>AWS</td>
<td>Daily/ Cumulative rainfall</td>
<td>Rainfall deviation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dry spells</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Weekly sowing progress</td>
<td>District/Madal wise sown areas deviation from normal.</td>
</tr>
<tr>
<td>Department</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation Department</td>
<td>Reservoir levels/ Water release data</td>
<td>Command area Mandals under canal irrigation</td>
</tr>
</tbody>
</table>

2.2 Methodology

![Flow chart]

Figure 1: Flow chart
3. Present status up to 15th September, 2017

3.1. Rainfall and other meteorological data

The status of rainfall as on 15th September, 2017 shown in Table (3) 89 mandals out of 670 mandals (13.28%) received deficit rainfall. 343 mandals (51.19%) and 238 mandals (35.52%) are under Normal and Excess category up to First fortnight of September, 2017 respectively.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>District Name</th>
<th>No. of Mandals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Excess</td>
</tr>
<tr>
<td>1</td>
<td>Srikakulam</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>Vizianagaram</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Visakhapatnam</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>East Godavari</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>West Godavari</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Krishna</td>
<td>11</td>
</tr>
<tr>
<td>7</td>
<td>Guntur</td>
<td>25</td>
</tr>
<tr>
<td>8</td>
<td>Prakasam</td>
<td>31</td>
</tr>
<tr>
<td>9</td>
<td>Nellore</td>
<td>30</td>
</tr>
<tr>
<td>10</td>
<td>Chittoor</td>
<td>38</td>
</tr>
<tr>
<td>11</td>
<td>Kadapa</td>
<td>23</td>
</tr>
<tr>
<td>12</td>
<td>Anantapur</td>
<td>22</td>
</tr>
<tr>
<td>13</td>
<td>Kurnool</td>
<td>13</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>238</strong></td>
</tr>
</tbody>
</table>

(Source: APSDPS, Planning Dept, AP)
The % deviation of Actual & Normal rainfall received up to 15th September 2017 shown in Fig. 2, 3, 4 respectively.

Figure 2: Deviation of Rainfall in percent w.r.t. Normal from September 01 to September 07, 2017

Figure 3: Deviation of Rainfall in percent w.r.t. Normal from September 08 to September 15, 2017
Government of Andhra Pradesh
Deviation of Rainfall in % w.r.t Normals
From 01-06-2017 to 15-09-2017

Data Source: AWS and DES
Prepared by: APSDPS, Planning Department

Figure 4: Deviation of Rainfall in percent w.r.t. Normal from June 01 to September 15, 2017
3.2. Crop Sowing Progress

The crop sowing progress up to 13th September 2017 shows that Nellore district under high negative deviation as compared to normal sown area as on date. Vizianagaram, Vishakapatnam, West Godavari, Prakasham, Kadapa, Kurnool, Chittoor and Anantapur are under 0 to -25 negative deviation as compared to normal sown area. Srikakulam, East Godavari, Krishna and Guntur districts are under positive deviation as compared to normal shown area. Up to 13th September 2017, total area sown in all districts of state is 32.30 Lakhs ha as against the normal sown area 34.86 Lakhs ha (deviation -7.34%) as on date. Up to First fortnight of September 2017, Paddy is at active tillering to panicle initiation stage. Maize is at vegetative to cob formation stage. Jowar, Bajra, Mesta and Redgram crops are at vegetative stage. Greengram, Blackgram, Sesamum crops are at flowering to pod formation stage. Groundnut is at vegetative to flowering and pod formation stage. Cotton is at vegetative to flowering stage. Sugarcane is at cane formation stage. In Kadapa and Kurnool districts water under KC Canal is not yet released. Detailed map is shown in Figure 5, Satellite view as on 13th September 2017 in figure 6 and deviation graph is shown in Figure 6.

![Figure 5: Deviation from normal crop sown area as on date 13-09-2017](image1)

![Figure 6: Satellite view as on date 13-09-2017](image2)
Table 5: District Wise Crop Sowing Area - Upto 13-09-2017

<table>
<thead>
<tr>
<th>District</th>
<th>Sowings as on 13/09/17</th>
<th>Deviation %</th>
<th>Satellite data based total cropped area as on 13th September 2017 in ha.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal (ha)</td>
<td>Actual (ha)</td>
<td>Deviation %</td>
</tr>
<tr>
<td>Srikakulam</td>
<td>219538</td>
<td>234639</td>
<td>6.88</td>
</tr>
<tr>
<td>Vizianagaram</td>
<td>169381</td>
<td>162503</td>
<td>-4.06</td>
</tr>
<tr>
<td>Visakhapatnam</td>
<td>164435</td>
<td>156196</td>
<td>-5.01</td>
</tr>
<tr>
<td>East Godavari</td>
<td>246914</td>
<td>254165</td>
<td>2.94</td>
</tr>
<tr>
<td>West Godavari</td>
<td>257504</td>
<td>238169</td>
<td>-7.51</td>
</tr>
<tr>
<td>Krishna</td>
<td>302741</td>
<td>321612</td>
<td>6.23</td>
</tr>
<tr>
<td>Guntur</td>
<td>406338</td>
<td>410242</td>
<td>0.96</td>
</tr>
<tr>
<td>Prakasam</td>
<td>162941</td>
<td>141490</td>
<td>-13.16</td>
</tr>
<tr>
<td>Nellore</td>
<td>70355</td>
<td>36461</td>
<td>-48.18</td>
</tr>
<tr>
<td>Chittoor</td>
<td>180475</td>
<td>171376</td>
<td>-5.04</td>
</tr>
<tr>
<td>Kadapa</td>
<td>95161</td>
<td>75838</td>
<td>-20.31</td>
</tr>
<tr>
<td>Anantapur</td>
<td>697269</td>
<td>536519</td>
<td>-23.05</td>
</tr>
<tr>
<td>Kurnool</td>
<td>512791</td>
<td>490830</td>
<td>-4.28</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3485843</strong></td>
<td><strong>3230040</strong></td>
<td><strong>-7.34</strong></td>
</tr>
</tbody>
</table>

Source: Department of Agriculture, Andhra Pradesh State

Figure 7: District wise deviation from normal crop sown area as on date 13-09-2017
3.3. Vegetation Index

The NDVI (Normalized Difference of Vegetation Index) for the First fortnight of September 2017 is shown in the figure 8.

Figure 8: NDVI - MODIS (250m): First fortnight of September 2017
3.4. Comparison of Vegetation Index

The NDVI (Normalized Difference of Vegetation Index) for the First fortnight of September 2017 shown and also compared with 2013, 2014, 2015, 2016 and 2017 in figure 9. The year 2013 is treated as a normal year.

Figure 9: NDVI - MODIS (250m): First fortnight of September 2017, 2016, 2015, 2014 and 2013
3.5. **Surface Wetness Indicators**: Normalized Difference Water Index (NDWI)

The map indicates status of moisture availability in soil as well as in crop canopy for First fortnight of September, 2017 (figure 10).

![Map of Normalized Difference Water Index (NDWI) for the first fortnight of September 2017 in Andhra Pradesh.](image-url)

Figure 10: NDWI- MODIS (250m) First fortnight of September 2017
3.6. Comparison of Surface Wetness Indicators

The map indicates comparison status of moisture availability in soil as well as in crop canopy. Year 2013 is treated as a normal year. NDWI situation for the year 2013, 2015 and 2016 w.r.t. 2017 are shown in the figure 11.

Figure 11: NDWI- MODIS (250m) First fortnight of September 2017, 2016, 2015, 2014 and 2013
3.7. The deviation of NDVI and NDWI w.r.t. 2013 are shown in the figures 12 and 13.

Figure 12: NDVI deviation-MODIS (250m) for the First fortnight of September, 2017 w.r.t. 2013

Figure 13: NDWI-MODIS (250m) deviation for First fortnight of September, 2017 w.r.t. 2013
3.8. Soil Moisture Index from Soil Water Balance Model

The Soil Moisture Index (SMI) is defined as the proportion of the difference between the current soil moisture and the permanent wilting point to the field capacity and the residual soil moisture. The soil moisture was computed using the soil water balance model - (book keeping procedure/bucket type). The root zone soil moisture for the selected crops is helpful in identifying the exact period and duration of stress in a particular region. 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 First 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. 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. The maps of Soil moisture index from 1st September to 15th September generated from soil water balance model are sown in figure 14, and 15 (Source: NRSC).
Soil Moisture Index maps from 01st September to 08th September 2017

Figure 14: Soil Moisture Index maps from 1st September to 8th September 2017
Soil Moisture Index maps from 09th September to 15th September 2017

Figure 15: Soil Moisture Index maps 9th September to 15th September 2017
3.9. Seasonal condition of Mandals:

3.9.1. Composite Criteria

For the First fortnight of September, 2017. The seasonal condition in the state is assessed using different indicators viz. NDVI, NDWI, Vegetation Condition Index (VCI), Rainfall deviation and Dry spells in all the mandals of Andhra Pradesh. All indicators were integrated for analysis and mandals were categorised into Normal and Watch. Mandal wise analysis for the First fortnight of September, 2017 indicated “Normal” agricultural situation in 591 mandals (88.21% of total mandals), agricultural situation is categorized under “Mild” in 66 mandals (9.85% of total mandals), agricultural situation is categorized under “Moderate” in 11 mandals (1.64% of total mandals)and 02 mandals under "Severe" agriculture situation (0.30% of total mandals). Nellore district is excluded in the assessment and considered as “Normal” as it is covered during North-East Monsoon period. Spatial distribution of mandals categorized under Normal and Watch are shown in Figure 16.

Figure 16: Seasonal condition assessment based on ISMS Criterion for the First fortnight of September, 2017
### 3.10 List of Mandals (district wise) under watch condition

<table>
<thead>
<tr>
<th>District Name</th>
<th>Moderate (Mandal name)</th>
<th>Severe (Mandal Name)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anantapur (63)</td>
<td>Yadiki, Rayadurg, Gummagatta, Raptadu, Ramagiri, Gorantla, Penukonda, Roddam, Somandepalle (09)</td>
<td>Puttaparthi (01)</td>
</tr>
<tr>
<td>Kadapa (51)</td>
<td>Peddamudium, (01)</td>
<td>Pulivendla (01)</td>
</tr>
<tr>
<td>Kurnool (54)</td>
<td>Sanjamala (01)</td>
<td></td>
</tr>
</tbody>
</table>

### 4. Conclusions

Summary of seasonal conditions for the First fortnight of September, 2017 are as follows:

- Mandal wise analysis up to the First fortnight of September, 2017 indicated “Normal” agricultural situation in 591 Mandals, 66 mandals under "Mild", 11 mandals under "Moderate" and 02 mandas under "Severe" situation.

- Nellore district is excluded in the assessment and considered as "Normal" as it is covered during North-East Monsoon.

- Up to First fortnight of September 2017, Paddy is at active tillering to panicle initiation stage. Maize is at vegetative to cob formation stage. Jowar, Bajra, Mesta and Redgram crops are at vegetative stage. Greengram, Blackgram, Sesamum crops are at flowering to pod formation stage. Groundnut is at vegetative to flowering and pod formation stage. Cotton is at vegetative to flowering stage. Sugarcane is at cane formation stage. In Kadapa and Kurnool districts water under KC Canal is not yet released. (Source: Department of Agriculture, Andhra Pradesh State).

### ANNEXURE I

**DISSEMINATION OF THE REPORT**

1. Hon'ble Chief Minister’s office
2. Chief Secretary to Andhra Pradesh Government
3. Principal Secretary, Finance
4. Commissioner, Disaster Management
5. Commissioner, Agriculture
6. Director, DES
7. Director, NRSC
8. Joint Directors (Agriculture) all 13 districts of Andhra Pradesh.
9. APSAC and APSDPS web site (http://apsac.ap.gov.in/ and http://apsdps.gov.in/)