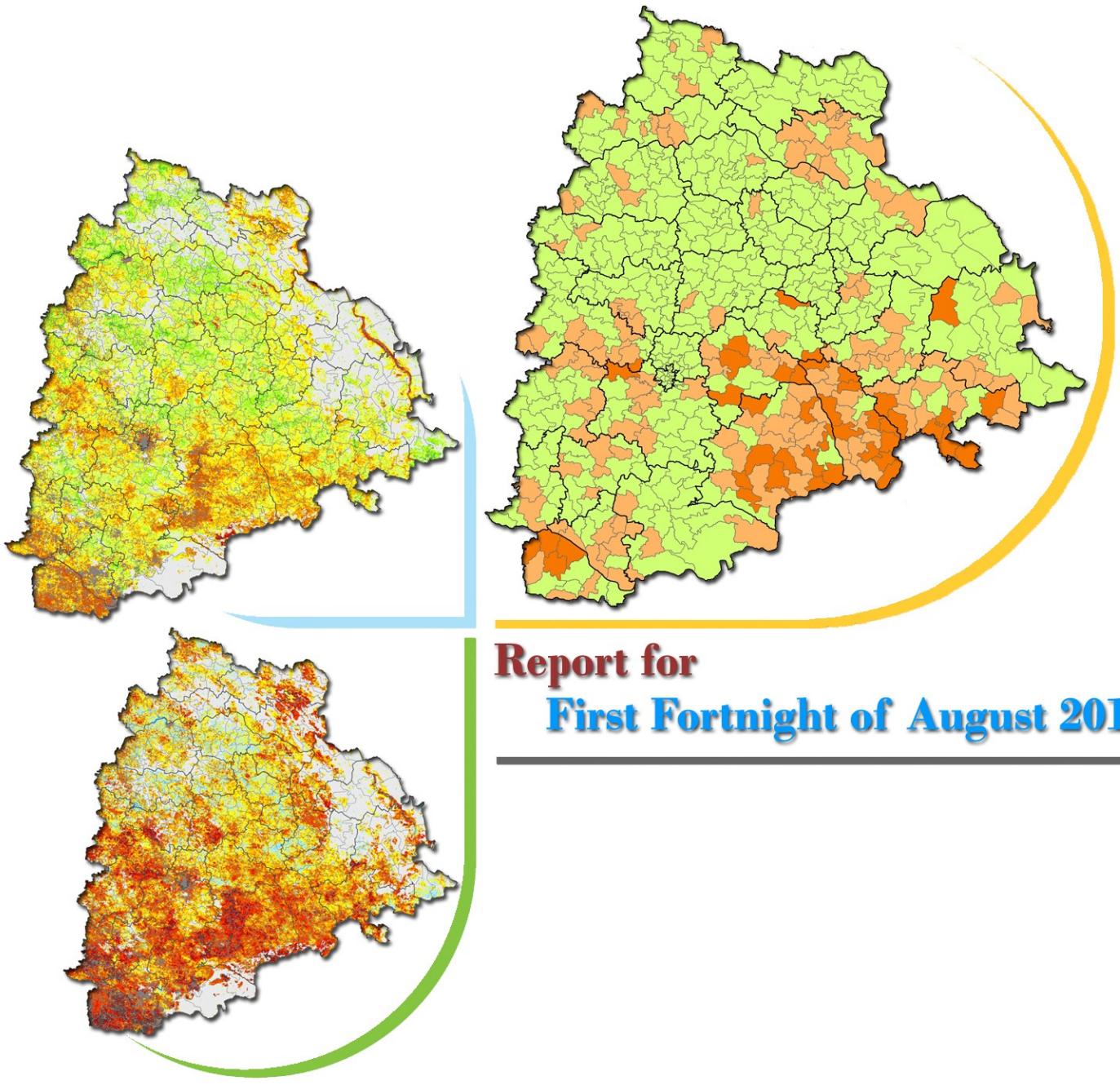
http://trac.telangana.gov.in

Seasonal Condition (Agricultural Drought) Monitoring

Telangana State



Report for
First Fortnight of August 2019

TELANGANA STATE REMOTE SENSING APPLICATIONS CENTRE

Planning Department, Government of Telangana

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Acknowledgement

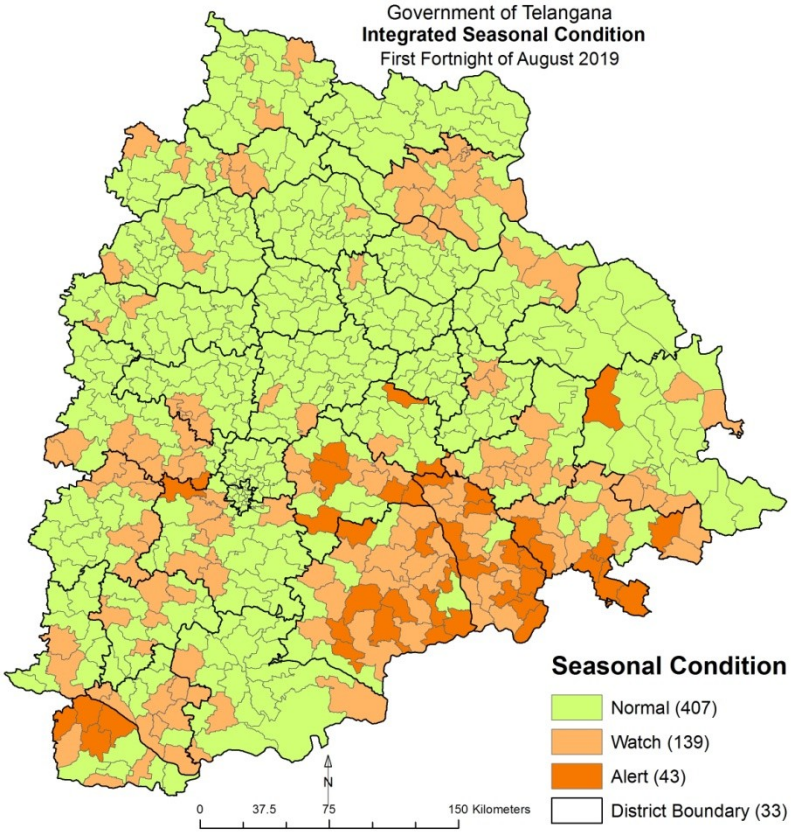
We take this opportunity to express our sincere thanks to Directorate of Economics and Statistics, Telangana State Developing Planning Society, and India Meteorological Department for providing rainfall data. We also express our gratitude to Department of Agriculture and Irrigation Department for sharing progress of crop sowings and reservoir water levels data respectively for integrated seasonal condition monitoring of the state.

HIGHLIGHTS

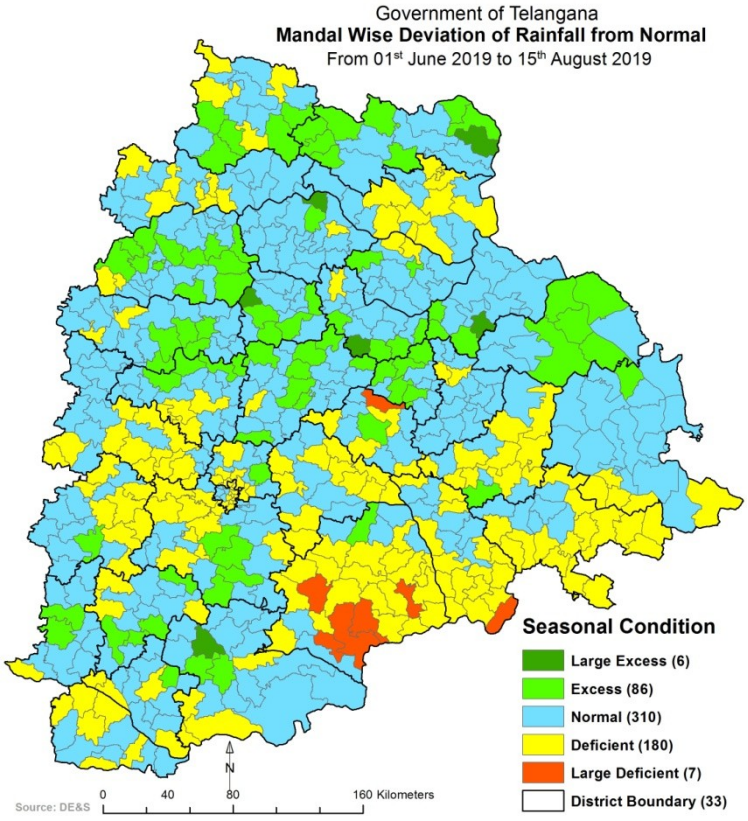
INTEGRATED SEASONAL CONDITION MONITORING SYSTEM (ISMS) - TELANGANA

Cumulative Report June 01st to 15th August, 2019

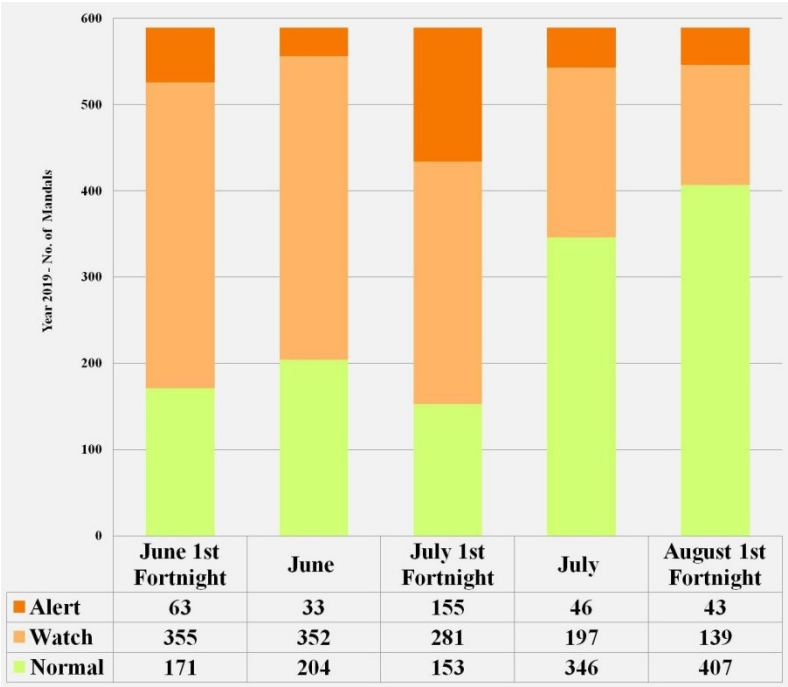
- Seasonal condition is categorised as **"Normal"** in **407** Mandals as on date 15th August 2019
- Seasonal condition is categorised as **"Watch"** in **139** Mandals as on date 15th August 2019
- Seasonal condition is categorised as **"Alert"** in **43** Mandals as on date 15th August 2019



Seasonal Condition First Fortnight of August 2019



Rainfall from 1st June to 15th August 2019



	June 1st Fortnight	June	July 1st Fortnight	July	August 1st Fortnight
Alert	63	33	155	46	43
Watch	355	352	281	197	139
Normal	171	204	153	346	407

Seasonal condition of Telangana First Fortnight of August 2019

Rainfall 01st June to 15th August, 2019

- **180** Mandals out of 589 (**31%**) of state received ***Deficient*** rainfall. **86** Mandals (**15%**) of the state received ***Excess*** rainfall. **7** Mandals (**1%**) of the state received ***Large Deficient*** rainfall. **6** Mandals (**1%**) of the state received ***Large Excess*** rainfall.

- **310** Mandals (**53%**) have received ***Normal*** rainfall respectively.

CONTENTS

List of Tables

List of Figures

1. Background and Rationale

Drought is a complex natural hazard. It is defined as any deficiency of water to satisfy the normal need to agriculture, livestock, industry, or human population. Drought assessment and monitoring is essential for the agricultural sector to take appropriate mitigation measures. Drought indices derived from satellite data play a major role in assessing the health and condition of the crops/vegetation.

National Agricultural Drought Assessment and Monitoring System (NADAMS) project of National Remote Sensing Centre (NRSC), Indian Space Research Organization (ISRO) established a remote sensing based drought assessment protocol utilizing the Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI). The Government of India has established Mahalanobis National Crop Forecast Centre (MNCFC) under Department of Agriculture and Cooperation, New Delhi for carrying out drought assessment at national level.

The Department of Agriculture and Cooperation, Government of India published a drought manual in 2016 which suggested parameters like rainfall deficiency, area under sowing, NDVI, NDWI, Moisture Adequacy Index (MAI) and other indictors to declare drought. State Government monitor drought by obtaining information from various sources on key variables of drought which include rainfall, reservoir / lake water levels, surface water / groundwater, soil moisture and sowing / crop conditions etc. The key variables for monitoring drought in Telangana are:

- Meteorological Data – Rainfall and other parameters like Temperature, Wind speed and Relative Humidity (AWS data)
- Weather forecast - Short, medium, extended range
- Soil Moisture (Moisture Adequate Index)
- Sown Area / Crop Health / Stress
- Satellite based Vegetation Index (NDVI/NDWI)
- Stream Flow - Discharge
- Groundwater Levels
- Reservoir and Lake Storage / Level
- Impacts – distress sale and migration of cattle, human migration, fodder availability, drinking water, animal health, employment opportunities in agriculture sector

An extensive weather observation network of 1044 Automatic Weather Stations (AWS) is established in Telangana. Telangana State Development Planning Society (TSDPS) monitors the data and maintains the networks. Figure 1 showing the location of AWS stations in Telangana.

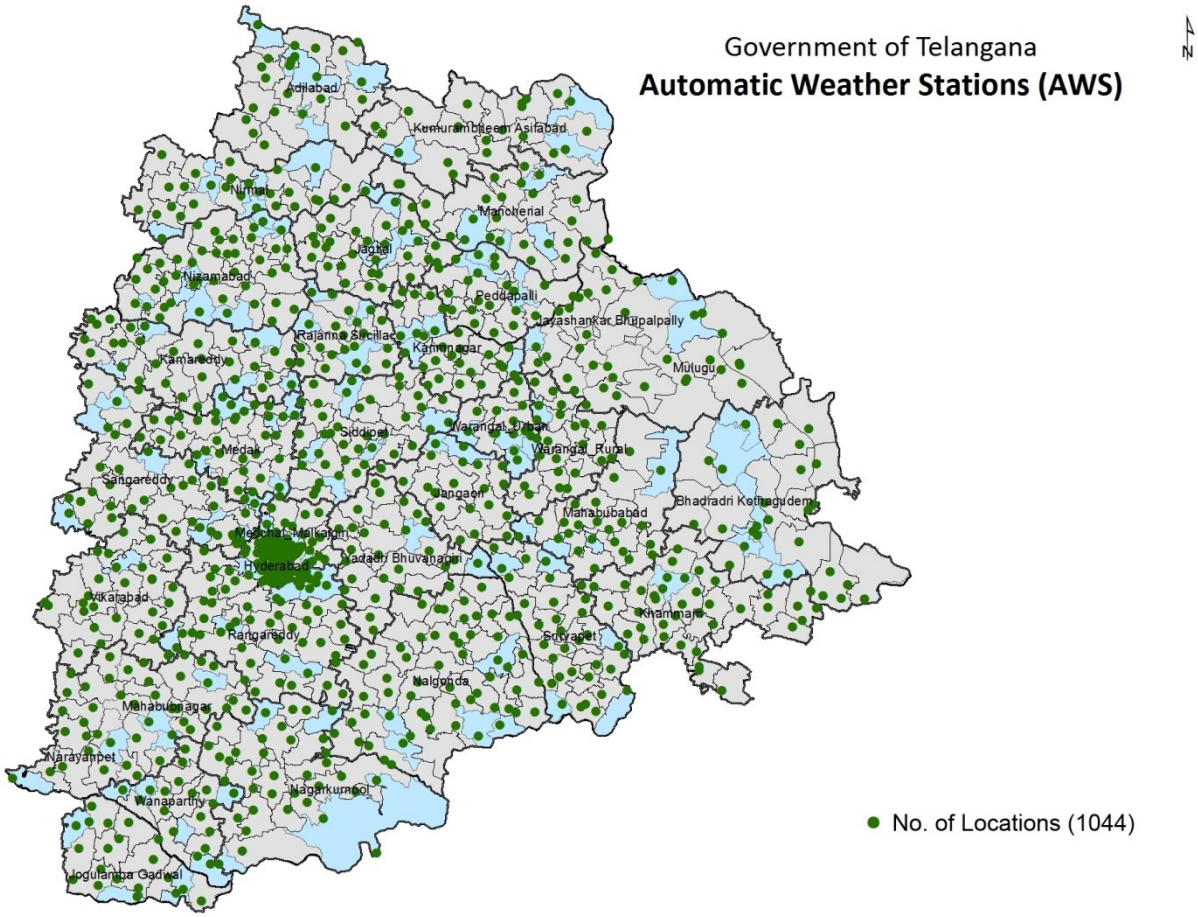


Figure 1: Location of automatic weather stations

Telangana State Remote Sensing Applications Centre (TRAC) has established a protocol ***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 and forecasting) of drought 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.*

ISMS uses the rainfall data provided by Directorate of Economics & Statistics (DE&S), weekly progress of crop area sowings, groundwater level and its fluctuation, command and non-command area, water releases data, reservoir levels in addition to the Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI) based methodology of MNCFC. This output is verified through ground truth, additionally in context of the state specific drought declaration criteria. The agricultural situation is classified in three to four categories as per the NRSC i.e. Normal, Watch, Alert for June to August and Normal, Mild, Moderate and Severe for September to October. The details of the classification of agricultural situation are given in Table 1.

Table. 1. Classification of agricultural situation

Duration	Condition	Description
July - August	Normal	• Agricultural situation is normal
	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
September - October	Mild drought	• Crops have suffered stress slightly
	Moderate drought	• Considerable loss in production. • Take measures to alleviate suffering
	Severe	• High risk significant reduction in crop yield • Management measures to provide relief

2. Data used, Indicators and Methodology

2.1. Data used

Details of data used under project are discussed in Table 2.

Table. 2. Data source and indicators

Data source	Product	Indicators
MODIS (250/500m)	Surface reflectance	NDVI & NDWI
AWiFS	Surface reflectance	NDVI & NDWI
AWS/ DES	• Daily rainfall • Crop sown area • Crop cutting experiments	• Rainfall deviation • Dry spells • Crop yield
Agriculture Department, GoTS	Weekly sowing progress	District wise sown areas deviation from normal
Irrigation Department, GoTS	Reservoir levels/ Water release data	Command area Mandals under canal irrigation

2.2. Indicators and Index

2.2.1. Rainfall data

In Telangana, South-West Monsoon is crucial for agriculture sector. ISMS use integrated (AWS+DES+IMD) Mandal wise rainfall data provided by Directorate of Economics & Statistics (DES). This data is used for computation of meteorological drought situation and to derive the mandal wise spatial distribution of rainfall in the state.

2.2.2. Reservoir water levels and water release - major and medium project

A scheme having Culturable Command Area **(**CCA) up to 2,000 hectares individually is classified as minor irrigation scheme. A scheme having CCA more than 2,000 hectares and up to 10,000 hectares individually is a medium irrigation scheme. A scheme having CCA more than 10,000 hectares is major irrigation scheme. In Telangana, water is released during Kharif season to major and medium command areas.

2.2.3. Crop sowing progress

Weekly crop sowing progress reports are taken from 'Season and Crop Coverage Report-Kharif 2019' of Commissioner of Agriculture, Telangana. The report includes current status of Weather condition, Water level, Crop sowing and Agricultural Operations.

2.2.4. Vegetation index

The crop/vegetation reflects high energy in the near infrared band due its canopy geometry and health of the standing crops/vegetation and absorbs high in the red band due to its biomass and photosynthesis. Uses of these contrast characteristics of vegetation in near infrared and red bands indicate both the health and condition of the crops/vegetation. Normalised Difference Vegetation Index (NDVI) is widely used for operational drought assessment because of its simplicity in calculation, easy to interpret and its ability to partially compensate for the effects of atmosphere, illumination geometry etc., (Malingreau 1986, Tucker and Chowdhary 1987, Kogan 1995). NDVI is derived by the difference of these measurements and divided by their sum.

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$

The vegetation index is generated from each of the available satellite data irrespective of the cloud cover present. To minimize the cloud, monthly time composite vegetation index is generated.

2.2.5. Surface wetness indicator

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 background 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;

$$NDWI = \frac{(NIR - SWIR)}{(NIR + SWIR)}$$

Higher values of NDWI signify more surface wetness. The wetness index is generated from each of the available satellite data irrespective of the cloud cover present. To minimize the cloud, monthly time composite wetness index is generated.

2.2.6. Vegetation condition index

Kogan (1995) developed Vegetation Condition Index (VCI) using the range of NDVI as under,

$$VCI = \frac{(NDVI - NDVI\ min)}{(NDVI\ max - NDVI\ min)} * 100$$

The current drought assessment expressed as percentage of deviation of NDVI and NDWI based on 10 year NDVI and NDWI index values. The minimum and maximum value of NDVI and NDWI, the VCI discriminated between the weather components.

2.3 Methodology

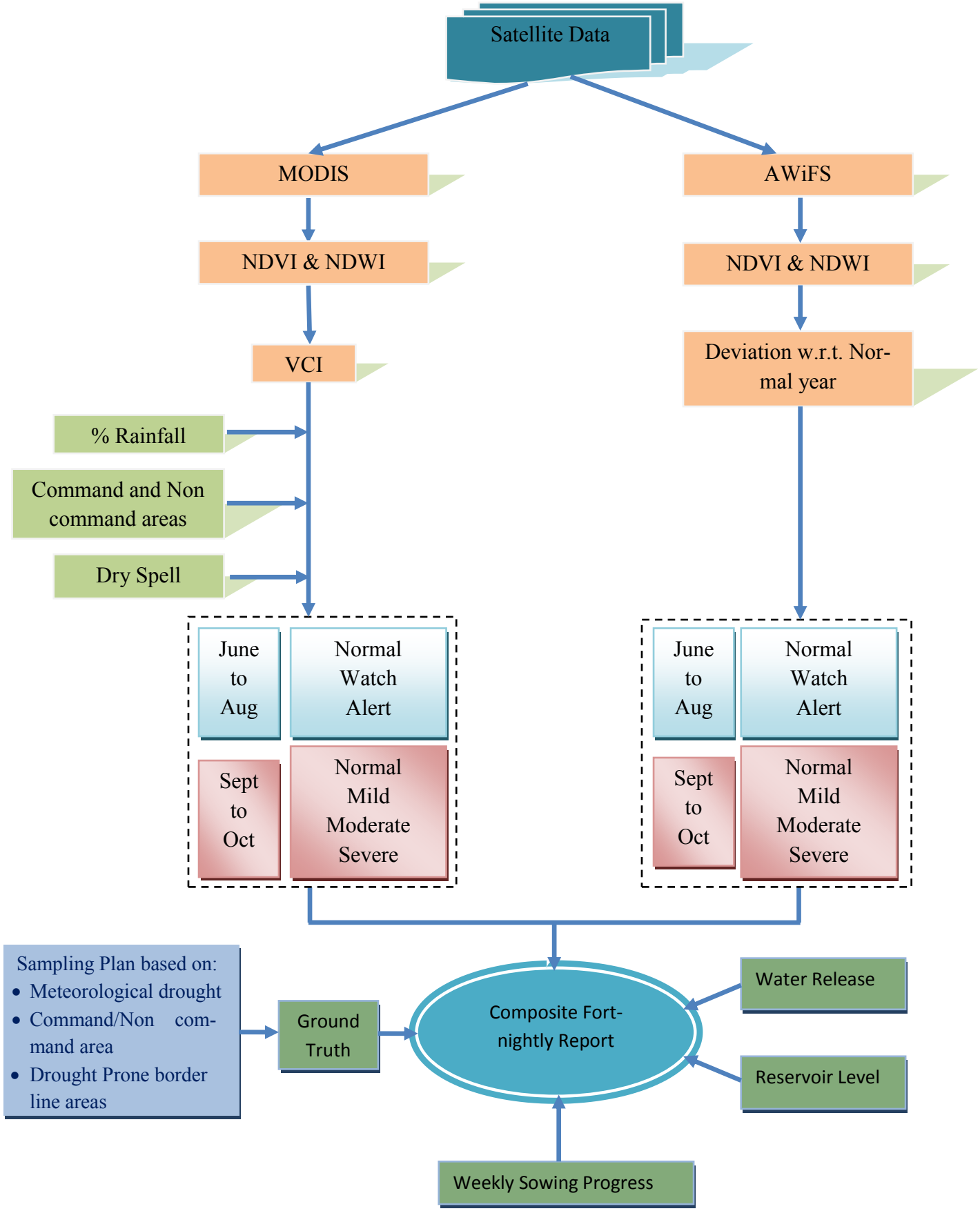


Figure 2: Flow chart of drought assessment methodology

The methodology to assess and monitor the agricultural conditions and situation in the state at district and Mandal level uses IRS Resourcesat-2 AWiFS data. Indian Remote Sensing satellite (IRS) Resourcesat-2 having Advanced Wide Imaging Field Sensor (AWiFS) payload collects data in two spectral bands 0.62-0.68 µm (red) and 0.77-0.86 µm (near infrared) with spatial resolution of 56 m and ground swath of 740 km with a revisit period of 5 days. Along with this MODIS 250/500 m satellite data provide spectra, radiometric and spatial resolutions products for better monitoring of the agriculture. The combination of AWiFS and MODIS is useful to increase the frequency of images.

The different activities carried out through ISMS commence with acquisition of MODIS (250 m) and AWiFS (56 m) satellite data. The satellite data being processed and NDVI and NDWI indices are developed. Based on these indices deviation with respect to normal year (2013) is calculated and Mandal wise statistics are derived. The agricultural situation is assessed incorporating rainfall deviation, command and non command areas, dry spell, drought prone border line areas, crop sown area progress and ground truth along with satellite derived indices. The flow chart of methodology is shown in Figure 2.

3. Present status up to First Fortnight of August 2019

3.1. Rainfall data

The status of rainfall as on 15th August 2019 is shown in Table.3.

- **6** Mandals (**1%**) of the state received **Large Excess** (+60% and above) rainfall.
- **86** Mandals (**15%**) of the state received **Excess** (+20% to +59%) rainfall.
- **310** Mandals (**53%**) have received **Normal** (+19% to -19%) rainfall.
- **180** Mandals out of 589 (**31%**) of state received **Deficient** (-20% to -59%) rainfall.
- **7** Mandals (**1%**) of the state received **Large Deficient** (-60% to -99%) rainfall.

Table. 3. Rainfall status as on 15th August 2019

S. No	District Name	Large Excess	Excess	No Rain	Normal	Deficient	Large Deficient	Total
1	Adilabad		5		8	5		18
2	Bhadradri Kothagudem		1		17	5		23
3	Hyderabad				5	11		16
4	Jagtial	1	1		15	1		18
5	Jangoan		1		6	4	1	12
6	Jayashankar Bhupalpally	1	3		7			11
7	Jogulamba Gadwal				6	6		12
8	Kamareddy		5		15	2		22
9	Karimnagar	1	4		10	1		16
10	Khammam				6	15		21
11	Kumurambheem Asifabad	1	8		6			15
12	Mahabubabad		1		5	10		16
13	Mahabubnagar		4		8	3		15
14	Mancherial				9	9		18
15	Medak		4		12	4		20
16	Medchal Malkajgiri		1		6	8		15
17	Mulugu		5		4			9
18	Nagarkurnool	1	2		13	4		20
19	Nalgonda		1		6	19	5	31
20	Narayanpet		2		8	1		11
21	Nirmal				13	6		19
22	Nizamabad		13		14	2		29
23	Peddapalli		2		10	2		14
24	Rajanna Sircilla	1	4		8			13
25	Rangareddy		4		14	9		27
26	Sangareddy				14	12		26
27	Siddipet		8		14	1		23
28	Suryapet				7	15	1	23
29	Vikarabad		1		9	8		18
30	Wanaparthy		1		9	4		14
31	Warangal Rural				14	2		16
32	Warangal Urban		5		6			11
33	Yadadri Bhongir				6	11		17
		6	**86**		**310**	**180**	**7**	**589**

SOURCE: DE&S

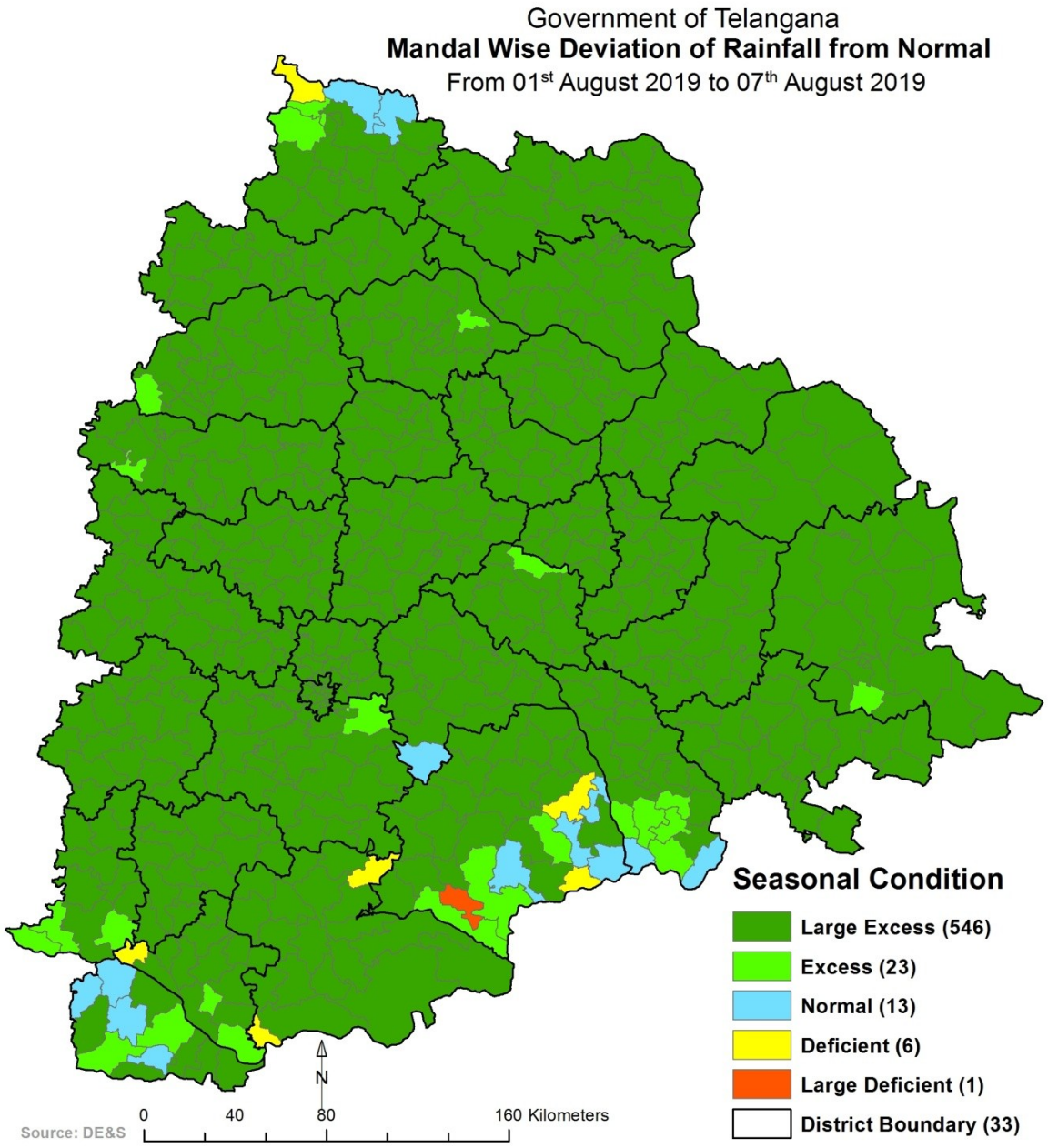


Figure 3: Deviation of rainfall in percent w.r.t. normal from August 01st to August 07th, 2019

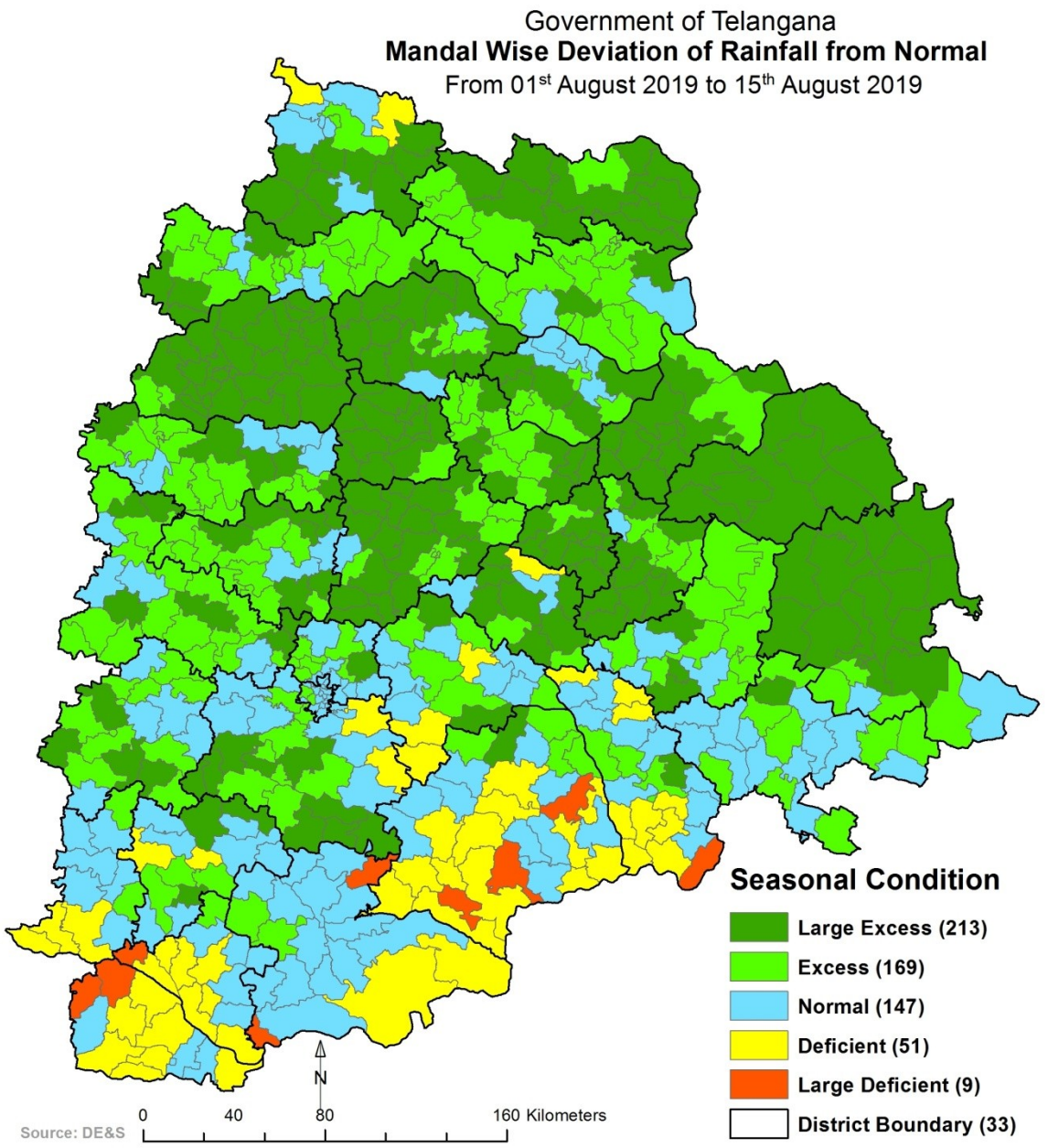


Figure 4: Deviation of rainfall in percent w.r.t. normal from August 01st to August 15th, 2019

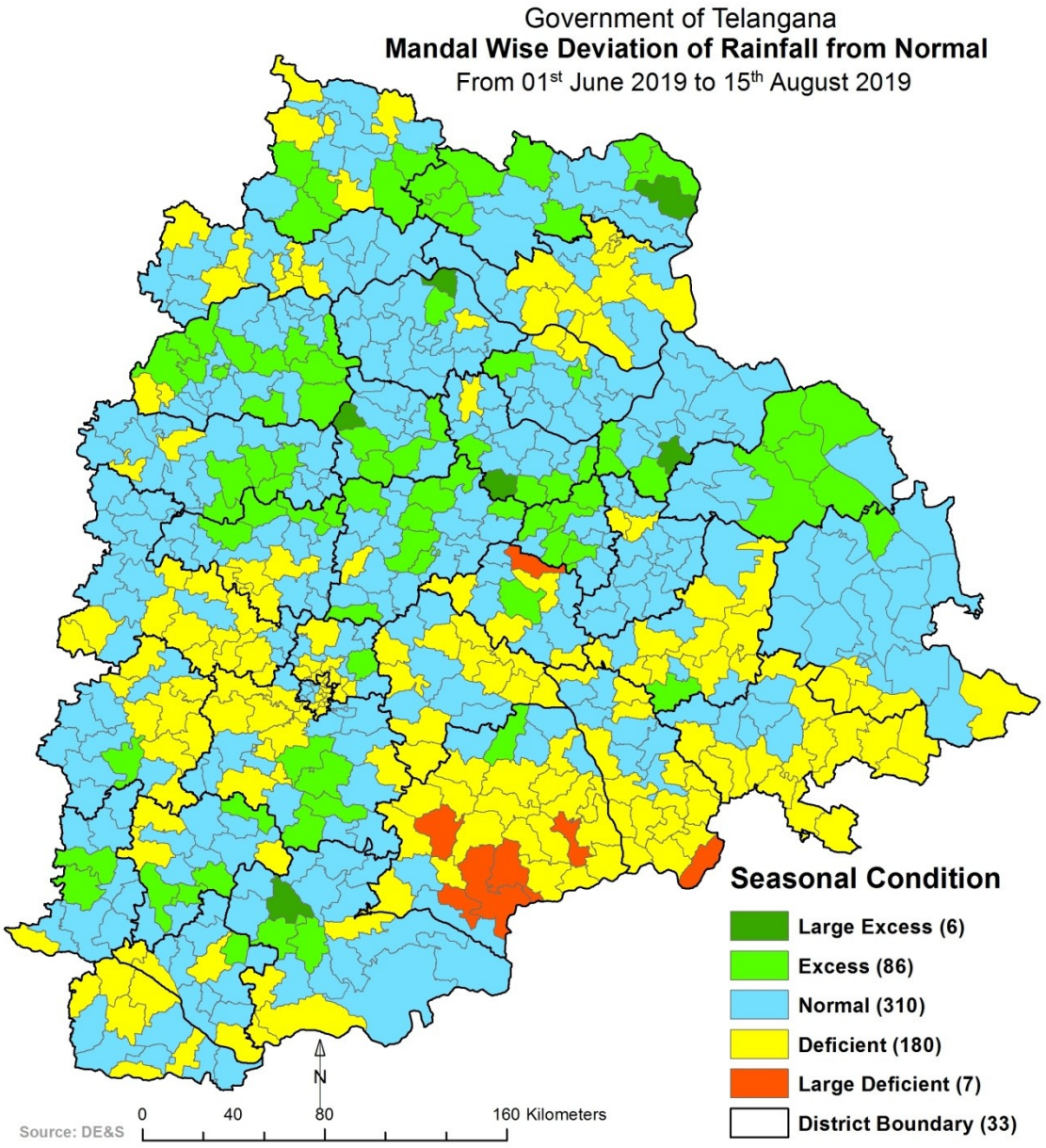


Figure 5: Deviation of rainfall in percent w.r.t. normal from June 01st to August 15th, 2019

3.2. Reservoir water levels

All the major reservoirs are holding 977 TMC as on 15-08-2019, and as on date last year the level had stood at 745 TMC. The details of water levels of all major reservoirs as on 15-08-2019 are furnished hereunder in Table.4.

Table.4. Reservoir Water Levels

PARTICULARS OF MAJOR RESERVOIRS AS ON 15/August /2019										
Sl No	Reservoir Name	Time	FRL	Gross Capacity	THIS YEAR				LAST YEAR	
					As on 15 / August / 2019				As on 15 / August / 2018	
			(feet)	(TMC)	Level (in feet)	Gross Storage (TMC)	Inflow (Cusecs)	Outflow (Cusecs)	Level (in feet)	Gross Storage (TMC)
Krishna Basin										
1	Almatti	10:15	1705	129.721	1700.82	107.92	538354	560991	1704.66	127.83
2	Jurala	09:51	1045	9.657	1038.39	5.94	718952	718778	1043.44	8.69
3	Nagarjunasagar	09:19	590	312.045	585.6	299.166	735644	515206	523.4	155.55
4	Narayanapur	10:16	1615	37.646	1605.64	25.79	577913	583892	1614.04	36.88
5	Srisailam	09:53	885	215.807	881.4	195.66	946432	844462	872.2	151.14
6	Tungabhadra	09:52	1633	100.86	1633	100.86	93336	64840	1631.34	95.64
7	Ujjaini	09:50	1630	117.24	1630	117.24	17129	17411	1619.46	83.97
Godavari Basin										
8	Jaikwad	09:55	1522	102.732	1520.53	96.59	7622	2790	1505.34	47.48
9	Kaddam	09:58	700	7.6	697.43	6.95	2015	880	698.45	7.201
10	Lower Manair Dam	09:57	920	24.074	881.85	3.52	0	204	881.4	3.41
11	Nizam sagar	09:56	1405	17.803	1368.36	0.14	26	10	1384.4	2.25
12	Singur	09:56	1717.93	29.91	1670.49	0.46	0	20	1696.52	7.36
13	Sri Ram Sagar	09:57	1091	90.313	1062.9	17.18	2000	389	1063	17.322

Source: Irrigation Department, Hyderabad

3.3. Crop Sowing Progress

For the end of 14th August 2019, the total area sown in the state is **3448202** ha as against the normal sown area of **4334487** hectare as on date. The details are shown in Figure 6 and the deviation graph is shown in Figure 7.

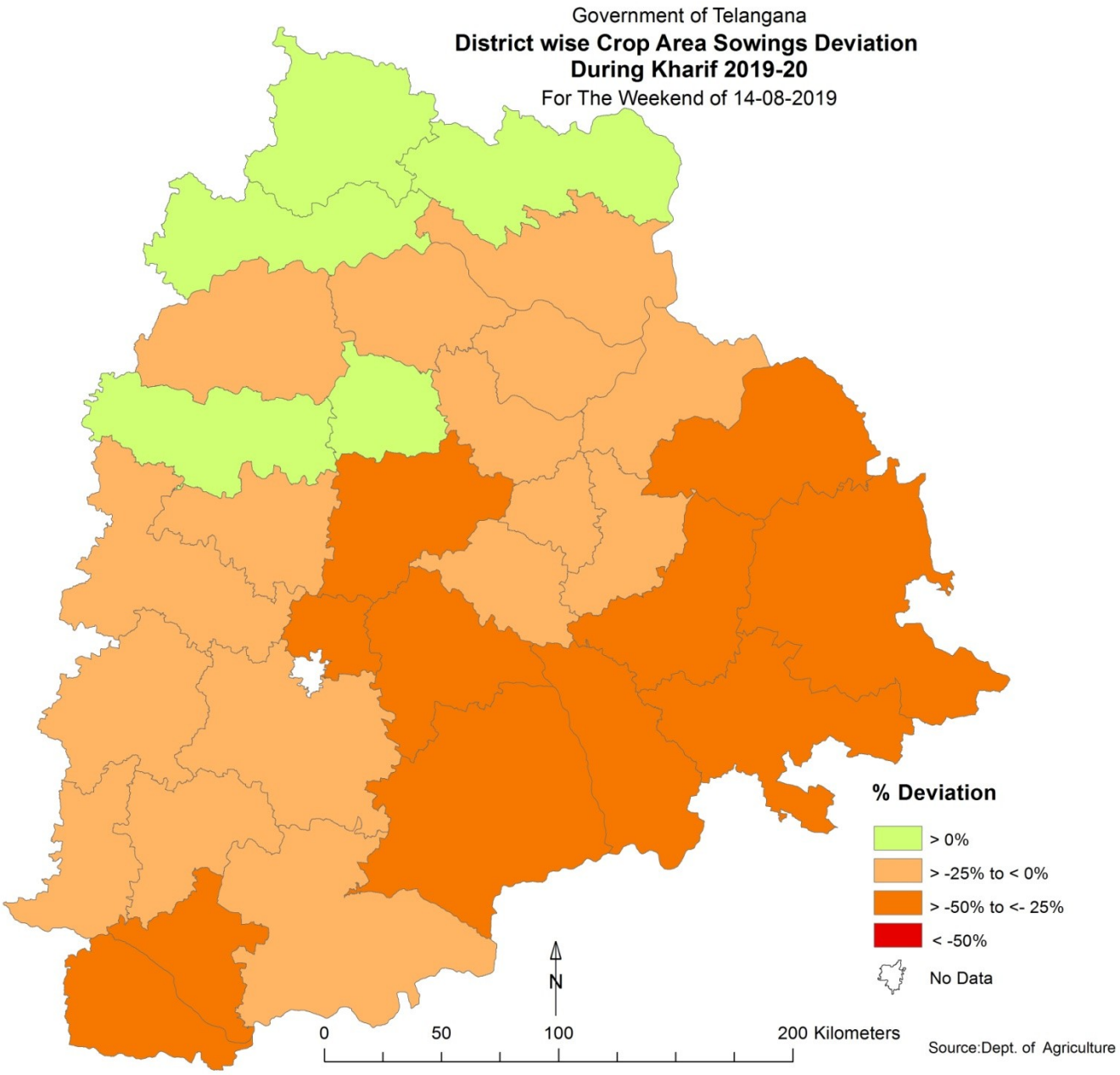


Figure 6: District wise deviation from normal crop sown area as on date 14-08-2019

Table 5: District Wise Crop Sowing Area - Up to the week ending 14-08-2019

S. No	District Name	Normal (ha)	Actual (ha)	Deviation %
1	**Khammam**	230498	119905	-47.98
2	Suryapet	157521	83548	-46.96
3	Wanaparthy	80405	44448	-44.72
4	Mulugu	54281	31343	-42.26
5	Jogulamba Gadwal	133468	88772	-33.49
6	Medchal Malkajgiri	7183	4852	-32.45
7	**Nalgonda**	335088	231917	-30.79
8	Siddipet	195839	136467	-30.32
9	Yadadri Bhuvanagiri	123426	87886	-28.79
10	Mahabubabad	120876	90198	-25.38
11	Bhadradri Kothagudem	124651	93317	-25.14
12	Peddapalle	85953	64667	-24.76
13	**Rangareddy**	167894	127531	-24.04
14	Jayashankar Bhupalpally	85228	65914	-22.66
15	**Warangal Rural**	138259	108216	-21.73
16	Jangaon	107473	86144	-19.85
17	Nagarkurnool	216703	174526	-19.46
18	**Medak**	83373	68350	-18.02
19	**Karimnagar**	111169	91354	-17.82
20	Narayanpet	137387	113223	-17.59
21	**Mahabubnagar**	117368	100196	-14.63
22	Jagtial	119149	103951	-12.76
23	Sangareddy	224132	198258	-11.54
24	Warangal Urban	55790	49483	-11.30
25	**Nizamabad**	169540	150385	-11.30
26	Mancherial	94260	83681	-11.22
27	Vikarabad	172153	155958	-9.41
28	**Hyderabad**	0	0	0.00
29	Kumarambheem Asifabad	124465	124833	0.30
30	**Adilabad**	193072	194110	0.54
31	Kamareddy	145275	146172	0.62
32	Nirmal	145982	148228	1.54
33	Rajanna Sircilla	76626	80369	4.88
	Total	**4334487**	**3448202**	

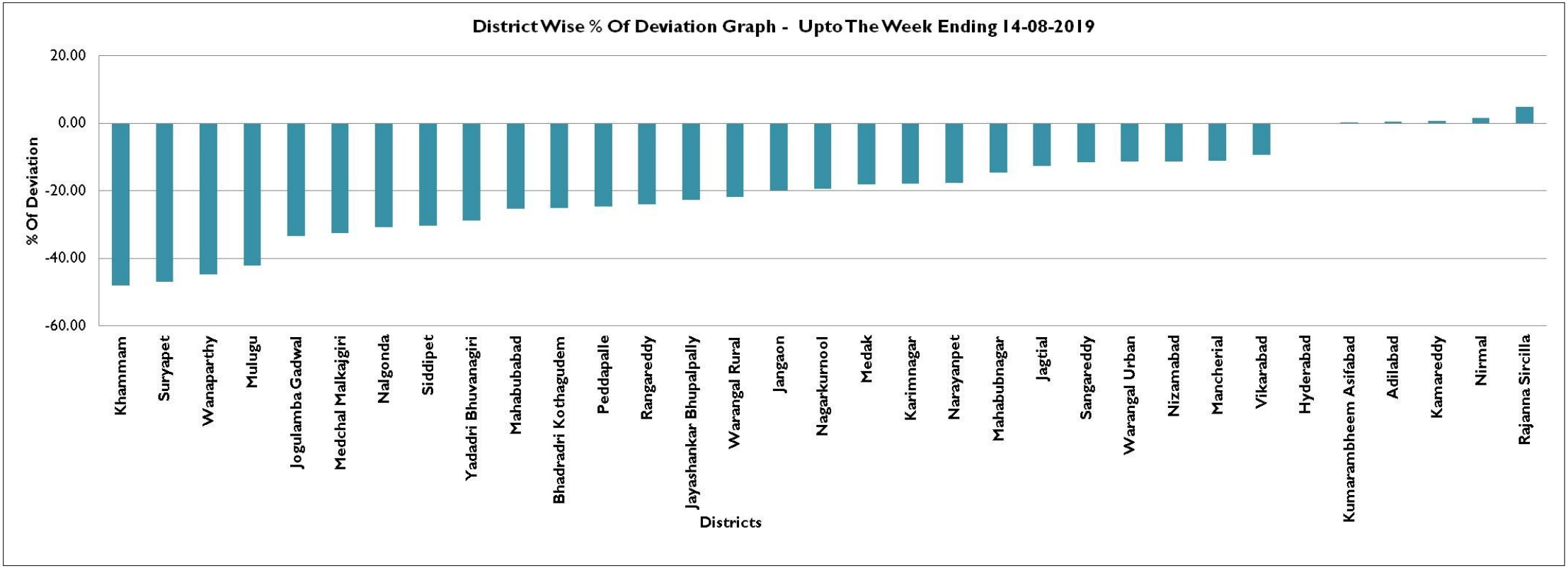


Figure7: District wise deviation (graph) from normal crop sown area as on date 14-08-2019

3.4. Vegetation index

The Normalized Difference of Vegetation Index (NDVI) for the First Fortnight of August 2019 is shown in the figures and also compared with 2018 and 2017. The year 2013 is treated as a normal year. Mandal wise NDVI, monthly agricultural situation for the year 2019, 2018 and 2017, deviation of NDVI w.r.t. 2013 are shown in the Figures 8, 9and 10 respectively. As per NDVI deviation w.r.t normal moderate stress is observed in Jogulamba Gadwal, Khammam, Nalgonda, Narayanpet, Suryapet and Yadadri Districts.

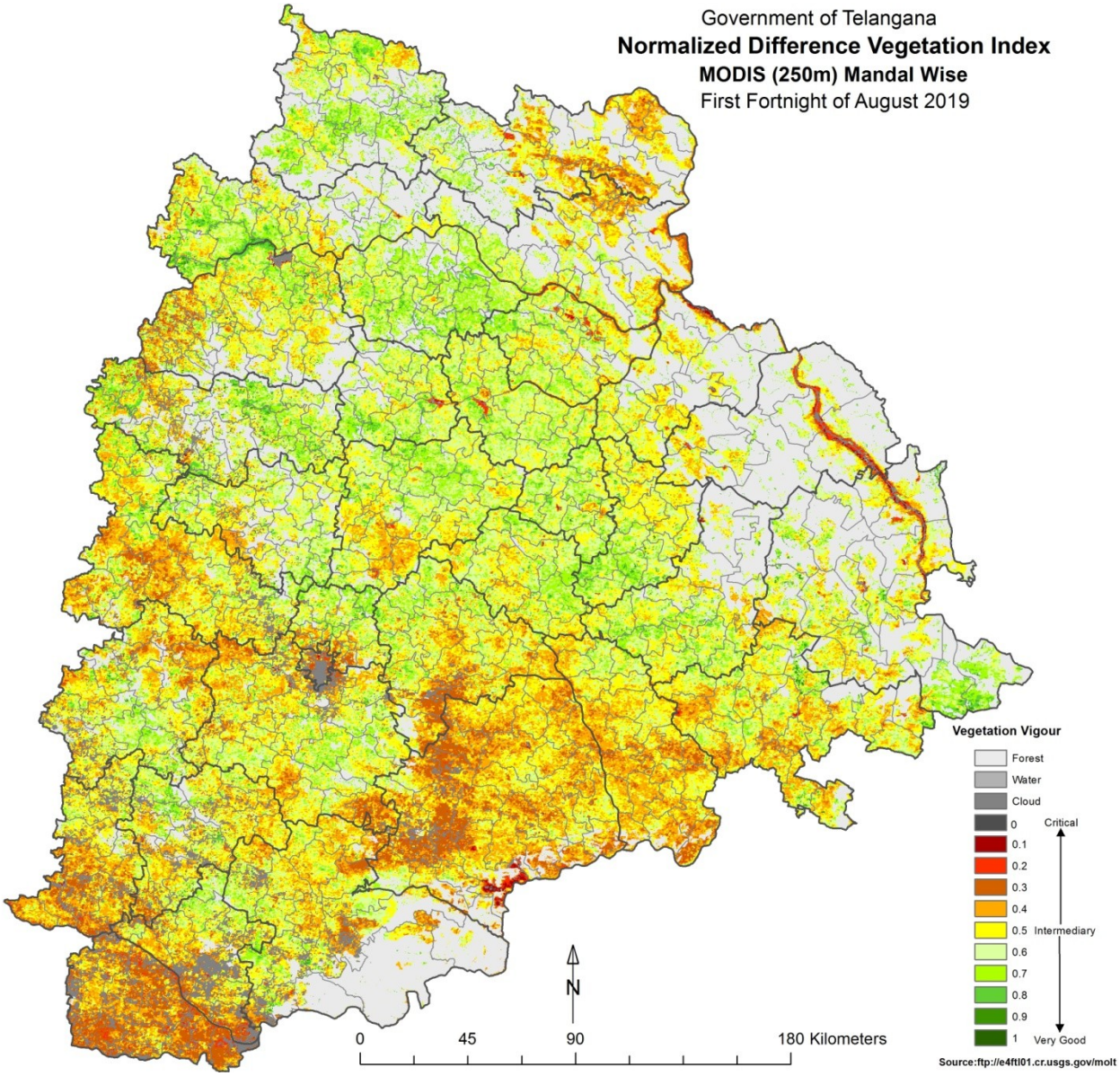


Figure 8: NDVI - MODIS: First Fortnight of August 2019

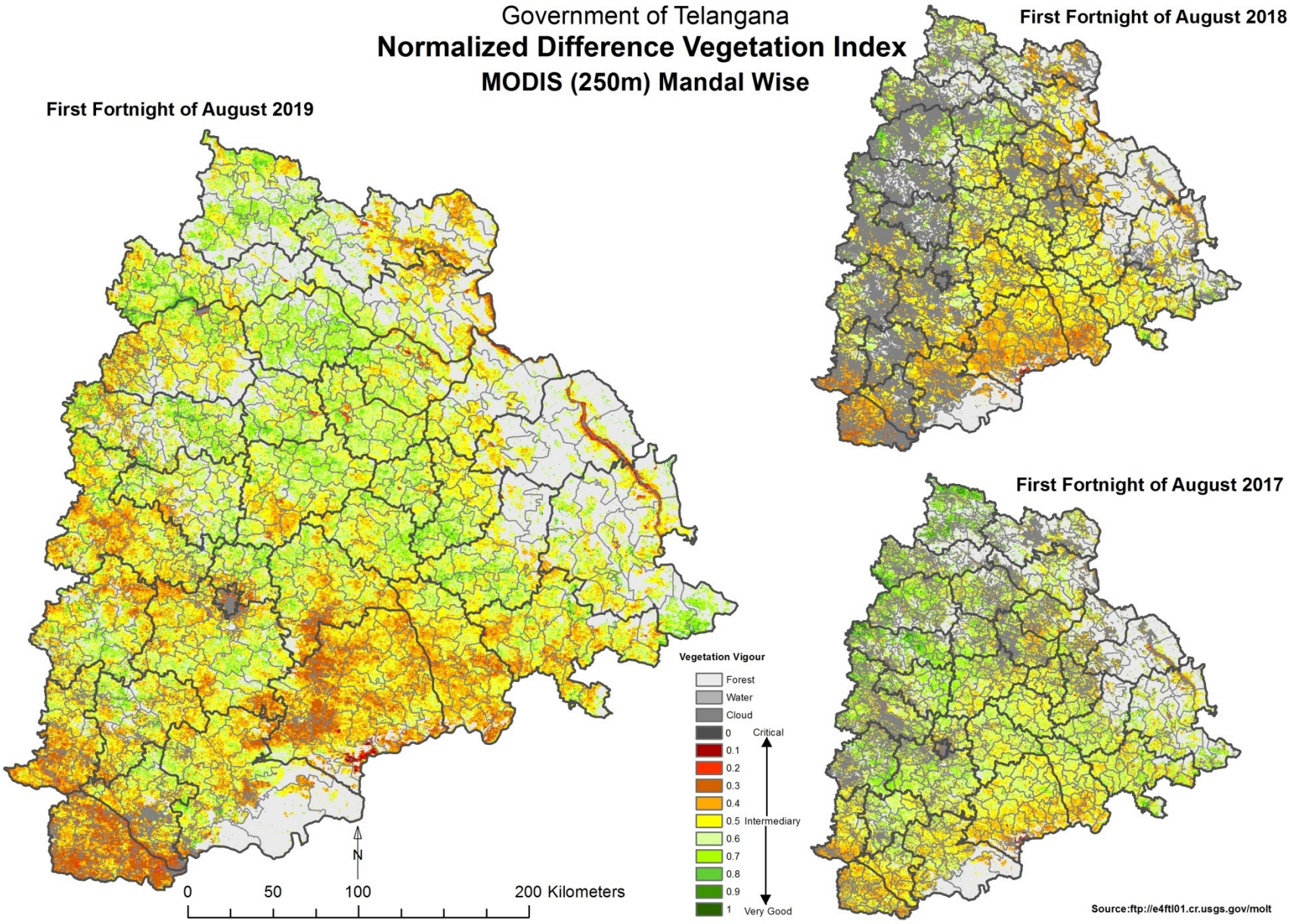


Figure 9: NDVI - MODIS, Yearly agricultural situation from August 2019, 2018 and 2017

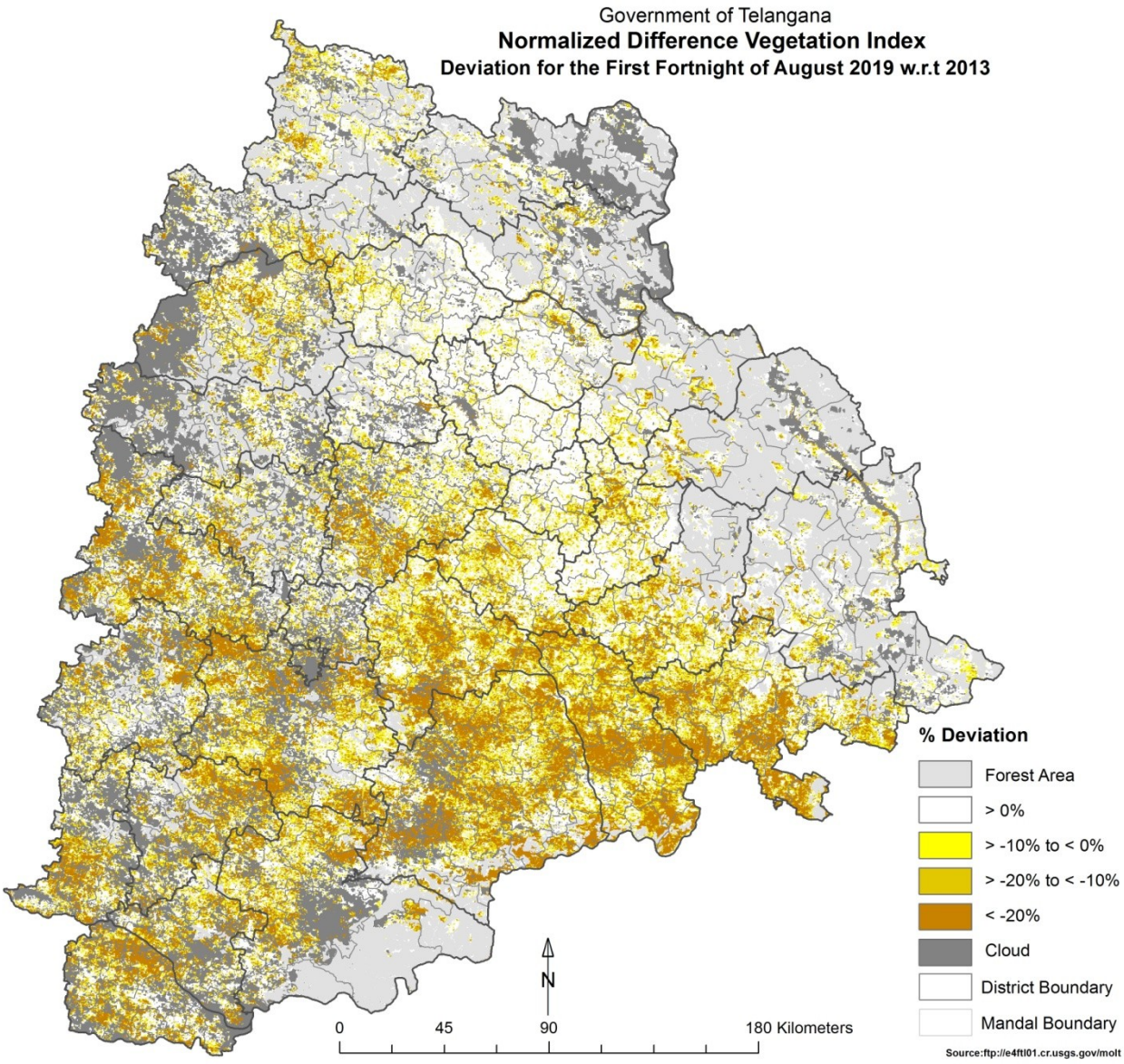


Figure 10: NDVI deviation (MODIS - 250m), First Fortnight of August 2019 w.r.t. 2013

3.5. Surface wetness indicator

The map indicates status of moisture availability in soil as well as in crop canopy for the First fortnight of August 2019. The year 2013 is treated as a normal year. Mandal wise Normalized Difference Water Index (NDWI) situation the year 2019, 2018 & 2017, Monthly agricultural situation deviation of NDWI w.r.t. 2013 are shown in the Figures 11, 12 and 13 respectively. As per NDWI deviation w.r.t normal, moderate stress is observed in few parts of J.Gadwal, Khammam, Mahabubnagar, Nalgonda, Sangareddy and Suryapet Districts.

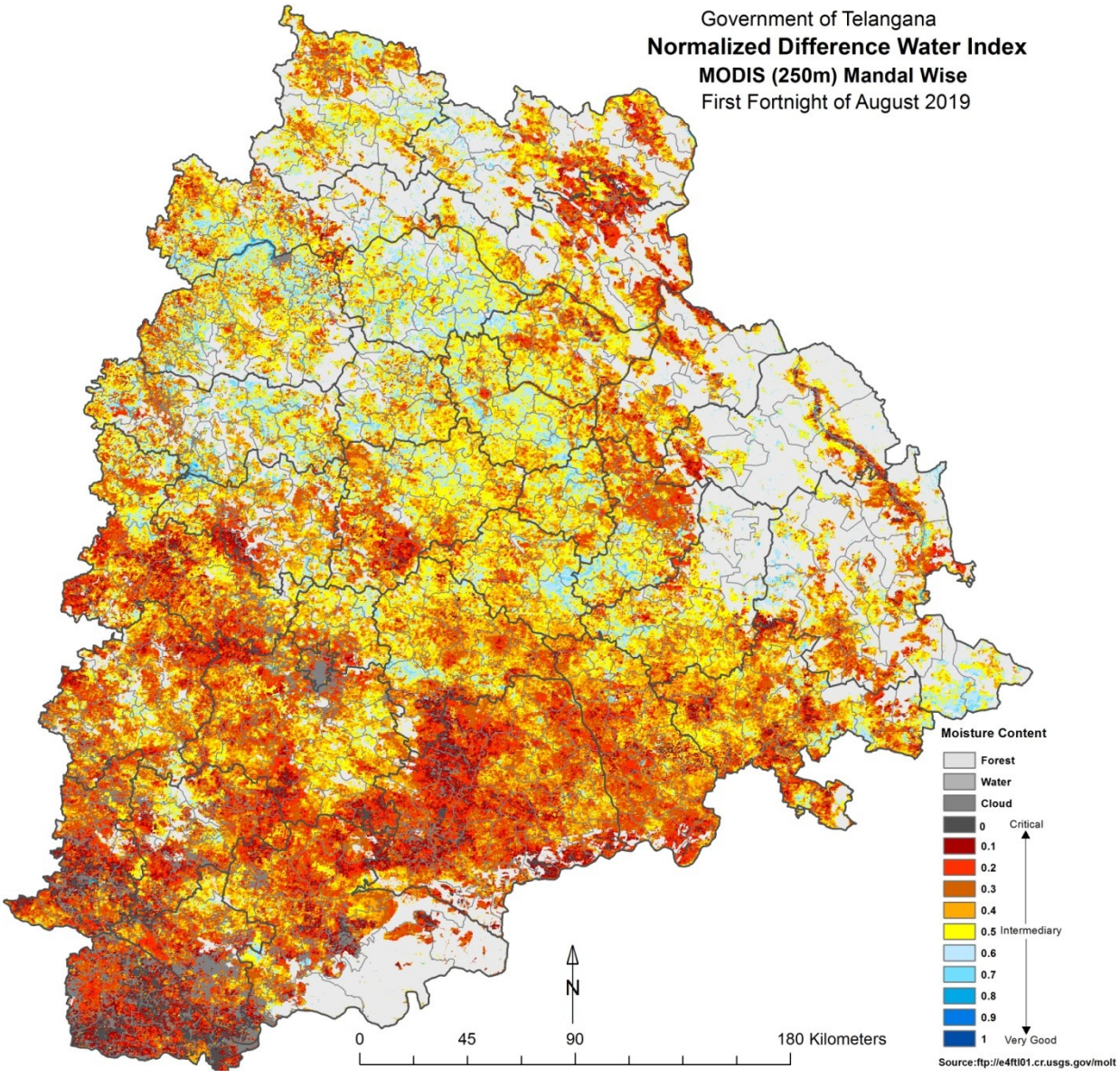


Figure 11: NDWI - MODIS: First Fortnight of August 2019

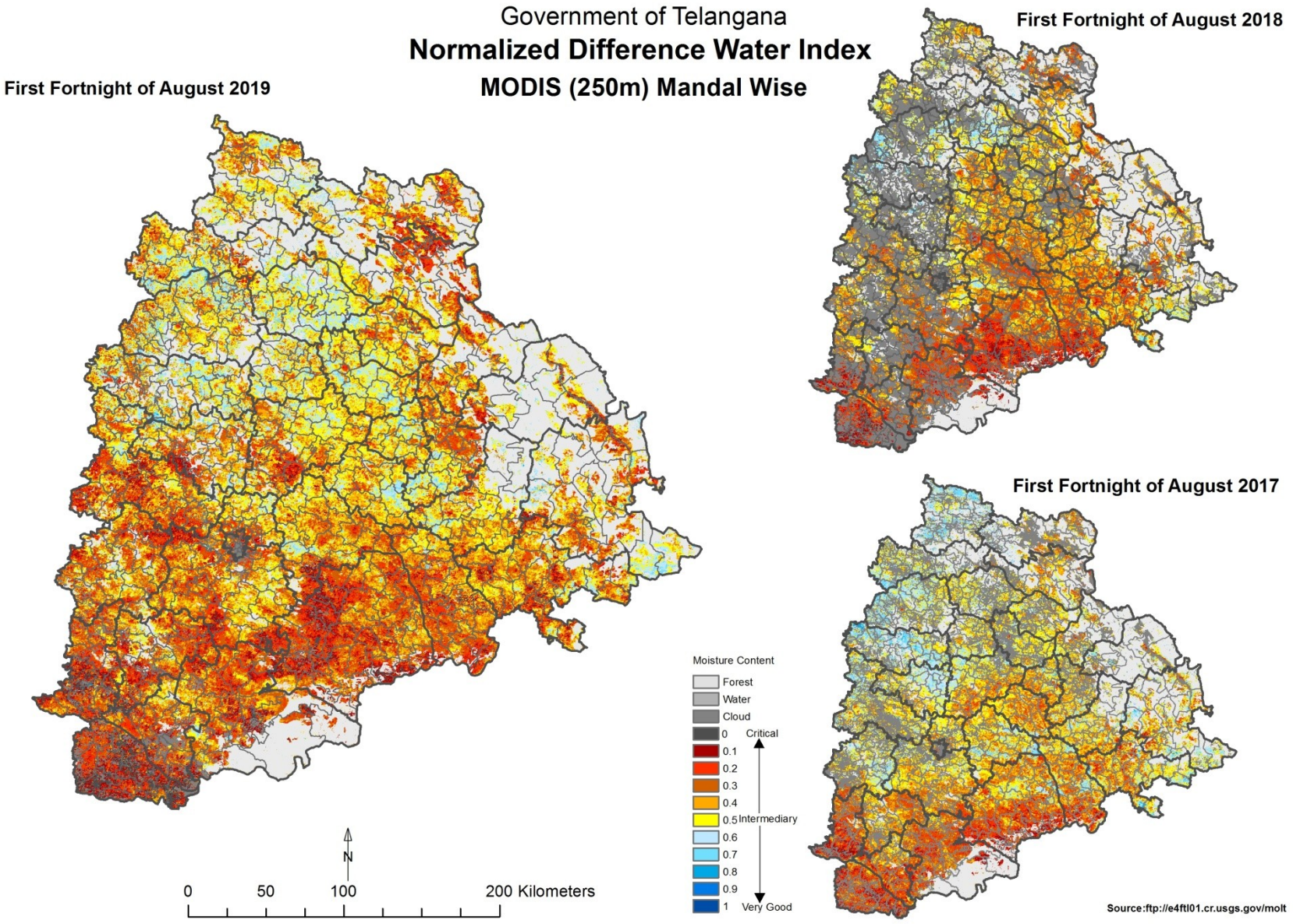


Figure 12: NDWI - MODIS, Yearly agricultural situation from August 2019, 2018 and 2017

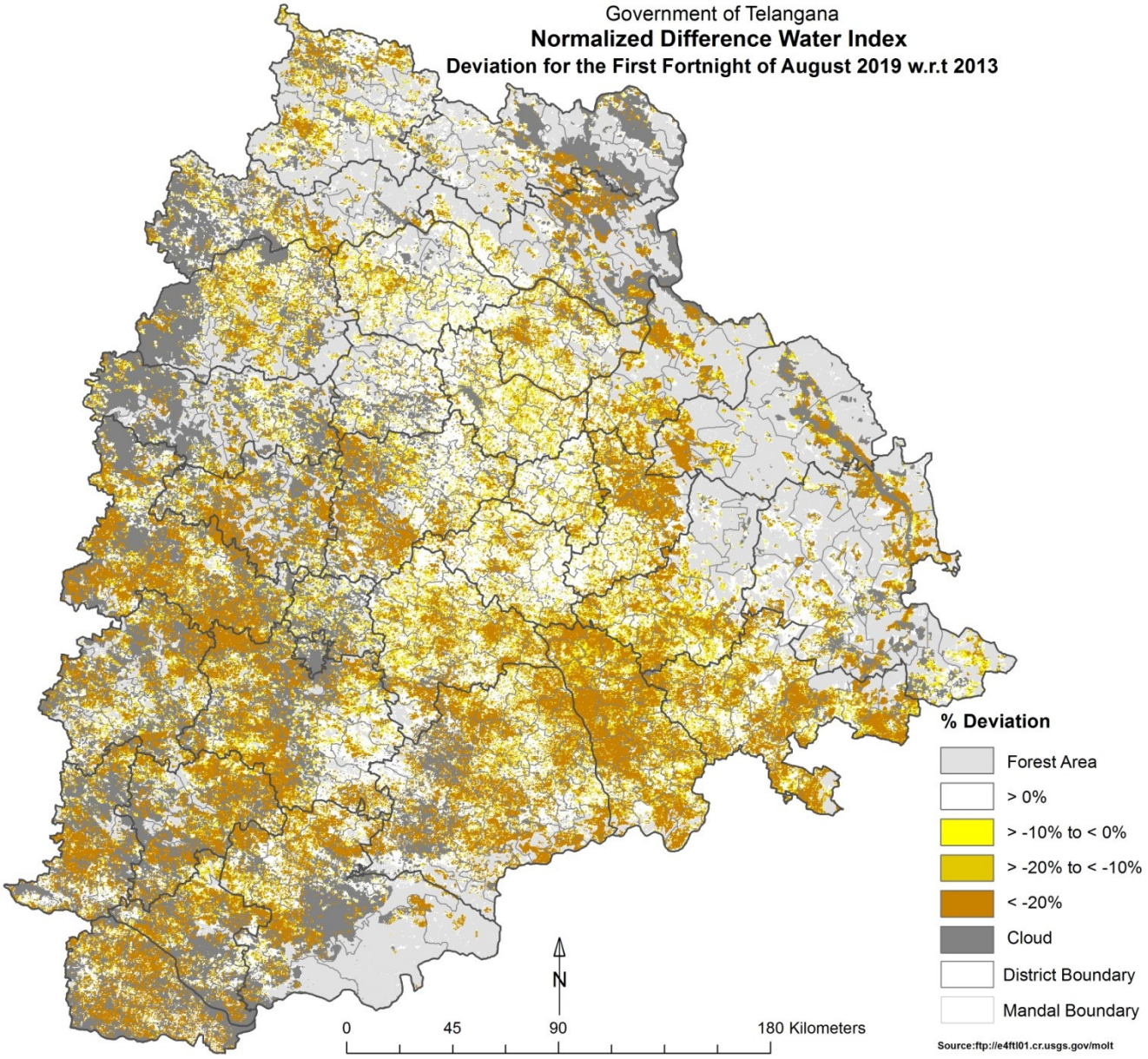


Figure 13: NDWI deviation (MODIS - 250m), First Fortnight of August 2019 w.r.t. 2013

3.6. Drought situation of Mandals

3.6.1 Composite criteria

The drought situation in the state is assessed using different indicators viz., NDVI, NDWI and rainfall deviation of mandals. Compositing all indicators, mandals were categorised into Normal, Watch and Alert. Mandal wise analysis for the First Fortnight of August 2019 indicated **"Normal"** agricultural situation in **407** Mandals. The agricultural situation is categorized as **"Watch" in 139 and "Alert" in 43** Mandals. The Mandals under Watch and Alert categories are given in the Table.6 and their spatial distribution is shown in Figure 14.

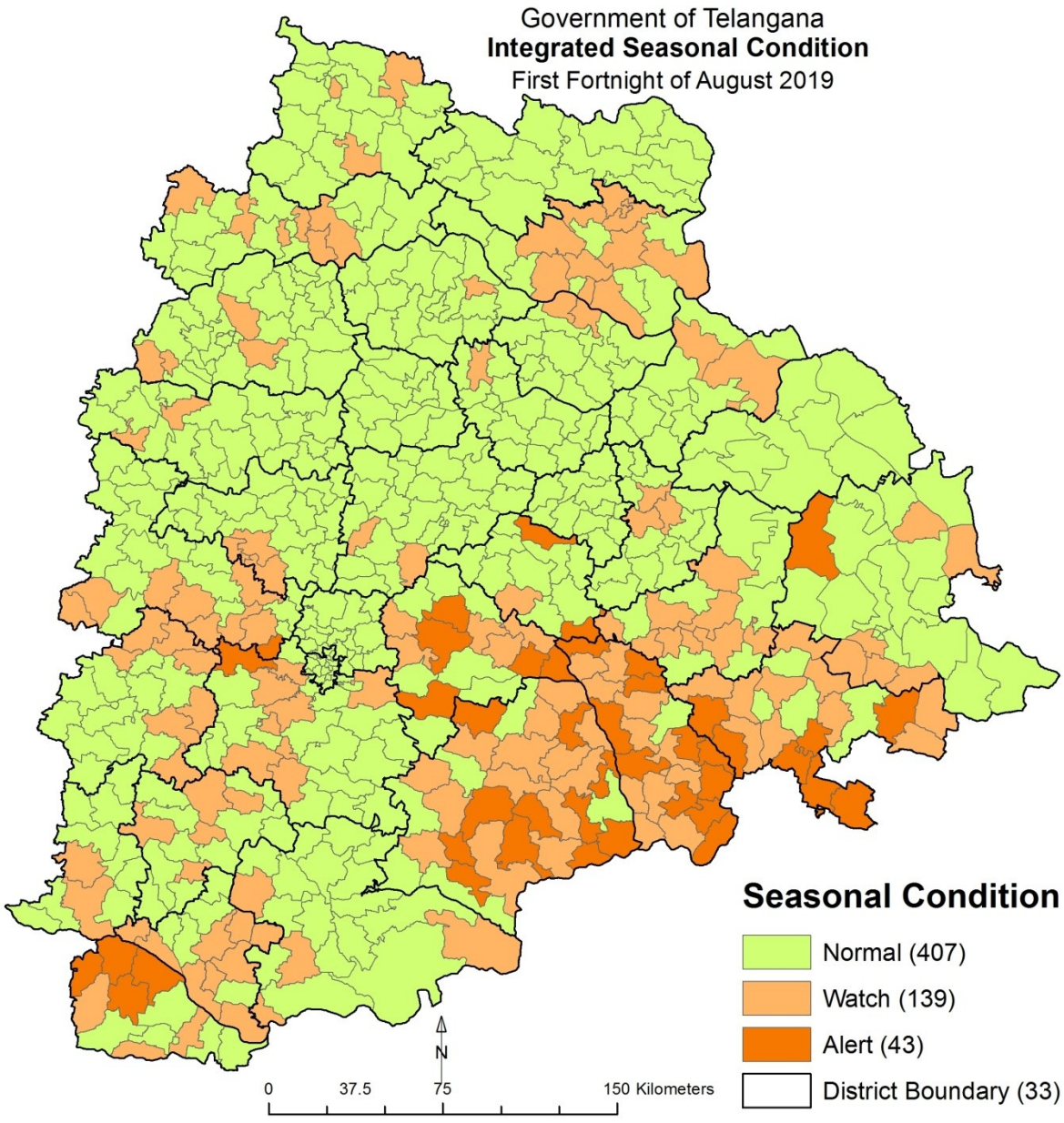


Figure 14: Mandal wise drought assessment based on ISMS criterion

Table.6. Mandals under Watch and Alert category based on ISMS criteria

District Name	Watch(139)	Alert(43)
Adilabad	**Total: 03** Bela, Mavala, Sirikonda.	
Bhadradri Kothagudem	**Total: 06** Annapureddipalle, Chandrugonda, Dummugudem, Julurupad, Manuguru, Sujathanagar.	**Total: 01** Gundala.
Jagtial	**Total: 01** Buggaram.	
Jangaon	**Total: 01** Lingalaghanpur.	**Total: 02** Chilpur, Kodakandla.
Jogulamba	**Total: 03** Ghattu, Manopad, Rajoli.	**Total: 04** Dharoor, Gadwal, Kaloor Thimmandoddi, Maldakal.
Jayashankar Bhupal-pally	**Total: 02** Kataram, Mutharam Mahadevpur.	
Kamareddy	**Total:02** Banswada, Pedda Kodapgal.	
Karimnagar	**Total: 01** Ramadugu.	
Khammam	**Total: 10** Chintakani, Enkoor, Khammam Rural, Mudigonda, Raghunadhapalem, Sathupally, Singareni, Thallada, Tirumalayapalem, Vemsoor.	**Total: 07** Bonakal, Kusumanchi, Madhira, Nelakondapally, Pe-nuballi, Wyra, Yerrupalem.
Mahabubabad	**Total: 09** Chinnagudur, Danthalapalle, Garla, Gudur, Kuravi, Mahabubabad, Narsimhulapet, Nellikudur, Peddavangara.	
Mahabubnagar	**Total: 05** Koilkonda, Mahabubnagar Urban, Moosapet, Nawabpet, Rajapur.	
Mancherial	**Total: 10** Bheemini, Hajipur, Jaipur, Kannepalli, Kasipet, Kotapalle, Man-damarri, Naspur, Nennel, Tandur.	
Medak	**Total: 03** Chilipched, Kowdipally, Narsapur.	
Nagarkurnool	**Total: 04** Bijinapalle, Padara, Peddakothapalle, Pentlavelli.	

Nalgonda	**Total: 14** Devarakonda, Kanagal, Kattangur, Kethepally, Madugulapally, Marriguda, Munugode, Nalgonda, Nampally, Nidamanoor, Peda Adisharla Palli, Shaligouraram, Tipparthy, Tirumalagiri Sagar.	**Total: 11** Adavidevulapally, Anumula_Haliya, Chityal, Damaracherla, Gurrampode, Kondamallapally, Nakrekal, Neredugommu, Peddavoora, Tripuraram, Vemulapally.
Narayanpet	**Total: 02** Makthal, Utkoor.	
Nirmal	**Total: 05** Kubeer, Laxmanchanda, Mamda, Narsapur G, Nirmal Rural.	
Nizamabad	**Total: 04** Dichpally, Kotagiri, Makloor, Rudrur.	
Peddapalli	**Total: 02** Anthergaon, Ramagundam.	
Rangareddy	**Total: 07** Abdullapurmet, Farooqnagar, Gandipet, Keshampeta, Kothur, Moinabad, Shamshabad.	**Total: 01** Shankarpalle.
Sangareddy	**Total: 08** Hathnoora, Kandi, Kondapur, Mogudampally, Munipally, Patancheruvu, Sadasivpet, Zahirabad.	**Total: 01** Ramachandrapuram.
Siddipet	**Total: 02** Jagdevpur, Raipole.	
Suryapet	**Total: 11** Atmakur S, Chilkur, Chivvemla, Garidepalli, Jajireddigudem, Mattampalli, Munagala, Nagaram, Nereducherla, Palakeedu, Thungathurthy.	**Total: 11** Ananthagiri, Chinthala palem, Huzur nagar, Kodad, Maddirala, Mellachervu, Nadigudem, Noothankal, Penpahad, Suryapet, Tirumalagiri.
Vikarabad	**Total: 07** Bantwaram, Kulkacharla, Marpalle, Mominpet, Nawabpet, Pargi, Pudur.	
Wanaparthy	**Total: 09** Amarchintha, Atmakur, Chinnambavi, Gopalpet, Pangal, Pebbair, Revally, Srirangapur, Wanaparthy.	
Warangal Rural	**Total: 03** Atmakur, Duggondi, Geesugonda.	
Yadadri Bhongir	**Total: 05** Athmakur (M), Bibinagar, Bommalaramaram, Gundala, Motakondur.	**Total: 05** Addagudur, Bhongiri, Choutuppal, Mothkur, Yadagirigutta.

3.7. Dry Spell

A dry spell is a short period, usually 4 weeks (up to 3 weeks in case of light soils), of low rainfall or no rainfall. Thus, consecutive 3-4 weeks after the due date for the onset of monsoon with rainfall less than 50% of the normal in each of the weeks is defined as a Dry spell. In State **167** Mandals experienced **one dry spell, 17** Mandals experienced **two dry spell** up to Month of August, 2019. The distribution of the Mandals under dry spell category is shown in Figure: 15 and Table 7.

***01* Mandal** in the state have recorded **one dry spell** with **large excess** rainfall, ***19* Mandals** in the state have recorded **one dry spell** with **excess** rainfall, ***61* Mandals** in the state have recorded **one dry spell** with **Normal** rainfall, ***4* Mandals** have recorded **one dry spell** with **large deficient** rainfall, ***82* Mandals** have recorded **one dry spell** with **deficient** rainfall.

***2* Mandals** have recorded **two dry spell** with **normal** rainfall, ***1* Mandal** have recorded **two dry spell** with **large deficient** rainfall, ***14* Mandals** have recorded **two dry spell** with **deficient** rainfall. (Figure: 16).

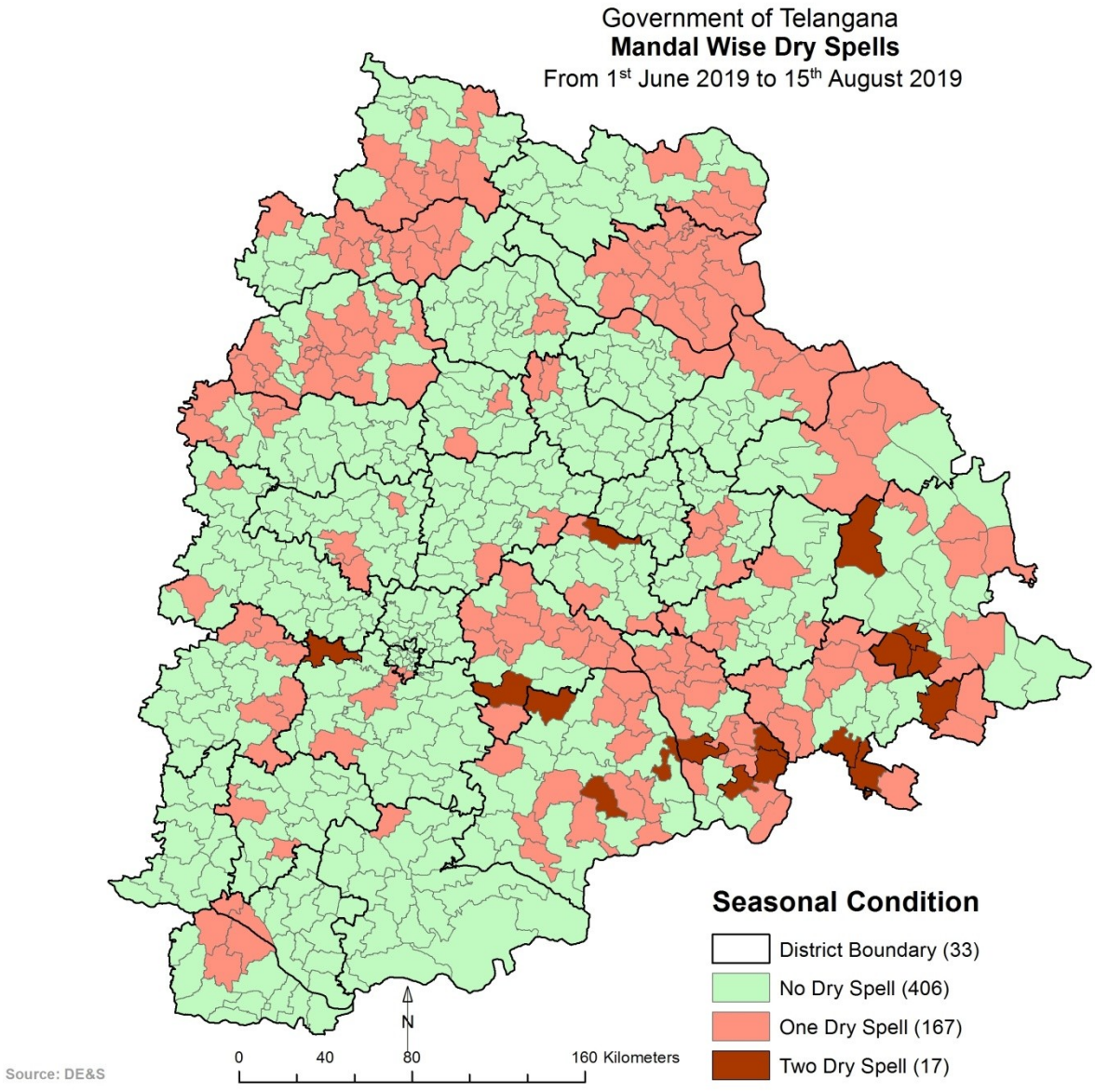


Figure 15: Dry spells from June 01st to August 15th, 2019

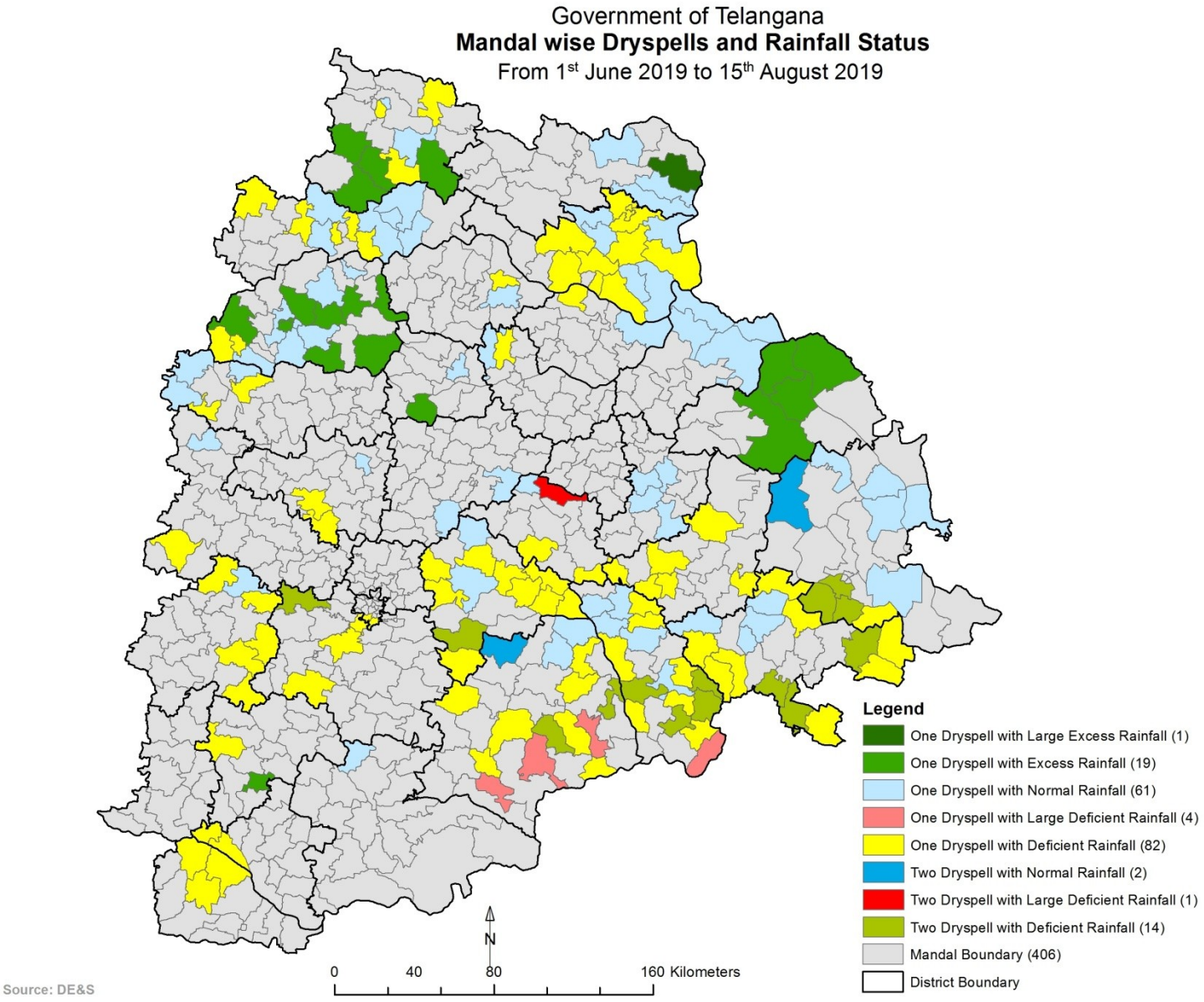


Figure 16: Dry spells With Rainfall Status from June 01st to August 15th, 2019

Table.7. Mandal wise Dry Spells

District Name	One Dry Spell (167)	Two Dry Spell (17)
Adilabad	**Total: 09** Adilabad Urban, Bazarhathnoor, Bela, Ichoda, Inderavelly, Mavala, Neradigonda, Sirikonda, Utnur.	
Bhadradri Kothagudem	**Total: 06** Annapureddipalle, Aswapuram, Dummugudem, Karakagudem, Manuguru, Mulakalapally.	**Total: 04** Chandrugonda, Gundala, Julurpad, Sujathanagar.
Hyderabad	**Total: 02** Bahadurpura, Bandlaguda.	
Jagtial	**Total: 02** Buggaram, Gollapalle.	
Jangaon	**Total: 03** Kodakandla, Lingalaghanpur, Tharigoppula.	**Total: 01** Chilpur.
Jogulamba	**Total: 03** Dharur, Gadwal, Maldakal.	
Jayashankar Bhupalpally	**Total: 04** Kataram, Mahadevpur, Mutharam Mahadevpur, Palmela.	
Kamareddy	**Total:05** Banswada, Jukkal, Madnur, Nasurullabad, Pedda Kodapgal.	
Karimnagar	**Total: 02** Gangadhara, Ramadugu.	
Khammam	**Total: 12** Enkuru, Kamepalle, Khammam Urban, Kusumanchi, Mudigonda, Nelakondapalle, Raghunadhapalem, Sathupalle, Singareni, Thirumalayapalem, Vemsoor, Yerrupalem.	**Total: 03** Bonakal, Madhira, Penuballi.
Komaram Bheem	**Total: 04** Bejjur, Dahegaon, Penchikalpet, Sirpur T.	
Mahabubabad	**Total: 06** Danthalapalle, Garla, Gudur, Narsimhulapet, Nellikudur, Peddavangara.	
Mahabubnagar	**Total: 02** Koilkonda, Musapet.	
Mancherial	**Total: 14** Bellampalle, Bheemini, Bhimaram, Chennur, Hajipur, Jaipur, Kannepalli, Kasipet, Kotapalle, Mandamarri, Naspur, Nennal, Tandur, Vemanpalle.	
Medak	**Total: 03** Kowdipalle, Narsapur, Narsingi.	
Mulugu	**Total: 04** Eturunagaram, Kannaigudem, Tadvai, Wazeed.	
Nagarkurnool	**Total: 01** Urkonda.	
Nalgonda	**Total: 12** Adavi devula palli, Gurrampode, Kattangoor, Kondamallapally, Marriguda, Nakrekal, Neredugommu, Nidamanur, Peddavura, Saligouraram, Thipparthi, Tripuraram.	**Total: 03** Anumula Haliya, Chityala, Vemulapalle.
Nirmal	**Total: 09**	

	Dilawarpur, Khanpur, Kubeer, Laxmanchanda, Mamda, Narsapur G, Nirmal Rural, Pembi, Sarangapur.	
Nizamabad	**Total: 17** Armur, Bodhan, Dichpalle, Indalwai, Jakranpalle, Kammarpalle, Kotgiri, Makloor, Mugpal, Mupkal, Nizamabad North, Nizamabad Rural, Nizamabad South, Rudrur, Sirkonda, Vailpur, Varni.	
Peddapalli	**Total: 02** Antargoan, Manthani.	
Rajanna Sirsilla	**Total: 02** Mustabad, Vemulawada.	
Rangareddy	**Total: 03** Farooqnagar, Rajendranagar, Shamshabad.	**Total: 01** Shankarpalle.
Sangareddy	**Total: 02** Sirgapoor, Zahirabad.	
Siddipet	**Total: 02** Jagadevpur, Maddur.	
Suryapet	**Total: 13** Atmakur S, Chilkur, Chinthala palem, Jajireddigudem, Maddirala, Mellachervu, Munagala, Nadigudem, Nagaram, Neredcherla, Noothankal, Suryapet, Thungathurthy.	**Total: 04** Ananthagiri, Huzur nagar, Kodad, Penpahad.
Vikarabad	**Total: 06** Kulkacharla, Marpalle, Mominpet, Nawabpet, Pargi, Pudur.	
Wanaparthy	**Total: 02** Amarchinta, Atmakur.	
Warangal Rural	**Total: 04** Duggondi, Geesugonda, Nekkonda, Sangem.	
Yadadri Bhongir	**Total: 11** Addagudur, Athmakur (M), B.Pochampally, Bhongiri, Bibinagar, Choutuppal, Gundala, Motakondur, Mothkur, Rajapeta, Yadagirigutta.	**Total: 01** Bommalaramaram.

3.8. District Wise NDVI / NDWI / VCI Status

NDVI/NDWI/VCI status as on 15/08/2019, Telangana								
S. No	District	NDVI Value	Average NDVI	NDWI Value	Average NDWI	VCI (NDVI)	VCI (NDWI)	VCI Condition
1	Adilabad	0.57	0.36	0.40	0.28	88.46	79.77	Normal
2	Bhadradri-Kothagudem	0.50	0.33	0.36	0.27	93.20	76.33	Normal
3	Hyderabad	0.19	0.10	0.14	0.06	54.72	61.25	Normal
4	Jagtial	0.59	0.42	0.48	0.33	93.55	99.24	Normal
5	Jangaon	0.53	0.40	0.40	0.28	88.16	90.09	Normal
6	Jayashankar-Bhupalpally	0.47	0.28	0.33	0.22	97.05	76.92	Normal
7	Jogulamba-Gadwal	0.25	0.19	0.07	0.08	61.28	31.91	Mild
8	Kamareddy	0.51	0.35	0.41	0.28	78.83	78.02	Normal
9	Karimnagar	0.54	0.38	0.44	0.30	90.47	93.66	Normal
10	Khammam	0.47	0.43	0.31	0.31	72.81	60.62	Normal
11	Komaram Bheem-Asifabad	0.46	0.27	0.36	0.22	86.29	83.45	Normal
12	Mahabubabad	0.53	0.42	0.40	0.32	89.56	80.16	Normal
13	Mahabubnagar	0.42	0.20	0.23	0.13	86.50	68.74	Normal
14	Mancherial	0.47	0.27	0.32	0.21	91.97	82.23	Normal
15	Medak	0.51	0.30	0.35	0.23	87.04	70.10	Normal
16	Medchal-Malkajgiri	0.47	0.24	0.32	0.16	89.50	91.23	Normal
17	Mulug	0.45	0.24	0.37	0.23	95.41	74.07	Normal
18	Nagarkurnool	0.40	0.20	0.21	0.10	90.70	83.45	Normal
19	Nalgonda	0.37	0.31	0.21	0.18	70.16	59.25	Normal
20	Narayanpet	0.36	0.17	0.18	0.09	93.78	77.08	Normal
21	Nirmal	0.54	0.29	0.40	0.22	91.46	88.64	Normal
22	Nizamabad	0.48	0.36	0.42	0.30	76.85	79.83	Normal
23	Peddapalli	0.52	0.35	0.38	0.29	93.98	87.47	Normal
24	Rajanna-Siricilla	0.55	0.42	0.44	0.30	86.86	96.01	Normal
25	Rangareddy	0.42	0.23	0.26	0.15	87.82	81.26	Normal
26	Sangareddy	0.45	0.27	0.30	0.21	78.82	64.14	Normal
27	Siddipet	0.52	0.37	0.37	0.26	86.69	82.46	Normal
28	Suryapet	0.42	0.41	0.28	0.29	62.10	56.36	Normal
29	Vikarabad	0.44	0.24	0.27	0.17	85.32	73.74	Normal
30	Wanaparthy	0.34	0.19	0.20	0.12	77.59	61.45	Normal
31	Warangal Rural	0.53	0.36	0.36	0.28	94.23	76.42	Normal
32	Warangal Urban	0.54	0.38	0.41	0.28	95.54	95.25	Normal
33	Yadadri-Bhongir	0.46	0.36	0.34	0.24	77.81	75.40	Normal

Table. 8 District wise NDVI / NDWI / VCI Status

**Normalized Difference Vegetative Index (NDVI) Value - Current year NDVI*
**Normalized Difference Wetness Index (NDWI) Value - Current year NDWI*
**Average NDVI - Average of previous 16 years NDVI* **Average NDWI - Average of previous 16 years NDWI*
**VCI (NDVI) - Vegetation Condition Index based on NDVI* **VCI (NDWI) - Vegetation Condition Index based on NDWI*
NDVI/NDWI Condition - **VCI>=60 (Normal), VCI>=40 (Mild), VCI>=20 (Moderate), VCI<20 (Severe)*

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