ESTIMATION OF MONSOON

189.   SHRI K.C. VENUGOPAL
SHRI SANJAY SETH:

Will the Minister of EARTH SCIENCES be pleased to state:

(a) whether IMD estimated the monsoon to be below average in some parts of the country during the current year and if so, the details thereof;

(b) whether Government has analysed the reasons for the deficiency of rain, if so, the details thereof and the extent to which farmers are likely to be affected due to possibility of drought, State/UT-wise; and

(c) whether any advance scientific upgrades and advanced equipment have been made for progressive predictions, if so, the details thereof and the reasons for delayed occurrences of monsoon in the country?

ANSWER
THE MINISTER OF STATE (INDEPENDENT CHARGE) OF
MINSTRY OF SCIENCE AND TECHNOLOGY AND
EARTH SCIENCES
(DR. JITENDRA SINGH)

(a) Yes Sir. India Meteorological Department (IMD)has updated the long range forecast issued for 2021 southwest monsoon season (June to September) rainfall over the entire country on 1st June 2021.The updated forecast indicates below average rainfall is most likely over some areas of north, east and neighbouring northeast parts of the country and western parts of the south peninsula. More details are given in the press release issued on 1 June 2021 enclosed as **Annexure-I**.

(b) The rainfall deficiency observed over many areas of northwest India and neighbouring central India and along the southwest coast of peninsula is due to the weakening of monsoon during20thJune-8th July, which is a part of the natural intra seasonal variability of the monsoon. This weakening phase of the monsoon was caused by the unfavourable phases of the Madden Julian Oscillation (MJO), intrusion of dry and warm westerlies over Northwest India from desert regions and above normal convective activity over equatorial Indian Ocean.

However, the forecast from latest global models indicate that the monsoon is gradually entering into active phase which will cause increased rainfall activity over most parts of the country during the second half of the July.

Due to unfavourable large scale atmospheric features, progress of southwest monsoon was delayed over northwest part of the country. However, as on 13th July, monsoon has covered the entire country with a delay of about 5 days, as the new normal date for monsoon to cover entire country is 8th July. All India summer monsoon rainfall is 94% of Long Period Average (LPA) till 13th July 2021. Out of 36 meteorological subdivisions, 23 subdivisions received normal or excess rainfall and 13 subdivisions are under deficient rainfall category. Seasonal rainfall map till 13th July 2021 is given in **Annexure-II**.

Details as available in the Crop Weather Watch Group (CWWG) report of Department of Agriculture, Co-operation and Farmers' Welfare (DAC&FW) dated 9th July 2021 indicate that there are states which reported less area sown for the major crops such as rice, pulses, cotton, oilseeds etc. during the week compared to normal area.

For the country as a whole, there is a decrease in area sown under Rice by 1.35 lakh ha compared to normal of corresponding week dated 9th July while it is less by 11.26 lakh ha compared to year 2020. For Pulses, cotton and Oilseeds, area sown is more compared to normal of corresponding week. Kharif area coverage compared to normal of corresponding week as on 9th July 2021 is given in the following table:

Crops	Increase (+)/ Decrease (-) over (area in lakh ha)	
	Normal of corresponding week	2020
Rice	-1.35	-11.26
Pulses	2.40	-0.87
Cotton	1.48	-13.58
Oilseeds	11.36	-18.38

State wise details are mentioned in **Annexure III**.

IMD runs an operational Agrometeorological Advisory Services (AAS) viz., Gramin Krishi Mausam Sewa (GKMS) scheme for the benefit of farming community in the country. Under the scheme, medium range weather forecast at district level is generated and based on the forecast, Agromet Advisories are prepared and communicated by the Agromet Field Units (AMFUs) located at State Agricultural Universities, institutes of Indian Council for Agricultural Research (ICAR) and Indian Institute of Technologies (IIT) etc., to the farmers on every Tuesday and Friday to take decision on day-to-day agricultural operations. AAS rendered by IMD is a step towards weather-based crop and livestock management strategies and operations dedicated to enhancing crop production and food security besides reducing crop damage and loss due to deficient rainfall situation.

A mobile App viz., 'Meghdoot' has been launched by Ministry of Earth Sciences (MoES), Government of India, to help the farmers to get the weather information including alerts and related agromet advisories specific to their districts.

(c) Yes. Recognizing the urgent need for improving monsoon prediction capabilities in the country in a systematic and timely manner, MoES had launched an ambitious and well-resourced research programme on mission mode, called the Monsoon Mission. The first phase of the mission was implemented during 2012-2017 and the second phase which started in 2017 is underway. Through this mission, country has augmented its capability of High-Performance Computing (HPC), which is close to 10 petaflops which has now become the backbone of the monsoon research and operational services in the country. The Monsoon Mission has helped in the significant improvement of monsoon forecasts in all time scales, right from short-range to seasonal. India is now proud of having one of the best weather and climate prediction systems for generating real time forecasts and warnings.

IMD has implemented a new strategy for issuing monthly and seasonal operational forecasts for the southwest monsoon rainfall over the country by modifying the existing two stage forecasting strategy. The new strategy uses the existing statistical forecasting system to generate these forecasts along with a newly developed Multi-Model Ensemble (MME) forecasting system based on coupled global climate models (CGCMs) from different global climate prediction and research centres including IMD's Monsoon Mission Coupled Forecasting System (MMCFS) model. The monthly probabilistic forecast for each of the monsoon months will also be issued at the end of the previous month based on MME approach. The spatial distribution of probabilistic forecasts for tercile categories (above normal, normal and below normal)for the seasonal rainfall(June to September) over the country was also issued for the first time in the history of the operational seasonal forecasting in the country.

भारत सरकार
Government of India
पृथ्वी विज्ञान मंत्रालय (एम. ओ. ई. एस.)
Ministry of Earth Sciences (MoES)
भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT
Updated Long Range Forecast
For the 2021 Southwest Monsoon Season Rainfall

Highlights

a)   Southwest monsoon seasonal (June to September) rainfall over the country as a whole is most likely to be **normal (96 to 104 % of Long Period Average (LPA))**.

b)   Quantitatively, the monsoon seasonal (June to September) rainfall over the country as a whole is likely to be **101% of the Long Period Average (LPA) with a model error of ± 4%**. The LPA of the season rainfall over the country as a whole for the period **1961-2010** is **88 cm**.

c)   The southwest monsoon seasonal (June to September) rainfall over the four homogeneous rainfall is most likely to be **Normal over Northwest India (92-108%) and South Peninsula (93-107%). Seasonal rainfall is most likely to be below normal over North east India (<95%) and above normal over Central India (>106%).**

d)   The southwest monsoon seasonal (June to September) rainfall over the monsoon core zone, which consists of most of the **rainfed agriculture regions in the country is most likely to be Above Normal (>106% of LPA).**

e)   Monsoon seasonal rainfall is likely to be well distributed spatially (Fig.1). Most parts of the country is expected to receive normal to above normal rainfall during the season.

f)   The latest global model forecasts indicate the prevailing neutral ENSO conditions are likely to continue over the equatorial Pacific Ocean and possibility of development of negative IOD conditions over the Indian Ocean during the monsoon season.

As sea surface temperature (SST) conditions over the Pacific and the Indian Oceans are known to have strong influence on Indian monsoon, IMD is carefully monitoring the evolution of sea surface conditions over these Ocean basins.

IMD will issue the **forecast for the July rainfall in the last week of June 2021.**

1. Background

This year, IMD has implemented a new strategy for issuing monthly and seasonal operational forecasts for the southwest monsoon rainfall over the country by modifying the existing two state forecasting strategy. The new strategy uses the existing statistical forecasting system to generate these forecasts along with a newly developed Multi-Model Ensemble (MME) forecasting system based on coupled global climate models (CGCMs) from different global climate prediction and research centers including IMD's Monsoon Mission CFS (MMCFS) model. The monthly probabilistic forecast for each of the monsoon months will also be issued at the end of the previous month based on MME approach.

Accordingly, on 16th April 2021, IMD had issued the first stage forecast for the 2021 southwest monsoon seasonal (June to September) rainfall over the country as a whole using the existing statistical forecasting system and the newly developed MME based forecasting system. The spatial distribution of probabilistic forecasts for tercile categories (above normal, normal and below normal) for the seasonal rainfall (June to September) over the country was also issued for the first time in the history of the operational seasonal forecasting in the country.

Now, IMD has prepared the following forecasts as a part of the second stage forecasts;

1. Updated quantitative and probabilistic forecasts for the monsoon seasonal rainfall over the country as a whole and spatial distribution of the probabilistic forecasts for the seasonal rainfall over the country.

2. Probabilistic forecasts for the seasonal rainfall over the four homogenous regions of India (northwest India, central India, south Peninsula and northeast India) and the monsoon core zone (MCZ).

3. Probabilistic forecast for the June rainfall over the country as a whole and spatial distribution of the probabilistic forecasts for the June rainfall over the country.

2. Sea Surface Temperature (SST) Conditions in the equatorial Pacific & Indian Oceans

La Niña conditions which peaked in November last year, started weakening in the early part of 2021 and turned into neutral ENSO conditions by end of April 2021. Presently, neutral ENSO conditions are seen over the equatorial Pacific along with substantially

warmer subsurface temperatures over the region. Atmospheric patterns also reflect neutral ENSO conditions. The latest MMCFS and other global model forecast indicate that neutral ENSO conditions will continue during the upcoming monsoon season.

At present, neutral Indian Ocean Dipole (IOD) conditions are prevailing over the Indian Ocean. The latest forecast from the MMCFS and other global models together indicate possibility of development of negative IOD conditions during the monsoon season.

3.   Second Stage Forecasts for the 2021 Southwest monsoon Rainfall

3a.   Updated Forecast for the 2021 Southwest Monsoon Rainfall over the Country as a Whole Based on the Operational Statistical Ensemble Forecasting System (SEFS)

The forecast suggests that quantitatively, the monsoon seasonal rainfall is likely to be **101% of the Long Period Average (LPA) with a model error of ± 4%.** The LPA of the season rainfall over the country as a whole for the period **1961-2010 is 88 cm**.

The 5 category probability forecasts for the Seasonal (June to September) rainfall over the country as a whole based on the SEFS forecast are given below, which suggests maximum probability for monsoon seasonal rainfall to be normal (96-104% of LPA).

Category	Rainfall Range (% of LPA)	Forecast Probability (%)	Climatological Probability (%)
Deficient	< 90	**8**	16
Below Normal	90 - 96	**18**	17
Normal	96 -104	**40**	33
Above Normal	104 -110	**22**	16
Excess	> 110	**12**	17

3.b. Updated Forecast for the 2021 Southwest Monsoon Rainfall over the Country based on the Multi Model Ensemble (MME) Forecasting System

The updated MME forecast for 2021 southwest Monsoon season rainfall has been computed using various coupled global model forecasts with May initial conditions. Climate models with the highest forecast skills over the Indian monsoon region including MMCFS have been used to prepare the MME forecast.

The updated MME forecast also suggests that the monsoon rainfall during the 2021 monsoon season (June to September) averaged over the country as a **whole is likely to be normal (96-104% of LPA).**

The spatial distribution of probabilistic forecasts for tercile categories (above normal, normal and below normal) for the seasonal rainfall (June to September) is shown in Fig.1. The spatial distribution suggests normal or above normal seasonal rainfall is most likely over many areas of north west India, central India and eastern parts of the southern Peninsula. Below normal seasonal rainfall is most likely over some areas of north, east and neighboring northeast parts of the country and western parts of the south peninsula. The white shaded areas within the land area represent climatological probabilities.

3c. Forecast for the 2021 Southwest Monsoon Rainfall over the four Homogenous regions of the country and MCZ based on the Multi Model Ensemble Forecasting System.

The tercile category forecasts for the four homogenous regions and MCZ for the 2021 southwest monsoon seasonal (June-September) rainfall based on the MME forecast generated using May initial conditions are given in the tables below.

Rainfall Category	NW India		Central India		South Peninsula	
	Range (% of LPA)	Forecast Probability (%)	Range (% of LPA)	Forecast Probability (%)	Range (% of LPA)	Forecast Probability (%)
Below Normal	<92	**27**	<94	**27**	<93	**33**
Normal	92-108	**41**	94-106	**34**	93-107	**34**

Above Normal	>108	**32**	>106	**39**	>107	**33**

Rainfall Category	Northeast India		Monsoon Core Zone (MCZ)	
	Range (% of LPA)	Forecast Probability (%)	Range (% of LPA)	Forecast Probability (%)
Below Normal	<95	**40**	<94	**27**
Normal	95-105	**33**	94-106	**33**
Above Normal	>105	**27**	>106	**40**

3d.   Probabilistic Forecast for the 2021 June Rainfall over the Country Based on the Multi Model Ensemble Forecasting System.

The MME probability forecast suggest that the 2021 June rainfall averaged over the country as a **whole is most likely to be normal (92 to 108 % of LPA).**

The spatial distribution of probabilistic forecasts for tercile categories (above normal, normal and below normal) for the June rainfall is shown in Fig.2. The spatial distribution suggests above normal rainfall probability is likely over most areas of eastern parts of central India, along the planes of Himalayas and east India. Below normal probability is likely over many areas of northwest India and southern parts of south peninsula and some areas of northeast India.   The white shaded areas within the land area represent climatological probabilities
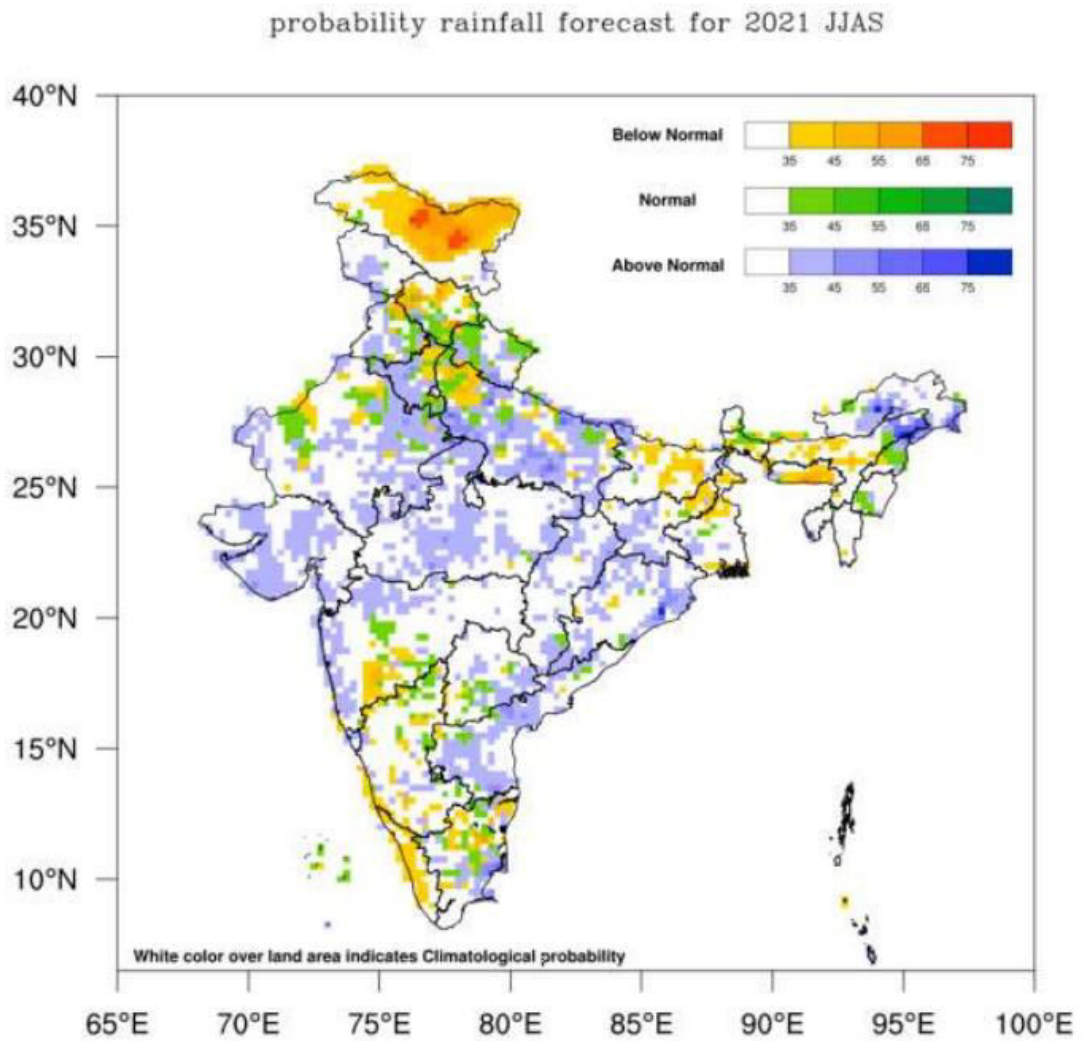
Fig.1. Updated Probability forecast of tercile categories* (below normal, normal and above normal) for the seasonal rainfall over India during the 2021 southwest monsoon season (June - September). The figure illustrates the most likely categories as well as their probabilities. The white shaded areas within the land area represent climatological probabilities. The probabilities were derived using the MME forecast prepared from a group of coupled climate models. (*Tercile categories have equal climatological probabilities, of 33.33% each).

probability rainfall forecast for 2021 JUN
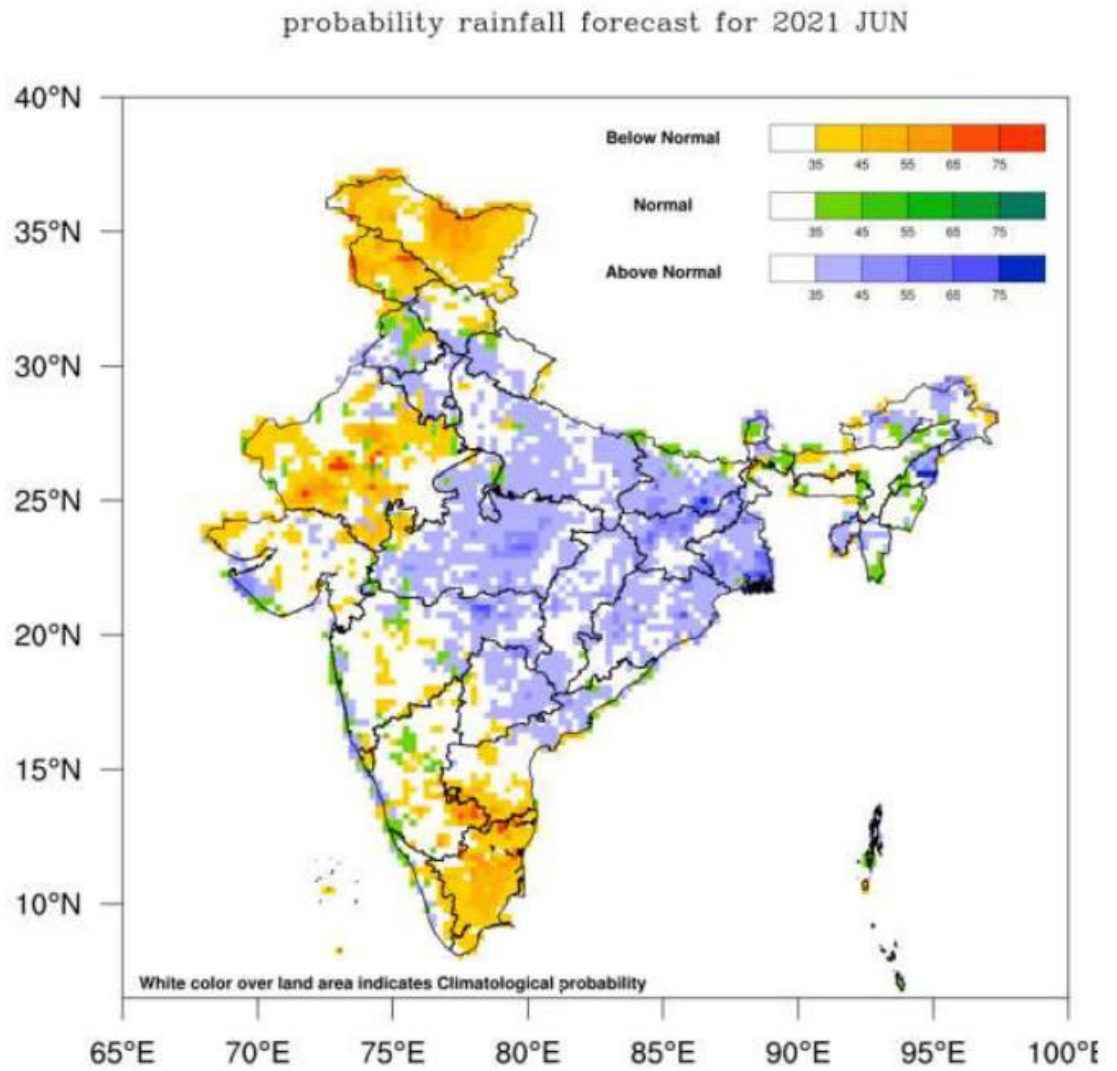
Fig.2. Probability forecast of tercile categories[*] (below normal, normal and above normal) for the 2021 June rainfall over India. The figure illustrates the most likely categories as well as their probabilities. The white shaded areas within the land area represent climatological probabilities. The probabilities were derived using the MME forecast prepared from a group of coupled climate models. ([*]Tercile categories have equal climatological probabilities, of 33.33% each).

भारत मौसम विज्ञान विभाग
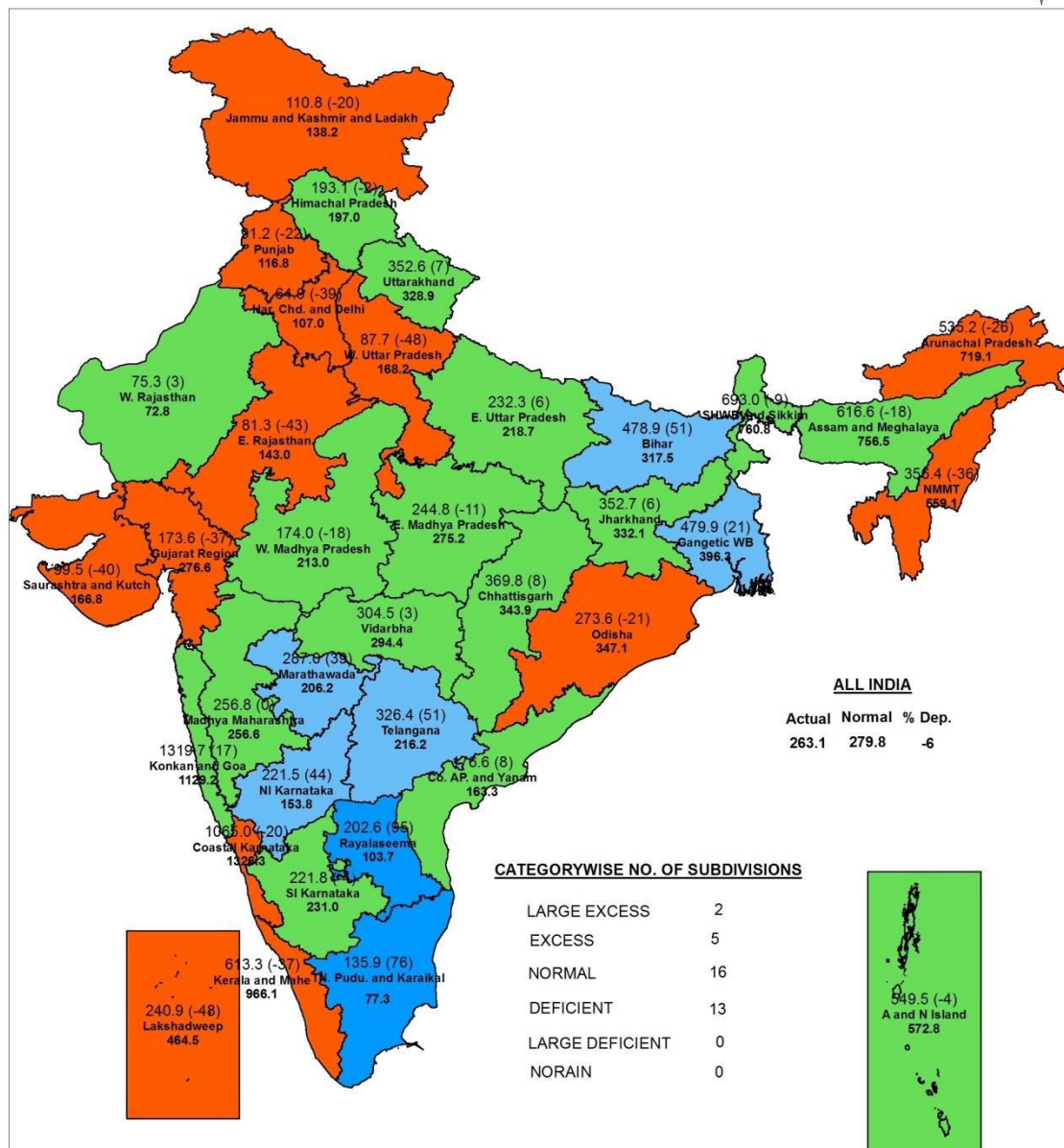**INDIA METEOROLOGICAL DEPARTMENT**

जल मौसम विज्ञान प्रभाग, नई दिल्ली
HYDROMET DIVISION, NEW DELHI

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SUBDIVISION RAINFALL MAP
Period : 01-06-2021 To 13-07-2021

110.8 (-20)
Jammu and Kashmir and Ladakh
138.2

193.1 (-2)
Himachal Pradesh
197.0

91.2 (-22)
Punjab
116.8

352.6 (7)
Uttarakhand
328.9

64.9 (-39)
Har. Chd. and Delhi
107.0

87.7 (-48)
W. Uttar Pradesh
168.2

75.3 (3)
W. Rajasthan
72.8

232.3 (6)
E. Uttar Pradesh
218.7

81.3 (-43)
E. Rajasthan
143.0

478.9 (51)
Bihar
317.5

693.0 (-9)
SHWB and Sikkim
760.8

535.2 (-26)
Arunachal Pradesh
719.1

616.6 (-18)
Assam and Meghalaya
756.5

355.4 (-36)
NMMT
559.1

173.6 (-37)
Gujarat Region
276.6

99.5 (-40)
Saurashtra and Kutch
166.8

174.0 (-18)
W. Madhya Pradesh
213.0

244.8 (-11)
E. Madhya Pradesh
275.2

352.7 (6)
Jharkhand
332.1

479.9 (21)
Gangetic WB
396.3

369.8 (8)
Chhattisgarh
343.9

273.6 (-21)
Odisha
347.1

304.5 (3)
Vidarbha
294.4

287.0 (39)
Marathawada
206.2

256.8 (0)
Madhya Maharashtra
256.6

326.4 (51)
Telangana
216.2

1319.7 (17)
Konkan and Goa
1129.2

221.5 (44)
Ni Karnataka
153.8

176.6 (8)
Co. AP. and Yanam
163.3

1065.0 (-20)
Coastal Karnataka
1326.3

202.6 (95)
Rayalaseema
103.7

221.8 (-4)
SI Karnataka
231.0

613.3 (-37)
Kerala and Mahe
966.1

135.9 (76)
TN. Pudu. and Karaikal
77.3

240.9 (-48)
Lakshadweep
464.5

ALL INDIA

Actual	Normal	% Dep.
263.1	279.8	-6

CATEGORYWISE NO. OF SUBDIVISIONS

LARGE EXCESS	2
EXCESS	5
NORMAL	16
DEFICIENT	13
LARGE DEFICIENT	0
NORAIN	0

549.5 (-4)
A and N Island
572.8

Legend

■ Large Excess [60% or more]   ■ Excess [20% to 59%]   ■ Normal [-19% to 19%]   ■ Deficient [-59% to -20%]   ■ Large Deficient [-99% to -60%]   □ No Rain [-100%]   ■ No Data

NOTES :
a) RainFall figures are based on operation data.
b) Small figures indicate actual rainfal (mm), while bold figures indicate Normal rainfall (mm).
c) Percentage Departures of rainfall are shown in brackets.

Kharif **area coverage compared to normal of corresponding week as on 9th July 2021**

Rice: Major states from where less area has been reported are Bihar (2.74 lakh ha), Chhattisgarh (2.18 lakh ha), Assam (1.37 lakh ha), Haryana (1.31 lakh ha), West Bengal (0.91 lakh ha), Andhra Pradesh (0.80 lakh ha), Manipur (0.74 lakh ha), Odisha (0.66 lakh ha), Nagaland (0.48 lakh ha), Jharkhand (0.40 lakh ha), Karnataka (0.25 lakh ha), Himachal Pradesh (0.24 lakh ha) , Tamil Nadu (0.22 lakh ha), Rajasthan (0.21 lakh ha), Arunachal Pradesh (0.20 lakh ha), Gujarat (0.16 lakh ha) and Mizoram (0.10 lakh ha). Overall, about 114.82 lakh hectare area coverage under rice has been reported compared to normal of 116.17 lakh ha for this week. Thus 1.35 lakh ha less area has been covered compared to normal of corresponding week in the country.

Pulses: Major states from where less area has been reported are Rajasthan (5.89 lakh ha), Andhra Pradesh (0.59 lakh ha), Telangana (0.57 lakh ha), Tamil Nadu (0.23 lakh ha), Bihar (0.22 lakh ha), Odisha (0.14 lakh ha), Uttar Pradesh (0.10 lakh ha), Himachal Pradesh (0.07 lakh ha), Punjab (0.06 lakh ha) and Tripura (0.03 lakh ha). Overall, about 52.49 lakh hectare area coverage under pulses has been reported compared to normal of 50.09 lakh ha for this week. Thus 2.40 lakh ha less area has been covered compared to normal of corresponding week in the country.

Cotton: Thus 1.48 lakh ha less area has been covered compared to normal of corresponding week. Major states from where less area has been reported are Andhra Pradesh (1.06 lakh ha), Punjab (0.62 lakh ha), Madhya Pradesh (0.23 lakh ha), and Odisha (0.21 lakh ha). Overall, about 86.45 lakh hectare area coverage under cotton has been reported compared to normal of 84.97 lakh ha for this week in the country.

Oilseeds: Major states from where less area has been reported are Rajasthan (2.94 lakh ha), Andhra Pradesh (1.95 lakh ha), Madhya Pradesh (1.02 lakh ha), Telangana (0.60 lakh ha), Chhattisgarh (0.35 lakh ha), Uttar Pradesh (0.11 lakh ha), Odisha (0.07 lakh ha), Jammu & Kashmir (0.04 lakh ha) and Bihar (0.04 lakh ha). Overall, about 112.55 lakh hectare area coverage under Oilseeds has been reported compared to normal of 101.19 lakh ha for this week. Thus 11.36 lakh ha less area has been covered compared to normal of corresponding week in the country.

Sugarcane: Major states from where less area has been reported are Tamil Nadu (0.78 lakh ha), Andhra Pradesh (0.45 lakh ha), Chhattisgarh (2.18 lakh ha), Telangana (0.08 lakh ha) and West Bengal (0.02 lakh ha). Overall, about 53.56 lakh hectare area coverage under Sugarcane has been reported compared to normal of 50.09 lakh ha for this week. Thus 3.47 lakh ha less area has been covered compared to normal of corresponding week in the country.

Coarse Cereals: Major states from where less area has been reported are Rajasthan (15.51 lakh ha), Haryana (2.19 lakh ha), Telangana (1.07 lakh ha), Maharashtra (1.02 lakh ha), Gujarat (0.80 lakh ha), Bihar (0.64 lakh ha), Jharkhand (0.44 lakh ha), Odisha (0.31 lakh ha), Andhra Pradesh (0.24 lakh ha). Overall, about 73.07 lakh hectare area coverage under Coarse Cereals has been reported compared to normal of 87.36 lakh ha for this week. Thus 14.28 lakh ha less area has been covered compared to normal of corresponding week in the country.

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