



Monsoon variability continues to dominate, La Nina pushes India for above normal rains

October, 2022

The four-month long Southwest Monsoon officially came to an end on September 30. After a lull start, the Monsoon season ended on a good note with the country receiving surplus rains. However, increasing Monsoon variability continued to dominate the rains on account of changing climatic conditions.

As [predicted](#), the Southwest Monsoon 2022 ended with above normal rainfall to the tune of 106% of Long Period Average (LPA). The country recorded 925 mm of rain against the normal of 870 mm from June 1 to September 30.

With this, for the fourth consecutive year India recorded normal to above rainfall. These surplus rains can be attributed to prevailing La Niña conditions across the Pacific Ocean for the straight third year in continuance.

Meanwhile, despite the above normal rains, 187 districts of the country recorded deficit rainfall, while seven districts were in large deficit.

According to statistics by state-run India Meteorology Department, out of the total 36 meteorological subdivisions in the country, 12 constituted 40% of the total area of the country which received excess seasonal rainfall, 18 subdivisions made 43% of the total area that received normal seasonal rainfall and 6 subdivisions with 17% of the country's land area received deficient seasonal rainfall. These 6 Met subdivisions which got deficient rainfall are Nagaland, Manipur, Mizoram & Tripura, Gangetic West Bengal, Bihar, Jharkhand, East Uttar Pradesh and West Uttar Pradesh.

Prolonged and widespread Monsoon rains during the second spell helped in maintaining the rain surplus in the country. six Monsoon Depressions were formed during the season; out of which, one system intensified into Deep Depression during 19-23 August. While four systems formed in August, one in July and one in September. The number of low-pressure system days was 67 during the season against the normal of 57 days.

In September 2022, around 224 stations reported very heavy rains, while 22 stations reported extremely heavy rainfall.

August witnessed the 8th [highest rainfall](#) since 2001 in the country. One Deep depression during 19 – 23 August over Bay of Bengal and three Depressions (2 over Bay of Bengal during 9 -10 August and 14 - 16 August and 1 over Arabian Sea during 12 – 13 August) formed during the month.

Triple Dip La Niña



The occurrence of three consecutive La Niña in the Northern Hemisphere is a relatively rare phenomena and is known as 'triple dip' La Niña. According to statistics, three La Niña events in a row has happened only twice since 1950.

Occurrence of La Niña is invariably linked with above normal Monsoon rains, but there have been exceptions. Unlike a fairly strong correlation between El Nino and weak Monsoon rains, La Niña does not find a convincing cause-effect relationship. According to meteorologists, in the case of prolonged La Niña conditions, the Monsoon rains are found better in the years when La Niña commences as compared to the following year.

To mark this, the country recorded above normal rainfall during the Southwest Monsoon 2020 to the tune of 109% of long period average (LPA). This was followed by a normal Monsoon season in 2021 where India recorded 99% rains of LPA. With La Niña extending its stay in 2022, India again recorded above normal rains.

Monsoon variability

India continued to witness uneven distribution of rainfall, where some districts saw normal to above normal rainfall, while few remained deficit. As a result, Central India was surplus by 22%, whereas the East & Northeast India region was deficit by 18%.

According to a report, [Assessment of Climate Change over the Indian Region](#), with continued global warming and expected reductions of aerosol concentrations in the future, climate models project an increase in the annual and summer monsoon mean rainfall, as well as frequency of heavy rain occurrences over most parts of India during the twenty-first century. The interannual variability of summer monsoon rainfall is projected to increase through the twenty-first century.

Heterogeneous regions of East and Northeast India underperformed this Monsoon accruing an overall deficiency of 18% rainfall. Nine out of 10 years in the last decade, the region has been recording rainfall on the negative side. After the West Coast, Northeast India is the second highest contributor in the Monsoon rainfall.

Year	Rainfall Departure in East & Northeast region during Southwest Monsoon
2022	-18%
2021	-11%
2020	7%



2019	-12%
2018	-25%
2017	-2%
2016	-10%
2015	-2%
2014	-10%
2013	-27%

Data Source: IMD

“The data clearly shows the impact of Climate Change over Monsoon trends. Most likely, a similar pattern will follow in the coming years. Monsoon systems have not been following their usual route which definitely has an impact on the region. As the emissions continue to increase, we are afraid good news is not in store for the region,” said **Mahesh Palawat, VP-Meteorology and Climate Change, Skymet Weather.**

Similarly, Northwest India also struggled with lower-than-normal rainfall across Northwest India, especially Delhi. The region managed to record normal rains by just 1% due to delayed withdrawal of Monsoon which formed a trough over Northwest India.

Change in Monsoon trends:

Meteorologists are citing concerns over changes in the track of Monsoon weather systems across the country. The trend has become more and more visible in the last 4-5 years, with the 2022 season being the latest one. Most of the weather systems formed in July, August and September travelled across Central India instead of taking the traditional route of crossing the Indo-Gangetic plains.

As a result, states like Madhya Pradesh, Gujarat, Rajasthan and parts of Maharashtra have been recording excess rainfall this season. Most of these regions are not used to heavy rainfall as in a normal scenario, Monsoon systems move across Northwest India causing rainfall over the region. In fact, places like Marathwada and Vidarbha were prone to deficit rainfall.



Besides this, most of the weather systems are developing in the south Bay of Bengal. As a result, Tamil Nadu and Karnataka have recorded excess rainfall by 45% and 30%, respectively.

“It has been very complex to understand the rainfall variability and how Monsoon patterns have been behaving off late, especially this year. The problem is very challenging for us to apprehend, which calls for a lot more research. What we are witnessing across the country, flooding in one region and deficit rainfall in other parts, is a combination of several parameters. Persistence of intense La Nina conditions, abnormal warming of East Indian Ocean, negative Indian Ocean Dipole (IOD), southward movement of most of the Monsoon depressions and lows and pre-Monsoon heating over Himalayan region melting glaciers. This is a very complex mix,” said **Dr R Krishnan, Executive Director, Centre for Climate Change Research, Indian Institute of Tropical Meteorology (IITM).**

With this, the South Peninsula recorded the highest rainfall in the country with surplus rainfall to the tune of 22%, followed by Central India at 19%.

Month-wise performance

June: The country recorded 8% less rainfall during the onset Month of June, on account of weak onset and sluggish progress thereafter. Out of 36 meteorological subdivisions of the country, 20 subdivisions were rain deficient, while only 10 observed normal rainfall.

July: Monsoon gave its best performance in July, where the country saw excess rains by 17%. However, East and Northeast India remained deficit by a big margin.

Month	Actual rainfall	Normal rainfall	Departure from normal
June	152.3 mm	165.3 mm	-8%
July	327.7 mm	280.5 mm	17%
August	263.7 mm	254.9 mm	3%
September	181.3 mm	167.9 mm	8%

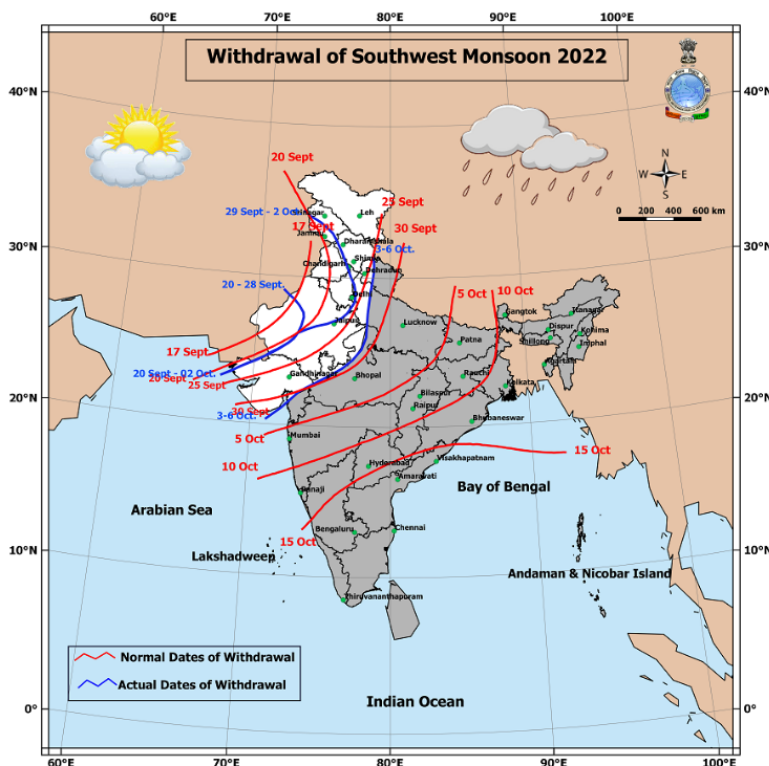
Data Source: IMD

August: The third month also recorded normal with just 3% more rainfall. Meanwhile, Northwest India joined East and Northeast India which continued to record deficit rains. Despite the formation of back-to-back Monsoon weather systems like low pressure areas

and depressions in the Bay of Bengal, both the regions recorded deficit rains. This could be attributed to the movement of these systems which was confined to Central India and which also kept the Monsoon trough south of its positions for most of the time.

September: The withdrawal month ended with 8% more rain. For the first time in the season, the East and Northeast Monsoon saw normal rains. The country as whole received excess rainfall mainly over North and Central India especially over Indo-gangetic plains due to favourable conditions like an increase in the strength of La Nina conditions and frequent passage of Western Disturbances and their interaction with the low pressure systems. There were three low pressure systems in September. Out of these, one system intensified into a Depression during 11-12 September.

Southwest Monsoon has started its journey back, with the withdrawal line presently passing through Uttarkashi, Nazibabad, Agra, Gwalior, Ratlam and Bharuch. However, it seems that Monsoon has decided to extend its stay for a few more days, like the last two years.



By October 5, Monsoon should have retreated from most parts of Uttar Pradesh, Madhya Pradesh and some parts of Maharashtra. This can be attributed to formation of low pressure areas in the Bay of Bengal in quick succession. The northwesterly movement of these systems across Central India halted the retreat of Monsoon current.

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