



WESTERN DISTURBANCES AND INDIA - GS I MAINS

Q. Discuss the phenomenon and origin of western disturbances and enumerate how does western disturbances affect weather patterns in India. (10 marks, 150 words)

News: *What are Western Disturbances? How do they impact rain and snowfall in India?*

What's in the news?

- The only source of rainfall and snowfall in the hills of north India are extratropical storms known as western disturbances (WDs).
- These form in the Mediterranean region and travel eastward to northern Bangladesh and south-eastern Nepal.

Key takeaways:

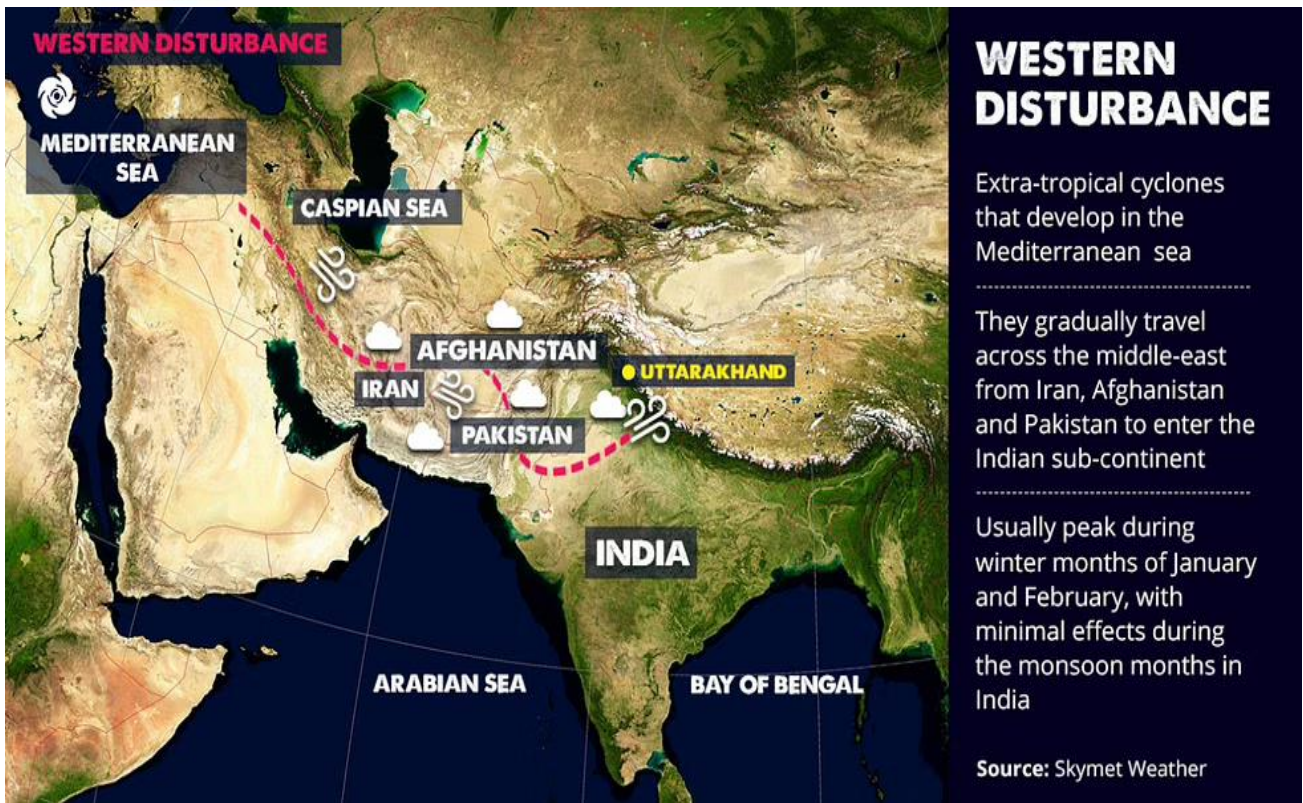
- The WDs have been showing a declining trend in intensity in the past few years due to changing climate.
- While Uttarakhand experienced 47 percent less rains than normal from October 1 to December 27, the deficit in Himachal Pradesh was 40 percent, according to data from the India Meteorological Department (IMD).
- Media reports say that snowfall has reduced drastically in the mountains of Jammu and Kashmir even though there has been rainfall during the post-monsoon season.

Western Disturbances:

- It is a non-monsoonal precipitation pattern that induces low pressure systems in the lower layers of the atmosphere driven by westerlies.
- It is a term used to describe an extra-tropical storm that brings sudden winter rain and snow to the north-western parts of the Indian subcontinent.

Origin:

- The moisture in these storms usually originates over the Mediterranean Sea and the Atlantic Ocean.
- They carry moisture usually in the upper atmosphere (unlike tropical storms where it is carried in the lower atmosphere).
- In India, moisture is sometimes shed as rain when the storm system encounters the Himalayas.
- In the Himalayan region of India, monsoon current progresses from east to west. But the Western Disturbances move across north India from west to east, with consequent rise in pressure and cold pool of air in the rear.



WESTERN DISTURBANCE

Extra-tropical cyclones that develop in the Mediterranean sea

They gradually travel across the middle-east from Iran, Afghanistan and Pakistan to enter the Indian sub-continent

Usually peak during winter months of January and February, with minimal effects during the monsoon months in India

Source: Skymet Weather

Variations of Western Disturbances in the Present Scenario:

- In recent years, there has been a trend towards more frequent and intense Western Disturbances (WDs).
- This is likely due to various factors, including climate change, El Niño, and La Niña.
- The variation of WDs can have a significant impact on the climate and water resources of North India.
 - For example, a year with weak WDs can lead to drought, while a year with solid WDs can lead to flooding.

North India and Variations in Western Disturbances:

- In 2020-21, North India experienced a severe winter drought due to weak WDs. This led to a shortage of drinking and irrigation water and impacted production. agricultural
- In 2021-22, North India experienced a series of solid WDs, which led to heavy rainfall and snowfall. This caused flooding and landslides in some areas and disrupted transportation and flights.

Role of Climate Change in the changing pattern of Western Disturbance:

- **Global Warming** has been making the world's weather more unstable and extreme.
- Recent studies have noted that the average global warming of 85 degrees Celsius is responsible for 75% of the daily heat extremes and 18% of the precipitation extremes.
- Pronounced warming over the Tibetan Plateau has increased the instability of westerlies which in turn is responsible for the increased variability of western disturbances.



- These disturbances have also been linked to the growing **instability of the jet stream** - strong winds that blow from west to east and separate the cold arctic mass from warm sub-tropical air.
- All these lead to a change in the pattern of western disturbances, resulting in record-breaking rainfall and heat.

Western Disturbances and its impact on Indian Weather:

1. Rainfall and Snowfall:

- Western disturbances bring rainfall and snowfall to different parts of the Indian subcontinent, particularly the northern and northwestern regions.
- They contribute to the winter precipitation in the form of rain and snow.
 - 30% of annual precipitation over Northwest Indian region (J & K, Ladakh, Himachal Pradesh & Uttarakhand) is received during winter and it is mostly associated with Western Disturbances.
 - It also causes rainfall over the adjoining places of north India.

2. Atmospheric Instability:

- The interaction of western disturbances with the prevailing weather systems can cause atmospheric instability, leading to the formation of clouds, thunderstorms, and sometimes severe weather events.

3. Influence on Temperature:

- Western disturbances can cause fluctuations in temperature patterns, bringing cooler conditions with their arrival and a subsequent rise in temperatures after their passage.

4. Influence on Monsoon:

- In some cases, western disturbances can influence the Indian summer monsoon by interacting with the monsoonal flow, leading to variations in rainfall patterns.

Western Disturbances and North and Northwest India:

- Precipitation associated with Western Disturbances (WDs) influences Himalayan climate, glaciers, snow-water storage, flora, fauna, agricultural crops and human inhabitants etc.

Western Disturbances and its Effects on Economy:

- Western Disturbances are important to the development of the Rabi crop in the northern subcontinent, which includes the locally important staple wheat and their effect sometimes also extends up to Gangetic plains and Northeast India.
- Weak western disturbances are associated with crop failure and water problems across north India.
- Unseasonable rainfall and hail brought about by western disturbances damages the crops in the North Indian states like Haryana, Punjab, Madhya Pradesh and Rajasthan.

Western Disturbances and its Implications for Monsoon Weather Systems:

- Increasing WDs during summer could interact with monsoon weather systems.
- Interaction with low-pressure areas and depressions in the Bay of Bengal and the Arabian Sea can lead to extreme rainfall events, floods, and landslides.



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- The Uttarakhand floods in June 2013 were caused by WDs interacting with monsoon weather systems.

According to the experts, **the frequency of western disturbances has increased, but not the precipitation associated with them, partly due to a warming atmosphere.** Western disturbances are low-pressure areas. If it is a feeble western disturbance it will not have moisture to precipitate. For precipitation, moisture is needed, and by virtue of a warming atmosphere, there is less amount of moisture available to precipitate. Simultaneously, because of warming in the atmosphere, western disturbances are going higher in elevation. In general, they move in subtropical westerly jet, now they are becoming lighter and moving higher, above 200 hectopascals.

