

## 1. What role do temperate cyclones play in causing precipitation in different parts of India? Explain.

### Demand of the question:

It expects students to write in detail the role of temperate cyclone in causing precipitation in different parts of India.

### Introduction:

The cyclonic system developing in the mid and high latitude i.e. 35° latitude and 65° latitude in both hemispheres, beyond the tropics is called the Temperate Cyclones or Extra Tropical Cyclones.

### Body:

Due to these cyclones, highly variable and cloudy weather is observed in temperate zone. It is in these latitude zones that the polar and tropical air masses meet and form polar fronts, most of these cyclone form wavelike twist i.e. wave cyclone.

Especially with respect to India, temperate cyclones are observed in the form of disturbances known as 'western disturbance'.

- Temperate cyclone is a common weather phenomena in India. Temperate cyclone is an extra tropical cyclone originating in the Mediterranean region that brings sudden winter rain to the north western parts of the Indian subcontinent.
- They are the cause of the most winter and pre-monsoon season rainfall across North-West India (such as Punjab, Haryana, Delhi and western Uttar Pradesh).
- Temperate cyclones, specifically the ones in winter, bring moderate to heavy rain in low-lying areas and heavy snow to mountainous areas of the Indian Subcontinent.
- This phenomenon is usually associated with cloudy sky, higher night temperatures and unusual rain.
- This precipitation during the winter season has great importance in agriculture particularly for rabi crops including wheat. It is estimated that India gets close to 5-10% of its total annual rainfall from temperate cyclones.
- Also, Saffron cultivation along with tea cultivation in the foothills of Himalayas is depending on the western disturbance.
- Over the Indo-Gangetic plains, they occasionally bring cold wave conditions and dense fog.
- Western disturbances very less likely cause precipitation in the southern i.e. peninsular part of India.

### Conclusion:

Most of the North and North-western India's Rabi crops yield better results because of the Temperate cyclones. Temperate cyclones provide the rain for most of the North and North-western India and fill the vacuum created by South west monsoon and also play a pivotal role in water need for human consumption and agriculture sector.

**2. With the help of suitable examples, discuss the endogenous factors that lead to the formation of volcanoes.**

**Demand of the question:**

It expects students to give detailed account of how the endogenous factors lead to formation of volcanoes with suitable examples.

**Introduction:**

The horizontal and vertical movements caused by the forces coming from the origin of the earth is known as endogenic forces. The origin of endogenic force is caused by the contraction and expansion of rocks due to variation in thermal conditions and temperature inside the earth. These forces are responsible for creation of many landforms one of such landform is volcano.

**Body:**

Endogenic factors that lead to formation of volcanoes:

- The ultimate source of energy behind forces that drive endogenic movements is earth's internal heat.
- Endogenic movements are divided into diastrophic movements and sudden movements.
- Plate Tectonics: The majority of volcanoes occur where two lithospheric plates converge and one overrides the other, forcing it down into the mantle to be reabsorbed.
- Ocean floor spreading: A major site of active volcanism is along the axis of the oceanic ridge system, where the plates move apart on both sides of the ridge and magma wells up from the mantle.
- Weak Earth Surface: Because of high pressure in the earth's interior, the magma and gases escape with great velocity as the pressure is released through eruptions where opportunity is provided by weak zones along the earth's surface.
- Faults: Whenever extreme pressure builds in the mantle, along fault lines an eruption is likely to happen next. The earthquakes, for instance, may expose fault zones through which magma may escape and volcanoes can be formed.
- Magma crystallization: Decreasing temperatures can cause old magma to crystallize and sink to the bottom of the chamber and this movement can force fresh liquid magma up and out – similar to dropping a brick in a bucket of water.
- Plate movement: Volcanism may occur because of plate movement over a "hot spot" from which magmas can penetrate to the surface. e.g. Islands of Hawaii

**Conclusion:**

Through these endogenic factors volcano formation takes place. Depending on the level of activity volcanoes are further classified as Active, Dormant and extinct. Apart from playing a prominent role by giving cooling effect to most part of earth, volcanoes also contribute Ash and lava which breaks down to form soil and rocks.

### 3. What do you understand by storm surge? How does a storm surge get formed? Discuss.

#### Demand of the question:

It expects candidates to write their understanding about storm surge. It also expects to write the mechanism of formation of storm surge.

#### Introduction:

Storm Surge is an abnormal rise of sea level as the tropical cyclone crosses the coast. The storms produce strong winds that push the water into shore, which might lead to flooding.

#### Body:

Storm surge depends on intensity of the cyclone (Maximum winds and lowest pressure associated with it and Coastal bathymetry (shallower coastline generates surges of greater heights). Following is the way of formation of cyclone:

- When a cyclone is in deep ocean waters, the circulating wind pushes the ocean surface to create a vertically circulating column of water, where the surge is barely visible.
- However, as the storm moves closer to the shore, the water which is being pushed downwards by the wind cannot move any lower, so the water forces itself from the sides towards land, causing a storm surge wave.
- Although low pressure also contributes to the surge, its influence is very small, i.e., around 5%.
- Whenever a cyclone moves near coastal areas, storm surges are the biggest and most common threat to life and property.
- This phenomenon is commonly found in low-pressure systems, and the severity of the storm surge wave depends on the tides, shallowness of the water in the area, and the angle at which the water is to the cyclone.

Following are some factors which determine the intensity of storm surge:

- **Strength and Size of the Storm:** During a cyclone, the water level rises to form storm surges, where the strength and speed of the winds are the highest. Usually, the largest surges occur in the direction of where the wind is blowing. Due to the rotation of the earth, the surge occurs towards the right side of the cyclone in the northern hemisphere, and towards the left side in the southern hemisphere.
- **Atmospheric Pressure:** The force exerted by the atmospheric pressure is a smaller factor in the formation of a storm surge.
- **Bottom Conditions Near Shore:** Another minor factor determining the strength of a surge is whether the coastal slope is steep or shallow, and rough or smooth. A shallow and smooth ocean floor near the coast can dramatically enhance the speed and power of the storm surge, while a steep climb with rough obstructions can slow and sometimes even stop a storm surge. A wider shore will have a higher surge than a narrower shore.

- Distance from Storm Centre to Shore: For a storm surge to achieve maximum potency, the distance between the eye of the storm and the shore should neither be too close nor too far. If the distance is less, the surge cannot gather enough velocity to gain power. However, if the storm is too far, the surge will lose its gathered energy by the time it reaches the shore.
- Tides: The gravitational force of the sun and moon cause low and high tides. If the storm surge occurs during a low tide, the intensity will be significantly reduced. However, a storm surge during high tide will cause a storm tide capable of heavy destruction.
- Freshwater: Usually, before a storm reaches land, most coastal areas receive heavy rainfall, causing water levels to rise. This is especially true in areas that have a river delta, causing bigger and stronger storm surges.
- Shape and Angle of Coast to the Storm: A shore with a convex shape will have a lower surge as compared to a concave shore. Also, if the storm is moving parallel to the shore, it will cause lower and weaker storm surges as compared to a storm moving perpendicular to the coast.
- Sea Waves: When waves break onto the beach, they may collect into pools, eventually making it easier for the surge to overcome the friction of the beach, and move even further inland.

A storm surge should not be misunderstood as seiche, as Storm surge is the unusual rise in the water levels generated by a storm over and above the predicted astronomical tide. The term seiche can be defined as a wave on the surface of a lake or landlocked bay; caused by atmospheric or seismic disturbances.

**Conclusion:**

Storm surge as high as 15 to 20 ft. may occur when all the factors contributing to storm surge are maximum. This storm tide inundates low lying coastal areas which have far reaching consequences apart from flooding. Hence, necessary precaution if taken will ensure the minimal loss of environment human life in the surrounding area.