

Science of Monsoon:

- Monsoon is the lifeline of Indian economy as 2/3rd of it depends on farm income and rain is the only source of irrigation for over 40% of the country's cropped area.
- Over 70% of India's annual rainfall occurs in July-September monsoon season.
- A good monsoon increases crop productivity, raises farm income and drives the economy while, a weak monsoon inflates food prices and harms the economy.

Key facts:

- The word "monsoon" is derived from Arabic word mawsim and/or Hindi mausam.
- Monsoon refers to the seasonal reversing wind accompanied by precipitation.
- It occurs due to a difference in temperature between the landmass and the ocean. Major monsoon of the world are West African and Asian-Australian monsoons.

Indian Monsoon:

Southwest monsoon:

- Indian subcontinent has a large heated landmass during the summer months (April to September), and a cooler water mass in the form of Indian Ocean.
- This causes a temperature difference, which creates a pressure gradient and drives moisture laden winds over Indian subcontinent.
- Impact of this monsoon is felt in India, Sri Lanka, Bangladesh and Myanmar and as far north as in China's Xinjiang.

It has two branches:

The Arabian Sea branch:

- It first hits the Western Ghats and Kerala gets the first rain in India.
- It causes rain in the coastal areas of Konkan and Goa as it moves northwards, but eastern part of the Western Ghats do not receive much precipitation.

The Bay of Bengal Branch:

- It picks up moisture-laden winds from Bay of Bengal and moves towards North-East India and Bengal.
- The Himalayas act as a barrier for them and thus, rain occurs in Indo Gangetic plains, Meghalaya, etc.

SW monsoon:

- Southwest monsoon accounts for over 80% of rainfall in India.
- Monsoon impacts Indian economy- agriculture, industry and society as a whole. It brings respite from heat and transforms large part of semi-desert areas into green land.
- Crops specially like cotton, rice, oilseeds, and coarse grains depends heavily on rains.
- Monsoons are often associated with conditions like 'El Nino' (Spanish for 'Little Boy') that occurs every 2 to 7 years and La Nina.
- It is caused by unusual warming in Eastern tropical Pacific Ocean and reversal of prevailing winds in the region.
- El Nino can trigger above average rains in northern Peru & draught in Southeast Asia, Australia and India

Northeast monsoon/ Retreating monsoon:

- The cycle is reversed during colder months (October to April). Wind blows from cooler landmass (Himalayas and Indo-Gangetic plain) towards Indian ocean (south of Deccan).
- This causes precipitation over the oceans and in regions like Tamil Nadu.

What cause Monsoon?

- During summer months in the Northern Hemisphere, the ITCZ (Intertropical Convergence Zone) shifts North, pulling southwest monsoon winds onto the land from the sea.
- Huge landmass of the Himalayas restricts the low-pressure zone onto the Himalayas themselves. When Tibetan plateau heats up more than the Himalayas, the ITCZ abruptly and swiftly shifts North. This leads to bursting of monsoon rain over the Indian subcontinent.
- A reverse shift takes place for the Northeast monsoon winds causing minor rainfall over the eastern Indian Peninsula during the Northern Hemisphere winter months.
- The rainfall caused due to Southwest monsoon is a type of orographic rainfall. It occurs when masses of air are pushed by wind upwards along the side of elevated landforms. This results in adiabatic cooling and ultimately condensation and precipitation. Along the leeward side rain shadow is observed.

Other Monsoons:

- Asian-Australian Monsoon: It stretches from North Australia to Russian Pacific coast and stretches into Indian ocean.

North American Monsoon:

- Monsoon season in North America brings rainfall primarily to northern Mexico, Arizona, and New Mexico, and to a smaller extent to parts of Utah, Colorado, southern California and Baja

California, according to the National Oceanic and Atmospheric Administration (NOAA).

- While the monsoon in North America is not as strong as those in India due to a lower and smaller plateau, the same patterns are followed.
- The North American monsoon begins between May and June, peaks in July and August, and winds down between September and October

Monsoons and global warming:

- According to a study, the effects of global warming on a monsoon can potentially be devastating due to frequent shifts and changes in precipitation levels and timelines.
- World Monsoons estimates that there will be an increase in rainfall during the summer monsoon seasons in the next 50 to 100 years.
- Greenhouse gases, such as carbon dioxide, can make warm air hold onto more water only to release it as rain over already soaked areas. During the dry winter monsoon seasons, it is believed that the land will become drier as evaporation increases in warmer temperatures.
- On shorter timescales, the amount of rainfall during a summer monsoon may be changed year to year by a variety of factors including air pollution, according to World Monsoons.
- El Niño in the Pacific oceans can also have effects on the monsoon in India on both the short- and long-terms, according to studies from the University of Colorado in Boulder.
- The strength of El Niño's warming was believed to be the main influence in the strength of the monsoon seasons. However, it now appears that instead of the strength of El Niño, it is in fact the location of the warming.

El Nino and India:

- The researchers compiled data of rainfall in India and satellite observations of the Pacific Ocean and discovered that when El Niño warming was located in:
 - the central Pacific, India experienced droughts.
 - the eastern Pacific, India experienced normal monsoon conditions.
 - The western Pacific, India experienced more rain.

Source: RSTV, Live Science