Climate Change and Extreme Rainfall

Why in News?

Severe flooding events have been occurring across the globe in Europe, Arab and American regions.

What are the extreme rainfall events across globe?

- **Europe** - Regions of Austria, the Czech Republic, Poland and Romania have been hit by days of heavy rainfall.
- Heavy or record-breaking precipitation triggered floods in Italy, Norway, Sweden and Slovenia.
- **Arab** - United Arab Emirates and Oman experienced the heaviest rainfall since records began.
- **Africa** - Deluges in Kenya claimed numerous lives and triggered landslides.
- **South America** - Brazil, floods damaged an area equivalent in size to the UK and displaced over half a million people.

What factors causes extreme rainfall?

- Winds, high tides, river, groundwater and flash flooding are all linked to heavy rainfall.
- **Water cycle** - The water cycle is a continuous process that involves the evaporation of water from the Earth's surface, the condensation of water vapor into clouds, and the subsequent fall of rain.
- **Air pressure** - Low-pressure systems have less air on top of them, which causes the air to rise into the clouds and condense into rain.
- **Air Temperature** - Air's capacity to hold moisture ***rises by 7%*** with every rise of 1 degree Celsius.
- **Air Mass** - When cold air enters an area, it forces warm air into the clouds, causing water vapor to condense into rain.
- **Geological barriers** - Mountains can alter rainfall patterns, with the windward side receiving more rain than the leeward side.
- **Human activity** - Human-produced carbon dioxide emissions and climate change have been linked to increased day-to-day rainfall fluctuations.

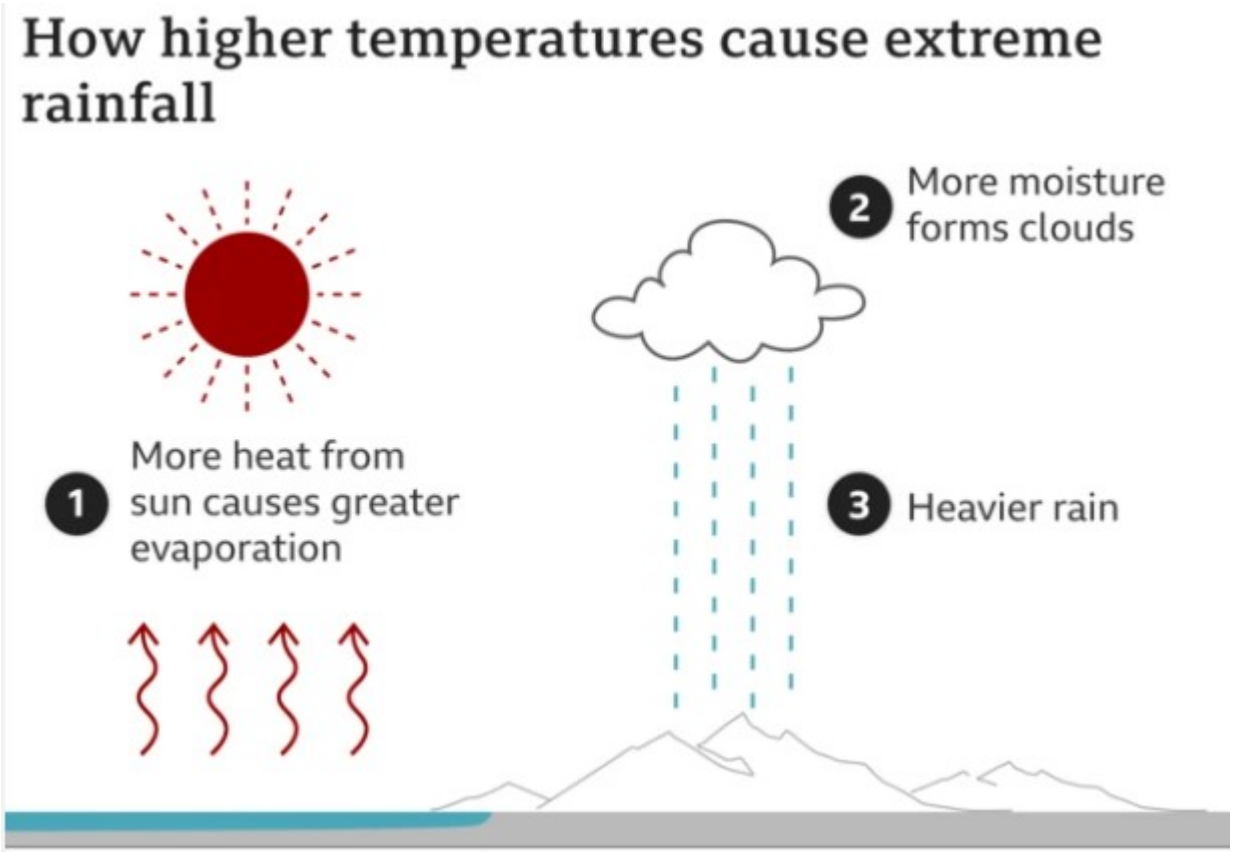
How is climate change impacting global rainfall?

- Climate change is impacting the ***frequency*** of heavy downpours during storms and sudden outbursts through its influence on complex atmospheric and weather patterns.
- **Green House Gases** - Greenhouse gases released by burning fossil fuels into the atmosphere act like a blanket on the earth, trapping heat and causing temperatures to rise.

- **Global Warming** - Since the pre-industrial era, global air temperatures have increased by around 1.3 degrees Celsius.
- Rising global temperatures is making rainfall more frequent and severe across most parts of the world.
- This leads to a more rapid evaporation of water on land and at sea, thus favouring conditions for heavy rainfall.
- **Impact on Climate patterns** - Climate change is likely to increase the warming effects of El Niño and decrease the cooling effects of La Niña.

El Niño and La Niña are climate patterns in the Pacific Ocean that can affect weather around the world and these are part of the El Niño-Southern Oscillation (ENSO) cycle, which is characterized by opposing climate patterns.

- **More Rainfall than snow** - Temperature rises also make more precipitation fall as rain instead of snow which can make high altitude regions vulnerable to flooding and landslides.
- In snowy, high-elevation parts of the Northern Hemisphere, rainfall extremes increased by an average of 15% per 1 degree Celsius of warming.



- **Increased frequency** - Heavy precipitation that would have been a once in a 10-year rainfall event will occur 1.5 times every decade.
- On average, 1 in 4 record rainfall extremes in the last decade can be attributed to climate change.
- **Increased rainfall amount** – Last year the average rainfall was 20% higher than the average for 1991-2020.

- Rainfall is over 10% wetter and Europe had around 7% rainier than normal, with most of the continent experiencing wetter-than-average conditions.
- **Future Projections** - At 2 degrees Celsius of warming above pre-industrial levels, what would have been a once-every-10-year rainfall event will occur 1.7 times per decade and be 14% wetter.
- At 4 degrees Celsius, heavy rains that used to hit once a decade could hit almost three times more often and release 30% more rain.

What are the impacts of extreme floods?

- Flooding, among the most widespread natural disasters, affects people's lives, critical infrastructure, wildlife and fertile soil and causes economic damage.
- **Loss of life** - Since 2000 the proportion of people exposed to floods is estimated to have increased by 24%.
- About 1.8 billion people, just under a quarter of the global population, are directly exposed to one-in-100-year floods.

An estimated 89% of people exposed to high flood risk live in low- and middle-income countries and Most live in South and East Asia, with 395 million exposed people in China and 390 million in India.

- **Damage to property** - Floodwaters can cause structural damage to homes, and carry away vehicles and other property.
- **Damage to infrastructure** - Floodwaters can damage bridges and roadways, making travel difficult.
- **Displacement** - Floods can displace people from their homes.
- **Health effects** - Floods can cause mental health problems, undernutrition, and pollute drinking water systems causing waterborne diseases.
- **Damage to cultural heritage** - Floods can damage monuments, structures, building contents, works of art, archive records, and manuscripts.
- **Landslides** - Floods can cause landslides and make soil and bank erosion, siltation.

What are the mitigation measures?

- **Structural measures** - Building flood barriers, levees, seawalls, and floodgates.
- Floodproofing is another strategy that involves elevating critical equipment or placing it in waterproof containers.
- **Non-structural measures** - Removing people and property from areas at risk, such as through zoning, subdivision, and building codes.
- **Green infrastructure** - Using rain gardens, bioswales, and permeable pavements to absorb rainfall and reduce flooding.
- **Nature-based solutions** - Restoring River bends, changing land management practices, and creating saltmarshes.
- **Aquifer storage and recovery** - Building infrastructure to increase groundwater storage, which can help with seasonal droughts.
- **Relocating facilities** - Moving utility infrastructure, such as pump stations and

treatment plants, to higher elevations.

Reference

The Indian Express | Climate change impacting flooding