

Environmental problems: sea level rise, extreme weather events

SEA LEVEL CHANGE:

The World Meteorological Organisation's (WMO) report titled "Global Sea-level Rise and Implications" highlights that India, China, Bangladesh, and the Netherlands are among the countries facing the most significant threat from sea-level rise worldwide. Furthermore, numerous major cities across all continents are at risk due to this phenomenon. These cities include Shanghai, Dhaka, Bangkok, Jakarta, Mumbai, Maputo, Lagos, Cairo, London, Copenhagen, New York, Los Angeles, Buenos Aires, and Santiago.

▪ Trends and Projections:

- Between 2013 and 2022, Global mean sea-level was 4.5 mm/year and **human influence** was likely the **main driver of these increases since at least 1971**.
 - Global mean sea-level increased by 0.20m between 1901 and 2018,
 - **1.3 mm/ year between 1901 and 1971,**
 - 1.9 mm/year between 1971 and 2006
 - 3.7 mm/year between 2006 and 2018.
- Even if global heating is limited to 1.5 degrees Celsius over pre-industrial levels, there will still be a **sizable sea level rise**.
- But every fraction of a degree counts. If temperatures rise by 2 degrees, that level rise **could double, with further temperature increases bringing exponential sea level increases**.

▪ Contributors to Sea Level Rise:

- Thermal expansion contributed to **50% of sea level rise during 1971-2018**, while ice loss from glaciers contributed to **22%, ice-sheet loss to 20% and changes in land-water storage 8%**.
- The rate of ice-sheet loss increased by a factor of four between 1992-1999 and 2010-2019. Together, icesheet and **glacier mass loss were the dominant contributors** to global mean sea level rise during 2006-2018.

▪ Impacts:

- At sustained warming levels between 2-3 degree Celcius, the Greenland and West **Antarctic ice sheets will be almost completely and irreversibly lost** over multiple millennia causing potentially multimeter sea-level rise.
- Sea-level rise will bring cascading and compounding impacts resulting in losses of **coastal ecosystems and ecosystem services**, groundwater salinization, flooding and damage to coastal infrastructure that cascade into risks to livelihoods, settlements, health, well-being, food, displacement and water security, and cultural values in the near to long-term.

What is the Scenario for India?

▪ Rate of Sea Level Rise:

- According to the Ministry of Earth Sciences, on average, the sea level along the Indian coast was observed to be rising at a rate of about **1.7 mm/year during the last century (1900-2000)**.
- A 3 cm sea level rise could cause **the sea to intrude inland by about 17 meters**. At future rates of 5 cm/decade, this could be 300 metres of land taken by the sea in a century.
- **India is more Susceptible:**
 - India is most **vulnerable to compounding impacts** of sea level rise.
 - In the Indian ocean half of sea level rise is **due to the volume of water expanding since the ocean is warming** up rapidly.
 - The contribution from glacier melt is not as high.
 - The **Indian Ocean is the fastest [warming ocean](#)** in terms of surface warming.
- **Implications:**
 - India is facing compound extreme events along our coastline. Cyclones are intensifying rapidly due **to more moisture and heat from ocean warming**.
 - The amount of flooding also increases because storm surges **are compounding sea level rise** decade by decade.
 - Cyclones are bringing more rain than earlier. Super [Cyclone Amphan \(2020\)](#) caused large-scale [flooding](#) and inundated tens of kms inland with saline water intruding.
 - Over time, the Indus, [Ganga](#) and Brahmaputra rivers may shrink, and rising sea levels combined with a deep intrusion of saltwater **will make large parts of their huge deltas simply uninhabitable**.

What are the Recommendations?

- There is a need to **address the [climate crisis](#) and broaden our understanding** of the root causes of insecurity.
- It is imperative to actively support **grassroots resilience efforts to tackle climate change** and improve **Early Warning Systems**.

EXTREME WEATHER EVENTS:

- When the **weather conditions show significant differences** than the usual weather, this is when the weather differs significantly from its usual patterns, it's categorized as extreme or severe weather. These conditions can persist for varying periods, ranging from a few days to just one or two. According to the World Meteorological Organization (WMO), extreme weather, climate, and water-related events have led to 11,778 reported disasters globally between 1970 and 2021, resulting in over two million deaths and economic losses totaling USD 4.3 trillion. Developing countries bore the brunt of these disasters, with over 90 percent of reported deaths occurring in these regions. In India, 573 disasters occurred between 1970 and 2021, claiming 138,377 lives.

- **Types of Extreme Weather Events:**

Events	Description	Example
Heatwaves	<ul style="list-style-type: none"> • A heatwave occurs when the maximum and the minimum temperatures are unusually hot (about 32.2 °C) over a three-day period at a location. This is considered in relation to the local climate and past weather at the location. • In India, Heat Waves typically occur between March and June, and in some rare cases even extend till July. 	<ul style="list-style-type: none"> • According to the European Space Agency in June 2023, Italy’s islands of Sicily and Sardinia could experience their hottest-ever temperature, with a predicted high of 48 degrees Celsius (118F) — potentially the hottest temperatures ever recorded in Europe. • In the middle of April a heatwave swept over China, India, Thailand, Laos, Bangladesh, and more countries across the Asian continent, with temperatures ranging from 38 degrees to 45 degrees Celsius — breaking temperature records in over a dozen countries.
Wildfire	<ul style="list-style-type: none"> • Wildfire, also called forest, bush or vegetation fire, can be described as any uncontrolled and non-prescribed combustion or burning of plants in a natural setting such as a forest, grassland, brush land or tundra, which consumes the natural fuels and spreads based on environmental conditions (e.g., wind, topography). 	<ul style="list-style-type: none"> • Canada: Canada is currently experiencing its worst ever wildfire season, largely due to an extreme dry period followed by a heatwave.
Droughts (খৰাং)	<ul style="list-style-type: none"> • Drought is a prolonged dry period in the natural climate cycle that can occur anywhere in the world. 	<ul style="list-style-type: none"> • From North America to Europe to China, vast swaths of the Northern Hemisphere

	<ul style="list-style-type: none"> • It is a slow-onset disaster characterized by the lack of precipitation, resulting in a water shortage. 	<p>experienced extreme drought in the summer of 2022, straining water resources, ruining crops, and priming the landscape for perilous wildfires.</p> <ul style="list-style-type: none"> • Horn of Africa drought, 2020-2023: A three-year drought in the Horn of Africa, has caused crops to wither, water to disappear, and livestock to starve in large parts of Kenya, Somalia and Ethiopia.
<p>Tropical Cyclones</p>	<ul style="list-style-type: none"> • A tropical cyclone is a rapid rotating storm. • Tropical cyclones typically form over warm ocean waters near the equator. They require sea surface temperatures of at least 26.5°C (80°F) to develop and thrive. These storms originate from clusters of thunderstorms that organize and strengthen over time. As warm, moist air rises from the ocean's surface, it creates an area of low pressure. Surrounding air rushes in to fill the void, creating a rotating system of winds. As the storm gains strength, it can develop an eye—a region of calm, relatively clear weather at the center of the storm. • It has a low pressure centre and clouds spiraling towards the eyewall surrounding the “eye”, the central part of the system where the weather is normally calm and free of clouds. 	<ul style="list-style-type: none"> • Tropical Storm ‘Mawar’ affected Guam, the Philippines, Taiwan, and Japan at the end of May and early June. <ul style="list-style-type: none"> ○ It is reported as the strongest tropical cyclone globally so far in 2023 and the strongest northern hemisphere cyclone ever recorded in May. • Cyclone Mocha Myanmar: It proved to be one of the strongest cyclones to ever hit the region. <ul style="list-style-type: none"> ○ The storm led to immense destruction, killing an estimated 145 people. ○ According to the UN, the cyclone impacted 800,000 people overall.

	<ul style="list-style-type: none"> • According to the IPCC, these have become more frequent over the last four decades. Furthermore, they are proving more destructive as they result in higher category hurricanes. 	
Flood and Flash Flood	<ul style="list-style-type: none"> • Flood: An overflow of water onto normally dry land. The inundation of a normally dry area caused by rising water in an existing waterway, such as a river, stream, or drainage ditch. Ponding of water at or near the point where the rain fell. • Flash flood: A flood caused by heavy or excessive rainfall in a short period of time, generally less than 6 hours. Flash floods are usually characterized by raging torrents after heavy rains that rip through river beds, urban streets, or mountain canyons sweeping everything before them. • Flooding is a longer term event than flash flooding: it may last days or weeks. 	<ul style="list-style-type: none"> • Pakistan floods, 2022: Major flooding caused by record monsoon rains claimed the lives of nearly 1,500 people during the summer of 2022, with millions more affected by clean water and food shortages. <ul style="list-style-type: none"> ○ The floods left a third of Pakistan underwater. ○ The country received more than three times its usual rainfall in August, making it the wettest August since 1961. ○ Increases in both extreme precipitation and total precipitation have contributed to increases in severe flooding events in certain regions.

Extreme Weather Events are influenced by many factors

- **Anthropogenic Factors:** Human activity is causing rapid changes to our global climate that are contributing to extreme weather conditions.
 - **When fossil fuels are burned for electricity, heat, and transportation**, carbon dioxide, a greenhouse gas that traps solar radiation, is released into our atmosphere.
 - These **greenhouse gas emissions and land use change** were a key factor in **extreme climate change events** around the world.

- **Climate change has increased the instability** in the atmosphere, leading to an increase in convective activity — thunderstorms, lightning and heavy rain events.
- **Cyclonic storms in the Bay of Bengal and the Arabian Sea** are also intensifying rapidly and retaining their intensity for a longer duration due to global warming.
- **Global Warming:** Global warming is the **long-term warming of the planet's overall temperature.**
 - It can contribute to the **intensity of heat waves** by increasing the chances of very hot days and nights.
 - Warming air also **boosts evaporation, which can worsen drought.**
 - More drought **creates dry fields and forests that are prone to catching fire,** and increasing temperatures mean a **longer wildfire season.**
 - It increases **water vapor in the atmosphere,** which can lead to more **frequent heavy rain and snowstorms.**
 - It **causes sea level to rise, which increases the amount of seawater,** along with more rainfall, that is pushed on to shore during coastal storms.
 - That seawater, along with more rainfall, **can result in destructive flooding.**
 - It **causes climate change,** which poses a serious threat to life on Earth in the forms of widespread flooding and extreme weather.

SOLUTION:

- **Climate Resilient Infra For Cities:** Implementing strategies to lessen the effects of flooding is necessary when **creating flood-resistant infrastructure and cities.**
 - Important techniques include **proper urban design, efficient drainage systems, floodwater storage facilities,** and flood-resistant construction materials.
 - Urban areas must incorporate efficient waste management systems, green areas, and renewable energy sources to lower carbon emissions and improve sustainability.
 - **Cities must also incorporate climate resilience** into their long-term urban development plans to adapt to shifting climatic trends.
- **Himalayas: A Safety First Approach:** This strategy entails establishing reliable monitoring systems that use cutting-edge monitoring tools, including satellite imaging, ground sensors, and remote sensing.

- **Strict land-use rules** must stop construction on perilous slopes and locations susceptible to flooding.
- **Adopting Greener Alternative:** Move beyond fossil fuels, by keeping fossil fuels in the ground and cleaning up pollution.
 - **Switching to clean energy**, by setting ambitious climate goals, removing barriers to clean energy, and electrifying our economy.
 - Protecting climate forests, promoting **climate-smart agriculture**, and stopping the petrochemical buildout.
- **Strengthening early warning systems:** Need for improved forecasting techniques, smarter infrastructure design, and adopting a safety-first philosophy **to lessen the effects of catastrophic catastrophes.**
 - **Efficient and reliable forecasting methods** are essential to **warn communities** and authorities about oncoming extreme weather occurrences.
 - Satellite images, localised doppler radars, weather models, and data analytics are examples of modern meteorological technology **that can assist in predicting rainfall patterns more accurately**, identifying possible flood-prone locations and offering timely warnings.
- **Collaborative Strategies:** Collaboration between government, academic institutions, engineering firms, urban planners, and local communities is required if we are to address the problems **caused by extreme weather occurrences.**
- **Climate Justice:** Centering environmental justice and expanding access to clean energy in every community.
- **Local Solution:** Need for **micro-action plans at the local level** to identify vulnerable areas and develop customized **disaster management strategies.**
- **Awareness:** Campaigns for public education, evacuation strategies, and community training programmes ensure that locals are prepared for **flood situations and can act quickly to save themselves and be effective first responders.**