Today's Prelims Topics

Colossal Squid

Context

Recently Marine scientists have captured the world's first footage of a colossal squid swimming freely in its natural habitat.

About Colossal Squid

- It is a massive squid that lives in the deep sea surrounding **Antarctica**.
- It is the **largest invertebrate on Earth.**
- It lives in cold, dark environments with low light and pressure.
- **Features:**
    - **Shorter arms**, **bulky body** (unlike the giant squid).
    - **Large, rotating hooks** on its tentacles to capture prey.
    - **Basketball-sized eyes** – among the largest in the animal kingdom, adapted for deep-sea vision. (Larger than great Whale)
- As it matures, it can grow up to **7 metres** in length and weigh nearly **500 kg** - making it the heaviest invertebrate on Earth.
- It belongs to the class **Cephalopoda**, which includes octopuses, cuttlefish and other squids.

Source:

- Indian Express - Colossal Squid

Perovskite Solar Cells

Context

Researchers have developed a water-based recycling method for perovskite solar cells.

About Perovskite solar cells (PSCs)

- PSCs are a type of photovoltaic (PV) cell, they utilize perovskite materials in their structure, which differs from traditional silicon-based PV cells.
- They are made using **perovskite crystals**. They offer a cheaper and more efficient alternative than Silicon solar panels.
- They can be manufactured using **simpler, low-cost processes**.
- **Structure of Perovskite Solar Cells:** It is composed of **multiple layers of -**
    - Perovskite crystal layer, Conductive charge transport materials, Metal electrodes & Glass sheets.
- **Challenges with Perovskite Solar Cells:**
    - **Toxicity concerns**: It contains **lead**, a hazardous element which must be carefully managed during **manufacturing and disposal**.
    - **Recycling issues**: Traditional recycling methods rely on **toxic organic solvents** like **dimethylformamide (DMF)**.These solvents are **harmful** and **unsuitable** for a circular economy approach.

Currently Silicon-based solar panels dominate the market but they have certain drawbacks:

- High **energy cost** of manufacturing.
- End-of-life **disposal problem** due to non-biodegradable silicon.

- Researchers have developed a **water-based recycling method** for perovskite solar cells that ensures:
    - Efficient degradation and recycling of used perovskite material.
    - **Recovery of high-quality perovskite crystals**, reusable for new solar cells.
    - **It avoids organic solvents**, making the process **greener** and more **sustainable**.

Solar Manufacturing Capacity in India:

- **Installed Solar Capacity:** As of now, India has installed **92 GW** of solar capacity.
- **Manufacturing Capacity:** India's solar-module manufacturing capacity stands at 63 GW, while the solar-cell manufacturing capacity is about 5.8 GW.
- **India's biggest solar power plant:** Bhadla Solar Plant (Rajasthan) - 2,245 megawatts

Source:

- The Hindu - perovskite solar cells'

Jal Jeevan Mission

Context

The Expenditure Finance Committee (EFC) has halved the funding for the extended period of Jal Jeevan Mission. There are **serious concerns** over inflated costs by states and contract irregularities.

About Jal Jeevan Mission (JJM)

- It was launched on August 15, 2019 by Prime Minister Narendra Modi.
- **Implementing Ministry:** Ministry of Jal Shakti.
- **Objective:** To provide **Functional Household Tap Connections (FHTCs)** to **all rural households** in India by **December 2024**, under the **"Har Ghar Jal"** programme.
- **Target:** 16 crore rural households to be covered.
- **Funding Pattern:**
    - **50:50** sharing between Centre and States for most states.
    - **90:10** for Himalayan and NE states.
    - **100%** Central funding for Union Territories.
- **Current Status (as of December 2024):**
    - **Coverage Achieved:** 75% tap connections delivered in 5 years.
    - **Remaining Households:** ~4 crore connections still pending.
    - **Extension Proposed:** Till **December 2028** to complete remaining work.

Expenditure Finance Committee (EFC):

- It is a crucial body within the **Union Department of Expenditure.**
- It is responsible for appraising and approving public funded schemes and projects with a budgetary allocation **(Above ₹500 Crore).**
- It ensures that government spending is efficient and aligned with overall fiscal policy
- **EFC is Chaired by:** Expenditure Secretary.
- Even if EFC recommends cost cutting, the final decision lies with the **Union Cabinet**, which can override **EFC recommendations.**

Source:

- Indian Express - JJM

Commissioner of Railway Safety

Context

Recently CRS has made a report regarding the safety measures to be taken by the Railways for operation of high-speed trains.

About Commissioner of Railway Safety (CRS)

- CRS is **a statutory authority under the Ministry of Civil Aviation, not Railways.**
- **It is an** Independent safety regulator for Indian Railways.
- **Key Functions:**
    - **Safety Oversight** of new railway infrastructure and systems.
    - **Approval of Railway Projects** (new lines, gauge conversions etc.).
    - **Investigation of Railway Accidents**.
    - Recommendations on Railway Operations and Safety Measures.
- **Why Not Under Railways?**
    - To maintain **independence and objectivity**, the CRS reports to the **Ministry of Civil Aviation**.

Key Concerns Highlighted in Safety Report

- **The leading coach** of Vande Bharat trains is **lighter than conventional locomotives**.
- This makes it **more vulnerable** to serious accidents **in case of collisions**, especially:
    - Cattle run-overs
    - Obstructions on the track
- Risk becomes severe **at higher speeds (up to 160 kmph).**

Recommendations by the CRS Report

- **Fencing and Trespassing Prevention:** Railways should **build sturdy fencing** along tracks to prevent:
    - Cattle intrusions
    - Human trespassing
- **Eliminate Level Crossings:** Eliminate all **level crossing gates** on routes with **160 kmph speed operations**.
- **Identify & Monitor Risk Zones:** Identify areas with:
    - Frequent trespassing
    - Regular cattle entry
- **Suggested safety measures:**
    - Deployment of Railway Protection Force (RPF)
    - Regular patrolling
    - Constructing subways for safe crossings

Source:

- The Hindu - CRS

United States Federal Reserve

Context

US President Donald Trump has expressed a desire to remove current Chair Jerome Powell over policy disagreements.

About US Federal Reserve (US Fed)

- The Federal Reserve is the most powerful economic institution in the United States.
- It is responsible for managing monetary policy and regulating the financial system.
- **Structure of the Federal Reserve System:**
    - **Board of Governors (Washington, D.C.)**
        - 7 members, appointed by the President, confirmed by the Senate.
        - **Chair** (currently Jerome Powell) and **Vice Chair** chosen from among them.
        - **Tenure**: 14 years (Chair serves a 4-year renewable term).
        - It oversees the entire Federal Reserve System and sets broad policies.
    - **12 Regional Federal Reserve Banks:**
        - Conduct research, supervise banks, and participate in monetary policy implementation.
    - **Federal Open Market Committee (FOMC):**
        - Main policy-making body for monetary decisions (e.g. interest rates).
        - Meets 8 times a year to decide on monetary policy stance.
- **Mandate**:
    - **Price Stability** – keeping inflation under control.
    - **Maximum Sustainable Employment** – keeping unemployment low.
- **Independent within Government:** Not under White House control, but accountable to Congress.

Comparison between Fed & RBI

Feature	US Federal Reserve	Reserve Bank Of India
Establishment	1913 (**Federal Reserve Act)**	1935 (RBI Act, 1934)
Headed by	Fed Chair (Jerome Powell)	RBI Governor (Sanjay Malhotra)
Appointment	President of USA (Confirmed by Senate)	Union Government (Appointments Committee of the Cabinet)
Tenure	Chair - 4 Years (Renewable), 14 Years (Governor)	3 Years (Extendable)
Main Mandate	Price stability + Employment	Inflation targeting + Monetary stability
Policy Body	Federal Open Market Committee (FOMC)	Monetary Policy Committee (MPC)
Ownership	Independent public institution	**Owned by the Government of India** (Nationalization in 1949)
Directions	Govt. cannot directly issue directions to the Fed	**Union govt. Can issue directions in Public Interest (Section-7 RBI Act)**

Removal	For cause" (misconduct or incapacity), not for **policy disagreements.**	Not explicitly defined, influenced by the government.

Source:

- Indian Express - US Fed

News in Shorts

Oil Import Dependency Reaches Record High

- In FY25, India's **oil import dependency rose to 88.2%**, up from 87.8% in FY24.
- Out of 88.2% only **11.8%** of petroleum product consumption was met through **domestically produced crude**.
- **Natural Gas Import Dependency**:
  - Natural gas import dependency has reached **50.8%** in FY25, up from **47.1%** in FY24.
- India's goal is to **raise the share of natural gas in the energy mix** to **15% by 2030** (currently around 6% over).

Growing reliance on imported oil and natural gas

	2024-25	2023-24
Domestic petroleum product consumption (mn tn)	239.2	234.3
Petroleum product output from domestic crude oil (mn tn)	28.2	28.5
Crude oil import dependency (per cent)	**88.2**	**87.8**
Domestic natural gas consumption (bcm)	72.3	67.5
Natural gas imports (bcm)	36.7	31.8
Natural gas import dependency (per cent)	**50.8**	**47.1**

- **Factors behind growing demand:**
  - Expansion of **energy-intensive industries**
  - Rise in **vehicle sales** and **aviation growth**
  - Greater consumption of **petrochemicals**
  - Population growth and urbanization.

About PPAC (Petroleum Planning & Analysis Cell)

- It is an attached office under the **Ministry of Petroleum and Natural Gas (MoPNG).**
- It is the **most authentic official source** for data and policy analysis on the **Hydrocarbon sector in India.**
- It was established in **2002**. (HQ- New Delhi)
- **Key functions:**
  - Provides **data and analysis** on production, consumption and imports
  - Assists in **policy formulation and pricing**
  - Prepares import dependency reports and energy demand forecasts.

Source:

- Indian Express - Oil imports

Exercise Desert Flag-10

- It is a multinational exercise being hosted by the **UAE Air Force at Al Dhafra Air Base.**
- **Participating Countries:** Australia, Bahrain, France, Germany, Qatar, Saudi Arabia, Republic of Korea, Turkey, UAE, United Kingdom, USA.
- Indian Air Force's **MiG-29 and Jaguar aircraft will participate** in the exercise.

Source:

- PIB - Desert Flag

Heald Initiative

- **HEALD** stands for Healthy Liver Education and Alcohol-associated Liver Disease Prevention
- It is a first-of-its-kind nationwide initiative aimed at tackling liver disease.
- It is a multi-sectoral program combining public education, early screening, psychological and medical treatment of alcohol use disorder and liver disease management.

Source:

- Business Standard - HEALD

Operation Atlanta

- The European Union Naval Force (EUNAVFOR) under Operation ATALANTA has proposed a joint naval exercise with the Indian Navy.

About Operation Atlanta

- It is European Union's military operation to contribute to maritime security in the **Western Indian Ocean and Red Sea** started in **2008**.
- Its initial focus was on combating piracy and armed robbery off the Somali coast.
- Over the years, it has diversified its operations.
    - It now protects World Food Programme vessels and monitors illegal activities such as drug trafficking and unregulated fishing.

Source:

- The Hindu - Operation Atlanta

Davis Strait proto-microcontinent

- Recently a hidden landmass called the Davis Strait proto-microcontinent has been found beneath the icy waters of the Davis Strait.

About Davis Strait Proto-Microcontinent

- A new landmass has been discovered **under the frozen waters of the Davis Strait, between Baffin Island (Canada) and Greenland.**
    - **Davis Strait** separates Canada's Baffin Island from Greenland.
- It has been classified as a **"proto-microcontinent"**—a **primitive, partially detached continental crust**.
- It has been named the Davis Strait proto-microcontinent since it **formed owing to the tectonic evolution of the Davis Strait.**
- **Size**: Estimated to be **19 to 24 km** wide.
- **What is a Proto-Microcontinent?**
    - It is a fragment of **continental crust** that has broken off from a larger continent but hasn't drifted away completely.
- Similar **microcontinental features** have been discovered in other parts of the world also:
    - **Jan Mayen** - Iceland
    - **East Tasman Rise** - near Tasmania.
    - **Gulden Draak Knoll** - Western Australia

Source:

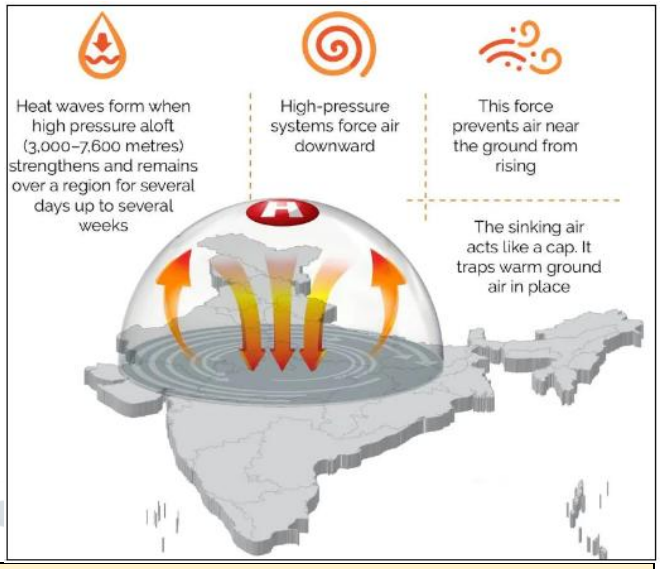
- TOI - New microcontinent

Editorial Summary

Tackle heatwaves with short- and long-term measures

Context

In the last decade, the number of severe heat days and the **severity/intensity of heatwaves** have been **rising**.



What are Heatwaves?

- Heat waves are extreme events in which **hot temperature** in **summer months** persist for a **relatively long period of time.**
- In India, heatwaves typically occur between **March and June**, and in some rare cases **even extend till July.**

Criterion for declaring a heatwave in India (as per IMD):

Heat wave is **considered** if the maximum temperature of a station reaches at least 40°C or more for **Plains** and at least 30°C or more for **Hilly regions.**	
Based on Departure from Normal	**Based on Actual Maximum Temperature**
➔ **Heatwave:** If departure from normal is 4.5°C to 6.4°C. ➔ **Severe heatwave:** If departure from normal is >6.4°C	➔ **Heatwave:** When actual maximum temperature ≥ 45°C ➔ **Severe heatwave:** When actual maximum temperature ≥47°C
Note: If above criteria met at least in 2 stations in a Meteorological sub-division for at least two consecutive days, then the heatwave will be declared on the second day.	
Criterion for describing a heatwave in coastal stations: When maximum temperature departure is 4.5°C or more from normal, Heat Wave may be described provided actual maximum temperature is 37°C or more.	

Causes of heatwaves

- **High-pressure systems:** When a high-pressure system becomes **stationary over a region**.
  - High-pressure systems promote **sinking air,** which inhibits cloud formation and prevents the release of heat through convection. As a result, the air near the surface becomes **trapped and warms up,** leading to prolonged periods of high temperatures.
- **Drought and lack of precipitation:** When the soil is dry, more of the sun's energy goes into **heating the air** rather than **evaporating moisture** from the ground. This leads to **increased temperatures** and further exacerbates the **heatwave conditions.**
- **Role of global warming:** Global warming is poised to make heat waves longer, more intense, and more frequent.
  - **The IPCC's 6th Assessment Report** projects that, for 1.5°C of global warming, there will be increasing heat waves, longer warm seasons and shorter cold seasons.
- **Urbanization:** Rapid urbanization and the growth of concrete jungles in cities can lead to the phenomenon known as the **"urban heat island effect."**
- **El Nino Effect:** During an El Nino event, the warming of the eastern Pacific Ocean can affect global weather patterns, causing changes in temperature, rainfall, and wind patterns around the world.

Impacts of Heatwaves

Health Impacts

- **Heat Stress**: When ambient temperatures near **37°C**, the body struggles to regulate its temperature.
- Affects vital organs — **kidneys**, **liver**, and **brain**.
- Can lead to **illness, organ damage, or death**.

Socio-Economic Impacts

- **Agriculture**: Farmers cannot work during peak hours.
  - Crop yields and **livestock productivity** decline.
- **Labour Productivity**: India's labour-intensive sectors (agriculture & construction) are **highly vulnerable**.
  - **~6% of work hours lost** in 2023 due to heat stress.
  - Estimated **GDP loss**: 3–5% in heat-stressed countries like India.
- **Electricity & Industry**: Rising demand for cooling leads to **power cuts** affecting industrial output.
- **Gender and Social Equity**: Women, elderly, migrants, and the poor are **disproportionately affected**.
  - Cultural norms make it harder for women to cope (e.g., kitchen work, clothing norms).

What are Heat Action Plans (HAPs)?

- **Origin:** First implemented in **Ahmedabad, Gujarat in 2013** (first in Asia).
  - Now adopted by **140+ cities** and **23+ States**.
- **Supported by**: **NDMA** under India's **National Programme on Climate Change and Human Health (NPCCHH)**.
- These are **India's primary policy response** to economically damaging and life-threatening heatwaves.
- **Core Components of HAP**
  - **Early Warning Systems**: Weather predictions and alerts.
  - **Public Awareness**: Campaigns about how to stay safe.
  - **Health System Readiness**: Training medical staff, stocking supplies.
  - **Long-term Urban Planning**: Planting trees, white rooftops, cool roofs.
  - **Data Monitoring**: Collection of mortality/morbidity data to improve interventions.

Centre for Policy Research (CPR)'s Report on India's Heat Action Plans (HAPs)

- The **Centre for Policy Research** has released a report titled **'How Is India Adapting to Heatwaves? An Assessment of Heat Action Plans with Insights for Transformative Climate Action'.**
- The Centre for Policy Research is a Delhi based **non-profit public policy think tank.**
- The report assessed **37 heat action plans across 18 states** in order to understand how well-prepared India is to deal with heat waves.
- **Key findings of the report include:**
  - **Not built for local context:** The report said that most heat action plans are not built for local context and have an **oversimplified view of hazards. Only ten out of 37 HAPs** reviewed seem to establish locally-defined temperature thresholds to declare heatwaves.
  - **Inadequate targeting of vulnerable groups:** Only two of 37 HAPs explicitly carry out and present **vulnerability assessments.** This leaves the implementer with little data on where to direct their scarce resources and could **lead to poor targeting.**
  - **Underfunded:** Only 11 of 37 HAPs discuss funding sources. Of these, eight asked implementing departments to self-allocate resources, indicating a **serious funding constraint.**

- **Weak legal foundations:** The report noted a lack of legal authority in heat action plans, leading to **reduced bureaucratic compliance** with plan instructions.
- **Insufficiently transparent:** The report said that there is **no national repository of heat action plans,** very few plans are listed online, and it is unclear whether the plans are being updated periodically.

Key Learnings & Action Points to Tackle Heatwaves in India

- **State-Level Heat Action Plans (HAPs):** Develop/update localized HAPs incorporating humidity data and vulnerability assessments.
  - Ensure clear stakeholder accountability and activate plans by early March.
- **Data-Driven Mortality Analysis:** Enhance heat-stress mortality tracking to identify vulnerable demographics and neighborhoods, enabling targeted interventions.
- **Advanced Warning Systems:** Adopt dual **day-night temperature monitoring like the UK's Heat Health Alert system**, with predictive models for thermal comfort and safer work-hour scheduling**.**
- **Invest in Long-term Urban and Housing Resilience:** Promote **heat-resilient infrastructure** and **cool roofing materials**.
  - Ensure buildings are constructed with **climate-sensitive designs**.
  - Provide **financial support** to informal sector workers who lose wages due to heatwaves.
- **Create Summer Shelters and Expand Cool Roof Programs:** Build **summer or cold shelters**, especially for urban poor and homeless populations.
  - Expand **Cool Roof Policies** using **reflective materials** to keep homes naturally cool.
  - Encourage **science-based and practical innovations** for long-term heat mitigation.
- **Context-Specific Advisories:** Replace generic "stay indoors" alerts with hyperlocal warnings reflecting neighborhood-specific heat risks and housing conditions.
- **Ensure Basic Amenities and Flexible Work Arrangements:** Local governments must ensure **drinking water points** and distribute **ORS/electrolytes** during heatwaves.
  - Encourage **staggered or cooler-hour work shifts**, especially for **outdoor and informal workers**.
  - Consider **midday work shutdowns** in extreme heat conditions.
- **Cost-Effective Investments:** Prioritize heat adaptation measures to reduce healthcare burdens and economic losses, integrating insurance for heat-related work disruptions.
- **Equity-Focused Approach:** Address heatwaves as a social equity challenge, focusing on vulnerable populations through coordinated multi-agency efforts including:
  - Urban planning authorities
  - Health departments
  - Labor and social welfare bodies.

In Short to Remember

- Localized HAPs with accountability frameworks
- Improved mortality data collection and analysis
- Dual temperature monitoring and thermal comfort predictions
- Heat-resilient infrastructure and wage protection
- Geo-specific risk assessments replacing blanket advisories
- Cooling shelters and reflective roofing policies
- Hydration access and flexible work schedules
- Economic prioritization of heat adaptation
- People-centric policy design for vulnerable groups

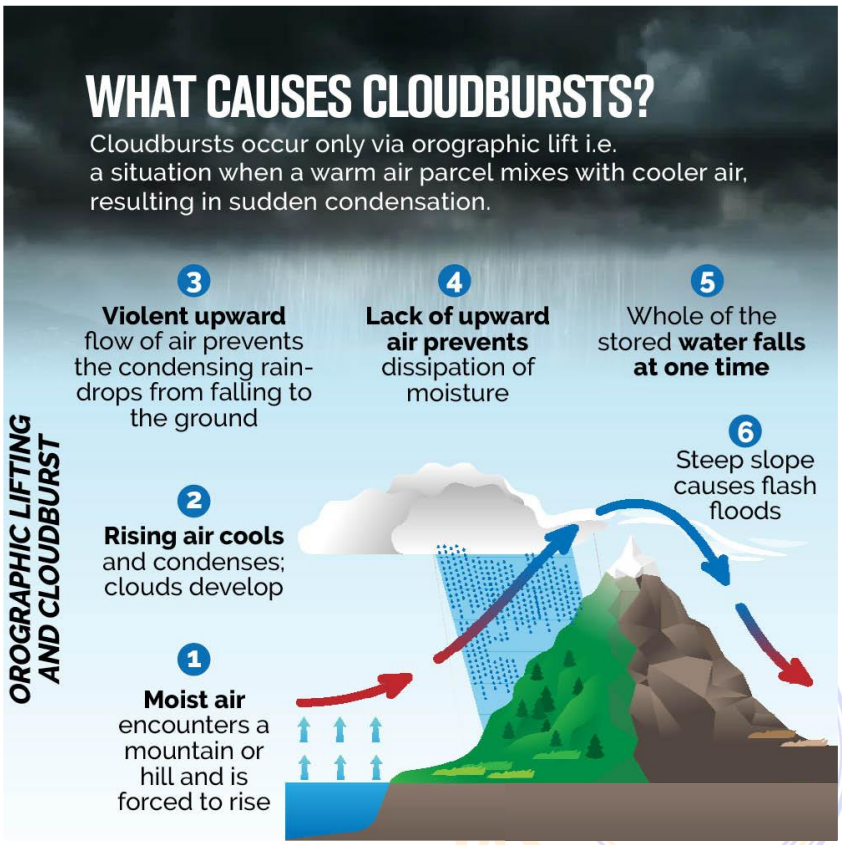
Source: [The Hindu: Tackle heatwaves with short- and long-term measures]

Cloudburst in J&K

Context

A catastrophic cloudburst struck the Ramban district of Jammu and Kashmir.

About Cloudburst



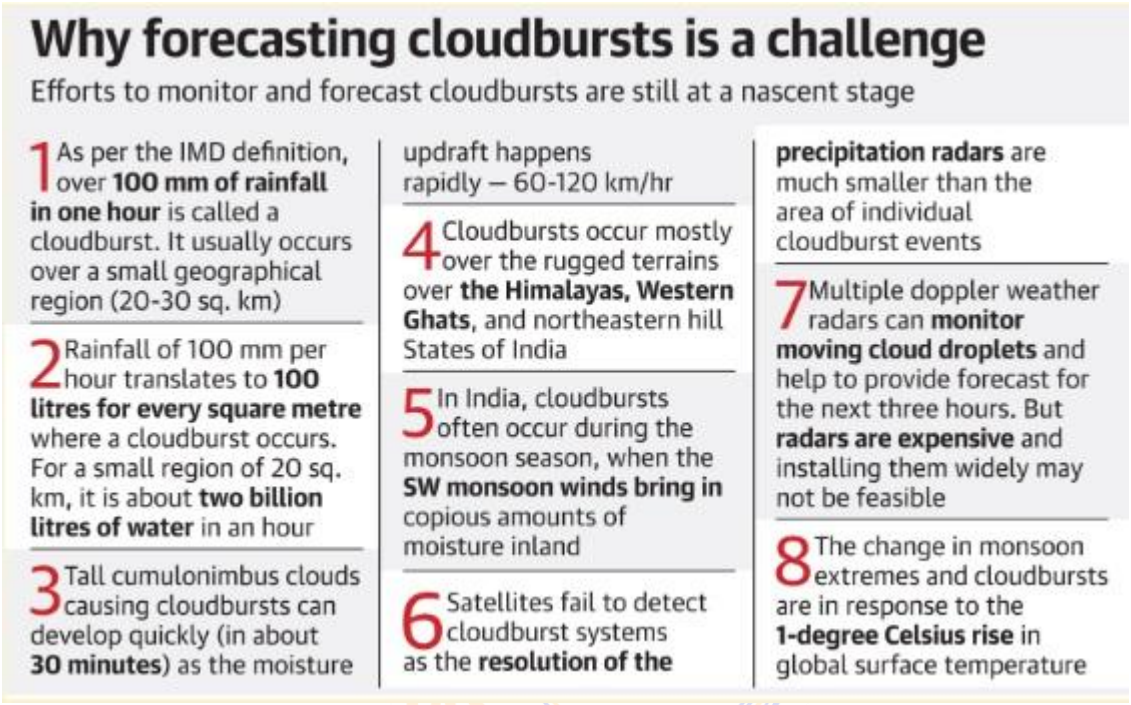
- It is a **sudden spell** of localised, **heavy rainfall over a small area.**
- The India Meteorological Department defines cloudburst as the condition where the amount of rainfall over a particular area **exceeds 100 millimetres (10 cm) in an hour.**
- They often result in flash floods and have become increasingly common from **May-September** when the southwest monsoon season prevails in India.

Consequences of Cloudbursts

- **Flash Floods**: Cloudbursts often trigger sudden and powerful flash floods, overwhelming rivers and streams. These floods can sweep away people, vehicles, and livestock, leading to significant loss of life and property.
- **Landslides**: The heavy rainfall saturates the soil, increasing the risk of landslides. This is especially dangerous in mountainous areas, where landslides can bury homes and infrastructure, causing further casualties and destruction.
- **Infrastructure Damage**: Roads, bridges, buildings, and communication networks are frequently damaged or destroyed. Washed-away infrastructure disrupts connectivity, hampers rescue and relief operations, and isolates affected communities.
- **Loss of Lives and Livelihoods:** The sudden nature of cloudbursts often catches people off guard, resulting in deaths, injuries, and missing persons. Many lose their homes, sources of income, and essential resources, leading to long-term socio-economic hardship.
- **Environmental Degradation**: Cloudbursts contribute to severe soil erosion, loss of vegetation cover, and degradation of the local environment. The aftermath can include altered river courses and destabilized slopes, increasing vulnerability to future disasters.

- **Disruption of Relief Operations:** The destruction of roads and bridges makes it difficult for rescue teams and relief agencies to reach affected areas quickly, delaying aid and increasing the suffering of survivors.
- **Widespread Chaos and Displacement:** Large numbers of people may be displaced, leading to temporary shelters and humanitarian crises, as seen in major incidents like the 2013 Uttarakhand disaster where thousands lost their homes.
- **Long-term Societal Impact:** The aftermath of cloudbursts can have lasting effects on the mental health, economic stability, and overall well-being of affected populations.

Challenges in Forecasting Cloudbursts



- **Small Spatial:** Cloudbursts are hyperlocal events, often affecting areas less than 20–30 km² and lasting minutes to hours.
- **Complex Himalayan Topography:** The interplay of steep terrain, wind patterns, and moisture convergence in mountainous regions like Uttarakhand and Himachal Pradesh creates unpredictable convective systems.
    - Numerical weather models struggle to simulate localized cloud dynamics and microphysical processes (e.g., ice-phase interactions) at the required 1–2 km resolution.
- **Technological and Infrastructural Gaps:** Current satellite and radar systems lack the resolution to detect such microscale phenomena, leading to missed warnings.
    - **E.g.,** India's Doppler radar network covers only 7 Himalayan regions, leaving vast gaps in monitoring.
- **Data Scarcity and Prediction Tools:** India has only 31 recorded cloudburst events, limiting training data for machine learning models.
    - Researchers often rely on adapted international datasets, reducing prediction accuracy.
    - Traditional rain gauges fail to capture sudden intensity spikes, while newer methods like laser-based atmospheric monitoring remain experimental.
- **Short Lead Time:** Even with improved monitoring, cloudburst warnings typically provide only 1–3 hours of lead time—insufficient for large-scale evacuations or infrastructure preparation.
- **Climate Change Complications**: Warmer temperatures amplify moisture retention, increasing rainfall intensity. However, linking specific cloudbursts to climate change remains uncertain due to chaotic atmospheric feedback.

- **E.g.**, In July 2021, Uttarakhand's Chamoli district saw devastating floods from an unpredicted cloudburst, highlighting monitoring gaps.

Major Cloudburst Events In India

Year	Location	State/UT	Impact
July 2023	Gaurikund (near Kedarnath)	Uttarakhand	Flash floods, loss of life, roads and infrastructure damaged
July 2022	Amarnath Cave	Jammu & Kashmir	16+ pilgrims died, 40 injured, caused flash floods in the pilgrimage area
August 2021	Hunzar and Kishtwar	Jammu & Kashmir	26+ deaths, dozens missing due to flash floods
July 2021	Lahaul-Spiti	Himachal Pradesh	7 killed, large-scale damage to infrastructure and homes
June 2013	Kedarnath	Uttarakhand	Massive flash floods, 5000+ killed, widespread devastation

Way Forward

- **Enhance Predictive Capabilities:** Scale up India's High-Performance Computing (HPC) capacity to 100 PetaFlops by 2024 to enable 1–3 km resolution forecasting, critical for detecting micro-scale cloudburst dynamics.
  - Expand Doppler radar coverage beyond the current 7 Himalayan stations to include vulnerable regions like Himachal Pradesh and Uttarakhand.
- **Data Infrastructure Development:** Build India-specific datasets (currently only 31 recorded events) by integrating historical data, satellite inputs, and IoT sensors for real-time monitoring.
  - **E.g.,** Adapt global datasets (e.g., from Australia) with Indian meteorological variables to train ML models while addressing data scarcity.
- **Early Warning Systems:**
  - **48-Hour Probabilistic Forecasts:** Leverage upgraded HPC to provide probabilistic warnings 2 days in advance, as planned by the Ministry of Earth Sciences by 2024.
  - **Hyperlocal Alerts:** Use 3 km resolution forecasts to issue location-specific warnings, reducing false alarms and improving community response.
- **Infrastructure and Policy Measures: Enforce building codes for flood-resistant structures**, improve stormwater drainage, and create retention ponds in cloudburst-prone areas.
  - Promote reforestation, green roofs, and soil conservation to enhance water absorption and reduce landslide risks.
- **Community Preparedness:** Educate communities on evacuation protocols and emergency response, particularly in high-risk Himalayan villages.
  - Establish emergency shelters (modeled after heat/cold shelters) with stockpiles of food, water, and medical supplies.
- **Interagency Coordination:**

  - **Disaster Risk Reduction (DRR) Integration**: Mainstream cloudburst mitigation into national policies, aligning with the Sendai Framework (2030 targets).
  - Partner with neighboring countries for cross-border data sharing and technology transfer, especially in shared river basins.
- **Post-Disaster Management:** Deploy AI-powered drones and GIS tools to map affected areas and prioritize resource allocation.
  - Provide insurance for lost wages and expedite financial aid through digitized relief distribution systems.

UPSC PYQ

Q. ***With reference to the National Disaster Management Authority (NDMA) guidelines, discuss the measures to be adopted to mitigate the impact of recent incidents of cloudbursts in many places of Uttarakhand.*** (2016)

Source: [Kashmir Observer: Heavy Rainfall, Landslides Wreak Havoc In J&K's Ramban; 3 Dead]

Technology in Shaping the Future Workforce

Context

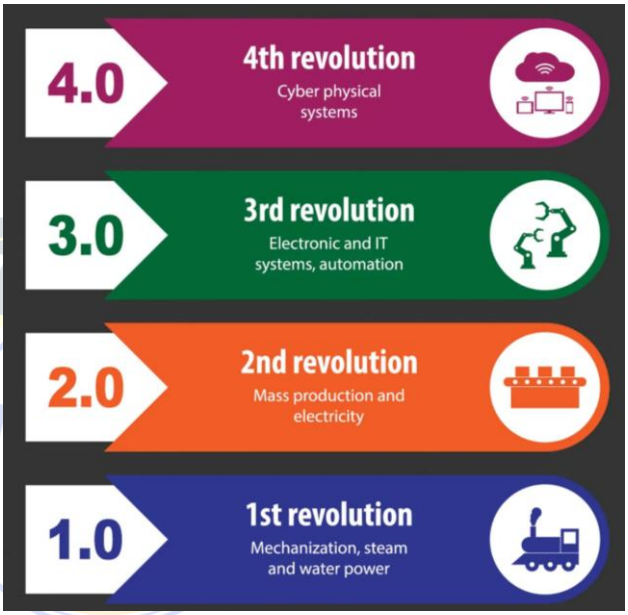
India faces a visible and invisible employment crisis, driven by youth joblessness and rapid technological change.

More In News

- The **visible crisis** is measurable — over 80% of unemployed Indians are youth, despite many having secondary or higher education.
- Alarmingly, one in three young Indians is disengaged from both work and education.
- By 2030, India needs to create over **90 million new jobs**, many in sectors that do not yet exist.

Technology and Workforce Transformation in India

- **Post-Independence Industrialization (1950s–1970s):** After independence, India focused on heavy industries and public sector enterprises.
    - Jobs were largely concentrated in agriculture and manufacturing, with limited technological integration.
    - The workforce was predominantly unskilled or semi-skilled.



- **IT Revolution (1980s–1990s):** The rise of the software and IT services industry marked a turning point.
    - With the liberalization of the economy in 1991, India emerged as a global IT outsourcing hub.
    - This created millions of white-collar jobs, particularly in urban areas, but also widened the skill gap between the educated elite and the rest.
- **Digital India and Skill India Missions (2015 onwards):** Recognizing the growing importance of digital technologies, the government launched flagship programs like **Digital India** and **Skill India** to promote digital literacy, entrepreneurship, and employability.
  Efforts were made to integrate digital tools into education and training systems.
- **Fourth Industrial Revolution (2010s–present):** The advent of **AI, automation, machine learning, and data science** has brought unprecedented changes to how work is done.
    - Unlike previous technological shifts that mainly affected manual labor, this wave is disrupting high-skill jobs as well.
    - Routine and even creative tasks are being automated, demanding a complete rethink of workforce readiness.
- **Shift Toward Lifelong Learning (2020s):** Post-pandemic, there is growing recognition that education must not stop at formal degrees.
    - The global trend toward **micro-credentials**, online learning, and interdisciplinary education is beginning to influence Indian policy and academic reforms, as seen in the **National Education Policy (NEP) 2020**.

Role of Technology in the Workforce

- **Redefining Job Roles:** Technology, especially AI and automation, is transforming both low-skill and high-skill jobs. It's not just replacing manual tasks but also reshaping creative, analytical, and decision-making roles.
- **Rising Need for Tech & Data Literacy:** Foundational skills like understanding digital systems and working with data are becoming essential across all professions — not just in tech-centric roles.
- **Continuous Reskilling:** With rapidly changing job demands, lifelong learning through modular tools like **micro-credentials** is critical for staying employable without needing full degrees repeatedly.
- **Shift in Education Models:** The traditional rote-learning approach is giving way to **experiential and interdisciplinary education**, driven by the need to adapt quickly in a tech-rich environment.
- **Supporting Human-Centric Skills:** Technology cannot yet replicate human abilities like empathy, creativity, contextual judgment, and cultural agility — making these skills more valuable in the workforce.
- **Creating a Future-Ready Workforce:** Integrating technology and data skills early in education ensures that not just engineers but also artists, policy-makers, and frontline workers can thrive in a digital economy.

How India Can Leverage Technology for Shaping the Future Workforce

- **Embed Tech & Data Literacy in Education:** Introduce foundational technology and data skills at the school and college levels across all disciplines—not just engineering.
    - This ensures students understand and adapt to digital systems, automation, and data-driven decision-making.
- **Promote Micro-Credentials and Modular Learning:** Encourage short, stackable certifications in emerging skills (like AI, data visualization, cybersecurity) that allow continuous upskilling.
    - This makes education more flexible, accessible, and industry-relevant.
- **Strengthen Experiential and Interdisciplinary Learning:** Move away from rote learning to project-based, cross-disciplinary education.
    - Encourage collaboration between fields—e.g., political science students learning data tools for public policy, or artists using generative AI.
- **Train Educators in Future-Ready Skills:** Empower teachers to act as facilitators of technology-integrated learning.
    - Training programs should include digital tools, pedagogy for interdisciplinary teaching, and industry trends.
- **Leverage AI for Personalized Learning and Skilling:** Use AI-driven platforms to personalize learning paths based on student strengths and interests.
    - Adaptive technologies can help bridge learning gaps and improve outcomes at scale.
- **Foster Public-Private Partnerships for Skill Development:** Collaborate with industry to design curriculum aligned with future job needs.
    - Encourage initiatives like skill labs, internship programs, and mentorship by tech professionals.
- **Support Human-Centric Skills Development:** Alongside tech skills, focus on creativity, empathy, critical thinking, and contextual reasoning—skills that AI cannot easily replicate and are vital for leadership and innovation.
- **Ensure Inclusive Access to Digital Infrastructure:** Expand digital access in rural and underserved areas to democratize learning opportunities.
    - Provide affordable internet, devices, and localized content to bridge the digital divide.

Source: Indian Express: Work in the Machine Age