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CLOUDBURST - 25

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Definition

A cloudburst is defined by the India Meteorological Department (IMD) as"An extreme amount of rainfall, sometimes accompanied by hail and thunder, with a rainfall rate of at least 100 mm per hour over a localised area of about 10–30 square kilometres."

Reasons for Occurrence of Cloudburst Events

1.Orographic Lifting

Moist monsoon winds are forced upward by the Himalayas or Western Ghats. Rapid cooling leads to sudden condensation and intense rainfall.

Example: Uttarakhand (Rudraprayag, July 2023) – cloudburst linked to moist monsoon air hitting steep Himalayan slopes.

2.Localized Convection in Moist, Unstable Air

Convective instability builds up when hot surface air rises, carrying moisture. If capped by cooler upper air, sudden vertical lifting can release energy explosively.

Example: Amarnath Yatra tragedy (July 2022) – strong localized convection produced a cloudburst, triggering flash floods.

3.Mid-Tropospheric Cyclonic Circulations

Circulations at 3–6 km altitude concentrate moisture and lift, creating conditions for high-intensity, short-duration rainfall.

Example: Himachal Pradesh (July 2024) – IMD attributed heavy rainfall and cloudburst-like events to mid-tropospheric disturbances.

4.High Moisture Availability from Monsoon & Western Disturbances

Interaction of moist monsoon currents with western disturbances in north India intensifies vertical motion.

Example: Kedarnath (2013 disaster) – combined effect of monsoon surge and western disturbance produced cloudburst-like rainfall.

5.Topographic Funnel Effect in Narrow Valleys

Narrow Himalayan valleys channel moist winds upward quickly, concentrating rainfall in a small area.

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Example: KullValley, Himachal Pradesh (Aug 2023) – flash floods after cloudburst due to valley funneling effect.

6.Climate Change & Rising Atmospheric Moisture

Warmer air holds more water vapor; extreme rainfall events (including cloudbursts) are increasing in frequency and intensity.

Example: Himachal Pradesh & Uttarakhand (2023–24) – state governments noted unusually frequent cloudburst-like downpours, linked to climate warming.

7.Urban Heat Island & Localized Convection

In expanding hill towns, concrete and heat islands can enhance localized convection, triggering intense downpours.

Example: Shimla & Manali (2023) – flash floods after intense cloudburst-type rainfall worsened by unplanned urban growth.

Impacts of cloudburst events in India

1.Triggering of Landslides and Debris Flows

Intense rainfall destabilizes slopes, worsening landslide risk.

Example:Rudraprayag (July 2023)* – multiple landslides following a cloudburst blocked Kedarnath route.

2.Urban Flooding in Hill Towns

Expanding hill cities with poor drainage are highly vulnerable.

Example: Shimla & Manali (2023) – cloudburst events led to urban flooding, collapsing houses and hotels.

3.Ecological Degradation

Cloudbursts wash away forests, cause riverbank erosion, and destabilize fragile mountain ecosystems.

Example: Chamoli (2021) – flash floods after cloudburst damaged biodiversity zones and river ecosystems.

4.Displacement of Populations

Villages in Himalayan states often face repeated evacuation.

Example: Himachal (2023) – ~20,000 people displaced due to recurrent cloudburst-triggered floods and landslides (State Disaster Mgmt Authority).

5.Destruction of Infrastructure

Roads, bridges, power lines, and communication networks are often washed away.

Example: Himachal Pradesh (July–Aug 2023) – infrastructure loss pegged at ?10,000+ crore due to cloudburst-induced flash floods (State Govt report).

6.. Loss of Human Lives

Cloudbursts often trigger flash floods and landslides, causing high casualties in a short span.

Example: Amarnath cloudburst (July 2022) – killed 16 pilgrims and injured over 40 within minutes (NDMA).

Way Forward

1. Strengthening Early Warning Systems (EWS)

Deploy Doppler Weather Radars (DWRs) in all Himalayan states for high-resolution forecasts.

Example: IMD installed radars in Himachal & Uttarakhand post-2013 Kedarnath disaster, but coverage gaps remain.

2. Improved Forecasting & Real-time Alerts

AI–ML based weather modeling for hyper-local rainfall predictions.

Integration of IMD, ISRO, CWC data with mobile-based alerts in vernacular languages.

3. Climate-Resilient Infrastructure

Flood-resilient roads, bridges, power lines, and underground drainage in hill towns.

Ban construction in landslide-prone & riverbank zones.

Example: Himachal Pradesh (2023) proposed “green infrastructure norms” post massive losses.

4. Watershed & Catchment Area Management

Afforestation, soil stabilization, check dams, and rainwater harvesting in Himalayan catchments.

This reduces runoff velocity and downstream flood risk.

5. Urban Planning in Hill Towns

Strict enforcement of building codes, zoning regulations, and slope stabilization in Shimla, Manali, Mussoorie, etc.

Promote sustainable eco-tourism instead of haphazard hotel construction.

6. Disaster Preparedness & Community Training

Train locals, yatris, and village committees in disaster drills, evacuation protocols, and use of rescue kits.

Example: Uttarakhand SDRF conducts annual mock drills for Char Dham Yatra pilgrims.

Conclusion

Cloudburst events, though natural in origin, are increasingly amplified by climate change and unplanned human activities in fragile Himalayan ecosystems. A balanced strategy of science-driven early warning, resilient infrastructure, ecological restoration, and community preparedness is essential to minimize their human and economic toll while ensuring sustainable mountain development.