Q6

What is the phenomenon of 'cloudbursts'? Explain.

UPSC Civil Services Mains 2024 · GS I · 10 marks · World's Physical Geography

Salient features of world's physical geography.

Core demand of the question

- State what the phenomenon of cloudbursts is
- Explain how and where they occur

Revision summary

A cloudburst is a short, very intense convective rainfall over a small area.

Indian usage often treats about 100 mm in an hour over a few tens of square kilometres as the mark.

The cloud does not literally burst. A thunderstorm cell unloads rain and hail at once.

Himalayan orography, monsoon moisture and steep valleys make the hazard famous in India.

Western Ghats and some urban thunderstorms can show similar intense cells.

Risk is multiplied by roads, hotels and towns on floodways.

Introduction

A **cloudburst** is not ordinary heavy rain with a dramatic name. It is a **short, violent dump of water** from a convective cloud over a small patch of ground. In the **Himalaya** that patch is often a valley that cannot drain the water as fast as it arrives. The explanation is atmospheric physics plus **mountain shape**. It is not a mysterious bursting of a cloud like a bag.

Body

What a cloudburst is

In Indian operational usage, associated with the **India Meteorological Department**, a cloudburst is typically **about 100 mm of rain in an hour** over a small area of a few tens of square kilometres. The rain is **convective**. A tall cumulonimbus has a strong updraft that holds rain and hail. Then a sudden downdraft and collapse unload it. Lightning, gusts and, in mountains, **debris flow** travel with it. It is **mesoscale**. It is not a monsoon front painted across a whole State.

The name misleads. The cloud does not "burst". The **precipitation efficiency** of a cell becomes extreme for a short time.

- **Intensity:** The fall is very high millimetres per hour. It is not merely a wet day.
- **Scale:** The cell covers a few kilometres to a few tens of kilometres. That is why a neighbouring village may stay dry.
- **Hazard:** Flash flood, landslide and a sudden rise of a nala follow, especially where slopes are steep and channels are clogged.

How and where they form

Warm moist air is lifted rapidly. In the Himalaya, **orographic lift** on south-facing slopes, a monsoon or western-disturbance moisture feed, and a **steep lapse rate** build deep convection. If a cell stalls against a ridge, rain accumulates in one catchment. The **Western Ghats** and, less often, arid hills that meet a monsoon surge can see similar cells. Urban **cloudburst-like** downpours happen when heat and moisture feed thunderstorms over a city. The classic Indian disaster narrative is still **Uttarakhand, Himachal, J&K and the Nepal Himalaya**.

Forecasting is hard because the cell is small and short-lived. Satellites and Doppler radar help. A warning may still lag the nala. Land use - roads cutting slopes, riverbed mining, hotels on fans - turns a meteorological event into a **catastrophe**.

- **Orography:** Mountains force ascent and can trap a cell.
- **Moisture and instability:** Monsoon air plus heating aloft or cold air above.
- **Human exposure:** Settlement on floodways makes the same rain deadly.

Kedarnath (2013) and Leh (2010) are remembered as Himalayan hydro-meteorological disasters. Extreme convective rain and mountain geomorphology combined in both. Each event had its own mix of rain, breach and debris. Both sit in the public meaning of a Himalayan cloudburst country.

Flow diagram

Moist monsoon air -> Orographic lift

Orographic lift -> Deep cumulonimbus

Deep cumulonimbus -> Hourly extreme rain

Hourly extreme rain -> Flash flood debris flow

Settlement on fans -> Flash flood debris flow

Conclusion

A cloudburst is extreme convective rain over a small area in a short time. Mountains produce the lift. Monsoon moisture supplies the fuel. Steep valleys deliver the flood. Policy needs radar, slope science and keeping people off the nala. It does not need a picture of a torn cloud.

Facts & figures

IMD-type threshold

A commonly cited Indian definition is rainfall of about 100 mm in an hour over a roughly 20-30 square kilometre area.

Orographic convection

Forced ascent of moist air over mountain slopes builds tall cumulonimbus cells that can stall and unload.

Leh 2010

A severe cloudburst and debris-flow disaster in Ladakh, often cited in Indian geography teaching.

Kedarnath 2013

A Himalayan disaster in Uttarakhand involving extreme rain and geomorphic failure in a pilgrim valley.