

LANDSLIDE ATLAS OF INDIA

Causes, Classification and Susceptibility

Indian Express

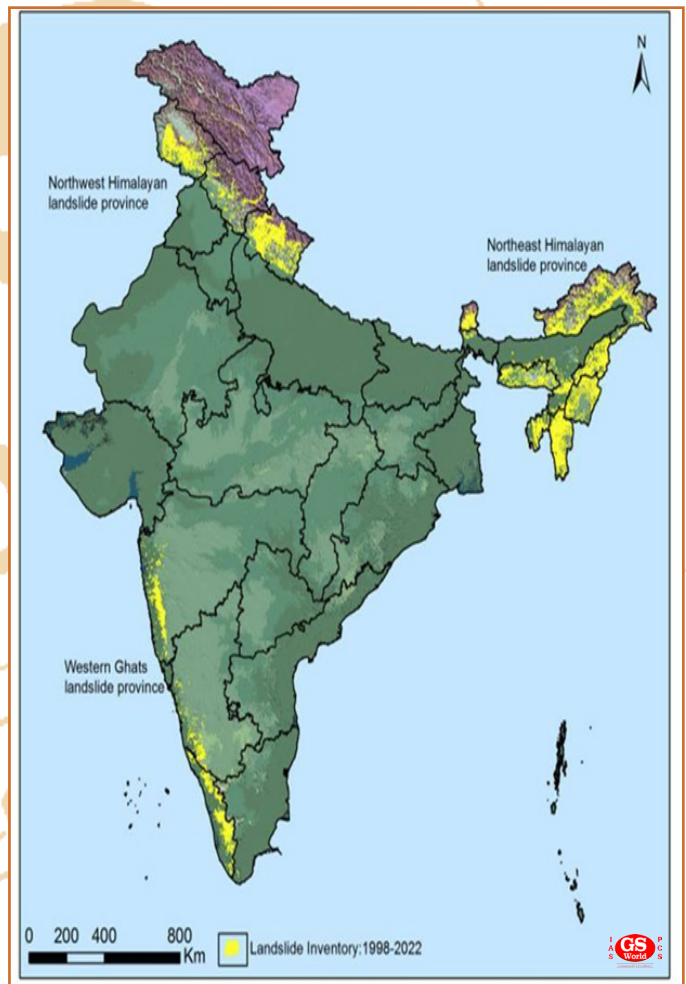
Paper-III
 (Disaster Management)

In 2022, heavy rain, floods and landslides claimed 835 lives in the country, according to the Statement of Climate of India 2022 released by the India Meteorological Department. With a steady rise in the number of extreme weather events, especially heavy rainfall capable of triggering landslides and floods, the Indian Space Research Organisation (ISRO) recently released the Landslide Atlas of India, a detailed guide identifying landslide hotspots in the country.

What Causes Landslides?

Landslides are natural disasters occurring mainly in mountainous terrains where there are conducive conditions of soil, rock, geology and slope. A sudden movement of rock, boulders, earth or debris down a slope is termed as a landslide. Natural causes that trigger it include heavy rainfall, earthquakes, snow melting and undercutting of slopes due to flooding. Landslides can also be caused by anthropogenic activities such as excavation, cutting of hills and trees, excessive infrastructure development, and overgrazing by cattle.

Considered among the most frequent natural disasters, landslides are extremely hazardous, posing a threat to human and animal lives, damaging property, roads and bridges, disrupting communication lines and snapping power lines. Some of the main factors that influence landslides are lithology, geological structures like faults, hill slopes, drainage, geomorphology, land use and land cover, soil texture and depth, and weathering



of rocks. All these are factored in when a landslide susceptibility zone is earmarked for planning and making predictions. In India, rainfall-induced landslide events are more common.

How are landslides classified and mapped?

Landslides are broadly classified based on the type of materials involved (rock, debris, soil, loose mud), type of movement of the material (fall, topple, slide, rotational slide or translational slide), and type of flow of the material. Another category is of landslides that spread laterally. Landslides mapped in the ISRO atlas are mainly event-based and season-based.

State	Total no. of landslide events	State	Total no. of landslide events
Mizoram	12,385	Nagaland	2,132
Uttarakhand	11,219	Sikkim	1,569
Tripura	8,070	Himachal Pradesh	1,561
Arunachal Pradesh	7,689	Karnataka	1,904
Jammu and Kashmir	7,280	Tamil Nadu	690
Kerala	6,039	West Bengal	172
Manipur	5,494	Haryana	100
Maharashtra	5,112	Ladakh	23
Meghalaya	2,639	Goa	03
Assam	2,569	Total	80,933

(Landslide hotspot areas in India (1998-2022))

ISRO’s National Remote Sensing Centre (NRSC), Hyderabad, has created a database of landslide-prone regions of India based on events during 1998 – 2022, primarily along the Himalayas and the Western Ghats. In addition to aerial images, high resolution satellite images captured using cameras Indian Remote Sensing (IRS-1D) PAN + LISS-III, satellites ResourceSat-1 and 2, etc., were used to study the landslides over the past 25 years. The pan-India landslide database classifies landslides into – seasonal (2014, 2017 monsoon seasons), event-based and route-based (2000 – 2017).

How prone is India to landslides?

India is considered among the top five landslide-prone countries globally, where at least one death per 100 sq km is reported in a year due to a landslide event. Rainfall variability pattern is the single biggest cause for landslides in the country, with the Himalayas and the Western Ghats remaining highly vulnerable. Excluding snow covered areas, approximately 12.6 percent of the country’s geographical land area (0.42 million sq km) is prone to landslides. As many as 66.5 percent of the landslides are reported from the North-western Himalayas, about 18.8 per cent from the North-eastern Himalayas, and about 14.7 percent from the Western Ghats.

Nearly half of the country’s landslide-prone area (0.18 sq km) is located in the states of Assam, Arunachal Pradesh, Sikkim, Meghalaya, Mizoram, Manipur, Tripura and Nagaland. Uttarakhand, Himachal Pradesh, Jammu and Kashmir cover 0.14 million sq km of the total landslide-prone areas, whereas Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu account for 0.09 million sq km. A relatively small area (0.01 million sq km) of the Araku region in Andhra Pradesh along the Eastern Ghats, too, reports landslide events. In the Western Ghats, despite fewer events, landslides were found to be making inhabitants significantly vulnerable to fatalities, especially in Kerala.

What does the landslide atlas suggest?

Uttarakhand, Kerala, Jammu and Kashmir, Mizoram, Tripura, Nagaland and Arunachal Pradesh reported the highest number of landslides during 1998 – 2022. Mizoram topped the list, recording 12,385 landslide events in the past 25 years, of which 8,926 were recorded in 2017 alone. Likewise, 2,071 events of the total 2,132 landslides reported in Nagaland during this period occurred during the 2017 monsoon season. Manipur, too, showed a similar trend, wherein 4,559 out of 5,494 landslide events were experienced during the rainy season of 2017. Of the total 690, Tamil Nadu suffered 603 landslide events in 2018 alone. Among all these states, an alarming situation is emerging from Uttarakhand and Kerala. While Uttarakhand's fragility was recently exposed during the land subsidence events reported from Joshimath since January, this Himalayan state has experienced the second highest number (11,219) of landslides since 1998, all events since occurring post 2000.

The year-wise number of landslide events in the state is: 2003 (32), 2010 (307), 2012 (473), 2013 (6,610), 2017 (1), 2021 (329) and 2022 (1). The number of districts with the maximum landslide exposure are in Arunachal Pradesh (16), Kerala (14), Uttarakhand and Jammu and Kashmir (13 each), Himachal Pradesh, Assam and Maharashtra (11 each), Mizoram (8) and Nagaland (7). Kerala has been consistently reporting massive landslides since it suffered the century's worst floods in 2018. The year-wise landslide events here are 2018 (5,191), 2019 (756), 2020 (9) and 2021 (29). From the events and images obtained, the NRSC ranked Rudraprayag in Uttarakhand at the top of 147 vulnerable districts. It has the highest landslide density in the country, along with having the highest exposure to total Population and number of houses.

Rank	District, State	Rank	District, State
1	Rudraprayag, Uttarakhand	16	Mandi, Himachal Pradesh
2	Tehri Garhwal, Uttarakhand	17	Udhampur, Jammu and Kashmir
3	Thrissur, Kerala	18	Idukki, Kerala
4	Rajauri, Jammu and Kashmir	19	Chamoli, Uttarakhand
5	Palakkad, Kerala	20	West district, Sikkim
6	Poonch, Jammu and Kashmir	21	Uttarkashi, Uttarakhand
7	Malappuram, Kerala	22	Cachar, Assam
8	South districts, Sikkim	23	Garhwal, Uttarakhand
9	East district, Sikkim	24	Kottayam, Kerala
10	Kozhikode, Kerala	25	Hamirpur, Himachal Pradesh
11	Imphal west, Manipur	26	Kannur, Kerala
12	Kodagu, Karnataka	27	Pulwama, Jammu and Kashmir
13	Wayanad, Kerala	28	Thiruvananthapuram, Kerala
14	Jammu, Jammu and Kashmir	29	Dehradun, Uttarakhand
15	Ernakulam, Kerala	30	Bilaspur, Himachal Pradesh

(Top 30 districts based on exposure to landslides.)

Expected Question

Que. Recently Indian Space Research Organization (ISRO) has released Landslide Atlas of India (1998 - 2022), in this context consider the following statements-

1. Rudraprayag (Uttarakhand) ranks first among the top 30 districts on the basis of landslide risk.
2. Arunachal Pradesh has the largest number of districts with maximum landslide risk.
3. The highest number of landslides have been recorded in Mizoram during the years 1998- 2022.

Which of the statements given above is/are correct?

- (a) Only 1
- (b) Only 2
- (c) Only 3
- (d) 1, 2 and 3

Answer : D

Mains Expected Question & Format

Que.: What is Landslide? Classifying them, give the causes of landslides and throw light on the landslide-prone areas in India considering their sensitivity.

Answer Format :

- ❖ Begin the answer by explaining landslides
- ❖ Give the classification of landslides as well as the causes.
- ❖ How sensitive is India to landslides?
- ❖ Discuss the landslide-prone areas of India.
- ❖ Conclude by giving its suggestions.

Note: - The question of the main examination given for practice is designed keeping in mind the upcoming UPSC mains examination. Therefore, to get an answer to this question, you can take the help of this source as well as other sources related to this topic.