Land Subsidence in Chenab Valley

For Prelims: Land subsidence, Himalayas, Earthquakes, Landslides, Joshimath, Land Subsidence

For Mains: Reasons for Land subsidence, and Measures and Recommendations.

Source: DTE

Why in News?

Recently, there were reports of Land subsidence in different parts of the **Chenab Valley,** especially in the Ramban, Kishtwar, and Doda districts, which led to destruction of several houses.

- Earlier, landslides were common during rain and snowfall in the region. However, there has been frequent occurrence of **land subsidence** in the last 10 to 15 years.

What is Land Subsidence?

- **About:**
  - According to the **National Oceanic and Atmospheric Administration (NOAA)**, Land subsidence is sinking off the ground because of underground material movement.
    - It can happen for many reasons, man-made or natural, such as the removal of water, oil, or natural resources, along with mining activities. Earthquakes, soil erosion, and soil compaction are also some of the well-known causes of subsidence.
    - It can happen over very large areas like whole states or provinces, or very small areas.
- **Causes:**
  - **Overexploitation of Underground Resources**: Extraction of resources like Water, Natural gas and Oil leads **to decreased pore pressure** and increased effective stress, causing ground subsidence.
    - Over 80% of the world's extracted water is used for irrigation and agricultural purposes, contributing to ground subsidence.
  - **Extraction of Solid Minerals:** Exploitation of **underground solid mineral** resources leads to **formation** of large empty space **underground (goaf),** which can lead to the ground sinking or subsiding.
    - Mining activities, such as coal mining, can lead to the formation of goaf areas, which contribute to ground subsidence.
  - **Load Exerted on Ground:**
    - The construction of tall buildings and heavy infrastructure can exert significant pressure on the ground, leading to soil deformation and subsidence over time.
    - **Soil creep is the slow, gradual movement of soil** downhill due to gravity and can contribute to ground subsidence over time.
  - **Soil Creeps**: Continuous **low load and soil creep can cause slow deformation** of the foundation, contributing to ground subsidence.
- **Examples:**

- **Jakarta, Indonesia**: It is experiencing severe land subsidence (25 cm/year) due to excessive groundwater extraction.
- **Netherlands**: Land subsidence has been a major **problem due to the extraction of natural gas** from underground reservoirs.

What are the Reasons for Land Subsidence in the Chenab Region?

- **Geological Factors**: Region has the presence of **soft sedimentary deposits** and **alluvial soils,** which contributes to land subsidence.
  - These materials are **prone to compaction** under the weight of overlying structures and the influence of external forces such as groundwater extraction.
- **Unplanned Constructions and Urbanization:**
  - Urbanisation and unplanned construction in hilly regions put immense pressure on the land.
  - The Himalayan **foothills** have witnessed rapid development, leading to land subsidence.
- **Hydroelectric Projects:**
  - Construction of **hydroelectric stations** can alter the natural flow of water and impact the stability of the land.
    - **Eg: Joshimath**, a popular town for tourists, faces subsidence due to its proximity to a hydroelectric station.
- **Poor Drainage Systems:**
  - Inadequate drainage systems in the **Chenab region** can worsen land subsidence through waterlogging, increased groundwater levels, soil erosion, saltwater intrusion, and infrastructure damage.
- **Geological Vulnerability:**
  - Scattered rocks in the area are covered with old landslide debris comprising boulders, gneissic rocks, and loose soil, with a low bearing capacity.
  - These gneissic rocks are highly weathered and have a low cohesive value with a tendency of high pore pressure when saturated with water, especially during monsoons.

Joshimath Land Subsidence

- Earlier, Joshimath in Chamoli district in Uttarakhand faced a series of landslides and floods.
- Certain areas of Joshimath were **gradually "sinking" due to a combination** of human activities and natural causes.
- The experts propose the **cause of the land subsidence** to unregulated construction, high population density, disruption of natural water flow, and activities related to hydropower.

Way Forward

- **Sustainable and Regional Development Plan:**
  - When developing the Himalayas, it is essential to prioritise the preservation of the environment.
  - The strategy should focus on utilising the region's natural resources, including forests, water, biodiversity, and ecotourism, in a responsible and sustainable manner.
  - Implementing **efficient water management practices,** such as rainwater harvesting and water recycling, can help reduce excessive groundwater extraction and alleviate subsidence.
- **Continuous Seismic Monitoring and Early Warning Systems:**
  - Setting up monitoring networks to track ground movements and **seismic activity** can provide early warning of potential subsidence and earthquake-related hazards.
  - Continuous monitoring of the region must be done using **satellite technology** and ground-level scientific studies.
- **Regulating Mining and Resource Extraction:**
  - Enforcing strict regulations on mining activities and resource extraction to prevent the creation of voids underground can mitigate land subsidence risks.

- **Climate Change Mitigation:**
    - Taking measures to address climate change, such as reducing greenhouse gas emissions and promoting sustainable practices, can slow down glacial melting and mitigate associated subsidence.

Mishra Committee Report of 1976 Regarding Joshimath Crisis

- In 1976, a committee was established to investigate the causes of the sinking phenomenon in Joshimath. The committee put forth several recommendations.
- **Imposition of Restrictions on Heavy Construction:**
    - Construction should only be allowed after examining the load-bearing capacity of the soil and the stability of the site, and restrictions should also be imposed on the excavation of slopes.
- **Keeping the Boulders:**
    - In the landslide areas, stones and boulders should not be removed from the bottom of the hill as it would remove toe support, increasing the possibility of landslides.
- **Conserving of Trees:**
    - It has also advised against cutting trees in the landslide zone. Extensive plantation work should be undertaken in the area to conserve soil and water resources.
- **Preventing Water Seepage:**
    - To prevent any more landslides in the future, the seepage of open rainwater must be stopped by the construction of a pucca drainage system.
- **River Training:**
    - The construction of structures to guide the river's flow should be carried out. Hanging boulders on the foothills should be provided with appropriate support.

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Read more...

Drishti Mains Question:

Discuss the causes and consequences of land subsidence in the Himalayan region. How can effective land-use planning and sustainable water management practices mitigate the risks associated with this phenomenon?

UPSC Civil Services Examination Previous Year Questions (PYQs)

Prelims:

Q.1 Which one of the following ancient towns is well known for its elaborate system of water harvesting and management by building a series of dams and channelizing water into connected reservoirs? (2021)

(a) Dholavira
(b) Kalibangan
(c) Rakhigarhi
(d) Ropar

Ans: (a)

Q.2 With reference to 'Water Credit', consider the following statements: (2021)

1. It puts microfinance tools to work in the water and sanitation sector.
2. It is a global initiative launched under the aegis of the World Health Organization and the World Bank.
3. It aims to enable the poor people to meet their water needs without depending on subsidies.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: (c)

Mains:

Q. Bring out the causes for more frequent landslides in the Himalayas than in Western Ghats. **(2013)**

Q. Describe the various causes and the effects of landslides. Mention the important components of the National Landslide Risk Management Strategy. **(2021)**