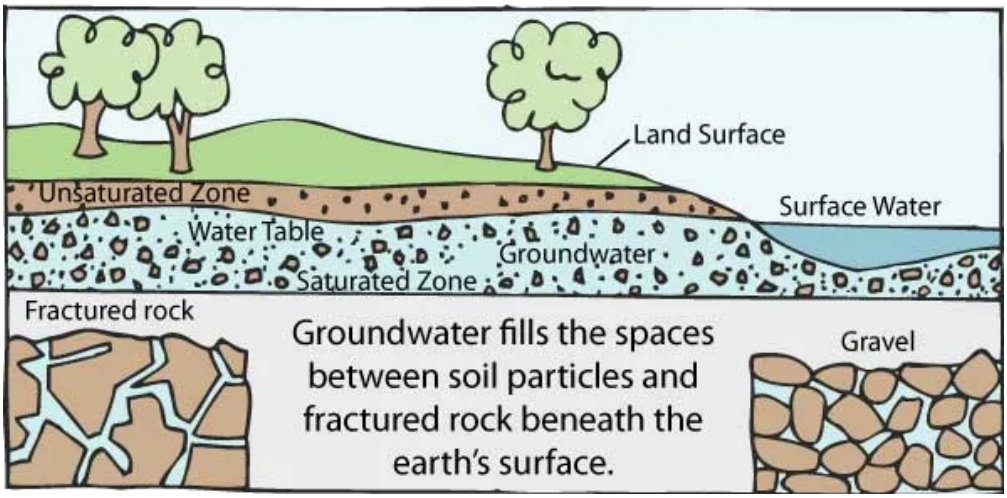
Groundwater Depletion

Why in news?

A recent study shows significant groundwater depletion in five Indian states.

What is groundwater?

- **Groundwater** – It is the water found underground in the cracks and spaces in soil, sand and rock.
- It is stored in and moves slowly through geologic formations of soil, sand and rocks called aquifers.
- **Aquifers** – They are typically made up of gravel, sand, sandstone, or fractured rock, like limestone.
- Water can move through these materials because they have large connected spaces that make them permeable.
- **Saturation zone** – The area where water fills the aquifer is called the saturated zone (or saturation zone).
- **Water table** - The top of the saturation zone is called the water table.
- It may be located only a foot below the ground's surface or it can sit hundreds of feet down.
- It may be deep or shallow that may rise or fall on basis of many factors.
- **Speed of groundwater flows** – It depends on the size of the spaces in the soil or rock and how well the spaces are connected.



- **Groundwater recharge** – They are recharged by rain and snow melt that seeps down into the cracks and crevices beneath the land's surface.
- 'Groundwater' is often referred to as the hidden lifeblood of our planet, essential for sustaining agriculture, industry, and communities.
- **Groundwater depletion** – It occurs when groundwater is extracted faster than it can be replenished.
    - Groundwater, constituting 62% of irrigation and 85% of rural water supply.

What are the key drivers of groundwater depletion?

- **Agricultural exploitation** – It dominates groundwater consumption, especially with high water-demand crops like paddy & sugarcane.
- Farmers continue to favor these crops for financial returns, even in arid regions, leading to excessive extraction.
    - In regions like Punjab and Haryana, traditional agricultural practices remain highly dependent on groundwater.
- **Energy subsidies** - Power subsidies in agriculture have *incentivized unregulated pumping*, adding to groundwater depletion.
- **Green revolution legacy** – *High-yield crops* introduced during the green revolution remain prevalent, adding pressure to already vulnerable regions.
- **Unregulated industrial use** – Rapid industrialization has led to unmonitored groundwater extraction across all affected states.
- Industries often have high water demands, especially those involved in manufacturing, textile processing, and other water-intensive sectors.
- **Population growth –** As population grows, they require substantial amounts of water for drinking, sanitation, and other domestic uses.
- **Rapid urbanization** – The rapid pace of urbanization has also strained groundwater resources.
    - The level of urbanization between 2001 and 2011 increased by 10 per cent, from 10 to 20%.
- **Encroachments over natural recharge zones** – It seals off areas where rainwater could previously seep into the ground and replenish aquifers.
- **Widespread use of bore wells –** Contributes to rapid extraction, often outpacing natural recharge rates.
- **Groundwater contamination –** Contaminants such as arsenic, nitrate, fluoride, and salinity compromise groundwater quality.
    - Pollution from fertilizers, industrial waste, and poor waste management has impacted nearly 60% of Indian districts.
- **Weak regulation** - With insufficient policies governing groundwater usage, both urban and rural areas face unchecked extraction.
- The lack of stringent regulations on private groundwater ownership has further deepened the crisis.

Status of Groundwater Depletion in India

• India, home to 16% of the global population but with just 4% of the world's freshwater.
• According to the Central Groundwater Board, ***17% of India's groundwater blocks are classified as over-exploited,*** with extraction far exceeding natural recharge rates- a situation worsened by climate change and pollution.
• A drop in net annual groundwater availability between 2004-05 and 2018-19 by 4%.
• **Hotspot categorization** – The study raises serious concerns for five hotspots with the northern and northwestern hotspots have suffered a staggering loss of approximately 64.6 billion cubic meters of water over the past two decades.

Hotspot	State	Decline in net annual groundwater availability (2004- 2018)
I	Punjab & Haryana	4 %
II	Uttar Pradesh	4 %
III	West Bengal	3 %
IV	Chhattisgarh	4 %
V	Kerala	17 %

What are its impacts?

Social Impacts	Ecological Impatcs
• Water Scarcity • Food Insecurity • Public Health Crisis • Livelihood Challenges	• Damages Habitat • Reduced Productivity • Reduced Biodiversity • Ecosystem Damages

- **Water scarcity** – It reduces water availability thereby impacting sustenance of living organisms.
- **Public health issues** - People may turn to unsafe sources, risking exposure to contaminants like arsenic.
- **Food insecurity** - Overexploitation of groundwater resources has led to large-scale depletion in key food producing countries, cascading impacts for global food security.
- **Impact on livelihood** - Marginalized section of people who cannot afford alternative water sources will have impact on their incomes.
- **Ecosystem damage –** It affects vegetation, wildlife, and wetland habitats that depend on consistent water levels.
- **Biodiversity crisis** – It leads to reduction in biodiversity, impacting flora and fauna and threatening overall ecological balance.

Groundwater Contaminants and their Impacts

• **Nitrates from fertilizers and sewage** – They contribute to health risks like methemoglobinemia.
• **Pathogens from poor sanitation** – They lead to waterborne diseases.
• **Trace Metals from industrial activities** – They pose carcinogenic risks.
• **Inorganic Compounds** – They degrade water quality, affecting human health and water hardness.
• **Organic Compounds from pesticides and industrial discharges** – They harm ecosystems and health.

What are the government measures?

- **Statutory measures –** The *Water (Prevention and Control of Pollution) Act 1974* aims to provide for the prevention and control of water pollution, and for the maintaining or restoring of wholesomeness of water in the country.
- **Policy measures** - *National Water Policy (2012)* promotes efficient water use across all sectors.
- **Institutional measures** - *Bureau of Water Use Efficiency (BWUE)* formed under the National Water Mission develops standards for water-efficient products and practices.
- *Central Ground Water Authority (CGWA)* regulates large-scale groundwater extraction.
- **Water management initiatives** - *Jal Shakti Abhiyan (JSA)* focuses on rainwater harvesting and groundwater recharge under Catch the Rain initiative.
- *Amrit Sarovar Mission* aims to rejuvenate and develop 75 water bodies in each district of the countries.
- Mahatma Gandhi National Rural Employment Guarantee Scheme (*MGNREGS*) focuses on building water conservation and water harvesting structures.
- Atal Mission for Rejuvenation and Urban Transformation (*AMRUT*) 2.0 uses 'Aquifer Management Plan' harvesting the rainwater through storm water drains into water body.
- *Atal Bhujal Yojana*, a community-led scheme focuses on sustainable groundwater management in 80 water-stressed districts of 7 States, viz., Haryana, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh.
    - The scheme incentivizes states to adopt water-efficient agricultural practices.
- *National Aquifer Mapping and Management (NAQUIM)* to delineate the aquifers, characterize them and prepare management plans.
- Watershed Development Component under Pradhan Mantri Krishi Sinchai Yojana (WDC-PMKSY) for the development of rain fed and degraded lands in the country.

What lies ahead?

- Strengthen groundwater regulations.
- Promote sustainable agricultural practices.
- Promote less water-intensive crops.
- Implement efficient irrigation techniques, such as drip and sprinkler systems.
- Invest in water infrastructure.
- Decentralize groundwater management.
- Encouraging Blue Credit schemes for encouraging water conservation efforts in both domestic and industrial sectors.

- Encourage community-based water management initiatives to promote sustainable water usage at the local level.
- Restore wetlands and urban recharge zones in urban areas.

Reference

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