Groundwater Contamination in India

For Prelims: **National Green Tribunal**, Central Groundwater Authority, Black foot disease, Blue baby syndrome, Itai Itai Disease, Atal Bhujal Yojana**,** Jal Shakti Abhiyan**,** Aquifer Mapping and Management Program**,** Pradhan Mantri Krishi Sinchayee Yojana

For Mains: Primary Agents Responsible for Contaminating Groundwater, Sources of Groundwater Contamination

Source: DTE

Why in News?

The National Green Tribunal **(NGT)** recently expressed dissatisfaction over the **Central Groundwater Authority's (CGWA)** response to the widespread issue of **toxic arsenic and fluoride in** groundwater across India.

- Groundwater contamination due to arsenic is prevalent in **230 districts across 25 states of India** while that caused due to **fluoride** is prevalent in **469 districts across 27 states.**

Note

- India is one of the **world's largest users of groundwater,** where groundwater contributes to more than **60% of the country's irrigation resources.**
- This **over-extraction of groundwater is non-renewable** since recharge rates are less than extraction rates and replenishing this resource can take thousands of years.

What are the Sources of Groundwater Contamination?

- **Naturally Occurring Contaminants:** High levels of arsenic**,** fluoride**,** iron**, and uranium** exist naturally in some geological formations, contaminating groundwater.
    - In terms of arsenic and iron pollution, **West Bengal and Assam** are the worst affected states respectively.
- **Agriculture**: Excessive use of fertilisers, pesticides, and herbicides leach harmful chemicals into the water table.
- **Industrial Waste:** Untreated industrial effluents often find their way into groundwater sources, introducing **heavy metals** and other toxins.
- **Urbanisation:** Leaky sewage systems and improper waste disposal in urban areas contribute to groundwater pollution.
- **Saltwater Intrusion:** In coastal areas, **over-pumping of groundwater** can cause saltwater from the ocean to infiltrate freshwater aquifers, rendering the water unusable for drinking or irrigation.

- **Rajasthan** has the highest number of rural habitations affected by (salinity) contamination.

What is the Central Ground Water Authority?

- **About:** The authority has been constituted under **Section 3 (3) of the** Environment (Protection) Act, 1986 to regulate and control the development and management of groundwater resources in the country.
- **Major Functions:**
  - To regulate, control, manage and development of groundwater in the country and to issue necessary regulatory directions for the purpose.
  - Exercise of powers under **section 4 of the Environment (Protection) Act, 1986** for the appointment of officers.

What are the Primary Agents Responsible for Contaminating Groundwater?

- **Arsenic:** While arsenic occurs naturally, it is also present in human-made forms used in agriculture, mining, and manufacturing.
  - Seepage from industrial and mining discharges, as well as from **fly ash ponds** in thermal power plants, can introduce arsenic into groundwater.
  - Chronic exposure to arsenic can cause **black foot disease.**
- **Fluoride:** In India, fluorosis is a prevalent issue due to the consumption of water with high fluoride content.
  - Excessive fluoride intake can result in neuromuscular disorders, gastrointestinal problems, dental deformities, and skeletal fluorosis, characterised by painful and stiff joints.
  - **Knock-knee syndrome,** marked by outward bending of the legs from the knees, can also occur.
- **Nitrates:** Excessive nitrate levels in drinking water react with haemoglobin, forming non-functional **methaemoglobin** and hindering oxygen transport, leading to methemoglobinemia and **blue baby syndrome.**
  - High nitrate levels can also contribute to the formation of **carcinogens** and accelerate eutrophication.
    - **Blue Baby Syndrome** cause a bluish discolouration of the skin in babies, **not just methemoglobinemia,** due to excessive nitrate levels in drinking water.
    - **Methemoglobinemia** is a condition where an **abnormal form of haemoglobin** (methemoglobin) is present in the blood, reducing its ability to carry oxygen.
- **Uranium:** Uranium, weak radioactive with a **long physical half-life,** is found in concentrations above WHO guidelines in localised pockets in India.
  - In regions like **Rajasthan and northwestern states,** uranium is primarily present in alluvial aquifers, while in southern states like **Telangana**, it originates from crystalline rocks such as granite.
  - Elevated uranium levels in drinking water can cause kidney toxicity.
- **Radon:** Recently, in some areas of Bengaluru, groundwater used for drinking has been found to contain significantly high levels of **radioactive radon.**
  - Radon originates from **radioactive granites and uranium,** which undergoes decay to radium and radon.
  - The presence of radon in air and water can **damage lung tissues, increasing the risk of lung cancer.**
- **Other Trace Metals:** Water may also be contaminated by trace metals such as **lead, mercury, cadmium, copper, chromium, and nickel,** which possess carcinogenic properties.
  - Water contaminated with cadmium can cause **Itai Itai disease**, also called **ouch-ouch disease.**
  - Mercury in water causes Minamata **(a neurological syndrome)** in humans

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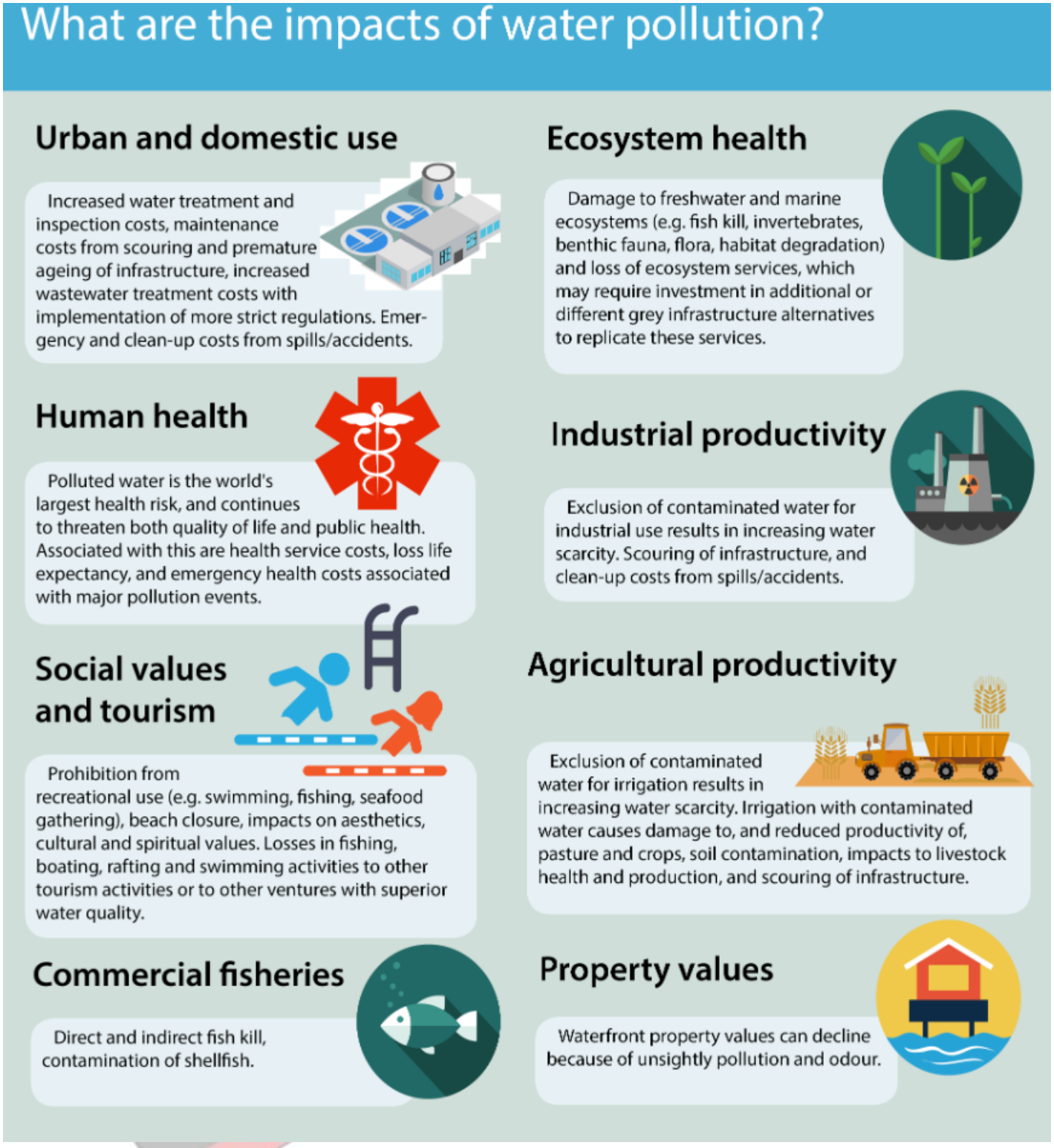

What are the Current Government Initiatives Related to Groundwater Management?

- **Atal Bhujal Yojana**
- **Jal Shakti Abhiyan**
- **Aquifer Mapping and Management Programme (NAQUIM)**
- Pradhan Mantri Krishi Sinchayee Yojana **(PMKSY)**
- **Water (Prevention and Control of Pollution) Amendment Bill, 2024**
- **National Green Tribunal**
- **Central Pollution Control Board (CPCB)**
- **Environment (Protection) Act, 1986**

Way Forward

- **Strengthening Groundwater Regulation:** Enforcing stricter regulations on **industrial waste disposal** and agricultural practices.
    - Implementing a permit system for groundwater extraction, with quotas based on aquifer recharge rates.
- **Promoting Sustainable Agriculture**: Provide subsidies and training for farmers to adopt **precision agriculture** techniques, careful utilisation of fertilizers, and efficient irrigation practices like drip irrigation.
- **Investing in Infrastructure:** Increasing investment in building and maintaining wastewater treatment plants to prevent untreated sewage from contaminating groundwater.
- **Decentralised Management:** Empowering local communities by fostering participatory water management models. This can involve forming **Water User Associations (WUAs)** for planning, monitoring, and regulating groundwater extraction in localized areas.
- **Blue Credit:** Offering financial incentives like **Blue Credit** for **rainwater harvesting, greywater recycling,** and adoption of water-saving technologies in domestic and industrial sectors.
- **Utilising Artificial Intelligence (AI):** Leveraging **AI** to analyse vast sets of data on **water quality, usage patterns, and aquifer characteristics.** This can help predict contamination risks and develop targeted interventions.

UPSC Civil Services Examination, Previous Year Question:

Prelims:

Q. How is the National Green Tribunal (NGT) different from the Central Pollution Control Board (CPCB)? (2018)

1. The NGT has been established by an Act whereas the CPCB has been created by an executive order of the Government.
2. The NGT provides environmental justice and helps reduce the burden of litigation in the higher courts whereas the CPCB promotes cleanliness of streams and wells, and aims to improve the quality of air in the country.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

Ans: (b)

Q. Which of the following can be found as pollutants in the drinking water in some parts of India? (2013)

1. Arsenic
2. Sorbitol
3. Fluoride
4. Formaldehyde
5. Uranium

Select the correct answer using the codes given below.

a) 1 and 3 only
b) 2, 4 and 5 only

c) 1, 3 and 5 only
d) 1, 2, 3, 4 and 5

Ans: C

Q. 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. 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.1 What are the salient features of the Jal Shakti Abhiyan launched by the Government of India for water conservation and water security? **(2020)**

Q.2 Suggest measures to improve water storage and irrigation system to make its judicious use under the depleting scenario. **(2020)**