Yamuna Revival in Delhi: Cleaning Technology & Methods

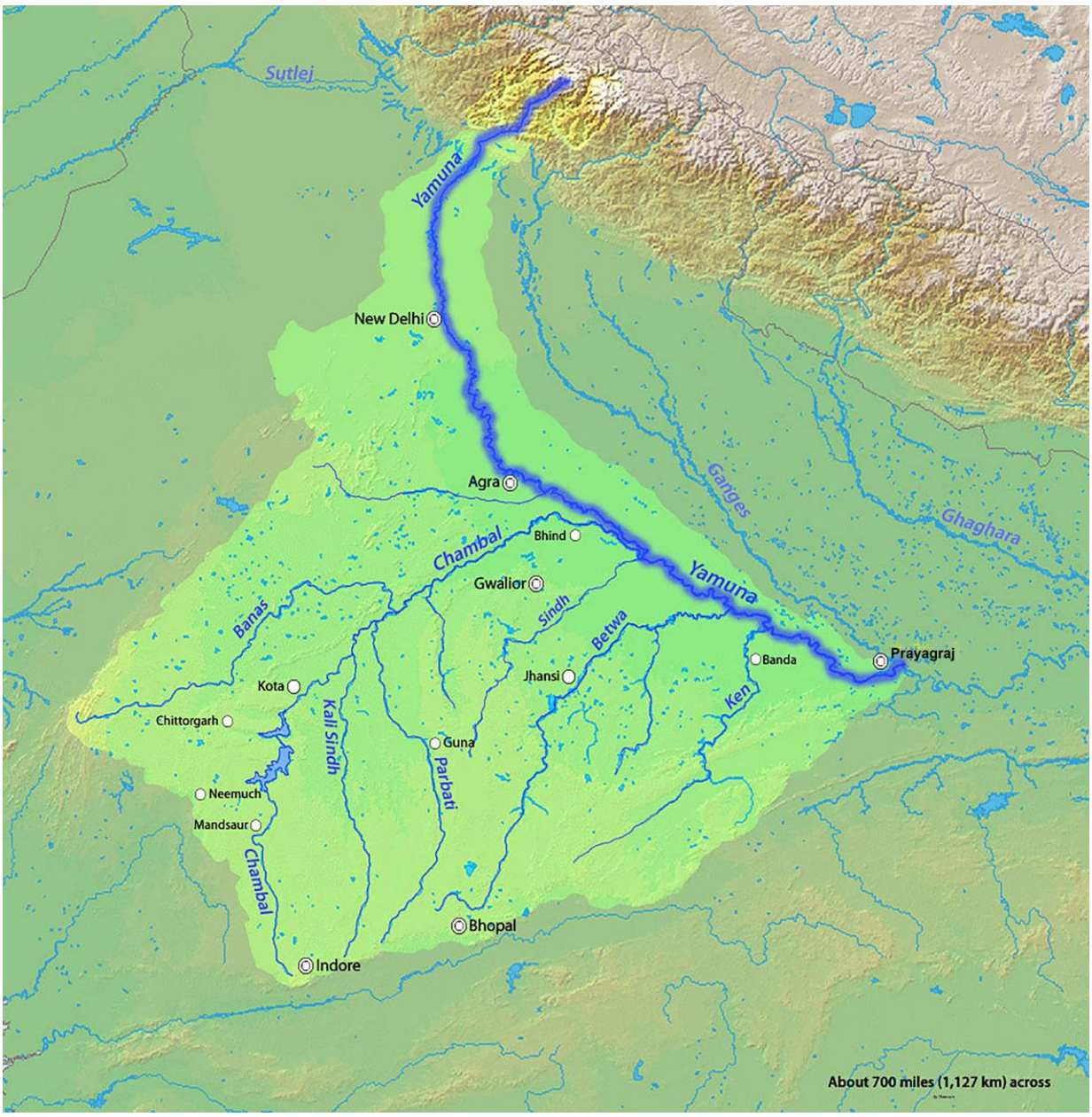
As far as sanctity is concerned, the River Yamuna is more directly connected with Lord Krishna than the Ganges. The Lord sanctified the River Yamuna from the beginning of His transcendental pastimes in the world. While His father Vasudeva was crossing the Yamuna with the baby Lord Krishna for a safe place at Gokula on the other bank of the river from Mathura, the Lord fell down in the river, and by the dust of His lotus feet the river at once became sanctified.

- (Srimad-Bhagavatam 1.19.6)

Context:

- Days ahead of the formation of the **Bharatiya Janata Party (BJP) government in Delhi**, a large-scale effort to clean the heavily polluted River Yamuna commenced on **Sunday February 16,2025.**
- The initiative, guided by a **four-pronged strategy**, aims to restore the river within three years.

1. What is the origin of Yamuna river?



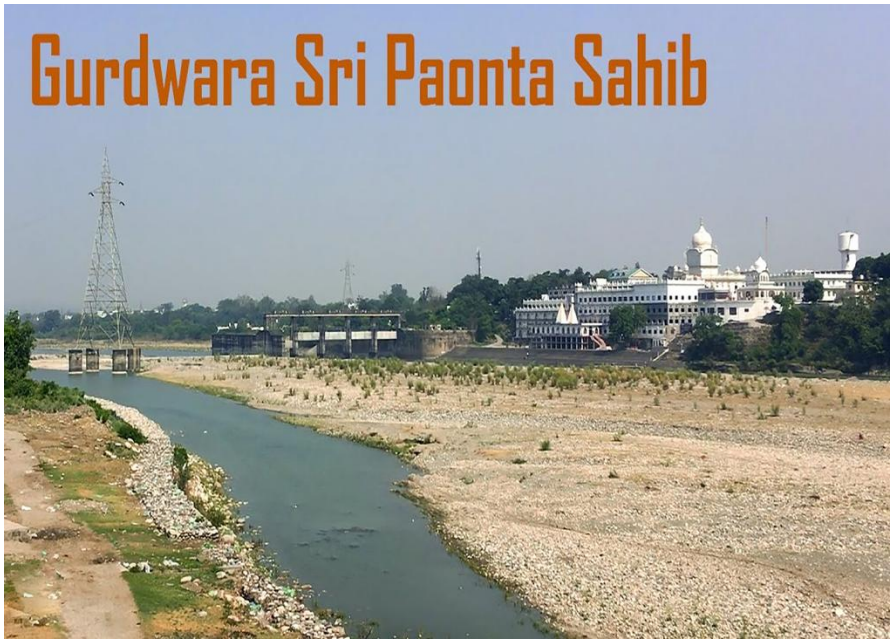
- The **Yamuna River originates from the Yamunotri Glacie**r near **Bandarpoonch Peak** in the **Mussoorie range** of the Lower Himalayas.

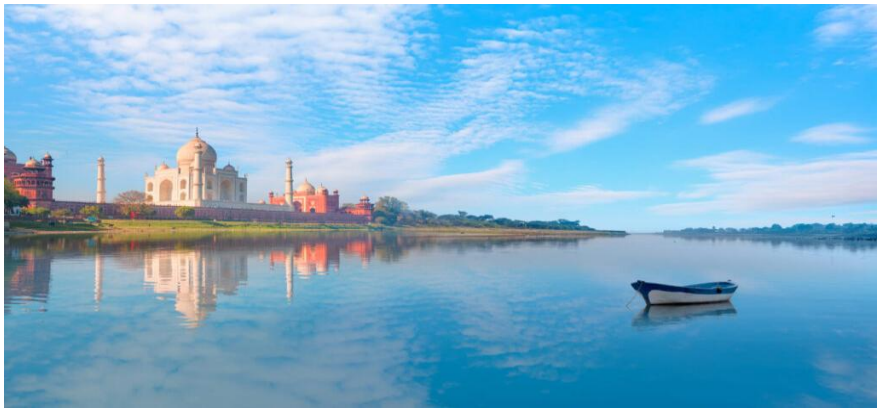
- This **glacier** is situated at an altitude of **approximately 6,387 meters** in the **Uttarkashi district of Uttarakhand**, India.
- The **Yamuna River** begins its journey from this glacier, **marking the source of one of India's most significant rivers.**
- The **Yamuna River flows along states of Uttarakhand, Himachal Pradesh, and Haryana and enters Delhi** and merges with the **Ganga near Triveni Sangam, Prayagraj.**

2. What is the Significance of River Yamuna?

"The Yamuna is not just a river; it's a lifeline weaving through the fabric of Indian civilization."

Significance	Analysis
Religious Significance	• Yamuna is worshipped in Hinduism as the **'Goddess Yamuna'** and as per Hindu mythology is the **daughter of the Sun and sister of the Yama the 'God of Death'.** • It is common practice for people **to bathe in the sacred waters to rid oneself of sins** and the last rites of the dead are also performed at its banks. • The Yamuna is considered a **river of heaven.** • The Yamuna is associated with **Krishna and Balarama, and events like the divine pastimes in Vrindavan.** • The Yamuna is a center of **pilgrimage for Krishna devotees.**

	• Many Hindus make an **annual pilgrimage to the Yamuna** to wash away their sins and to bring health and prosperity.
Socioeconomic Significance	• It helps create the **highly fertile alluvial Yamuna- in the Indo-Gangetic plain.** • Nearly **57 million people depend on** the **Yamuna's waters.** • With an annual flow of about **10,000 cubic billion metres,** the river accounts for more than **70% of Delhi's water supply.**
Tourism	• Important pilgrimage centers like **Yamunotri, Ponta Mathura, Vrindavan, and Prayagraj** and tourism centers like **Delhi, Agra** are located on the **banks of the river Yamuna,** making it a center of **pilgrimage and tourism.** 



3. Enlist various Hydraulic structures on Yamuna River?

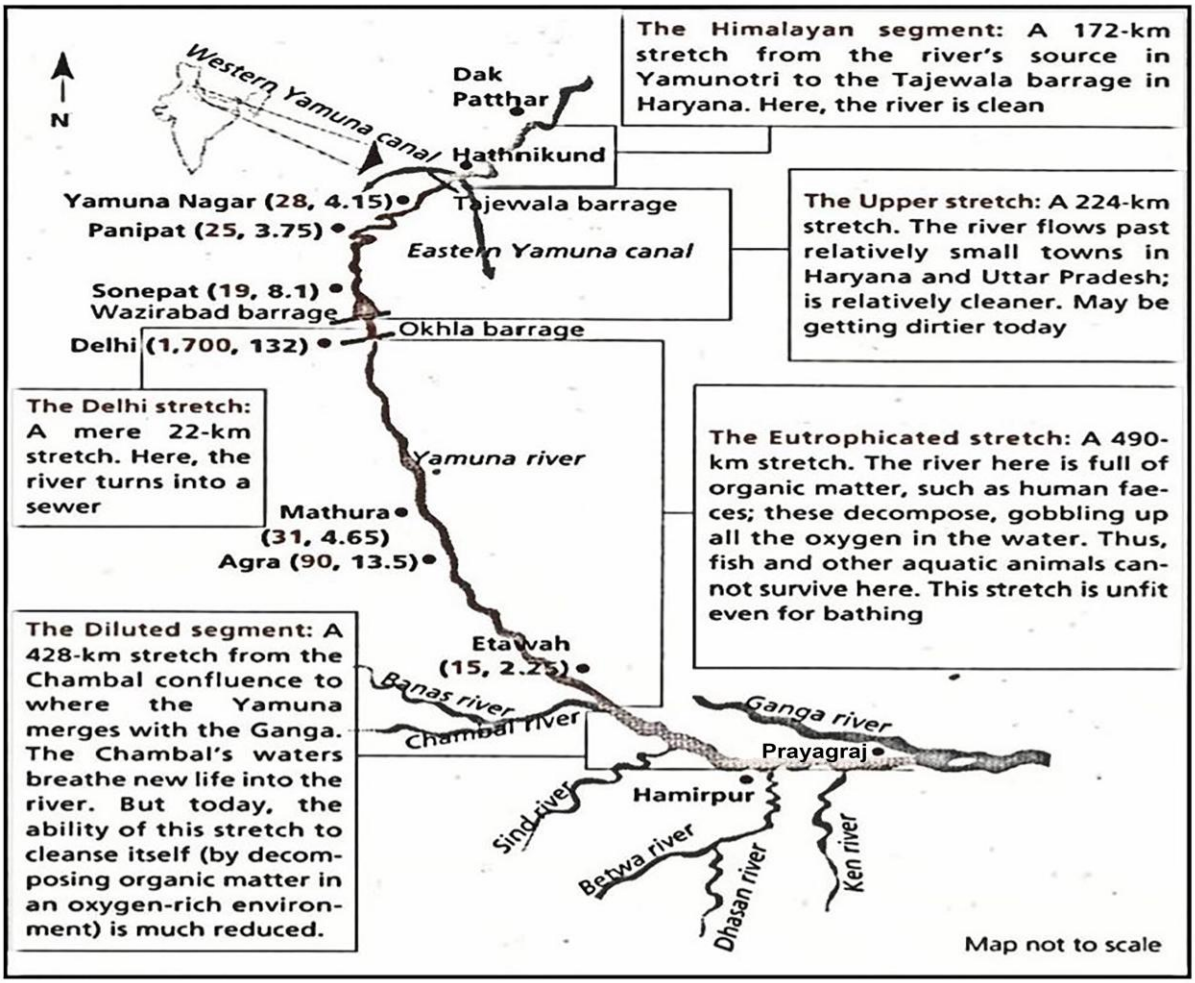
Table 1: Hydraulic structures on the Yamuna River

Section	State	Length (Km)	Tributaries/drains	Dam/Barrage	Canal
Hills (Yamunotri-Hathnikund Barrage)	Uttrakhand, UP and HP	172	Kamal, Giri, Tons, Asan	Dak Patthar Barrage, Asan Barrage	Dakpatthar Canal, Asan Canal
Upstream Delhi (Hathnikund Barrage – Wazirabad Barrage)	Haryana and UP	224	Som, Choti Yamuna drain no. 2 & 8	Hathnikund Barrage	Western and Eastern Yamuna canals
Delhi (Wazirabad Barrage– Yamuna Barrage – Okhla)	Delhi	22	22 drains, Hindon cut	Wazirabad and Yamuna Barrage	Agra canal
Downstream Delhi (Okhla Barrage confluence with Chambal)	UP and Haryana	490	Hindon, Bhuria Nala Mathura – Vrindavan drain, Agra Drain	Okhla Barrage	Agra Canal, Gurgaon Canal
Revived Yamuna(Confluence with Chambal. Confluence with Ganga)	UP	468	Chambal, Ken, Sindh, Betwa	-	-
Total		1376			

Source:Central Inland Fisheries Research Institute, 2014

4. What are various segments of the Yamuna River?

Diagrammatic presentation of the segments of the Yamuna River



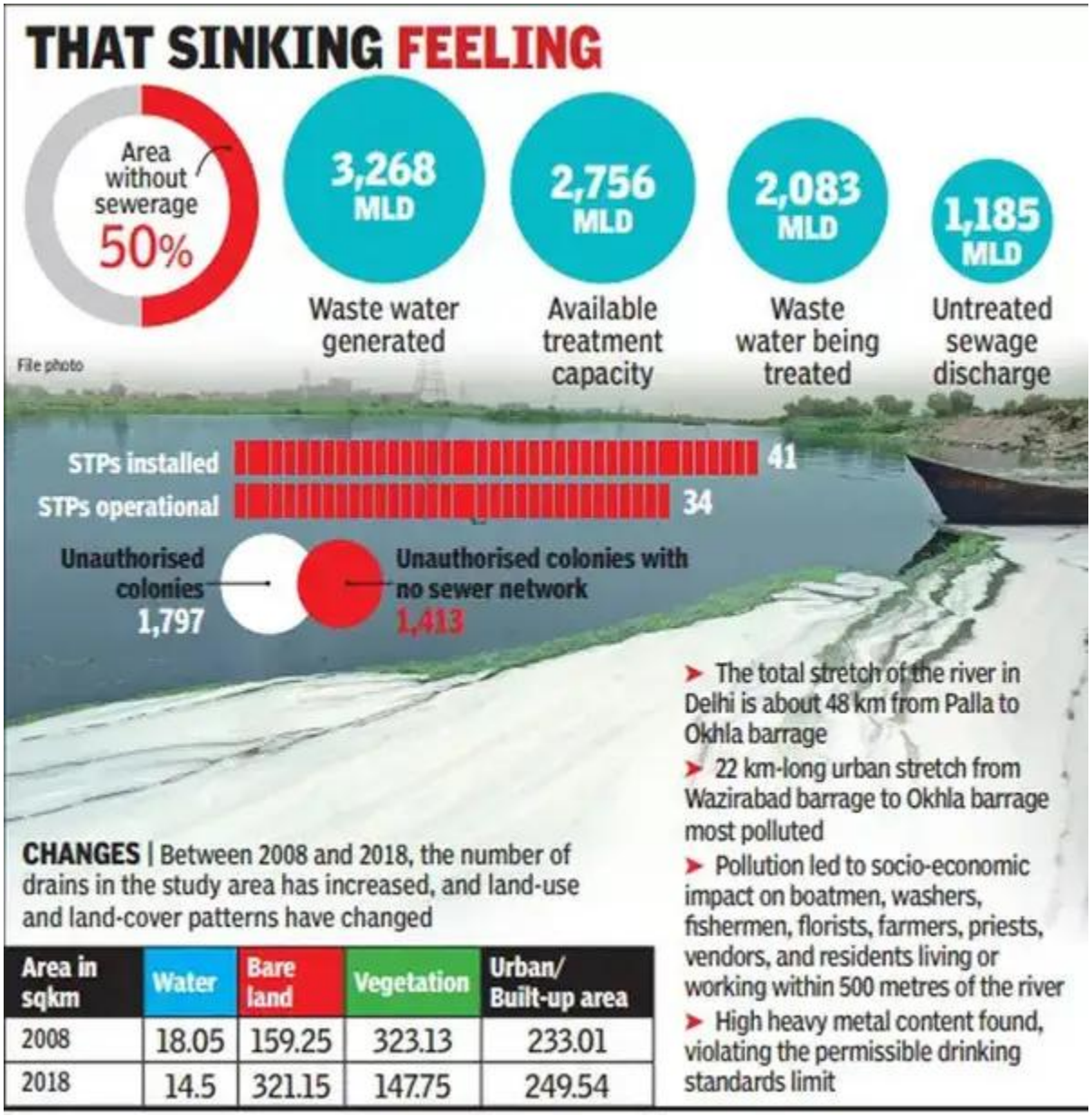
Source: CPCB,2006-2007

5. Enlist various usages of the Yamuna River?

- The **Yamuna River** sustains **all forms of life** along its **banks and various social and commercial activities** depend on it.
- It is the **major source of drinking water** to millions of Indiansand has multiple other uses.
- The **Yamuna Basin is of great economic significance** due to its **fertility and high productivity,** particularly many parts of Uttar Pradesh and Haryana.

- Some well-designated uses of the water of the Yamuna River are as follows:
  - **Drinking water**
  - **Bathing water**
  - **Irrigation**
  - **Livestock use**
  - **Industrial use**
  - **Navigation**
  - **Aesthetics**
  - **Recreation and**
  - **Religious and Cultural**
- The availability water of the **Yamuna River varies greatly with time and space with 80% of the water** flowing in it in the Monsoon period (July, August and September) whereas whatever water is available in it in the non-monsoon period (October to June) is widely used for irrigation and drinking, leaving very little water in the river to flow .
- Along its course, the water of Yamuna River is abstracted for a variety of purposes such as about **94% for irrigation, 4% for domestic use, and 2% for the industries**.
- The river water is extensively abstracted at **Hathnikund/Tajewala and Okhla barrages.**

6. What are the main sources of Yamuna Pollution?



Area in sqkm	Water	Bare land	Vegetation	Urban/ Built-up area
2008	18.05	159.25	323.13	233.01
2018	14.5	321.15	147.75	249.54

- The **Yamuna River** is one of the **most contaminated rivers of India.**
- **Untreated or partially treated domestic sewage, industrial effluents** and agricultural effluents are the major contributors of pollution in the river.
- The **cities alongside the Yamuna River release loads of contaminants in it.**

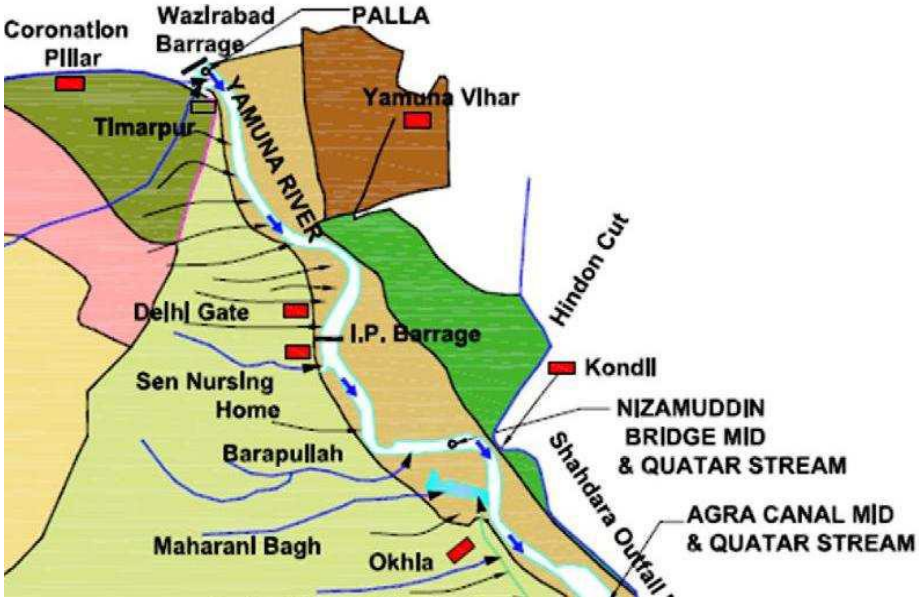
- Due to its **religious, cultural, social and economic significance the Yamuna River flows** in the hearts of many Indians, but unfortunately like many other riverine systems of the country, it too is affected by the **setbacks of industrialization, urbanization and rapid agricultural developments.**
- Studies reported that **due to industrialisation in the towns along the Yamuna River basin**, all the industrial effluent finds its way into it.
- It has also been reported that the **tributaries of the Yamuna River** also transferred their pollution load into it.
- Water is consumed for different activities which generate a lot of wastewater causing deterioration of water quality of Yamuna River.
- Various **point and nonpoint sources contribute to the contamination of the Yamuna River.**

Sources	Analysis
Point Sources	• **Point sources are organized sources of pollution** with **measurable pollution load** (CPCB 2008).

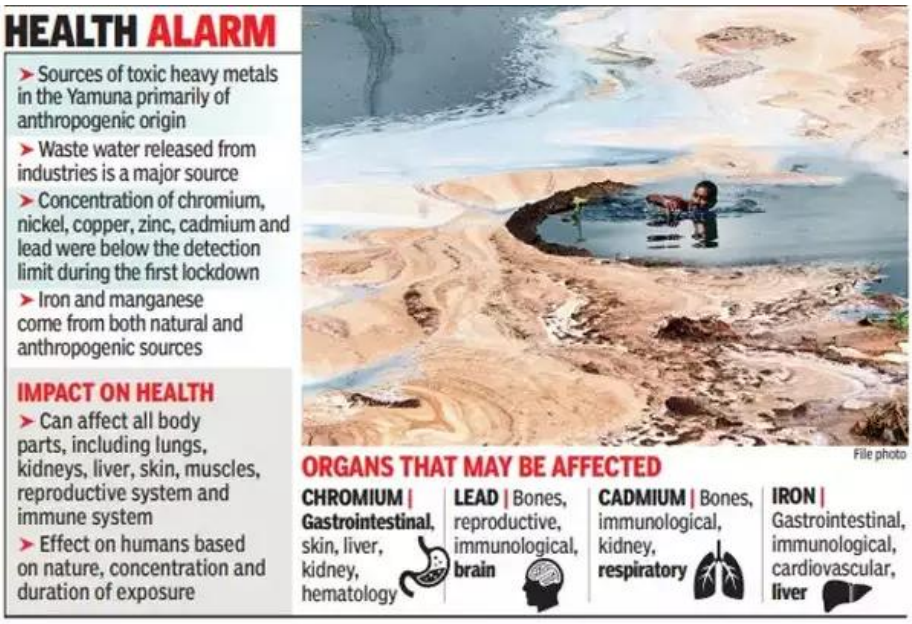
	• These sources include **surface drains carrying municipal sewage or industrial wastes**, sewage pumping stations etc.
Untreated Sewage	• More than **800 million litres** of largely **untreated sewage** is pumped in the **Yamuna each day.** • Another **44 million litres of industrial effluents** are also **discharged daily into the river.** • **Sewage** that is treated before being released into the river accounts for **only 35% of the total estimated sewage discharge.** • According to the **Central Pollution Board,** the water contains a concentration of **1.1 billion fecal coliform bacteria per 100 milliliters of water.** • The **standard for bathing is 500 coliform bacteria per 100 milliliters.** • Although **Sewage treatment plants (STPs) have been constructed in various parts of Delhi**, the treated, or partially treated sewage from these STPs is continuously being **discharged directly or through the carrier drains into the river.**
Najafgarh drain	• One **major source of pollution is the Najafgarh drain,** which **carries industrial waste, sewage, and other pollutants into the river.**

	 • The drain was **originally a natural rain-fed river, bringing a huge amount of water** though mostly contaminated into the Yamuna.
Domestic pollution	• **Domestic pollution accounts for 85% of the pollution in the Yamuna River** and is sourced to the major cities along the river (CPCB 2010). • These cities include **Delhi, Ghaziabad, Mathura-Vrindavan, Agra, Etawah, Panipat, Sonepat and Prayagraj.**

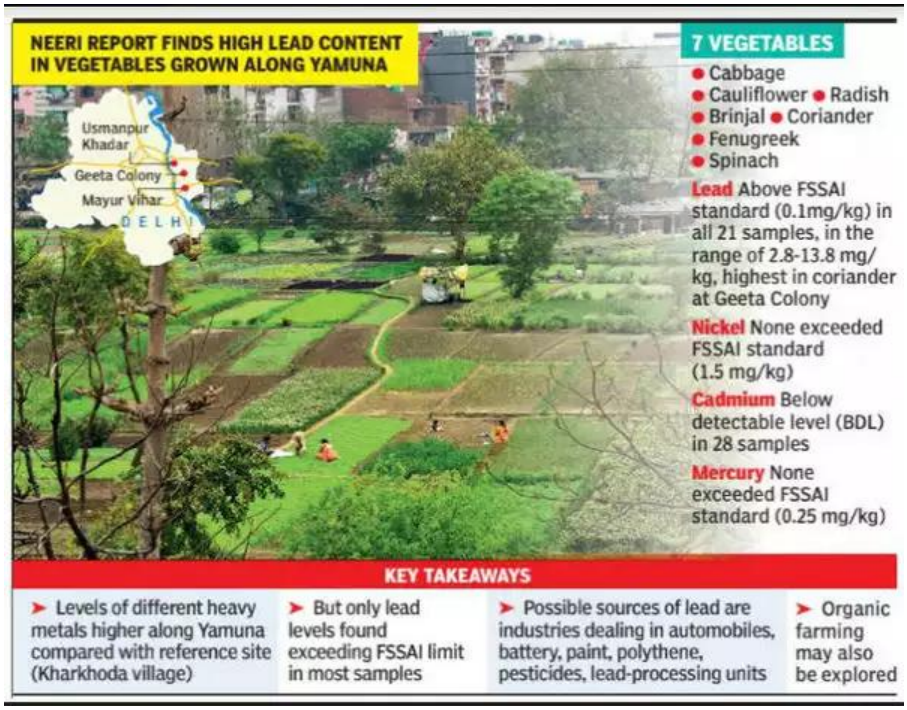
	• The domestic waste majorly comprises **organic matter and microorganisms, salts, detergents, nutrients, oil and grease** and others.
Industrial pollution	• A number of **towns along the Yamuna River have numerous industries that discharge their waste water into the Yamuna.** • According to the **CPCB (2009) report** —the **industries include textile, chemical, pharmaceuticals, oil refineries, sugar, paper and pulp Leather, thermal power, fertilizers, food industries**, etc. were set up in many cities. • Many of these have **poor environment management systems and discharge untreated or partially treated wastewater containing toxic** and organic effluents into the river, thus contributing to the degradation of water quality.
Non Point Sources	• **Non-point sources are the numerous diffused and unspecified sources of pollution** and are **non-measurable** as the amount of pollution generated by each source is less.

	• These include the **organic matter, residues of plants, topsoil, microbes, toxicants** etc. (CPCB 2009). • Such sources are influenced by the **land-use patterns in the overall watershed** and include sources from both the natural processes and the anthropogenic inputs. • The **chief non-point pollution sources are: Agricultural runoffs Dumping of solid waste, dead bodies, animal carcasses e**tc. 
Industrial heavy metal contamination	• The **catchment area of River Yamuna** in Delhi is **highly urbanized** and is networked with several drains. • **Najafgarh and Shahdara drains are the major drains that discharge** a heavy load of pollutants into the river. • **Rapid urbanization and population growth** resulting in industrialization pose a major threat of **heavy metal pollution for nearby water bodies.**

- The **water quality monitoring of River Yamuna** has indicated a **significant presence of several heavy metals in its water.**

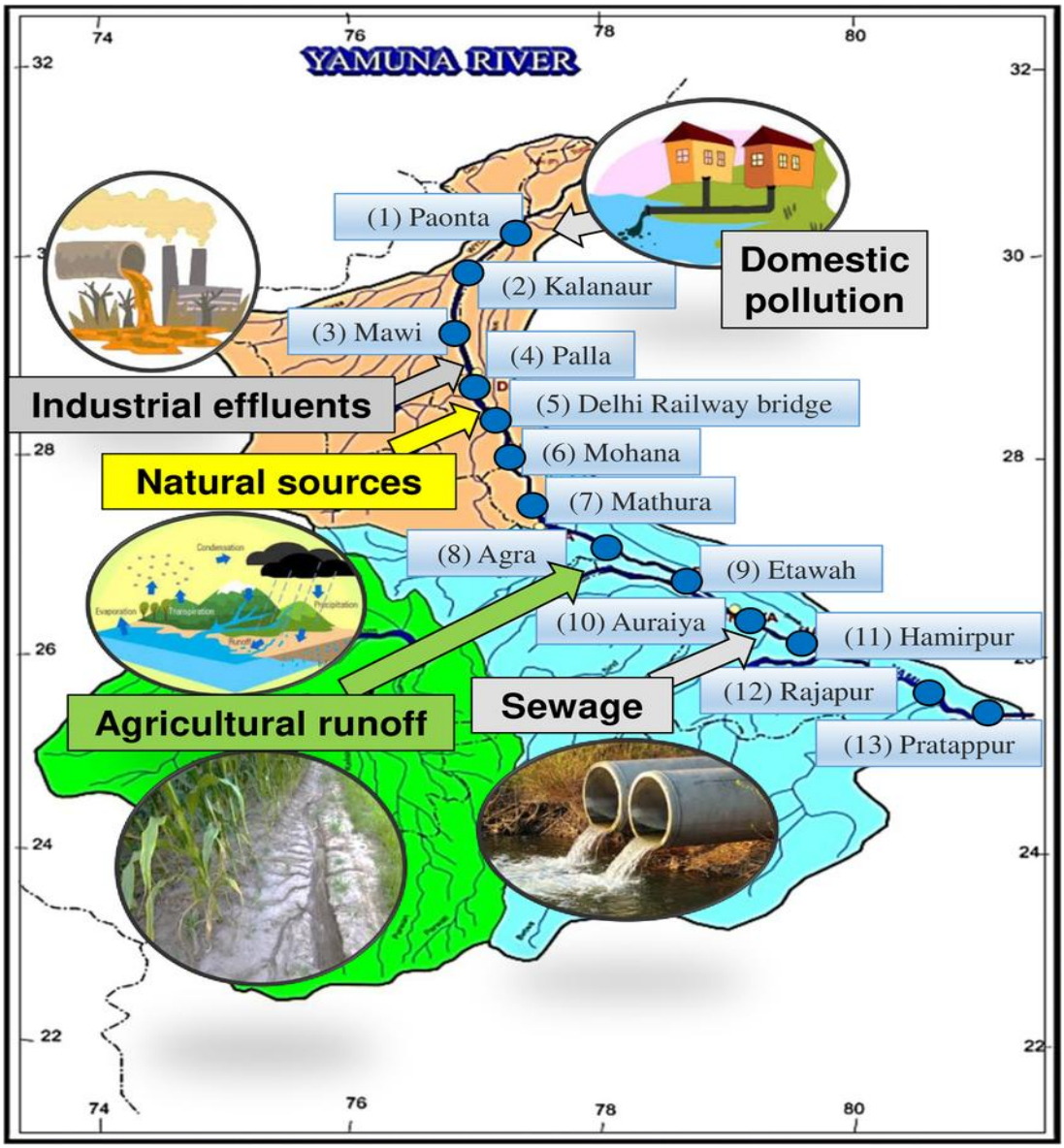


- Among the heavy metals investigated in the **River Yamuna water, Iron (Fe) was found to be most abundant and even exceeding the limit.**

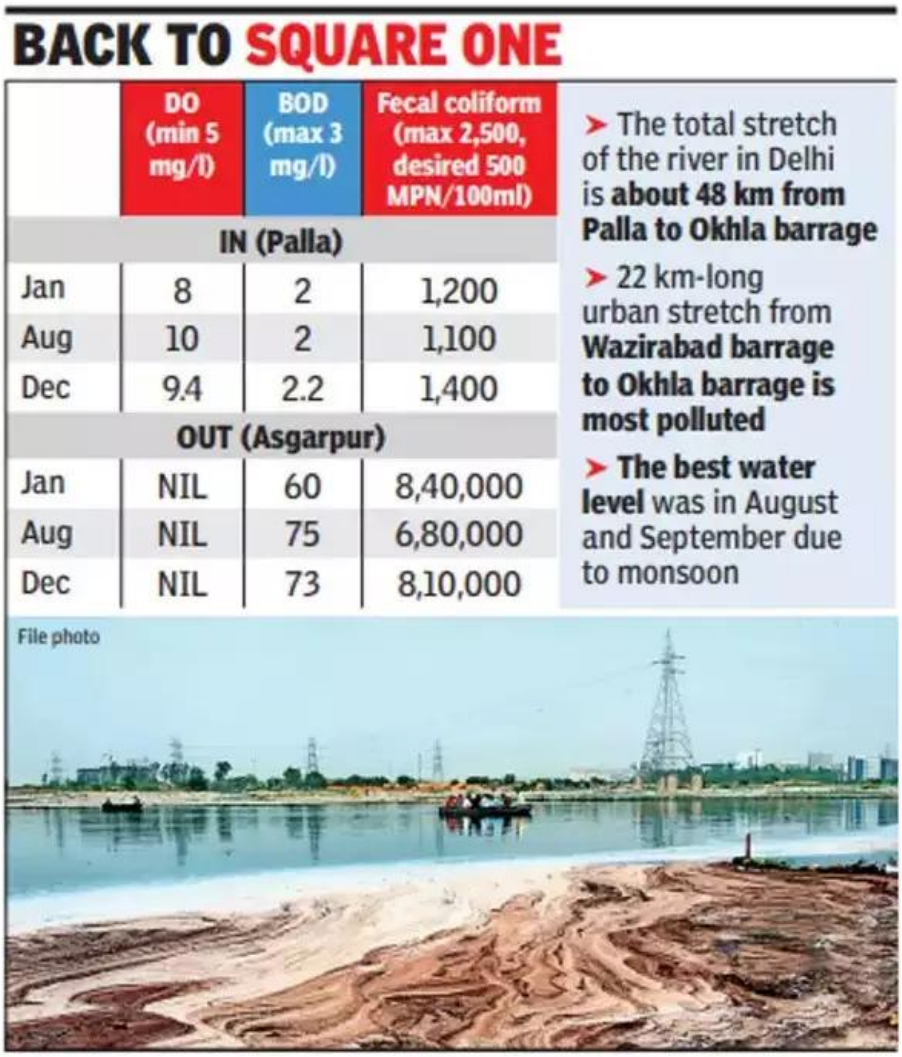


Idol Immersion leading to increased toxicity	• **Immersion of idols during festivals with cheap lead and chrome paints** and plaster of paris and puja articles such as **polythene bags, foam cut-outs, flowers, food offerings, decorations, metal polish, plastic sheets**, cosmetic items all are a cause for concern for the river's quality. • **Post-immersion, the Central Pollution Control Board (CPCB)** found that the level of heavy metals such as **chromium and iron increased significantly.** • **Chromium increased 11 times from the permissible limit of 0.05mg/L, while iron concentration increased 71 times from the 0.3 mg/L limit.** • If the water is not treated, it will increase the **chance of toxins entering the food chain through vegetables grown on the floodplains.** • The **toxicity of heavy metals can damage the brain, lungs, kidney, liver,** other vital organs functions and alter blood composition.

Plastic Pollution	• **In Agra**, the **Yamuna has been choked** by **intense plastic pollution**. • After the **2017 ban on single-use plastics**, there has still been rampant use of plastics which is evident by the production of plastic. • According to records, **Delhi produces 2,51,674 tonnes of plastic each year 50% of which is single-use.** • That's **roughly 63,000 elephants worth of plastic.** • Along the river, **anything from flip-flops to paper products lay in piles every few feet** and a lot of plastic bags, **even recyclable ones, end up in the river.** • Dr Anil Kumar, **director at the state environment department,** said **plastics enter the river mostly through open drains** in which people dispose of their waste.


YAMUNA RIVER
(1) Paonta
(2) Kalanaur
(3) Mawi
(4) Palla
(5) Delhi Railway bridge
(6) Mohana
(7) Mathura
(8) Agra
(9) Etawah
(10) Auraiya
(11) Hamirpur
(12) Rajapur
(13) Pratappur
Domestic pollution
Industrial effluents
Natural sources
Agricultural runoff
Sewage

7. Enlist some alarming facts about the rising level of pollution in Yamuna?

Facts	Analysis
Dissolved oxygen (DO)	• **Wazirabad** is the **point where Yamuna enters the city**. • At this point, **its dissolved oxygen (DO) content is 7.5 milligrammes per litre.**  • At its point of exit from city limits, the **DO level is only 1.3 mg/l.**

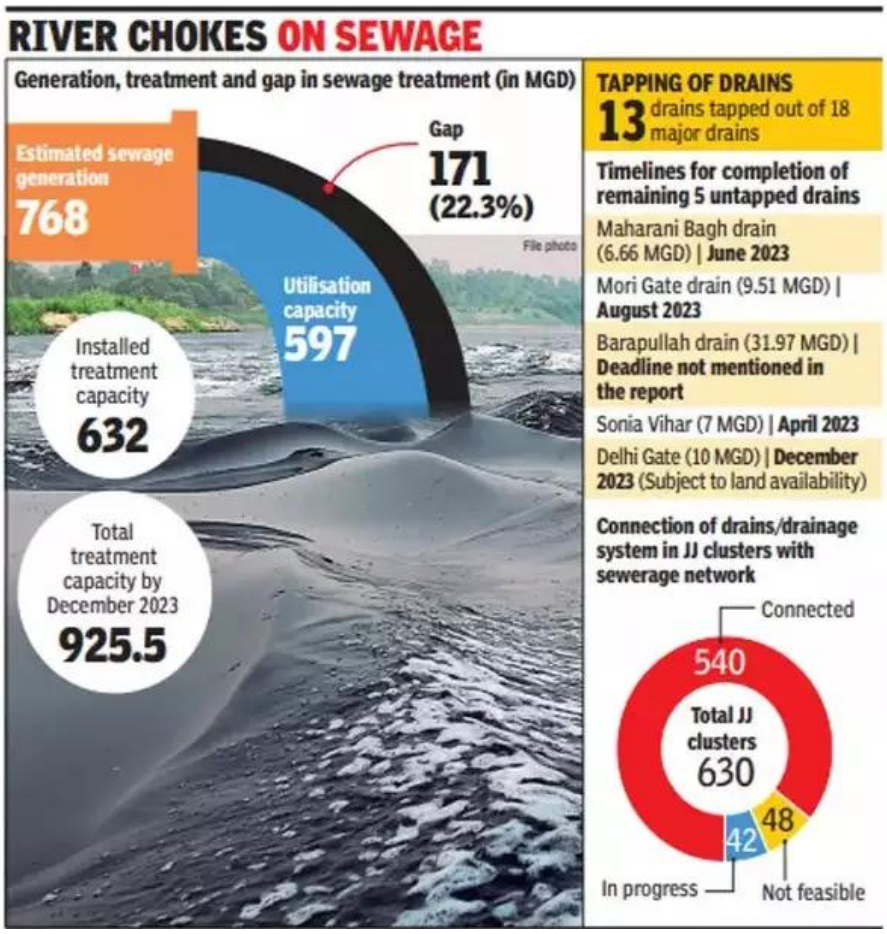
BACK TO SQUARE ONE

	DO (min 5 mg/l)	BOD (max 3 mg/l)	Fecal coliform (max 2,500, desired 500 MPN/100ml)
IN (Palla)			
Jan	8	2	1,200
Aug	10	2	1,100
Dec	9.4	2.2	1,400
OUT (Asgarpur)			
Jan	NIL	60	8,40,000
Aug	NIL	75	6,80,000
Dec	NIL	73	8,10,000

- The total stretch of the river in Delhi is **about 48 km from Palla to Okhla barrage**
- 22 km-long urban stretch from **Wazirabad barrage to Okhla barrage is most polluted**
- **The best water level** was in August and September due to monsoon

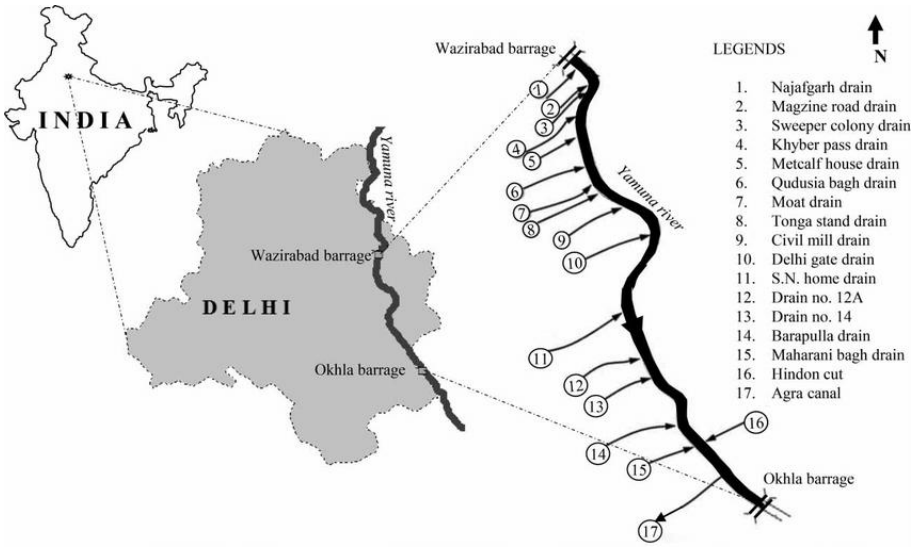
File photo

Biological Oxygen Demand (BOD)	• The **Yamuna River entering Delhi at Palla exhibits a Biological Oxygen Demand (BOD)** of **around 2 mg/l**, but this level significantly **increases to 85 mg/l at Asgarpur,** where it **exits the city,** indicating a substantial rise in water pollution. • Data collected over a 10-year period by the **Central Water Commission through its 371 monitoring stations** across the country shows that **Yamuna has the highest level of biochemical oxygen demand (BOD) concentration when it passes through Delhi.**
Sewers	• A **total of 55 percent of the city's 15 million people** are connected to the **city's sewer system and its treatment plants**, but because of corrosion and clogging in the system, many **treatment plants do not run at full capacity.** • Because of this**, waste from 1500 unplanned neighborhoods runs straight into the river.**



Drains

- A total of **18 drains of Delhi**, whose **water flows into the Yamuna, create 80 percent pollution in the river.**



8. Why is there froth in the Yamuna river?

River of foam cuts across Delhi

Every year, as winter sets in, the Yamuna begins to resemble a glacier, as thick sheets of foam blanket the river. This froth is toxic, and can have extremely adverse effects if consumed, or even touched

AJAY AGGARWAL/HT PHOTO

What is foam or froth formation?

Foam or froth formation is a phenomenon that takes place on many lakes and streams. Foam bubbles are produced when organic matter decomposes. These foam-producing molecules have one end that repels water and another end that attracts water and they work to reduce the surface tension on the water surface. These foam bubbles are lighter than water, so they float on the surface as a thin film that gradually accumulates.

What are the sources of pollution that cause foam formation?

- Untreated sewage may contain soap/detergent particles
- Industrial run-off
- Organic matter from decomposing vegetation
- Presence of filamentous bacteria that let out surfactant molecules
- Pollutants from sugar and paper industries in UP that travel through the Hindon Canal

What is foam made of?

About 1% of the foam is made up of foaming agents like phosphates and surfactants. The remaining 99% is air and water.

Why does foam form in places like the Kalindi Kunj Okhla barrage?

When water with surfactants or detergent-like molecules fall from a height (such as the Okhla barrage), they churn to form bubbles in water. Foam begins to form after monsoon, but intensify as winter approaches, because foam bubbles are much more stable in lower temperatures

Health hazards

- Short-term exposure can lead to skin irritation, allergies
- Ingestion may cause gastrointestinal problems and diseases like typhoid
- Long term exposure to heavy metals in industrial pollutants can cause neurological issues and hormonal imbalances

How can froth formation be stopped?

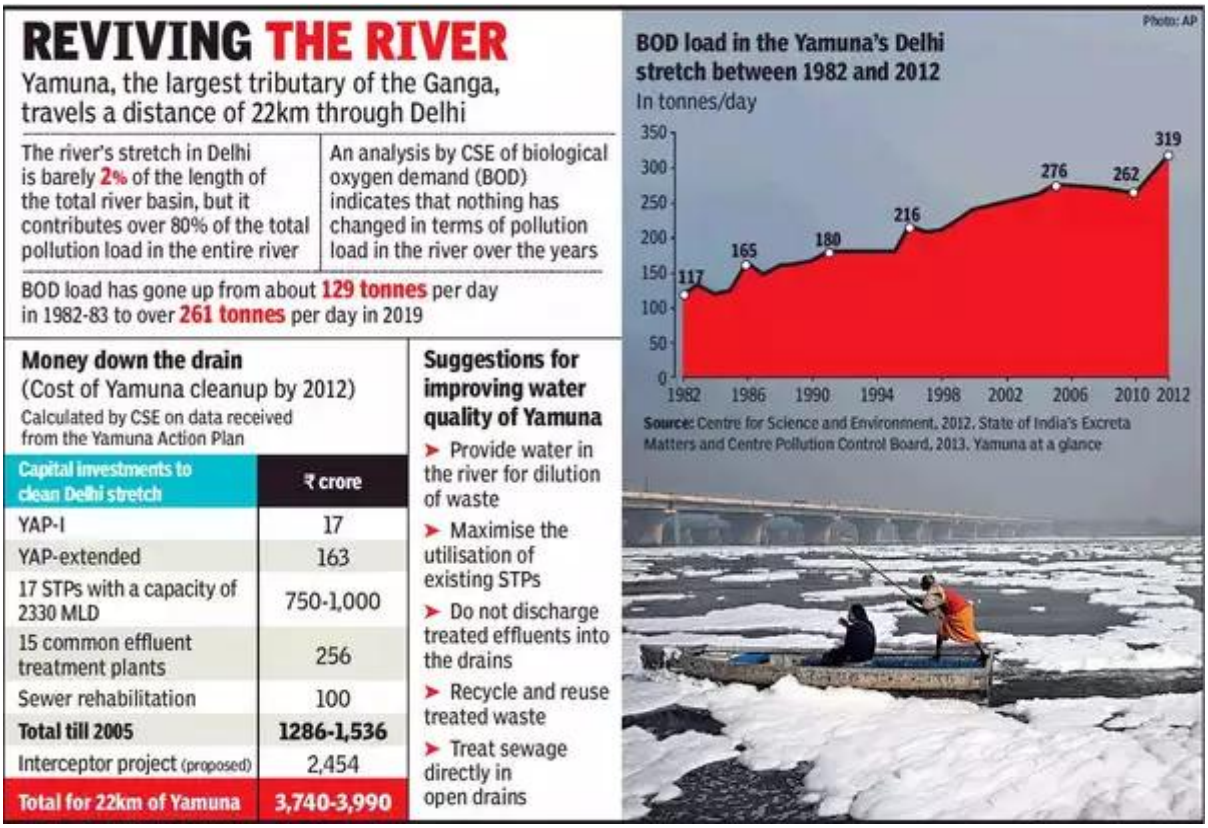
IN THE SHORT-TERM

- Rid Okhla pondage of water hyacinth
- Detergents must be biodegradable so they do not persist and lose their ability to cause foam

IN THE LONG TERM

- UP, Haryana, Delhi need to upgrade sewage treatment plants
- Industrial pollution to be stopped
- Increasing the flow of the river

9. What is the Yamuna Action Plan and enlist various phases of its implementation?

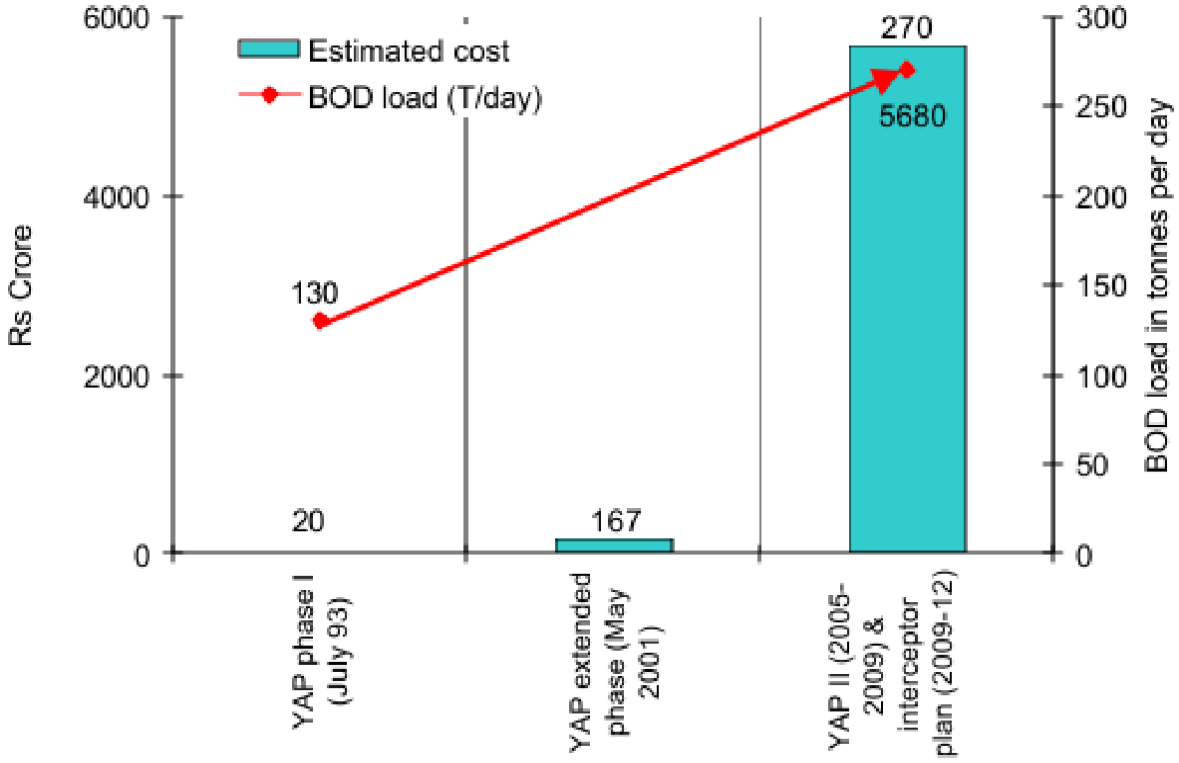


- It is **one of the largest river restoration projects** in India which is a bilateral project between the **Government of India and Japan.**
- It is being executed by the **National River Conservation Directorate** and the **Ministry of Environment and Forests and the Government of India.**
- **The project is divided into 3 parts:**

Plans and Projects	Analysis
Yamuna Action Plan I (YAP I) – 1993 – 2002,	• The **plans were carried out by the National River Conservation Directorate (NRCD),** Ministry of Environment in collaboration with various State Department.

2002 – 2003 (Extended Phase)	• The **plan focused on two types of actions which are Sewerage and non-sewerage facilities.** • **Sewerage:** ▪ Construction of **29 STPs 58 pumping stations and 179 km of sewers was proposed.** • **Non-sewerage:** ▪ **1282 public toilet complexes, 96 crematoria, Riverfront development, plantation and public awareness and participation were proposed.** ▪ A study on river pollution to estimate future pollution loads of the river Yamuna from different sources. • The **total sewage treatment capacity created under YAP I was 750MLD.**
Yamuna Action Plan II (YAP II) – 2004 – 2011	• **YAP II** was mostly to **undertake non-sewerage part of the objectives.** • The **total STP capacity sanctioned under YAP II was 189 MLD**. • The total budget sanctioned: **INR. 6.24 billion.** • There was an emphasis on **Public Participation & Awareness, Public Relations and Institutional Strengthening & Capacity Building of MCD.** • Various Pilot projects included **Dairy Farm Waste Management, Dhobighat Sudhar Yojna, Slaughterhouse Modernisation** and Waste Management, Antim Niwas Sudhar Yojna and Slum Rehabilitation Study.

Yamuna Action Plan Phase III – 2018 onwards	• 11 Projects under National Mission for Clean Ganga (NMCG) have been planned to conserve River Yamuna in Delhi including **rehabilitation of sewers**, rehabilitation of Rising mains, **Tertiary Treatment Plants and Sewerage projects in four packages of Kondli (K1, K2, K3, K4),** three packages of **Rithala (R1, R2, R3) and Okhla Zone (O).**



10. What is Yamuna Purification Drive, 2018?

- Organized by the **Public Health Department** and covers 15 towns including **Gurgaon, Faridabad, Yamuna Nagar, Karnal, Panipat, and Sonepat.**
- Its objectives are to control the discharge of raw sewage into the river.
- Initiative that has been done are:
  - **Eleven treatment plants are being installed along the 83-km-long sewer line.**
  - A **treatment plant that can treat 30 million liters a day** has been installed in Gurgaon which will help reduce the level of **pollution from 200 mg a liter to 30 mg a liter**, before it enters the Yamuna.
  - A **5.8-km-long sewer line** has been **laid in the city** to collect the polluted water at the treatment plant.

11. Enlist various community initiatives wrt River Yamuna?

Initiatives	Analysis
Yamuna Foundation for Blue Water Inc.	• **Started in 2000** and the objective is to clean the pollution in the Yamuna River throughout its course and **to create a better ecosystem in New Delhi.** • On **World Water Day, 2010**, local team **members, students, and activists in Agra, Hyderabad, and Delhi**, India, along with Wuhan, China led **several watershed cleanup projects.**
'Maa Shri Yamuna Seva Samiti' or Friends of Yamuna	• Volunteer group started by newspaper **hawker Ashok Upadhyay** to do his **bit in protecting the river f**rom further pollution.

12. Mention recent initiatives taken to clean Yamuna river?

- The **cleaning of the Yamuna River**, a major issue during the Delhi Assembly elections, has **officially commenced** following the **Bharatiya Janata Party's (BJP) landslide victory.**

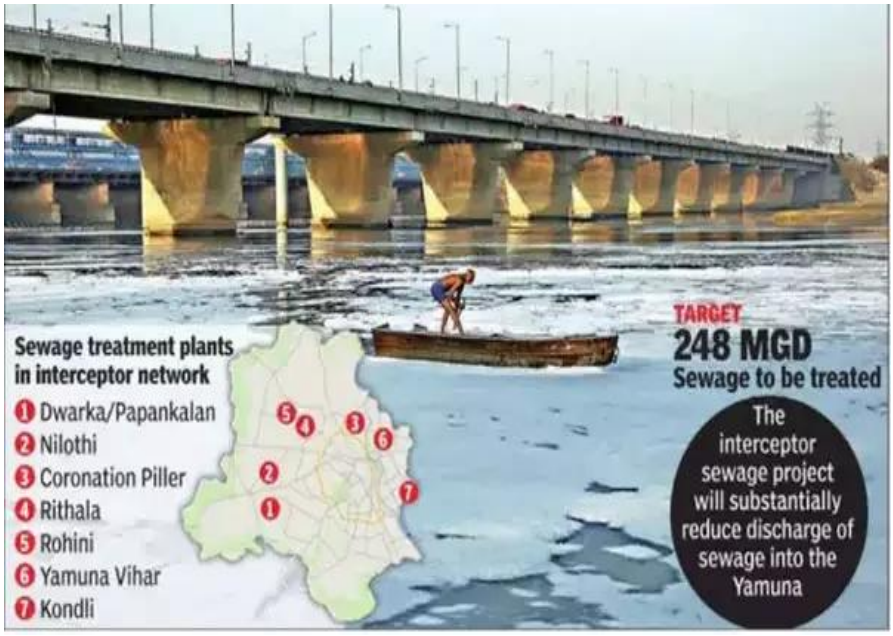
- The **Lieutenant Governor's (LG) office** confirmed the **initiation of the project,** which aims to restore the river's health.
- According to the LG office, w**ork on cleaning the Yamuna has already begun**, with **specialized machines such as trash skimmers, weed harvesters,** and a dredge utility craft being deployed in the river.
- The ambitious project, which **aims to clean the river within three year**s, will require coordinated efforts from multiple agencies, including the **Delhi Jal Board (DJB), Irrigation & Flood Control Department (I&FC), Municipal Corporation of Delhi (MCD), Public Works Department (PWD), Delhi Development Authority (DDA), and the Environment Department.**

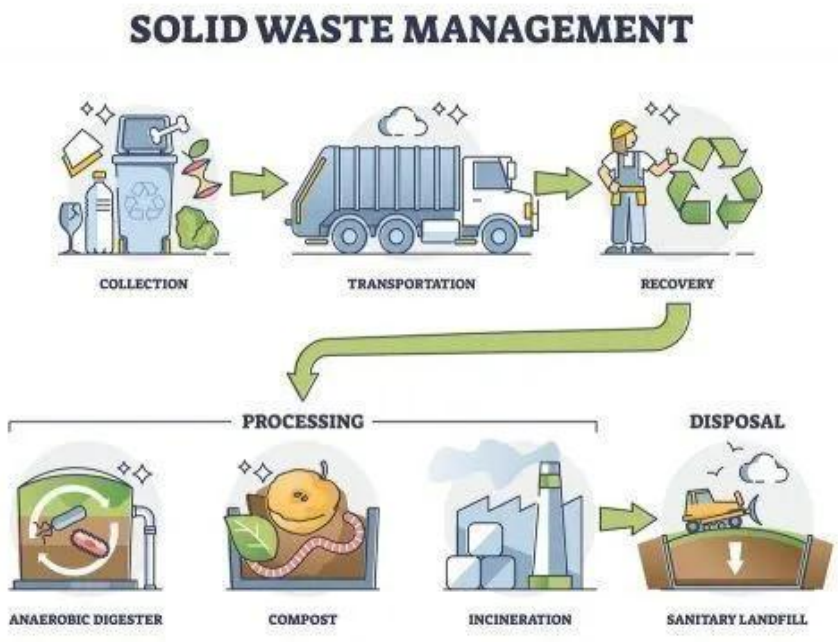
The LG office outlined a four-phase strategy to ensure the river is cleaned efficiently:

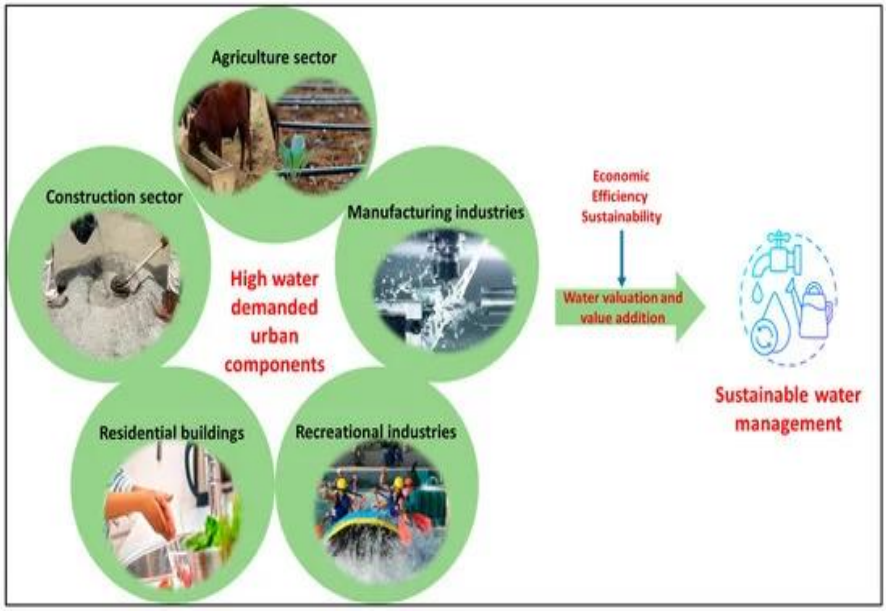
Strategy	Analysis
1. Removal of waste and silt from the riverbed	• The **first step involves clearing the accumulated debris** and sludge from the Yamuna.
2. Cleaning major drains	• A **cleaning drive** has been **launched in key drains such as the Najafgarh drain** and **Supplementary drain**, which are significant contributors to river pollution.
3. Monitoring sewage treatment plants (STPs)	• **Existing STPs** will be **closely monitored** for their **efficiency in treating wastewater** before it enters the river.
4. Construction of new STPs	• To address the **treatment deficit of approximately 400 MGD** (million gallons per day), **new sewage treatment plants** (STPs) and decentralized STPs (DSTPs) will be **set up under a time-bound plan.**

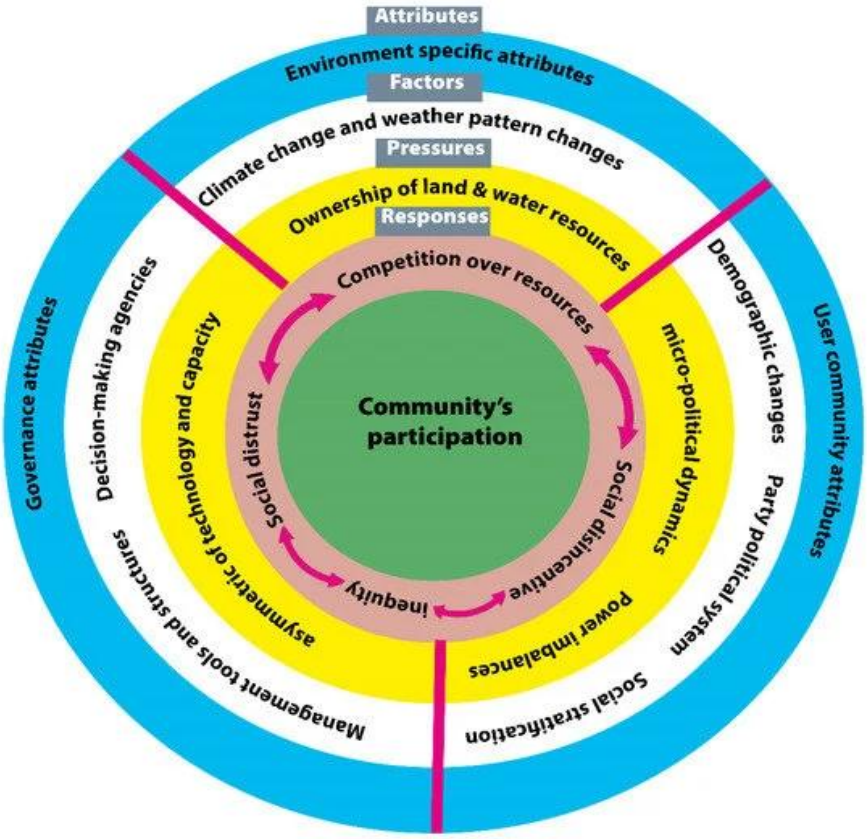
13. Mention about various river cleaning methods?

Methods	Analysis
Proper Sewage Management	• **Sewage is one of the main sources of pollution in the Yamuna River** and untreated or partially treated sewage effluents are still being discharged into the river. • It calls for a **total ban on such discharges** and effective legislation on it. • The **capacity of existing sewage treatment plants STPs** should be increased and more sewage treatment plants of greater capacity should be constructed.

	• **New technologies to reduce the BOD levels to below 10 mg/L should be implemented.** • The water authorities of **Delhi are already in progress with an innovative master sewage plan 2031** for sewered and unsewered areas to effectively manage the **wastewater system of the National Capital Territory.** 
Effective Solid Waste Management	• Due to rapid urbanization along the **Yamuna River a lot of solid waste is being generated everyday,** adding to the pollution load on the river due to lack of proper solid waste management and disposal system. • Most of the **towns and cities need proper and adequate solid waste management** systems and recycle and reuse units for effective waste management. • New landfill sites are required for proper disposal of the ever increasing solid waste.

	• These should be **designed on the WHO standards.** • Since **waste reduction and waste reuse and recycling** are good methods of waste prevention as they **not only eliminate the production of waste** at its source of generation but also **reduces the demand for waste treatment** and disposal facilities. • Keeping this in view, the **public should be made aware and encouraged to use various ways of waste reduction** in everyday life. • Any **developmental activity within the river zone should be restricted.** 
Community-based approach to address water related	• Creating awareness among people about **pollution in Yamuna River** and its **ill effects on the lives of people** is very important.

problems	• This can be done by the **joint venture of public-private organizations**. • The **role of local institutions** such as the **Panchayats should be increased.** • **Active community participation** is the need of the hour for monitoring, management and restoration of the Yamuna River. • Involvement of the **public in program design helps ensure the smooth running of the programs (EPA, 1995)**. 

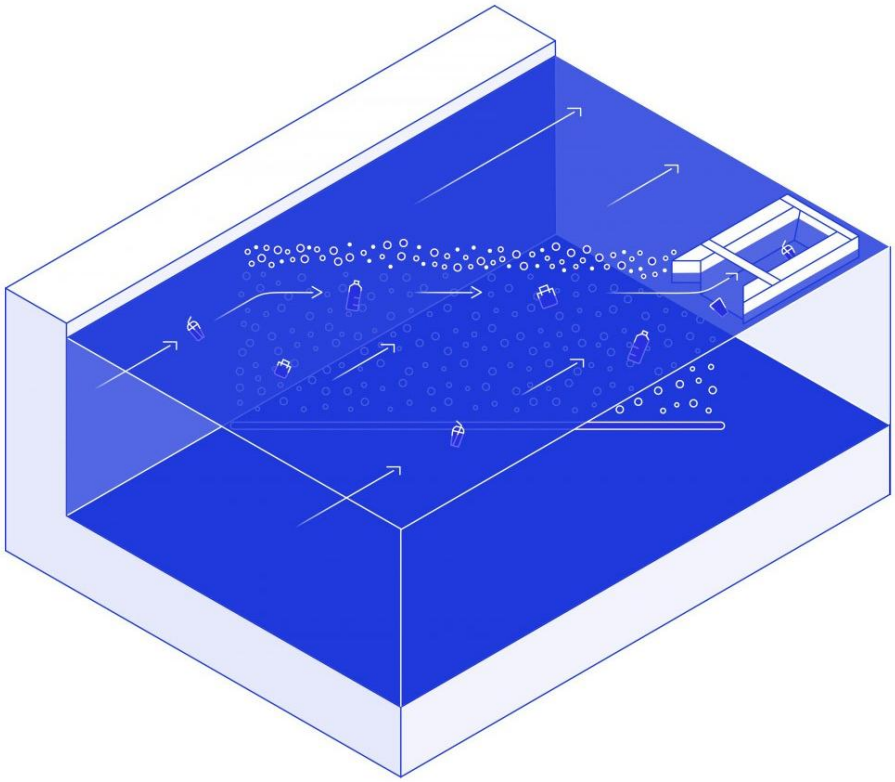
	
Role of science and technology	• New techniques should be used to develop suitable technologies **to manage solid waste such as encouraging the emergence and development of industrial ecology** where there is no such thing as waste but only resources. • Where **waste from one activity is input of raw materials for another activity.** • Such technologies will pave way for **integrated waste management (IWM)** which is best defined as a **set of management alternatives, including reuse, source reduction, recycling, composting, landfill** and incineration and pyrolysis a good and **Eco friendly** alternative to incineration for the thermal decomposition of solid wastes in an inert atmosphere

Improved agricultural practices	• The **unscientific use of chemical fertilizers, insecticides and pesticides in agriculture** has significantly contributed to **pollution in the Yamuna River.** • The agricultural practices need to be **improved to minimize the effects of the chemicals**. • This can be done by some of the following ways: ▪ **Employing organic or biological farming methods and prohibiting the use of pesticides,** insecticides and fertilizers for agriculture in the river basin. ▪ **Creating aw**areness among the farmers to avail facilities of programs like **Kisan Call Centre run by the ministry of agriculture** for solving all their agriculture related queries including scientific guidance on the use of **chemical fertilizers in cultivation, easily** accessible through phones and mobiles; ▪ **Emphasizing the use of bio-fertilizers** which have least chemical constituents. ▪ Efforts should be made **to reduce and prevent soil erosion in the river catchment area through vegetation cover.** • A suggested way is the development of Greenways along the drains. • These are severe for many other purposes, contributing to the conservation of the river.
Constructive Interactions	• **Interactions among consumers, policymakers, researchers,** and industry representatives are **needed to share their experiences** and ideas about **water quality management** and propose sustainable and cost-effective solutions.

	• There is also a need for **continued interaction among scientist**s with different backgrounds, experiences, and knowledge bases **to find solutions to the challenges of water availability, quality, and remediation** and to explore ways for **chemical, physical and biological solutions** for dealing with water-related problems. • Lessons should be learnt from the success stories of the **Rhine river (Europe), Thames river (England), Seine river (France) Mississippi river (USA),** etc. for planning the cleanup action for the Yamuna River.

14. Mention a few river cleaning techniques?

Techniques	Analysis
The Great Bubble Barrier	• **Bubble Barriers capture plastic in waterways** with bubbles. • A **bubble curtain is created** by **pumping air** through a **perforated tube on the bottom** of the waterway. • The **bubble curtain creates an upward current** which directs the plastics to the surface. • By placing the **Bubble Barrier diagonally in the river, the natural flow will push the plastic waste** to the side and into the **catchment system.**

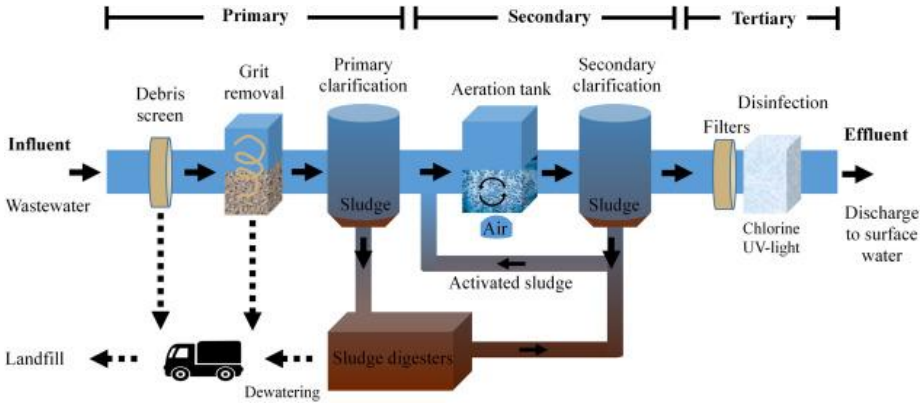
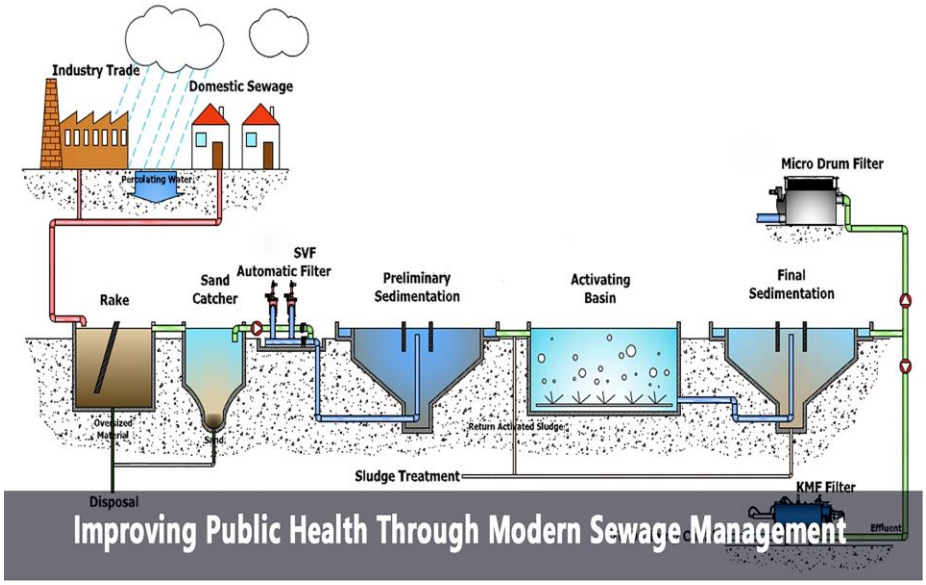
	
Drainage nets	• The **Australian city of Kwinana** has designed a simple and c**ost-effective solution** to deal with the **discharge of waste from drainage systems**. The town has put nets on the **outlet of drainage pipes.** • These **nets stop waste and pollutants from leaving the sewers**, **preventing garbage transported by rain waters** from contaminating the town's local water reserve. • It is a **simple filtering system** and it works like a charm.

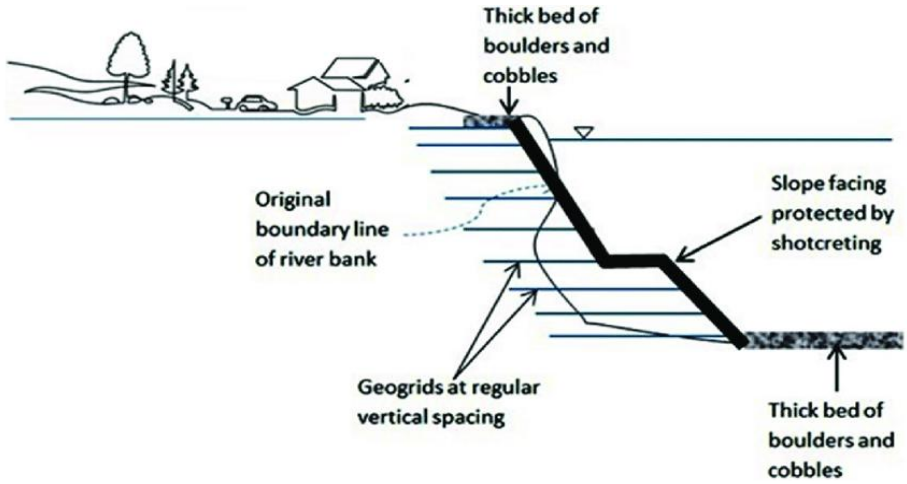
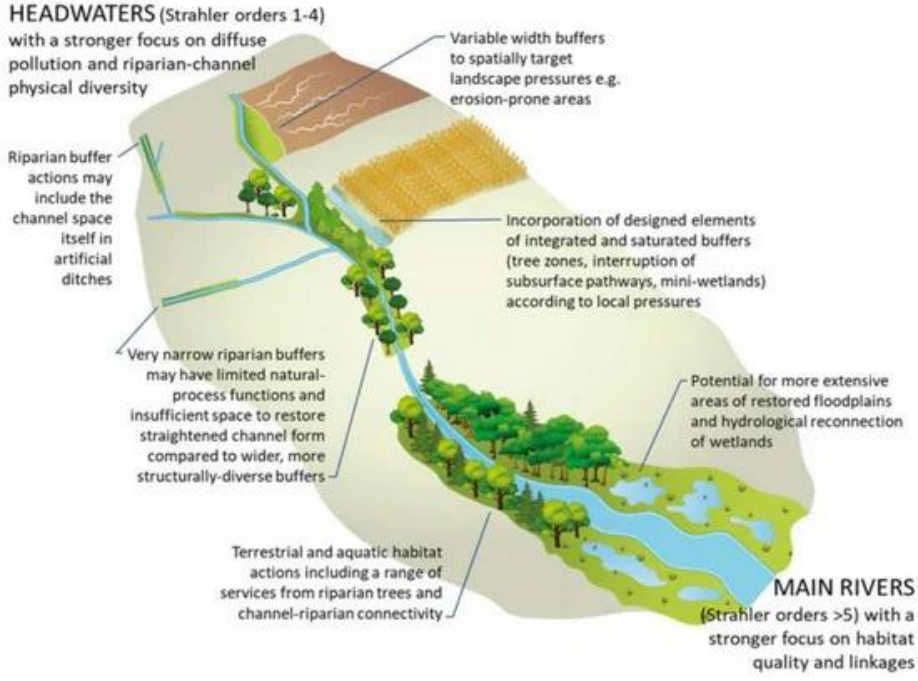
The Canal Cleaner	• "**The Canal Cleaner"** refers to **machines** or tools used to **remove sediment, debris, and vegetation from canals**, which are **human-made waterways** used for irrigation, transportation, and other purposes. • A r**ecent project in Thiruvananthapuram,** India, involved **cleaning the tunnel part of the Amayizhanjan Canal.**

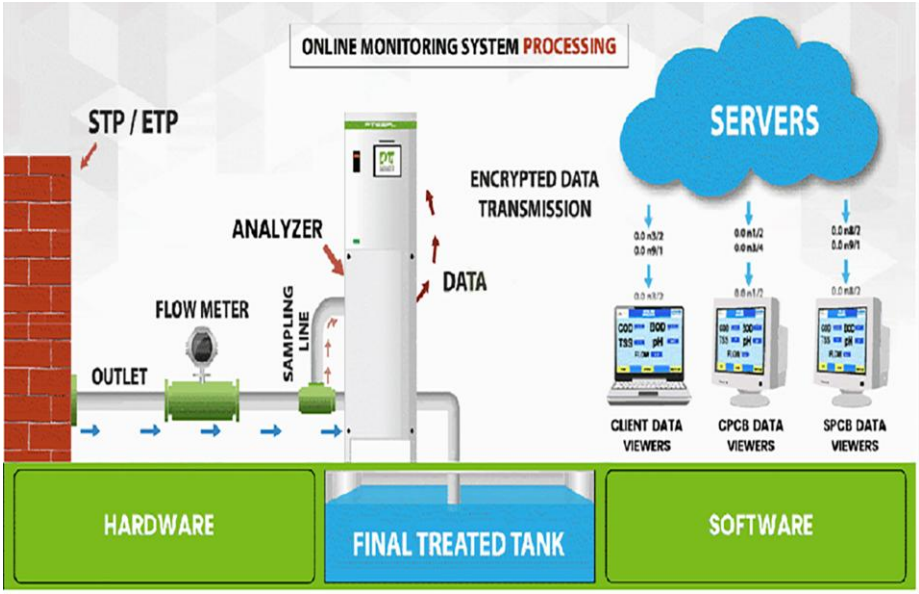
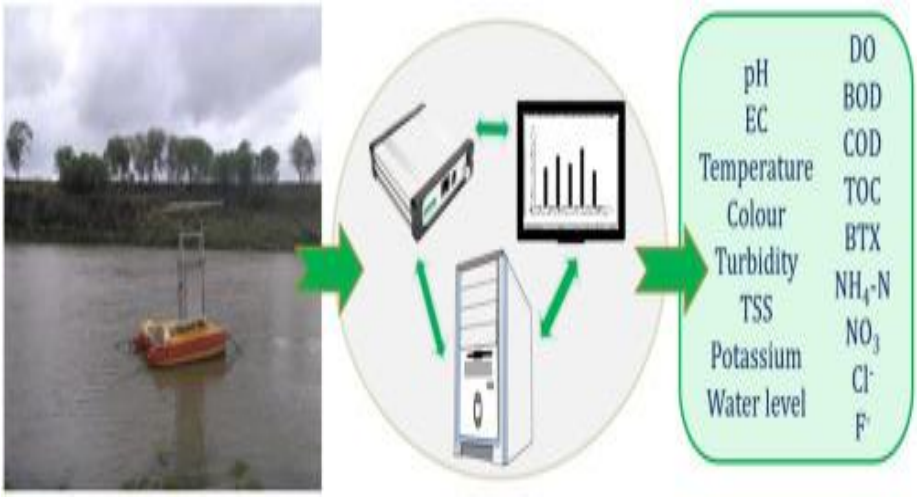
Bolina Booms	• **Bolina Booms** are **floating barriers,** primarily used for **marine safety, security, and environmental protection** in **inland waterways, dams,** and critical infrastructure, with a focus **on debris containment, watercraft safety, and oil spill containment.**

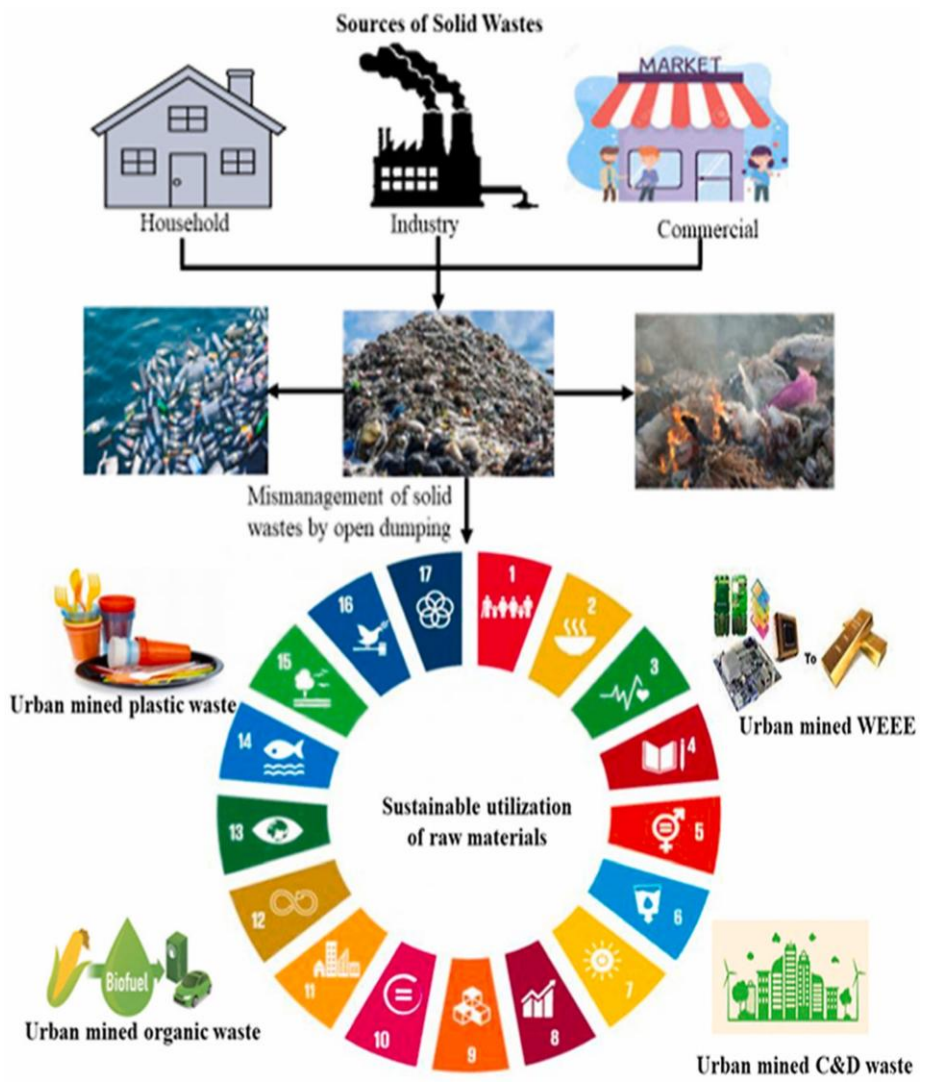
15. How can civil engineering in India help in cleaning rivers?

- From **creating efficient water management systems to designing sustainable infrastructure**, **civil engineers are helping to reduce the impact of water scarcity** and ensure **access to clean water for all.**
- **Civil engineers in India** can play a **crucial role in cleaning and restoring** rivers like the **Yamuna, Ganga** through a variety of approaches and strategies:

Aspects	Analysis
Infrastructure Development	• **Wastewater Treatment Plants (WWTPs):** ▪ **Design and implement efficient wastewater** treatment **facilities to treat sewage** before it enters the river. ▪ This includes **both large-scale municipal plants and decentralized systems.**  • **Sewage Systems:** ▪ **Improve existing sewage systems** to **prevent leaks and overflows,** ensuring that wastewater is properly directed **to treatment facilities.** 

Riverbank Management	• **Erosion Control:** ▪ Design structures such as **gabions, retaining walls, and vegetation barriers** to prevent erosion of riverbanks, which can lead to sedimentation and pollution.  • **Reforestation and Green Buffers:** ▪ **Implement projects to plant trees and create green buffers** along riverbanks to enhance water quality and biodiversity. 

Pollution Control Measures	• **Monitoring Systems:** ▪ **Develop and install water quality monitoring** systems to track pollution levels and sources, helping to target interventions more effectively.   • **Solid Waste Management:** ▪ **Create systems for managing solid waste in urban areas** that drain into rivers, including **recycling programs and public awareness campaigns.**



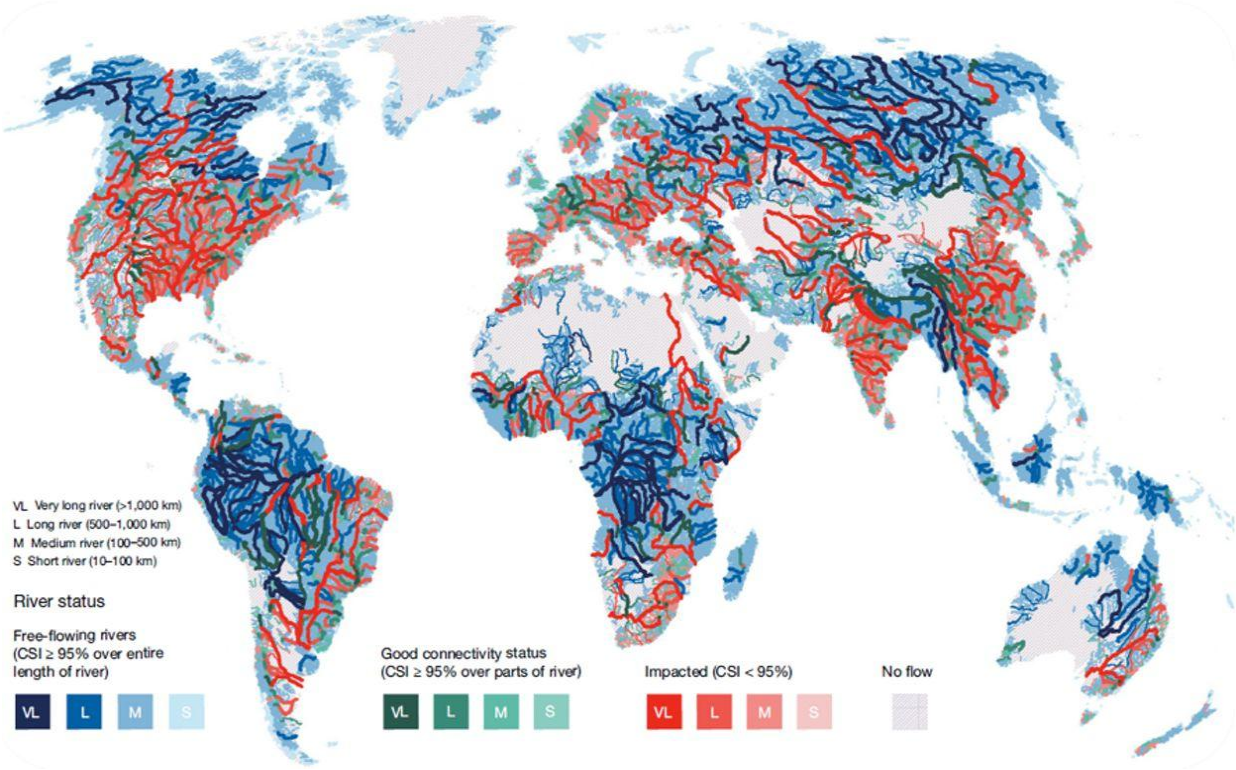
16. Mentions various sustainable solutions wrt River Yamuna?

- **Creating a project that balances the social, environmental, and economic interests of a community** is important to achieve sustainability. When a **project is planned in consideration of all these aspects,** it will create a **long-lasting program that benefits everyone.**

Levels	Solutions
What can be done at the administration level	• Develop **more public toilets and crematoria to reduce the sewage waste** into the river. • **Educational programs to increase awareness** encouraging people to use biodegradable paints for painting idols and stop dumping wastes in the rivers is needed. • **Stringent Implementation of regulation for industries** and hospitals not to dump waste in the river • **Upgradation of existing sewage treatment plants (STPs)** that don't comply with standards. • Integration of **water management by linking the private sector, local communities and NGOs** to ensure an effective and efficient allocation and use of water for all. • New strategies for the existing water treatment such as **automated river quality monitoring.** • **Develop parks with fountains or grassy lands, pools, plantations**, etc., along the **riverbanks to provide opportunities f**or water to undergo artificial aeration that leads to self-purification of the river. • Full and participatory **environmental impact assessments should be ensured for all projects.**
What can be done at the Community Level	• The **locals can report ground results** and activities on a regular basis to help authorities keep check on the effluent disposal by the industries.

	• **Train and educate people about ensuring proper maintenance** of the sewage system and waste disposal methods. • **Create a waste management system that can help the community make a livelihood** for themselves in the **form of recycling and upcycling the wastes.** • Apply **rainwater harvesting to meet water requirements throughout the year** that is uncontaminated for domestic and other needs. • **Improving the community's literacy rate** (taken as a proxy for awareness). • A study has shown that a **significant positive relationship is found between the rate of increase in literacy level in a district** and the water quality in rivers flowing through the district. • Communities can use **more environmentally friendly idols alternatives that use organic materials.**

17. What is the global status of river pollution?



18. Enlist a few best practices?

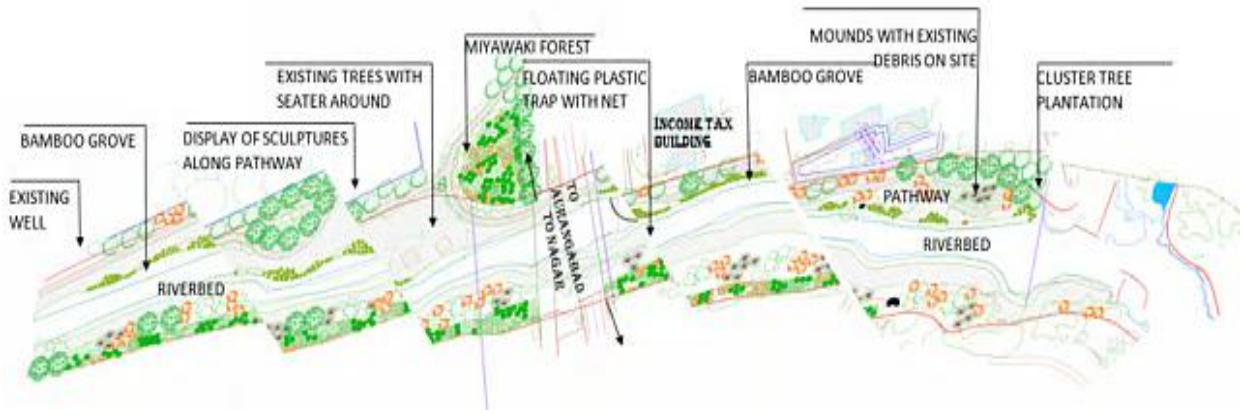
Kham river restoration project:

- Rising in the **Jatwada hills** near the city, the **65-km Kham river flows through Aurangabad before it meets the Nathsagar water** body near the **Nadikathche Gaon.**
- **Leakage from sewage systems,** indiscriminate encroachment and **dumping of solid waste** has **reduced the once seasonal river** into a **perennial flow of garbage**
- For years, the **Kham River had been reduced to little more than a dirty, foul-smelling drain**, a far cry from the lifeline it once was.
- **Choked by pollution, plastic waste, and unchecked encroachments**, the river was a stark reminder of what happens when urban expansion comes at the cost of nature.
- But where most saw an irreversible disaster, one man saw an opportunity for transformation.
- That man was **2011 batch IAS officer Astik Kumar Pandey who is now serving as Commissioner & CEO, ESIS, Mumbai, Maharashtra.**
- With his leadership, the **Kham River Restoration Project was launched, a project that would go on to become a model of sustainable** development, community participation, and administrative willpower.
- The restoration project was **divided into multiple phases, each targeting a critical issue plaguing the river.**

Phases of river restoration	**Analysis**
Phase 1: Cleaning the Riverbed	• The first phase involved c**learing out the heaps of plastic, debris, and silt** that had accumulated over the years. • Hundreds of **volunteers, along with municipal workers,** rolled up their sleeves and stepped into the filthy waters.

	 • The scene was overwhelming where **piles of garbage, discarded furniture, rusting vehicles, and even animal carcasses**. • It was an arduous, backbreaking task, but no one gave up.
Phase 2: Stopping the Pollutants entering the river	• The **second phase focused** on **stopping the flow of untreated sewage and industrial w**aste. • This required setting up **sewage treatment plants (STPs)** and **ensuring industries adhered to waste disposal regulations.**

	• **Municipal officials**, in collaboration with the Maharashtra Pollution Control Board, **cracked down on illegal dumping.**
Phase 3: Reviving the Ecosystem	• Once the **river was cleaned and pollution controlled,** the **focus shifted to restoring** its **natural ecosystem.** • **Native plant species were reintroduced** along the banks to **prevent soil erosion** and **improve water retention**. • Environmentalists and ecologists worked on **reviving aquatic life,** and **reintroducing fish** and other species that had vanished due to the toxicity of the waters. • Additionally, **afforestation drives were launched, with thousands of trees planted** along the riverbanks to improve the air and water quality. • **Walkways, gardens, and public spaces were developed to transform the once-polluted stretch** into a green corridor, reconnecting the people with their rivers.



Transforming the Thames river:

- The **River Thames**, known alternatively in parts as the **River Isis,** is a river that flows through s**outhern England including London.**
- At 215 miles, it is the **longest river entirely in Engl**and and the **second-longest in the United Kingdom,** after the River Severn.

Sources of Pollution:

- **Industrial Waste:**
  - Factories along the **Thames discharged untreated waste directly into the river.**
- **Domestic Waste:**
  - Before the widespread adoption of sewage systems, household waste, including **human sewage, often flowed directly into the Thames.**
- **Tributaries as Dumping Grounds:**
  - **Smaller rivers and streams feeding into the Thames** became dumping grounds for industrial and domestic waste.
- **Sewage and Wastewater:**
  - With the expansion of London's population and infrastructure, more **sewage and wastewater were added to the Thames, worsening pollution.**
- **Population Growth:**
  - In the mid-1800s, **London's population surged to over 2.5 million,** leading to an increase in waste production.

The Cleanup Process:

1. Seek opportunities for nature restoration
2. Collect, use & share meaningful data and research
3. Engage with the public to access, understand and value the river
4. Create funding opportunities to enable innovation and technological development
5. Partner with businesses to co-develop best management practices to reduce pollution
6. Thames is an evidence-based exemplar for solutions to river pollution in the UK
7. Combat pollution pathways into the river
8. Co-produce holistic and enforceable legislation
9. Understand the plastic lifecycle to tackle sources of litter
10. Remove existing litter in the river

Process	Analysis
Engineering Projects	• **Thames Embankments:** ▪ **Land reclamation** from the **river to create parks and roads,** which also helped to **increase water flow, aiding in natural cleaning.** • **Thames Tideway Tunnel:** ▪ A massive **25-kilometer tunnel, designed to divert sewage overflow** into treatment plants. Completion is expected by 2025.
Legislative Actions	• **Sewage Treatment (1976):** ▪ Legislation mandated that **all sewage entering the Thames be treated, preventing untreated waste from polluting the water.** • **Water Quality Standards (1961–1995):** ▪ Laws were **passed over several decades to raise water quality standards**, addressing industrial discharge and domestic waste.

Public Awareness Campaigns	• **Thames Litter Forum:** ▪ Initiated by the **Port of London Authority,** this forum brought **attention to litter and pollution reduction.** • **Thames Environment Fund:** ▪ Funded projects aimed at **reducing pollution** in the river **through community involvement** and environmental initiatives.
Other Actions	• **Biotic Monitoring:** ▪ Introduced to **track and maintain the health of the river's wildlife and ecosystem**, ensuring the river's ecological balance. • **River Clean-Ups:** ▪ Organizations like **Thames21** organized **community efforts to physically clean the river** and its banks, removing waste and debris.

Current State of the Thames:

- **Improved Water Quality:**
  - Through the combined efforts of **engineering, legislation, and public action,** the Thames' water quality has dramatically improved.

- **Ecological Restoration:**
  - The Thames is now **home to a wide range of wildlife, including salmon, fish, invertebrates, and various bird species**, such as herons and cormorants.

- **One of the Cleanest City Rivers:**
  - Today, the Thames is **considered one of the cleanest city rivers globally.**

19. What is the relevance of the topic for UPSC CSE?

- **For Prelims:** Yamuna river and its tributaries, River pollution, Dissolved oxygen, BOD.
  - **For Mains:** Yamuna river pollution, Floods in Yamuna river.

Some previous years prelims questions.

Q1. Which one of the following has been constituted under the Environment (Protection) Act, 1986? (2022)

(a) Central Water Commission
(b) Central Ground Water Board
(c) Central Ground Water Authority
(d) National Water Development Agency

Ans: (c)

Q2. Consider the following pairs: (2019)

	Glacier		***River***
1.	Bandarpunch	:	Yamuna
2.	Bara Shigri	:	Chenab
3.	Milam	:	Mandakini
4.	Siachen	:	Nubra
5.	Zemu	:	Manas

Which of the pairs given above are correctly matched?

(a) 1, 2 and 4 only
(b) 1, 3 and 4 only
(c) 2 and 5 only
(d) 3 and 5 only

Ans: (a)

Some previous years mains questions.

Q1. Industrial pollution of river water is a significant environmental issue in India. Discuss the various mitigation measures to deal with this problem and also the government's initiative in this regard.

(10M-2024)

Some questions from this year and previous years interview transcripts.

Preeti Sudan mam:

- Tell me something about River Yamuna.

Board Manoj Soni sir:

- If you are the commissioner in Delhi, what steps will you take to address Yamuna river pollution?

Some questions for QUIZ.

Q1. Consider the following rivers:

1. Giri
2. Tons
3. Sindh
4. Betwa
5. Ken

How many of the above are tributaries of Yamuna river?

(a) Only two
(b) Only three
(c) Only four
(d) All five

Ans: (d)

Some questions for POLL.

Q1. Do you think Yamuna can get clean in three years?

(a) YES

(b) NO

(c) Can't say.

Q2. Is Delhi responsible for the Yamuna river pollution?

(a) YES

(b) NO

(c) Can't say.

■■■■