THE GANGA

IT'S POLLUTION ASSESSMENT AND THE WAYOUT

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The Head of our Department and my Mentor has helped me in developing the project report. Except this all faculties of Department of chemistry are hereby sincerely acknowledged

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-SAUMIK MAL

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❑Contents

❑Introduction and Geomorphology

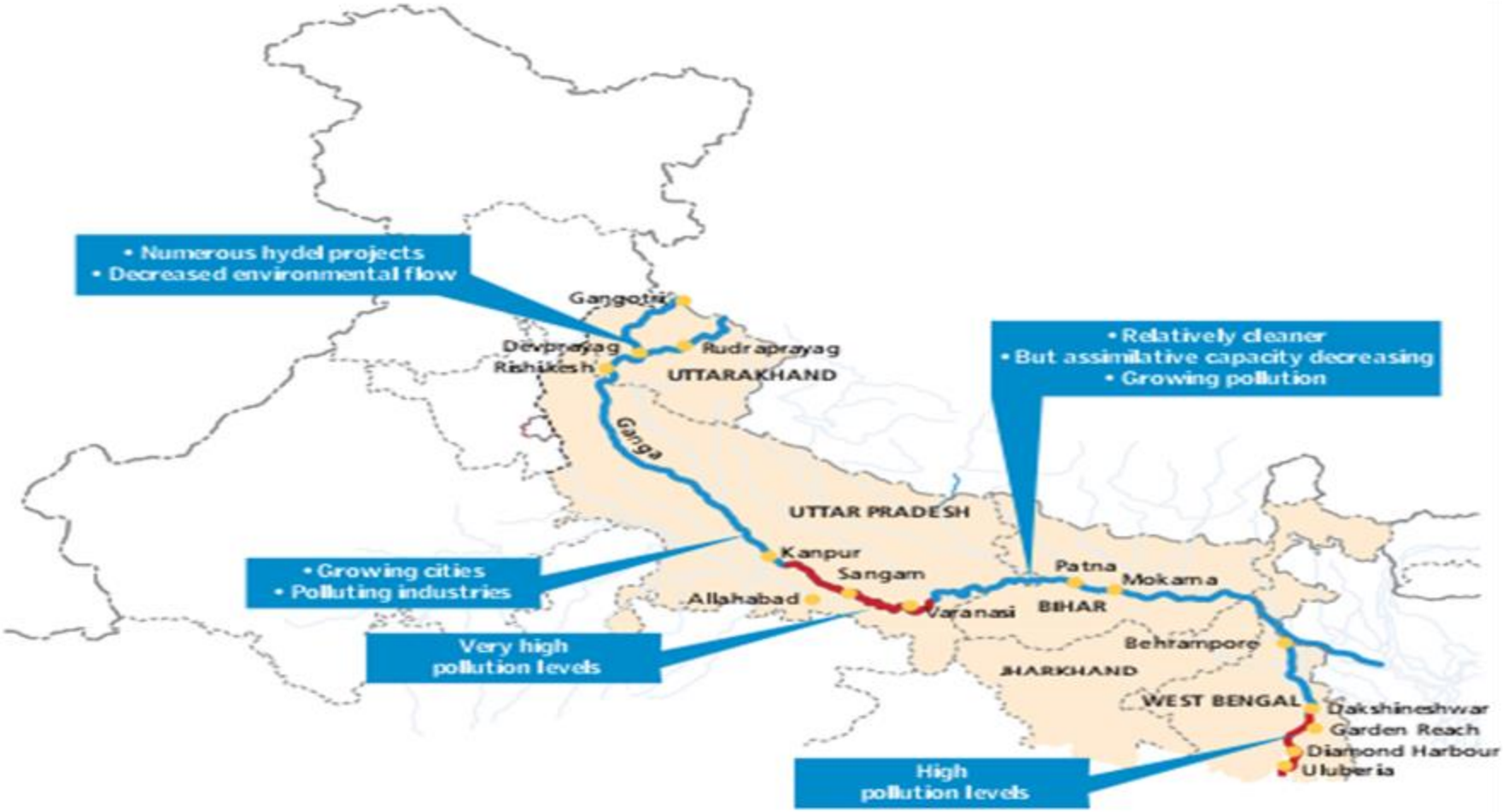
The Ganga basin accounts for a little more than one-fourth (26.3%) of the country's total geographical area and is the biggest river basin in India, covering the entire states of Uttarakhand, Uttar Pradesh (UP), Bihar, Delhi, and parts of Punjab, Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh, and West Bengal. The Ganga basin is bound in the north by the Himalayas and in the south by the Vindhyas.

The main river stream originates in the Garhwal Himalaya (300 55' N, 7907' E) under the name of the Bhagirathi**.** The ice-cave of Gaumukh at the snout of the Gangotri glacier, 4100 meters above sea level, is recognized as the traditional source of River Ganga. The river cuts its path through the Himalayas and flows a distance of about 205 Kilometers from Gaumukh and transverses through two districts of Uttrakhand state i.e. Uttarkashi and Tehri to reach Devprayg where another head stream, the Alaknanda, joins it to form Holy Ganga. The River Alaknanda is a major tributary of the River Ganga at Uttarakhand that begins at the confluence of the Satopanth and Bhagirath Kharak glaciers in Uttarakhand and it travels approx 190 km. before meeting Bhagirathi.

- After flowing through the northern-most part of Uttarakhand, the riverflowsthrough Uttar Pradesh, Bihar, Jharkhand and West Bengal, and finally drains into the Bay of Bengal. The river traverses a length of 1450 km in Uttarakhand and Uttar Pradesh while touching the boundary between UP and Bihar for a stretch of 110 km. It then flows through Bihar, more or less covering a distance of 405 km.The length of the river measured along the Bhagirathi and Hugli rivers during its coursein West Bengal is about 520 km. The River Ganga has a large number of tributaries, namely, Kali, Ramganga, Yamuna, Gomti, Ghaghara, Gandak, and Kosi. The River Yamuna, although a tributaryof Ganga, is a river basin in itself. Its major tributaries are

Chambal, Sind, Betwa, and Ken. The main plateau tributaries of the Ganga river are Tons, Son, Damodar, and Kangsabati-Haldi.

❑ The Ganga: The run of the river



UTTARAKHAND	UTTAR PRADESH	BIHAR	JHARKHAND	WEST BENGAL
450 km	1,000 km	405 km	40 km	520 km
14 drains	43 drains	25 drains		54 drains
440 MLD	3,270 MLD	580 MLD		1,780 MLD

❑Salient Features of River Ganga

➢ Total Length	2525 kms
➢ Uttarakhand	450 kms
➢ Uttar Pradesh	1000 kms
➢ Sharing length between UP & Bihar	110 kms
➢ Bihar	405kms
➢ Jharkhand	40kms
➢ West Bengal	520 kms
➢ Area Ganga Basin	8,61,404 sq km (26.4%) of India
➢ Average Annual discharge	4,93,400 million cubic meter
➢ Main Tributaries	Yamuna, Ramganga, Gomti, Ghaghara, Gandak, Damodar, Kosi & Kali-East
➢ Main sub tributaries	Chambal, Sindh, Betwa, Ken, Tons (beyond Five States), Sone & Kasia-Haldi
➢ Major Cities located on the bank	Srinagar, Rishikesh, Haridwar, Roorkee (in Uttarakhand), Bijnor, Narora, Kanauj, Kanpur, Allahabad, Varanasi, Mirzapur (In Uttar Pradesh), Patna, Bhagalpur (In Bihar) and Bahrampur, Serampore, Hawarah and Kolkata (in West Bengal)

❖ Main stem of river Ganga houses a population with high density. In absence of proper sanitation, abstraction of surface and groundwater for irrigation and drinking purposes and partially treated domestic and industrial effluent turns Ganga into a polluted river in the stretch from Kannuj to trighat in the state of Uttar Pradesh and also makes the water of river Ganga unfit even for bathing purposes

❑POLLUTION IN RIVER GANGA

➢ Current state, why is it so, and the way ahead

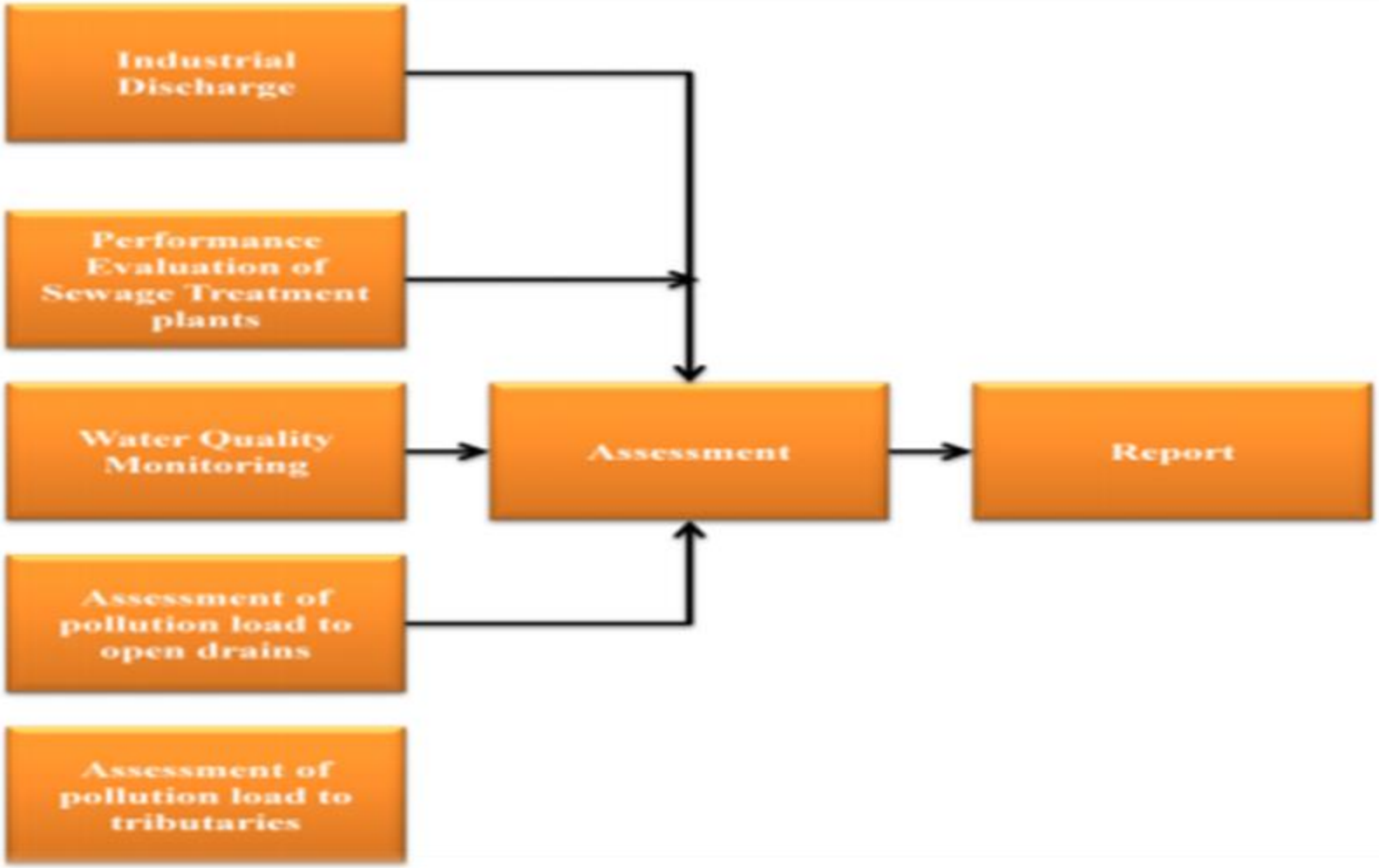
➢ The Ganga Action Plan (GAP-I) had selected 25 towns located along the river in Uttar Pradesh, Bihar and West Bengal. In 1993, the second phase (GAP-II) continued the programme, but included work on four tributaries of the river — Yamuna, Gomti, Damodar and Mahanadi.

In August 2009, the Union government re-launched the Ganga Action Plan with a reconstituted National Ganga River Basin Authority (NGRBA). Under the notification, dated February 20, 2009, the government gave the river the status of a National River. The objective was to ensure abatement of pollution and conservation of the river. The key difference between the first Ganga Action Programme and now, is the recognition that the entire basin

of the river has to be the basis for planning and implementation. It is not enough to plan for one city's pollution, without considering the impact of the pollution on the downstream area. It is accepted that the plan for pollution control must take into account the need for adequate water in the river — its ecological flow.

❑How polluted is the river?

➢ The challenge of pollution remains grim. According to July 2013 estimates of the Central Pollution Control Board (CPCB), fecal coliform levels in the mainstream of the river — some 2,500 km from Gangotri to Diamond Harbour —
remain above the acceptable level in all stretches, other than its upper reaches.



POLLUTED RIVER STRETCHES

2009	121 rivers	150 polluted streches
2015	275	302
2018	323	351

CPCB is currently monitoring 445 rivers in the country

Bulk of increase in the least polluted category where the BOD level recorded between **3-6 mg/l**

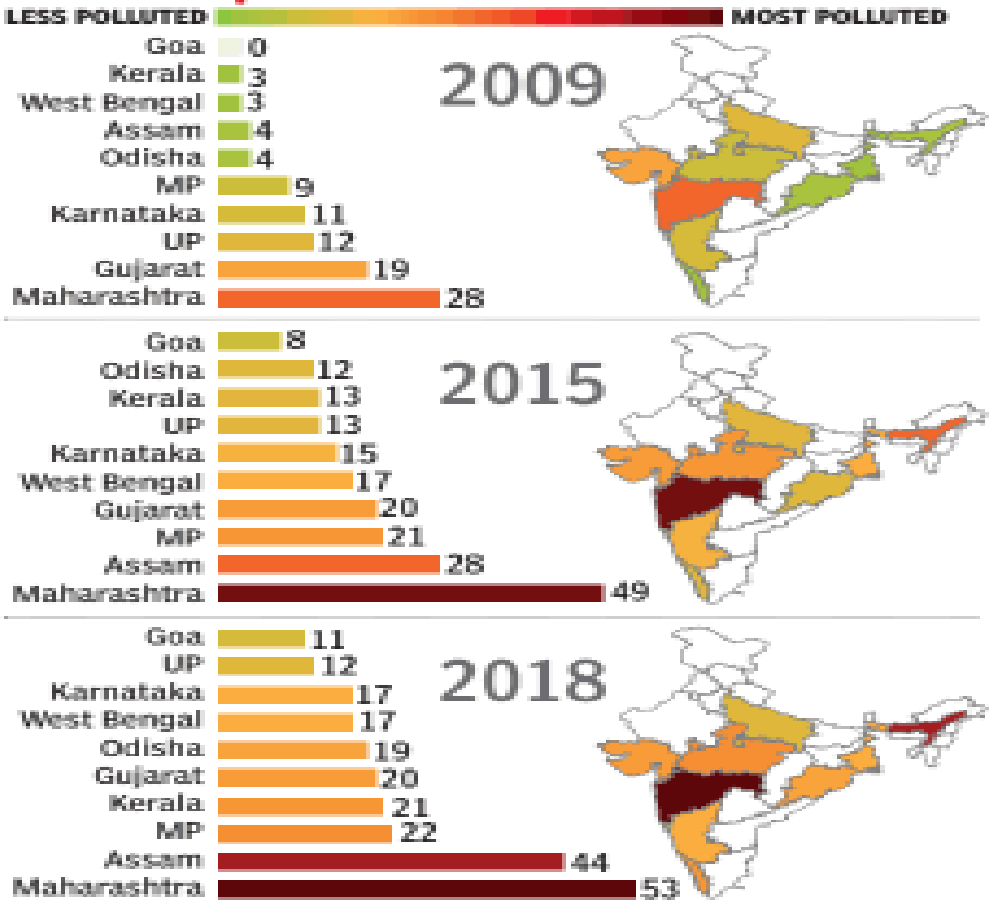
No. of polluted stretches in the 3-6 mg/l of BOD category

Ten dirtiest stretches in 2018

State | *River* | **River Stretch**

1. Tamil Nadu | *Vasishta* | **Manivilundhan to Thiyaganur**
2. Haryan | *Ghaggar* | **Punjab-Haryana border to Sirsa**
3. Gujarat | *Bhadar* | **Jetpur to Saran village**
4. Punjab | *Ghaggar* | **Sardulgarh to Mubarakpur**
5. Maharashtra | *Mithi* | **Powai to Dharavi**
6. Gujarat | *Khari* | **Lali village to Kashipura**
7. Tamil Nadu | *Thirumanimuthar* | **Salem to Papparapatti**
8. Gujarat | *Sabarmati* | **Kheroj to Vautha**
9. UP | *Hindon* | **Saharanpur to Ghaziabad**
10. Punjab | *Sutluj* | **Rupnagar to Harika Bridge**

State-wise polluted river stretches



Parameters

- Polluted locations in a continuous sequence are defined as polluted river stretches
- Biochemical Oxygen Demand (BOD)-level is a key indicator of organic pollution
- Water bodies having BOD more than 3 mg/l are considered as polluted
- If BOD exceeds 6mg/l in water body, the Dissolved Oxygen (DO) gets reduced below desired levels
- Water bodies with low DO level do not support aquatic life

(Data Source: CPCB Reports of 2009, 2015 and 2018)

7.

❑Key problem and approaches

➢ **There are three problem areas that need to be addressed in order to find a comprehensive solution to Ganga pollution**

1. **The inadequate flow of water in the river, needed to dilute and assimilate waste**

2. The growing quantum of untreated sewage discharged from cities along the river.

3. **The lack of enforcement against point-source pollution from industries discharging waste into the river.**

❖ But even in these reaches, there are worrying signs as fecal coliform levels are increasing all over India's Ganga flow way like Rudraprayag , Devprayag, suggesting that there are inadequate flow for dilution even in these highly oxygenated stretches *(**See Graph: Previous page**).*

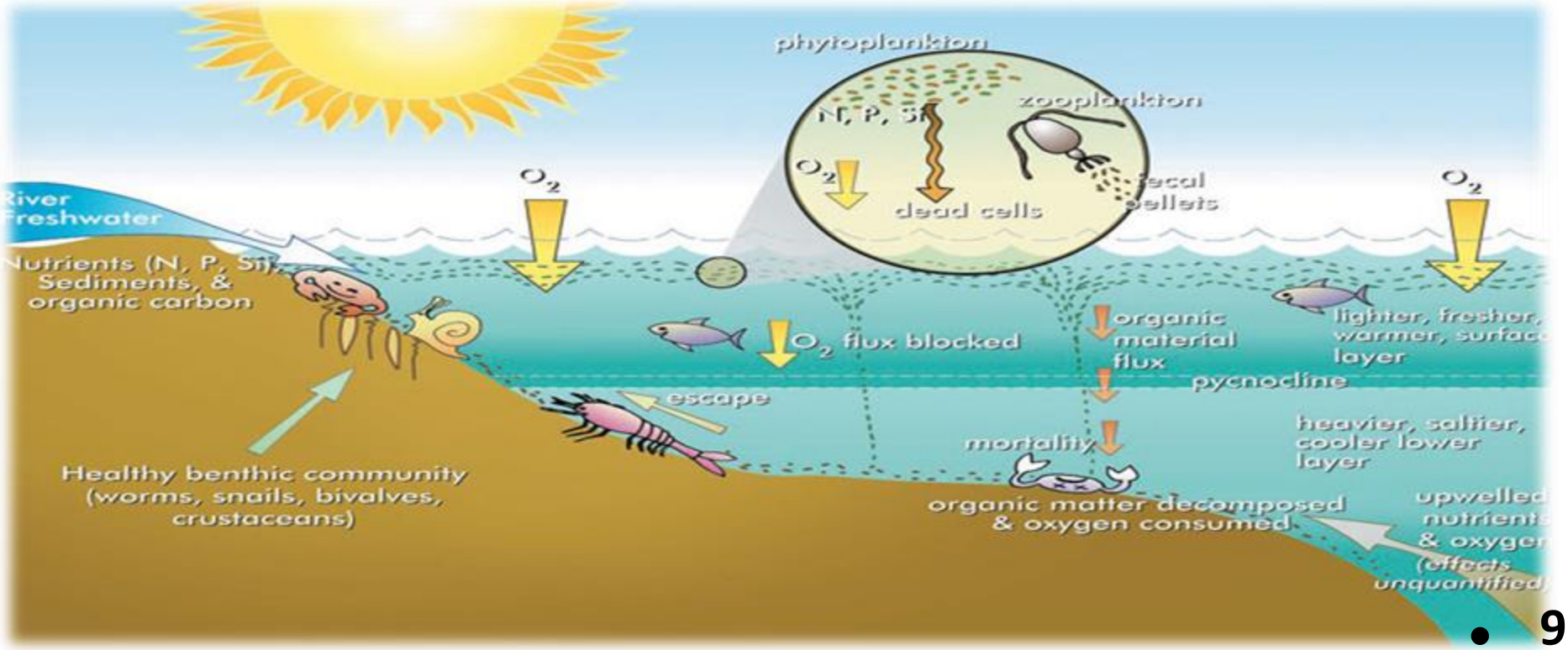
The pollution levels are a cause of worry in the hotspots — the mega and fast growing cities — along the river. According to the CPCB's monitoring data, biological oxygen demand (BOD) levels are high downstream of Haridwar, Kannauj and Kanpur and peak at Varanasi. But what is worrying is that in all the stretches, pollution is getting worse. This is not surprising given that all along this heavily populated stretch, freshwater intake from the river is increasing. In this way, water is drawn for agriculture, industry and cities but what is returned is only waste. Funds have been used up to create infrastructure, without much attention paid to the use and efficacy of this hardware. But with all this done, the cities are still losing the battle with the amount of infrastructure that has yet to be built to convey the sewage and then of course, to treat it and dispose of it.

❑Ecological flow and the need for dilution

➢Rivers have a self-cleansing ability, which allows for assimilation and treatment of biological waste. But in the current context, where withdrawal from the river is much higher than the discharge of waste, pollution is inevitable.

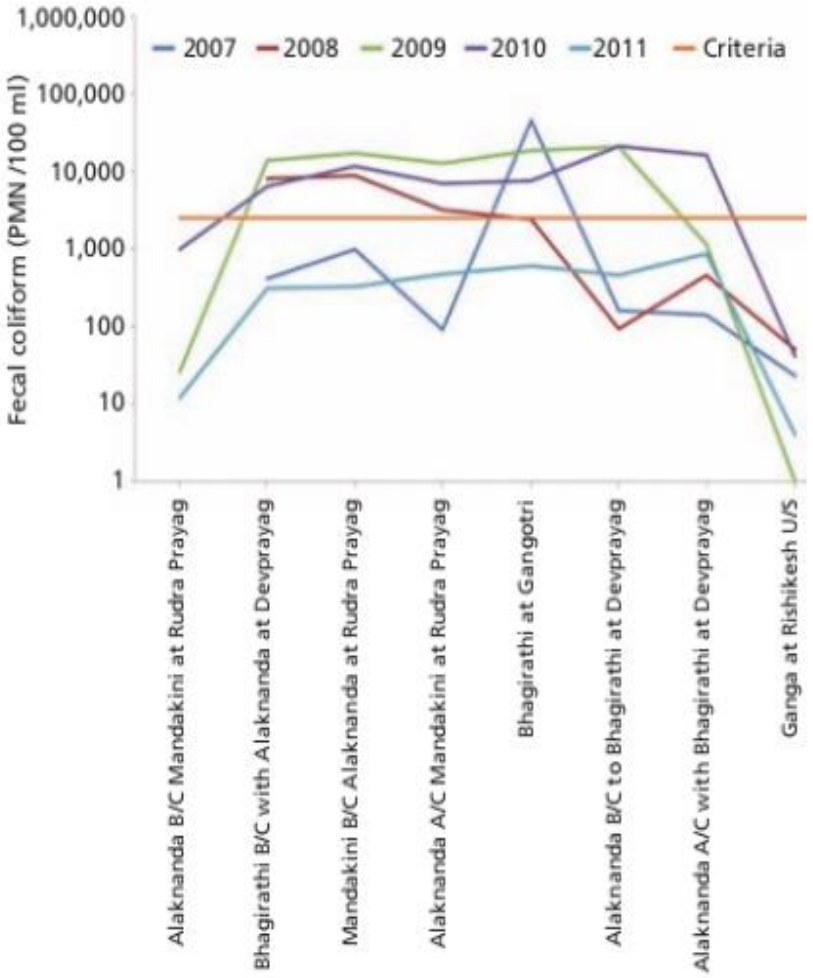
In the upper reaches of the river, where the oxygenating abilities of the river are the highest, there are growing signs of contamination. This suggests that even here, water withdrawal for hydroelectricity is endangering the health of the Ganga (*see Graph: Annual trend of fecal coliform: the upper reaches*

As the river reaches the plains, the water withdrawal peaks for irrigation and drinking water. In this stretch of the river from Rishikesh to Allahabad, there is almost no water during winter and summer months. In other words, the river stops flowing. But the wastewater flow does not ebb. The river then receives only waste and turns into a sewer *(see Graph: Seasonal mean discharge into the Ganga).*

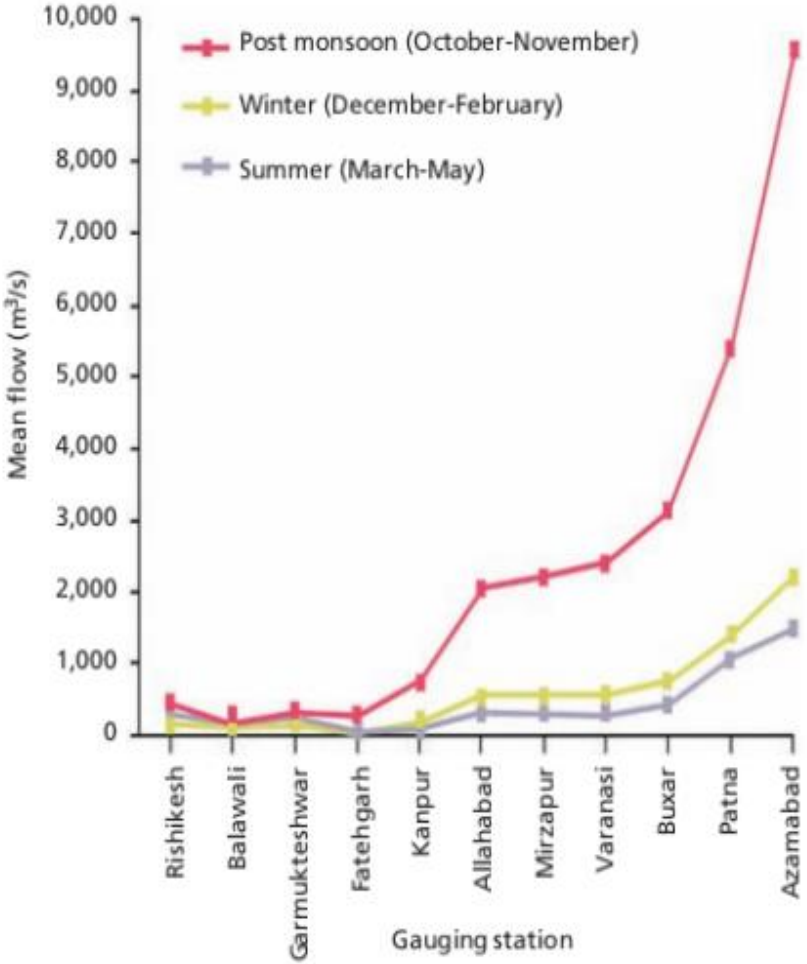


❑Graph: Ecological flow in Ganga

Graph: Annual trend of fecal coliform: the upper reaches



Graph: Seasonal mean discharge into the Ganga



❑Domestic sewage and why the treatment plants do not solve the pollution problem

➢ Domestic sewage is the major cause of contamination in the river. According to the CPCB, 2,723 million litre a day (MLD) of sewage is generated by 50 cities located along the river, which adds up to over 85 pr cent of the river's pollution load. The key problem comes from the main cities on the Ganga. The 36 Class I cities contribute 96 per cent of the wastewater generation. *Furthermore, 99 per* cent of the treatment capacity is installed in these cities. But the problem is that the focus on treatment plants has taken away the attention from cleaning the river. This is what needs to be addressed. But the answers are not just building new sewage treatment plants. The answer lies in the fact that these cities will have to do sewage management differently. Why?

➢There is a growing gap between installed capacity and treatment

The most recent assessment shows that there is a massive gap between the generation of domestic sewage and treatment capacity in the main stretch of the Ganga. The 2013 CPCB estimate shows that generation is 2,723.30 MLD, while treatment capacity lags behind at 1,208.80 MLD. It is important to compare this with the 2013 estimate *(see Table: Sewage generation and Treatment capacity created in the Ganga), which shows that even as we invest in sewage* treatment capacity, the gap remains the same. According to this estimate, over half the sewage goes untreated into the river or other water bodies.

➢Even the sewage treatment plants (STPs) built are not working

➢ The sewage treatment capacity is poor because of factors ranging from lack of electricity to operate the plant, to the lack of sewage that reaches the plant for treatment. The 2013-2017 CPCB report inspected 51 of the 64 sewage treatment plants (STPs) to find that less than 60 per cent of the installed capacity was utilised, and 30 per cent of the plants were not even in operation *(see Table: Ganga STPs: what works and what does not, as checked by CPCB).*

Table: Sewage generation and treatment capacity created in the Ganga

	2009	2012
Sewage generation (MLD)	2,638	2,723
Treatment capacity (MLD)	1,174	1,208
Gap (MLD)	1,464	1,514
% gap: treated vs untreated	**55**	**55**

Source: CPCB 2009 and 2013

Table: Ganga STPs: what works and what does not, as checked by CPCB

States	No of STPs inspe-cted	Installed capacity	Actual utilised capacity	Total no of STPs not in opera-tion	STPs exceeding BOD/COD limits
Uttarakhand	4	54	-	0	2
Uttar Pradesh	8	358	287	1	4
Bihar	5	140	100	1	1
West Bengal	34	457	214	13	3
Total	51	1,009	602	15	10

Note: The CPCB inspected 51 out of 64 STPs on the Ganga in 2012-13
Source: CPCB 2013, *Pollution Assessment: River Ganga*, Central Pollution Control Board, MoEF, July

➢Sewage generation is underestimated and hence the treatment capacity needed is much higher

➢ The actual gap between generation and treatment is grossly under estimated. The problem lies in the manner in which governments estimate pollution load and plan for sewage treatment. The estimation of sewage generation is based on the quantum of water supplied. The assumption is that 80 per cent of the water supplied is returned as wastewater. But as cities do not know how much water is lost in distribution and how much groundwater is used within their boundaries, the waste generation estimate could be wide off the mark *(seeTable: Difference between actual and measured sewage generation).*

This shows up in the most recent data collected by CPCB on Ganga. The actual measured discharge of wastewater into Ganga is 6,087 MLD — which is 123 per cent higher than the estimated discharge of wastewater. In other words, the gap between treated and untreated waste is not 55 per cent, but 80per cent. According to this, the estimation is that the BOD load is 1,000 tonne/day inn the mainstream of the river.

➢STPs are ineffective because of lack of connectivity

➢ Most cities along the Ganga do not have any sewage conveyance systems. In Kanpur, Allahabad and Varanasi, 70 to 85 per cent of the city does not have a working underground drainage system. As a result, drains are not connected to STPs. What exist are open drains, which make their way into the river. In Allahabad, 57 drains flow into the river; city officials say 10 of these do not add to pollution as their discharge does not reach the river *(see Table: Connectivity for sewage treatment plants: UP cities). But the problem is that this untreated* effluent adds to the pollution load by contaminating groundwater.

➢ Therefore, cities must address the underlying problem of lack of connectivity to sewage systems. This is not done and estimates are prepared, which suggest that cities — old and congested — will be able to lay underground sewage and intercept waste before it reaches the river over time. But experience shows that building a fully connected system across the city does not happen. The STP is first built, but the drains to intercept sewage do not get completed and the river continues to be polluted.

Table: Difference between actual and measured sewage generation

	Official estimate of sewage generation (MLD)	No of drains	Actual measured sewage flow (MLD)	Gap (untreated waste) (%)
Uttarakhand	61	14	440	95
Uttar Pradesh	937	45	3,289	86
Bihar	407	25	579	71
West Bengal	1,317	54	1,779	69
Ganga mainstream	2,723	138	6,087	80

Source: CPCB 2013, *Pollution Assessment: River Ganga*, Central Pollution

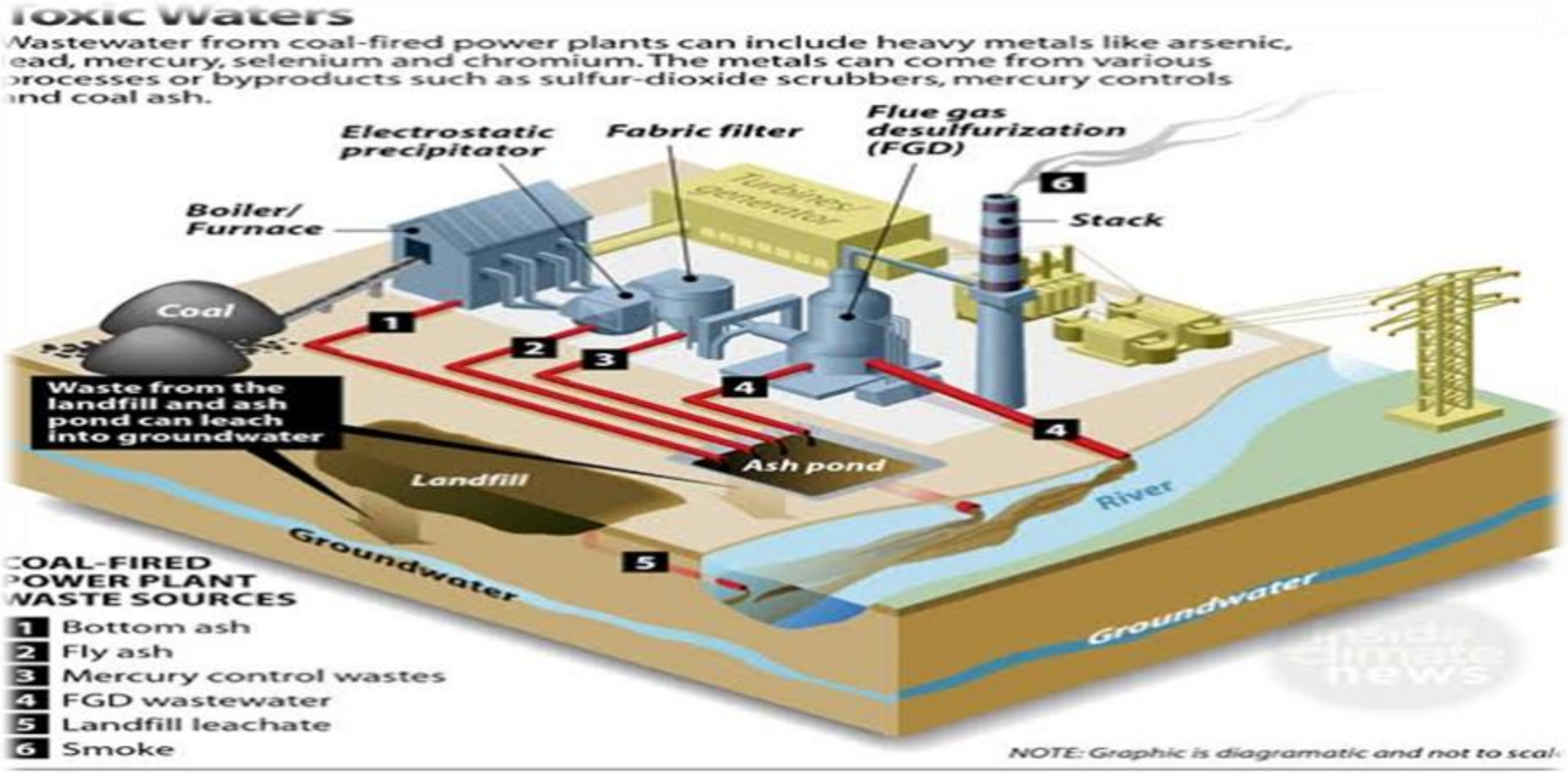
Table: Connectivity for sewage treatment plants: UP cities

City	Area of city (ha)	Area with sewerage (ha)	Un-sewered area (ha)	Un-sewered area (%)	Drains
Kanpur	25,810	7,558	18,252	71	37
Allahabad	9,510	2,013	7,397	78	57
Varanasi	10,058	1,635	8,432	84	23

Source: UP government 2010, Presentation made at the meeting of the Executive Committee of the State Ganga River Conservation Authority, Lucknow, *mimeo*

❑Industrial pollution :Need for enforcement

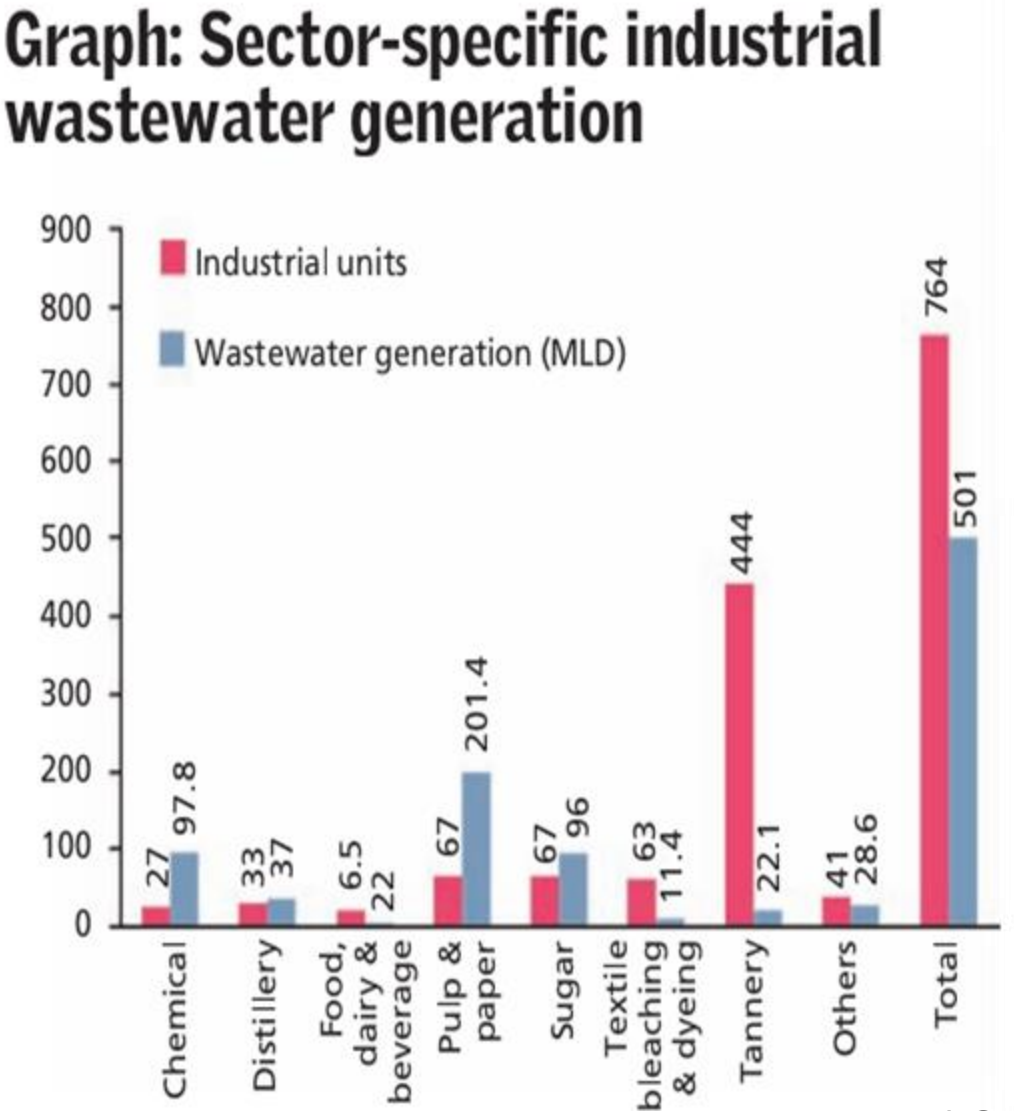
- Industrial pollution into the main Ganga has been an issue of attention and focus, but without much success. The problem is that many of the industries that discharge noxious chemical pollutants into the river are small-scale, where technologies for treatment are inadequate or unaffortable. The 2013 CPCB estimates show that 764 industries in the mainstem of Ganga (and its two tributaries, Kai and Ramganga) consume 1,123 MLD of water and discharge 500 MLD of effluent. The bulk of these industries ..



❑Graph: Industrial pollution

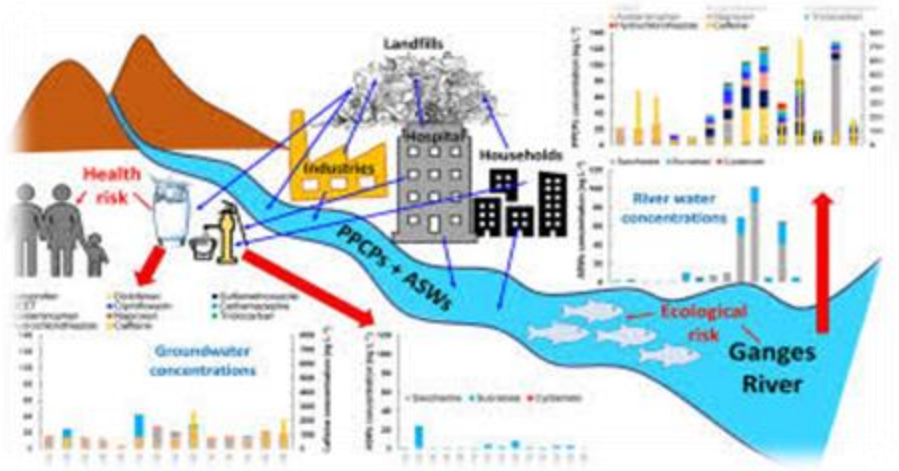
- 90per cent — operate in the Uttar Pradesh stretch of the river (see Box: UP's shame: industries that pollute).

The sector-specific industrial wastewater generation forming the bulk of the pollution comes from pulp and paper sector. Tanneries are the highest in number but have a lower wastewater generation in comparison. But the problem is that this waste is both concentrated in stretches of the river where there is no dilution and assimilative capacity and is particularly toxic because of its high chemical load *(see industrial wastewater generation).* Over the past years, many efforts have been made to reduce the pollution impact of these industries, but with little success. As a result, the only real difference is seen when industries are given closure or stop work notices. But as this is not a permanent solution, clearly more will need to be done to find ways to reduce the pollution from the industries urgently and effectively.



❑WEST BENGAL SHAME: INDUSTRIES THAT POLLUTE

- This state which has520 km of the river's length and big cities ton boot, also has 687 grossly polluting industries that pollute the Ganga. These tannery, sugar, pulp and paper and chemical industries contribute 1,780MLD of wastewater. While tanneries are large in number — 442 — they only contribute 8 per cent of the wastewater but this is highly toxic and



concentrated in the Jharkhand belt(40 km). Sugar, pulp and paper and distillery plants add up to 70 per cent of the wastewater. The inspections by CPCB showed that of the 404 units inspected, only 23 required no action. The rest were non-compliant in terms of the laws of the country. WB, June 2013-2017 enforcement action was in various stages, but this was still to show on the ground. Clearly, enforcement with big teeth is the issue at hand.

➢Table: CPCB action against industries polluting the Ganga

❑ Action	No of industries
➢Direction under Section 5 of Environment Protection Act, 1986	142
➢Directions under Section 18 (1) (b)of Water Act 1974	12
➢Letter issued for ensuring compliance Action under process 191	25
➢Total	370
➢Found closed during inspection	11
➢No action required	23

❑What is the solution for Ganga pollution ? What should we do?

1. Provide for water in the river for ecological flow and dilution

- Accept that for cleaning rivers in India, where cost of pollution control treatment is unaffordable and unmanageable, the availability of water for dilution will be critical. The available standards for 'acceptable water quality' provide for a dilution factor of 10. This is why discharge standards for water bodies are set at 30 for BOD, while bathing water quality standard is 3 BOD. The fact is that given the huge unmet challenge of wastewater treatment, the cost of reducing standards will be unaffordable. Instead, what should be provided is water inflow, to build the assimilative capacity in the river for self-cleansing waste. It is essential to note that rivers without water are drains. It is also a fact that this release of additional water deprives farmers upstream of irrigation; cities and industries of water. The additional water for ecological flow becomes contested. But this flow must be mandated so that it comes from the state government's own allocation of riparian water. The government then has a choice to build storage to collect monsoon water for dilution within its territory or to 'release' water to rivers and make other choices for use in agriculture, drinking or industry. In other words, all users must be forced to plan for water needs based on what the river can spare, not what they can snatch.

❖ Action plan

- Ecological flow will be mandatory in all stretches of the river. In the upper stretches, where the requirement is for critical ecological functions as well as societal needs, it will be mandated at 50 per cent for mean season flow and 30 per cent for other seasons. In the urbanised stretches, it will be mandated based on the quantum of wastewater released in the river and calculated using a factor of 10 for dilution .All Central government funding under the National Mission for Clean Ganga will be conditional on the quantum of ecological flow made available by the state.

❖Mission Clean Ganga (Namami Gangae Project)

GANGA CLEANING DEADLINE: 2018-19

Tasks to be completed by then

- Sewage Infrastructure: Setting up Sewage Treatment Plants (STPs) in all 118 towns
- Projects are ongoing in 50 towns
- Projects will be allotted in remaining 68 towns by June 2016
- Tapping (disallowing untreated water from flowing into river) all 144 drains; 65 have already been tapped
- Setting up Central Effluent Treatment Plants (CETPs) at main industrial clusters and make it sustainable
- Provision of public amenities at Char Dham Yatra and Ganga Sagar

- River front management at 7 identified locations including Kedarnath, Hardwar, Allahabad, Varanasi, Kanpur and Patna
- 100% sanitation coverage for 1,657 Gram Panchayats
- Raising 4 battalions (4,000 personnel) of Ganga Task Force

- – involving ex-servicemen along Ghats
- Setting up a workforce of trash collectors by involving urban local bodies (ULBs)
- Conservation of aquatic life – special attention to dolphin, turtles and ghariyals

2. Accept that urban areas will not catch up with the infrastructure to build conventional sewage networks at the scale and pace needed for pollution control.

➢Therefore, the conveyance of waste must be re-conceptualised and implemented at the time of planning treatment plants. This will then lead to innovative ideas for controlling pollution in drains

in situ treatment of sewage as well as local treatment and reuse. Also, as the plans are premised on the acceptance of non-availability of sewerage networks, the discharge of treated effluent will be carefully reconsidered and designed. The treated effluent will not be 'mixed' with the untreated waste in drains. Instead, all treated effluent will either be designed for reuse or it will be discharged directly into the river.

❖ Action Plan:

➢ 1. Drain-wise plan, which looks to treat waste without and pumping to sewage *levels of* discharge that is not intercepted. Bottom-in treatment plant. Also plan for first building the internal conveyance system. Plan for interception *In-situ drain treatment, as it will bring down pollution* e, use the open drain for treatment of waste. This is the reality that we cannot ignore.

➢ 2 . Ensure that there is a plan for treated effluents do not treat and put back treated wastewater into open drain, where it is again mixed with untreated waste. Instead, plan deliberately for utilisation or disposal of treated effluent.

➢ 3. Plan the reuse and recycling of Treated effluent, either for city water use or agricultural use. Plan deliberately. Implement this objective

➢4 .Plan to treat waste water before it discharges into the river. Either intercept drain before discharge to treatment plant or build treatment plant on the bank of the river or the remaining waste.

➢ **5**. No untreated waste should be disposed into river. The provision for ecological flow for assimilation of waste will be critical of setting standards for discharge. If there is no water in the river, only waste that is discharged, then standards have to be so stringent that they can meet bathing or even drinking water quality. This will be prohibitively expensive and it makes no economic sense (in a poor country) to clean wastewater to drinking water quality and then not use it for this purpose.

➢ **6**. If all this is not acceptable, or does not get operationalised, then the only alternative for river cleaning is to ask cities to get their water supply downstream of their discharge points. In other words, they will have to use their wastewater and then invest to clean it to turn it into drinking water for their citizens.

❖ Otherwise, we must learn that we all live downstream. Today, each city's waste is fast becoming the next city's water supply.

3. Accept that there is a need to publicly fund Ganga cleaning programmes but simultaneously ensure that state and municipal governments have to contribute either through funds or through release of water for ecological flow.

- Even if the current situation requires Central government assistance for capital and operational costs, this is not tenable in the long run or for the scale of pollution control infrastructure that is required to clean the river.

As long as states do not have the responsibility to build sewage treatment systems or to maintain these they have no incentive to plan for affordable solutions or even to implement projects. In the current system the Central government will pay full capital cost for infrastructure and even pay for running the plant. There is absolutely no incentive to plan the water-waste infrastructure for affordability and sustainability.

❖Action Plan:

➢Build clear conditionality in Central government funding, that it will match financial support to the quantum of ecological flow released by the state in the river or payment for capital and operation of infrastructure.

As water utilities do not have infrastructure to charge for operations, build innovative systems for collection of pollution payments at the city/settlement level.

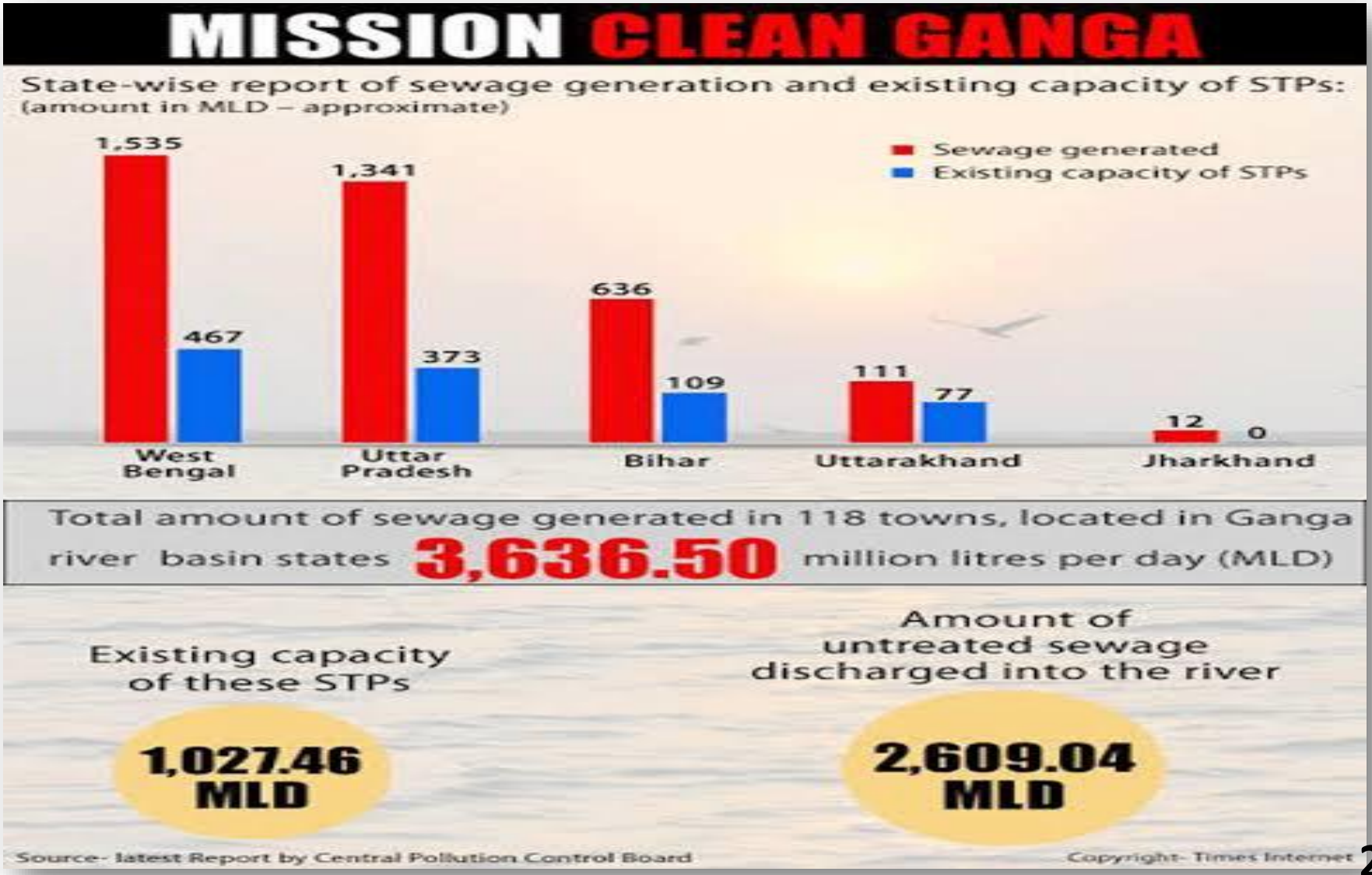
4. Tighten enforcement of industrial pollution norms.

- There are no alternatives for this. It is clear that industries must be able to meet discharge standards that have been legally set in the country. In all the state , the water quality data is recorded and some problem may be faced to state government to inspect the industries's pollution data . But some of cases legal action might be taken.

Almost all industries the Central Pollution Control Board inspected by2013-2017 are in breach of existing standards. It is time for tough action. Nothing less.

❑Graphical presentation :

(Namami Gangae Project)



❑CONCLUSION

➢ Ganga is India's largest river basin: it covers 26 per cent of the country's landmass and supports 43 per cent of its population. In 1986, the government o f India launched the Ganga Action Plan (GAP). In August 2009, GAP was re-launched with a reconstituted National Ganga River Basin Authority. The objectives in the past 30-odd years have remained the same: to improve the water quality of the river to acceptable standards (defined as bathing water quality standards) by preventing pollution from reaching it — in other words, intercepting the sewage and treating it before discharge into the river. But despite programmes, funds and some attention, the Ganga still runs polluted. Worse, recent studies show that pollution is increasing even in the stretches which were earlier considered clean.

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