



EXCRUCIATING PAIN OF RIVER YAMUNA

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ABSTRACT

The River Yamuna originates from the Yamunotri glacier. It passes through the states of Uttarakhand, Uttar Pradesh, Himachal Pradesh, Haryana, Madhya Pradesh and Delhi-NCT. Further dividing the Yamuna into five segments on the basis of hydrological and ecological conditions, only one segment can meet the water quality standards. Also, no other segment meets the demands of surrounding area, especially in summer and winter seasons. The prime reason for this is the augmentation of pollution in river Yamuna from different sources. The polluted water has presence of heavy metals which are harmful and toxic at high concentrations affecting aquatic animals as well as human life. A number of aquatic organisms are reported dead every year and the mortality rate of fishes has increased by 50%. Even the biological parameter of river water, BOD has turned 3 times from 1980 to 2015. The main use of river Yamuna has become only of transportation of industrial wastes, sewage and dirt making it a futile river. It's high time to realize this situation of Yamuna turning into a complete waste drain and take essential measures to reduce these pollution loads and save the ailing river.

Keywords: BOD, Delhi Segment, DO, Pollution, River Water Quality, Sewage waste, Water Quality Parameters, Yamuna River

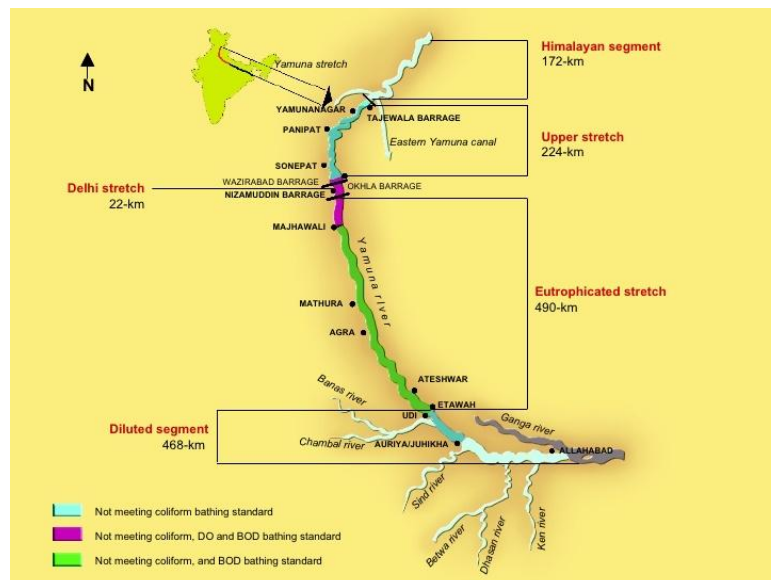
I. INTRODUCTION

River Yamuna is one of the largest tributaries of Ganga. The total length of the River Yamuna is about 1370 KM approximately. The origination of Yamuna is known as 'Yamunotri'. Yamunotri glacier is situated in the Uttarkashi District of Uttarakhand. The classified five segments of Yamuna are namely, Himalayan Segment, Upper Segment, Delhi Segment, Eutrophicated Segment and Diluted Segment. According to the CPCB report (1980-81 and 1982-83), Yamuna river contributes 40.14% of the total Ganga Basin i.e. 345848 KM² of the area. The course of flow of Yamuna river initiates from Yamunotri then passes through the Lower Himalayan Valleys for about 200 KM to Tejawala Barrage. Till here, the water quality of river water meets all the standards. Then it flows through Yamuna Nagar district (Haryana) where the water is divided into Eastern Yamuna Canal (EYC) and Western Yamuna Canal (WYC). Here, to meet the demands of the nearby districts, the water is not allowed to flow further downstream of the Tejawala Barrage in summers that's why the river abides dry in most areas between Tejawala and Delhi. The river enters Delhi near the Palla village. Again the river is confined at Wajirabad Barrage for the fulfillment of the water needs of people of Delhi. In lean seasons, very little water is

allowed to flow further from it. From Wajirabad barrage to Okhla barrage, this segment of Yamuna is known as the Delhi segment. This segment is found to be the dirtiest and most polluted segment of Yamuna. Actually, during the flowage of Yamuna through this segment, the main components of flow are the 17 sewage drains of Delhi out of which Najafgarh drain is the most contaminated one. From there, the Yamuna travels towards Agra Canal where the prime focus of use is for irrigation and finally after collecting water from its various tributaries, it joins the Ganga and Saraswati at Prayag (Allahabad), which is a holy place known as SANGAM.

II. UTILITY OF RIVER YAMUNA

Even today when the technology has changed by leaps and bounds, we still have not been able to find the alternative sources of water other than rivers. Cities like Delhi, Mathura, Agra and Allahabad are wholly and solely dependent on this river for drinking purpose. Four irrigation canals: Western Yamuna canal, Eastern Yamuna canal, Agra canal & Gurgaon canal use almost 93% of Yamuna water. A total of 2234 MW of electricity is being generated by different hydropower projects such as Chibro, Dhakrani, Dhalipur, Khulal, Giri Bata on River Yamuna. There are large scopes of aquatic lives and fisheries on banks of this River. Approximately 70%-80% cattle bath in this river. The river water of Yamuna serves not only for abstractive uses but also for in stream applications viz. irrigation, agriculture, transportation, domestic water supply, industrial wastes disposal etc. With the continuous increase in the population of Delhi, Haryana, UP, MP etc, the volume of disposal wastes has undergone a subsequent growth as a consequence of which the river has turned into a pale and stinking drain. The pollution level has reached to a critical level turning the water quality to class 'E' in Yamuna river. This paper is concerned with the most leading reasons of pollution of Yamuna River and easily feasible measures for control of pollution of Yamuna.



(Diagram showing various segments of Yamuna River)

**Classification of various segments of Yamuna River**

River Segments	Segment Area	Approx. Segment Length
Himalayan Segments	From Origin to Tajewala Barrage	172 km
Upper Segment	Tajewala Barrage to Wazirabad	224 km
Delhi Segment	Wazirabad Barrage to Okhla Barrage	22 km
Eutrophicated Segment	Okhla Barrage to Chambal Confluence	490 km
Diluted Segment	Chambal Confluence to Ganga Confluence	468 km

“How Noble The Indian Rivers Are! How Hard Their Journey Is? But They Don’t Mind It At All”

III. YAMUNA WATER QUALITY STATUS**Water Quality Status at Different Places**

It can be calculated by the study of chemistry, nutrients, and biology. The conditions required for a healthy river are that it should contain at least 4 mg/L of Dissolved Oxygen (essential for the survival of marine life) and about 3 mg/L of Biochemical Oxygen Demand. The Pathogens identified by the Faecal Coliforms should be within 500 per 100 mL of water. Indian River water qualities has been classified into five major classes viz. Class A : Fit for drinking after proper disinfection by the addition of chlorine or bleaching powder. Class B: Fit for bathing.

Class C: Fit for drinking only after filtration and other treatments.

Class D: Fit only for fish and wildlife

Class E: River water is suitable only for irrigation, industrial cooling etc.

As mentioned above , Yamuna River belongs to class E

The water quality of Yamuna at the point of its entry into Delhi fits to water quality standards in terms of Dissolved Oxygen (DO) and Biochemical. However, at the point of its exit from Delhi, the water quality of the river is unfit for any purpose.

**Catchment Area of River Yamuna**

Name of the State	Total Catchment Area in Yamuna (sq.km)
UP (including Uttarakhandl)	74208
Himachal Pradesh	5799
Haryana	21265
Rajasthan	102883
Madhya Pradesh	14028
Delhi	1485
Source- Central Water Commision	

CHEMICAL WASTE WATER QUALITY PARAMETERS● **DISSOLVED OXYGEN-**

Deficiency of D.O. indicates the presence of Organic Matter. More the deficiency of D.O., more will be organic matter in water. It is found out by winkler's method.

● **CHEMICAL OXYGEN DEMAND-**

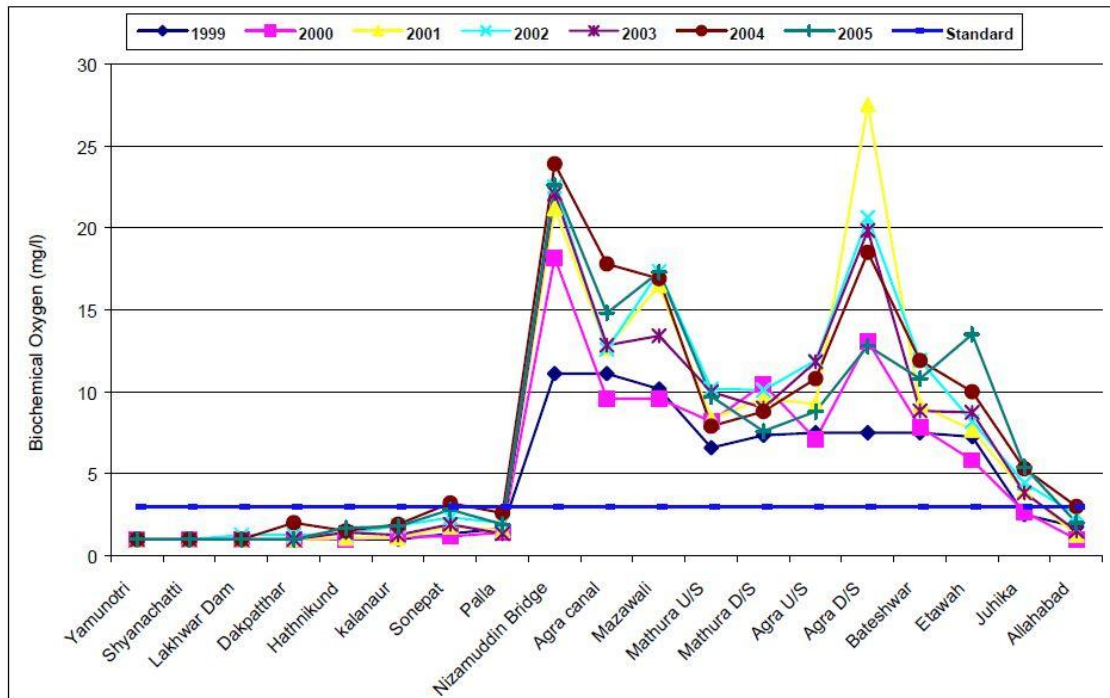
The amount of oxygen required to carry out the decomposition of bio-degradable and non bio-degradable organic matter present in water is called chemical oxygen demand. It can be determined by adding potassium dichromate and sulphuric acid in the water to be tested and noting the amount of oxygen consumed for decomposition of organic matter.

● **BIOCHEMICAL OXYGEN DEMAND-**

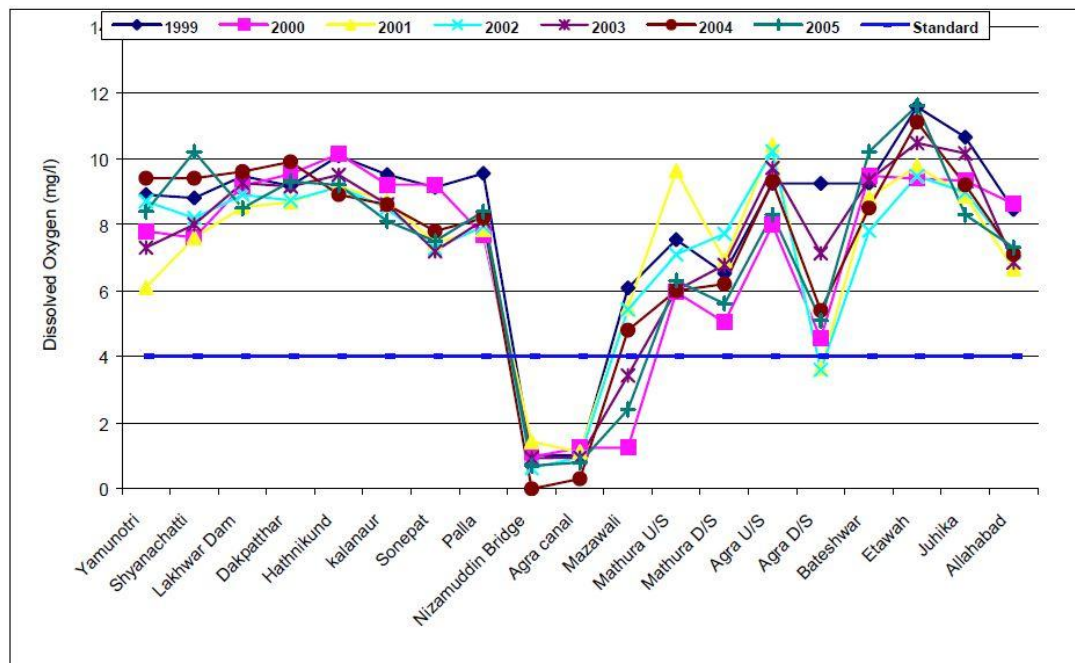
The amount of oxygen required for decomposition of only biodegradable organic matter. BOD₅ at 20°C is taken as standard BOD which is approximately 68% of ultimate BOD. BOD is determined by diluting the known volume of the test sample with known volume of aerated water sample and analyzing the dissolved oxygen present in the diluted sample before and after incubation for 5 days at 20°C.

Parameters of Water Quality for Bathing Standards

Parameter	Prescribed standard
Dissolved Oxygen (DO)	Not less than 5 mg per liter
Bio Chemical Oxygen Demand (BOD)	Not more than 3 mg per liter
Total Coli form (TC)	Not more than 500 per 100 ml
Source: Report on Government of NCT of Delhi of 2005	



(Longitudinal Profile of BOD Source: CPCB)



(Longitudinal Profile of DO Source: CPCB)



Parameter Range Values in River Yamuna

S No.	Parameters	Minimum			Maximum		
		Values (mg/l)	Location	Year	Values (mg/l)	Location	Year
1	TDS	83	Hathnikund	2000	1357	Etawah	2002
2	Chloride	2	Hathnikund Sonepat Kalanaur	2001	424	Agra d/s ($\frac{1}{2}$)	2005
3	Sulphate	7	Etawah	2005	217	Nizamuddin Bridge	1999
4	Sodium	6	Hathnikund Sonepat	2001 2003 2004	406	Agra d/s ($\frac{1}{4}$)	2004
5	Calcium	7	Kalanaur	2001	291	Agra d/s ($\frac{1}{2}$)	2005
6	Magnesium	0.4	Sonepat	2004	77	Agra Canal ($\frac{1}{2}$)	2004
7	Total hardness	46	Hathnikund	2005	792	Agra u/s	2005
8	Alkalinity	40	Hathnikund	2000	425	Mazawali	2004 2005
9	Phosphate	0.02	Palla	2005	2	Mathura u/s	2004
10	Potassium	1	Hathnikund	2000	48	Agra d/s	1999

IV. SOURCES OF POLLUTION IN YAMUNA RIVER

The entire expansion of Yamuna River from origin to confinement with Ganga is used for various human activities and as a result these activities generate lot of wastewater. The various sources of pollution are classified in two groups:

➤ POINT SOURCE OF POLLUTION

When the source of pollution is individual specified and generate considerable amount of pollutants known as point source. Urban centers situated along or near the bank of Yamuna River are the major pollution sources of River Yamuna. The point source of pollution covers two major categories:

(a) Domestic Pollution

The domestic pollution is one of the significant cause of pollution in Yamuna River and it estimates about 85% of pollution in urban centres (Sonepat, Delhi, Ghaziabad, Mathura-Vrindavan, Agra, Etawah and Allahabad). If wastewater retains for longer time within urban regions before reaching to collecting water bodies resulting in less pollution load due to biodegradation and settling. Organic matter, total salts, chlorides, nutrients, detergents, oil & grease etc. are also key compounds generated by the domestic sources. Unauthorized colonies existing in various urban centres have non-availability of sewerage system therefore; the night soil is collected, transported and dumped into tributaries or directly into river without any treatment.

**(b) Industrial Pollution**

Rapid industrialization and large clusters of industries established at Kota, Gwalior, Indore, Nagda, Khetri, Yamuna Nagar, Panipat, Sonapat, Delhi, Baghpat, Ghaziabad, Gautam Budha Nagar, Faridabad, Mathura & other places are playing a major role in polluting Yamuna River. Industries like Pulp & paper, Sugar, Distilleries, Textiles, Leather, Chemical, Pharmaceuticals, Oil Refineries, Thermal Power Plants, food etc discharge wastewater into Yamuna river. It is essential to treat the effluent to achieve prescribed standards before discharging effluent into river for reducing pollution.

➤ DIFFUSED SOURCES OF POLLUTION

In this case, Sources of pollution are unspecific, large in numbers and contribution is of less significance. This pollution is original in the catchment area of the river and transported regularly or occasionally by leaching, drainage and surface water off during monsoon. The pollutants are topsoil, organic matter, plant residues, nutrients, organic chemicals, toxicants, microorganisms etc. The important diffused pollution sources contributing to river Yamuna are:

(a) Agricultural Pollution Sources

There are three major sources that contribute agricultural pollution in the river:

- * Agricultural residues
- * Fertilizer and Pesticides
- * Animal husbandry

(b) Dumping of Garbage and Dead bodies

A large portion of the solid waste generated by the unauthorized inhabitants along the bank of Yamuna River or its tributaries finds its way into the river. The waste includes domestic waste, waste from dairies, unauthorized slaughtering, flowers and other material used during worships of animals idols, etc. The dumping of human and animal dead bodies are also sometimes observed in the Yamuna river. Floating human dead bodies partially eaten by animals and in rotten state are generally observed in the lower part of the river. Such disposal of dead bodies increases the risk of pathogenic contamination besides other negative impact.

(c) Immersion of Idols

Immersion of idols, especially during Durga Puja, Ganesh Puja takes place all along the bank of river. Flowers, Straw, Bamboo, Clay / Plaster of Paris, harmful chemicals used for paints, plasticbags are finds its way into the river. As the Durga Puja festival is also getting popularity in Northern India the rate of idols immersion is also increasing every year.

(d) Pollution Due to In-stream use of Water

- * Bathing and clothes washing
- * Cattle wading
- * Open defecation

Mass bathing, contributes disease causing pathogens in the river water and increase the bacterial load. The religious activities e.g. offering flowers, milk, sweets etc. into the river water further increase organic loading in the river. Excessive presence of detergent caused significant foaming at the site of turbulence. Foaming reduces

the oxygen diffusion rate in the river water, essential for self-purification as well as affects various biological activities.

➤ **POLICIES AND STRATEGIES TO IMPROVE YAMUNA WATER QUALITY AND REDUCE POLLUTION**

Government taken Policies: Various policies and plans have been introduced by the government for the improvisation of water quality of river Yamuna and reduction of Pollution level. These include :

(i) NCR-Regional Plan 2021

In order to improve the overall situation in the National Capital Region for the perspective 2021, for the harmonized and balanced development of the region following strategies and policies are proposed:

- Blueprint for Water Resources in the Region
- Integrated Regional Schemes for Augmentation of Drinking Water Supply (surface and ground) considering NCR as a Single Entity
- Protection of Land for Ground Water Recharging:
- Recharge of Aquifer
- Relocation of Water Consuming Industries
- Recycling of Waste Water for Non-Drinking Use
- Creation of Mass Awareness On Saving Water
- Commercial Approach for Tariff
- Institutional Capacity Building
- Allocation of land for Water Treatment Plants and Water Distribution System
- Funding of Water Supply Schemes through Five-Year Plans

(ii) Yamuna Action Plan

Launched in April 1993, by the union Government to tackle the pollution of Yamuna River. The schemes under this scheme are being implemented by the State Governments through identified nodal agencies with due emphasis on public participation and institutional development. All the works under this are being executed by DJB and MCD for Delhi, UP Jal Nigam for UP and PHED for Haryana. It basically emphasizes on (a) minimization of the cost of conveyance of sewage and the energy needs for pumping through decentralization of sewerage and sewage treatment facilities, and (b) encouraging low cost technology options for sewage treatment through agro-forestry, oxidation ponds etc.

(iii) Inland Waterways Authority of India (IWAI)

The Inland Waterways Authority of India (IWAI) came into existence on 27th October 1986 for development and regulation of inland waterways for shipping and navigation. The Authority primarily undertakes projects for development and maintenance of IWT infrastructure on national waterways through grant received from Ministry of Shipping. The head office of the Authority is at Noida. The Authority also has its regional offices at Patna, Kolkata, Guwahati and Kochi and sub-offices at Allahabad, Varanasi, Bhagalpur, Farakka and Kollam.



(iv) NEERI's EMP for rejuvenation of rivers

The National Environmental Engineering Research Institute has introduced Environment Management Plan for the renovation of Yamuna River. In this project, the mission is to provide innovative and effective solutions for the reduction of pollution along with river restoration. It includes the proposal of constructing earthen dams and waste weirs for water storage and efficient use. Monitoring of pesticides and toxic wastes in rivers are also involved in the EMP.

(v) Yamuna Riverfront Development by Landscape Division of DDA(2010),

Development Project The Structure Plan:

The floodplain has been studied & analysed based on several ecological & physical parameters, such as

- existing natural features like water bodies, vegetation, etc.,
- proximity to habitation & movement corridors,
- intensity & conformity of abating activities
- socio-cultural characteristics

STATUS IN DELHI

There are 30 Sewage Treatment Plants at 17 locations in the NCT of Delhi and 5600 kms long sewerage lines under the jurisdiction of the Delhi Jal Board.

Further, For sewage management, Delhi is divided into five drainage zones:-

- 1) Okhla
- 2) Keshopur
- 3) Rithala-Rohini,
- 4) Coronation
- 5) Shahdara

In 2005, for Controlling Water Pollution in River Yamuna in Delhi further new areas were setup that are Pappan Kalan (Dwarka), Vasant Kunj, Sarita Vihar and Narela.

CPCB SUGGESTIONS:

There must be introduction of water harvesting system so that the exploitation of river can be compensated up to certain level.

- Disposal of solid waste and semi solid wastes in river must be restricted.
- There must be community participation for Awareness campaign.
- In every small small stretches, construction of barrages should be done in order to solve water scarcity problem.

➤ INNOVATIVE SUGGESTIONS FOR POLLUTION CONTROL

- **Drainage Water Management by use of dams:** It depends on natural rainfall. This activity can be done by water control structures such as dams. These structures manage the surface runoff and also recharges ground water table. These also provide water for irrigation power generations as well.
- **Establishment of Water Closets (WC):** In every inhabited area nearby the banks of Yamuna river, whether a village or township, there must be a provision of establishing a Water Closets at an interval of 300 meters for avoiding the open defecation which indirectly enhances water pollution.



- **Natural Channel Design:** This method is used for bringing river into its natural and original form. For stabilization of banks, bio-engineering design can be implemented in Yamuna River. This restricts the passage of undesired pollutants into the river.
Also, by utilizing these chemical compounds in Yamuna River, the pollution can be controlled upto a certain extent :
- **Chlorine Cuisine**
If they make their way into the groundwater, chlorinated wastes, like those found in dry-cleaning fluids and paint thinner, can cause liver problems and cancer in people. But some bacteria find these chemicals quite palatable: When *Dehalococcoides ethenogenes* comes in contact with the chemicals; it feasts on chlorinated compounds, converting them into harmless gases.
- **Fly Ash Bricks**
In the process of generating electricity, U.S. coal plants spew more than 70 million tons a year of a radioactive waste called fly ash. Now a Missouri company has found a way to turn the ash into bricks, an innovation that reduces fly ash while providing an extra benefit: The bricks soak up toxic mercury from the air.
- **Purging Pesticides**
White rot fungi, common in the forests of North America, use special enzymes to convert the carbon in trees to energy. These same enzymes can oxidize environmental pollutants such as pesticides and PCBs, rendering them benign.
- **Flushing Iron**
Metal toxins commonly found at mining sites could be treated with the stinky remains of human wastewater. The human waste, rife with iron, would be especially useful if dumped at sites loaded with cadmium, lead, and arsenic. The iron would readily react with the other metals and keep them from dissolving into nearby groundwater.
- **Plutonium Pyramids**
Hematite, a shiny black mineral sometimes used to make jewelry, can soak up plutonium and uranium waste from nuclear plants. Scientists recently found that hematite crystals placed in acid grow pyramid-like structures on their surface. As the structures form, contaminants can settle into tiny pockets in the hematite crystal, where they could remain stable for hundreds of years.

V. CONCLUSION

Thus we find from all the statistical facts and information that the degree of pollution of Yamuna has reached to a considerably larger extent. The agricultural fields of UP, MP, Haryana as well as Uttarakhand has added significantly to the river pollution. For the protection of pollution related with irrigation, the river catchment area is to be safeguarded from the chemical contamination of water. Therefore, the use of organic farming methods and biological farming methods should be encouraged across the common mass especially the rural people and farmers. Awareness should be spread for curtailing the use of chemical fertilizers and pesticides. The



river water can be treated not only by using the prevalent water treatment methods which are based on filtration, chemical coagulation and biological slow sand filtration but also by emphasizing easily accessible and economically feasible approaches that are capable of deprecating the pesticide content. The restoration process of Yamuna at diverse points is a very complicated and interdisciplinary venture. The mere diversion of different drains carrying wastewater across the course of Yamuna and installation of numerous sewage treatment plants won't help substantially in abatement of pollution. The required ground plan or road map for control of pollution should be a multi-dimensional and infallible perspective. The ground level implementation of the effectual and perpetual solutions without putrefaction with fixed time duration schemes can only bring back the mint and esteemed status of River Yamuna.

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