

# Judicial Directives vs Ground Realities: Water Pollution Trends in Najafgarh Drain and Yamuna River(August 2019– August 2023)

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## ABSTRACT

Background: The Yamuna River is a very important resource of water for the people of Delhi is still one of the most polluted rivers in India. Najafgarh Drain (Sahibi River), which is its tributary, carries almost 60% of the pollution load in March- 2020. The National Green Tribunal gave strict order to stop illegal water polluting industries and made sure that effective treatment systems to work properly. Then came the COVID-19 lockdown which gave us a rare chance to study the effect of reduced human activity on water quality of the Yamuna River.

Aim: This study looks at how well judicial orders worked to improve the water quality by comparing pollution trends in Najafgarh Drain and the Yamuna River during the pre-COVID lockdown and post-lockdown periods.

Methods: Monthly water quality data (COD, BOD, TSS for Najafgarh Drain and COD, BOD and DO for Yamuna) from August 2019 to August 2023 were studied. We used basic statistics, time series, trends and interrupted time series approach with March 2020 as the point when the judicial orders started. We compared the pollution trends with judicial orders to see the impact of enforcement.

Results: There were some temporary improvement during April to July 2020 with COD and BOD showing a significant drop and DO in the Yamuna River going up to 4.2 mg/L for a brief period. However, these improvements did not last long. By 2021–2023, COD in the Yamuna River went over 270 mg/L and BOD exceeded 70 mg/L. Najafgarh drain showed COD over 350 mg/L and BOD above 80 mg/L. DO in the Yamuna dropped back to zero, showing the river was still in bad condition and required more improvements. Trends clearly showed that pollution of Najafgarh drain directly impacted water quality of the river Yamuna and responsible for its bad condition.

Conclusion: This study shows that there is still a big gap between judicial orders and real world results. Even though there were strong court orders, pollution worsened after 2021. This shows that legal orders alone can't fix the problem. To improve things in the long run, we need better enforcement, monitoring and investment in working sewage treatment systems. Without these, the River Yamuna will continue to get worse, even with judicial action.

**Keywords:** Yamuna River, Najafgarh Drain, COD, BOD, DO, TSS.

## INTRODUCTION

The Yamuna River is very important for Delhi for its water needs but it is the most polluted rivers in India. The river has been turned into a place in Delhi where untreated sewage, industrial waste and garbage, all mix, leading to the death of aquatic life. The O<sub>2</sub> level in the river is very low that is

why no fish or even the toughest water animals can survive. The Najafgarh drain is the main source for its pollution, making up almost 60% of the total pollution. It brings the maximum organic waste, solids and untreated sewage and industrial waste which makes it a big problem for the River Yamuna. From the last 20 years, there have been many attempts to resolve this issue. A major change was seen on 20th March, 2020, when the National Green Tribunal (NGT) told the Delhi Pollution Control Committee (DPCC) to act strictly against the illegal industries and not to allow new water polluting industries in approved industrial areas. At the same time, the COVID-19 pandemic and the lockdown caused by it reduced industrial activity. Reports showed some increments in water quality including in the River Yamuna, which gave hope that it could get better. But the real question is whether these improvements were permanent and whether the judicial orders really helped improve the Yamuna's condition. Many studies have shown that the Yamuna's condition is getting bad to worse but the judicial actions have had limited impact. Some of the relevant studies show temporary improvements in water quality during the COVID-19 but they didn't look at long-term data and judicial interventions together. This difference makes it hard to understand if judicial actions, like the NGT's 2020 order, can really help River Yamuna or if other issues prevent them from working well. This study looks at long-term water quality data and compares it with judicial actions to understand the real impact of legal orders on the river.

## **MATERIALS AND METHODS**

**Study Area:** This study was done on two important places in Delhi's water system.

**Najafgarh Drain:** The largest drain that flows into the River Yamuna, bringing untreated sewage, industrial waste and solid waste.

**Yamuna River (Agra Canal, Jaitpur):** The river downstream of Delhi where the water quality is affected after various drains including Najafgarh Drain releases its pollution.

### **Data Sources**

Monthly water quality data from August 2019 to August 2023 was used. The data came from the Delhi Pollution Control Committee (DPCC) and the Central Pollution Control Board (CPCB).

### **Parameters Analyzed:**

For Najafgarh Drain: COD, BOD and TSS

For Yamuna River: COD, BOD and DO

### **Study Period:**

The study was split into three phases:

1. Pre-COVID: August 2019 to February 2020
2. COVID (Lockdown period): March 2020 to December 2020
3. Post-COVID & Judicial Oversight: January 2021 to August 2023

### **Statistical Tests:**

We used statistical tests like Analysis of Variance (ANOVA) and Pearson correlation to study the differences in pollution levels and their relationships.

1. Analysis of Variance (ANOVA) was used to test significant differences in pollutant levels across the three phases.
2. Pearson correlation was applied to examine the relationship between Najafgarh Drain and Yamuna River pollutant concentrations.
3. The tests were performed to compare pre-COVID vs lockdown and lockdown vs post-COVID phases.

### Ethical Considerations:

This study used publicly available government datasets CPCB and DPCC hence, no ethical approval was required. However, due acknowledgment of data sources has been ensured.

### RESULTS

Table 1 presents monthly variations in COD, BOD and DO for the Yamuna River at Agra Canal Jaitpur. During the pre-COVID phase, (Aug 2019–Feb 2020), COD values averaged  $86.4 \pm 25.2$  mg/L while BOD averaged  $28.1 \pm 8.3$  mg/L and Dissolved oxygen (DO) remained critically low, often recorded as Nil. A temporary improvement was observed during the lockdown phase (Apr–Jul 2020), where COD declined to 48–58 mg/L and BOD to 17–18 mg/L while DO briefly recovered to 4.2 mg/L in April 2020. However, this improvement was unsustainable by 2021–2023. COD values peaked at 272 mg/L (Aug 2022) and BOD rose to 75 mg/L (Aug 2022) significantly exceeding pre-COVID levels ( $p < 0.01$ , one-way ANOVA). DO again returned to “Nil” throughout most months, reaffirming the septic condition of the river.

**Table 1. Yamuna River (Agra Canal, Jaitpur) Monthly Water Quality (Aug 2019–Aug 2023)**

| Period   | COD (mg/L) | BOD (mg/L) | DO (mg/L) |
|----------|------------|------------|-----------|
| Aug 2019 | 32         | 8          | 2.8       |
| Mar 2020 | 92         | 32         | Nil       |
| Apr 2020 | 48         | 17         | 4.2       |
| Jul 2020 | 58         | 18         | Nil       |
| Dec 2020 | 112        | 36         | Nil       |
| Jul 2021 | 160        | 31         | Nil       |
| Dec 2021 | 192        | 60         | Nil       |
| Aug 2022 | 272        | 75         | Nil       |
| Mar 2023 | 191        | 54         | Nil       |
| Jul 2023 | 182        | 40         | Nil       |

Trend: Temporary COD/BOD dip during Apr–Jun 2020; DO briefly detected (4.2 mg/L). By 2021–23, COD and BOD rose above pre-COVID values, DO again Nil.

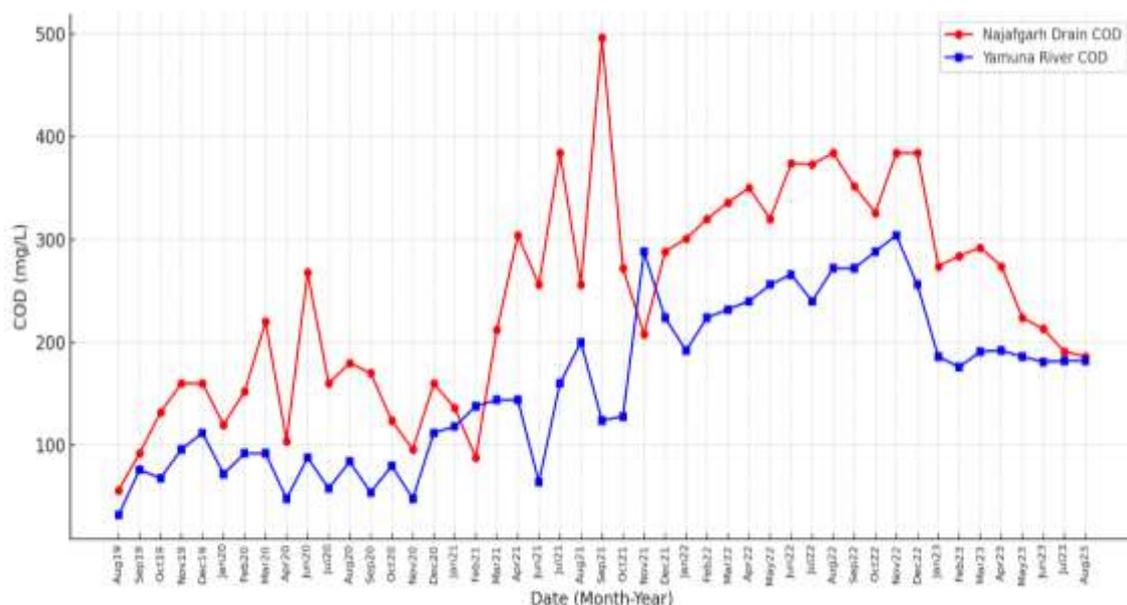
Table 2 shows monthly variations in COD, BOD, and TSS for the Najafgarh Drain. Pre-COVID averages stood at COD  $148.2 \pm 45.6$  mg/L, BOD  $54.2 \pm 16.8$  mg/L and TSS  $102.3 \pm 28.7$  mg/L. During the lockdown (Apr–Jul 2020), values temporarily decreased (COD 104–160 mg/L; BOD 35–39 mg/L; TSS 89–150 mg/L). However, post-2021 values surged dramatically with COD exceeding 380 mg/L, BOD crossing 80–90 mg/L and TSS frequently above 150 mg/L. Statistical comparison confirmed a significant increase in COD and BOD post-lockdown compared to pre-COVID ( $p < 0.05$ , paired t-test).

**Table 2. Najafgarh Drain Monthly Water Quality (Aug 2019–Aug 2023)**

| Period   | COD (mg/L) | BOD (mg/L) | TSS (mg/L) |
|----------|------------|------------|------------|
| Aug 2019 | 56         | 20         | 22         |
| Mar 2020 | 220        | 84         | 156        |
| Apr 2020 | 104        | 35         | 89         |
| Jul 2020 | 160        | 39         | 150        |
| Dec 2020 | 160        | 50         | 84         |
| Jul 2021 | 384        | 70         | 196        |
| Dec 2021 | 288        | 82         | 132        |
| Aug 2022 | 384        | 75         | 172        |
| Mar 2023 | 292        | 58         | 108        |
| Aug 2023 | 186        | 42         | 100        |

Trend: April 2020 saw reduced COD, BOD and TSS. However, pollution levels rebounded sharply in 2021–22, peaking at COD > 380 mg/L and BOD > 80 mg/L. Trend analysis from Figures 1 to 4 showed a strong correlation between Najafgarh Drain pollution and Yamuna water quality. COD values of Najafgarh drain were positively correlated with River Yamuna COD ( $r = 0.78, p < 0.01$ ) while BOD trends also showed significant correlations ( $r = 0.72, p < 0.05$ ). Peak in Najafgarh drain pollutant load consistently preceded similar peaks in River Yamuna by one monitoring cycle, confirming Najafgarh drain as the dominant contributor.

The role of Total Suspended Solids (TSS) was also decisive. TSS levels above 150 mg/L in Najafgarh Drain coincided with higher COD and BOD in the Yamuna, indicating the combined effect of sediment load and organic matter discharge.



**Figure 1. COD trends (Najafgarh drains vs Yamuna, 2019–2023)**

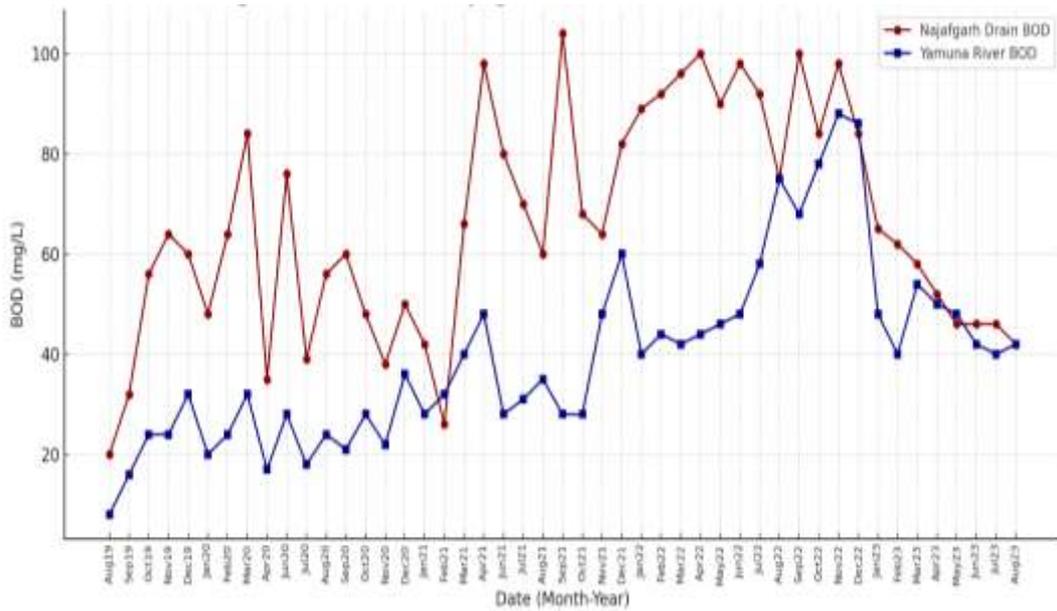


Figure 2. BOD trends (Najafgarh drain vs Yamuna)

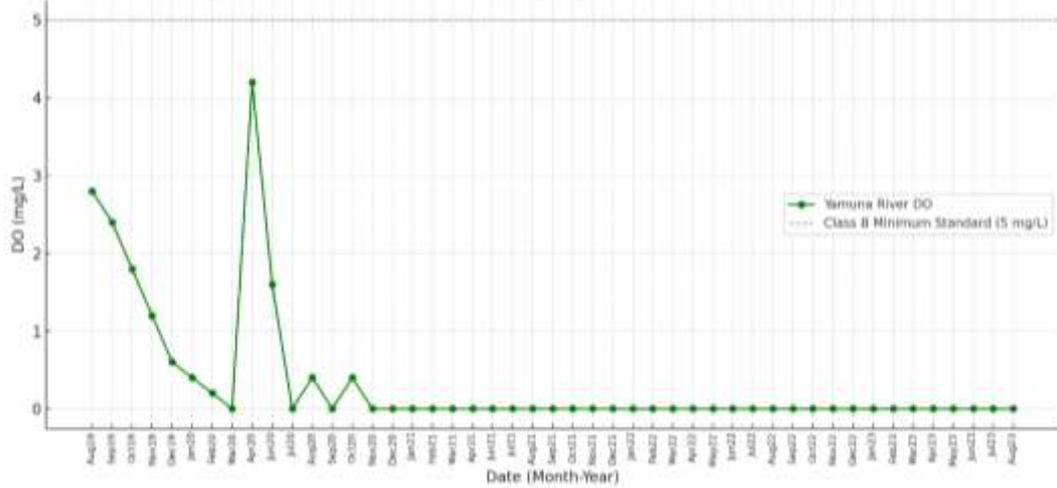


Figure 3. DO trends (Yamuna River)

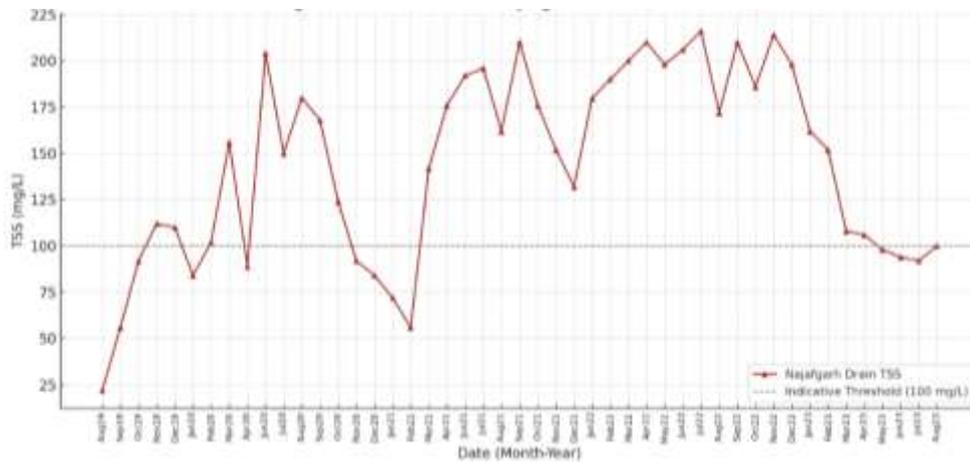


Figure 4. TSS trends (Najafgarh Drain)

## **DISCUSSION**

The findings of study reveal a paradox in the management of river pollution in Delhi while the COVID-19 lockdown in 2020 shows the capacity of river for shorter term recovery, the subsequent rebound of pollution levels highlighted the inability of judicial directives alone to bring about long-term ecological improvement. COD and BOD values in both Najafgarh Drain and the River Yamuna fell significantly during April–July 2020 with the Yamuna briefly registering a DO of 4.2 mg/l. However, these improvements were transient. By 2021–2023, COD and BOD levels not only returned to pre-COVID levels but far exceeded them; while DO collapse back to nil. This pattern underscores the resilience of pollution drivers such as untreated sewage inflows, dysfunctional treatment infrastructure and unchecked industrial discharges which overwhelmed temporary gains from reduced anthropogenic activity. The role of the Najafgarh Drain emerged as particularly decisive. Strong correlations between Najafgarh drain pollutant loads and River Yamuna water quality confirmed that the drain remains the single largest contributor to ecological decline in Delhi river stretch. Earlier estimate by DPCC suggesting that Najafgarh drain contributes 60–65% of the pollution load were validated by this long-term dataset. The persistently high COD  $\geq 300$  mg/L and BOD  $> 80$  mg/l values in Najafgarh drain highlights chronic failures in wastewater interception and treatment. The frequent exceedance of 150–200 mg/L TSS further suggests that sediment-bound pollutants also aggravate downstream deterioration. These results reaffirm that without targeted action on Najafgarh drain efforts to rejuvenate the Yamuna will remain symbolic.

The temporary improvements during lockdown period align with observation from other Indian rivers. The assessment by the CPCB (2020) noted temporary gains in the water quality of River Yamuna at Nizamuddin and Okhla. Where BOD declined by ~50% and COD by over 40% similar result reported by Mishra 2021 and et. al., in the Ganga with Dissolved Oxygen levels rising above 6 mg/l during the lockdown. Studies on the Cauvery and Godavari also documented temporary decline in pollution during reduced industrial activity by Lokhandwala & Gautam, 2020. Navarrete 2021 observed significant water quality improvements in Europe based river such as the Guadalquivir during lockdown while Wang 2021, examined comparable results from Yangtze of China. These parallel confirm that anthropogenic pressure remains the dominant determinant of river health and that ecological recovery is possible if pollutant loads are systematically controlled. However, consistent with Singh 2022, the study presented such improvements were not sustained once restrictions were lifted. The post-2021 rebounds in the River Yamuna pollution mirrors trends in the Tietê River in Brazil and in China rivers post-COVID. Wang-2021, suggesting that temporary suspensions of human activity cannot substitute for structural reform in wastewater management. The enforcement gap is particularly evident in Delhi where despite the NGT's 2020 order mandating closures of polluting units and stricter CETP compliance, pollution levels worsened. The Weak inter-agency coordination, bureaucratic inertia and political resistance undermine judicial activism. Beyond ecological implications, the findings also have public health significance. Persistently high BOD and nil DO indicates septic conditions that facilitate the growth of pathogens and compromise water safety for domestic and agricultural use. Communities dependent on river water for irrigation face risks of crop contamination and food-chain exposure. Elevated TSS levels also increased treatment costs for potable water supply placing further strain on urban utilities. Thus, failure to implement effective pollution control has direct socio-economic and health consequences for millions of people in Delhi and downstream states. Taken together, these results demonstrate that while judicial directives are important catalysts for policy action, they could not achieve environmental restoration without systemic infrastructural upgrades and institutional accountability. This study reinforces the argument of Chaturvedi 2019 and Krishnan 2020 that judicial activism must be supported by adequate technical, financial and governance mechanisms. Future strategies for Yamuna rejuvenation must prioritize

- (i) upgrading and ensuring functional sewage treatment plants (STPs) and CETPs
- (ii) realtime pollution monitoring
- (iii) stricter enforcement of effluent standards and
- (iv) interagency coordination backed by political will.

Unless such structural reforms are implemented, the Yamuna will continue to function as a sewage canal despite repeated judicial interventions.

## **CONCLUSION**

This 4 year comparative study highlight the persistent disconnect between judicial intents and ground realities in the management of Yamuna River pollution. The temporary improvements observed during the COVID-19 lockdown demonstrate the rivers in the capacity for self recovery when anthropogenic pressure is curtailed. However, the sharp rebounds of pollution levels in the post lockdown periods with COD and BOD values surpassing pre-COVID levels and DO returning to Nil, underscores the fragility of such short term gains. The Najafgarh Drain, emerged as the dominants determinant of River Yamunas' downstream water quality with strong statistical correlations confirming its role as the single largest contributor to the river's ecological declines. Despite progressive judicial directives including Hon'ble NGT's 2020 order mandating stricter enforcement and control measures the absence of systemic infrastructural upgrade and institutional accountability resulted in negligible long-term improvements. The findings reaffirm that judicial pronouncements alone are insufficient to reverse ecological declines without complementary investments in wastewater management, real-time monitoring and effective inter-agency coordination. Functional and upgraded sewage treatments plants (STPs) and common effluent treatment plants (CETPs) must form the backbone of any meaningful rejuvenation effort. Strengthening regulatory enforcements, ensuring transparency in compliance reporting and integrating advanced monitoring technologies are equally critical. So the failure to act decisively not only perpetuate ecological degradation but also carries significant public health and socio-economic risks, given the widespread dependence on River Yamuna water for irrigations, domestic use and downstream supply. In essence the study emphases that river restoration in Delhi requires a paradigm shift from judicial symbolism to systemic reforms. Only through strict enforcement, infrastructural modernization and sustained political commitments can revive Yamuna's ecological and cultural significance.

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