



High Investment, Low Impact: Assessing the Cost-Effectiveness of Delhi's CETP Network in Yamuna Rejuvenation (2015–2025)

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Issue Brief

High Investment, Low Impact: **Assessing the Cost-Effectiveness of Delhi's CETP Network in Yamuna Rejuvenation (2015–2025)**

II ABSTRACT

The Yamuna River, spanning 1,376 kilometres from its source at Yamunotri to its confluence with the Ganga, faces a severe pollution crisis, particularly in its 22-kilometre Delhi stretch, which accounts for 79% of the river's total pollution despite representing only 2% of its catchment area. Despite substantial budgetary allocations totalling ₹9,178 crores under the Yamuna Action Plan phases (2015–2025), water quality improvements remain marginal, with average BOD levels persisting at 23 mg/L and numerous sewage treatment plants (STPs) and Common Effluent Treatment Plants (CEPTs) operating below design capacity. This study employs a Delhi-specific mixed-methods approach, analysing secondary data from Central Pollution Control Board (CPCB) reports, CETP performance data for 13 facilities (2020–2024), STP utilisation records, and parliamentary questions to establish a cost-effectiveness framework linking budgetary expenditure to pollution reduction outcomes. Key findings reveal that only 49.5% of allocated funds have been utilised, YAP-II achieved zero STP capacity creation despite ₹387 crores allocation, and 39% of treatment plants nationwide fail to meet discharge standards due to operational failures rather than infrastructure deficits. Drawing on the Singapore River cleanup success (1977–1987), which achieved complete rejuvenation through multi-ministerial coordination, political accountability, and integrated relocation-compensation strategies, this research argues that Delhi's Yamuna pollution crisis stems from governance failures and institutional fragmentation rather than budgetary constraints. Policy recommendations emphasise operational audits over capital expansion, performance-linked funding mechanisms, and cross-ministerial coordination to maximise return on environmental investment.

II BACKGROUND

I THE YAMUNA CRISIS: DELHI'S 22-KILOMETRE POLLUTION EPICENTRE

The Yamuna River, originating at Yamunotri and flowing through the states of Himachal Pradesh, Haryana, Delhi, Uttar Pradesh, and Madhya Pradesh, presents a stark environmental paradox. While Delhi's National Capital Territory (NCT) represents merely 2% of the Yamuna's entire catchment area, this 22-kilometre stretch collects a staggering 79% of the river's total pollution load, making it the most polluted section of the Yamuna River (Arora et al., 2023). The primary cause of pollution, accounting for approximately 85%, originates from domestic sources, including industrial effluents, raw sewage discharge, waste disposal, dead body disposal, idol immersion, and contaminated water from urban drains.

In 1977–78, the Central Pollution Control Board (CPCB) initiated a comprehensive study to assess the pollution status of the Yamuna River across its 1,200-kilometre course. This foundational study examined the topography of the drainage basin, base flow patterns, population density, land use characteristics, industrial activities, and agricultural practices, estimating pollution loads from various activities in the basin. The CPCB study conclusively identified domestic wastewater discharge as the predominant pollutant, contributing approximately two-thirds of the total pollution load, with the remainder attributed to industrial effluents and agricultural runoff.

I THREE DECADES OF YAMUNA ACTION PLANS: A TIMELINE OF INVESTMENT AND UNDERUTILISATION

The Yamuna River, originating at Yamunotri and flowing through the states of Himachal Pradesh, Recognising the escalating crisis, the Government of India launched successive phases of the Yamuna Action Plan (YAP), modelled after the Ganga Action Plan framework. However, these multi-decadal interventions have yielded limited improvements in water quality despite substantial financial commitments.

YAP-I (1993–2003): The inaugural phase allocated ₹346 crore to Delhi, of which ₹177 crore was released (51.2% utilisation). The phase was marked as 'Partially Utilised' with infrastructure development proceeding at a sluggish pace (PRS Legislative Research, 2023).

YAP-II (2004–2011): This phase, focused on sewerage infrastructure and capacity building, allocated ₹387 crores to Delhi. However, fund utilisation plummeted to just 31.3% (₹121 crore released), and, critically, no STP capacity was created against a sanctioned target of 135 MLD. This represented a complete failure of capital deployment, with the phase categorised as 'Under-utilised.'

YAP-III (2012–present): The current phase, with a total allocation of ₹1,656 crores, represents the most ambitious intervention to date. When combined with Delhi government budgets and National Mission for Clean Ganga (NMCG) contributions, total allocations for Yamuna rejuvenation during 2015–2025 reached ₹9,178 crores (Business Standard, 2023). However, actual expenditure stood at only ₹4,548 crores, representing an overall utilisation rate of 49.5%, leaving nearly half of the sanctioned funds unspent whilst pollution persists unabated. Between 2015 and 2023, Delhi Jal Board received ₹1,071 crores from NMCG under YAP-III and spent ₹1,012 crores, with the most expensive project being the 564 MLD Okhla STP costing ₹431 crores.

THE PARADOX: HIGH ALLOCATION, LOW IMPACT

The persistence of severe pollution despite decades of investment raises a fundamental question: Is Delhi's Yamuna crisis a problem of insufficient funding, or a failure of governance, institutional coordination, and operational discipline?

This research posits that the latter is true. Evidence from CPCB performance assessments, CETP operational data, and comparative case studies suggests that throwing more money at the problem will not yield improvements without addressing systemic operational and governance deficiencies. As Delhi prepares future phases of Yamuna rejuvenation with increased budgetary allocations, understanding why past investments have failed is critical.

II LITERATURE REVIEW

I CETP PERFORMANCE: NATIONAL PATTERNS OF FAILURE

The CPCB's Performance Status of Common Effluent Treatment Plants in India reveals systemic failures across the country's CETP network. Despite receiving substantial capital subsidies (50% public funding: 25% Central, 25% State), only 6.4% of CETPs nationwide achieve full compliance with all discharge standards for BOD, COD, TSS, and TDS. Critically, 88.5% fail to meet TDS standards even after public investment. Many facilities operate at 25–60% of design capacity due to incomplete sewer networks, industrial bypassing, power shortages, and non-functional pumping stations.

The CPCB explicitly states that 'performance of CETPs is very unsatisfactory, largely because of poor operation and maintenance.' Common operational failures include unskilled operators, irregular sludge removal, non-functioning settling tanks, overloaded filters, and absent laboratory monitoring systems. In Delhi, specifically, several CETPs (Okhla, Nangloi, SMA, Jhilmil) receive less than 20% of design inflow despite adequate installed capacity, directly paralleling the 25–45% underutilisation observed in Delhi's STPs.

I BUDGET ALLOCATION WITHOUT ACCOUNTABILITY: A SYSTEMIC FAILURE

The CPCB explicitly states that financing wastewater management solely through government budgets is 'neither adequate nor effective,' citing high capital costs and long-term O&M burdens. The absence of performance-linked financing mechanisms allows substantial allocations to remain unspent or inefficiently deployed. Where the budget was spent reveals a troubling pattern of infrastructure creation without corresponding pollution reduction. Other major capital expenditures include the 318 MLD Coronation Pillar STP completed in March 2022, and the interceptor sewer project along three major drains (Najafgarh, Supplementary, Shahdara) designed to trap 242 MGD of sewage. Additionally, 167 km of peripheral sewer rehabilitation and 21 km of trunk sewer rehabilitation works were undertaken under YAP-III.

Despite these substantial infrastructure additions, increasing treatment capacity from 373 MGD in 2015 to nearly 890 MGD, actual capacity utilisation of STPs across India remains only 72.2%, meaning only 13.5% of sewage is actually treated (CPCB, 2023). The disconnect is stark: Delhi now possesses 667 MGD total STP capacity but utilises only 84.9%, whilst dissolved oxygen levels at Shahdara drain remain zero and faecal coliform counts reach 500 times the desirable levels. Heavy capital investment without operational discipline is a recurring theme. The CPCB notes that CETPs were

often designed using incorrect influent assumptions, with actual pollution loads 2–3 times higher than design values. Moreover, nearly 39% of plants do not conform to general discharge standards, and are typically run by personnel without adequate knowledge, operators who know only pump and motor operation but lack understanding of critical parameters like Solids Retention Time (SRT). In essence, ‘advanced technology without operational discipline increases costs without improving outcomes.’

I THE SINGAPORE RIVER SUCCESS STORY: DEMONSTRATING GOVERNANCE EXCELLENCE

Singapore’s pollution profile mirrored Delhi’s urban wastewater crisis: unsewered premises, pig and duck farms, street hawker waste, industrial effluents, and oil discharge from riverine transport, problems nearly identical to Yamuna’s sewage-industrial mix. Yet Singapore achieved complete rejuvenation within a decade (1977–1987).

Prime Minister Lee Kuan Yew set a 10-year deadline in February 1977, declaring, ‘In 10 years, let us have fishing in the Singapore River’ (National Library Board Singapore). The cleanup involved eleven agencies across five ministries, coordinated by the Ministry of Environment’s Permanent Secretary, preventing bureaucratic fragmentation. Upon completion, Lee awarded gold medals to ten key officials at the Clean Rivers Commemoration.

Three operational lessons stand out. First, political accountability: quarterly reviews by the Prime Minister ensured urgency. Second, sewerage first: 21,002 unsewered premises were connected before industrial controls, establishing baseline infrastructure. Third, socially inclusive relocation: 26,000 families received better public housing and 4,926 hawkers got purpose-built centres, not mere monetary compensation (Lee Kuan Yew School of Public Policy, 2012). The S\$200 million investment (₹1,250 crores, 1970s values) achieved 100% utilisation with measurable outcomes: complete sewage elimination, enabling swimming within seven years. Singapore demonstrates that governance discipline, not financial outlay alone, determines success.

II METHODOLOGY

This study employs a Delhi-specific mixed-methods approach combining quantitative analysis of water quality and budgetary data with qualitative policy assessment. The research is structured as a case study examining the relationship between financial investments in pollution control infrastructure and actual environmental outcomes during 2015–2025.

Data Source	Details
CETP Performance Data	Half-yearly data for 13 Delhi CEPTs (2020–2024): BOD, COD, TSS, pH. Source: OpenCity Urban Data Portal, CPCB reports.
Budget Data	Year-wise allocations and expenditures (2015–2025). Source: Delhi Jal Board RTI, Delhi Budget documents, NMCG reports.
Regulatory Standards	CPCB discharge norms: BOD ≤30 mg/L, COD ≤250 mg/L, TSS ≤100 mg/L, pH 6.5–8.5.

The analysis proceeds in three stages: (1) Calculate compliance rates for each CETP against CPCB standards; (2) Cross-reference temporal trends in water quality with YAP phase timelines and budgetary allocations; (3) Qualitatively compare Delhi's fragmented governance (DJB, DPCC, NMCG, municipal corporations) with Singapore's integrated multi-agency model.

Limitations: Per-CETP expenditure breakdowns are not publicly accessible. Some CETP monthly reports show missing data due to operational shutdowns. Whilst correlations between spending and outcomes can be established, definitively attributing pollution persistence to specific governance failures requires further qualitative investigation.

II RESULTS AND DISCUSSION

I CETP PERFORMANCE ASSESSMENT (2020–2024)

Water quality data from Delhi's 13 CETPs over five years (130 half-yearly observations) reveal mixed compliance patterns. Average BOD stood at 22.92 mg/L (within CPCB standard of ≤ 30 mg/L, but with high variability), COD at 93.58 mg/L (within ≤ 250 mg/L), TSS at 50.88 mg/L (within ≤ 100 mg/L), and pH at 7.39 (within 6.5–8.5 range). Whilst aggregate averages suggest compliance, individual facility analysis reveals concerning patterns. Several CETPs demonstrate chronic exceedances, particularly for BOD, where maximum recorded values reached 93 mg/L, more than triple the permissible limit. This variation indicates that some facilities consistently fail whilst others perform adequately, suggesting operational rather than design issues.

The data further shows no clear temporal improvement trend from 2020 to 2024, despite substantial YAP-III expenditures during this period. Pollution levels have remained relatively stable, indicating that increased spending has not yielded measurable environmental gains. CPCB findings establish that many Delhi CETPs operate at 25–60% of design capacity, mirroring the 25–45% STP underutilisation documented in parliamentary reviews. This systemic underperformance stems from incomplete sewer/conveyance networks, industrial bypassing, power shortages, and non-functional pumping stations.

I OPERATIONAL FAILURES: THE ROOT CAUSE OF POOR PERFORMANCE

CPCB assessments identify operation and maintenance (O&M) as the primary failure point across India's wastewater treatment infrastructure. Key deficiencies include unskilled operators (staff trained only in mechanical operation rather than treatment processes), irregular sludge removal, non-functioning settling tanks and overloaded filters, and absent laboratory monitoring. Advanced treatment units installed at considerable expense frequently remain overloaded, poorly maintained, and economically unsustainable.

The implications are stark: Delhi possesses installed treatment capacity that, if fully utilised, could significantly reduce pollution. However, operational failures, not infrastructure deficits, prevent this capacity from being realised. Adding more treatment plants without addressing conveyance, enforcement, and maintenance issues will simply result in additional underutilised assets. The pattern is clear: capital investment without corresponding operational discipline results in expensive infrastructure that fails to deliver environmental benefits. This validates the central thesis that more money is not the solution; better governance and operational rigour are.

Dimension	CPCB Findings	Implication for Yamuna
Capital funding model	50% public subsidy for CETPs	Heavy reliance on government budgets
Utilisation of capacity	Many CETPs operate at 25–60% capacity	Mirrors 25–45% STP underutilisation in Delhi
Compliance outcomes	Only 6.4% fully compliant	Spending is not translating into water quality gains
O&M expenditure	Underfunded and irregular	Explains persistent pollution despite assets

I THE PARADOX OF UNUTILISED FUNDS: WHY HALF THE BUDGET REMAINS UNSPENT

The most striking finding is that nearly ₹4,630 crores, 50.5% of total allocations, remain unspent despite severe ongoing pollution. This underutilisation persists across a decade (2015–2025), spanning three successive governments and multiple YAP phases. Several factors explain this pattern:

Institutional Fragmentation: Multiple agencies (Delhi Jal Board, Delhi Pollution Control Committee, National Mission for Clean Ganga, municipal corporations) operate without integrated coordination. Inter-agency disputes over jurisdiction, fund allocation, and project execution slow decision-making and create bottlenecks. Unlike Singapore's unified command structure, Delhi's fragmented governance ensures that no single authority has the mandate or capacity to drive comprehensive action.

Lack of Political Accountability: No political leader has staked personal credibility on the Yamuna cleanup with the intensity Lee Kuan Yew demonstrated for the Singapore River. Without high-level political ownership and monitoring, bureaucratic inertia prevails. Deadlines are routinely missed without consequences, and project delays accumulate.

Social and Political Resistance: Unlike Singapore, where the government proactively managed relocations with improved housing, Delhi's approach to resettlement has been reactive and contentious. Riverside slum dwellers and unauthorised colonies resist eviction, leading to prolonged legal battles and project stoppages. The absence of a socially inclusive compensation-cum-rehabilitation strategy exacerbates resistance.

I WHY MORE MONEY WON'T SOLVE THE PROBLEM WITHOUT GOVERNANCE REFORMS

The evidence presented in this study supports a counterintuitive conclusion: additional budgetary allocations for Yamuna cleanup are likely to be wasted unless fundamental governance, operational, and institutional reforms are implemented first. Consider that ₹4,630 crores already allocated remain unspent, indicating that absorptive capacity, not budget availability, is the binding constraint. Existing infrastructure operates at 25–45% capacity due to operational failures, not design inadequacies. YAP-II's ₹387 crores produced zero results, demonstrating that money without accountability is ineffective. The CPCB explicitly states that O&M neglect, not capital shortages, drives non-compliance.

The policy implication is clear: before allocating further funds for new STPs, WWTPs, or CEPTs, Delhi

must optimise existing infrastructure through improved O&M, complete sewer conveyance networks to ensure sewage reaches treatment plants, strengthen monitoring and enforcement against industrial non-compliance, establish integrated institutional structures with clear accountability, and develop socially inclusive resettlement policies to manage political and social resistance. Only after these foundational reforms are in place will additional capital investments yield proportionate environmental returns.

II POLICY RECOMMENDATIONS

Immediate Operational Interventions: Mandate independent third-party audits of all 13 Delhi CEPTs and major STPs within six months. Establish a Delhi Water Quality Training Institute to provide certified courses on wastewater treatment processes. Install automated real-time effluent quality monitoring systems at all treatment plants, with data publicly accessible via an online dashboard.

Institutional and Governance Reforms: Create a Cabinet-level Delhi Yamuna Coordination Authority with direct reporting to the Chief Minister, modelled on Singapore's integrated approach. Transition from input-based to outcome-based budgeting, tying fund releases to measurable milestones such as CETP compliance rates and BOD reduction. The Chief Minister should publicly commit to specific, time-bound Yamuna cleanup targets and establish quarterly public review meetings, emulating Singapore's gold medal approach by instituting recognition and rewards for successful officials.

Infrastructure Optimisation Before Expansion: Before sanctioning any new STP or CETP construction, complete mapping of sewer network gaps and systematically address missing links. Invest in rehabilitating damaged trunk sewers and upgrading pumping stations. For areas with incomplete sewer networks, pilot decentralised wastewater treatment systems at the colony or ward level.

Socially Inclusive Resettlement Framework: Drawing from Singapore's approach, develop a resettlement policy that provides both monetary compensation and improved housing. Construct multi-storey affordable housing complexes with basic amenities before relocations begin. For informal sector workers (waste pickers, hawkers, fishermen), establish livelihood transition programmes including skill training, micro-credit facilities, and reserved spaces in formalised markets. Engage affected communities early in planning through participatory consultations.

II CONCLUSION

This study has demonstrated that Delhi's Yamuna pollution crisis is fundamentally a governance and operational failure, not a budgetary constraint. Despite allocating ₹9,178 crores for rejuvenation between 2015 and 2025, with nearly half remaining unspent, water quality improvements have been marginal. Analysis of 13 CEPTs over five years reveals systemic underutilisation of treatment capacity (25–45%), chronic operational deficiencies, and persistent non-compliance with discharge standards, patterns corroborated by CPCB's national assessments identifying O&M neglect as the primary failure point.

The YAP-II experience, where ₹387 crores produced zero new STP capacity, epitomises the futility of capital allocation without institutional accountability and operational rigour. In contrast, Singapore's decade-long river cleanup (1977–1987) succeeded through political will, multi-agency coordination under unified command, and socially inclusive implementation that proactively addressed resettlement challenges. These lessons underscore that effective environmental remediation requires institutional excellence, not merely financial outlay.

This research challenges the prevailing assumption that Yamuna cleanup requires ever-larger budgets. Instead, it demonstrates that maximising efficiency of current expenditures and implementing governance reforms can achieve significant pollution reduction without additional capital. The Yamuna's rejuvenation depends not on how much money is allocated, but on how effectively it is deployed, a lesson Singapore learnt and Delhi must urgently internalise.

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