Rejuvenating and Cleaning the Ganga: Past Efforts and Future Plans

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Global experience with large, but once equally or even more polluted than the Ganges today, rivers such as the Danube, the Thames, the Rhine, the Nile, and the Elbe show that strong river basin management organisations capable of generating basin-scale knowledge and scenarios, identifying hotspots of pollution and potential solutions incorporating urban and rural waste for closing the nutrient gaps in agriculture, prioritising interventions and investments and advising on awareness and policy are central to river cleaning and rejuvenation

Occupying a special place in every Indian's heart, Ganga is the most sacred river in the country with a unique cultural and spiritual significance. Traversing over 2,500 km, the colossal Ganga River is celebrated and used by millions of people from its origin in the Gangotri glacier in the Himalayas to the Sunderbans delta in Bangladesh. The Ganga basin generates approximately 40 per cent of the country's GDP and is a valuable environmental and economic resource for India. Along its long journey, the river enriches the vast lands of Gangetic plains and sustains 50 major Indian cities and hundreds of smaller towns. Several tributaries in the higher reaches have the potential to generate sufficient hydropower to boost India's energy supplies and in the downstream, the river has the potential to become a vibrant waterway to carry goods and people across long distances.This is the only river basin in India which is resource rich with lots of surplus water still available.

But unfortunately, this massive river is currently reeling from decades of negligence and ill-treatment meted out to it by an ever growing population. The mere mention of Ganga brings up conflicting images in mind. On one hand, it is the epitome of holiness symbolizing purity but on the other hand, it is a large, polluted, stagnant body of water filled with dirt and plastic. Heavy pollution loads, over-abstraction in the lean season for extensive irrigation, competing water demands and diversions and obstructions in the main stream and tributaries have wrecked havoc on the health of the river and its ability to nourish the millions of people who live and work in the basin (Ruhl, 2015). It is at this point when one wonders as to how one of the world's mightiest rivers ended up as a garbage dump!

Issues affecting the river are myriad and seldom simple. They range from untreated sewage and industrial waste dumping to restricted flows and rampant underground water withdrawal. All forms of pollutants including discarded offerings and heavily dyed clay idols used in various religious acts and ceremonies are blatantly released into the river. The degraded water quality affects millions of people who depend on the river's water across boundaries and countries. To top it, floods and droughts are a common phenomenon in the basin which kills people and seriously damages crops, livestock

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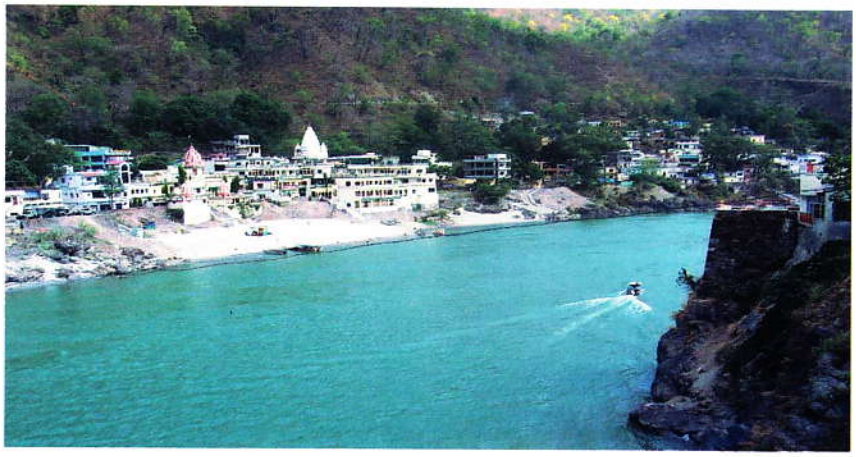


and infrastructure. The combination of glacial retreat, decreasing ice mass, early snowmelt and increased winter stream flow add on to the pressure and suggest that climate change is already affecting the Himalayan ice cover impacting the river in the long term.

The water quality challenges vary across the course of the river: (i) from Gangotri to Rishikesh, the river is enjoined by several small and fast flowing tributaries and is much less polluted due to human activities but is threatened by ill-planned dams for hydropower generation affecting highly sensitive and fragile ecosystem and bio-diversity, (ii) the middle stretch from Rishikesh to Kanpur, Allahabad, Patna and Farakka is heavily abstracted and the most polluted (pollution levels decrease as one traverses downstream) due to domestic, municipal, agricultural and industrial effluents. It also causes heavy flooding in the eastern Uttar Pradesh and northern Bihar plains. (iii) the last stretch forms part of the *Sunderbans*-world's largest active delta and has experienced considerable changes in the channel path, salinity ingress and tidal storms and is subjected to water sharing conflicts among the riparian countries (IITC, 2010).

Gangetic Pollution: Main Causes

Ganges basin is considered the world's most populous river basin and is home to more than 600 million urban and rural Indian population, or about half of the country's total population. The incidence of deep and multi-faceted poverty is high in the basin and the water and sanitation infrastructure is either absent or unsatisfactory. The basin is largely agrarian with urban centres having several small scale, unregulated and polluting industries and a number of pilgrimage or religious centres. So the root cause of pollution is from unmanaged sewage, septage and solid waste generated by a large population, industrial effluents, agricultural chemicals and waste and remains of religious offerings which are exacerbated by reduced flows during lean months and the climatic variability.

i. Sewage, Septage and Municipal Solid Waste:

The main stream of the Ganges passes through 36 Class I cities (with population over 100,000); 14 Class II cities (population between 50,000 and 100,000) and about 50 smaller towns with population above 20,000. According to Central Pollution Control Board of India (CPCB, 2013), these Class I and Class II cities generate more than 2.7 billion litres of sewage every day, although this figure may be underestimated (CSE, 2014) as it is calculated as a portion of the municipal water supplied to towns and cities, neglects urban run-off and does not include the wastewater generated in smaller towns. With the installed capacity of 1.2 billion litres per day (functional or actual, operational capacity is even much smaller), only a fraction of this wastewater is treated before it reaches the river. According to an inspection and estimation of the CPCB, only about 26 per cent of the wastewater generated along the Ganga is treated and the vast amount of wastewater is directly dumped into the river. The tributaries of the

Table 1. Freshwater consumed and wastewater generated by major industrial units in the Ganges basin

Industrial units	Total Units	Water Consumption (MLD)	Wastewater Generation (MLD)
Chemical	27	210.9	97.8(46.4 per cent)*
Distillery	23	78.8	37.0 (46.9 per cent)
Food, Diary & Beverages	22	11.2	6.5(58.0 per cent)
Pulp & Paper	67	306.3	201.4(65.8 per cent)
Sugar	67	304.8	96.0(31.5 per cent)
Textile, Bleaching & Dyeing	63	14.1	11.4(80.9 per cent)
Tannery	444	28.7	22.1(77.0 per cent)
Others	41	168.3	28.6(17.0 per cent)
Total	**764**	**1123**	**501 (44.6 per cent)**

Source: Central Pollution Control Board (of India), 2013

*Figures in parenthesis are percent of wastewater generated to the total water consumption

Ganga like Ramganga, Gomati, Kali, Yamuna, Hindon and several others are even more polluted and aggravate the problem as they merge into the main river. CPCB has identified 138 large wastewater drains which disgorge a massive 6 billion litres of highly polluted water directly into the Ganga. Storage, leakage and disposal of solid wastes through septic tanks is another serious problem. The Ganges basin states of Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal have a very poor sanitation infrastructure. As per the latest Census (2011), about 45 to 53 per cent of the urban households use septic tanks and there are no plans and mechanisms for septic management and these are emptied into open fields, landfills and drains which eventually pollute the river flows. Open defecation is practised by more than 25 per cent of the population and is a serious and direct threat to human health and water pollution. The collection capacity and proper disposal of solid waste is utterly lacking in the Ganga basin states. Most villages, towns and cities dump the solid waste of organics, plastics, glass, dead animals and other disposables around the banks of the river which not only choke and pollute the stream, it is an eyesore and repelling aesthetics for the population.

ii. Unused or Abandoned Religious Offerings:

The Ganga is India's most sacred river and surrounded by traditions and mythologies. Offerings of various kinds of materials are offered daily to the river by millions of devotees. On special occasions and festive seasons millions of pilgrims gather at its banks, take bath and remove all the dirt of body and clothes into the river. Highly coloured clay idols of deities are immersed into the river. Taken together this may amount to several tons of toxic materials contaminating and choking the river. The river also finds the ultimate disposal place for unclaimed dead bodies and other half or fully burnt dead bodies which decay and pollute the freshwater,

iii. Industrial Wastewater:

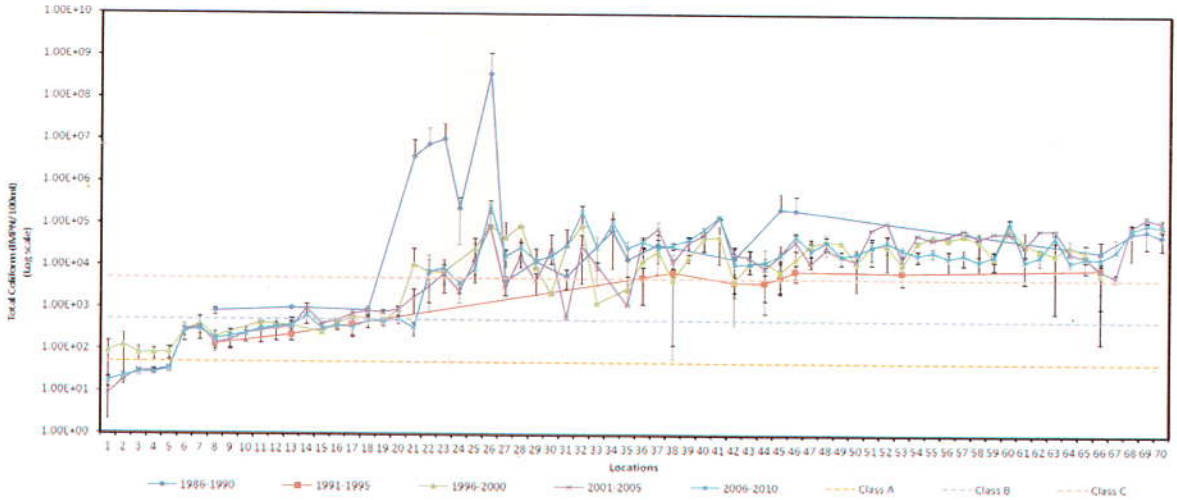
The large urban centres are also the industrial hubs for the highly polluting large and small chemical, distillery, food and dairy, pulp and paper, sugar, textile and dyeing, and tannery industry. All these industries consume, pollute and discharge large amounts of wastewater into the river (Table 1). The regulations for treatment of these wastewater are weak and often flouted by the unscrupulous industries. These effluents are generally toxic, poisonous and non-degradable and thus pose a major threat to the riverine aquatic life.

As is evident from the data, the textile, tannery and pulp and paper industries, the most prevalent in the basin, are also the most polluting industries. Several of these are in small scale and household sector and thus devoid of any self or imposed regulation.

iv. Pollution from Agricultural Fields:

Though pollution from agricultural fields is not as intense and severe as the municipal and industrial pollution, yet in certain stretches of intensive agriculture close to the river banks and in the basin can be hazardous especially the residues from insecticides and pesticides (Trivedi, 2010). Agro-chemicals have the potential to damage the riverine ecosystem to the extent that the river loses its self-treatment capacity. Pollution due to livestock and aquaculture is not properly understood. The continued increase in the use of fertilisers and agro-chemicals and intensification and diversification of agriculture pose a potential threat to the deterioration of freshwater quality.

Figure 1: *Variation in 5-year average total coliform at 70 locations along the Ganga River (source: IIT Consortium, 2013)*



Class A: water for use as drinking water source without conventional treatment but after disinfection.
Class B: waters for use for organized outdoor bathing.
Class C: Class C waters for use as drinking water source with conventional treatment followed by disinfection

v. *Insufficient Environmental Flows:*

A healthy river requires that after meeting all the requirements of the diverse stakeholders, adequate quantities of high quality water must continue to flow in the river throughout the year. At no point of time and in no particular stretch of the river, the flow may become insufficient and discontinuous. As all the human users and uses are very vocal and demanding, it is generally the silent but most important 'environmental flow' which generally gets sacrificed. Large scale abstractions of surface water directly through diversion canals and distributed groundwater pumpage throughout the basin seriously impact the river flow regime. The middle stretch of around 1,080 km from Haridwar to Varanasi is the most degraded due to significant irrigation diversions through extensive canal network and groundwater pumpage and high degree of pollution loads from different sources. Flow estimates after the canal diversions at Haridwar, Bijnor and Narora indicate that original Ganga River is almost completely lost, with little or no capacity to perform its ecosystem services and assimilate the large pollution loads (Mateo-Sagasta, 2015).

Past Efforts to Clean the Ganga

The poor river health, besides the large negative environmental, cultural and health impacts also constrains the livelihood options for many of those dependent on the river as more than 200 million people in the basin are among the India's poorest. The pervasive poverty in the states of Uttar Pradesh, Bihar and West Bengal has a strong correlation with 'water poverty' (Sharma et al., 2010). Faecal contamination caused by increasing amounts of untreated sewage and septage directly discharged into the streams is a major concern for the Ganges. Coliform levels are high all along the river and make the water generally unsuitable for traditional bathing, not to speak of drinking, barring a few upstream locations. What is even more alarming is that the situation has not improved in the last decades; on the contrary, coliform levels are on the rise and have substantially increased from 1996 through 2010 at all locations throughout the entire course of the Ganga River (IITC, 2013, Fig. 1). The Ganges Basin has an installed capacity to treat up to 44 per cent of the sewage produced in its Class I cities, but only 8 per cent of the Class II towns (Table 1) (CPCB, 2009) and virtually 0 per cent in smaller towns. Vast parts of the cities and most towns are, however, not covered by sewage networks or these networks are not operational or not ending in treatment plants, and so large quantities of wastewater remain untreated. But even where there are constructed sewers and treatment plants, these often do not operate properly or are not maintained, which means that the actual treatment is much lower than the installed capacity (CSE, 2014).

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Waste and wastewater from cities, industries and agriculture contain pathogens and chemicals that concentrate in the Ganga waters and sediments and accumulate along the trophic chain posing serious risks for human health, the environment and productive activities (Hernande-Sancho et al., 2015). This also impacts the riverine species. In the middle segment, most of the aquatic species are under severe threat because of the impacts of industrial effluents disposed into the river (Sarkar e al., 2012). Accumulation of heavy metals has been observed in fish in this stretch of the river. In Allahabad, a heavily polluted stretch, a steady decline of all economic fish species has been observed during the last six decades. According to Sarkar et al., 2012, the fish catch/km declined from 1344 to 300 kg between 1950 and 2010.

Two serious and revealing assessments by the Central Pollution Control Board conducted during 1982 and 1984 found that most pollution from point sources was coming from 25 Class I cities in Uttar Pradesh, Bihar and West Bengal and these formed the basis for the first-ever multi-state, national level substantial effort for controlling the pollution of the river which was launched in the form of Ganga Action Plan (GAP) in 1985. Main focus of the plan was on interception, diversion and treatment of sewage generated from these 25 cities. The plan continued for several years without achieving any improvement in river water quality. Subsequently, GAP II was started in 1993 and is still under progress in five states of Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal. Through the provisions of GAP-I and GAP-II, interception, diversion and treatment of sewage of more than 37 cities was established. The plan also identified grossly polluting industries and made it obligatory to install the effluent treatment plants. As per Ministry of Environment and Forestry, an estimated amount of Rs. 1612.38 crore was spent upto 2011. Though these efforts made some beginning and were able to highlight the magnitude of the problem of pollution in the Ganges, it had several limitations and constraints. As per the findings of IIT Consortium (IITC, 2011), only limited pollution issues were considered, the ownership among the local urban bodies was lacking, there were large implementation delays, no business model or provisions for operation

and maintenance of the created assets was established and as such, these remained shut or non-functional; and underutilisation of the installed STPs due to either non-conveyance of the sewer or non-availability of power to run the plants.

Present and Future Plans and Innovations

Faced with the directives from Tribunals and Courts and a very persistent civil society; and also the resolve of the new Government itself, a number of serious and meaningful measures are underway for cleaning and rejuvenating the river Ganga. Some important measures include:

i. Establishment of National Mission for Clean Ganga (NMCG):

The NMCG is established by (initially under Ministry of Environment and Forests) the Ministry of Water Resources, River Development and Ganga Rejuvenation Society under the Societies Registration Act 1860 for the implementation of the World Bank assisted National Ganga River Basin Project (NGRBP) of the National Ganga River Basin Authority (NGRBA). The NMCG is the planning, financing, monitoring and coordinating body at the Union Government and being supported by suitable State-level Program Management Groups (SPMGs) for the purpose of achieving the twin objectives of the NGRBA: effective abatement of pollution and conservation of the river Ganga by adopting a comprehensive river basin approach. For this purpose, the NMCG is empowered to take all necessary actions that may be necessary or incidental for the achievement of the objectives.

ii. Reallocation of the Business and Rechristening the Role of the Ministry:

Cleaning of the river Ganga is a flagship program of the new Government and is being regularly monitored by the Cabinet Secretariat and the Prime Minster's Office. Most of the business pertaining to the cleaning of the Ganga has been moved from MoEF&CC to the Ministry of Water Resources (MoWR). To reflect the new mood, name of the Ministry itself has been changed to *Ministry of Water Resources, River Development & Ganga Rejuvenation (MoWR, RD&GR)*. Several foreign governments (Japan, France, Israel, UK, Singapore, Australia etc.) and institutions (IWMI, Thames Authority, Murray-Darling Basin Authority) have been requested to provide the support besides India's own Consortium of Indian Institutes of Technology.

iii. Namami Gange:

The Government of India recently (2015) approved the "*Namami Gange*" program, which integrates the efforts to clean and protect the Ganga River in a comprehensive manner. For the next Plan period, an outlay of INR 200 billion has been allocated and has subsumed the GAP programs into its ambit. This program is much more comprehensive and includes the treatment of wastewater flowing through the open drains through bio-remediation, use of innovative technologies , additional STPs, installation of new industrial effluent treatment plants and retrofitting of all the existing plants to make these functional and operate at full capacity.

Global experience with large, but once equally or even more polluted than the Ganges today, rivers such as the Danube, the Thames, the Rhine, the Nile, and the Elbe show that strong river basin management organisations capable of generating basin-scale knowledge and scenarios, identifying hotspots of pollution and potential solutions incorporating urban and rural waste for closing the nutrient gaps in agriculture, prioritising interventions and investments and advising on awareness and policy are central to river cleaning and rejuvenation.

iv. Ganga River Basin Management Plan:

Based on the exhaustive studies and consultations, a Consortium of seven IITs have developed a comprehensive Ganga River Basin Management Plan (GRBMP) and submitted to the Ganga River Basin Authority for its consideration and implementation (Tare et al., 2015). The proposed plan makes suggestions and recommendations in the form of eight missions: *Aviral Dhara* (Continuous uninterrupted flow), *Nirmal Dhara (*Un-polluted clean flow), Ecological Restoration, Sustainable Agriculture, Geological Safeguarding, Basin Protection against Disasters, River Hazards Management, and Environmental Knowledge-Building and Sensitisation. One of main recommendations is to ensure 'zero discharge' policy for all the polluting industries. A total of USD 100 billion has been estimated as an expenditure for the next 25 years for implementation of the recommendations.

Conclusion

Global experience with large, but once equally or even more polluted than the Ganges today, rivers such as the Danube, the Thames, the Rhine, the Nile, and the Elbe show that strong river basin management organisations capable of generating basin-scale knowledge and scenarios, identifying hotspots of pollution and potential solutions incorporating urban and rural waste for closing the nutrient gaps in agriculture, prioritising interventions and investments and advising on awareness and policy are central to river cleaning and rejuvenation. In India, the past and large parts of the current efforts and investments on pollution abatement are on construction of sewers and conventional sewage treatment plants. Current and planned investments are yet to address the problems of large but uncontrolled septage disposal and wastewater

flows from non-networked sewer areas and non-point source pollution from agriculture and livestock. It is proposed that the new initiatives may be multi-pronged and address the problem holistically through (i) reduced pollution loads from unsewered urban areas and their safe use in agriculture, (ii) development of a viable environmental flow-water quality management system, (iii) support establishment of an innovative Ganga Demonstration centre, or a Ganga University, and (iv) improve governance, communication and implementation capacity of the major stakeholders. These components have good synergy with the cherished objective of securing clean and continuous flow in the Ganges.

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