KEY WORDS:
Ganga, Rejuvenation, Wastewater Treatment, Bioremediation, Governance

Rejuvenating Ganga: Challenges in Institutions, Technologies and Governance

Kelly D. Alley

Tekton
Volume 3, Issue 1, March 2016
pp. 08 - 23

ABSTRACT

In India and worldwide, the river Ganga (Ganges) has been a Mother, Goddess, purifier and sustainer of all life for millennia. The cleaning of Mother Ganga, on the other hand, is a more recent invention. This invention has resulted in a series of complicated approaches that have had limited success in arresting the mounting pollution and deteriorating water quality of this sacred river. In the latest iteration, the clean Ganga mission is a rallying cry for the nation, reignited by the Prime Minister of the country. In this paper, I introduce the current iteration of river clean-up–Ganga rejuvenation–and consider key challenges and opportunities in terms of institutional constraints and possibilities, technological limitations and innovations, and governance entanglements.

Kelly D. Alley (PhD, Anthropology, University of Wisconsin–Madison, 1990) is Alma Holladay Professor of Anthropology at Auburn University in the USA. She has been researching citizen interpretations and engagements with rivers in South Asia for two decades. Her book, *On the Banks of the Ganga: When Wastewater Meets a Sacred River* (University of Michigan Press, 2002), explores Hindu interpretations of the sacred river Ganga in light of current environmental problems. She has also authored book chapters and articles on religion and ecology and environmental law and justice in India. Along with students and river experts in India, she recently posted an interactive web site of hydropower and wastewater infrastructure at http://www.cla.auburn.edu/gangabrahma.

alleykd@auburn.edu

Introduction

In India and worldwide, the river Ganga (Ganges) has been a Mother, Goddess, purifier and sustainer of all life for millennia (Alley and Drew, 2012; Eck, 1982a, 1982b). The cleaning of Mother Ganga, on the other hand, is a more recent invention (Alley, 2002, 2014, 2015; Alley & Drew 2012; Haberman, 2006; Markandya and Murty, 2000). This invention now comprises a number of complicated, and largely unsuccessful, plans to arrest the mounting pollution and deteriorating water quality of this sacred river (Rauta, 2015; Sanghi, 2014; Tare and Roy, 2015). In the latest iteration of river clean-up—called "Ganga Rejuvenation—the Clean Ganga Mission" has become a rallying cry for the nation, promoted by India's Prime Minister, a decisive and charismatic leader. The mission title, '*Namami Gange*', translates as "obeisance to the Ganga".

> **In contradictory and troubling ways, Ganga's rejuvenation lies alongside the growth agenda promoted by the country's top leaders, so the goals for increasing energy generation, irrigation, and manufacturing, and for developing the river as an inland waterway compete with Ganga cleanup.**

In this paper, I introduce this clean-up mission and consider key challenges and opportunities in terms of institutional constraints and possibilities, technological limitations and innovations, and governance entanglements.[1]

In contradictory and troubling ways, Ganga's rejuvenation lies alongside the growth agenda promoted by the country's top leaders, so the goals for increasing energy generation, irrigation, and manufacturing, and for developing the river as an inland waterway compete with Ganga cleanup. I propose a couple of ways in which a higher level of success might be achieved in this dynamic environment while emphasizing that growth as usual will present a worsening of the serious water and sanitation crises gripping the country.

'Mode of Informality' and Governance Behaviour

This paper draws theoretical insight from Ananya Roy's (2005, 2009, 2012) notion of the 'mode of informality', which she applies to decision-making elites who follow or suspend, as they see fit, specific policies, rules and procedures for land and water uses. It is useful to use this inverted notion of informality to show that by avoiding official mapping of current land-uses such as informal settlements, agricultural uses and existing natural or cultural heritage, a government entity may intentionally disregard these elements and others in project plans. The intentional vagueness of project plans, protocols and associated regulations can then be used by state actors to re-plan and re-map the urban landscape for desired development projects in the so called public interest. Roy notes, the absence of land titles, the existence of fuzzy boundaries and incomplete maps, and the vagueness of urban policies are "the basis of state authority and serve as modes of sovereignty and discipline" (Roy, 2009, p. 83). While a longer conceptual discussion could point out the limitations of using the formal-informal binary to frame this mode of sovereignty and might consider another name for these calculated strategies of exceptionalism, it is used here to orient the discussion on governance behavior related to wastewater treatment projects.

Austerity Capitalism and Rent-seeking

The decisions and choices on wastewater technologies and infrastructures also display the features of 'austerity capitalism' described in Laura Bear's (2015) account of river port development along the Hoogly. Cycles of finance and debt interlace policy and project deals and chronic state debt makes public sector infrastructure projects unsustainable and then dangerous when their components break down. These cycles of state debt also impoverish the pay scale of government workers who then create rent-seeking activities out of their decision-making authorities and responsibilities. This is especially the case in wastewater management where there is little revenue, in terms of taxes or user fees, generated from the use of the infrastructure.

This outline also demonstrates how citizens use the legal remedy of continuing mandamus to penetrate, disrupt and expose the mode of informality and rent-seeking behaviors. Their legal actions have provided pathways for intervening in elite decision-making, project planning and environmental impact assessment and have pushed for better enforcement and implementation of environmental laws, policies and protocols (Price et al., 2014; Subramanian et al., 2014).

Ganga Rejuvenation: Multiple Challenges

Ganga rejuvenation occurs in two general areas of activity - 1) institutions and governance, and 2) technologies, infrastructure, and energy. First, I review the governance structure and temptations that shape decisions on technologies, scale, operators and siting of facilities for wastewater treatment. Then I turn to the serious infrastructure problems embedded in the ancient and multipurpose cities that generate the bulk of the wastewater load for the river today (Chattopadhyay, 2012). Many of the technologies used or proposed for wastewater management are imported from the advanced industrial countries and require a continuous supply of energy and skilled maintenance to operate. Over the past thirty years of the Ganga Action Plan, state governments have not secured continuous electrical power for sewage pumping stations and wastewater treatment facilities and this has remained a low priority despite the fanfare associated with each phase of the Ganga Action Plan, the National River Conservation plans and all the other river action plans evolving from these base frames. Emergency standby generators meant to run on bio-gas produced through treatment are not effectively utilized when grid power is unavailable. As a result, the intermittent operation of sewage pumping stations and sewage treatment plants has been ineffective at protecting water quality and provisioning safe drinking water and sanitation in cities within the basin.

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1. Governance, Institutional Constraints, and Leverage Possibilities

Here, I create a context of the complex decision making, implementing, managing and monitoring systems within which the mission of rejuvenation of Ganga has to operate. Several challenges of governance arise out of this scenario and impact the progress of the mission.

Complex Web of Governance and Centre-State Relations

The Government of India established the Ganga Action Plan in 1986 to lead the way in river pollution control programs. After this the National River Conservation Directorate was created in the Ministry of Environment and Forests (MoEF, since renamed as MoEFCC to include climate change) to expand the number of river action plans. In 2009, the Government declared the Ganga a national river and established the 'National Ganga River Basin Authority' (NGRBA) as a central advisory body. An empowered steering committee was set up under the NGRBA; it was headed by the Secretary, Ministry of Water Resources and included the Secretaries of Urban Development, Environment and Forests, Finance, Power, and Science and Technology, Planning Commission (now NITI Aayog) officials and Chief Secretaries of the five Ganga basin states through which the river flows (Ghanekar, 2015). This committee decides which projects to pursue and then goes on to link central and international funding sources to these projects. The National Mission Clean Ganga (NMCG) is the implementing agency under this Authority. Earlier, it used to sit in the Ministry of Environment and Forests but with the change of government in 2014, it was transferred to the renamed 'Ministry of Water Resources, River Development and Ganga Rejuvenation'. At the state level, the Project Management Group (PMG) is chaired by the Chief Minister who oversees project implementation at the state level. This group includes members of the state ministries of environment and irrigation, the state pollution control board and the state water commissions. The State PMG decides whom to select for work, and in most cases uses the state level sewage engineers to execute wastewater project work. Looking at the recent minutes of the Empowered Steering Committee under the NGRBA, one can see that current and proposed projects are all executed by the state level agencies. In Varanasi, the state agency-the UP Jal Nigam- works closely with the 'Japanese International Co-operation Agency' or JICA. JICA provides partial funding, advice and supervision but cannot make decisions on selection of companies and contractors.

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Since the NMCG is registered as a society under the Societies Registration Act and not bound by the stricter rules of a full government agency, the NMCG can out source consultancy work and allocate projects to NGOs and the private sector on design-build-operate-maintain or build-own-transfer basis. To date, NGOs have been assigned smaller pilot projects but have not been able to crack the market on the large scale diversion and treatment projects (Singh, 2015). This still leaves out the local municipalities who are generally not included in the final decision-making and are not empowered to fund the operation and maintenance of these facilities through local revenue and tax collection. Dutch consultants in Kanpur pushed for institutional capacity building at the city level for many years during the Ganga Action Plan phase I (Alley, 2002), but their recommendations failed to change state-center arrangements on authority, control of decision-making and debt. This means that cities in the basin have had very little motivation to raise the funds for the development and maintenance of this infrastructure. Even when central government bodies interact with state agencies they choose their allies carefully to keep out those who disagree with their plans. In Banaras, for example, respect was accorded to active citizens such as Dr. Veer Bhadra Mishra, but the central authorities always kept their final decisions separate from the courtesies they offered him in the earlier years. In the five years before his death, he was ex-communicated from official meetings for his insistence on low energy sewage treatment alternatives (Mishra, 2005).

Top Down Decision Making

Since the beginning of the Ganga Action Plan, and all other river action plans across India, there have been debates about the extent to which states should contribute to the cost of river clean-up plans. Earlier in the Action Plan's history, matching arrangements required states to contribute 30% of capital and operation and maintenance costs while the central government contributed 70%. This proved to be difficult for states to meet, and the plans eventually proposed a 100% contribution by the central government. The management of wastewater has been a top-down enterprise since the onset and the bulk of the funds have flowed from the central government through the state governments and then to the state engineering agencies. Although operation and maintenance costs were in theory to be handled by the local municipalities, they have been covered by central funds when those are available. This has led to a deficit of operation and maintenance funds over time, causing a deterioration of expensive infrastructure and the perpetuation of a malfunctioning system (Alley, 2015; Rauta, 2015; Tare and Roy, 2015).

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Water Bureaucracy and Rent Seeking

The government's monopoly hold on wastewater infrastructure projects means that this sector has evolved into an established rent-seeking arena at central and state levels. Jennifer Bussell's (2012, 2013) study of the digitization of government services helps to explain how rent structures may determine the motivation, extent and effectiveness of governance reform. Bussell shows that rent-seeking is uneven across the Indian bureaucracy, with some departments showing more interest than others. The interest is usually predicated upon the ability to wield influence but especially from a specific position in the bureaucratic structure. "Octroi" positions, as they are called, are the plum posts; their positions are nodes in overlapping networks and as such situate the bureaucrat along the path or in the center of legitimizing practices such as document production. From the bureaucrat's ability to manipulate a number of relationships in these networks, he or she can convert document production into tollbooths that require a fee. As Hull (2012, p.58) explains for the Pakistani bureaucracy, "It is not so much that documents move through regimes of

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value, in and out of commodity phases, but that they can be at once a thing paid for and an object of bureaucratic practice, mediators of practices that are at once bureaucratic work and a paid service".

In the field of Ganga clean-up, the multiple layers of committee membership create a water bureaucracy at the state and central levels which is so vast that it is ineffective at generating proper implementation, compliance and monitoring- all key problem areas. Moreover the MoEFCC has become a rentier agency through its control over rights to convert forest land to other uses, divert and channel wastewater, and allocate private land from citizens to infrastructure projects.[2] The state engineering departments also earn rents through their choice of contractors for the construction of sewage pumping and treatment facilities. Decisions on contractors are shaped by a diffuse and heterogeneous set of bureaucratic practices that embody rent-seeking at different intensities and scales. Rents move slowly across departments and also up and down the political hierarchy over an extended period of time. In these contractor choices and appropriations of land for projects, authorizing documents become mediators of monetary exchanges that are unrecorded, often invisible to the average citizen, and knowable only through anecdote and probes into accumulated wealth through police raids.

Environmental Laws

In late 2014, the High Level 'T.S.R. Subramanian Committee' proposed a rewriting of the country's six main environmental laws in order to streamline the allocation of infrastructure permits and clearances through a single window. Their report recommended taking the clearance powers away from the MoEFCC and vesting them in a national level National Environmental Management Agency and a state level State Environmental Management Agency (Rajshekhar, 2014). Such a move would enable "expeditious clearances" for projects of national importance. The subtext however was that such a change could empower central ministries in the clearance process, facilitate a vertical deployment of rents, and diminish the horizontal distribution of rents across a swath of agencies. The move to develop single windows for expeditious clearances could also facilitate the entrance of larger global financiers and companies eager to participate in mega infrastructure projects. Since then, critics have argued that the new structure would advance an even more disjunctive technocratic approach to environmental management, while further weakening government monitoring and compliance, and perpetuating state debt in public sector projects (Alexander, 2014; Bear, 2015). The hollowing out of the regulatory framework advanced by single window clearances could also prompt a more vigilant response from citizen monitors (Rao, 2015). In fact, this has already started to happen; in July, a House Parliamentary Panel, in response to citizen outrage, recommended scrapping the Subramanian report. But again, in the manner of official informality, the MoEFCC has continued taking steps in this direction. It has hired the consultancy firm Ernst and Young and one of India's law firms, Amarchand and Mangaldas & Suresh A. Shroff, to create a framework from the report's recommendations (Ghanekar, 2015).

Citizens Led Leverage Activities Strive for Influence

To date, the citizen-led petitions in the National Green Tribunal (NGT) have had the greatest effect in bringing some corrective to poor plans and practices, lack of compliance to regulations, and the rent-seeking culture. Like the Supreme Court Justices before them, the NGT Judges have fined or ordered the closure of polluting industries in the effort to slow down river water pollution. They have ordered industries to set up their own effluent treatment facilities and mandated that empowered and monitoring committees include not only government officials but experts, scientists and non-governmental organization members with powers to decide management plans and technologies.[3] A few government ministers have also responded positively to citizen activists and monitors. Mr. Jairam Ramesh during his tenure as minister of Environment and Forests, oversaw the construction of a chrome recovery plant in Kanpur to pre-treat and recycle chromium from tannery effluent before routing the wastewater to the city's treatment plants. After push from activists Dr. Agarwal, (now Swami Sanand) and M. C. Mehta, Mr. Ramesh also had an eco-sensitive zone notified around Gangotri in the upper Ganga basin to protect the watershed from over-development and diminishing river flows. These leverage activities and dedicated individuals have been critical to the initiatives for reducing the pollution load on the river. Now with the Prime Minister's calls for a partial decentralization of clean-up activities and sewage treatment systems, citizens are pushing to dismantle the rent-ridden system and promote multi-level monitoring and reporting on industrial dumping and groundwater contamination around industrial plants. Ms. Uma Bharti, the minister of Water Resources, has also stressed citizen monitoring to stop illegal dumping and industrial pollution. The NMCG has included crowd sourcing in its planned mechanisms for data collection and has funded the 'Bhuvan Ganga' project. This project provides a public domain geo-portal and databases on wastewater infrastructure and water quality (Mohan, 2014). These are good initiatives that require continuous updating and additional scientific contributions. NGOs interested in supporting these activities require financial support. Moreover NGOs, municipalities and citizens can play a larger role in decisions on infrastructure and technology in order to find

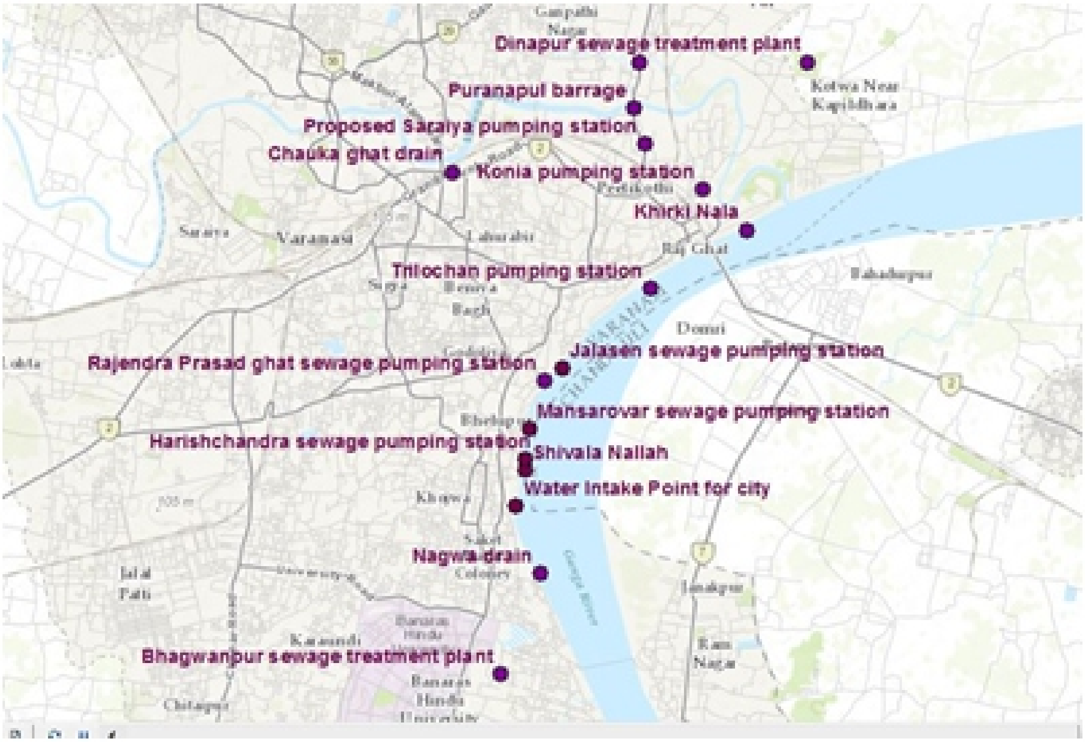

Figure 1: Map of sewage management infrastructure in Varanasi, Uttar Pradesh. (Credit: Author)

long term, effective treatment solutions. The NGT assists by assigning citizens and NGO members to monitoring and steering committees, but the decision-making process is often drawn down by co-optation; after court appointed committees produce reports, they are either accepted or dismissed by powerful persons who then demand new committees and outcomes that overturn stricter decisions. The endless creation, dismantling and reconstitution of committees, reports and court orders may advance the vetting process but makes any remediation, clean-up or infrastructure improvement extremely time consuming.

2. Technological Limitations and Innovations

Here, I discuss many technological challenges that render a highly expensive and energy intensive sewage treatment infrastructure that remains largely inoperable, non-functional, and unable to meet its stated water quality goals.

Untreated Wastewater Discharged into the River

The Central Pollution Control Board has identified 144 drains along the main stem of the Ganga that currently discharge about 6,614 MLD of wastewater into the river (Central Pollution Control Board, 2013).[4] These drains direct untreated wastewater directly into the river without any treatment or remediation. In the

Figure 2: Dump site along the banks of the Varuna River, below the Puranapul Bridge at Varanasi.

existing wastewater management system, a significant amount of energy is required to pump wastewater from these open drains toward and into wastewater treatment facilities. To understand how the infrastructure works, we can look at the current situation in Varanasi using maps and photographs from our online portal (see http:// www.cla.auburn.edu/ gangabrahma).

The main drains for the city of Varanasi are the Nagwa drain, located in the south and upstream of the main city, and Khirki nallah, located in the north and downstream of the main bathing ghats on the river (see **Figure 1**). The Ganga flows northward in Varanasi. The Varuna River enters from the west and circles the outer part of the older sacred city complex before draining into the Ganga at the downstream or northern end. In the last year, the Varuna River has turned into a wastewater pond upstream of the barrage built under the Puranapul Bridge that crosses the Varuna River. The Varuna river banks downstream of that barrage are also the dumping grounds for all forms of solid waste and the entire landscape is hellish (see **Figure 2**) . One wonders how the communities in the vicinity can survive.

Facilities Operate at Low Capacity

The existing wastewater management facilities include three sewage treatment plants, five sewage pumping stations along the ghats, and one main sewage pumping station at Konia. The Konia pumps are supposed to pump up to 80 million

Figure 3: Screw pump at Konia pumping station that lifts wastewater to the pipe leading to the Dinapur treatment plant.

liters of sewage per day to the Dinapur treatment plant located in the trans-Varuna neighborhood of Dinapur village, if they work at full capacity. However they rarely do.

For instance, only one screw pump was working on the day of my visit in the summer of 2014, so that means it was running at 1/3 its capacity (see **Figure 3**) . This also means that the Dinapur treatment plant was receiving 1/3 of the wastewater it was capable of treating, according to its nominal treatment capacity, and was therefore running at 1/3 capacity. However to be exact, one would have to know number of hours of operation each day of the week in order to calculate the capacity factor. For instance, if the pumping station was running at 1/3 capacity for only 6 of 24 hours each day, then the capacity factor would be just 1/12 or about 8%.

If capacity factors of the pumping stations and treatment plants are taken into account in a Life Cycle Cost assessment then the cost per unit volume (ML) of treated sewage increases significantly. The state level engineering agency, the UP Jal Nigam, does not keep a daily operational log with data on energy usage, so there are no metrics, no measures, and no good management practices. This adds up to a lack of proper governance.

Malfunctioning System Components

Many monitoring committees have made visits to site facilities but have failed to correct the daily malfunctioning of this system. Plans are now underway to increase the capacity of the Dinapur treatment plant to 140 MLD by adding additional infrastructure. Plans are also afoot to enhance the capacity of the Bhagwanpur plant and the UP Jal Nigam has just made decisions on contractors for another 50 MLD plant at Ramana, on land acquired several years ago during a dispute with the Sankat Mochan Foundation over treatment technologies.[5] Wastewater must be pumped to that site on the southern part of town through a pumping station built next to the Nagwa drain (see **Figure 4**). The pipes directing the sewage away from the pumping station and toward that treatment site were built a few years ago but were then damaged by floods in 2013. Since then they have remained broken and neglected along the riverbank (see **Figure 5**).

Figure 4: Nagwa pumping station, inactive until the treatment plant can be built at Ramana.

Energy Intensive Technologies without Reliable Power Supply

The pumping of wastewater and the treatment process using the currently popular Activated Sludge Process (ASP) require a continuous supply of energy. Biological secondary treatment through the ASP uses energy intensive aeration equipment and mixers. The Upflow Anaerobic Sludge Blanket (UASB) technology employed in Kanpur uses less energy than an ASP plant but requires pre-treatment recovery of chrome and other metals and post-treatment to reduce fecal coliform counts. These pre and post treatments increase the energy, capital and land costs, making it just as consumptive as the ASP method (Walia et al., 2014). Oxidation ponds and advanced ponding systems require less energy but more land. State agencies have often rejected these technological proposals for their land requirements. Moreover these rejections may be motivated to keep certain kinds of construction contractors in the mix and generate the desired rents.

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With unreliable and intermittent power, energy-intensive treatment technology cannot achieve the stated water quality goals. Moreover, the concentration of contaminants will remain high in drains, tributaries and rivers. Studies of water quality show high levels of total suspended solids (TSS) and biological oxygen demanding wastes (BOD), heavy metals, toxic organic compounds, and fecal coliform bacteria in the Ganga's tributaries and main stem (Sanghi, 2014). Fecal coliform bacteria indicate the potential presence of enteric waterborne disease pathogens in wastewater drains, streams and rivers. This means sewage treatment as it exists now is a largely inoperable and non-functional cost. If the capacity factors of the pumping stations and treatment plants are taken into account in a Life Cycle Cost assessment, then the cost per unit volume (ML) of treated effluent is much higher than options for in situ bioremediation. All these limitations and indicators show that sewage treatment infrastructure will remain an inoperable, non-functional, sunk cost if the existing technologies and scales are the only solutions.

Need For Alternative Solutions in

Figure 5: Broken sewage pipeline extending from Nagwa pumping station. Taken on June 2014 by Kelly Alley.

Wastewater Management

New solutions for wastewater management are needed to overcome the large land needs of comprehensive sewage treatment and high maintenance costs of infrastructure linking households and industries to a centralized diversion and treatment grid. This is why some critics and planners are brainstorming decentralized approaches and systems that could be facilitated by modestly upgraded central infrastructure. solutions.

In situ Bioremediation as an Alternative

The decentralized approach to in situ remediation through ecological floating bed techniques and constructed wetlands has been developed to bio-remediate polluted surface waters in other countries. These approaches have been piloted in the drains and floodplains of existing sewage canals and highly polluted streams running into the Ganga. They are now being considered by the Central Pollution Control Board and the National Mission Clean Ganga under the Ministry of Water Resources, River Development and Ganga Rejuvenation. In addition to potential cost savings, in situ remediation does not require highly skilled labor and can be applied and monitored by NGOs such as World Wildlife Fund and the Indian National Trust for Art and Cultural Heritage (INTACH), citizen groups, and the municipal authorities.

Bioremediation is an option that seeks to destroy or render contaminants harmless using natural biological processes. The literature touts these projects for their low-cost, low technology techniques which can be carried out on site (Jain et al, 2013, p.2; Shukla et al., 2010; Vidali, 2001). Bioremediation may use micro-organisms, fungi, green plants or their enzymes to restore ecological and hydrological functions and conditions degraded by contaminating wastewaters (Kumar et al., 2011; Rani and Dhania, 2014). The Central Pollution Control Board (2013, p.2) refers to in situ bioremediation as: *"Treatment of sewage in the running battery of flow without displacing; and by employing microbial consortia in aerobic and facultative environment to degrade sewage resulting into CO2 and H2O and reduce odour"*. In the process, biological oxygen demanding wastes (BOD), chemical oxygen demand (COD), total suspended solids (TSS), and total dissolved solids (TDS) can be reduced. Due to the action of the dominant microbial consortia, pathogenic bacteria E.coli and others may be suppressed or eliminated from the treated water. Heavy metals may also be removed with constructed wetlands (Rai et al., 2012).

In situ remediation processes such as ecological floating bed techniques and constructed wetlands have been developed for bioremediation of polluted surface waters in other countries and have been piloted in the drains and floodplains of existing sewage canals and highly polluted streams running into the Ganga. WWF-India, the Central Pollution Control Board, INTACH and IIT-Kanpur have used microbes to convert waste to non-toxic substances with some success.[6] This method does not require pumping wastewater to a far off location and aerating it. The in situ approach treats the wastewater where it is and degrades the bacteria before sending the water back to the river system. The costs are much less for in situ bioremediation in sewage drains; the annual cost for operation and maintenance is about Rs. 300,000 (USD 4,760) per MLD. By comparison, costs for the ASP treatment run up to Rs. 750,000 (USD 12,000) per MLD. The upfront construction costs for in-channel bioremediation treatment are much lower at Rs. 50,000 (USD 793) per MLD. By contrast, equipment for activated sludge treatment costs Rs. 8,000,000 (USD 127,000) per MLD and the process requires 2000 sq.meters of land per MLD.[7] When compared with the land and energy costs of ASP, bioremediation has a much smaller carbon footprint. In addition to potential cost savings, in situ remediation does not require highly skilled labour and can be applied and monitored by NGOs such as WWF or INTACH, citizen groups, and the municipal authorities.

> **New solutions for wastewater management are needed to overcome the large land needs of comprehensive sewage treatment and high maintenance costs of infrastructure linking households and industries to a centralized diversion and treatment grid.**

Conclusions

While the Ganga Action Plan has employed many specialist consultancies and generated complex technological plans, very little has improved in terms of wastewater management and river water quality. What remains is a significant gap between the high tech vision of treatment, dependent on an abundant power supply, the constant infusion of funds for maintenance, and skilled labour and effective operation. Meanwhile, wastewater flows continue to disrupt human livelihoods and undermine the river and hydrological and ecological systems all species need to thrive.

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This paper has proposed that current institutional arrangements, the financial requirements for large centralized systems, past performance and current needs for increasing coverage in urban populations will stress existing infrastructure and make multiple small-scale alternatives more attractive. Decentralized forms of treatment could be piloted and developed as alternatives to the centralized systems now rendering wastewater treatment a sunk cost. Citizen intervention is critical in slowing down or blocking government decisions riddled with rent interests. Key individuals have helped reform the system but co-optation of important monitoring and regulatory committees mars the decision-making processes. Moving onward, it is critical that engineering and remediation agencies be carefully selected and held accountable to residents. A welcoming approach to decentralized methods of technology and governance, including in situ bioremediation in drains and neighborhoods, and a vigilant citizen monitoring of all systems can help reform the system. Most strategically, wastewater drains may become spaces of transformation, where treatment and conservation can bring cleaner water to nearby communities at lower costs than energy intensive processes. This can enhance the quality of life for many across the Ganga basin. ■

Photo Credits: All photographs by the author taken in June 2014.

Notes:

[1] Shorter versions of this paper have been presented in Alley 2014 and Alley 2015.

[2] This Ministry issues the Forest Clearance through the Forest Advisory Committee, a committee of experts appointed by the Ministry to assist in clearance decisions. Likewise the Ministry issues the Environment Clearance through its Expert Appraisal Committee. The Expert Appraisal Committee (EAC) and the Forest Advisory Committee (FAC) assist the Ministry in assessing projects before issuing clearances. In addition to these key clearances, a project developer must get a clearance from many other agencies. (Narain 2014; Rajshekhar 2014).

[3] In Manoj Mishra's case focusing on Yamuna clean-up, the National Green Tribunal issued a broad program to reform the wastewater management infrastructure, but the central government intervened. The central government argued that it was too costly and proposed private sector involvement instead (Singh 2015). In Ritwick Dutta's case, the National Green Tribunal ordered a number of polluting industries to shutter until they could set up on-site effluent treatment facilities.

[4] See also: First list of river cleaning projects appraised under Ganga mission. Daily Pioneer 12 May 2015. Retrieved December 15, 2015 from http://www.dailypioneer.com/nation/first-list-of-river-cleaning-projects-appraised-under-ganga-mission.html.

[5] Memorandum for Empowered Steering Committee (ESC) on the Proposal for setting up a Sewage Treatment Plant (STP) at Ramana-Varanasi (District "3"). U.P. Under NGRBA (National Ganga River Basin Authority Programme). Retrieved December 15, 2015, from http://www.moef.nic.in/sites/default/files/ngrba/Memo%20Ramana%20STP.PDF

[6] See In situ bioremediation for treatment of sewage carrying drains joining river Ganga: Performance evaluation of technologies and development of guidelines and protocols. Retrieved December 15, 2015, from http://cpcb.nic.in/ngrba/aboutprojectinsitu.pdf; INTACH Natural Heritage Retrieved December 15, 2015 from http://naturalheritage.intach.org/?cat=19.

[7] Personal correspondence with Manu Bhatnagar, Natural Heritage Division, INTACH.

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