Varanasi's Ganga Wastewater Management: Why has it remained such an Intractable Problem?[1]

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Varanasi is newsworthy these days, situated symbolically and politically in the new Prime Minister's agenda. In his victory speech, the PM-elect Narendra Modi vowed to clean the sacred river Ganga. After assuming the office of Prime Minister, he reiterated the vow and pledged renewed efforts for Ganga cleanup.

Three months later, a skeptical Supreme Court reviewed the new government's Ganga Plan and remarked that with this approach the river will not be cleaned in 200 years. The Supreme Court asked for the full details of the cleanup plan, and inserted its role as a monitor over central government plans. The government has reportedly submitted a new plan to the court, but no details are available yet in the public domain. However, from media reports, it seems the plan is not very different from what has been done in the name of the Ganga Action Plan so far.

As residents and sympathetic outsiders know, the wastewater problem in this sacred, ancient city is seemingly intractable. In order to implement lasting solutions to the recurring river pollution scenario, we need to investigate the current situation. I just completed a field trip to this special city that many call Banaras. I visited all the existing and planned components of the wastewater collection, treatment, and disposal system. In this article I will try to create a visual map of the wastewater infrastructure and management problems and define the current lines of command and control within the vast and overlapping water, environment, and public health bureaucracies. This should help to identify systemic problems in each that need to be addressed when charting a new direction.

The seemingly intractable problems of Ganga clean up (rejuvenation will need so much more than just a clean up) in Banaras can be divided into three categories. First, there are governance problems that are related to how decisions on technologies, scale, operators and siting are made. These include problems with the solicitation, selection, and implementation of projects, especially the design and construction and operation and maintenance of sewers, sewage pumping stations and sewage treatment plants. Second, there are serious infrastructure problems that are part of the complexity of this ancient city.

Third, there is a real electrical power supply problem. Securing continuous electrical power for sewage pumping stations and wastewater treatment facilities is a low priority, and emergency standby generators are not used when the grid-provided power is unavailable. As a result, the intermittent operation of sewage pumping stations and sewage treatment plants is ineffective in protecting water quality in Ganga and in provisioning safe drinking water and sanitation in Varanasi.

[1] A blog with same content can be found at: http://sandrp.wordpress.com/2014/09/25/varanasis-ganga-wastewater-management-why-has-it-remained-such-an-intractable-problem/

When the sewerage infrastructure is operated intermittently, the treatment technology cannot treat the wastewater adequately, and the concentration of contaminants and water quality indicators such as total suspended sewage solids (TSS) and biological oxygen demand (BOD), heavy metals, toxic organic compounds, and the Most Probable Number (MPN/100ml) of fecal coliform bacteria--indicating the presence of enteric waterborne disease pathogens in the treated effluent--remain high. So in a way providing partial power to a sewage treatment plant does not do the work and is therefore a largely inoperable, non-functional, sunk cost.

Governance

The Government of India established the Ganga Action Plan in 1986 to lead the way in river pollution control programs. In 2009, the Government declared the Ganga a national river and established the National Ganga River Basin Authority. The National Mission Clean Ganga (NMCG)--the implementing agency under this Authority--is now housed in the Ministry of Water Resources, River Development and Ganga Rejuvenation under the Government of India. The Mission Director is the chief executive of the NMCG.

At the state level in Uttar Pradesh, there is a state Project Management Group (PMG) chaired by the Chief Minister. It includes members from the State Ministries of Environment and Irrigation, the Uttar Pradesh Pollution Control Board and the state water commissions. The State PMG decides whom to select for work, and in most cases uses the Uttar Pradesh Jal Nigam (the state level sewage engineers) to execute wastewater project work.

The State PMG can outsource consultancy work and allocate projects to NGOs as well; although in all cases, it has allocated the wastewater engineering work to the Uttar Pradesh Jal Nigam. These layers of committee membership create a vast water bureaucracy at the state level in addition to the committee memberships and officers at the Central level. They are not independent regulators, monitors and compliance officers (which are needed) but contributors and benefactors of political and profitable decisions in the ongoing issuing of contracts, clearances and other approvals.

This is a big problem because any contract for sewerage work must pass through all these departments and boards, with money wasted on bids and approvals for specific projects. In addition there is no other implementing agency in Varanasi so if the UP Jal Nigam's work is shoddy or even fraudulent, then the Ganga River and the whole city suffers without an alternative. This situation is well known to Banaras residents who will complain daily that funds meant to improve the sewerage system are simply eaten up by various agencies while wastewater is diverted into the sacred river without treatment.

In addition, the foreign donor agency, the Japan International Cooperation Agency or JICA, has been present in Varanasi for many years to advise and assist with capacity building and technological cooperation for the Ganga Action Plan. Apart from controlling the flow of funds, however, it appears that JICA has worked within the

current lines of command and control, thereby helping to perpetuate rather than reform the system.

Infrastructure

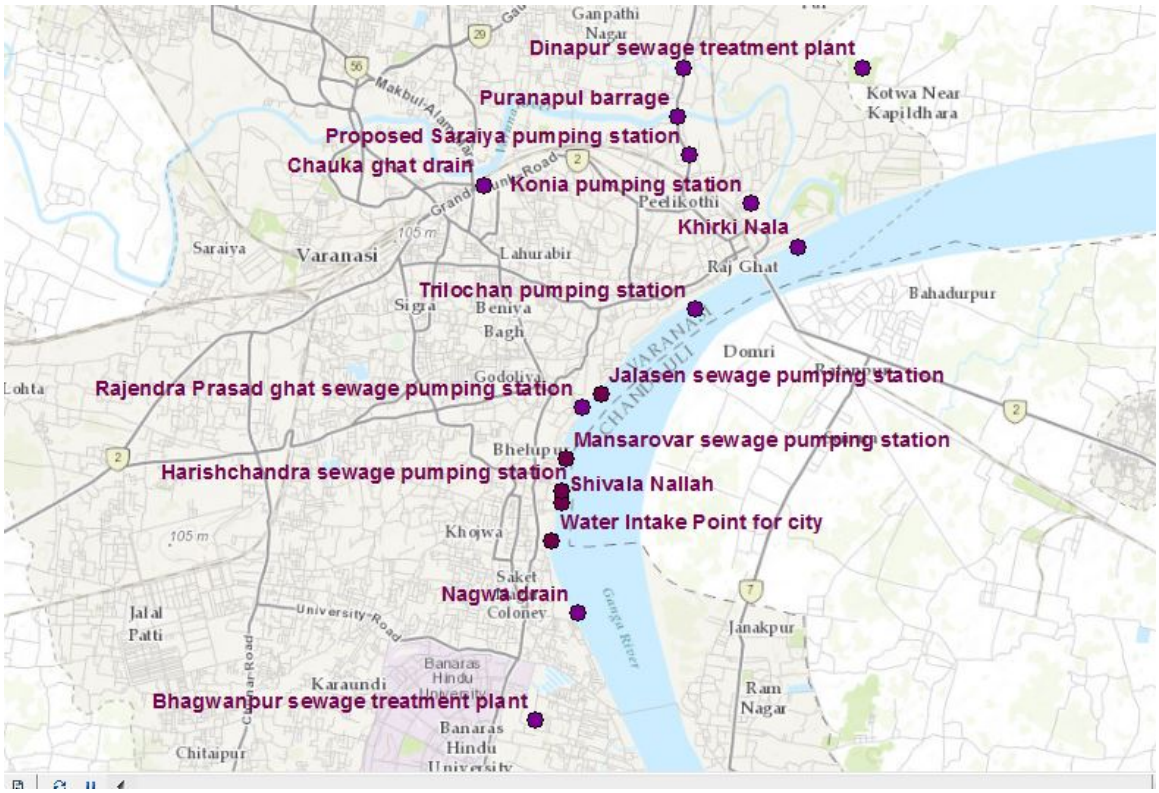
So what is the current situation with the main wastewater drains? The main drains for the city are the Nagwa drain, located in the south and upstream of the main city, and Khirki nallah, located in the north downstream of the main bathing ghats. The Ganga flows northward at Banaras (see map). The Varuna 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 recently built under the Puranapul Bridge that crosses the Varuna River. The Varuna river banks downstream of that barrage have also become the dumping grounds for all forms of solid waste and the entire landscape is hellish. One wonders how the communities in the vicinity can survive.

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 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, so that means it was running at 1/3 its capacity. This would also mean that the Dinapur treatment plant was receiving only 1/3 of the wastewater it is capable of treating, according to its nominal treatment capacity, and therefore it was running at 1/3 capacity. However to be exact one would have to know how many hours the one pump operates each day of the week and then the capacity factor can be calculated. For instance, if the pumping station runs at 1/3 capacity for only 6 of the 24 hours each day then the capacity factor would be 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 would sky rocket. The UP Jal Nigam does not keep a daily operational log with data like energy usage data, and thus there are no metrics, no measures, and no good management practices. This adds up to a lack of proper governance. Many monitoring committees have made visits to site facilities but have failed to correct the daily malfunctioning of the entire system. On my trip to videotape the Khirki wastewater drain in late June, I said to the boatman taking me, "So they release this water into Ganga ji at night and in early morning, right? Like chup ke?" He replied, "No Madam not chup ke. It is right there running wastewater all the time. Everyone can see it, and they are not even bothering to hide it!"

Below are current pictures of parts of the system that have been damaged, destroyed or poorly maintained. The map can be used to place these pictures in the city space.



Map of main infrastructure facilities in Varanasi

Rajendra Prasad ghat sewage pumping station (one of five ghat pumping stations that send sewage running underground toward the river back to the main trunk line and on to Konia pumping station)

A drain in the western side of Banaras in the unsewered area near the Varuna river. This drain runs to Chauka ghat where the Chauka ghat pumping station is proposed.

The Puranapul bridge with the barrage hidden behind the pillars.

Solid waste dumpsites just downstream of the Puranapul bridge.

A drain in the trans Varuna region.

Khirki Nallah, just upstream from the confluence of the Varuna & Ganga rivers and downstream from the sacred city.

Bhagwanpur sewage treatment plant.

Konia sewage pumping station. Only one screw pump is working.

Another shot of Konia sewage pumping station with only one screw pump working.

Aeration basins at the Dinapur sewage treatment plant.

Low efficiency splasher aerators in the aeration basin

Secondary clarifier at the 80 MLD Dinapur sewage treatment plant.

Canal taking treated effluent back to the river.

Treated wastewater--it looks "clean" but the fecal coliform content is usually in the range of 100,000 MPN/100ml to 1,000,000 MPN/100ml. This is well above safe levels for bathing and human consumption.

Nagwa wastewater drain, near the confluence of the Assi and Ganga and upstream of Assi ghat and the raw (drinking) water intake point for the city. The non-functioning Nagwa pumping station is in the background.

Sewage pipeline damaged by the flood of June 2013 but not repaired. When it was built, it was the pipeline to nowhere. There was no treatment plant constructed at its terminus in Ramana Village along the river bank and upstream of the Nagwa drain.

Power

We have to think about wastewater problems in the context of public health, environmental health, electrical power supply and national and state priorities for power distribution. In the current scenario using existing technologies and scales (there are better options for technology and scale), a significant amount of energy is required to pump and treat wastewater using sewage pumping stations and the activated sludge treatment process. In India energy supplies are allocated to industrial and urban needs long before they are distributed to sewage treatment plants. Looking at the current energy scenario in India it is not hard to see that wastewater pumping and treatment require continuous power and are not sustainable in the context of the current power deficit. Biological secondary treatment using the Activated Sludge Process (ASP) uses a significant amount of electricity to operate aeration equipment and mixers. Another technology used in Kanpur, the Upflow Anaerobic Sludge Blanket (UASB), is also a capital and energy intensive process. With other demands high on the agenda, it is unlikely that precious power will be available to run all the existing and proposed sewage pumping stations and sewage treatment plants on a daily basis now and into the future if the existing technologies and scales continue to be used.

Take Away Points

If wastewater infrastructure is built, it is done with large government investments of public funds, sometimes with capital from international banks; there is little private equity to drive the process. Instead the costs of building (and also poorly building) these facilities are absorbed across a range of human services including public health, education, housing and infrastructure. The costs of operating and maintaining sewage pumping stations and treatment plants are also high and operation and maintenance of the facilities become a low priority after construction.

For instance, the sewage treatment plant laboratories are ill-equipped and this means that the UP Jal Nigam operators are unable to monitor, measure, and report operational and water quality data. Due to the absence of laboratory equipment, instruments and analytical capacity, they are not able to optimize the treatment process. Generally the functional components of the sewerage infrastructure - the sewage pumping stations and treatment plants - are overwhelmed by the dysfunctional components and by the enormous pollution load. In this way the functioning units in the system become important, not for effectively treating the waste but for projecting a façade of functional infrastructure, especially when site visits by monitoring agencies are underway. Yet the norm is that facilities are operated only periodically and usually below capacity, and the result is that untreated wastewater is passed through open drains to agricultural fields or rivers. During rains and the monsoon, wastewater combined with storm water flows directly into the Assi, Varuna, and Ganga Rivers.

This sacred city requires a competent participatory authority to master plan, design, select the right scales and technology, construct, operate and effectively maintain a comprehensive wastewater collection, treatment and reuse system. Its governance requires clearly defined norms of transparency, accountability and participation.

A competent authority should connect central, state and municipal levels and be accountable to the residents of the city not just through the municipal corporation and its elected officials, but also directly through norms of participatory governance. These governance reforms should include clearly defined norms of transparency, accountability and participation that pertain to the entire system and to each component part--the pumping stations, sewage and water treatment plants, sewers and associated facilities. A piecemeal approach with the Jal Nigam exclusively at the helm has not worked thus far and it has sunk crores of rupees into poorly operated and maintained infrastructure, even in the face of national and global attention and numerous judicial interventions to the cause of Ganga cleanup. A careful constitution of accountable engineering agencies, a welcoming approach in planning and implementation to citizen contributions, and a vigilant monitoring of operations and maintenance practices by concerned citizen groups can go a long way to reforming the system. There is no doubt that this cause runs deep in the hearts of every Banaras resident.

Additional Information:
1) Video of the run off coming through the Rajendra Prasad ghat pumping station after a heavy rain in June 2014: https://www.youtube.com/watch?v=ujBB2FLYkZM
2) Video of Khirki Nallah in June 2014: https://www.youtube.com/watch?v=S0KUXEw7DRg
3) Video of Nagwa Nallah in June 2014:
https://www.youtube.com/watch?v=7xraLNjdPg4&feature=youtu.be