Swachh Bharat Mission
Groundwater Contamination in Peri-urban India

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The Swachh Bharat Mission promises to address issues of sanitation and water in rapidly urbanising areas. However, without an adequate understanding of all potential sources of contamination, the mission may, at best, only achieve the goal of universal sanitation but may not meet the goal of safe drinking water.

The Swachh Bharat Mission (SBM) was announced on 2 October 2014 with the objective to achieve universal sanitation and make India open defecation free by 2019, the 150th birthday of Mahatma Gandhi. The SBM is the latest sanitation programme, in a long line of programmes, going back to the First Five Year Plan in 1954 when the rural sanitation programme was first introduced. The SBM has arguably been more visible to the public than its predecessor, the Nirmal Bharat Abhiyan. The SBM programme is being implemented by the Ministry of Drinking Water and Sanitation (2014) (MDWS) for the rural (*Gramin*) segment and the Ministry of Urban Development (2014) (MoUD) for the urban segment. Under the SBM (Gramin), for example, there has been a rise of nearly 16% in households with toilets since 2014, and over 1.2 lakh villages have self-declared to be open defecation free. Similarly, under the SBM (urban), almost 28 lakh individual and community toilets have been constructed and 405 cities are open defecation free.[1]

The SBM, therefore, offers a promising solution to address the issues of sanitation and water in rapidly urbanising areas. However, the groundwater and sanitation nexus, in the emerging peri-urban regions, needs a detailed discussion in order to understand its implications for the SBM.

Peri-urban Infrastructure

The first step is to understand the characteristics of peri-urban regions. Although there are multiple definitions of what "peri-urban" means, broadly, it can apply to areas at the edge of the city which contain an overlapping mix of densely populated slums along with spacious well-constructed houses (McConville 2014: 1; Prakash et al 2011; Narain et al 2013). Moreover, the peri-urban areas are highly dynamic and are set to expand. In contrast, an urban city core is characterised by dense networks of underground drainage (UGD) systems and piped-water supply networks, whereas rural regions have a high incidence of open defecation due to insufficient toilets and the limited presence of piped-water supply (primarily public taps). In peri-urban towns, local groundwater is the primary source of domestic water supply and on-site sanitation systems (OSS) are the primary human-waste disposal method. One statistic indicates that in the peri-urban regions of Chennai, the incidence of open defecation is about 16% (Vasundara 2012), and the majority of households use some form of OSS such as septic tanks, soak pits and lined pits. Groundwater and surface water quality become a concern as poorly designed soak pits and septic tanks can leach contaminants into local waterbodies and aquifers (Shah 2014: 6). Moreover, such local or decentralised systems are viewed as "stop-gap" measures, or transient solutions, with the long-term goal of moving towards a centralised UGD system.

Under the centralised UGD system, the sewage is transported through pipes to centralised treatment plants at a significant cost. In Bengaluru, for example, there are plans to set up 19 new sewage treatment plants (STPs) with the intent to pump 800 million litres of sewage over a long distance at a cost of ₹2,500 crore (Menezes 2016). However, the STPs may not be effective in treating the wastewater. A recently concluded study by the Ashoka Trust for Research in Ecology and the Environment (ATREE) shows that due to a lack of adequate underground sewage networks, the Vrishabhavathy-Valley Treatment Plant (VVTP), one of the oldest STPs in Bengaluru, is unable to treat waste water efficiently (Jamwal et al 2015).

The centralised treatment of wastewater and piped-drinking water, nonetheless continues to be applied in small towns. Ramanagara and Doddaballapur, two small towns in the periphery of Bengaluru, were recently upgraded from OSS to UGDs; but due to insufficient funds for laying the UGD networks or for operations

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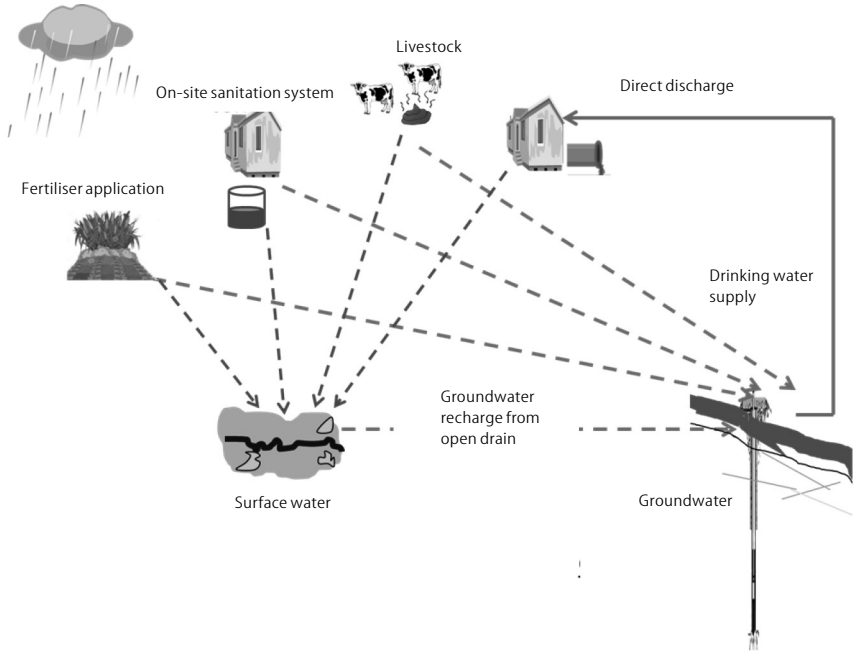
Figure 1: Sources and Pathways of Groundwater Contamination



and maintenance (O&M), the STPs are either defunct or inefficient. As a result, the untreated waste water is released into local waterbodies. This has led to contamination of surface waterbodies in the area. In the context of rapid urbanisation, expanding the UGD systems can be an expensive and inadequate solution to the waste-water problem.

Decentralised sanitation and water supply solutions are promising alternatives and a well-designed OSS can eliminate the possibility of water contamination. Therefore, rather than transient solutions, these systems can function as potential long-term solutions. However, it is important to map out all possible contaminants and their pathways under the decentralised water supply and sanitation system. This way, not only can the SBM be used to design effective sanitation solutions, but also indicate when and where to intervene, to protect domestic water supply.

The link between decentralised sanitation systems and groundwater is complicated by the fact that apart from poorly designed OSS, there are other sources of contamination such as fertilisers, livestock waste, and solid waste. The question then is: are agricultural pollution, livestock waste, and solid waste contributing to water contamination? And based on the sources and pathways of contamination, and the extent to which OSS contributes to contamination, what are the most effective points of policy intervention? The next section explores the linkages between the groundwater contamination, domestic water, and surface waterbodies, in a fairly typical peri-urban town where sanitation systems and domestic water sources are localised.

Pathways of Water Contamination

Broadly, water contamination sources can be classified into sanitation-related and non-sanitation-related sources. Under sanitation-related sources, households may dispose both black water (untreated/partially treated sewage) and grey water (domestic waste water other than sewage) into open drains, which contaminate local waterbodies and which further contaminates the groundwater, or the waste water percolates into the groundwater from poorly designed soak pits and septic tanks.

In case of non-sanitation related sources, the past use of fertilisers (chemical pollution) and animal waste disposal (biological pollution) remain relevant in peri-urban towns, as they transition from rural areas into semi-urban regions. The aspect of past pollution, as a major source of contamination, has not been addressed in the SBM. If, in a peri-urban town, past pollution from agriculture or current livestock practices is the major contributor to water contamination, then the SBM may achieve the goal of universal sanitation but it will not solve the problem of unsafe drinking water, as most drinking water treatment systems are not designed to treat nitrates.

Moreover, the underlying nature of the aquifer can significantly influence the rate of flow of the contaminants. In areas with hard-rock aquifers, there have been examples of groundwater contamination from nitrates even at depths of over 1,200 feet (NRDWP website), because of the presence of "preferential flow paths" through fractures. Figure 1 illustrates the sources of contamination and their pathways.

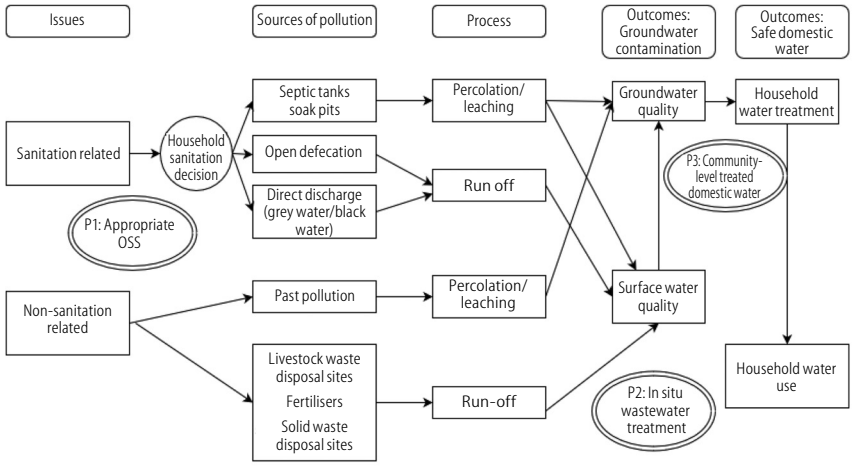
Policy Interventions

The mapping exercise (Figure 2) illustrates that in peri-urban areas water contamination can stem from poor sanitation and from non-sanitation related activities. The scale, scope and types of policy intervention(s) will be dependent on the source and type of contaminants. The three points of policy intervention (P1, P2, and P3) based on the source and types of contamination are:

P1: Appropriate OSS: If it is established that household-level poor sanitation systems and toilet designs are the main source of contamination, then the appropriate intervention is well-designed toilets and OSS under the SBM. Households can be incentivised, under the SBM, to move from soak pits to an improved OSS such as lined pits or septic tanks. Under the SBM, households can also avail the services of honeysuckers[2] at a subsidised rate to remove the waste from their pits. This can benefit poorer households which invest in soak pits, not only because they are cheap but because they cannot invest in private honeysucker services frequently, as they tend to be expensive.

P2: In situ wastewater treatment: In the case of partially treated effluents being directly released into open drains, low-cost technology such as reed-beds in open drains and constructed wetlands can be used.

Figure 2: Contamination Pathways and Points for Policy Interventions



P3: Community-level treated domestic water: If it is found that contamination is taking place from non-sanitation related sources, any interventions in the design of sanitation facilities will not solve the problem of water contamination. Contaminants such as nitrates and fluorides cannot be treated with the simple process of boiling water. In such cases, community-level intervention to provide treated drinking water is a potential solution (for example: Water automated teller machines). This intervention is especially crucial for low-income and slum households.

Future of OSS in Growing Cities

There is significant potential for local domestic water supply and sanitation systems to act as long-term solutions in rapidly growing peri-urban areas. However, as towns grow and become more populated, their water consumption as per government norms also increases. Technically, if the per capita water-use in toilets increases, it will reduce the cost efficiency of the oss as the pits fill up faster and require frequent cleaning. Given that peri-urban towns are fairly young, there is scope to introduce subsidised water-saving sanitation options (for example: Ecosan toilets) on a large-scale. Alternatively, as more apartments are built over time, apartment level waste-water treatment can be a potential solution. Repeated engagements with the local community to influence people's sanitation and water-use behaviour can also provide a sustainable solution to the problem of the groundwater and sanitation nexus.

NOTES

1 http://www.swachhbharaturban.in/sbm/home/#/SBM.

2 These are trucks that are used to collect and safely dispose solid waste from septic tanks and soak pits.

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