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Large-scale sanitation programme, climate trends, aquifer vulnerability and public health impact: a study from two Indian states

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42nd WEDC International Conference**ONLINE: 13 – 15 September, 2021****EQUITABLE AND SUSTAINABLE WASH SERVICES:
FUTURE CHALLENGES IN A RAPIDLY CHANGING WORLD****Aquifer vulnerability and public health impact of large
scale sanitation programme:
Examples from two Indian States**

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Background

The Sustainable Development Goal (SDG) Goal 6 (UN 2017) aims to increase the access to safe drinking water for major population across the world (Clasen, *et al.*, 2012). As it is widely recognized that inadequate separation of human excreta from human contact presents a serious threat to water sources and to public health (Bartram and Cairncross, 2010; Prüss-Ustün, *et al.*, 2014). In the last five years, India has made significant improvement in sanitation access and gains on health indicators specially reduction in Diarrhoeal diseases. In a study based on long-term temporal (1990–2017) and high-resolution spatial (n=2217) datasets of water-borne faecal pathogen concentration in groundwater, using satellite-based nightlight (NL) and multivariate statistical models to investigate the statistical trends and causal relationships. Results shows that the spatially variable groundwater faecal pathogen concentration (FC, 2002–2017) has been significantly decreased across the basins. Role of India's Sanitation Programmetowards improved sanitation construction and utilization are the major factors which govern the drastic decrease of faecal coliform concentration after 2014 (Duttagupta S. *et al.*, 2019). However, other studies suggest that sanitation interventions in rural areas are also contaminating groundwater derived potable supplies. Here hydrogeological settings, inadequate headworks, poor sanitary seals, and/or faulty casing are likely factors of excreta entering individual supplies as a result of (J.P.R. Sorensen, *et al.*, 2016). large scale sanitation campaign. Given that 65% of rural India is dependent on groundwater for drinking and domestic purposes, the contamination of drinking water through sanitation remains a big concern for the spread of diseases. However it is also observed that despite the widespread global reliance on both pit latrines and groundwater, a limited number of studies have explicitly examined links between groundwater pollution and contamination from on site sanitation. Within these studies, the quality of experimental techniques and chosen indicator contaminants varied greatly.(Jay P. Grama, 2013).

This study was undertaken in the districts of Bahraich and Samastipur from Indian provinces ofUttar Pradesh (UP) and Bihar with the objective to look into the impact of Sanitation programmes on water, environment and health across ODF (Open Defecation Free) and low ODF locations. The study area in both the states are part of Gangetic River alluvial plains comprised of Quarternary Sediments with high water table conditions. For the sampling purpose two cohorts of three villages each were identified in the study areas of UP and Bihar where both structured purposive and random sampling techniques were used. At the core of the study, fecal contamination tests were conducted at water sources, and health surveys at household level. Analysis in cohort villages of 2 states, over a period of three years from 2017-19 show that higher rainfall period for a sustained duration of three or more months results in the spread of fecal contamination of groundwater from sanitation facilities, with a high correlation of 0.89 over 3 monthly rainfall trend and fecal contamination percentages. This also reflects the fact that seasons are a stronger determinant of water contamination than ODF status. It is also observed that when the distances between sanitation and drinking water facilities is more (UP vs Bihar), the fecal contamination reduces from 40% to 80% across seasons. This

however remains the same across villages which are at different stages of being Open defecation free (ODF), implying that contamination levels are more climatic and rainfall controlled. A sanitation and groundwater assessment tool was applied to develop a risk assessment model for on-site sanitation to water contamination in the study locations across seasons, that confirms similar patterns as from the study, and suggests additional measures of containment of fecal waste and distancing as necessary conditions to prevent the spread of epidemics from Water. Health data across sites with ODF/non ODF status villages were also analyzed, where villages in UP reflects statistically significant difference across water vector, water borne and water washed disease, with ODF villages showing a strong improvement in health indicators. However this is not observed in Bihar, one possibility could be greater distance separation between sanitation and water sources in case of UP. Primarily, the study concludes the following observation:

- There is no significant fecal contamination difference between ODF and non ODF villages across seasons, sites and locations
- A seasonal trend of fecal contamination is observed in each site which is controlled possibly by groundwater levels
- Disease incidence shows significant reduction with ODF status in Bahraich, but not in Samastipur

It is therefore important to ensure mandatory monitoring of groundwater sources in areas served by on-site sanitation systems.

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