Action brief

March 2022

Nitrate and Fluoride in groundwater:
An emerging threat in rural areas

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Context:

- Groundwater is generally thought of as safe for human consumption, as it is considered a natural underground source. It is assumed to be less susceptible to microbial and other contamination when compared with surface and freshwater sources.

- Contamination of groundwater is caused either by extraction of water due to leaching of the naturally occurring chemicals, or by infiltration of chemicals from the surface from agriculture use or, contamination through pollution from industry and urbanisation.

- The chemicals analysed in the current study area are fluoride and nitrates. The consumption of water with higher than the permissible levels of both nitrate and fluoride, causes several health problems such as methemoglobinemia and fluorosis respectively.

- The quality of groundwater from a different point and non-point sources requires assessment for contaminants, to avoid health risks to humans.

Key Recommendation:

The groundwater quality needs to be checked for multiple parameters with multiple perspectives other than just comparing water quality with standards prescribed by WHO/BIS

Introduction:

Water for human consumption and agriculture (irrigation) are met through the shallow open well and deep bore-wells in many parts of India (Jha & Sinha, 2010). In India, over 90% of rural and 30% of urban population depend on groundwater for drinking and domestic purposes (Jaiswal et al., 2003); approximately 85% of the groundwater is used for irrigation and 10% is used for domestic and drinking purposes in Maharashtra (Duraiswami, 2007). Groundwater is considered a safe source for human consumption as it is supposed to have natural quality, consistent temperature and less susceptibility to microbial contamination as compared with freshwater resources (Mukate et al., 2018). This has resulted in 93% of the total drinking water sources being entirely based on groundwater that meets the needs of about 90% of the rural and 3% of the urban population in Maharashtra (Duraiswami, 2007).

a

b

Figure 1: Typical groundwater sources in Rural India: (a) A bore well and it's surrounding in a village (b) A dug well for agricultural use

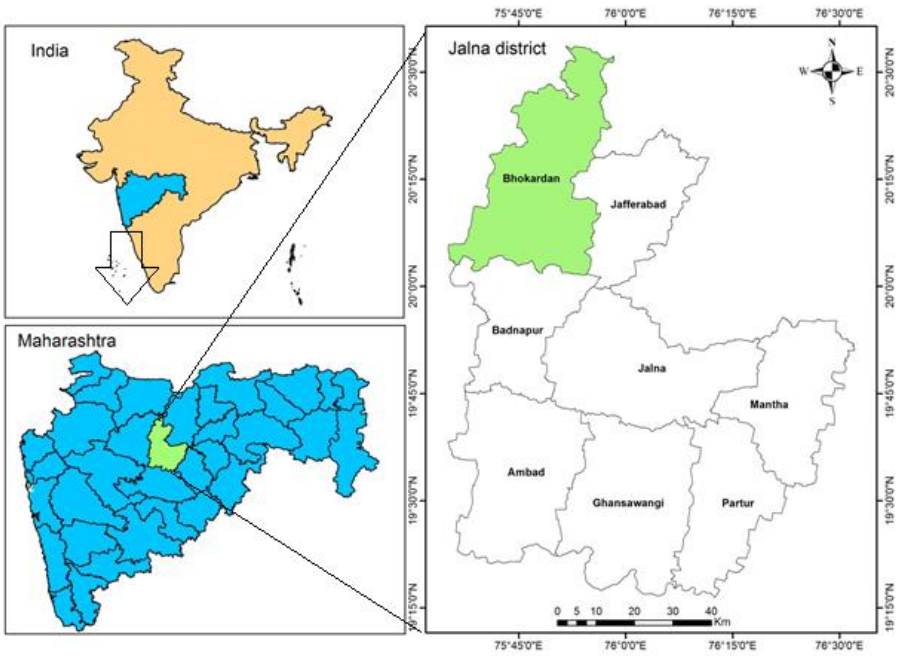
Fluoride contamination in groundwater is largely attributed to the geogenic sources, and nitrate pollution to anthropogenic reasons (Central Ground Water Board, 2014), mainly caused by its application in agriculture. Consumption of nitrate rich groundwater can cause methemoglobinemia, or blue baby syndrome, and other health problems for pregnant women (Fewtrell, 2004). Excessive fluoride in drinking water leads to disruptions in bones and teeth (Alvarez et al., 2009; Fejerskov et al., 1990) as is observed in fluoride contaminated areas throughout the world (Ali et al., 2016). Hence, there is a need to identify the health risks arising due to increased nitrate and fluoride in groundwater among the different age group of the population residing in Bhokardan tehsil of Jalna district.

Justification:

A study was undertaken in 2018 in the Bhokardan tehsil of Jalna District in the Marathwada region of Maharashtra. Bhokardan tehsil covers 1204 km^2 comprising of 157 villages, and has approximately 62,566 households with residents of 3,11,303 (2,86,887 in villages and 24,416 in municipal council of the Bhokardan town). The tehsil experiences the sub-tropical to tropical temperate monsoon climate with an average rainfall of 688.32 mm from the south west monsoon. Majority of the rural inhabitants are from the agriculture community, this being their main livelihood source. Where water resources are available, agriculture is dependent of irrigation, and is mainly flood irrigated. In general, farmers cultivate cash crops of soybean, BT cotton and maize, which require high amounts of chemical fertilizers such as DAP, SSP, Urea and 15:15:15.

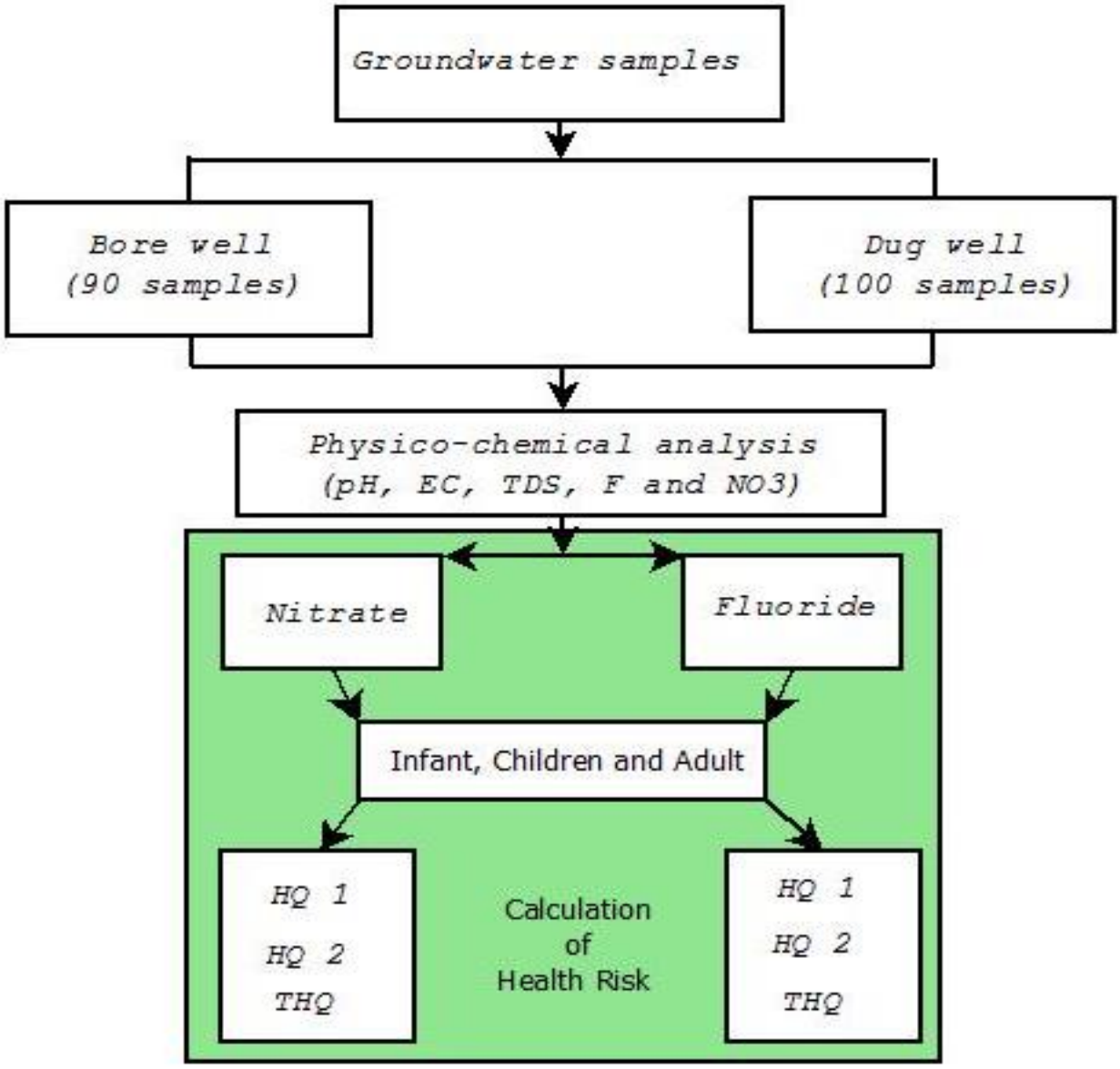
This context triggered a study to be undertaken with the following objectives:

- To evaluate the concentration of nitrate and fluoride in dug wells and bore wells.
- To assess the health risk emerging from the elevated concentration of nitrate and fluoride for different age groups residing in Bhokardan tehsil



Map: Study site location map

Methodology:



Study Findings/Results:

Nitrate content in 14 bore wells and 77 dug well samples exceeds the 45 mg/l permissible limit, hence is unsafe for drinking

Fluoride content: only one sample each from a dug and bore well has the concentration below the permissible limit of 0.5 mg/l; majority of the samples (i.e. 63 – bore wells and 58 dug wells) have a concentration between 0.5 – 1.5 mg/l, and 41 dug wells and 26 bore wells have the fluoride concentration above 1.5 mg/l which exceeds the permissible limit set by BIS

The children are highly vulnerable to fluoride and nitrate contamination in groundwater followed by infants and adults.

Conclusion:

The regular and excessive use of nitrates as fertilizers in agriculture seems to be the cause of nitrate contamination, as water is the dug wells have a higher concentration as compared to the water in the deep bore wells. The nitrate risk is higher in dug wells because of the mixing of surface run-offs from the agriculture fields and water infiltration that generally occurs during the rains and in flood irrigation.

As fluoride is of geogenic origin. It is the extraction of groundwater that causes its leaching into the water. With the number of wells and borewells are on the increase in Bokhardan, the risk of fluoride contamination and its impact on human health will further increase.

By following the Adaptive Sustainable Agricultural Practices and the use of organic fertilizers in Bhokardan tehsil, the health risks can be minimized. In addition, the promotion of rooftop rainwater harvesting for human consumption can reduce the impact of both contaminants.

Recommendations for Action:

This study emphasizes the importance of monitoring of nitrate and fluoride levels in dug wells and bore wells. Human health risk assessment will help to identify the individuals at risk due to nitrate and fluoride enrichment in groundwater. It will help to reduce the present and prevent future implications on human health.

This study offers the following recommendations for programmatic action at the level of the concerned authorities in the health, and agriculture departments, as also at the practitioner and gram panchayat/community levels. Coordination between these actors is important.

- Monitoring of nitrate and fluoride in drinking groundwater resources periodically
- The health risk assessment and the health risk identification surveys are to be carried out at a regular interval
- At the community level, awareness about the health impacts - the symptoms of fluorosis and nitrate toxicity are to be disseminated to villagers and the alternatives that remedy / prevent the situation.
- Roof water harvesting for household consumption is to be promoted.
- The agriculture link to the health impacts of chemical contamination and groundwater extraction needs to be discussed with villagers and together with the alternatives are to be sought.
- The groundwater protection through concretization around bore and dug wells structures are of prime importance and should be practiced wherever necessary

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