Case Study: **India**

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NILOGON TECHNOLOGY: A HOME-BASED COMMUNITY LEVEL SOLUTION FOR FLUORIDE MITIGATION IN KANKER DISTRICT OF CHHATTISGARH, INDIA

Background

Chhattisgarh is a state in central India. Water contamination has always been a matter of grave concern in numerous areas of Chhattisgarh. Groundwater here faces contamination with fluoride, iron, turbidity, arsenic, nitrate, etc. Monitoring groundwater quality is essential through representative sampling in different hydrological units. The chemical water quality is monitored by Central Ground Water Board (CGWB)once a year in India. 19 districts of 28 districts of Chhattisgarh are affected by fluoride (CBGA Report, 2019). Nearly 90% of the rural population of the country uses groundwater for drinking and domestic purposes and due to excess fluoride in groundwater, a huge rural population is threatened with health hazards of fluorosis (CGWB report). Drinking water dependency is also high in the ground water source in Chhattisgarh. An excessive amount of fluoride in drinking water exposes people to risks of skeletal fluorosis, dental fluorosis, and/or both.

Kanker is one of the fluoride-affected tribal districts of Chhattisgarh. As per the Bureau of Indian Standards (BIS), 10500:2012 the acceptable limit for fluoride in drinking water is 1.0 mg/l whereas the permissible limit in the absence of an alternative source of drinking water is 1.5 mg/l [1]. In some villages though, the fluoride contained in the water exceeds 5.0 mg/l. Therefore, in many villages in the Kanker districts children and other populations are found to be with dental fluorosis.

[1] The Bureau of Indian Standards (BIS) has specified safe drinking water quality standards (IS 10500:2012) which is followed for Drinking Water Supply protocol by departments of drinking water supply in India.

Strategy and implementation

Global water quality monitoring framework

The UN General Assembly in 2010 declared access to clean water a fundamental human right and a prerequisite for the realisation of many other human rights. SDG 6.1 aims to achieve universal and equitable access to safe and affordable drinking water for all by 2030. Indictor 6.1.1. speaks of the proportion of the population using safely managed drink water services[2].

UNICEF's Water Game Plan: Universal safe and sustainable water services for all by 2030 (March 2020) says geogenic contamination is present and persistent in many locations. At least 200 million people drink water with concentrations above the 1.5 mg per litre guideline for fluoride. It suggests that the approaches to addressing quality standard issues include investments in water treatment technologies, innovation, supply chain strengthening, household water treatment and safe storage, or chemical removal (including the use of reverse osmosis when technically and financially feasible).

National strategy

The government's national flagship program Jal Jeevan Mission (JJM)[3] aims to provide tap water connections with adequate quantity (55 LPCD - Liter Per Capita per Day) and prescribed quality (BIS:10500) to every household by 2024. Recognizing the risks, water quality-affected areas are accorded priority in the implementation of JJM. Similarly, water quality monitoring and surveillance activities are also prioritized.

Strategy for community-level intervention

In line with the global and national framework on water quality management, UNICEF Chhattisgarh began implementation of this project on fluorosis mitigation in the Kanker district with home-based water filter technology in November 2021.

UNICEF India Chhattisgarh's office partnered with the district administration and a local civil society organization named Samarthan to intervene in 60 villages affected by fluoride. It had as objective to empower the community with skill and knowledge for the entire intervention. In collaboration with the health department health camps were planned to physically identify a population with fluorosis and create awareness. [4] As a short-term measure water purification at the household level was important to reduce the number of people affected by fluorosis. It was also important to make the community aware of food habits to be adopted in areas with high fluoride content in water. Following activities were undertaken to achieve project results.

1. Selection and intervention of household-level fluoride removal water filter
    a. 60 villages were identified for intervention in consultation with the Public Health Engineering Department (PHED) and community-based organizations.
    b. Village-level meetings, mapping of water sources, and focus group discussions were organized from November 2021 to March 2022.
    c. Forty-four health camps were organized in three blocks (Kanker, Charama and Narharpur) covering all 60 intervening villages.

2 A safely managed drinking water service is defined as one located or premises, available when needed and free from contamination.
3 Jal Jeevan Mission (JJM) is a national flagship program in India which was launched in 2019 to bring piped water supply to every rural household in India by 2024.
4 The concept of transferring the skill of women on water quality testing through FTK is one of the mandates of the JJM.

d. Physical verification of 4041 people in the age group from 10 years to above 70 years was done in health camps in which 1800 people were identified as affected with fluoride.
e. Based on the health camp and household level data collected from 60 villages, two villages which had a maximum number of fluorosis cases were identified for intervention.
f. After a series of discussions with local self-government leaders (*Sarapanch*) and community members of two intervening villages, a urine test for fluoride was done for 160 members above the age of 40 from different households.
g. Out of those 160 persons, 80 with high fluoride in urine were selected to receive the household water filters.

2. Adoption of Nilogon Technology for water filtration at the household level

Nilogon is a tested fluoride removal technology developed by Dr Robin Dutta and team at the Department of Chemical Science, Tezpur University, Assam. Nilogon means removal in Assamese. According to a research article on India waterportal: "*Fluoride Nilogon may be called the phosphoric acid-crushed limestone treatment method of fluoride removal from water. (…) The crushed limestone bed remains active for at least four years and nine months. The crushed limestone bed where the fluoride-containing water, premixed with a very small quantity of edible phosphoric acid to 0.00068 molar concentrations, is treated for a residence time of 3 hours*." [5] The same source mentions that "*Fluoride Nilogon units can be custom designed with any capacity of treated water*."

The household-level Fluoride Nilogon units (15 litres per batch capacity) adopted in Kanker district in 80 households by UNICEF was given out in two villages: Murdhuwa (Charama block) and Shamtara (Narharpur block) constituted a) a 40-litre plastic bucket with a plastic tap for the crushed limestone bed b) approx. 50 kg of crushed limestone between 0.1 and 1.5 cm big, c) a sand-gravel filter of a 20-litre plastic bucket.

The cost of one filter is around 3500 Indian Rupees in the Kanker district. The cost for limestone, which has an almost unlimited lifetime, is included. Recurring cost incurred in the use of the Fluoride Nilogon filter are the cost of phosphoric acid and for distilled water.

During the project time the market retail price of 1 liter of 85% phosphoric acid was 200 Indian Rupees and distilled water cost about 50 Indian rupees per liter. 900 ml distilled water were used for dilution with 100 ml phosphoric acid. Only 7 ml diluted solution were required for filtering 15 liters of water.

The Tezpur University claims that this low-cost filter technology is environment friendly and limited maintenance is required.

3. Community mobilization and system strengthening for the sustainability of program intervention

a. Community members were oriented on the water filter technology and food habits to be adopted in fluoride-affected areas.
b. A user group consists of 25 to 30 members with one member of different households being trained.
c. *Sarpanch, Panch* members from each ward (lower units of local self-government), and health front-line workers (*Mitanins*) are also members of this group.

[5] Nilogon for fluoride removal from groundwater

Progress and results

Surveillance activities for water quality management identify and evaluate factors that can pose a health risk. Active community involvement in water quality surveillance activities enabled them to take preventive or remedial action to ensure potable water. The intervention process, findings of the water quality test, and urine test were discussed at the district level with district officials from different government departments. Some key results are listed below:

a. All 80 households that received the water filter provided by partner Samarthan supported by UNICEF are using it.
b. Wall painting on fluorosis and food habits was done in various key places in the 60 intervention villages to support messaging.
c. 300 women named *Jal Behni* (water sisters) were trained on water quality testing via field testing kits by project staff in collaboration with PHED staff working for JJM at a local level. The gained capacity is enabling the women to test water from all sources in their respective villages.
d. 24 drinking water sources in two intervening villages have been tested through field testing kits and a confirmation test has been done in the district water quality testing laboratories of PHED.
e. Three user groups are meeting every fortnight to discuss issues relating to water quality and collect funds for the maintenance of the water filters. Funds per household vary from 100 to 200 Indian Rupees depending on the size of the household.
f. Such training for women and the involvement of local leaders, youths, and school children in the project area have increased awareness of water quality management and fluorosis.
g. Dietary counselling by field volunteers, front-line workers, and user group members resulted in changing the food habits of the community. This will be supporting improved future health outcomes.

Lessons learned and way forward

Key lessons learned while implementing this project and some ways forward are explained below.

a. The evidence generated from this intervention needs further distribution. UNICEF India Chhattisgarh office will work with the district administration to develop a framework of water quality monitoring and surveillance (WQMS) with a special focus on fluoride and bacteriological contamination. Convergence of various departments will be promoted further (Phase 2)
b. Rural villagers were keen to adopt new technologies, however, for responsible and sustainable scale-up, government departments need to promote interventions at the household level until the supply of safe water from an alternative source, in such water quality affected areas can be guaranteed.
c. Upstream advocacy at the state level will be done by sharing the learning from this UNICEF intervention in the Kanker district for scale-up by local government in other parts of the state and beyond state boundaries. Other states and countries which are facing similar geogenic contamination in groundwater may adopt similar small community-led technological interventions to manage water quality issues locally.

d. Different financing opportunities can be explored for water quality management. Confining CSR funds, additional earmarking of specific human resource provisions, and funds can be planned. Good, innovative public-private partnership (PPP) models for WQMS can be created to achieve the global goal of universal and equitable access to safe and affordable drinking water for all by 2030.

Related links:

- States Wise Details of Partly Affected Districts with Select Contaminants in Ground Water of India
- Indian Standard Drinking Water- Specification
- Groundwater quality features of the country

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