INTEGRATED DRINKING WATER MANAGEMENT

RATIONALE - THE WHY

India is faced with an unprecedented problem of drinking water contamination today. 80% of the country's residents depend upon groundwater for drinking purposes (Central Groundwater Board, 2018-19). Excessive extraction has led to severe contamination of the resource from point/non-point sources and due to natural geogenic processes (Krishnan, 2012).

Apart from biological contaminants, excessive levels of fluoride, arsenic, nitrate, iron and salinity are affecting groundwater aquifers of different regions of India. A major challenge is the limited geological understanding which inhibits our knowledge of the distribution of these contaminants (Ibid).

RELEVANCE FOR THE CENTRAL TRIBAL BELT

An ironic reality is that water-related diseases have a significant poverty signature and are thus mostly associated with the poor and marginalized sections of society. According to a study of 25 villages in North Gujarat (Shah & Indu, 2004), 70% of the people suffering from atleast one of the forms of fluorosis were from the monthly income group of Rs. 500 to Rs. 3500 with an average cost (medicinal + wage loss) of Rs. 5,500 per person per year on treatment for the same (Ibid).

INTEGRATED DRINING WATER MGMT - THE WHAT

In the face of the massive increase in disease burden in rural areas due to consumption of contaminated drinking water, an Integrated drinking water solution is needed that combines measures such as regular water quality testing, access to safe water nd focus on proper diet and nutrition. INREM's work on water quality management offers valuable insights in this regard.

IMPLEMENTATION PROCESS - THE HOW

A step-wise process adopted by the organisation is mentioned below:

1. Water quality testing of common sources
2. Health check-up of the entire village community
3. Identification of people affected by diseases
4. Awareness generation about effects of drinking contaminated water
5. Capacity building of frontline health workers
6. Implementation of integrated prog
7. Set up of District Water Quality Mgmt centres

Water quality testing of common sources

Source Mapping of all the water sources, public and private, used by the village community is done. Water samples are collected to check the level of contamination. Basic water contaminants such as fluoride, nitrate, iron, salinity, tubidity, etc. are tested through Field Testing Kits (FTKs).

On the basis of the water quality tests which are favourably undertaken in the presence of community members, the contaminated sources are marked with red paint to signify that they are not suitable for consumption.

Health check-up of village community

Health check-ups are conducted to identify the water-related diseases present in the villages. If high fluoride has been detected in a water source in the village, the cases of dental and skeletal fluorosis are identified. If high arsenic has been found, instances of skin disease are sought, if iron contamination has been found, then cases of anaemia, sickle-cell anaemia are identified.

Awareness generation

Due to limited knowledge about water contaminants and the associated diseases, many superstitions abound among the community. People consult quacks and local healers who not only perform dubious rituals but charge a ton of money from the troubled victims.

A close-knit communication programme is thus required to make the community aware of the perils of consuming contaminated water. Involvement of community in water testing, street plays, interactive IEC material such as Safe water flashcards, wall paintings, etc. are used for developing a general understanding among the community about the health problems associated with poor quality water and its solutions.

Capacity building of frontline health workers

ASHA workers, ANM and Anganwadi workers play an important role in the identification of cases, provision of pharmaceutical tablets and follow-up of prescribed treatment. School teachers can play an important role in the provision of adequate nutrition through the supply of nutritional mid-day meals.

Implementation of Integrated water quality measures

Two core components of this approach are access to

Nilesh recovering in Jhabua, 2015

Source: : INREM Foundation Website

safe water and proper nutrition.

1. Ensuring Safe Water
Based on the results of the water testing exercise, the community is asked to discontinue the use of contaminated sources. Generally shallow dug wells and surface water sources have low levels of chemical contamination and borewells, as well as handpumps, have high chemical content.

In the absence of a nearby safe water source, portable water filters are installed at household level. For water contaminated with fluoride, activated alumina is used for treatment. Manganese green sand filters remove high iron whereas activated alumina and reverse osmosis are successful in removing excess arsenic from water.

2. Proper Nutrition
A diet rich in calcium, magnesium, zinc, Vitamin D3 and Vitamin C is recommended for treating dental and skeletal fluorosis. For treating anaemia, a diet rich in iron, zinc and vitamin C is recommended. Nutritional/Kitchen gardens at the community level or household level are promoted to ensure that the household is meeting its nutrient requirements.

Setting up of District-level centres
Setting up a District Water Quality Management Centre (DWQMC) helps scale up the programme in all the affected villages of the district. This centre brings together government departments such as PHED, Health, Education, Forest, etc. along with CSOs, activists and sector experts. The coordinated efforts of government and non-government bodies brings about desirable changes in the water supply, quality and management.

IMPACT

1. Reversal of skeletal fluorosis among children through a combination of safe water and proper nutrition.
2. Community knowledge building regarding basic water quality parameters and safe water sources
3. Access to safe drinking water through portable water filters
4. Collaboration with government on the integrated approach in 9 districts.

MAJOR LEARNINGS

1. Convergence is not easy especially when interdepartmental efforts are required. If clear delineation of department-wise responsibilities enables implementation of integrated approach.
2. The support of CSOs and activists is needed to take up the work at district and state-levels.
3. The importance of Behaviour Change Communication was realized early on in the programme when it was observed that despite visible results some community members were reluctant to participate. Various communication methods were deployed for training government frontline workers
4. While groundwater treatment is necessary and inevitable, over-extraction of the resource has made it unsuitable for human consumption in the future. The long term solution to this problem is household-level rainwater harvesting systems. Most houses in ancient India, especially in the western part of the nation were equipped with traditional roof rainwater harvesting structures which were

Change in design of water filters from clay to plastic to deal with breakage of clay pots | Source: : INREM Foundation Website

used to meet the drinking and domestic needs of the household.

5. Multi-layer Nutrition gardens (25by25ft) have proved an effective means to ensure the inclusion of green leafy vegetables in the diet of communities that are rich in calcium, magnesium and micronutrients.
6. Programmatic changes need to be made based on close monitoring of community feedback of the interventions suggested. INREM made different tweakings to their programme design in the initial years to ensure maximum adoption of the practices.

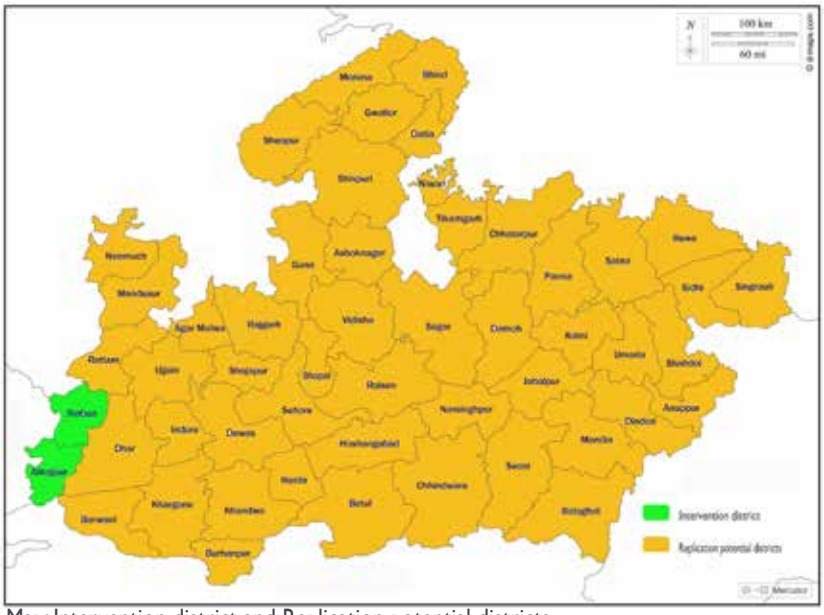
- The sweet and salted amla candies were replaced by amla tablets as sweet candies vanished in a day or two the salted ones were not touched by children.
- Despite cassia tora's high calcium content, its vegetable was rarely made by households, It was thus replaced with Cassia tora powder.
- Constant maintenance is essential for the proper functioning of fluoride removal filters. Towards ensuring sustained use of filters in this case, a modular design was prepared.
- The organization had promoted a household-level clay pot filter with activated alumina. It was learnt that the clay pots tend to break and the alumina taste was unpalatable. In response, the organization developed plastic-body filters and added activated carbon to improve the taste of water (Fluoride Knowledge and Action Network, 2016).

SUSTAINABILITY, SCALE UP AND REPLICATION

The Integrated water quality management approach initially piloted in Jhabua district now has nation-wide acceptance and replication. The programme has today evolved into a comprehensive approach for drinking water management being implemented in 9 districts across the country through District platforms on fluorosis and arsenicosis.

After the success achieved in treating cases of Skeletal Fluorosis, INREM set up the Fluoride Knowledge Action Network (FKAN) in 2013 with the support of Arghyam, European Union and UNICEF to take the lessons learned to other fluoride-contaminated parts of the country. This network brings together Civil Society Organizations (CSOs), government departments, prime experts on fluoride, activists and technology enthusiasts (Fluoride Knowledge and Action Network, 2016).

Under the network, District Fluoride Mitigation Committees (DFMCs) have been set up in priority districts; Chikballapur (Karnataka), Nalgonda (Telangana), Dungarpur (Rajasthan) and Nagaon (Assam).
The network has been successful in developing



Map: Intervention district and Replication potential districts

working models of mitigation efforts both as community-based programmes and as convergence programmes with government institutions. The PHED (Public Health Engineering Department), Health Department and Rural Water Supply Department (RWSS) are the major stakeholders.

Training of frontline workers of PHE and Health department on the identification of fluorosis and arsenosis, water testing, information on nutrition supplements, continuous monitoring of identified cases is undertaken. Coordinated efforts by frontline workers of the government, CSOs, activists and active community members have led to significant progress in the fight against fluorosis in the mentioned districts.

The FKAN has since been merged with the Arsenic Knowledge and Action Network (AKAN) coordinated by SaciWaters to form the larger national-level Water Quality Network in 2019. The work of the network is being implemented in 9 districts of 6 states through the District (Fluoride or Arsenic) Mitigation platforms.

Knowledge dissemination about water quality and associated health concerns emerged as a key area of focus during scale-up attempts. It was realized that to allow scale-up of the integrated approach.

The use of IEC and technological tools played an important role in the scale-up of the programme. Some of the efforts have been enlisted here:

- Nukkad Nataks (Street Plays)
- Safe water learning cards: These vernacular cards with customized and atomic content have been crucial in developing capacities of more than 10,000 front line health workers.
- Speaking Walls : Interactive wall paintings at common community spaces provide information about fluoride and arsenic-related diseases and preventive measures to people (Sen & Pawar, 2021).
- Water Quality Management Course: This online monthly course is aimed at equipping practitioners as well as government officials on information about water chemical and biological water contaminants, safe limits, corrective measures, etc. It has 9 modules delivered through two weekly sessions (INREM Foundation, 2021). The medium of instruction is bilingual (Hindi and English). To date, the course has completed 6 batches. The course aims to assist Jal Jeevan mission officials in taking the knowledge forward to rural communities. This course along with the system of Safe water learning cards, together will support a Behaviour change communication (BCC) campaign on the ground.

POLICY RELEVANCE

The fluoride mitigation work initiated over a decade earlier has now metamorphosed into a National-level Water Quality Network which works in close coordination with various government departments. The Network is playing a crucial role in improving the water literacy of government officials working under the Jal Jeevan Mission through the Water Quality Management Course. The network has emerged as an active platform for bringing up and addressing water quality issues across the nation.

The Jhabua Experience

In 2010, the INREM team was probing societal issues concerning water when they came in touch with nine-year-old Nilesh, who had severe skeletal fluorosis. He was bowlegged, complained of constant joint pain and couldn't walk properly. A life of handicap lay ahead of him. This led the organization to probe further. They surveyed inhabitants of two villages in Jhabua; Jasoda Khunji and Miyati, where the doctors associated with INREM diagnosed 23 children with skeletal fluorosis and severe bone deformities. All of them had high levels of blood serum and urinary fluoride (Forest Lanterns, 2017).

It was revealed that people were drinking high fluoride water upto 8mg/l on the one hand and on the other the calcium consumption was quite poor, upto 200 mg/day, much lesser than the recommended daily intake of 800mg/day (Fluoride Knowledge and Action Network, 2018).

In coming up with a solution the organization found that research in the 1980s and 90s had reasoned that clean water and good nutrition could reduce symptoms of the disease (Devotta, et al., 2007). It was also found that fluoride intake led to calcium deficiency in patients. As much as 40 mg of calcium was needed by the body for each ingested milligram of fluoride (Fluoride Knoweldge and Action Network, 2018). Other authors found that Vitamin C and Magnesium helped with fluoride detoxification.

By 2011, INREM Foundation had come up with a treatment protocol comprising of nutritional supplements and safe water. Shallow dug wells if found close by were recommended, and in cases of absence of safe water sources, a portable defluoridation unit was provided to households. It was developed by a local potter trained by INREM using clay pots and activated alumina. The work Dr Iyengar, IIT Kanpur did in the 1980s with help of UNICEF proved instrumental in designing the filters (Iyengar, Dwivedi, & Chouhan, 2007).

For ensuring needed nutrition, pharmaceutical Composite tablets having content per tablet of Calcium (1000 mg), Magnesium (150 mg), Zinc (4 mg), Vitamin D3 (IU 1000 mg) (INREM Foundation, 2013) were provided. For Vitamin C, initially sweet and salted amla candies and later amla tablets were provided. This was coupled with the promotion of food rich in these nutrients such as Til-gud Chikki, Soya, spinach, Amaranth, Milk powder and Eggs. The consumption of Cassia tora or Chakoda baji was recommended as it contains 500mg Calcium and 380 mg Magnesium/100 gm (UNICEF, 2004).

A robust communication strategy was built to ensure adoption of safe water and nutritional supplements, which was crucial to the success of the programme. Knowledge among community about water quality through simple field testing kits using the pink-yellow differentiators became popular and was known as 'lal-pila' among community members. The organization also undertook close monitoring of community's feedback on the practices introduced and made changes in the programme such as modified plastic modular filter, cassia tora powder, amla tablets, etc.

The organization followed individual cases closely and found promising signs of recovery. Nilesh joined the programme in 2010 and within 4 years, his bow-legged bone structure corrected considerably and he could run! A round of clinical tests including X-rays validated the recovery (Forest Lanterns, 2017) (Aarambh, 2014). His case story has been published in API Textbook of Medicine by Dr Raja Reddy (Munjal & Sharma, 2015).

25 children were rescued from a life of handicap and today lead normal lives as physically healthy adults. This has lend credibility to their integrated model as the recovery among affected children has been stark.

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