Azim Premji University

STORIES OF CHANGE

2019-2020

Case Studies on
Development Action and Impact

Azim Premji University Publication

Stories of Change: Case Study Challenge

Azim Premji University
2019-2020

Table of Contents

Stories of Change: Case Study Challenge

Azim Premji University

Modern India has a history of a vibrant and active social sector. Many local development organisations, community organizations, social movements and non-governmental organisations populate the space of social action. Such organisations imagine a different future and plan and implement social interventions at different scales, many of which have lasting impact on the lives of people and society. However, their efforts and, more importantly, the learning from these initiatives remains largely unknown not only in the public sphere but also in the worlds of 'development practice' and 'development education'. This shortfall impedes the process of learning and growth across interventions, organizations and time.

While most social sector organizations acknowledge this deficiency in documentation and knowledge creation, they find themselves strapped for time and motivation to embark on such efforts. Writing with a sense of reflection and self-analysis which goes beyond mere documentation and creates a platform for learning requires time and space. As a result, their writing is usually limited to documentation captured in grant proposals or project updates or 'good practices' literature with inadequate focus on capturing the nuances, boundaries and limitations of action.

Recognizing this need, the Azim Premji University launched 'Stories of Change: Case Study Challenge' with the objective of encouraging social sector organisations to invest in developing a grounded knowledge base for the sector. We are delighted to report that in the inaugural year of this challenge (2018 – 19) we received 95 cases, covering interventions from education, sustainability, livelihoods, preservation of culture and community health. The target groups included adivasis, small farmers, children, women, youth and differently abled persons, among others. Through a two–stage evaluation process, the university selected 3 winners and 3 special mentions for the 2018-19 Stories of Change Challenge. In addition, we have selected 4 additional submissions, which together with the cited winners, is appearing in this jointly published compendium.

We hope that educators and practitioners alike find these stories valuable in their multiple engagements: influencing policy, building capacity of practitioners, documenting good practices for future learners, providing space to practitioners in teaching, collaborative research and even incubating new ideas for social change.

Acknowledgments

This compendium is a result of Azim Premji University's 2018 – 19 'Stories of Change: Case Study Challenge'. We thank all the organizations who submitted their stories from the field for this initiative. We appreciate the time and effort they have spent in developing the cases.

We had a two – stage evaluation process to select the ten submissions included in this compendium. We deeply appreciate the 19 colleagues from Azim Premji Foundation who agreed to review all the 95 submissions and shortlist the best ones. Their names, in alphabetical order, are: Anchal Chomal; Annapurna Neti; Aparna Sundar; Arima Mishra; Ashok Sircar; Geetisha Dasgupta; Himanshu Upadhyay; John Kurien; Kade Finnoff; Malini Bhatacharjee; Manjunath SV; Manu Mathai; Nazrul Haque; Puja Guha; Rahul Mukhopadhyay; Rajesh Jospeh; Richa Govil; Saswati Paik and Shreelata Rao Seshadri.

Annapurna Neti, Ashok Sircar, Malini Bhattacharjee, Rajesh Joseph, Rahul Mukhopadhyay and Shreelata Rao Seshadri are also the authors of the introductions for the 5 themes in this compendium.

Multiple individuals from the 10 organizations selected for this compendium worked closely with University team as well as with the copy editor, Malini Sood, to arrive at the final print-ready versions of their cases. All of them took out time from their busy schedules and were always very prompt and serious in their engagement. This compendium is a reality only because of each of those individuals. We are also grateful to Malini for her very professional and careful language editing.

Throughout the entire initiative – from publicity and outreach about the case study challenge to final design and page layout of this book – our colleagues from the Communication Team supported and helped at every step. Thank you, Sachin Mulay, Radhika and Nanit for making this happen.

Finally, Anurag Behar, the Vice Chancellor of Azim Premji University, has been very supportive of the Stories of Change initiative. Our Registrar, Manoj P was, as always, enthusiastic and encouraged us to imagine the task at a bigger scale than we had planned earlier. We want to thank Anurag and Manoj for their continuous support.

As mentioned in the cover of this book, this is the first Volume of our proposed 'Stories of Change: Case Studies on Development Action and Impact series and we want to continue this effort in the future as well. We hope this book will reach the intended audience – educators, researchers, practitioners, policy makers as well as students of development – and will be regarded as a persuasive and authentic account of the Indian social impact ecosystem. Readers can write to us at case.study@apu.edu.in with their valuable comments, suggestions and reviews so that we can improve our next editions. Thank you for reading and look forward to hear from you.

2.2 Fluorosis Mitigation through Community-based Safe Drinking Water Supply in Dhar District, Madhya Pradesh

People's Science Institute (PSI), Uttarakhand[2]

Abstract

Fluorosis is a disease caused by a high concentration of fluoride in drinking water drawn from the ground through sources or devices like handpumps and tubewells. It results in physical deformities which affect not only the health and well-being of the people, but also their socio- economic conditions and status. The case study presented here is of Dhar district in Madhya Pradesh where this crippling disease mostly affects vulnerable population groups and children. The major cause is the dependence of people on groundwater that has fluoride levels that are much higher than the norm of 1.5 mg/l prescribed by the Bureau of Indian Standards (BIS), Ministry of Consumer Affairs, Food and Public Distribution, Government of India (GoI).1 There is no treatment for fluorosis, but the disease can be prevented or mitigated by consuming fluoride-safe water. Interventions like the installation of handpump-based defluoridation units have been largely unsuccessful in this region owing to their difficult operation and maintenance (O&M).2 People's Science Institute (PSI), Dehradun successfully

2 Contributed by Anita Sharma.

implemented community-based safe drinking water supply systems in 17 villages in Dhar district during 2013–18 with the financial support of FRANK Water, UK, a safe water and sanitation charity, and is extending the work in 10 more villages. The interventions were based on hydrogeological studies, groundwater and urinary fluoride monitoring, the creation of village-level institutions to manage water sources, and the adoption of community-based water supply systems that tapped fluoride-safe sources. PSI's initiative has set a successful example of the decentralized management of ground water resources and promises a sustainable and cost-effective solution to fluorosis.

Fluorosis Mitigation through community-based safe drinking water supply in Dhar District, Madhya Pradesh - background

In India, more than 25 million people are estimated to have serious health problems due to the consumption of fluoride-contaminated water.[3] The disease is endemic in about 230 districts across 20 states and union territories of India[4](Figure 1). This is because a large number of Indians rely on groundwater for drinking purposes and water at many places is rich in fluoride due to the minerals present in the rocks beneath. Long-term consumption of water having fluoride level above 1.5 mg per litre results in bone and teeth deformities.

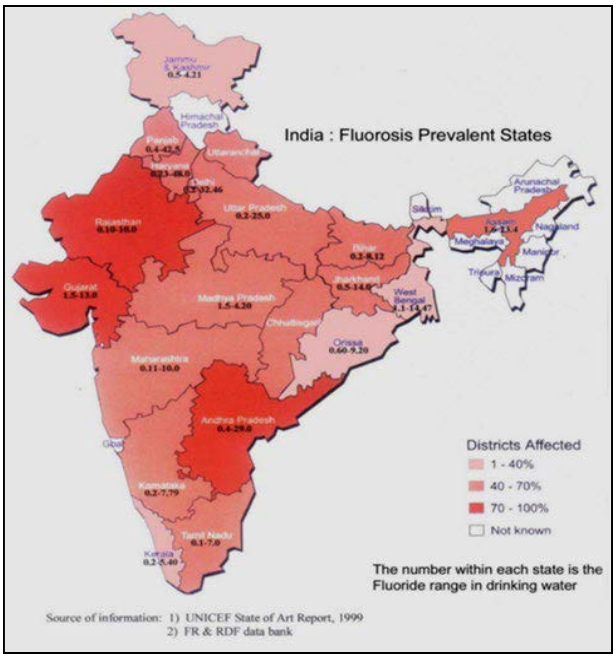


Figure1: Prevalence of fluorosis in India

In many rural areas, groundwater extracted through hand-pumps and tubewells is the only source of drinking water. In these areas, fluoride-contaminated groundwater has emerged as a serious health concern. Fluorides enter the human body mainly through the consumption of water. Although the intake of fluorides can also be through food products, drinking water is the major source and hence the major cause.

Consumption of groundwater contaminated with fluoride results in dental, skeletal, and non-skeletal fluorosis. Skeletal fluorosis affects the bones and major joints of the body like the neck, backbone, shoulder, hip, and knee, causing severe pain, rigidity or stiffness in the joints, and leading to partial disability and sometimes even complete disability. Dental fluorosis mostly affects children, manifesting itself in discoloured and disfigured teeth. Metabolically active and vascular bones of children accumulate fluoride at a faster and greater rate than adults.[5] Fluoride can have devastating effects, causing mottled teeth and osteoarthritis.[6] It can cause gastric pain at very low levels and can even damage the enzymes in the body.[7] Physical disabilities and deformities have a severe impact on the livelihoods, socio-economic conditions, and quality of life of the affected people. The sufferers face social stigma as well.

Since 1937 when the first case of skeletal fluorosis was reported in India, many efforts have been made by government and non-government agencies to mitigate this problem. The National Programme for Prevention and Control of Fluorosis (NPPCF) was launched by GoI as a new health initiative during the 11th Five Year Plan in 2008–09. Under this programme, assistance to critically affected states was provided for fluorosis mitigation. In 2014, funds were released to 18 states,[8] but these funds were underutilized by most of the states (Figure 2), indicating lack of effective implementation of the plans by the concerned government departments.

Defluoridation methods like adsorption, ion exchange, activated alumina, precipitation, and reverse osmosis have

Figure2 Data Source: Ministry of Health & Family Welfare, GoI[8] been largely unsuccessful owing to their difficult operation and maintenance. In addition, they are expensive and have certain ecological disadvantages that limit their usage on a large scale, especially in marginalized areas. There is no treatment for fluorosis.

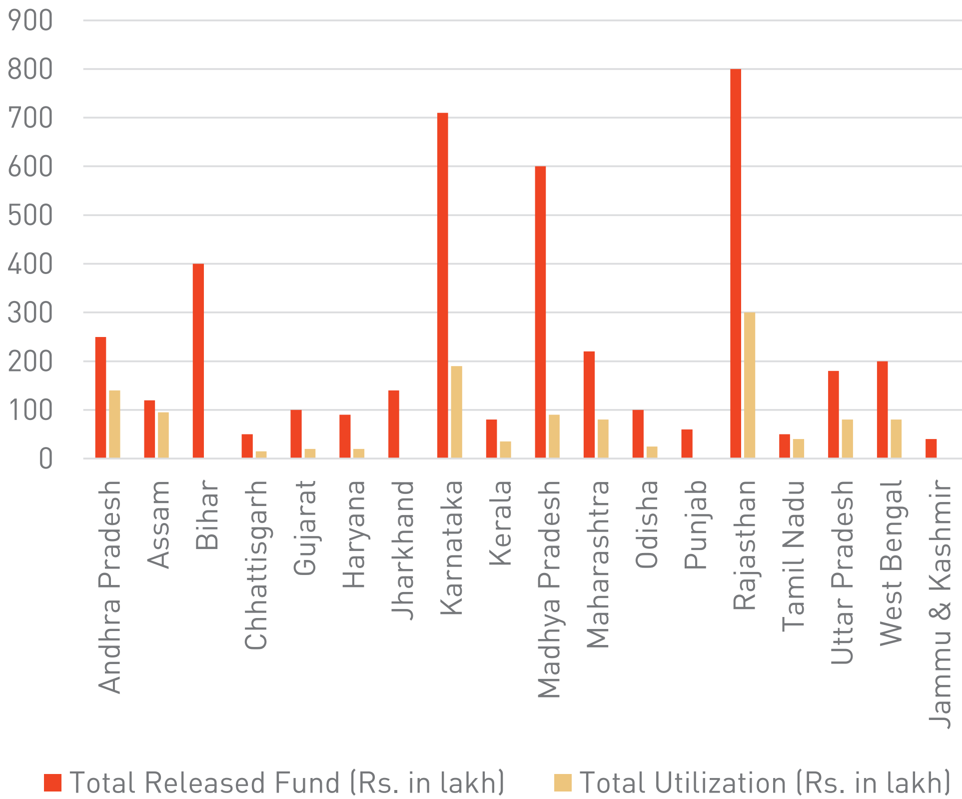


Figure2 Data Source: Ministry of Health & Family Welfare, GoI[8]

But the disease is easily preventable if diagnosed early and if steps are taken to prevent the intake of excessive fluoride through the provision of safe drinking water and the adoption of appropriate food interventions.

Introduction

Madhya Pradesh is one of the states affected by fluorosis (Figure1). The state receives low rainfall of less than 1000 mm per year, which has serious and major implications for the availability of safe drinking water. Although seven major rivers flow through the state, drinking water needs are being met almost entirely (about 99 percent) through groundwater extraction.[9]

The existence of fluorosis was first discovered in Madhya Pradesh in 1997. As per the WaterAid India report published in 2005, there were 4,018 villages with 7,746 water sources in 22 districts of Madhya Pradesh that were affected by fluoride contamination in groundwater.[10] Since then, the number of fluoride-affected districts in the state has been increasing continuously. In 2012, out of the total 50 districts in Madhya Pradesh, 27 districts were fluoride affected (Figure 3).

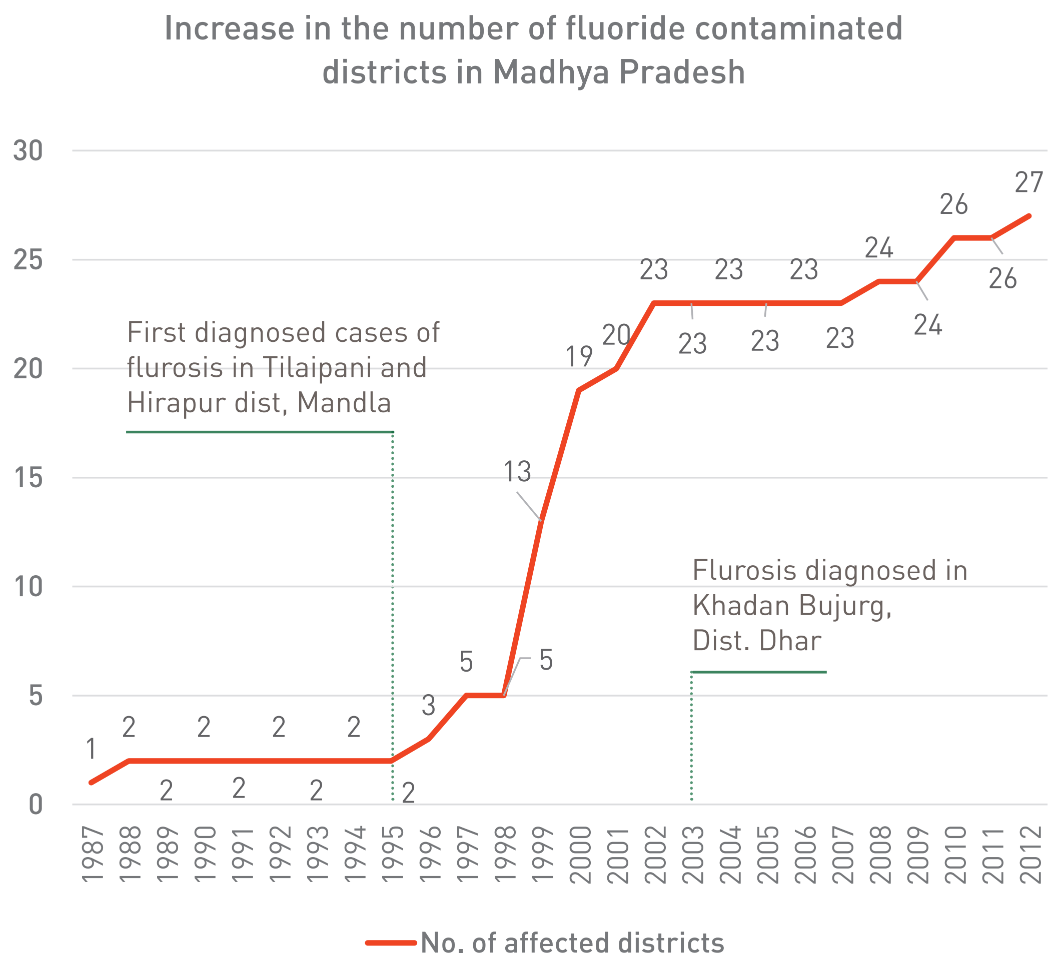


Figure 3: Trend of fluoride-affected districts in Madhya Pradesh
Source : Flurosis Mitigation History in Madhya Pradesh bu India Natural Resource Economics Management(INREM) Foundation and CSIR-National Environmental Engineering Research Institute(NEERI), Support UNICEF, Bhopal

Geologically, Madhya Pradesh state is underlain by some major fluoride mineral-bearing rocks like the Deccan trap basalt, gneiss, and granite.[11] Because of rock–water interaction and long residence time, fluoride is naturally found in higher concentration in groundwater, especially in deeper aquifers. Continuing population growth will necessarily lead to greater drinking water requirement and probably increased dependence on groundwater, which will eventually result in an increase in the areas and population groups affected by fluorosis. Hence, a need was felt for fluorosis mitigation in the region by identifying locally available safe drinking water sources and developing community-based water supply systems.

About the project area and objectives

Madhya Pradesh is the second largest state in the country by area. It is known as the "heart of India" due to its geographical location. There are 46 recognized Scheduled Tribes in Madhya Pradesh, three of which have been identified as "particularly vulnerable tribal groups". Bhil is the most populous tribe. Their highest population is found in Jhabua district, followed by Dhar.[12] Their main occupations are agriculture and labour.

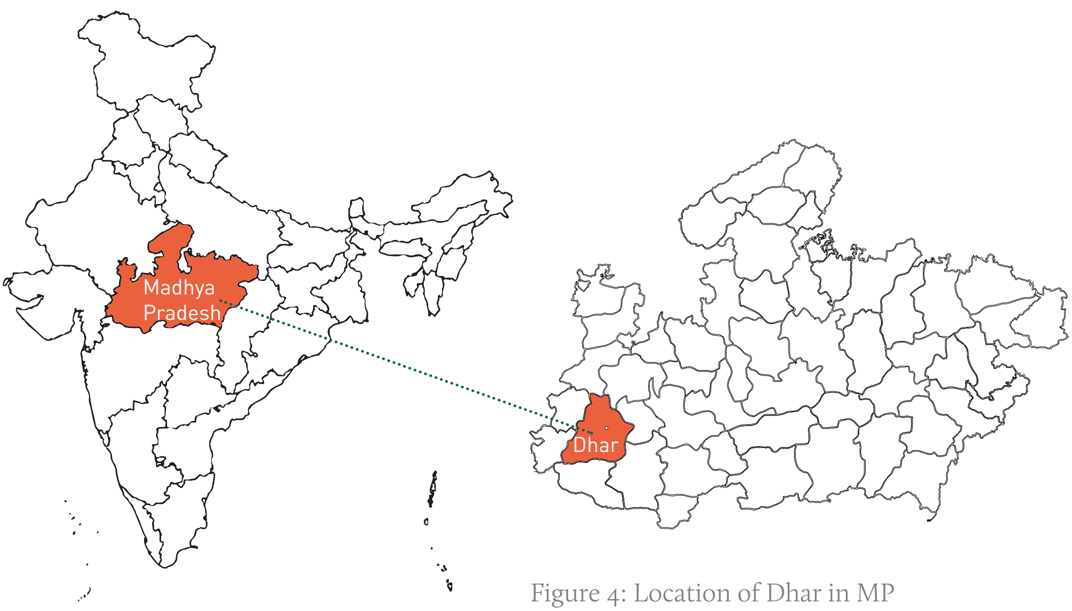
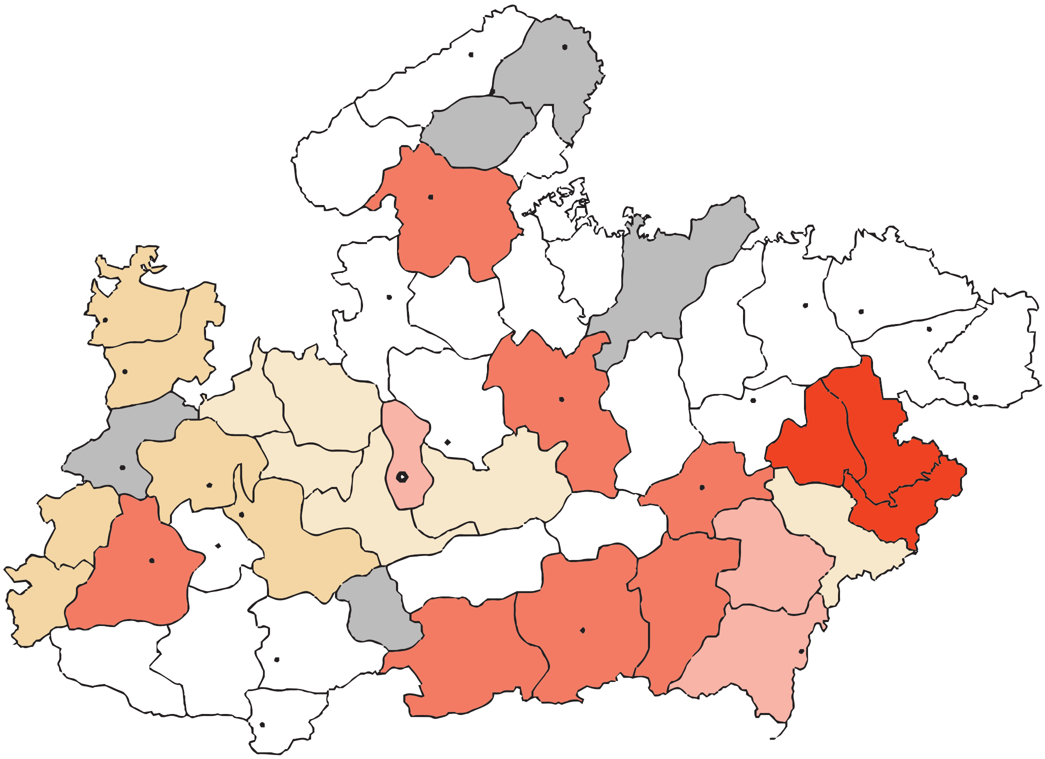


Figure 4: Location of Dhar in MP



Fluoride, Salinity and Iron
Districts: Rajgarh, Shajapur, Sehore, Raisen, Dindori

Fluoride and Salinity
Districts: Jhabua, Ujjain, Dewas, Neemuch, Mandasaur

Fluoride and Iron
Districts: Mandla, Balaghat

Fluoride
Districts: Dhar, Betul, Chhindwara, Seoni, Jabalpur, Sagar, Shivpuri

Iron
Districts: Umaria, Shahdol

Salinity
Districts: Ratlam, Harda, Chhatarpur, Gwalior, Bhind

Figure 5: Districts affected by problems of water quality in Madhya Pradesh[10]

Dhar district lies in the southern tribal belt (22° 35' N,75° 20' E) of the state (Figure 4). It comprises 13 blocks, eight tehsils, and more than a thousand villages. It is a drought- prone area and routinely suffers from water scarcity between January to June every year. People are dependent on groundwater, which they traditionally withdrew from open wells. With the increase in irrigated agriculture, the groundwater level has gradually fallen. Wells usually dry up in summer, forcing people to dig deeper and to switch to handpumps. As electricity has made it possible to draw water from deeper aquifers, tubewells were introduced in Dhar. It is these deeper sources of water (handpumps and tubewells) that actually have more concentrations of fluoride. According to a study,[2] Dhar district has an average fluoride concentration of 4.07 mg/l in its ground water against the BIS standard of 1.5 mg/l. Figure 5 shows the districts affected by water quality problems in Madhya Pradesh and Dhar is one such critical district.

To help mitigate fluorosis in Dhar, People's Science Institute (PSI), Dehradun, India and FRANK Water, UK launched an initiative in late 2013 to provide safe drinking water to the fluoride-affected communities. The overall purpose was to provide access to naturally occurring fluoride-safe drinking water to those most in need through community involvement. The basis of this initiative was scientific investigation.

The issues

Hydrogeological and water-quality monitoring studies were conducted by PSI in this area. These studies revealed that geogenic contamination is proportional to the depth of the water source in this area, as deeper sources allow for more contact with subterranean rocks. That is why most of the deeper sources of water here like tubewells and handpumps have a higher concentration of fluoride (greater than 1.5 mg/l) as compared to shallow-water sources like dug wells (Figure 6 shows fluoride concentration in different sources of water in Daheriya village, Dhar district).

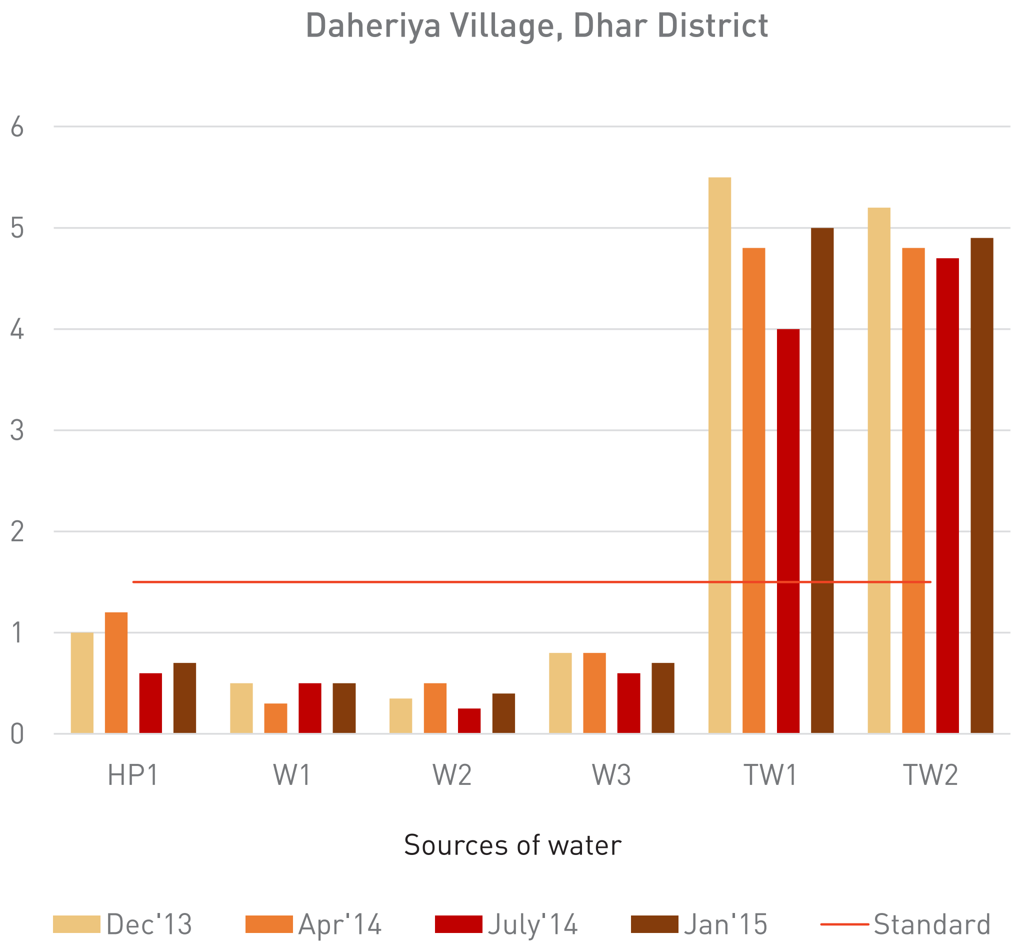


Figure 6: Fluoride concentration in different sources of water.
HP–Handpump, W–Well, TW–Tubewell

Source	Concentration of Fluoride (mg/l)	Depth	Use
Wells	0.3 to 0.7	20-60 ft	Irrigation
Hand pumps	1.6 to 11	200 - 300 ft	Drinking water
Tube wells	5 to 8	160 - 430 ft	Drinking water & Irrigation

• BIS standard for fluoride in drinking water 1.5 mg/l
Figure 7: Relation between water depth and water quality

However, it was observed that the unsafe sources, namely handpumps and tubewells, were being used for drinking and domestic purposes because of their easy accessibility whereas the safer sources (wells) were mostly being used for irrigation (Figure 7).

Secondly, prior to our work, fluorosis-mitigation measures were initiated by some agencies like the Public Health Engineering Department (PHED) by installing handpump-attached defluoridation units in 56 villages in Dhar (Source: Personal Communication with PHED officials). However, the PHED's intervention could not achieve the desired level of success as the programme design had no scope for community involvement nor for proper O&M. This led to the installed units becoming dysfunctional after sometime.

Health concerns

As per a household survey conducted in 2013 by PSI in seven villages— Kalapani, Badichetri, Daheriya, Maalpura, Bankpura, Sankota, and Katchwanya, and covering a surveyed population of 3,332 people, 24 per cent of the surveyed population was found to be affected by dental and skeletal fluorosis (Figure 8). The most vulnerable population group was found to be children.

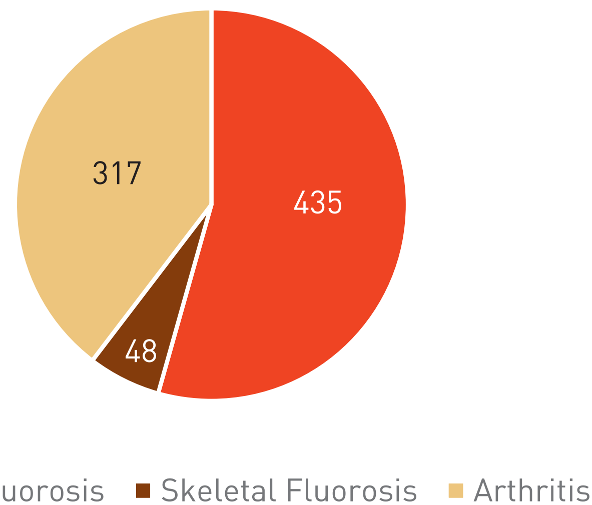


Figure 8: Fluorosis cases in the surveyed villages

The approach

The programme was initially based on the principles of participatory groundwater management (PGWM), which includes recognizing groundwater as a common-pool resource, studying the local hydrogeology to assess the extent of geogenic contamination, and working towards the sustainable and equitable use of groundwater by involving the local communities. To begin with, a pilot programme was designed for Kalapani, Badichetri, and Daheriyavillages in Dhar district, with the financial assistance of FRANK Water, UK. In 2018, the integrated water resources management (IWRM) approach was introduced; it includes community participation, hydrogeological studies, groundwater recharge, and hygiene awareness.

Uniqueness of the approach used

The use of this concept in a fluoride-affected area was probably the first of its kind. Here, the science of hydrogeology was used to correlate the depth of fluoride mineral-bearing rocks and water contamination. Urinary fluoride monitoring was used as a tool to measure the impact of the interventions on the health of the people.

Secondly, use of well water was promoted rather than the installation of defluoridation units or the adoption of rainwater harvesting. The reason was simple: change is hard to bring about and even more difficult to sustain. The closer things are to what people are accustomed to, to what is “natural” for them, the more likely it is that they will adopt new practices and habits, because these changes do not significantly disrupt their lives. The entire system is operated and managed by the communities themselves. This kind of participatory and scientific approach is safe, sustainable, and less expensive than the installation of defluoridation units attached to handpumps.

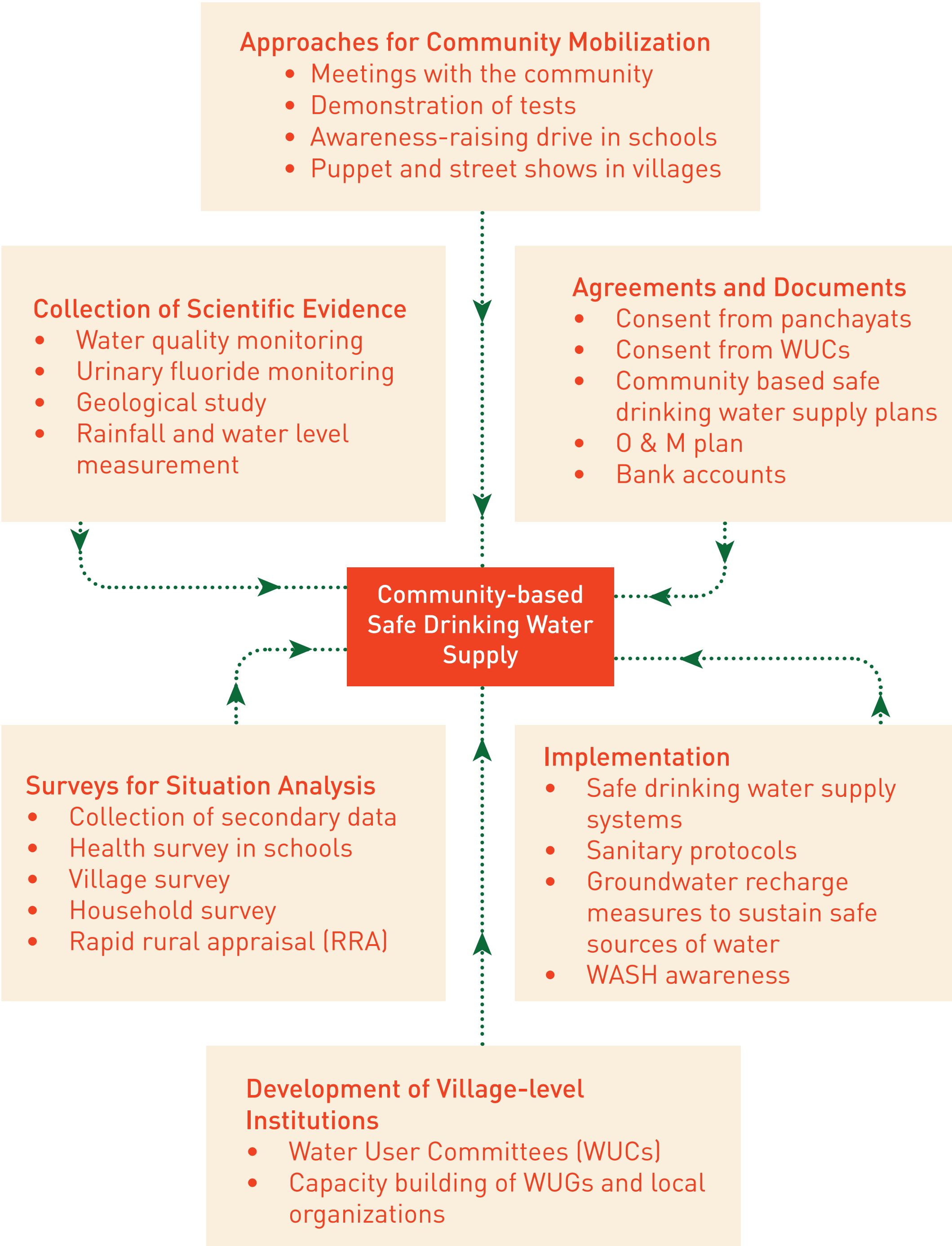


Figure 9: Methodology used for implementing community-based safe drinking water supply

Methodology

The methodology involved collection of secondary information, setting up of a field station in the project area, and frequent field visits to understand the root cause of the problem (Figure 9). These activities were followed by a dental and skeletal survey in schools, water quality monitoring, and hydrogeological studies. These exercises were carried out in order to shortlist the villages affected by fluorosis. The rationale for choosing schools as a survey site was that the students who attend these schools come from various areas nearby. The identification of students with dental or skeletal fluorosis would thus easily help in short listing the fluorosis-affected villages. Tools like rapid rural appraisal (RRA) and puppet and street shows were used to mobilize the communities. Extensive and effective community mobilization resulted in strong village-level institutions, better O&M of the systems developed, and more equitable sharing of groundwater resources within the village and even between two villages.

Details of the activities

1. ***Collection of secondary information and field visits:*** To begin with, the PSI team met the PHED officials and collected water-quality data from them. Based on the information received from them, a preliminary survey in two blocks of Dhar district, Manawar and Dharampuri, was carried out to get an overview of the villages in terms of sources of water, sanitary conditions, economic status of the people, and feasibility of the interventions required.

2. ***Setting up of the field office:*** A field office for conducting laboratory work and for providing accommodation to the PSI personnel was set up in Dhamnod, which is close to the project site. The laboratory was set up for performing water and urine quality tests and for facilitating frequent interaction with the target community.

3. ***Dental and skeletal survey in schools:*** After identification of the critical blocks in Dhar district in terms of water quality (basically fluoride contamination), the next task was to find the villages in these two blocks that are highly affected by fluoride and to identify the communities that need help. For this purpose, a health survey, including a primarily dental and skeletal survey, was conducted in 20 schools in Dharampuri and Manawar blocks. A survey proforma was prepared for conducting the survey. It included questions about the symptoms of dental and skeletal fluorosis and details of the drinking water sources from where the families collected water for domestic use. Information about the status of dental fluorosis included categorization of symptoms as suspected, mild, moderate, and severe (Figure 10). Some physical tests were conducted to identify cases of skeletal fluorosis. Based on the school survey, we listed more than 40 villages affected by dental and skeletal fluorosis. Out of these 40 villages, 29 villages having the highest number of students affected by dental fluorosis were selected for further study.

Figure 10: Categorization of dental fluorosis symptoms

4. ***Village survey:*** A village survey was conducted in the 29 selected villages to collect information on the number of households, population, number of SC/ST/OBC and General Caste category people, type of drinking water sources, sanitary

conditions, etc. The details of the village survey are given in Table 1. Based on the type and condition of the available water sources, dependency of the people on these sources, severity of fluorosis, sanitary conditions, etc., some villages were selected for water quality monitoring.

5. Water quality monitoring: Water sources in the shortlisted villages were tested for fluoride and total dissolved solids (Table 2). Standard American Public Health Association (APHA)procedures13 were followed to collect the samples and to test the samples against certain parameters. On the basis of the water quality data obtained, villages were selected for RRA, household survey, holding of village meetings, detailed water quality monitoring, geological study, urine analysis, and awareness-raising campaigns.

Table 1: List of Villages Surveyed

Sl. No	Village	Block	Population	% of Different Caste Categories			
				SC	ST	OBC	GEN
1	Palasiya	Dharampuri	1,780		80	20	
2	Khokarya	Dharampuri	800		10		
3	Kachhwanya	Dharampuri	2,000	10	90		
4	Heerapur	Dharampuri	782		10		
5	Bagwaanya	Dharampuri	2,000	10	80	10	
6	Dhapla	Dharampuri	1,240	20	50	30	
7	Semaldah	Dharampuri	2,500	8	15	75	2
8	Dongargaanv	Dharampuri	1,300	18	70	10	2
9	Chityaawar	Dharampuri	3,625		80	20	
10	Pandhaniya	Dharampuri	1,176	10	75	12	3
11	Daheriya	Dharampuri	750	2	70	28	
12	Baasvi	Dharampuri	556	1	98	1	
13	Ahmedpura	Dharampuri	665		10		
14	Surjapur	Dharampuri	2,100	2	98		
15	Banjari	Umarbann*	1,200		10		

Sl. No	Village	Block	Population	% of Different Caste Categories			
				SC	ST	OBC	GEN
16	Sankota	Dharampuri	1,275		10		
17	Tarapur	Dharampuri	3,500	12	80	5	3
18	Lohari	Dharampuri	1,200	20	60	10	10
19	Bankpura	Dharampuri	800	3	73	12	12
20	Balwari	Dharampuri	5,000	10	80	10	
21	Mehgaav	Dharampuri	1,600	13	75	12	
22	Gujari	Dharampuri	2,925	10	15	75	
23	Imalipura	Dharampuri	600		10		
24	Jamuniya	Dharampuri	1,458	20	80		
25	Kusumla	Dharampuri	3,960	17	80	3	
26	Maalpura	Dharampuri	500		10		
27	Badichetri	Umarbann*	335	75	25		
28	Kalapani	Umarbann*	825		10		
29	Ramadhama	Umarbann*	3,428	3	89		8

Population data source: Village census data received from the village sarpanch and sachiv;*Umarbann block falls under the panchayat of Manawar block.

Table 2: Water Quality Profile of Different Sources of Drinking Water

Sl. No.	Village	Kind of Sources	No. of Sources	TDS (mg/l)	Fluoride (mg/l)
1	Dhapla	HP	8	139–967	0.19–1.29
		Well	1	694	0.78
		TW	0	-	-
2	Bagwaanya	HP	5	452–2460	0.21–1.21
		Well	0	-	-
		TW	1	815	1.45
3	Heerapur	HP	7	295–605	0.40–4.66
		Well	2	370–438	0.69–0.73
		TW	1	527	1.10

Sl. No.	Village	Kind of Sources	No. of Sources	TDS (mg/l)	Fluoride (mg/l)
4	Balwari	HP	5	297–486	0.29–3.55
		Well	1	556	0.61
		TW	0	-	-
5	Sankota	HP	3	258–383	2.87–6.87
		Well	1	277	0.96
		TW	0	-	-
6	Maalpura	HP	3	451–517	0.56–3.21
		Well	1	564	0.58
		TW	1	539	1.02
7	Bankpura	HP	3	414–855	1.44–7.87
		Well	2	423–501	0.53–0.58
		TW	0	-	-
8	Kachhwanya	HP	1	585	6.89
		Well	3	115–669	0.77–1.5
		TW	1	639	2.8
9	Daheriya	HP	0	-	-
		Well	1	430	0.46
		TW	1	785	5.59
10	Badichetri	HP	4	311–475	0.56–7.92
		Well	2	485–527	0.27–0.58
		TW	0	-	-
11	Kalapani	HP	3	451–654	0.46–11.1
		Well	3	283–474	0.23–0.60
		TW	0	-	-

Standard value of fluoride = 1.5 mg/l; TDS = 500–2000 mg/l; figures highlighted in red indicate high level of fluoride.

Geological study: Detailed knowledge of the geological and hydrological features of an area is necessary for correlating the results of water quality monitoring and for identifying safe drinking water sources. Our geological study revealed that there are two major types of rock forms in this area: igneous and granite. They contain various minerals. Igneous rocks are located in the upper bed rock. Most wells are also in this layer. Granite rocks are located in the lower bed rock. Fluorite, a fluorine-bearing mineral, is present in granite rock and gets dissolved in underground water. Most handpumps and tubewells are located in this layer (Figure 11). That is why the fluoride concentration was found to be more in handpumps and tubewells as compared to wells.

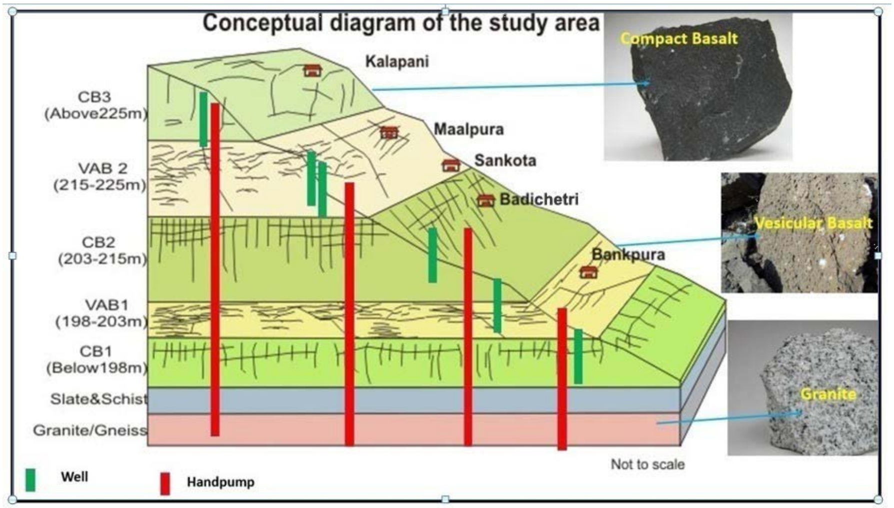


Figure 11: Geological study of Dhar district

Rapid rural appraisal (RRA): For identification of water-related issues (quality of water, uses of water, sources of water, availability of water, sanitary and hygienic conditions), RRA was conducted in the shortlisted villages.

Household survey: The purpose of conducting a household (door-to-door) survey was to collect information regarding the number of households, status of education and employment of household members, sources of drinking water, issues related to drinking water, water-related health problems, willingness to accept water treatment interventions, prevailing sanitary conditions, etc. A questionnaire was used for this purpose. The survey covered 612 households (3,332 people) out of a total of 1,040 households.

Urinary fluoride monitoring: Urine samples were collected in non-reactive plastic containers. During the pilot programme, a total of 500 urine samples from six villages (78 samples from Kalapani, 95 from Badichetri, 79 from Maalpura, 58 from Bankpura, 145 from Daheriya, and 45 from Sankota) were collected and analysed for fluoride content. Out of a total of 500 urine samples, 256 samples were of females and 244 samples were of males.

Selection of pilot villages: After conducting the above-mentioned activities, the three pilot villages of Kalapani, Badichetri, and Daheriya were finally selected based on the following criteria:

- Worst fluorosis-affected village
- Fewer number of fluoride-safe sources of drinking water; more dependency on handpumps and tubewells for water for drinking and cooking
- Distance of safe water source from houses
- Resources available in villages
- Feasibility of water supply plans
- Marginalized nature of the communities
- Willingness of the communities to participate in the programme
- Chances of sustainability of the programme

Community mobilization: After selecting the villages, puppetry and street shows were used to create awareness about fluorosis and the need for safe drinking water. This was the most difficult task and took a lot of time as the people were not ready to believe that it is their drinking water that is causing them health problems.

A profile of the selected villages is given in Table 3:

Village	HHs	Population	Percentage of different caste categories				Sources of water	No. of sources
			SC	ST	OBC	Gen		
Kalapani	100	825	0	100	0	0	Well	3
							HP	3
							TW	0
Badichetri	65	335	75	25	0	0	Well	2
							HP	4
							TW	0
Daheriya	150	750	2	70	28	0	Well	1
							HP	0
							TW	1

A door-to-door campaign and handwashing exercises were also carried out in these villages to spread awareness about the importance of cleanliness, personal hygiene, and use of toilets.

The interventions

The major interventions included the following:
Development of village-level institutions: After the households and communities became aware of, and convinced about, the issue of fluorosis, Water User Committees (WUCs), or Gram Jal Upbhokta Samitis in Hindi, were formed in all the three villages—Kalapani, Badichetri, and Daheriya. The purpose of the committees was to regulate water services at the village level. Bank accounts were opened for these committees.

Signing of agreements: A letter of consent was collected from the panchayat in each village so that, we could begin our work officially. Letters of consent duly signed by the WUC members were also collected. In each village, the O&M plans were prepared by the people themselves.

- Defining the rules and responsibilities of WUCs: The following rules and responsibilities were unanimously agreed upon: Supply of water from the identified safe water source will be done twice in a day for a fixed number of hours.

- Collection of the amount of money decided and depositing it into the WUC's bank account.

- Use of the money collected for the O&M of the water supply system and for paying the motor operator (water man) on a monthly basis.

- Water will be used for drinking and domestic purposes only.

- Water will not be used for gardening, irrigation, or for construction activities.

- During weddings and other functions, water will be obtained only after taking permission from the WUC members.

- Cleaning of water tanks will be done twice in a month.

- Chlorination of wells will be done once in a month

- Open defecation will be prevented near the water sources.

- The WUC will hold regular meetings and will maintain proper record books of its activities.

Implementation of community-based safe drinking water supply: Safe drinking water sources were identified in the three pilot villages through water testing. These sources were the wells that are owned privately by the villagers. There were government wells as well. After understanding the entire issue of fluoride contamination in water and the importance of the availability of safe water sources in the villages, the villagers planned their own water supply system, that is, they planned which well should be tapped for the water supply system so that it would be accessible to most of the residents. In Kalapani village, the owner of a private well, Udai Singh, donated his well for the water supply system in his village since there was no government well nearby. In Badichetri and Daheriya, the government well was planned to be used. Three drinking water supply tanks were set up in each village, tapping water from the wells that had been selected for this purpose. The tanks were duly inaugurated by the people. Some hygiene awareness activities like hand washing were also carried out.

> *Outsiders often hesitate to marry their daughters into our village as it is known as a cursed village. But now I hope that this situation will change. I hope we will be relieved of this social stigma. There will be fewer fluorosis-affected people in our village and it will turn out to be one of the best villages. I am thankful to PSI for this day.*
>
> *- Sakku Bai, resident of Kalapani village*

Major outcomes

- Development of a methodology that can be replicated in other areas
- Adoption of measures for groundwater recharge based on scientific studies
- Involvement of the local people in the planning and implementation process (Figures 13 and 14)
- Equitable distribution of safe drinking water
- Installation of functional water supply systems
- Sharing of water from a common source within the village
- Creation of hygiene awareness among the people

The major achievements were:

1. ***Community-managed drinking water supply systems***
   - O&M plans prepared by the communities of all three project villages

2. ***Sharing of water sources***
   - Donation of a well by a villager in Kalapani village
   - Fair sharing of water within the village
   - Sharing of a common well between two villages

3. ***Groundwater management***
   - Agreement signed by the villagers that the source well water will not be used for gardening, irrigation, construction, or other purposes until and unless there is urgency.

The impacts

1. ***Health improvements:*** Within eight months of the project's launch, a reduction in human urinary fluoride was observed (Figures 12 and 13), indicating a reduced intake of fluoride by the body.

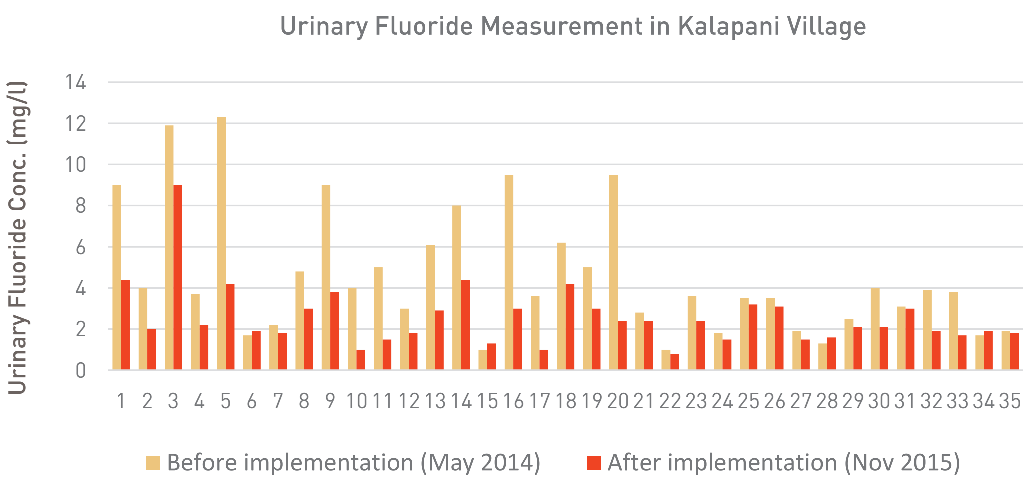


Figure 12: Reduction in urinary fluoride in Kalapani village

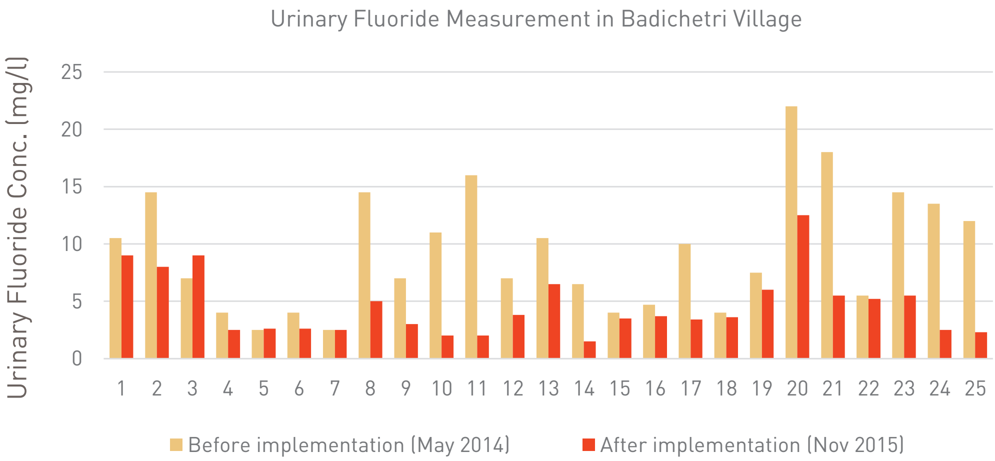


Figure 13: Reduction in urinary fluoride in Badichetri village

2. ***Improvement in access to safe drinking water:*** An impact assessment was carried out in the three pilot villages. A structured questionnaire was used for this purpose. Information was collected related to the quality of water currently available and the social and economic impacts of this water consumption. The sample size was 225/315 (71.4 per cent coverage of the villages). The conditions before and after the implementation of the safe drinking water supply system were compared. The data gathered revealed that the distance travelled to fetch drinking water per day had been reduced significantly in all the three villages (Figure 14). Earlier women and children had to travel a minimum of 2 km per day to collect water for cooking. But the PSI project had increased the availability of water, which in turn had reduced the drudgery of women (Figure 15). Now women had more spare time to engage in some productive work. With the availability of clean drinking water, they suffered less from waterborne diseases and there was less expenditure on medication (Figures 16).

Results of impact assessment:

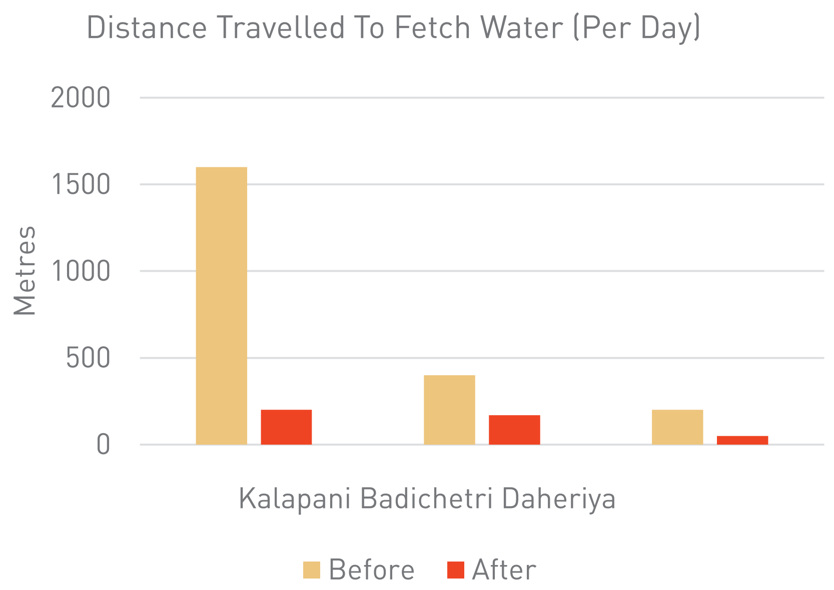


Figure 14: Reduction in distance travelled to fetch water every day

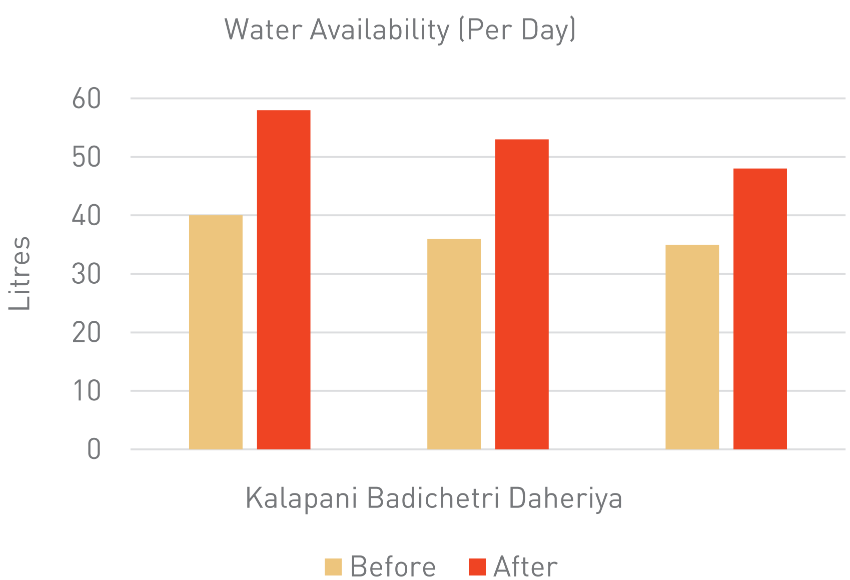


Figure 15: Increase in water availability after implementation of drinking water supply system

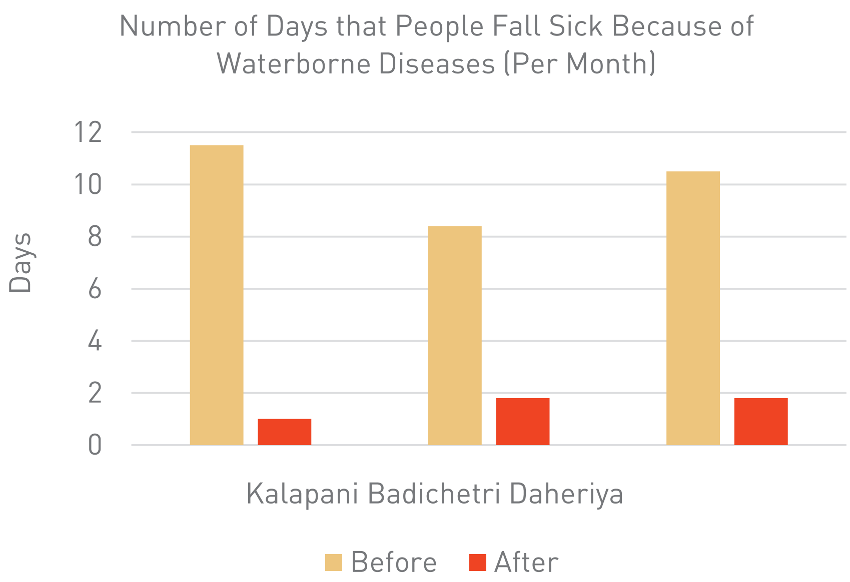


Figure 16: Reduction in money spent on medication

3. ***Behavioural changes:*** Behavioural changes were also observed among the people. During the survey, 95 per cent of the respondents said that they use soap for washing hands after defecation and feel the need of having a toilet at home (Figure 17).

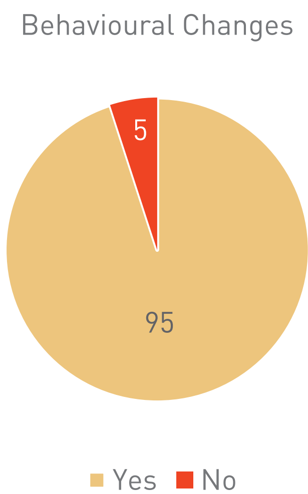


Figure 17: Survey results indicating behavioural changes

4. ***Initiatives taken by the district administration***

   The work carried out in these villages was noticed and appreciated. The District Collector sanctioned Rs. 25 lakh to the self-help group (SHG) of Kalapani village for the construction of 203 toilets.

   Some local doctors came forward to help the victims of fluorosis. They organized a health camp and announced free surgery for 23 severely affected people

   Under the National Fluorosis Mitigation and Control Programme, a one-day district-level workshop was organized for local doctors to brief them about the causes, symptoms, and treatment of fluorosis. The workshop was conducted in Dhar on 17 August 2015 by the Department of Community Services and Health.

5. ***Information dissemination and awareness creation:***

   Information and data were collected and documented through a continuous process for the purpose of dissemination. Given below are some of the links of the published case studies, all of which appeared on the India Water Portal website.

   - ***Safe water to fight fluorosis, 12 July 2018***
     What Basubai and her children needed to fight fluorosis was access to safe drinking water.
     http://www.indiawaterportal.org/articles/safe-water-fight-fluorosis

   - ***Setting safe sanitation example, 12 July 2018***
     Villager builds twin pit latrine and sets example for others on behaviour change and safe sanitation.
     http://www.indiawaterportal.org/articles/setting-safe-sanitation-example-0

   - ***Well water makes a difference, 9 October 2017***
     A village affected by fluorosis understands the importance

of drinking fluoride-safe water with help from experts.
http://www.indiawaterportal.org/articles/well-water-makes-difference

- ***How water brought a village together,11 June 2016***
  The villagers of Bankpura have access to clean drinking water now. In the long run, it will certainly improve their health and quality of life.
  http://www.indiawaterportal.org/articles/how-water-brought-village-together

- ***Bringing potable water to villagers of Dhar,1 June 2016***
  Fluorosis-affected villagers can now heave a sigh of relief. The dream of safe drinking water at their doorstep has become a reality.
  http://www.indiawaterportal.org/articles/bringing-potable-water-villagers-dhar

- ***Using community support to battle fluoride contamination, 8 December 2015***
  Dhar, a drought-prone district in the southern tribal belt of Madhya Pradesh, has high levels of fluoride in its groundwater.
  http://www.indiawaterportal.org/articles/using-community-support-battle-fluoride-contamination

- ***How Bandu Singh recovered hope,8 July 2015***
  Endemic fluorosis exists in 31 villages of Dhar district, Madhya Pradesh. This is the story of how one village is reclaiming its health and dignity.
  http://www.indiawaterportal.org/articles/how-bandu-singh-recovered-hope

- http://hindi.indiawaterportal.org/node/49601

- http://hindi.indiawaterportal.org/node/49600

- http://hindi.indiawaterportal.org/node/49598

Scaling up

The results of the impact study were quite encouraging in terms of scaling up the work. The work was extended to more villages in Dhar during 2014–18. However, it was soon realized that the region requires not only safe drinking water supply and water, sanitation, and hygiene(WASH) initiatives, but also groundwater recharge measures. This is because the district receives the maximum rainfall during the south-west monsoon, that is, from June to September. Hence, surplus water for groundwater recharge is available only during the months of the south-west monsoon.14 The rest of the year is dry. It was thought that groundwater recharge efforts would not only increase water availability but would also help reduce fluoride concentration in water due to the dilution effect. Hence, a holistic or Integrated Water Resources Management (IWRM) approach was adopted in 2018 to mitigate fluorosis through safe drinking water supply systems, groundwater recharge measures, and WASH initiatives with the support and guidance of Arup, UK. The IWRM approach is linked with the United Nation's Sustainable Development Goal 6 (clean water and sanitation) and Goal 6.5 (water resources management). It involves a six-stage process, as mentioned in Table 4.

Stage	Activity	Description of Activity
1	Needs Assessment and Recce Visit	Literature review, collection of data from secondary sources; shortlisting of critically affected villages; informal village meetings; collection of information from the villages about water usage, available water resources, water level, type of catchment area, hygiene and sanitation status; drinking water quality monitoring; dental and skeletal surveys

Stage	Activity	Description of Activity
2	Interim Report	Overview of needs assessment and recce visit; preparation of an interim report; selection of project villages
3	Detailed Field Visits	Baseline surveys, social and resource mapping, awareness campaigns, community mobilization, water quality and urinary fluoride monitoring, village-level institutions, water resource inventory, cropping and irrigation patterns
4	Hydrogeological Studies	Geological cross-sections, aquifer mapping
5	Water Balance Assessment	Assessment of water demand and supply gap, crop water requirements, groundwater recharge potential
6	Implementation and O&M	Summarization of all the information gathered, community-based safe drinking water supply plans, design and estimates of groundwater recharge structures, catchment management and WASH solutions, operation and maintenance plans, implementation of plans, strengthening of village-level institutions, monitoring, learning, evaluation, and impact assessment.

Outreach

During the last six years, the work has been carried out in 17 villages, covering 1,335 households with a population of8,175 people. In addition, village water security plans based on the IWRM approach are being prepared for seven villages having 332 households with a population of 1,950 people.

Challenges

- ***Support from panchayat and PHED:*** We could not get any financial or material support from the panchayat or the PHED, although verbally they had agreed to help us. Groundwater recharge measures need additional funding support. The concerned government departments should provide support through convergence.

- ***Community mobilization:*** We are working with and for the marginalized communities in Dhar. Basic facilities like toilets, hospitals, and good schools are almost non-existent in the poor villages in the district. The people belong to the socially and economically backward categories of the Scheduled Castes and the Scheduled Tribes. A majority of them are illiterate and work as daily wage labourers. They live hand to mouth, eking out a precarious living. Their priority is to earn so that they can feed themselves. On top of all these problems, there is the prevalence of fluorosis, a disease about which they have no knowledge. Their condition was both a challenge as well as a constraint. Mobilizing them was very difficult because they had other priorities. Clean water was not an issue that was sufficiently important to them, that it, it was not important or urgent enough to motivate them to participate in our programme. To work with them on an issue that was not important to them because their priorities were different from ours was a big challenge for us.

- ***Sanitation and personal hygiene:*** Convincing the target communities about the importance of personal hygiene, good sanitary practices, use of toilets, etc. is very difficult. Encouraging the village community to adopt safe sanitation practices is not easy due to the prevalence of age-old beliefs and practices. Despite the construction of some toilets under the Swachh Bharat Abhiyan, it is a challenge to motivate the people to use these toilets when they can easily defecate in abandoned areas or fields. Community mobilization is a continuous and time-consuming process requiring time, resources, dedication, and patience.

- ***Availability of time to meet people:*** Since the majority of the people perform manual labour to earn a living, they are available to meet and talk to the PSI personnel and staff either around 8.00 in the morning or after 6.00 in the evening. Women are mostly busy in their fields. During the day, only small children, a few old men, and women are available at home. Hence village or community meetings with a good turnout are difficult to organize.

- ***Training:*** Training the communities to follow the rules and regulations that they have set themselves; ensuring the proper and timely O&M of the water supply systems; carrying out the regular chlorination of wells, etc. is a challenge. Creating awareness about the importance of dietary supplements and encouraging the use of organic fertilizers in the fields are also crucial steps to reduce the effect of fluoride accumulation in the body.

Lessons learnt

- The PHED does make an effort to mitigate fluorosis by using handpump-fitted defluoridation units, but it is not able to neither ensure or sustain community involvement nor undertake the proper O&M of the installed units.

- The learning through PSI's initiative is that it is possible to make safe drinking water available without the use of chemical-based and cost-intensive defluoridation units.

- Scientific knowledge and evidence, and actual demonstrations on the ground of the benefits that are claimed to result from certain interventions, can help encourage the target community to involve itself in such project work over the long term. When the water quality and urine tests were demonstrated to the people, they started believing in what was being told to them.

- Scientific evidence such as the findings of a geological study of this area helped us to prove our point that handpump-based defluoridation units will not solve the problem of fluorosis. Geogenic contamination needs to be examined through geological studies and correlated with the depths of water sources in the area to identify safe sources of drinking water. This can reduce the government's expenditure on digging handpumps and on installing defluoridation units. The learning is that we need to conserve, promote, and facilitate shallow sources of water in fluorosis-affected regions of Dhar.

- Groundwater recharge efforts would not only increase water availability but would also help reduce fluoride concentration in water due to the dilution effect.

- WASH is also an important component to be incorporated in safe drinking water supply programmes.

Conclusion

The sustainable use of groundwater and its quality issues are matters of great concern these days, particularly in terms of public health and community welfare. There is an urgent need to promote safe sources of drinking water based on a participatory approach to reduce the adverse health impacts of fluoride. To make this effort sustainable, there is also a need to promote the O&M of these water supply systems by the local communities as is currently being done by PSI in Dhar district. The interventions undertaken by PSI in the villages of Dhar district have led to an improvement in the availability of safe drinking water without the use of chemical-based and cost-intensive defluoridation units.

Awareness building and community-led actions are essential for the success of such programmes, and a rapid extension of the IWRM approach is required to end the water woes of fluoride-affected rural populations. Advocacy is also required to inform policy makers and civil society organizations about the IWRM approach. The adoption of the IWRM approach in government flagship programmes will pave the way for fluorosis mitigation and the sustainable management of groundwater resources.

This kind of participatory and scientific approach is safe, sustainable, and less expensive than the installation of defluoridation units attached to handpumps which become dysfunctional after sometime.

Acknowledgements

The team involved in this project included Dr Anil Gautam, Anita Sharma, Puja Raghuvanshi, Amrita Mishra, Heena Kannauj, Sharad Yadav, and Dalpat Muwel. Dr Anil Gautam initiated the work by training the project staff in conducting dental and skeletal surveys, awareness campaigns, urinary fluoride analysis, and water quality monitoring, as well as in selecting fluoride-affected villages.

References

1. Indian Standard Drinking Water Specification (Second Revision) IS 10500: 2012. (2012). Bureau of Indian Standards, New Delhi.
http://cgwb.gov.in/Documents/WQ-standards.pdf

2. Jinwal, A., & Dixit, S. (2009). An assessment of fluoride concentrations in different districts of Madhya Pradesh, India. International Journal of Chemical Sciences, 7(1), 147–154.

3. Fluoride Action Network (2012). Skeletal fluorosis in India and its relevance to the west.
https://fluoridealert.org/articles/india-fluorosis/

4. National Health Portal. (2016). Fluorosis. https://www.nhp.gov.in/disease/non- communicable-disease/ fluorosis

5. Teotia, M., Teotia, S. P., & Singh, K. P. (1998). Endemic chronic fluoride toxicity and dietary calcium deficiency interaction syndromes of metabolic bone disease and deformities in India: year 2000. Indian Journal of Pediatrics, 65(3), 371–381.

6. Flouride Action Network. (no pub. date). Arthritis. fluoridealert.org/issues/health/arthritis. Accessed 7 July 2019

7. Jones, D. (1999). Fluoride: Damning new evidence. Excerpted from "What doctors don't tell you", March 1999. https://www.nofluoride.com/what_doctors_donot_tell.cfm. Accessed 7 July 2019.

8. Press Information Bureau (2014). Control of fluorosis: Year wise Fund Release and Total Expenditure to States/ Districts underNPPCF. Ministry of Health and Family Welfare, Government of India. http://pib.nic.in/newsite/PrintRelease.aspx?relid=107823

9. Das, K. (2012). Drinking water and sanitation in rural Madhya Pradesh: Issues and challenges for policy. Journal of Rural Development, 31(3), 287–304.

10. Khanna, A., & Khanna, C. (2005). Water and sanitation in Madhya Pradesh: A profile of the state, institutions, and policy environment. New Delhi: WaterAid, India Country Programme.

11. Ground Water Year Book – Madhya Pradesh (2016–17). Central Ground Water Board, North Central Region, Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India, January 2018, 7. http://cgwb.gov.in/Regions/GW-year-Books/GWYB-%20 2016-17/M.P.pdf

12. Madhya Pradesh, Data Highlights: The Scheduled Tribes, Census of India 2001. Government of Madhya Pradesh. http://censusindia.gov.in/Tables_Published/SCST/dh_st_madhya_pradesh.pdf

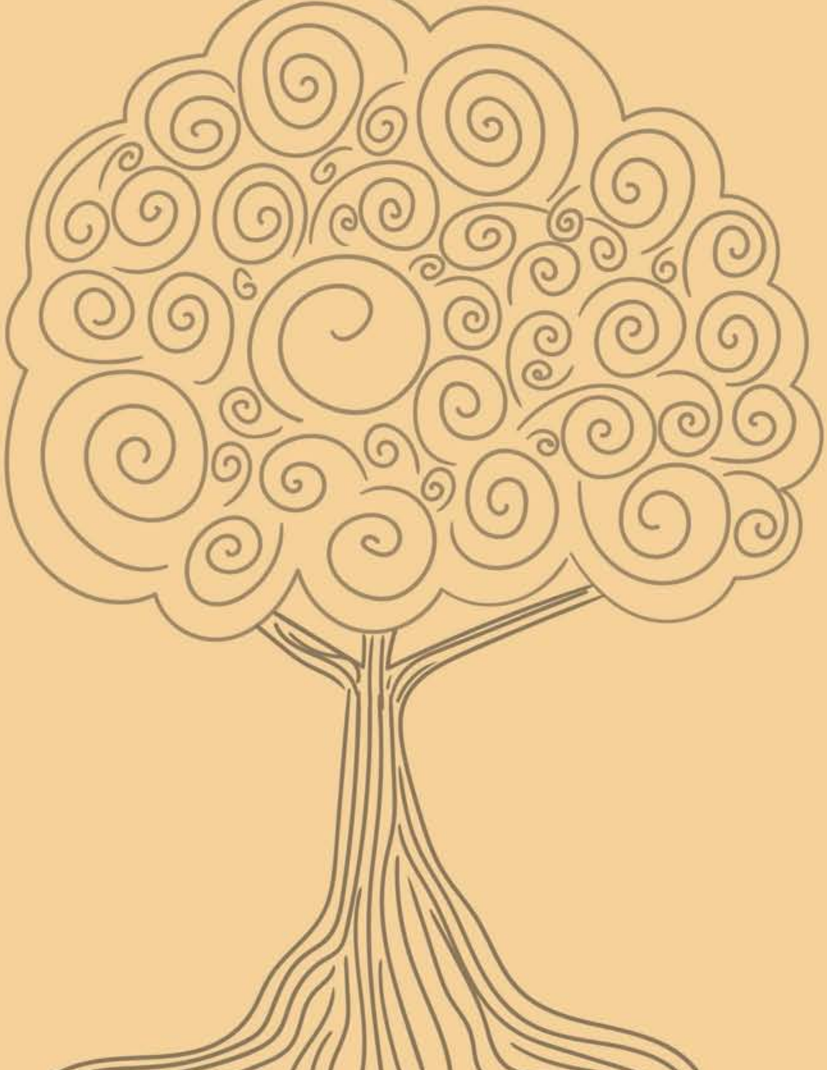
13. American Public Health Association, American Water Works Association, & Water Environment Federation (1992). APHA Method 9221: Standard Methods for the Examination of Water and Wastewater (18th ed.). American Public Health Association Washington, D.C., 1992, file:///C:/Users/Malini/Downloads/apha.method.9221.1992.pdf Accessed 7 July 2019.

14. District Ground Water Information Booklet, Dhar District, Madhya Pradesh (2013). Central Ground Water Board, North Central Region, Bhopal, Ministry of Water Resources. http://cgwb.gov.in/District_Profile/MP/Dhar.pdf

People's Science Institute (PSI), Uttarakhand[2]

Established in 1988, People's Science Institute is a non-profit research and development organisation. Its activities are spread all over India with a focus on the central-western Himalayan states of Uttarakhand and Himachal Pradesh and the poverty-ridden districts of western Orissa. The operational headquarters is in Dehra Doon, Uttarakhand.

PSI's has ongoing projects focussing on natural resource management, environmental quality monitoring, disaster mitigation and response and developing innovative technologies and social processes. Research at PSI is undertaken to improve the implementation of field projects, identify new areas of work and to innovate new technologies and social processes. It spans a variety of subjects from studies on traditions of water management, food security, work patterns of women in the central-western Himalayas, environmental quality and urbanization in mountain regions to action research on integrated water and forest management by mountain communities, enhancing productivity of paddy cultivation, development of GIS software, and the design of earthquake-safe rural houses and intermediate-sized hydrams.



Azim Premji University, Electronics City, Bengaluru- 560100
Website- azimpremjiuniversity.edu.in