

Madhya Pradesh's 'fluoride warriors' unleash citizen science to empower community

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Radhika Iyengar who leads the project and social work students visit fluoride hit communities in Alirajpur. Photo by Sahana Ghosh/Mongabay

• *Social science students in Madhya Pradesh are documenting excess fluoride in water points through a citizen science approach led by Columbia University researchers and local partners using smartphones and portable fluoride detection kits.*

Madhya Pradesh is one of the 19 Indian states severely affected by high fluoride content in drinking water. Long-term ingestion of large amounts of fluoride can lead to dental and skeletal fluorosis.

About 60 percent of the students are women and were eager to understand the issue through the lens of science. Women found it easier to connect with the female students because it is principally the women who are responsible for managing water in their household. For many of the women, the citizen science project was their maiden public speaking experience and they felt empowered with the use of data to bring awareness in their communities.

Pinky Alawa and Sapna Rawat cautiously approach a woman drawing water from a hand-pump in the hilly part of central India, in [Alirajpur](#) district in Madhya Pradesh.

The pump is marked with a prominent yellow ring, an indication of water that has fluoride at concentrations much higher than the average value (1.5 mg per litre) in the district dominated by indigenous populations.

The yellow marker was painted on the handpump in Rajawat village by Alawa and Rawat's batchmates, who make up the 65 students of Master's in Social Work (MSW) programme at Alirajpur Post Graduate College, trained by [Columbia University](#) researchers, as part of their citizen science approach to map fluoride levels in the water.

Since September 2019, students have been putting science into action to test the fluoride levels in water sources, as a part of their coursework's annual mandatory internship. A blue ring indicates water is safe for fluoride.

Pinky Alawa and Sapna Rawat (right) communicate the issue of impacts of high fluoride in water on health to women in Alirajpur, Madhya Pradesh. The yellow ring on the pump indicates water that has fluoride at concentrations much higher than the average value. Photo by Sahana Ghosh/Mongabay.

Alawa and Rawat, who are from the district, start a casual conversation with the woman drawing the water from the handpump marked yellow.

They ask her a bunch of questions – whether she uses the water for consumption, why does she use it for consumption even though the pump is marked unsafe and probe her awareness on the issue of fluoride.

They discovered that some of their batchmates had visited the homestead in front of which the handpump stands, tested the fluoride level and had informed the person who was available at that point in time to refrain from using the water from that hand pump for consumption and opt for a neighbouring blue-ringed pump instead.

However, the message was not passed on to the rest of the family by the person. "Most of the community members are away in their farmlands during the day so we can speak to only those who are at home. On several occasions, we have approached the community members when they are on their farms. We are shooed away with abuses or we are mistaken for mechanical repair workers or plumbers. Villagers often ask us to fix broken pipes!" Pinky Alawa told this visiting Mongabay-India correspondent with a chuckle.

Pinky Alawa and the group move on to speak to men in the homestead. Upon requesting them to consider using the neighbouring blue-marked hand pump for drawing water for consumption, the students are met with vehement protests. The man they are talking to refuses to go to the water source that is five minutes away by foot.

Eventually, they manage to calm him down and unveil posters on health effects of excess fluoride and bring out their fluoride testing kit to show the colour changes to drive home the message.

This is all in a day's work for 27-year old Pinky Alawa and her batchmates, who undeterred by abuses and glares, have become the 'fluoride warriors' of Alirajpur block in Alirajpur district of Madhya Pradesh.

The batch comprised 60 percent women students, a metric that worked in their favour while communicating the problem and solutions to the women in their communities who were principally responsible for managing water in their household.

[Social work students learn to upload data online. Photo by Sahana Ghosh/Mongabay.](#)

With fluoride testing kit and reagents stowed in their backpacks, these science detectives investigate water samples, conduct surveys, digitally document location-specific data, and communicate the issue of fluorosis, an acknowledged major public health problem in the state.

From evidence to communication

The handpump in Rajawat is one among the 2000 handpumps and water sources monitored and marked by the students across 70 villages in Alirajpur block of the namesake district. About ten percent of the water sources tested positive for more than permissible levels of fluoride.

Long-term ingestion of large amounts of fluoride can lead to dental and skeletal fluorosis. Symptoms include staining and pitting of the teeth, joint problems, and abdominal pain and vomiting. Madhya Pradesh is one of the **19 Indian states** severely affected by high fluoride content in drinking water with as many as **140 habitations** where water quality is affected by excess fluoride.

"The government has done a great job of drilling and providing handpumps in most locations. However, many of the hand-pumped wells have high levels of fluoride in their water. Tackling this issue involves both science and social science," said Radhika Iyengar of Columbia University's Centre for Sustainable Development (CSD), who led the project.

Iyengar and social science experts from CSD and a team of scientists from the university's Lamont-Doherty Earth Observatory worked with district collector of Alirajpur, Surabhi Gupta and local partners

India Natural Resources Economics and Management Foundation

(INREM), Mahashakti Seva Kendra and Pratham, to crystallise this marriage of science and society.

"Because of the citizen science approach, we now have a map which is very interactive and everyone, all the stakeholders, can see what is the extent of this problem. Before coming to the solution we need to understand the whole issue," explained Iyengar.

Sunderrajan Krishnan of INREM Foundation believes collaboration between academics, government and civil society is critical to address problems of water contamination such as fluoride. "Getting citizens to be more vigilant, contribute data and having students as data producers and messengers are excellent learnings from Alirajpur, one that could be scaled up to any other place in India," Krishnan said.

Portable fluoride testing kit for water. Photo by Sahana Ghosh/Mongabay.

Data empowering young women

Lex van Geen, a geochemist at the

Lamont-Doherty Earth Observatory

, who is associated with the project, worked on refining the field testing idea and the procedure involving smartphones that the students can use.

Based on his experience of working on arsenic across Bangladesh for kit-based sampling, van Geen said lab-based measurements may not make it back to the well-owner whereas portable field testing kits can provide immediate access to the data to the well-owners.

"If the kit works reasonably well and if the contaminant concentrations span a wide range, then even some imprecision relative to the lab is less important than the fact that the result is inexpensive to obtain and immediately available in the field," van Geen said.

Access to data was also empowering for Alawa and Rawat. By showcasing real-time evidence (water samples changing colour on testing positive for excess fluoride) and maps Pinky Alawa said she was able to get her point across in her community.

"People took us (young women) more seriously when we started going out on the field with the maps and kit. They could not snub us once they saw the extent of the problem," said Alawa.

From a diffuse and poorly understood problem, the student project, said Lex van Geen, defined the fluoride in water problem, much more precisely and is allowing action.

"It's only really a handful of villages, where most of the high fluoride wells are located. This precise information can help the public health and engineering department (PHED) plan targeted interventions. We haven't solved it, but at least people know where the safe wells are," van Geen said.

Lex van Geen said the high fluoride in Madhya Pradesh is unlikely to have anything to do with human activities – it is a natural process. "Exactly what that process is in Madhya Pradesh and how it compares to other regions affected with fluoride (e.g. Rajasthan) would require additional measurements – pH, conductivity, calcium concentrations etc.," he explained.

According to an iteration of Madhya Pradesh State

Action Plan

on Climate Change, groundwater is in a "critical condition" across the state, most affected being the western parts where Alirajpur is located. The action plan notes that though State Water Policy 2003 mentions that groundwater should be explored only for drinking purposes, lack of adherence is often observed.

District-wise groundwater balance data indicate high levels of groundwater

abstraction in the western and north-western districts compared to the eastern and south-eastern districts, where groundwater potential developed, is only a tenth of the utilisable reserves, the plan states.

"In the last 25 to 30 years the villages have shifted to groundwater extraction through wells and hand pumps for their domestic purposes. Compared to the 30 percent urban water supply met out with groundwater, a massive 70 percent of the rural water supply is dependent on the same source," the plan adds.

Citizen science and community engagement

During their field-based training workshop in September 2019, the researchers also cleared the air on fluorosis. Many had seen browning of teeth, especially of children in their villages. Some believed that the browning was caused by intake of tobacco, while others thought that it was caused by irregular brushing of their teeth.

"We didn't know what fluoride was and why it was harmful in excess. In my own village, the tubewell near my house has high levels of fluoride. Once I found out I refused to consume the water from that source. My husband now fetches water for cooking and drinking from another area that is far off and has good water quality," a five-month pregnant Alawa said.

Both women and men were eager to learn the science of fluoride testing in water. Photo by Sahana Ghosh/Mongabay.

For many women, including Alawa and Rawat, this was the first time they spoke publicly. Women and men were equally eager to use science to understand the issue, observed Iyengar.

"During our workshops, we noticed that women spoke very little in class and asked almost no questions. It was very difficult to figure out whether they understood the procedure. But on the field, the girls took charge and were able to confidently explain the problem," said Iyengar.

For Sapna Rawat, communicating the issue was easier with women. "In our communities, there is a serious problem of alcoholism and you would find men sprawled up in fields in a drunken state. Caster and gender barriers thwart preventive measures," Rawat lamented.

According to Tanusree Paul of the Centre for Women's Studies at Visva-Bharati University, Santiniketan, a gendered critique of the national water policies of India indicates that these fail to appropriately reflect gender concerns in water but plenty of empirical experiences show that women's active participation is the key to successful water resource management.

"In India, the National Water Framework Bill 2016 emphasises on providing uniform national legal framework to manage water in a better and efficient way. Fortunately, it does talk about unique needs of women in the context of project planning and management and emphasises on involving women in planning and implementation of water projects in the context of participatory irrigation management. Thus, this could become a potential tool for addressing gender concerns in water," Paul told Mongabay-India.

Brenda Dobia of Western Sydney University, Australia, who specialises in education for sustainability, ecopsychology, community engagement, and participatory research methods and was not involved with the project, hopes that this initiative also opens the way for the social work students to become advocates for sustainability in their ongoing work.

"Issues of water quality and availability make disadvantaged communities the most vulnerable. Providing women and men in these communities with the tools to monitor their own water is really crucial. A human rights perspective on water emphasises that water monitoring should empower communities by sharing the kind of knowledge, delivered in an accessible way that enables collective action for water safety and security. Since women carry the burden of providing water to

families, access to safe water in close proximity to their homes is a particular issue for them.”

Spending more time per day fetching water increased Indian women’s risk of delivering a low birth weight baby, according to a [study](#) that said two hours was the median time women trekked to collect water.

Community members often use piped surface water for washing and well-drawn water for consumption. The district administration is trying to generate awareness among the community to use surface water for consumption. Photo by Sahana Ghosh/Mongabay.

The students are now planning a slew of communication strategies with the district administration even as the fluoride warriors gear up to take on the role of mentors to expand the project to other blocks in Alirajpur as well as to the adjoining Jhabua district.

“We are figuring out a solution together with the students, the administration and the community. We can do supply dropping of technology, we can talk of policy, but let’s figure out a solution which can be locally developed and locally maintained,” added Iyengar.

At the outset, on India’s Republic Day (January 26) this year, the ‘fluoride warriors’ showcased a tableau on the fluoride issue in Alirajpur.

District Collector Surabhi Gupta wants to use the geo-referenced data to conduct health camps in the stretches that have wells marked yellow.

“It is not just an issue of access to safe drinking water but we have to also look at the nutrition intake aspect because people consume food that comes from crops that are grown with the help of irrigation and that water also likely contains fluoride,” Gupta said.

“And in backward districts, women are still not very aware and empowered and this is one opportunity where they can explore new roles for themselves,” Gupta added.

Social work students map extent of high fluoride in water in Alirajpur. Photo from Radhika Iyengar.

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