Centre for Science and Environment
41, Tughlakabad Institutional Area, New Delhi 110 062, INDIA
Ph: +91-11-29956110 - 5124 - 6394- 6399
Website: www.cseindia.org

COMMUNITY ENGAGEMENT IN MONITORING THE QUALITY AND QUANTITY OF GROUNDWATER USED FOR DRINKING IN RURAL INDIA

- 69 per cent of India's population lives in rural areas. Over 80 per cent of the rural population uses groundwater as their spource of drinking water. Rural Uttar Pradesh records the maximum number—over 2 million—of groundwater sources.
- Due to overdependence of groundwater, the percentage of safe districts in India fell from 92 to 73 per cent and of overexploited districts increased from 4 to 11 per cent in 1995–23.
- The percentage of districts with groundwater level more than 40 m below ground level increased from 4 per cent to 34 per cent in just the six years between 2014–15 and 2021–22.
- Drinking-water sources of several villages are affected by both physical and biological contaminants. Recent (2024) Jal Jeevan Mission (JJM) data shows that the most prominent contaminant is coliform—affecting more than 30,000 villages—which results due to mixing of black water from faulty toilets with drinking-water sources. Turbidity, iron and nitrate (physical contaminants) affect drinking water sources in more than 20,000 villages. Kerala tops the list of contaminated water sources, with 55 per cent of drinking water samples contaminated.
- Out of 2,124 district laboratories, 66 per cent is under the National Accreditation Board for Testing and Calibration Laboratories. Madhya Pradesh, Manipur, Tripura and Nagaland have 100 per cent of their laboratories under the accreditation of NABL.
- Communities are trained to test the water quality supplied to their households using field testing kits (FTKs). States with 100 per cent villages trained for FTKs include Maharashtra, Karnataka, Tamil Nadu, Chhattisgarh, Punjab, Haryana, Nagaland and Manipur. But the actual per cent of villages using FTKs in these states is much lower. Large states such as Maharashtra and Karnataka have only around 80 per cent of the villages where communities use FTKs.
- No data is available on how communities are monitoring the quantity of their groundwater-based sources.
- Communities need to check both quality and quantity to develop their water budgets and make data-driven decisions with regard to sustainability of their drinking-water sources.

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INTRODUCTION

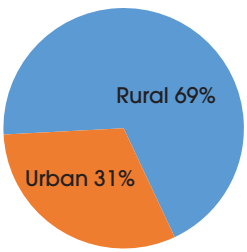
Overdependence of groundwater for drinking-water sources in rural India makes it necessary to monitor the quality and quantity of groundwater. Jal Jeevan Mission (JJM) under the Ministry of Jal Shakti supplies 76 per cent of rural households with safe water.

More than 80 per cent of the drinking-water supply depends on groundwater. Groundwater stress has increased in the six years since 2014–15, leading to plunging groundwater levels in villages, especially the northwest of the country. Over-extraction of groundwater has also led to increase in fluoride, iron and hardness in drinking water. Arsenic content in groundwater also increases due to geogenic reasons. Mismanagement of wastewater near groundwater sources also increases nitrate content in drinking-water sources.

For safe and sustainable source water, groundwater has to be monitored periodically. Since communities are in-charge of drinking-water supply projects, they need to be trained. Under JJM, there is provision for training the communities in the use of field-testing kits, which are handy, economical and easy to operate. While the JJM dashboard displays the number of villages with communities trained in the use of FTKs, it does not mention the monitoring of the quantity by the communities. Maintaining an MIS is necessary for communities to plan for the sustainability of drinking-water sources.

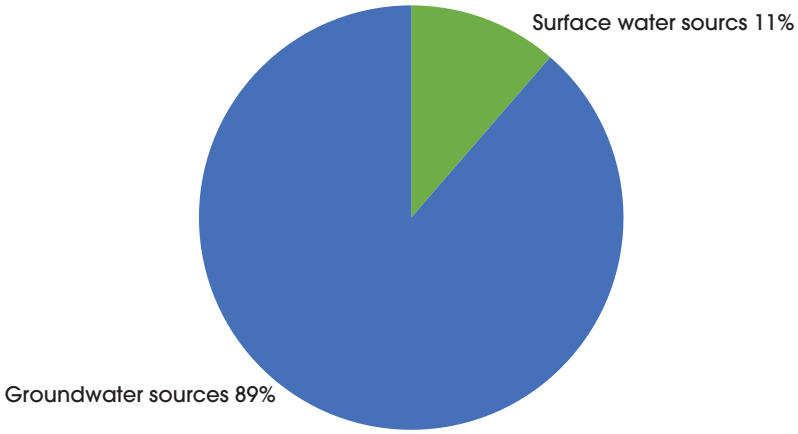
Over-extraction of groundwater leads to 18.9 percentage decrease in safe districts and 7.2 percentage increase in overexploited districts.

69 per cent of India's population lives in rural areas



Source: https://censusindia.gov.in/census.website/data/population-finder, accessed on April 24, 2024

Rural population is depndent on groundwater for their drinking-water sources



Source: Jal Jeevan Mission MIS Report (https://ejalshakti.gov.in/IMISReports/Reports), accessed on April 12, 2024

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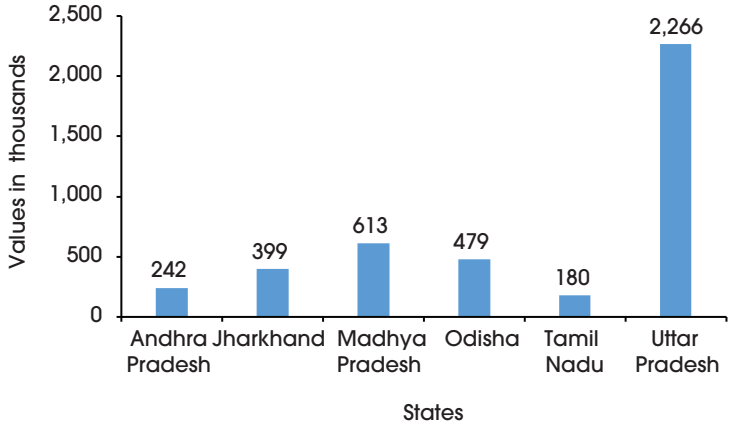
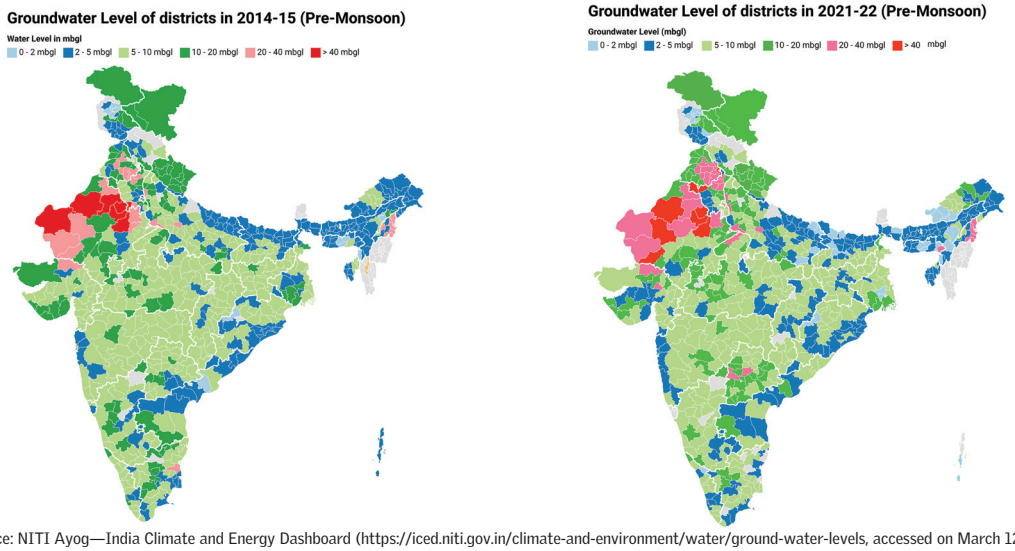
Top five states dependent on groundwater sources for drinking-water supply



Source: Jal Jeevan Mission MIS Report (https://ejalshakti.gov.in/IMISReports/Reports), accessed on April 12, 2024

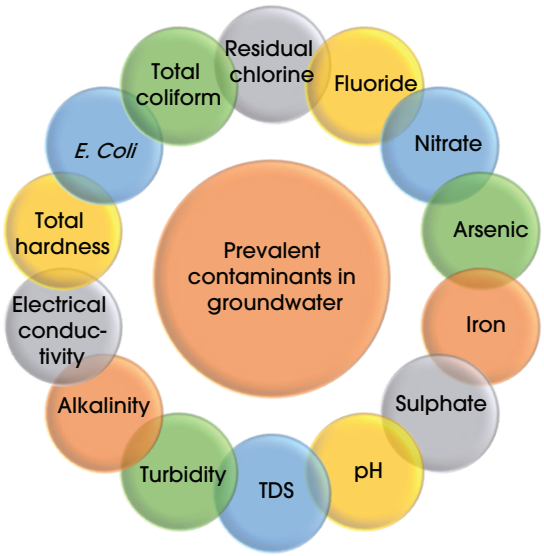
Status of groundwater decline in different hydrogeological regions

The comparative situation of groundwater levels from 2014–15 to 2021–22



Source: NITI Ayog—India Climate and Energy Dashboard (https://iced.niti.gov.in/climate-and-environment/water/ground-water-levels, accessed on March 12, 2024.

Status of contamination in different states in different hydrogeological regions



Source: Groundwater Year Book 2021–22, Central Groundwater Board

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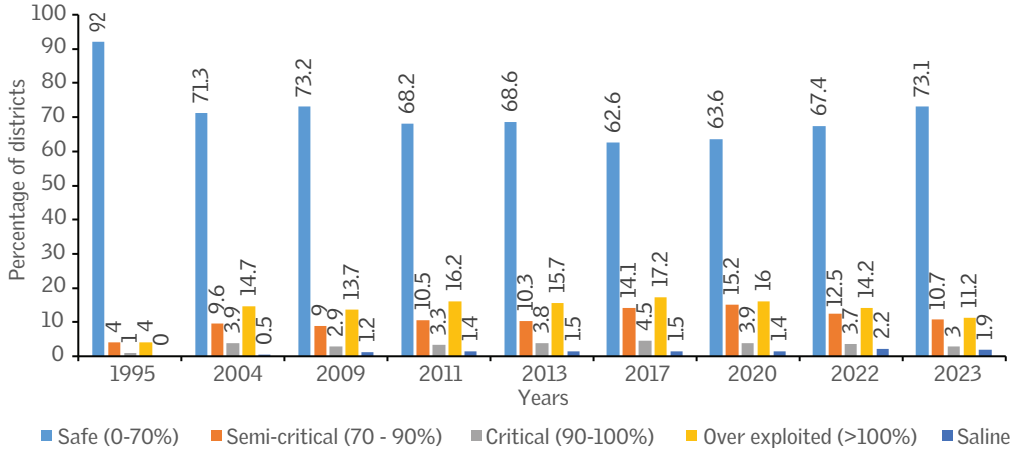
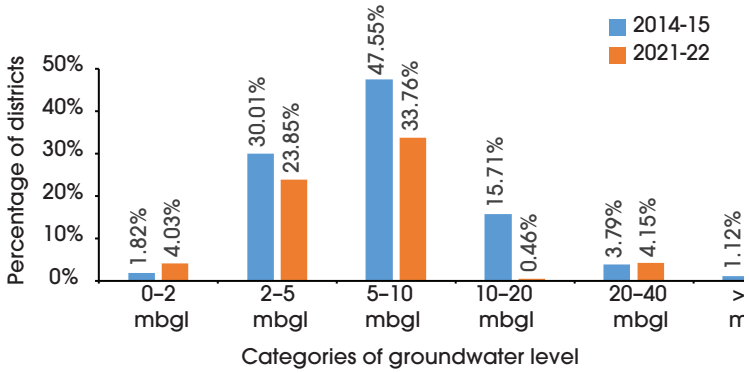
Comparative change in groundwater development categories (1995–2023)



Source: National Compilation on Dynamic Groundwater Resources of India, 2023

More districts started to show decline of groundwater in just six years

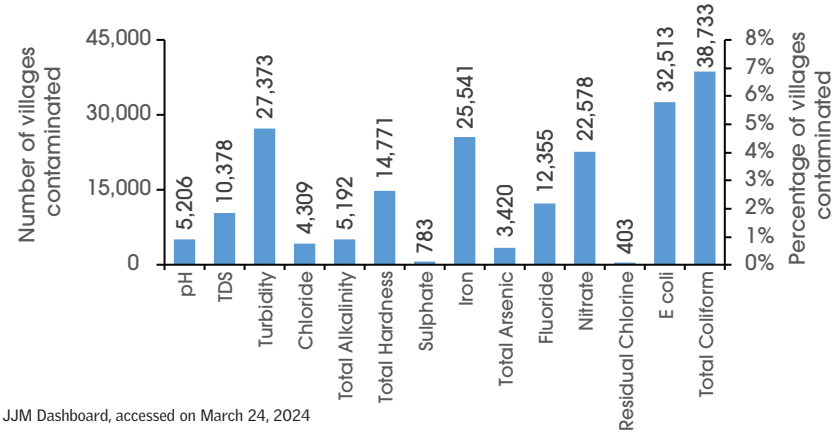


Source: NITI Ayog—India Climate and Energy Dashboard (https://iced.niti.gov.in/climate-and-environment/water/ground-water-levels, accessed on March 12, 2024

Water quality affected in villages

The testing of drinking water is carried out in villages through laboratories and field-testing kits. The testing data shows that there are a significant number of villages whose drinking-water quality is affected above permissible standards[1] (see graph below).

Number of villages with contamination in drinking-water sources (above permissible limits)



Source: JJM Dashboard, accessed on March 24, 2024

1. cpcb.nic.in/who-guidelines-for-drinking-water-quality/ and Indian Standards Drinking Water Specifications (IS 10500 : 2012)

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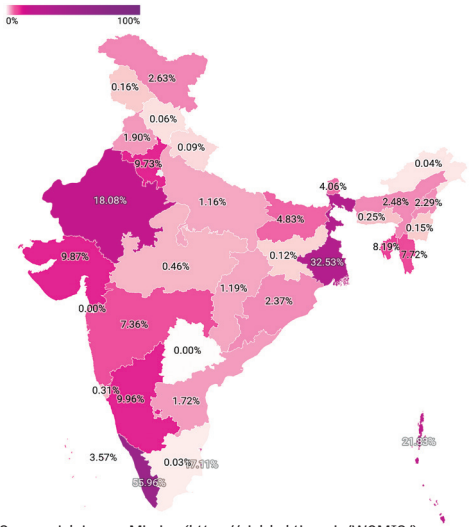
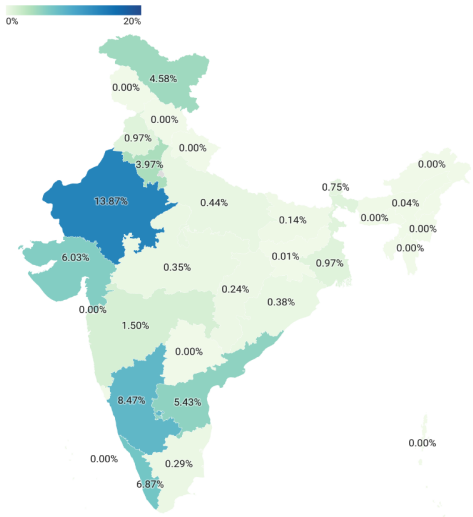
State-wise percentage of tested drinking-water samples found to be contaminated

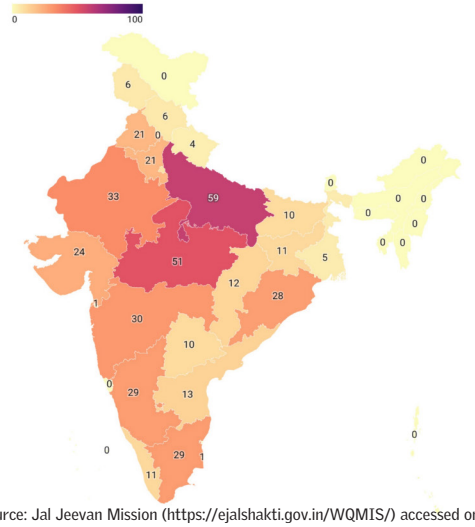


State-wise percentage of villages affected by fluoride in drinking-water sources

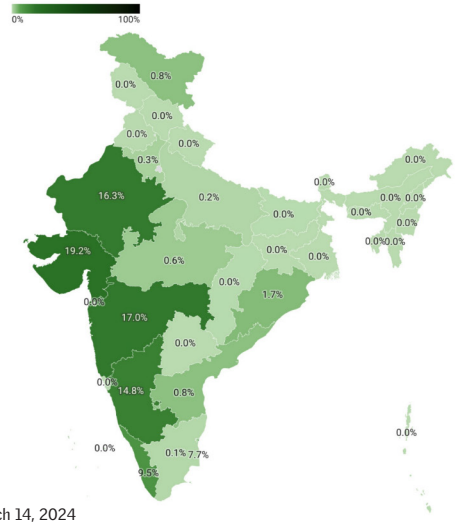


Source: Jal Jeevan Mission (https://ejalshakti.gov.in/WQMIS/) accessed on March 14, 2024

State-wise number of districts affected by nitrate in drinking-water sources



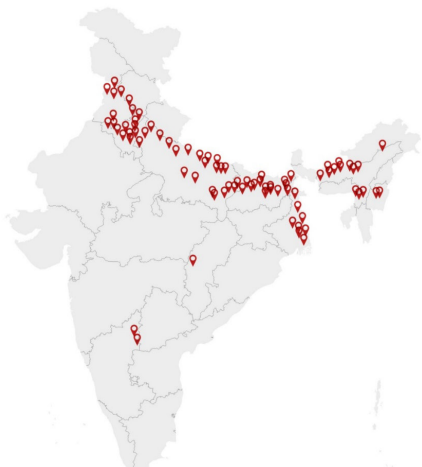
State-wise percentage of villages affected by nitrate in drinking-water sources



Source: Jal Jeevan Mission (https://ejalshakti.gov.in/WQMIS/) accessed on March 14, 2024

State-wise number of districts affected by nitrate in drinking-water sources

State-wise percentage of villages affected by nitrate in drinking-water sources



Source: Central Groundwater Board

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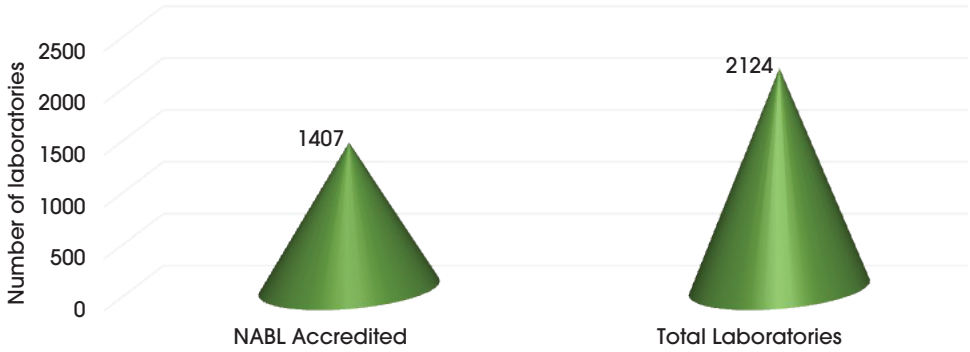
How states are monitoring the quality of water sources?

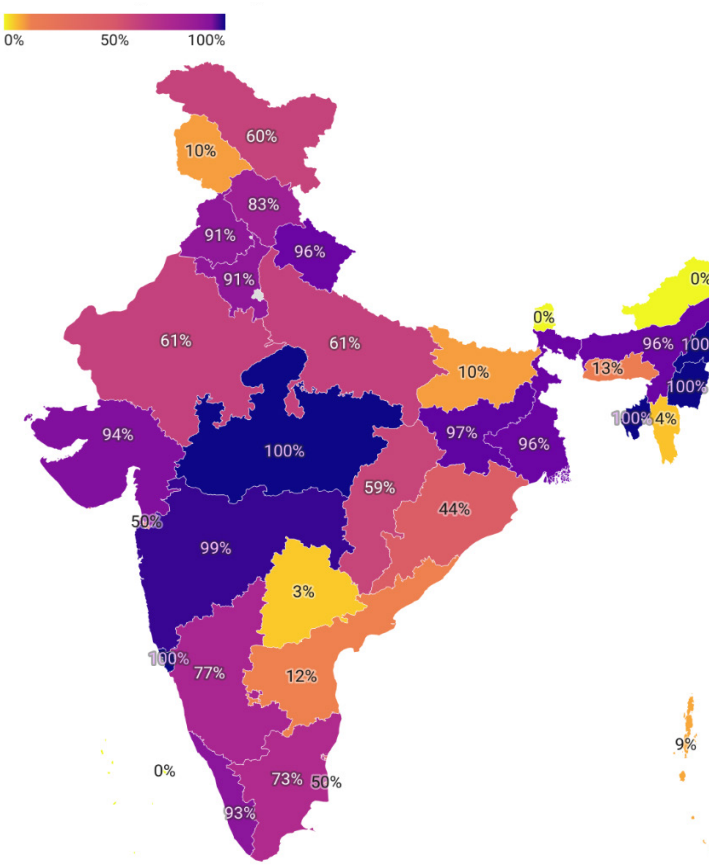
The quality of water for drinking through different sources is monitored through the laboratories set up at the state, district, block, and subdivisional levels. The laboratories take samples from supply sources and test them for physical chemical, and biological parameters. The status of laboratories with regard to their accreditation under the National Accreditation Board for Testing and Calibration Laboratories is shown in the following figure.

Status of laboratories (total number vs NABL accredited)



Source: Jal Jeevan Mission (https://ejalshakti.gov.in/WQMIS/) accessed on March 14, 2024

State-wise percentage of NABL-accredited laboratories



Source: Jal Jeevan Mission (https://ejalshakti.gov.in/WQMIS/) accessed on March 14, 2024

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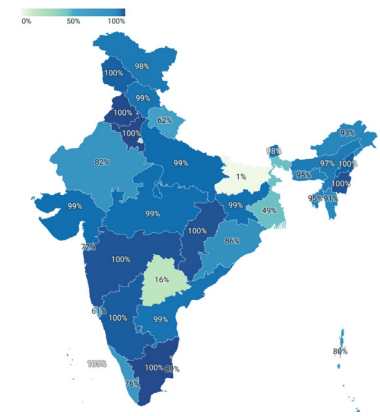
How many states have communities that monitor the quality of drinking-water sources?

According to Jal Jeevan Mission (JJM), every village should have a village water and sanitation committee that monitors the quantity and quality of water supplied to households. The quality of water will be tested by using field-testing kits (FTKs) and communities (four to five women from each village) will be trained to use them. The trained communities will test the quality of water supplied to their households and ensure that the water is fit for drinking. Data from the JJM portal shows that states have progressed in training communities to use FTKs. The following map shows the percentage of villages in each state with women trained in using FTKs.

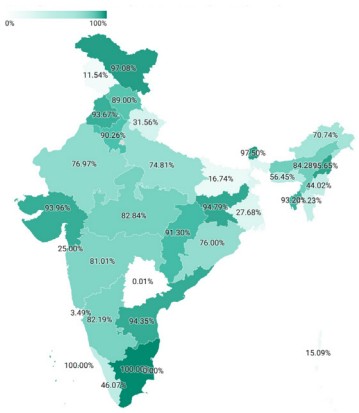
The data from the map shows that nine states have 100 per cent of their villages with communities that have been trained to use FTKs. Telangana and Bihar rank very low, with the least percentage of villages that have trained communities to test the quallity of drinking water.

It is important to note that even though a large number of community members have been trained to test water quality, the testing of samples by FTK at the village level is relatively low. The data in the map below shows the percentage of total villages in each state, where testing is done using FTK. Maharashtra, Karnataka, Punjab, Haryana, Chhattisgarh, Tamil Nadu, Jammu, Manipur and Nagaland show 100 per cent of their villages with communities trained in using FTKs. But the per cent of villages actually using FTKs in these states is much lower. Large states such as Maharashtra and Karnataka have only around 80 per cent of their villages where communities use FTKs. This may lead to underreporting or erroneous reporting on groundwater quality.

State-wise percentage of villages that have trained communities in using FTKs



State-wise percentage of villages where drinking-water quality is tested using FTKs



Source: Jal Jeevan Mission (https://ejalshakti.gov.in/WQMIS/) accessed on March 14, 2024

The following are some organizations that have developed FTKs used by communities to test the drinking water quality:

Cost of some widely used FTKs

S. no.	Organization	Estimated price (in Rs)
1	Defence Research and Development Organization (DRDO)	6,000–7,000
2	Tamil Nadu Water Supply and Drainage Board (TWAD)	2,500–3,000
3	Development Alternatives	3,000–8,000

Source: www.twadboard.tn.gov.in; https://www.indiawaterportal.org/articles/water-quality-testing-kits-field-use-part-2-3

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41, Tughlakabad Institutional Area, New Delhi 110 062, INDIA
Ph: +91-11-29956110 - 5124 - 6394- 6399
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VWSC IN VILLAGE ISDAR TRAINED TO MONITOR QUALITY OF DRINKING WATER

Village Isdar in Ahwa block of Dang district, Gujarat, started receiving drinking water in households in 2019 under Jal Jeevan Mission. The source of this water was well water that was pumped to an overhead tank and distributed to each household. The project for this water supply was implemented by the Water and Sanitation Management Organization (WASMO) in 2019. For an uninterrupted water supply as well as for operation and maintenance, WASMO created a Village Water Sanitation Committee (VWSC), also known as Pani Purotha Samiti, in December 2019.

Photo credit: Vivek Sah, CSE

Kantaben, member of the VWSC, displaying the water-testing kit and the manual

To ensure clean water supply to every household, the six-membered VWSC attended a training on 'Use of field testing kit at your doorstep' conducted by the district water-testing laboratory post implementation of the water supply project. At the end of the training, a field-testing kit (FTK) was provided to the VWSC along with a manual for maintaining the regular record of water quality. The VWSC was advised to test the water quality twice in three days. One FTK can test almost 100 samples. The VWSC members send the water samples from the village to the district laboratory twice a week.

Kantaben Manubhai, 45 years, Asha worker and VWSC member trained by district lab explains, 'Testing of water is new to me. I learned about the different contaminants in water and their impact on human health. Previously I was not aware about contaminants but after the one week of training I learned how to use the field-testing kit. Now I am doing four tests a week. Regular monitoring of drinking water helps the villagers get clean water.'

Kantaben also gets additional pay from the district administration for testing the water quality in her village. Sometimes she visits a nearby village to do the same. The district administration pays her Rs 5,000 per month to test the water quality.

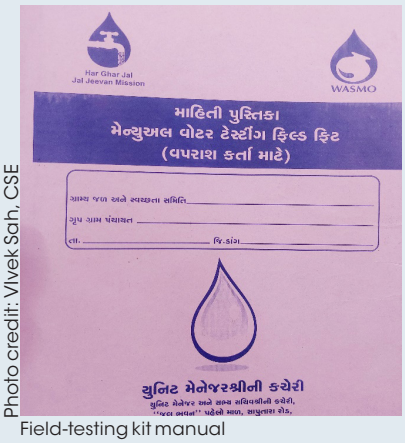
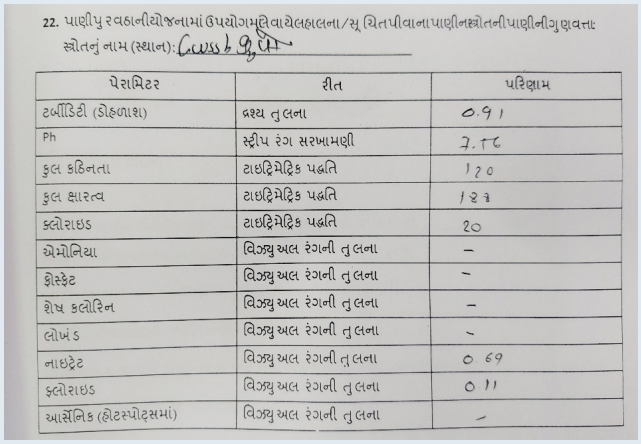


Photo credit: Vivek Sah, CSE

Field-testing kit manual



22. પાણીપુરવઠાનીયોજનામાંઉપયોગમાંલેવાયેલહાલના/સૂચિતપીવાનાપાણીનાસ્ત્રોતનીપાણીનીગુણવત્તા:
સ્ત્રોતનું નામ (સ્થાન): Cross b Pump

પેરામિટર	રીત	પરિણામ
ટર્બીડિટી (ડોહળાશ)	દ્રશ્ય તુલના	0.91
Ph	સ્ટ્રીપ રંગ સરખામણી	7.56
કુલ કઠિનતા	ટાઇટ્રિમેટ્રિક પદ્ધતિ	120
કુલ ક્ષારત્વ	ટાઇટ્રિમેટ્રિક પદ્ધતિ	124
ક્લોરાઇડ	ટાઇટ્રિમેટ્રિક પદ્ધતિ	20
એમોનિયા	વિઝ્યુઅલ રંગની તુલના	–
ફ્લોરાઇડ	વિઝ્યુઅલ રંગની તુલના	–
શેષ ક્લોરિન	વિઝ્યુઅલ રંગની તુલના	–
લોખંડ	વિઝ્યુઅલ રંગની તુલના	–
નાઇટ્રેટ	વિઝ્યુઅલ રંગની તુલના	0.69
ફ્લોરાઇડ	વિઝ્યુઅલ રંગની તુલના	0.11
આર્સેનિક (હોટસ્પોટ્સમાં)	વિઝ્યુઅલ રંગની તુલના	–

Photo credit: Vivek Sah, CSE

Testing report of open well water of village Isdar

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Are communities equipped to monitor groundwater quantity?

The commonly used methods of groundwater monitoring used by the village communities include the following:

Steel tape: This can be considered economical and the most used technique of measuring the groundwater level. Before lowering this tape into a well or borewell, a line on the lower part of the tape is marked with a chalk. A weight at the bottom of this tape helps to lower the tape faster into a well. An understanding of the approximate level of groundwater is necessary for this. Once the tape goes down to a level around the existing groundwater level, the tape is rapidly brought to the ground surface and the part of the chalk mark that is wet is studied. The final reading is the topmost level of the wet part of the tape. This method is mostly accurate for groundwater levels around 50–60 m below the ground surface. Since this system only involves a simple tape, the price is negligible.

Tape sounders: For deeper levels, electronic measuring tapes or tape sounders are used, which are made up of a pair of separated insulated wires. Well dippers and sounding devices with acoustic and light signs are extensively used to check groundwater levels more accurately and quickly. Whenever the device touches the groundwater level, there is a beep and the reading is taken. The price for such tape is in the range of Rs 9,000–12,000.

According to a 2022 World Bank report, over 2,000 villages have prepared their water budgets to find out how much groundwater is available, how much is estimated to be recharged, and how much can be set aside for agriculture.[2]

To estimate groundwater levels pre-and post-monsoon, well levels are studied by communities. A few communities, with the help of non-profits, have begun to monitor groundwaters level by using tape sounders. There is no information on the JJM dashboard about villages monitoring groundwater levels.[3]

Need to develop MIS on groundwater quality and quantity

Once a water supply project is implemented by the government, it is handed over to the community. The community becomes responsible for sustainability of the project. If the source of supply is groundwater based, the communities are not only responsible for the supply but also responsible to sustain the sources. It is important that they are capacitated with the knowledge of monitoring the quality and quantity of the groundwater. The states are progressing in terms of training the community and providing FTKs for testing of drinking water quality. The dashboard does not mention anything about the monitoring of groundwater level. CSE's survey to different districts also confirms that the communities lack a formal training on surveying of groundwater level. However, the communities have traditional knowledge for a broad understanding of the groundwater levels by observing levels of water in the wells pre and post monsoon.

2. https://blogs.worldbank.org/en/endpovertyinsouthasia/india-seeks-arrest-its-alarming-decline-groundwater as viewed on April 15, 2024
3. Tariq, M.A.U.R.; Hashmi, M.Z.U.R.; Waseem, M.; Sarwar, M.K.; Ali, W.; Farooq, R.; Almazroui, M.; Ng, A.W.M. An Overview of Groundwater Monitoring through Point-to Satellite-Based Techniques. Water 2022, 14, 565. https://doi.org/ 10.3390/w14040565 as viewed on April 22, 2024

Management information systems (MISs) are needed for water auditing and making decisions about water-conservation measures and overall making the drinking water sources safe and sustainable.

Annexure: Water quality standards prescribed BIS Standards (IS 10500:2012)

S. no.	Parameter	Acceptable limit	Permissible limit in absence of alternative source
1	pH value	6.5–8.5	No relaxation
2	Odour	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable
4	Colour (Hazen units)	5	15
5	Turbidity (NTU)	1	5
6	Total dissolved solids (mg/L)	500	2000
7	Chloride (mg/L)	250	1000
8	Fluoride (mg/L)	1	1.5
9	Iron (mg/L)	0.3	No relaxation
10	Manganese (mg/L)	0.1	0.3
11	Nitrate (mg/L)	45	No relaxation
12	Total alkalinity (mg/L)	200	600
13	Total hardness (mg/L)	200	600

Source: https://cpcb.nic.in/wqm/BIS_Drinking_Water_Specification

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