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Unknown and Undrinkable?

India drinks what it does not measure: why a clean record is not the same as clean water, and how a sampling rule scaled to its people would show what pesticides are in its rivers, wells and taps

VIJAY RAMPRASAD RAO, PHD · TAILENDERS ANALYTICS

FOR WATER AND POLLUTION REGULATORS, THE JAL JEEVAN MISSION, PUBLIC-HEALTH AGENCIES, WATER UTILITIES, BOTTLERS AND FOOD COMPANIES, JOURNALISTS AND SCHOLARS

ABSTRACT

Is there pesticide in the water India drinks? And how would anyone know? India's rules answer the second question with a design that cannot answer the first. The national drinking-water standard sets limits for 18 pesticides and no testing frequency. The Jal Jeevan Mission tests sources for chemicals once a year and leaves pesticides to state laboratories. The river network samples pesticides once a year, before the monsoon, and in 2020 produced pesticide data for at most 114 stations, one for every 12.3 million people. The European Union, by contrast, requires at least 88 pesticide samples a year for a supply zone serving 10 million people, and the United States samples every entry point to a water system and moves to quarterly testing wherever a pesticide is found. India tests bottled water for pesticides twice a year; we found no rule requiring any tap, well or hand pump to be tested at all. Where independent scientists did look, they found α-endosulfan at 58 µg/L in Kasaragod wells, about 145 times India's limit, and imidacloprid at 63.33 µg/L in the Teesta, a compound for which India sets no limit. The gap is widening: the United States now regulates two PFAS at four parts per trillion, and India's standards contain no PFAS parameter. These gaps fall on the same households, those that cannot buy their water, live far from a state laboratory and drink from sources beside the fields, and they reproduce themselves, because a source that is never tested never records the exceedance that would justify testing it. The paper recommends a sampling rule: test every drinking-water source at least twice a year, scale testing to the people served, raise it on detection, follow use, and publish every result with its detection limit. A clean record is not the same as clean water.

KEYWORDS

pesticides; drinking water; groundwater; rivers; India; CPCB; Jal Jeevan Mission; IS 10500; endosulfan; imidacloprid; monitoring; sampling frequency; PFAS; equity; missing layer; tail-end; Tailwinds

INTERACTIVE MAP

Pesticides in India's waters: interactive map

SUGGESTED CITATION

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Argument

Is there pesticide in the water India drinks? And how would anyone know? These are the questions a family drawing from a hand pump in the Ganga plain, or an open well in Kasaragod, would ask. The answer India's official record gives is that there is little or nothing to find. This paper shows that the record gives that answer because of how it is built, not because of what is in the water.

This paper makes four claims. First, India's monitoring of pesticides in water is designed in a way that cannot detect what it is meant to detect: too rarely, at too few stations, for the wrong compounds, at undisclosed detection limits, and outside the laboratories where drinking water is tested. Second, wherever anyone measured independently, they found concentrations far above India's own drinking-water limits, and the state's own published annex contains values that its written answer to Parliament left out. Third, India runs two standards for two kinds of water: a strict one for water that is bought and a loose one for water that comes from a tap or a well. The people who drink the second kind are the tail. Fourth, these gaps fall on the same households and reproduce one another, and the remedy is a sampling rule scaled to the people India's water serves, of the kind the European Union and the United States already write into law.

1

The record that finds nothing

The Central Pollution Control Board's National Water Quality Monitoring Programme had 4,703 locations in January 2024, including 1,233 on groundwater. Its 2017 guidelines list 18 pesticides and pesticide groups, among them the herbicides atrazine, alachlor, butachlor, isoproturon and 2,4-D, to be analysed 'once a year during pre-monsoon period' (Central Pollution Control Board 2017). Once a year, before the monsoon, misses the spray season and the runoff that follows it: a 43-site survey of the Ganga found organochlorines two to five times higher after the monsoon than in the dry season (Sah et al. 2020).

The practice is thinner than the protocol. The only national station-level pesticide tables we found are an annex to a 2021 answer in the Lok Sabha (Unstarred Question 3585). For 2020, they report 13 compounds on 11 rivers, with data for at most 114 of 479 stations for any compound: 16 of 92 stations on the Ganga for α-HCH, 1 of 43 on the Godavari, 1 of 28 on the Mahanadi. None of the five herbicides on the paper list appears. The written answer told Parliament that DDT was below detection and aldrin no higher than 0.07 µg/L. The same answer's annex prints p,p′-DDT at 4.5 µg/L in the Beas and aldrin at 3 µg/L at all 14 Ghaggar stations. Against the drinking-water limits the ministry itself cites, that is 4.5 times for DDT and about 100 times for aldrin. The identical values across 14 stations may be a data-entry artefact. Either Parliament was told less than the annex shows, or the state's published numbers cannot be relied on. Both are findings.

Groundwater fares no better. Asked by the National Green Tribunal about agricultural contamination in Punjab, the Board reported that 12 pesticides at 43 groundwater stations were 'Below Detection Limit (BDL) in the State during 2019 – 2023'. It did not state the detection limit. India's drinking-water standard sets α-HCH at 0.01 µg/L and aldrin and dieldrin at 0.03 µg/L; a method that cannot see below those values cannot show compliance with them. A non-detect without a stated limit is a non-measurement presented as a result.

Drinking water is tested by the Jal Jeevan Mission's laboratory network. Its framework marks total and individual pesticides 'Yes' at state laboratories and 'No' at every district and block laboratory, and pesticides are absent from the contaminant categories the Mission uses to count quality-affected habitations. We found no published count of how many drinking-water samples were tested for pesticides, or how many exceeded a limit.

2

What was found when someone looked

Independent measurement tells a different story. The table sets the highest verified concentrations in drinking-water sources against India's own standard, IS 10500:2012, Table 5.

WATER SOURCE AND PLACE	COMPOUND	HIGHEST REPORTED (µg/L)	IS 10500 LIMIT (µg/L)	MULTIPLE OF THE LIMIT
Open wells, Kasaragod, Kerala (post-monsoon 2010)	α-endosulfan	58	0.4	about 145 times
Hand pumps, Kanpur, Uttar Pradesh (published 2005)	Dieldrin	16.2	0.03	about 540 times
Village groundwater, Greater Noida, Uttar Pradesh (published 2026)	α-HCH	13.57	0.01	about 1,357 times
Wells, Thiruvallur, Tamil Nadu (published 2007)	p,p′-DDT	14.3	1	about 14 times
Domestic wells, Hyderabad (published 2006)	α-endosulfan	2.14	0.4	about 5 times
Tube wells, Hisar, Haryana (2002–03)	α-HCH	1.24	0.01	about 124 times
Groundwater, Western Bengal basin (2014–2016)	Atrazine	3.93	2	about 2 times
Groundwater, Greater Noida	Chlorpyrifos	4.65	30	below the limit

Rivers and lakes carry the same signal at lower levels. The one river study that used methods able to see the insecticides India sprays today, on the Teesta in North Bengal, found imidacloprid at 63.33 µg/L and chlorpyrifos at 23.35 µg/L at Domohoni, Jalpaiguri, before the monsoon (Dutta et al. 2024). In the Hooghly basin, 93.7 percent of river samples carried more than 0.5 µg/L of total pesticides, the European limit for drinking water, in 2014 to 2016 (Mondal et al. 2018). Chilika Lake carried chlorpyrifos up to 2.73 µg/L and organochlorines up to 23.4 µg/L in 2012 to 2016 (Nag et al. 2020).

Two cautions keep the findings honest. Most of these are single campaigns, often a decade or more old, and no study repeated its measurements at the same wells or lakes, so none can say whether the 2011 national ban on endosulfan changed what people drink. And the compounds that breach Indian limits are mostly banned organochlorines with very low limits; the insecticides and herbicides in use today, with much higher Indian limits, rarely breach them even where authors report breaches against European benchmarks. That is not reassurance. It is the next finding.

3

Two standards for two kinds of water

In February 2003, the Centre for Science and Environment reported that bottled water from 17 Delhi-area brands averaged 36.4 times the European limits for pesticides, with residues of lindane, DDT, malathion and chlorpyrifos traced to the groundwater the bottlers drew. Within a week, the Bureau of Indian Standards amended the packaged-water standard 'to align the Indian standards with EU norms'. Today, packaged water may carry no more than 0.1 µg/L of any pesticide and 0.5 µg/L in total.

The water people draw from taps and wells did not get the same treatment. IS 10500:2012 sets compound-specific limits for 18 pesticides, with no total limit: chlorpyrifos 30 µg/L, butachlor 125 µg/L, malathion 190 µg/L. For malathion, that is 1,900 times the limit on bottled water. Imidacloprid and glyphosate have no limit at all, so the Teesta's 63.33 µg/L of imidacloprid breaches no Indian drinking-water standard. The standard moved for water that is bought. It did not move for water that is not.

The monitoring the state promised after 2003 did not follow. A 2004 sub-committee chose nationwide monitoring over final product standards; a 2013 review found that none of the Joint Parliamentary Committee's recommendations had been effectively implemented; and we found no peer-reviewed study of pesticides in Indian bottled water since, and no laboratory measurement of pesticides in Indian water by any civil-society group from 2023 to 2026.

4

The global models see what India reports

The most cited global model of pesticides in rivers places the Ganges among the rivers most exposed to pesticide runoff (Maggi, Tang and Tubiello 2023). It also inherits India's blind spots. Its inputs scale each country's estimated use to FAOSTAT, and FAOSTAT carries India at exactly 40,094 tonnes a year for every year from 2010 to 2024: an official figure for 2010, carried forward and flagged as imputed for 2011 to 2021 and estimated for 2022 to 2024. India's own plant protection directorate records 64,506 tonnes for 2022–23 in its August 2026 tables and 53,630 tonnes in the version on the government's open data portal, counting technical-grade chemical and formulated product together; almost the whole gap between the two releases is Jammu and Kashmir, revised from 391 to 11,267 tonnes (Directorate of Plant Protection, Quarantine and Storage 2026). Its only check against Indian measurement is chlorpyrifos at 19 to 2,730 ng/L, cited from a review that has since been retracted (Sarker et al. 2021, retracted 2025); the range belongs to one lagoon, Chilika, from Nag et al. (2020), and the model's own mean for India was 0.33 ng/L. A global model calibrated on a flat estimate and checked against a single lagoon through a retracted secondary source cannot see India. It sees what India reports.

The other leading global assessment judges groundwater 'relatively protected from pesticide pollution' (Tang et al. 2021). By construction, it leaves out compounds banned before 2015, which are exactly the compounds driving India's measured well exceedances.

5

The geography of not knowing

We found no peer-reviewed pesticide measurement for the Narmada, the Mahanadi main stem, the Godavari main stem or the Beas from 2000 to 2026, and none for the rivers of Madhya Pradesh, Chhattisgarh, Jharkhand, Rajasthan, Karnataka or Himachal Pradesh. A review of 61 publications on the Ganga basin found that 'most of the Ganga's major tributaries, and the entire southern part of the catchment, have not been investigated' (Ghirardelli et al. 2021). These are likely gaps from keyword searches, not proven absences, and Indian journals without digital identifiers may hold more.

What has been measured is mostly what older methods could see. The record is dominated by DDT, HCH, endosulfan, aldrin and dieldrin because laboratories calibrated for organochlorines cannot detect neonicotinoids or most herbicides. We found no peer-reviewed river measurement of atrazine, 2,4-D, glyphosate or monocrotophos. A well tested only for organochlorines has not been tested for the pesticides sprayed today, which is different from being tested and found clean.

This is the same pattern as the global evidence on pesticide harm (Ramprasad 2026): the record is thinnest where the burden is likely heaviest. In India's case the gap has an address. It is the hand pump and the open well in the cotton, paddy and soy belts, tested once if at all, for the wrong compounds, at a limit no one discloses.

6

How rarely India looks

How often does anyone test the water a family drinks for pesticides? In India the rules answer: rarely, and for drinking water, by no stated rule at all. The national standard sets limits for 18 pesticides and no testing frequency; its sampling clause prescribes how to draw a sample, not how often (Bureau of Indian Standards 2012). The Jal Jeevan Mission asks that every drinking-water source be tested for chemical parameters at least once a year, but assigns pesticides to state laboratories alone (Ministry of Jal Shakti n.d.). The river and groundwater network tests pesticides once a year, before the monsoon (Central Pollution Control Board 2017). In 2020 that produced pesticide data for at most 114 river stations, one for every 12.3 million people in a country of 1.40 billion (Lok Sabha 2021; World Bank 2026).

Other systems scale testing to the people served and raise it when something is found. Table 2 sets the rules side by side.

SYSTEM	WATER COVERED	MINIMUM PESTICIDE TESTING	WHAT RAISES IT	SOURCE
India, drinking-water standard (IS 10500)	Drinking water	No frequency stated	Nothing stated	Bureau of Indian Standards 2012
India, Jal Jeevan Mission	Every drinking-water source	Chemical parameters at least once a year; pesticides only at state laboratories	Positive samples referred upward	Ministry of Jal Shakti n.d.
India, national river and groundwater network	Monitoring stations	Once a year, before the monsoon	Nothing stated	Central Pollution Control Board 2017
India, packaged drinking water	Each producer	Twice a year, individual and total	Not stated in the scheme	Food Safety and Standards Authority of India 2025
European Union	Each supply zone	At least once a year; 12 a year above 100,000 m^3 a day, plus one for each further 25,000 m^3	Risk assessment may change it	European Union 2020
United States	Every entry point to the distribution system	Four quarterly samples every three years, or two after a clean period	Any detection: quarterly at that point	US EPA 2026a

The difference is one of design, not of degree. The European Union ties the minimum number of pesticide samples to the volume each supply zone distributes: at the Directive's own assumption of 200 litres per person a day, a single zone serving 10 million people must be tested for pesticides at least 88 times a year (European Union 2020). The United States ties testing to every entry point into a distribution system and makes detection the trigger: four quarterly samples in each three-year period, falling to two after a clean period, and quarterly sampling at any point where a regulated pesticide is found, until the state is satisfied the system is reliably below the limit (US EPA 2026a). India's rules contain neither mechanism for pesticides. Testing does not grow with the population served, and a detection does not raise the frequency.

India tests bottled water more often than tap water. Since January 2026 every packaged drinking-water producer must test for individual and total pesticide residues once every six months (Food Safety and Standards Authority of India 2025). We found no rule that requires any particular tap, well or hand pump to be tested for pesticides at all.

PFAS and industrial pollutants: the limits India has not written

The gap widens beyond pesticides. The United States now regulates PFOA and PFOS, two of the synthetic 'forever chemicals', at 4.0 nanograms per litre each, requires quarterly sampling wherever they exceed a trigger level, and sets compliance for April 2029 (US EPA 2026a). In May 2026 the EPA proposed to keep those limits while letting systems apply for two more years, to 2031, and separately proposed to rescind its limits for PFHxS, PFNA, HFPO-DA and their mixtures (US EPA 2026b). The European Union's limit of 0.10 µg/L for the sum of 20 PFAS applies from 12 January 2026 (European Union 2020). Four nanograms per litre is four parts per trillion, about four seconds in 7,900 years; one gram of PFOA would bring 250 million litres, about 100 Olympic pools, to the US limit. That is 25 times stricter than Europe's limit for any single pesticide and 47,500 times stricter than India's limit for malathion. India's drinking-water standard, its bottled-water regulation and the Jal Jeevan Mission's framework contain no PFAS parameter at all. While the United States argues over how fast to reach four parts per trillion, India has not begun the argument.

Industrial pollutants show the same pattern from a different angle. For most of them, India's numbers match the WHO's: 0.5 µg/L for PCBs, 0.1 µg/L for polyaromatic hydrocarbons, 10 µg/L for lead and 3 µg/L for cadmium (Bureau of Indian Standards 2012; WHO 2022). The gaps lie elsewhere. Arsenic, which the Jal Jeevan Mission names first among the natural contaminants of rural groundwater, is held to 10 µg/L but relaxed to 50 µg/L 'in the absence of alternate source', so the households with the fewest options receive the weakest protection. PCBs, polyaromatic hydrocarbons, cadmium and cyanide are tested only at state laboratories (Ministry of Jal Shakti n.d.). And for pharmaceutical waste, the government told Parliament in 2021 that active pharmaceutical ingredients are 'not a notified parameter' for common effluent treatment plants, and that an expert committee had not accepted a standard for antibiotic residues because 'no other country in the world implemented these standards' (Lok Sabha 2021).

Who the gaps fall on

Each gap in this paper is also a line of inequity, and the lines run through the same households. Five stand out.

1. **Bought and drawn water.** Water that is bought is held to 0.1 µg/L per pesticide and tested twice a year. Water drawn from a tap, well or hand pump is held to limits up to 1,900 times looser and has no stated pesticide testing frequency. The families that cannot buy their water get the weaker standard.
2. **Village and capital.** The Mission's own framework records that 85 percent of rural water supply depends on groundwater (Ministry of Jal Shakti n.d.), yet only state laboratories are expected to test it for pesticides. The farther a source sits from a state laboratory, the less likely its water is ever tested for what is sprayed around it.
3. **Season.** Testing once a year before the monsoon misses the season when spraying and runoff peak, and so misses the weeks when exposure is highest for the households that live beside the fields.
4. **Old and new chemicals.** India's limits are stricter than Europe's only for three isomers of HCH, an organochlorine of an earlier generation, and set nothing at all for imidacloprid or glyphosate. The strictness sits where the spraying has largely moved on.
5. **North and South.** Rich-country regulators now write limits for PFAS in parts per trillion and require quarterly testing where they are found; India writes none. Arsenic is relaxed fivefold for households with no other source. The chemical trade runs the other way. In 2024 member states of the European Union notified about 122,000 tonnes of pesticides banned on their own farms for export (Public Eye 2025), and within a month of proposing to ban 27 insecticides in 2020, India's government amended the draft to let firms keep making them for export (Ministry of Agriculture and Farmers Welfare 2020). Chemicals a richer jurisdiction will not use, or will not tolerate in its water, travel toward places that do not measure them.

The dimensions compound, and they reproduce themselves. A source that is not tested produces no exceedance; a district with no recorded exceedance attracts no laboratory; a standard with no recorded exceedance is not revised; and a chemical with no limit is never added to the panel. The silence of the record is then read as the safety of the water. This is how inequity persists without anyone deciding that it should: the people least able to buy their way out are the people the measurement system is least designed to see.

A sampling rule for a nation of 1.4 billion

The policy recommendation is a sampling rule, written into the drinking-water standard and funded through the Jal Jeevan Mission, with four parts.

1. **Scale testing to people.** Test every drinking-water source and piped scheme for pesticides at least twice a year, before and after the monsoon, with the number of samples rising with the population served, on the European model. The pollution board's own 2020 protocol already asks for river monitoring before and after the monsoon (Central Pollution Control Board 2020); the 2017 guidelines that govern the network still say once a year.
2. **Raise testing on detection.** Any detection moves that source to quarterly testing until consecutive results show it reliably below the limit, on the American model.
3. **Follow use.** Equip pesticide-capable district laboratories first in the districts with the highest recorded consumption, so that testing follows spraying rather than past detections.
4. **Publish the record.** Release station, date, compound, value and detection limit for every sample. A result of 'below detection limit' without the limit is not a result.

Alongside the rule, widen the panel and the limits. Add the pesticides India sprays today, including imidacloprid and glyphosate, and add PFOA and PFOS, to IS 10500, or adopt the bottled-water caps of 0.1 and 0.5 µg/L for all drinking water (Food Safety and Standards Authority of India 2011). A standard that protects bought water and not drawn water should be made one standard.

Verification can begin before any of these reforms. A sampled, confidential survey of drinking-water sources in high-use districts, analysed with methods able to see current-use pesticides and reported only by district, would show within one season whether the record's silence is the water's. Its findings would travel toward the people drinking the water, never against the farmers whose wells are sampled.

What would overturn this argument is stated in advance: a published, repeated, seasonal series of current-use pesticide measurements in Indian drinking-water sources, with stated detection limits, that finds concentrations consistently below the bottled-water caps.

Confidentiality, privacy and data sharing

This paper uses published studies, official records and public court filings. It names no person, household, village or well. Several studies infer recent use of banned pesticides from the chemistry of well water; a public map that placed such inferences beside named villages or wells would turn a contamination record into a list of potential offenders. The companion map therefore shows groundwater findings only at district level. Brand names from the 2003 bottled-water tests are not repeated; products tested in 2003 say nothing about products sold today.

Limits

This is a synthesis, not a new measurement. Most measured values come from one-off campaigns with different methods, compounds and years, and many sampling years and coordinates are not stated in the sources. Several key papers are paywalled, so some values come from abstracts or review tables, and two extreme values reported in the literature (malathion at 9,330 µg/L in West Bengal groundwater; 392.71 µg/L in the Sabarmati) are excluded pending full-text checks. Comparisons with IS 10500 apply a drinking-water standard to river and well water, as the ministry itself does. The 2020 state annex may contain data-entry errors; we report it as printed. Gaps are drawn from keyword searches, not a systematic review.

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