Household Drinking Water Treatment Practices in India: Insights from the NSS 76th Round

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Abstract—**The present paper attempts to study the method of treating drinking water in India. The study is based on secondary data collected from the 76th cycle of the NSS, conducted from July 2018 to December 2018, as reported in NSS No. 584, "Drinking Water, Sanitation, Hygiene, and Housing Conditions in India." This study examines the household drinking water treatment practices across Indian States and Union Territories using a Composite Index derived from normalized indicators of electric purification, boiling, chemical treatment, non-electric filtration, and untreated water usage. The results reveal significant regional disparities: Northeastern states and parts of Western India demonstrate strong adoption of safe treatment methods, while Bihar, Uttar Pradesh, West Bengal, Odisha, and Andhra Pradesh show extremely high dependence on untreated water. Maharashtra ranks highest, whereas Bihar ranks lowest. The findings highlight an urgent need for targeted awareness, affordable purification technologies, and improved access to safe household drinking water in low- low-performing regions.**

A Composite Index based on different methods of treatment of drinking water in India has been explored to determine the overall state of methods of drinking water in India.

Keywords— **drinking water, Households, method of treatment,**

I. INTRODUCTION

Access to safe and potable drinking water is a fundamental prerequisite for human health, socio-economic development, and overall well-being. Despite significant progress in improving water supply infrastructure, safe drinking water remains a persistent challenge in many developing countries, particularly India, where both rural and urban households rely on diverse and often vulnerable water sources. Contamination of drinking water—whether biological, chemical, or physical poses a major public health concern, contributing to a substantial burden of water-borne diseases such as diarrhoea, cholera, typhoid, hepatitis A and E, and other gastrointestinal infections. According to various national health assessments, a large proportion of illnesses and child mortality in India can be attributed to the consumption of unsafe water. Ensuring the availability of treated and safe drinking water is therefore essential for improving public health outcomes and achieving national development goals.

The treatment of drinking water at the household level plays an important complementary role to public water-supply systems. While initiatives such as the National Rural Drinking Water Programme (NRDWP) and Jal Jeevan Mission aim to provide piped water connections to every household, challenges such as intermittent supply, distribution losses, aging pipelines, and contamination during storage and handling persist. As a result, even households connected to formal systems may not always receive microbiologically safe water. Household-level water treatment practices—such as boiling, filtration through electric and non-electric purifiers, chemical disinfection using chlorine tablets or alum, and simple cloth filtration—serve as crucial protective barriers. These methods help households safeguard their drinking water quality irrespective of source vulnerabilities.

Understanding the patterns and determinants of household drinking water treatment practices is vital for several reasons. First, treatment practices reflect household perceptions, awareness levels, and behavioural responses to water quality concerns. Second, they highlight socio-economic disparities across states, regions, and rural–urban settings. Households with higher education levels, awareness, and financial capability are more likely

to adopt improved treatment technologies such as electric purifiers, while economically weaker households may depend on traditional or no-treatment methods. Third, variations in treatment practices across India reveal gaps in infrastructure coverage, reliability, and quality of supplied water. These insights are important for policymakers as they design targeted interventions to improve water safety, promote appropriate household treatment methods, and address awareness gaps.

The National Sample Survey (NSS) 76th Round (July–December 2018), Report No. 584 on "Drinking Water, Sanitation, Hygiene and Housing Conditions in India" provides one of the most comprehensive datasets for analysing household drinking water conditions. It includes detailed information on the principal source of drinking water, availability, distance, quality perception, and methods of water treatment adopted by households. The dataset offers a valuable opportunity to examine the spatial patterns and socio-economic dimensions of drinking water treatment practices across states and Union Territories in India.

Given the significance of safe water for public health and sustainable development, this study aims to assess the current scenario of household drinking water treatment practices in India using NSS 76th Round data. The study seeks to analyse variations across states, understand disparities between rural and urban households, and identify the prevalence of different treatment methods. Such an assessment is essential for informing policy interventions, strengthening water safety strategies, improving public health outcomes, and ensuring the realisation of Sustainable Development Goals (SDGs), particularly Goal 6: "Clean Water and Sanitation for All."

II. OBJECTIVE

1. To examine the prevalence of different household drinking water treatment methods (boiling, electric purifier, chemical treatment, filtration, and untreated) across Indian states and Union Territories.
2. To analyze rural–urban differences in drinking water treatment behaviour and identify significant spatial disparities.
3. To construct a composite index that measures the overall level of drinking water treatment

practices using selected indicators from the NSS 76th Round.

III. DATABASE AND METHODOLOGY

The present study is based on a secondary data analysis of household drinking water practices in India, using data from the National Sample Survey (NSS) 76th Round, conducted between July and December 2018. The relevant dataset, published as NSS Report No. 584, focuses on "Drinking Water, Sanitation, Hygiene, and Housing Conditions in India" and provides comprehensive information on the source, availability, and treatment of drinking water at the household level. Information on drinking water treatment included boiling, chemical treatment (using alum, bleach, or chlorine tablets), electric purifiers, non-electric purifiers, cloth filtration, and households that consume water without any treatment. Simple percentages, coefficient of variations, simple correlation, and the creation of a composite index are used in the analysis. Data accuracy is ensured by using ArcGIS software.

Indicator Used

1. Type of water treatment: Boiling, chemical treatment, electric purifier, non-electric purifier/cloth filtration, and untreated water.
2. Spatial distribution: State- and UT-wise prevalence of different treatment methods.
3. Rural–urban differences: Comparison of treatment practices between rural and urban household.

Treatment for drinking water production involves the removal of contaminants from raw water to produce water that is pure enough for human consumption without any short-term or long-term risk of any adverse health effect. Substances that are removed during the process of drinking water treatment include suspended solids, bacteria, algae, viruses, fungi, and minerals such as iron and manganese.

The processes involved in removing the contaminants include physical processes such as settling and filtration, chemical processes such as disinfection and coagulation and biological processes such as slow sand filtration.

Measures taken to ensure water quality not only relate to the treatment of the water, but to its conveyance and distribution after treatment. It is therefore a common practice to keep residual disinfectants in the treated water to kill bacteriological contamination during distribution.

Method of treatment of drinking water by the household: From NSS 76th Round information on treatment of drinking water was collected considering the usual practice of the household to treat drinking water received from all the sources (either principal or supplementary or both) to improve its quality.

Interpretation

The spatial distribution of household drinking water treatment practices in India reveals substantial inter-state disparities shaped by socio-economic, cultural and infrastructural factors. The all-India pattern shows that 65.3 percent of households do not treat their drinking water, indicating widespread dependence on raw or untreated sources. This overall trend conceals sharp regional contrasts.

Spatial Distribution of method of treatment of drinking water in India

Sl. No	State/UTs	Treated With				Not Treated
		Electric Purifier	Boiling	Chemically Treated (with Alum/bleach/Chlorine tablet	Non- Electric Purifier or Filtered with Cloth	
1	Andhra Pradesh	5	8.4	0.8	9	76.9
2	Arunachal Pradesh	1.6	66	2.6	20.9	10
3	Assam	5.6	5.3	6	47.7	35.4
4	Bihar	2.7	0.1	0	1.8	95.3
5	Chhattisgarh	2.5	2.1	0.9	24.1	70.4
6	Delhi	36.5	3.8	0.3	7.6	51.9
7	Goa	14.6	66.7	0.2	6.3	12.1
8	Gujarat	16.5	2.3	0.3	47.8	33.2
9	Haryana	19	0.6	0	5.7	74.7
10	Himachal Pradesh	5.7	8.3	0.8	9.2	76
11	Jammu & Kashmir	7.5	28.4	1.2	9.1	53.9
12	Jharkhand	4.1	6.8	1.6	14.3	73.4
13	Karnataka	13.4	10.7	0.2	13.5	62.3
14	Kerala	5.1	86	0.2	0.6	8.1
15	Madhya Pradesh	4.3	0.6	0.8	39	55.3
16	Maharashtra	13.9	6.9	10	38.6	30.6
17	Manipur	1.6	57.4	3.2	13.3	24.5
18	Meghalaya	5.2	79.4	0	7.4	7.9
19	Mizoram	5.9	10	2.2	67.9	14.1
20	Nagaland	5	82.9	0.7	11.3	0.2
21	Odisha	7.5	2.3	0.8	10.9	78.6
22	Punjab	35.9	1.3	0	4.7	58
23	Rajasthan	6.5	0.2	1.2	44.8	47.4
24	Sikkim	11.4	76.9	0.3	9.9	1.5
25	Tamil Nadu	8.5	19.2	0.3	3.6	68.3
26	Telangana	5.9	1.9	0.4	25.1	66.7
27	Tripura	1.6	0.2	0.3	78.8	19
28	Uttarakhand	21.8	1.9	0	6.5	69.7
29	Uttar Pradesh	4.1	0.4	0.1	1.6	93.7
30	West Bengal	7	1.3	0.4	6.7	84.6

31	A & Nicobar Islands	14.8	32.5	0.9	33.8	18
32	Chandigarh	35.9	1	0	8	55.1
33	Dadra and Nagar Haveli	6.3	2.7	2.1	7	82
34	Daman & Diu	3.8	3.6	0	6.9	85.7
35	Lakshadweep	1.8	60.9	3.1	3.4	30.8
36	Puducherry	15.7	18.9	0	2.4	63
37	All India	8.7	7.7	1.4	16.9	65.3
Mean		10.12	21.05	1.16	18.05	49.67
SD		9.50	29.01	1.97	19.36	28.91
CV		93.87	137.81	169.82	107.25	58.20

Source: NSS 76th Round, Report No.584: Drinking Water, Sanitation, Hygiene and Housing Condition in India
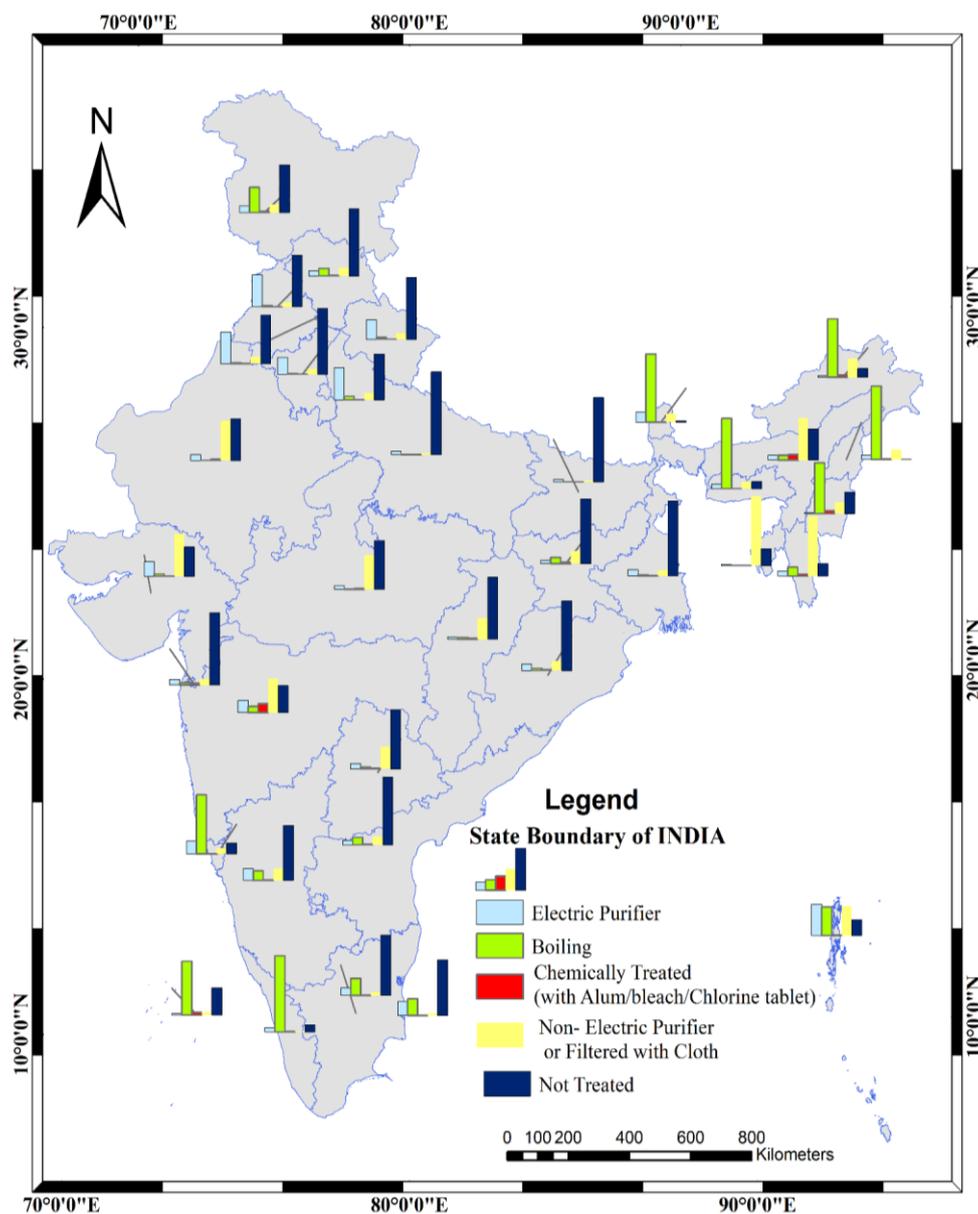

Fig. 1 shows the graphical interpretation of drinking water treatments in India (Data *Source: NSS 76th Round, Report No.584: Drinking Water, Sanitation, Hygiene and Housing Condition in India and the graph is plotted with the help of ArcGIS)*

A distinct cluster of states in the Northeastern region demonstrates the highest adoption of boiling as a treatment method. States such as Nagaland (82.9%), Sikkim (76.9%), Meghalaya (79.4%), and Arunachal Pradesh (66%) rely overwhelmingly on boiling. These states are characterized by abundant rainfall, spring-fed water systems and cultural practices that promote boiling as a preventive measure. Kerala in southern India also follows this pattern, with 86 percent of households boiling water—the highest in the country. The high variability in boiling behaviour is reflected in its coefficient of variation (CV = 137.81), indicating strong geographical and cultural influence.

In contrast, the adoption of electric water purifiers is concentrated in highly urbanised and economically advanced regions. Delhi (36.5%), Punjab (35.9%), Chandigarh (35.9%), Goa (14.6%), and Gujarat (16.5%) represent the highest usage. These patterns are consistent with higher household incomes, access to retail markets and greater risk perception regarding water contamination. States such as Maharashtra, Karnataka and Tamil Nadu also show moderate adoption.

The use of non-electric filters and cloth filtration is common in states like Tripura (78.8%), Mizoram (67.9%), and Gujarat (47.8%), indicating partial access to treatment methods but limited affordability of advanced technologies. Chemical treatment with chlorine or alum remains marginal across the country, with very low average usage (mean = 1.16%), though states like Maharashtra and Assam show slightly higher adoption.

The most concerning pattern emerges in the Gangetic plains and eastern states, where an overwhelming majority relies on untreated water. Bihar (95.3%), Uttar Pradesh (93.7%), West Bengal (84.6%), and Odisha (78.6%) fall into this category. High rural population density limited piped water access and low awareness, contribute to these outcomes.

Method of treatment of drinking water		Percentage distribution of households		
		Rural	Urban	All
Treated With	Electric purifier	2.4	20.8	8.7
	Boiling	5.9	11.1	7.7
	Chemically treated with Alum	0.5	0.3	0.4
	Chemically treated with bleach/chlorine tablets	1.3	0.5	1.0
	Non-electric purifier	2.4	5.5	3.5
	Filtered with cloth	12.9	9.4	11.7
	Others	1.9	1.5	1.7
Not treated (including not required to be treated)		72.8	50.9	65.3
All		100	100	100

Source: NSS 76th Round, Report No.584: Drinking Water, Sanitation, Hygiene and Housing Condition in India

Method of Treatment of Drinking Water – Rural, Urban, All
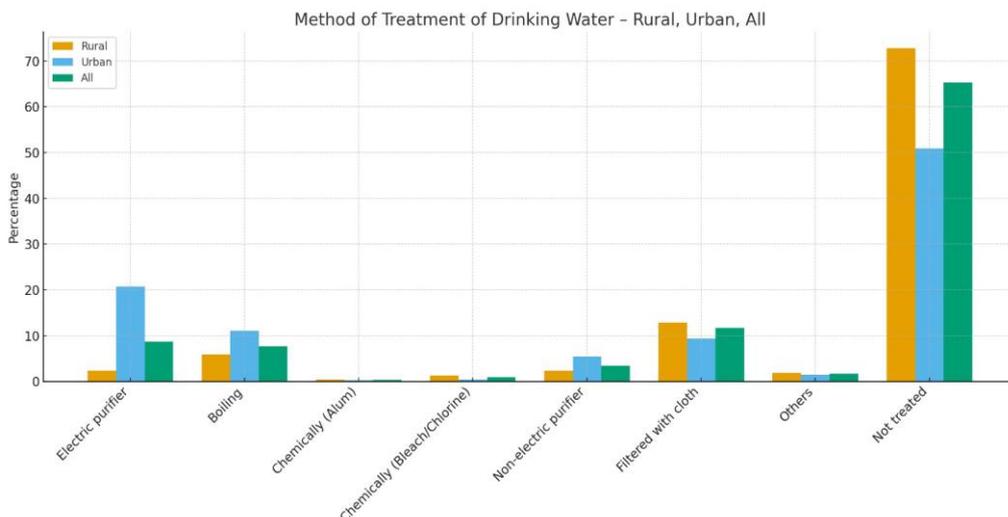
The distribution of households by method of drinking water treatment reveals significant differences between rural and urban areas in India. Overall, a large proportion of households (65.3%) do not treat their drinking water before consumption. This practice is particularly prevalent in rural areas, where nearly 73% of households do not use any treatment method, compared to 50.9% in urban regions. This indicates a substantial disparity in awareness, accessibility, and affordability of water purification facilities.

Among households that do treat their drinking water, the use of electric purifiers is most common in urban areas (20.8%), reflecting better access to modern purification technologies and higher household incomes. In contrast, only 2.4% of rural households use electric purifiers. Boiling, a traditional and low-cost method, is adopted by 5.9% of rural and 11.1% of urban households, suggesting that awareness about microbial contamination is higher in urban settings.

Low-cost or easily accessible methods such as filtering with cloth (12.9% rural; 9.4% urban) and non-electric purifiers (2.4% rural; 5.5% urban) are more common in rural areas, highlighting infrastructural and economic limitations. Chemical methods, such as using alum or chlorine tablets, are used by only a small share of households across both regions, indicating limited awareness or availability of these options.

Overall, the pattern reveals a clear rural–urban divide in drinking water treatment practices. While modern purification methods are predominantly urban, traditional or no-treatment practices dominate rural areas. This underscores the need for enhanced awareness campaigns, improved water supply infrastructure, and policies promoting affordable purification technologies to ensure safe drinking water for all households.

Composite Index of different methods of treatment of drinking water in India

State/UT	Electric	Boiling	Chemical	Non-Electric	Not-Treated	Norm Electric	Norm Boiling	Norm Chemical	Norm Non-Electric	Norm Not Treated	Composite Index	Rank
Andhra Pradesh	5	8.4	0.8	9	76.9	0.097	0.096	0.08	0.107	0.193	0.114	32
Arunachal Pradesh	1.6	66	2.6	20.9	10	0	0.767	0.26	0.259	0.896	0.436	4
Assam	5.6	5.3	6	47.7	35.4	0.114	0.060	0.6	0.602	0.629	0.401	10
Bihar	2.7	0.1	0	1.8	95.3	0.031	0	0	0.015	0	0.009	36
Chhattisgarh	2.5	2.1	0.9	24.1	70.4	0.025	0.023	0.09	0.300	0.261	0.140	28
Delhi	36.5	3.8	0.3	7.6	51.9	1	0.043	0.03	0.089	0.456	0.323	15
Goa	14.6	66.7	0.2	6.3	12.1	0.372	0.775	0.02	0.072	0.874	0.423	6
Gujarat	16.5	2.3	0.3	47.8	33.2	0.426	0.025	0.03	0.603	0.652	0.347	13
Haryana	19	0.6	0	5.7	74.7	0.498	0.005	0	0.065	0.216	0.157	25
Himachal Pradesh	5.7	8.3	0.8	9.2	76	0.117	0.095	0.08	0.109	0.202	0.121	29
Jammu & Kashmir	7.5	28.4	1.2	9.1	53.9	0.169	0.329	0.12	0.108	0.435	0.232	19
Jharkhand	4.1	6.8	1.6	14.3	73.4	0.071	0.077	0.16	0.175	0.230	0.143	27
Karnataka	13.4	10.7	0.2	13.5	62.3	0.338	0.123	0.02	0.164	0.347	0.198	21
Kerala	5.1	86	0.2	0.6	8.1	0.100	1	0.02	0	0.916	0.407	8
Madhya Pradesh	4.3	0.6	0.8	39	55.3	0.077	0.005	0.08	0.491	0.420	0.214	20
Maharashtra	13.9	6.9	10	38.6	30.6	0.352	0.079	1	0.485	0.680	0.519	1
Manipur	1.6	57.4	3.2	13.3	24.5	0	0.667	0.32	0.162	0.744	0.378	11
Meghalaya	5.2	79.4	0	7.4	7.9	0.103	0.923	0	0.086	0.919	0.406	9
Mizoram	5.9	10	2.2	67.9	14.1	0.123	0.115	0.22	0.860	0.853	0.434	5

Nagaland	5	82.9	0.7	11.3	0.2	0.097	0.963	0.07	0.136	1	0.453	3
Odisha	7.5	2.3	0.8	10.9	78.6	0.169	0.025	0.08	0.131	0.175	0.116	31
Punjab	35.9	1.3	0	4.7	58	0.982	0.013	0	0.052	0.392	0.288	17
Rajasthan	6.5	0.2	1.2	44.8	47.4	0.140	0.001	0.12	0.565	0.503	0.266	18
Sikkim	11.4	76.9	0.3	9.9	1.5	0.280	0.894	0.03	0.118	0.986	0.462	2
Tamil Nadu	8.5	19.2	0.3	3.6	68.3	0.197	0.222	0.03	0.038	0.283	0.154	26
Telangana	5.9	1.9	0.4	25.1	66.7	0.123	0.020	0.04	0.313	0.300	0.159	24
Tripura	1.6	0.2	0.3	78.8	19	0	0.001	0.03	1	0.802	0.366	12
Uttarakhand	21.8	1.9	0	6.5	69.7	0.578	0.020	0	0.075	0.269	0.188	23
Uttar Pradesh	4.1	0.4	0.1	1.6	93.7	0.071	0.003	0.01	0.012	0.016	0.022	35
West Bengal	7	1.3	0.4	6.7	84.6	0.154	0.013	0.04	0.078	0.112	0.079	33
A & Nicobar Islands	14.8	32.5	0.9	33.8	18	0.378	0.377	0.09	0.424	0.812	0.416	7
Chandigarh	35.9	1	0	8	55.1	0.982	0.010	0	0.094	0.422	0.302	16
Dadra and Nagar Haveli	6.3	2.7	2.1	7	82	0.134	0.030	0.21	0.081	0.139	0.119	30
Daman & Diu	3.8	3.6	0	6.9	85.7	0.063	0.040	0	0.080	0.100	0.057	34
Lakshadweep	1.8	60.9	3.1	3.4	30.8	0.005	0.707	0.31	0.035	0.678	0.347	14
Puducherry	15.7	18.9	0	2.4	63	0.404	0.218	0	0.023	0.339	0.197	22

The analysis of drinking water treatment practices across Indian States and Union Territories, based on the Composite Index derived from normalized indicators of electric purification, boiling, chemical treatment, non-electric filtration, and untreated water consumption, reveals significant regional contrasts. The index highlights the extent to which households adopt safe drinking water practices, reflecting both infrastructural availability and behavioural awareness.

Overall, the Northeastern region emerges as the strongest performer, with Sikkim, Nagaland, Arunachal Pradesh, Mizoram, and Meghalaya ranking within the top ten. These states exhibit widespread use of boiling and minimal dependence on untreated water, a pattern associated with hilly terrain, vulnerability to microbiological contamination, and established cultural practices prioritising boiled water. Maharashtra tops the national list, driven by comparatively high adoption of chemical treatment and non-electric purification methods, supported by better market penetration and awareness levels. Goa, Kerala, the Andaman & Nicobar Islands, and Assam similarly demonstrate relatively advanced treatment behaviour.

Conversely, the lowest-ranking states—Bihar, Uttar Pradesh, West Bengal, Odisha, and Andhra Pradesh—show extremely high reliance on untreated water, often exceeding 80–90 per cent. These patterns reflect structural challenges, including low access to household-level purifiers, limited economic capacity, persistent dependence on groundwater, and inadequate public communication regarding water safety. Even regions with favourable socioeconomic indicators, such as Himachal Pradesh and Dadra & Nagar Haveli, perform poorly due to complacency regarding untreated natural sources.

Broadly, a distinct regional divide is evident: the Northeast and parts of Western India display strong water treatment behaviour, whereas the Central, Eastern, and Indo-Gangetic plains lag significantly. The findings underscore the need for region-specific policy interventions, including low-cost filtration technologies, community awareness campaigns, and improved piped water systems to ensure universal access to safe drinking water.

IV.   CONCLUSION

The present study provides a comprehensive assessment of household drinking water treatment practices in India using data from the NSS 76th Round (2018), highlighting pronounced spatial and socio-economic disparities across States and Union Territories. Despite sustained policy efforts to improve drinking water infrastructure, the findings

reveal that a substantial proportion of Indian households—nearly two-thirds at the national level—continue to consume untreated drinking water, underscoring a critical public health concern.

The analysis demonstrates that household water treatment behaviour varies significantly across regions. Northeastern states such as Sikkim, Nagaland, Meghalaya, Arunachal Pradesh, and Mizoram exhibit relatively better performance, largely driven by widespread reliance on boiling and non-electric filtration methods. These practices appear to be shaped by cultural norms, environmental conditions, and perceived vulnerability to water contamination. Western and urbanised states, including Maharashtra, Goa, Gujarat, Delhi, Punjab, and Chandigarh, show higher adoption of electric purifiers and chemical treatment, reflecting better economic capacity, market accessibility, and awareness of water quality risks.

In contrast, the Indo-Gangetic plains and eastern states—particularly Bihar, Uttar Pradesh, West Bengal, Odisha, and Andhra Pradesh—emerge as the most vulnerable regions, with an overwhelming dependence on untreated water. The Composite Index clearly identifies these states as low-performing, pointing to persistent structural constraints such as limited access to affordable treatment technologies, high rural population concentration, reliance on groundwater sources, and low levels of risk perception and awareness. Notably, chemical treatment remains marginal across most states, indicating limited penetration of low-cost disinfection methods despite their potential effectiveness.

The Composite Index approach adopted in this study proves effective in capturing the multidimensional nature of household water treatment practices, integrating both positive (treated) and negative (untreated) indicators. It highlights that improved water treatment behaviour is not solely dependent on infrastructural availability but is equally influenced by socio-economic conditions, cultural practices, and behavioural awareness. Even states with relatively better natural water availability or infrastructure exhibit poor treatment practices due to complacency and perceived safety of source water.

Overall, the study underscores the urgent need for region-specific and context-sensitive policy interventions. While initiatives such as the Jal Jeevan Mission focus on expanding piped water supply, parallel emphasis must be placed on promoting household-level water safety through awareness campaigns, behavioural change communication, and dissemination of affordable and locally appropriate treatment technologies. Strengthening community-level education on water-borne health risks, improving access to low-cost filtration and disinfection methods, and ensuring the reliability and quality of supplied water are essential for reducing regional disparities.

Ensuring universal access to safe drinking water is central to public health improvement and the achievement of Sustainable Development Goal 6. The findings of this study provide valuable empirical evidence to guide policymakers, planners, and public health practitioners in prioritising interventions for low-performing regions and in strengthening India's overall water safety framework.

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