

Water Accessibility and Contamination in Rural India: A Comprehensive Analysis of Population Coverage, Water Supply Schemes and Water Quality

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Abstract

The Ministry of Drinking Water and Sanitation (MDWS), Government of India, is responsible for providing financial and technical resources for ensuring safe and sufficient drinking water in rural India. According to data from the Ministry of Drinking Water and Sanitation (MDWS) regarding the progress of the National Rural Drinking Water Programme (NRDWP), 63.74 per cent of India's rural population has been provided with a minimum of 40 litres per capita per day of water supply. The present study aims to examine water accessibility and contamination in rural India using data from National Rural Drinking Water Programme (NRDWP) reports. The study focuses on the percentage of the population with access to drinking water sources, the coverage of surface and groundwater schemes and the prevalence of water contamination in rural habitations. The study shows remarkable progress in extending water infrastructure, with a large number of surface and groundwater-based schemes installed in rural areas. The comparatively low percentage of the population with piped water supply, on the other hand, highlights the need for additional investment and attempts to improve coverage. The presence of over 2,000 laboratories for water testing is promising, but the large number of contaminated sources reveals persistent issues in maintaining water quality standards.

Keywords: India, Rural Population, Piped Water Supply, Groundwater Schemes, Surface Water Schemes, Water Contamination

Introduction

Water shortage is one of the world's most significant environmental challenges now due to the current

imbalance between water availability and water demand. Despite the fact that the MDG objective for safe drinking water was met in 2015, evidence from 43 studies reveals that insufficient drinking water remains a significant issue throughout Africa and Asia. Almost all studies indicated average water availability below the criterion of 50-100 LPCD. Water scarcity was more severe in rural areas than in urban ones (Thomas et al., 2020). The lack of access to clean drinking water in many parts of the world limits consumption and lowers the quality of life for billions of people. Currently, at least 1 billion individuals worldwide encounter a supply interruption for at least part of a day (Kumpel & Butler, 2018). Approximately 3.1 billion people rely on unstable, non-piped water supply located off-site (Tamason et al., 2016). Surface fresh water is the most easily accessible resource for meeting the water needs of agriculture (including irrigation and livestock), industry, families, and towns (Falkenmark, 1997).

For decades, rural drinking water delivery in India has been a major issue, harming the health and well-being of millions of people. Despite significant progress in providing access to safe drinking water, disparities are present. Despite international progress toward universal access to drinking water, only 63.74% of the population in India reports having an improved water supply that is fully functional, available when required, conveniently accessible and delivers good quality and safe water. Water scarcity, pollution, and insufficient infrastructure affect many rural communities, resulting in waterborne diseases and water stress. India's population is predicted to reach around 1640 million by 2050 (WHO & UNICEF, 2017).

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As a result, total per capita water availability will drop from 1820 m³/year in 2001 to 1140 m³/year in 2050. The country's total water requirement for various activities around the year 2050 has been estimated to be 1450 km³/yr. This is far greater than the present estimate of utilizable water resource potential (1122 km³/yr.) under traditional development tactics. As a result, compared to the current availability of 500 km³/yr., water availability around 2050 will need to be nearly tripled (Gupta & Deshpande, 2004). In India, there is currently insufficient data to estimate the population using a water source that is "available when needed," indicating a need for evidence to address this gap.

The Indian government, in collaboration with various non-governmental organizations (NGOs) and international organizations, has been striving to solve these issues through initiatives such as the National Rural Drinking Water Program (NRDWP) and the Swachh Bharat Mission (Clean India Mission). These initiatives seek to establish long-term water supply infrastructure, promote water conservation habits, and improve water quality monitoring and treatment facilities.

The present study seeks to address the pressing concerns of water scarcity and drinking water challenges in rural India through a thorough investigation and analysis of many aspects of drinking supply. One of the primary areas of focus is the evaluation of the total laboratories available for water testing, which plays an important role in ensuring water quality. The study also looks at the many drinking water sources that have been tested to determine their quality and security. Moreover, the present study is also an attempt to examine Surface and Groundwater-Based Schemes that have been implemented to provide access to safe drinking water and their effectiveness in different regions. An essential aspect of the study, i.e. evaluating the extent of Habitations Covered by these water supply schemes, ensuring equitable distribution of clean water across rural areas has also been covered in this study. Lastly, the study assesses the percentage of the population covered by Piped Water Supply Schemes, as piped water networks are vital for sustained and convenient access to safe drinking water. By exploring these various dimensions, the study aims to provide valuable insights and recommendations to address the pressing drinking water challenges in rural India and improve the overall water supply situation in the country.

Study Area

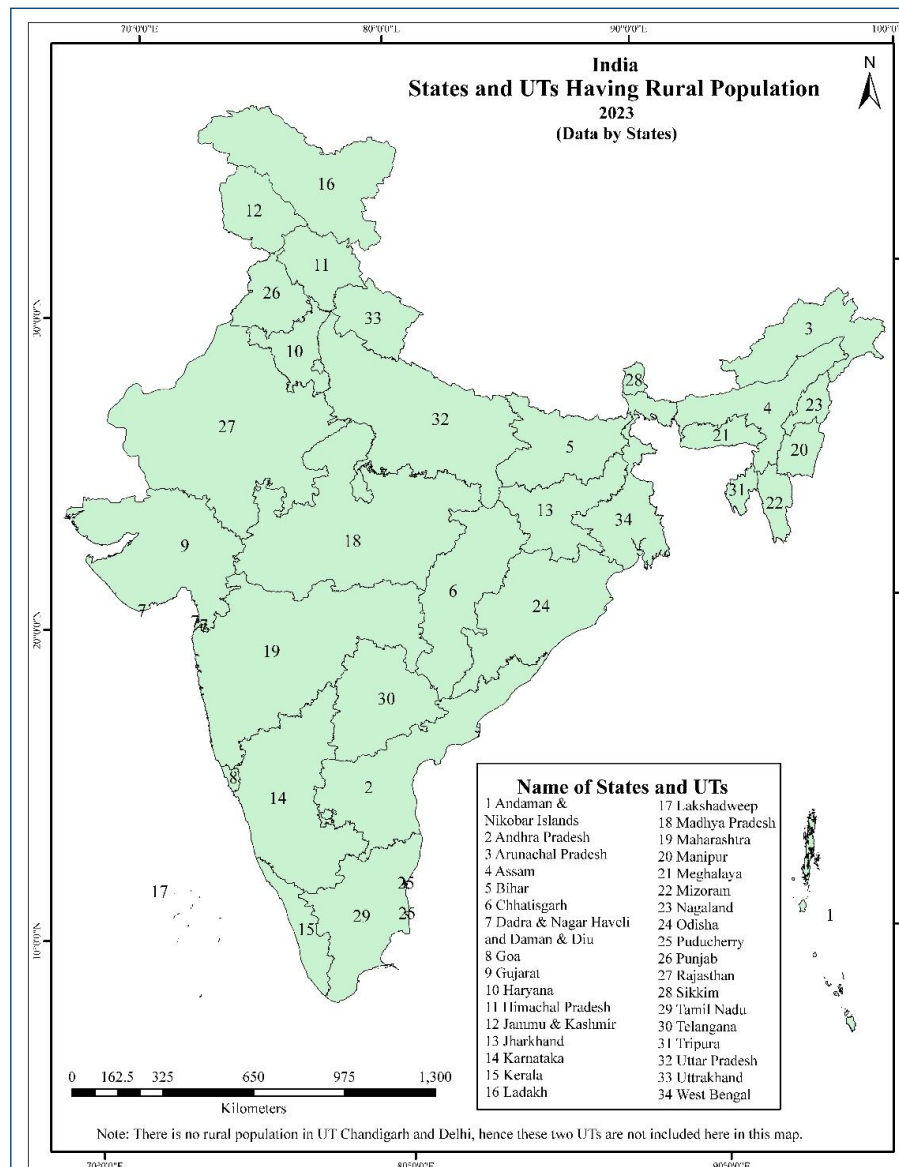
India, officially known as the Republic of India, is a varied and vibrant South Asian country. It is made up of 28 states and 8 union territories, each having its own culture, traditions, and languages. India's latitudinal extent is around 8°4'N to 37°6'N, and its longitudinal extent is approximately 68°7'E to 97°25'E, with a total land area of approximately 32,87,263 square kilometres (Map 01). India's population is approximately 140.76 crores in 2021, making it the world's second most populated country. Because of its large size and numerous physical features, India's climate varies greatly, with six distinct climatic regions: tropical, arid, semi-arid, temperate, alpine, and subtropical. The Himalayan Mountain range in the north, the fertile Indo-Gangetic plains, the arid Thar Desert, the Western and Eastern Ghats, and the coastal regions encircling the Indian Peninsula describe India's physiography.

While India has extensive water resources, drinking water supply is inconsistent across the country, with some places experiencing water scarcity and others having excessive rainfall, resulting in flooding. To maintain a sustainable, equitable supply of drinking water to its huge and rising population, the government has been working on different water management and conservation measures. The National Rural Drinking Water Programme (NRDWP) is one of the government's major efforts. The goal of the NRDWP is to provide safe and drinkable drinking water to rural communities around the country. This program aims to improve access to and availability of safe drinking water in distant and neglected villages. To meet the needs of rural communities, the NRDWP emphasizes the development of water infrastructure such as hand pumps, wells, and piped water supply systems. Furthermore, the initiative seeks to create awareness about water conservation measures and the need to preserve water supplies for long-term sustainability.

By implementing the NRDWP, the government aims to address the issues caused by water scarcity in rural areas while also improving the overall standard of living of the rural population. However, due to the extensiveness and diversity of India's geography and demography, obtaining fair access to safe drinking water remains a difficult challenge. As a result, ongoing efforts and novel solutions are required to meet the expanding demand for drinking

water supply while also addressing the particular water difficulties encountered by different parts of the country. Therefore, the present study is an attempt to look into

the significance of NRDWP in ensuring drinking water supply in the country's rural areas.



Source: Maps of India, 2022 and Arc GIS.

Map 1: Map of Study Area (India)

Objective of the Study

- To examine the coverage of surface and groundwater-based schemes in rural India.
- To investigate the coverage of rural population with access to piped water supply.

Data Sources and Research Methodology

The present study is based only on secondary data sources. The aim of this study is to examine the status of the drinking water supply system in rural India. The secondary data has been collected from the reports of the

National Rural Drinking Water Programme (NRDWP) at the state level for the year 2023. The study focuses on key indicators such as rural population, total laboratories, tested sources, contaminated sources, surface water-based schemes, habitation covered with surface schemes, groundwater-based schemes and the percentage of the population covered with piped water supply. Appropriate maps have been prepared by using ArcGIS 10.3 software for a visual representation of the results.

Results and Discussion

- Distribution of rural population and coverage of piped water supply.
- Surface and groundwater supply schemes and coverage of habitations.
- Analysis of water quality.

Distribution of Rural Population and Coverage of Piped Water Supply

In 2023, India's population reached 1,428,627,663 people, accounting for 17.76% of the total world population, and ranked first in the world in terms of population. The rural population is defined by national statistical offices as the people who live in rural areas. It is determined as the difference between the total and urban population. According to the World Bank's collection of development indicators derived from officially recognized sources, India's rural population (% of the total population) was reported at 64.13% in 2022.

Table 1 and map 2 show the rural population of India's various states and union territories. According to the data collected from NRDWP (National Rural Drinking Water Programme) reports, India's entire rural population is approximately 961 million. With about 168 million people living in rural areas, Uttar Pradesh has the largest rural population among the states, followed by Bihar with approximately 95 million and West Bengal with over 80 million. Sikkim, with roughly 548,000 inhabitants, and Lakshadweep, with around 74,000, have considerably lower rural population. The data also shows that several union territories have substantially smaller rural populations than states, such as Puducherry, which has roughly 562,000 people living in rural areas, and Ladakh, which has around 250,000. Overall, the data highlights the large differences in rural population distribution across

India's states and UTs, emphasizing the significance of taking regional disparities into account when developing development policies and initiatives.

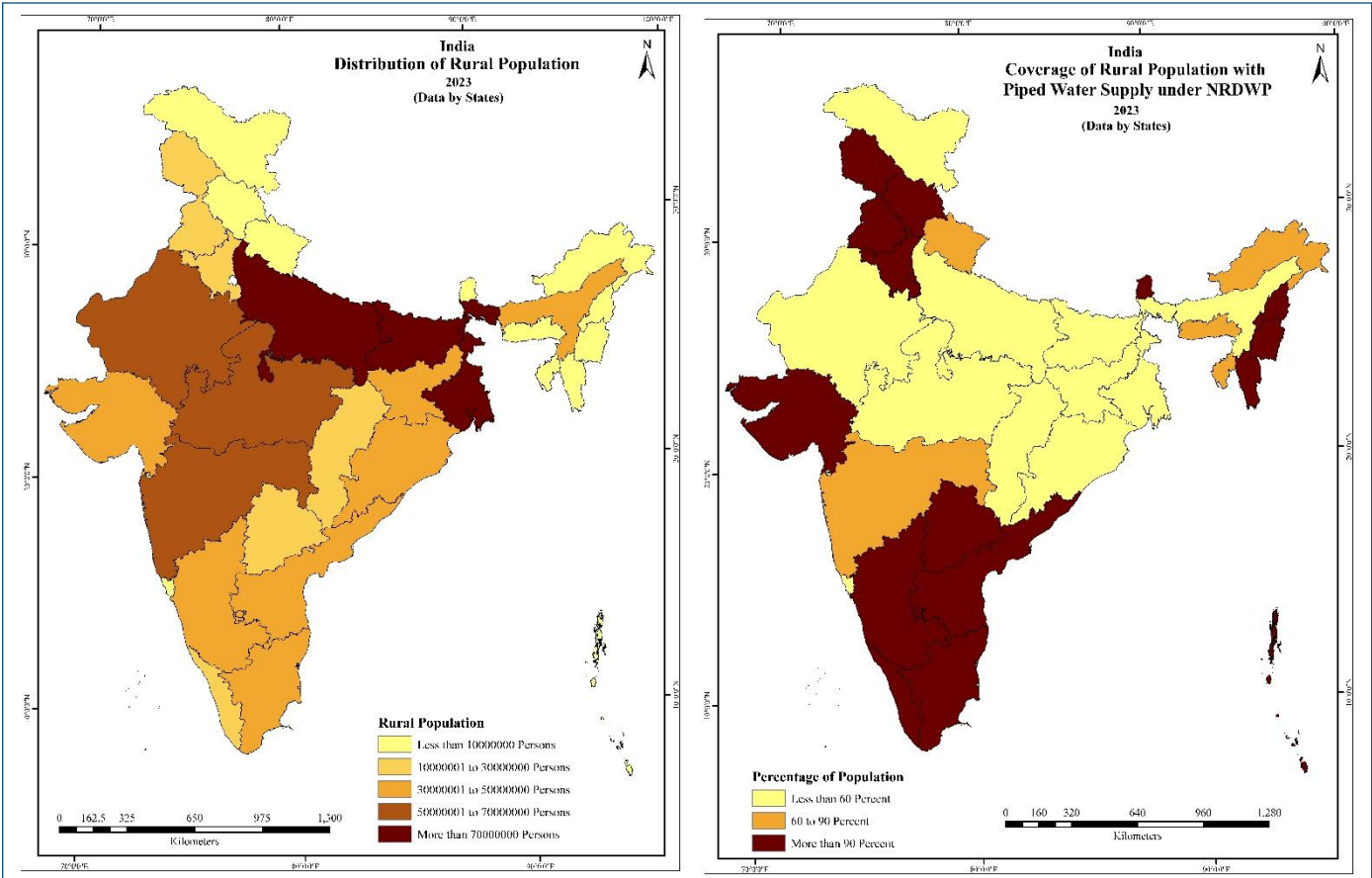
Table 1: India: Rural Population and Coverage of Piped Water Supply (PWS), 2023

State	Rural Population	Percentage of Pop with PWS
Andaman & Nicobar Islands	252204	91.36
Andhra Pradesh	38059344	94.61
Arunachal Pradesh	1334171	62.84
Assam	33104480	46.5
Bihar	95065781	11.71
Chhattisgarh	22630061	36.27
Dadra & Nagar Haveli and Daman & Diu	420418	DNA
Goa	1137274	DNA
Gujarat	43729964	95.25
Haryana	17782877	96.44
Himachal Pradesh	7559615	94.09
Jammu & Kashmir	11025392	92.65
Jharkhand	31599953	25.54
Karnataka	44516534	95.9
Kerala	28895631	97.72
Ladakh	249828	DNA
Lakshadweep	74640	DNA
Madhya Pradesh	60276827	41.06
Maharashtra	68633797	83
Manipur	2424223	96.27
Meghalaya	3584484	65.84
Mizoram	665884	93.92
Nagaland	1880620	93.3
Odisha	38404882	46.37
Puducherry	562027	56.45
Punjab	18232210	91.11
Rajasthan	58850320	51.75
Sikkim	547938	92.07
Tamil Nadu	49290143	99.19
Telangana	20696907	97.28
Tripura	3256608	85.61
Uttar Pradesh	168704222	15.64
Uttarakhand	7198769	74.07
West Bengal	80381657	43.55
Total	961029685	63.74
*DNA= Data not available.		

Source: Reports of National Rural Drinking Water Programme, 2023.

In 2009, the government of India launched the National Rural Drinking Water Programme (NRDWP), a centrally sponsored program. It attempts to provide rural people with adequate and safe water for cooking, drinking,

and other domestic requirements on a sustainable basis. The progress and achievements of this program have been reviewed in this study.



Source: National Rural Drinking Water Programme Report, 2023.

Map 2 Map 3

In India, the National Rural Drinking Water Programme (NRDWP) was established to address the essential issue of providing safe and adequate drinking water to rural populations. Access to safe drinking water is a basic human right that is essential for sustaining public health, preventing waterborne diseases, and fostering overall well-being. The NRDWP aims to improve rural water supply infrastructure, provide water quality testing, promote water conservation and management techniques, and raise rural population awareness about safe drinking water practices. It seeks to provide safe and drinkable drinking water to every rural household in India, hence improving the overall well-being and health of rural communities. The table shows the proportion of the

population with Piped Water Supply (PWS) in major Indian states and union territories by the year 2023. The data is a component of the National Rural Drinking Water Programme (NRDWP), which aims to provide safe and enough drinking water to rural inhabitants.

In this study, the proportion of the population with Piped Water Supply (PWS) in major Indian states and union territories has been analysed for the year 2023 (Table 1 and Map 3). All states and union territories in the country have been categorised into three groups based on the proportion of the population that is covered with piped water supply, including states with low, medium, and high coverage. The detailed description of each category is discussed in the following section.

● *States with Low Coverage*

The states and union territories having less than 60% coverage with piped water supply have been included in this category. Puducherry has a coverage percentage of 56.45 per cent, showing that a sizable portion of the people still do not have access to piped water. Rajasthan comes in second with 51.75 per cent coverage, followed by Assam, Odisha, and West Bengal with 46.5 per cent, 46.37 per cent, and 43.55 per cent coverage, respectively. These states confront significant hurdles in supplying piped water to their rural regions. Coverage percentages in Madhya Pradesh and Chhattisgarh are 41.06 per cent and 36.27 per cent, respectively, emphasizing the need for additional efforts to increase access to safe drinking water in these states. Jharkhand has a low coverage rate of 25.54 per cent, while Uttar Pradesh and Bihar have the lowest coverage rates of 15.64 per cent and 11.71 per cent, respectively, showing that their rural populations have a significant lack of access to safe water sources. Furthermore, the data is not available for Dadra & Nagar Haveli and Daman & Diu, as well as Goa, Ladakh, and Lakshadweep, and shown in the table as DNA (Data not Available).

● *States with Medium Coverage*

States and union territories having population coverage ranging from 60 to 90 per cent are classified as states with medium coverage. Tripura stands out among these states, with 85.61 per cent of its population having access to piped water, demonstrating significant progress in the implementation of the National Rural Drinking Water Programme (NRDWP). Maharashtra comes in second with 83 per cent coverage, indicating significant efforts to provide safe drinking water to its rural residents. Uttarakhand (74.07 per cent), Meghalaya (65.84 per cent), and Arunachal Pradesh (62.84 per cent) have also made tremendous achievements in providing piped water to a major section of their respective populations. While these governments have achieved significant progress, they still confront the challenge of expanding coverage further in order to achieve the objective of universal access to clean drinking water. Continued commitment to the NRDWP and effective distribution of resources will be critical in upgrading water infrastructure and increasing the general well-being of these states' rural inhabitants.

● *States with High Coverage*

States and Union Territories having more than 90% population coverage with piped water supply are

categorised as high-coverage states. Tamil Nadu leads in this respect, with 99.19% of its population having access to piped water, followed by Kerala (97.72%), Telangana (97.28%), and Haryana (96.44%). These states have achieved great progress in ensuring that a sizable portion of their rural population has access to safe drinking water. Manipur (96.27%), Karnataka (95.9%), Gujarat (95.25%), and Andhra Pradesh (94.61%) are some important states. Himachal Pradesh (94.09%), Mizoram (93.92%), Nagaland (93.3%), Jammu & Kashmir (92.65%), Sikkim (92.07%), the Andaman and Nicobar Islands (91.36%), and Punjab (91.11%) all make significant efforts to provide piped water to their citizens. Such extensive coverage in these states reflects the successful implementation of the National Rural Drinking Water Programme (NRDWP) and demonstrates these regions' commitment to ensuring access to safe drinking water, which is critical for the well-being and health of their rural communities.

In a nutshell, the states with low, medium, and high piped water supply coverage demonstrate the various progress and problems in executing India's National Rural Drinking Water Programme (NRDWP). States such as Tamil Nadu, Kerala, and Telangana have made impressive progress in supplying safe drinking water to a considerable section of their rural populations, but states such as Uttar Pradesh, Bihar, and Jharkhand face severe challenges due to poor coverage rates. The data highlights the urgent need for ongoing efforts, funding, and water supply projects in low-coverage states to enhance living circumstances, public health, and general well-being by guaranteeing universal access to safe drinking water.

Surface and Groundwater Supply Schemes and Coverage of Habitations

Surface water and groundwater supply schemes are undertaken in India under the National Rural Drinking Water Programme (NRDWP) to provide safe and sustainable drinking water to rural areas. Surface water supply schemes include extracting water from diverse surface sources such as rivers, lakes, ponds, and reservoirs by building water treatment plants and distribution networks. These schemes are frequently designed to serve bigger population clusters and provide a centralised supply of treated water. Groundwater supply projects, on the other hand, focus on tapping into subsurface aquifers through the installation of hand pumps, borewells,

and tube wells. Groundwater projects are especially important in locations where surface water supplies are limited or inaccessible. The NRDWP emphasises the need for sustainable source management, water quality

monitoring, and community involvement in planning and implementation. A detailed discussion of these schemes is given in the following:

Table 2: Surface and Groundwater Supply Schemes and Habitation Coverage in Rural India

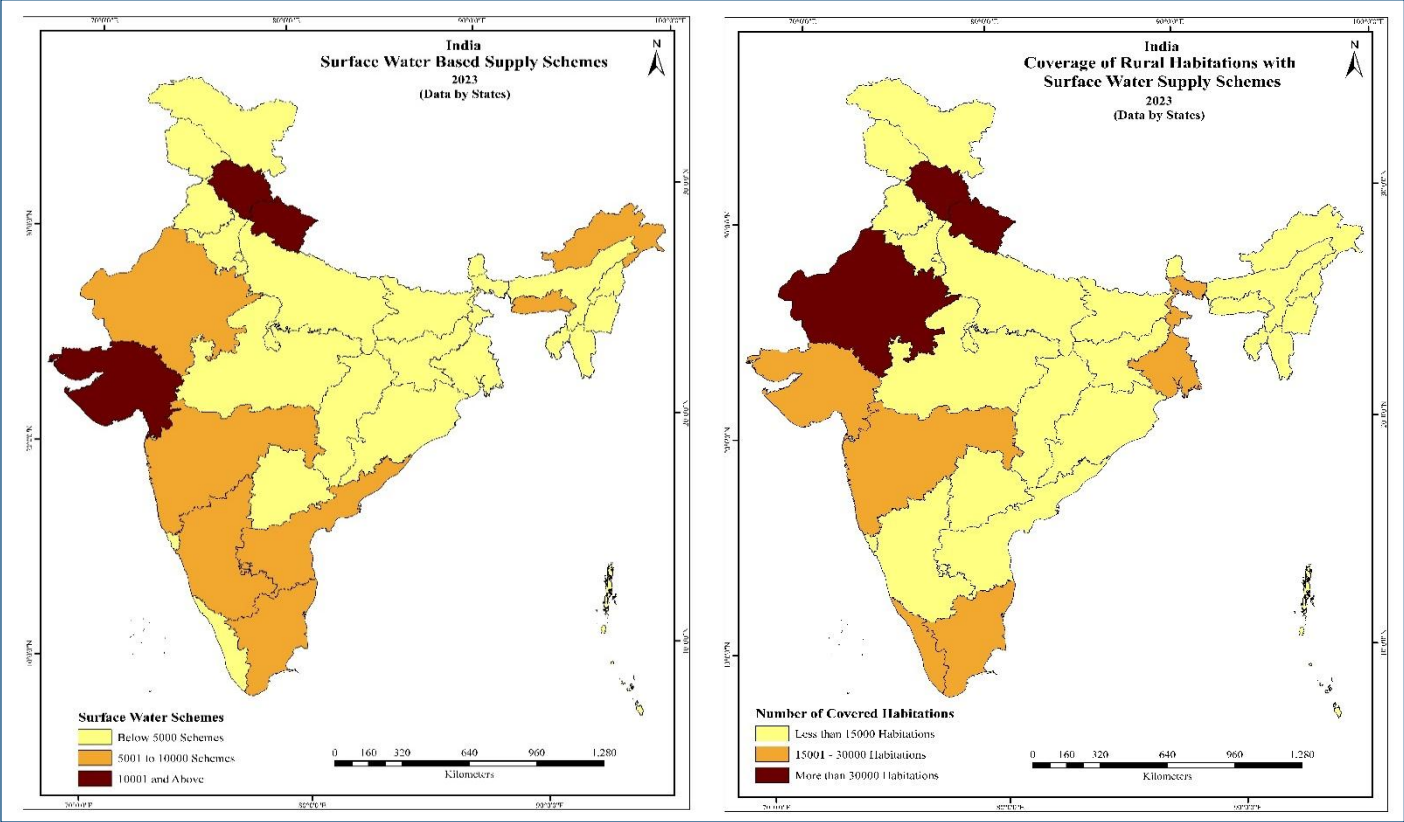
States	Surface Water Based Schemes	Habitation Covered with Surface Schemes	Groundwater Based Schemes	Habitation Covered with Groundwater Schemes
Andaman & Nicobar Islands	205	226	181	72
Andhra Pradesh	8243	14563	337808	80625
Arunachal Pradesh	8551	4794	1352	960
Assam	3272	9887	141638	92735
Bihar	23	348	138531	119257
Chhattisgarh	96	626	261538	104463
Dadra & Nagar Haveli and Daman & Diu	0	0	0	0
Goa	33	75	95	79
Gujarat	10523	17741	82179	37405
Haryana	4739	3957	9587	8139
Himachal Pradesh	11611	43473	21098	22187
Jammu & Kashmir	3382	11858	8596	9383
Jharkhand	788	6963	417263	137033
Karnataka	7992	13298	400689	104457
Kerala	2200	16989	2348	10875
Ladakh	0	0	0	0
Lakshadweep	0	0	0	0
Madhya Pradesh	402	2467	635577	151529
Maharashtra	8223	17735	127707	106369
Manipur	4461	2766	301	339
Meghalaya	6786	7063	5276	3401
Mizoram	879	850	34	34
Nagaland	3363	1336	633	278
Odisha	1866	4899	503223	189296
Puducherry	0	0	349	322
Punjab	1739	2908	14151	17948
Rajasthan	7605	36758	99658	85244
Sikkim	3728	2504	6	6
Tamil Nadu	9021	23248	340429	162721
Telangana	4176	10764	275400	53209
Tripura	265	510	24231	14012
Uttar Pradesh	1031	610	2275778	286480
Uttarakhand	16962	31807	2379	4863
West Bengal	562	22113	223139	127341
Total	132727	313136	6351174	1931062

Source: National Rural Drinking Water Programme Report, 2023.

Surface Water Supply Schemes and Coverage of Habitations

Table 2 and maps 4 and 5 show the number of surface water supply schemes and the habitations covered by these schemes in rural areas of India's various states and union territories. Surface water supply schemes, particularly in rural regions, are critical for supplying clean and accessible water to the population. Himachal Pradesh has the most habitation covered by surface water supply schemes (about 43,473) of all the states. Rajasthan, Uttarakhand, and Tamil Nadu also have a significant number of surface water supply schemes,

with 36758, 31807, and 23248 habitations covered, respectively. However, several states, like Dadra & Nagar Haveli, Daman & Diu, Ladakh, and Lakshadweep, currently need data on surface water delivery schemes, indicating potential areas for future expansion in water infrastructure. Certain states, such as Bihar, Jharkhand, and Puducherry, have a comparatively low number of schemes and habitations covered. To satisfy the demands of their rural populations, these areas require special focus and investment to improve water supply and accessibility. The data indicates several states' attempts to implement surface water supply schemes to ensure safe and reliable drinking water supplies.



Source: National Rural Drinking Water Programme Report, 2023.

Map 4

There is still considerable scope for further expansion and improvement, especially in states with limited coverage. Addressing inequality in the supply infrastructure will be critical for achieving equitable access to clean water and increasing the well-being of the Indian rural population.

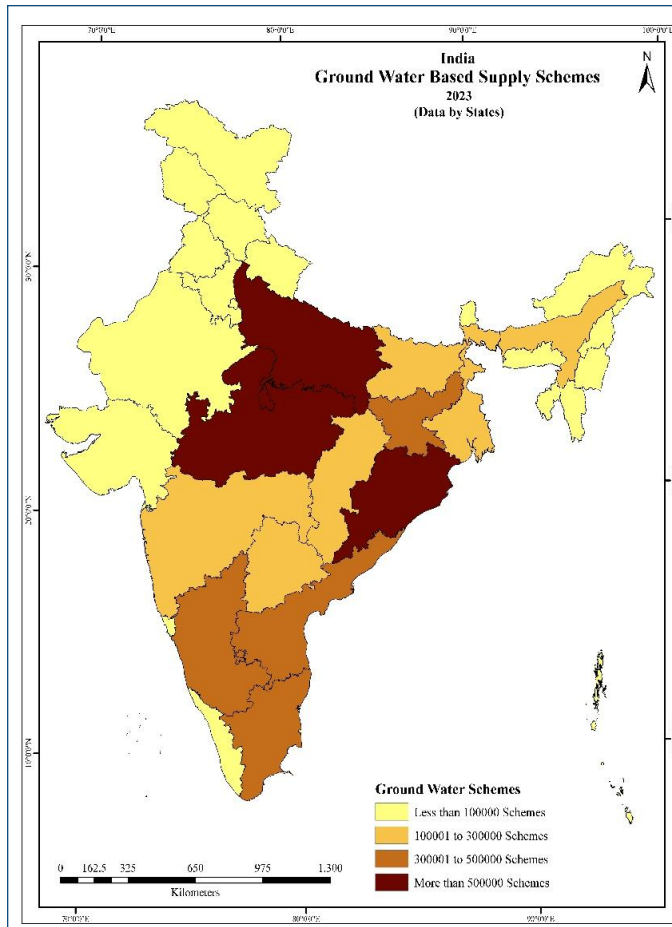
Map 5

Groundwater Supply Schemes and Coverage of Habitations

Table 2 and maps 6 and 7 show the number of Groundwater Supply Schemes that have been implemented in various

Indian states and union territories, as well as the number of habitations that have been covered by these schemes. Uttar Pradesh has the most Groundwater Supply Schemes, with a total of 22,75,778, providing groundwater access to 286,480 habitations. Odisha comes in second with covering 1,89,296 habitations, followed by Tamil Nadu

with 1,62,721 and Madhya Pradesh with 1,51,529 covered habitations, respectively. Several states have clearly made great efforts to implement these plans, assuring a consistent supply of groundwater to various habitations while also enhancing water accessibility and availability.



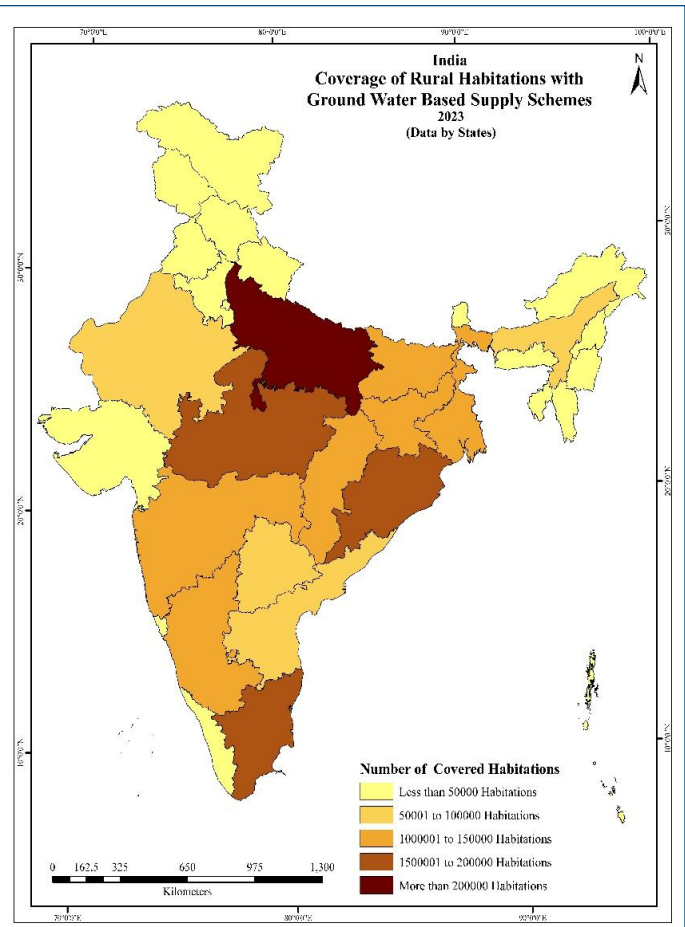
Source: National Rural Drinking Water Programme Report, 2023.

Map: 6

The data emphasises the significance of these programs in alleviating water scarcity and improving the quality of life for rural populations by providing a critical resource for a variety of residential, agricultural, and livelihood needs.

Analysis of Water Quality

Water quality testing laboratories play an important role in ensuring the provision of safe and potable drinking water to the rural population in India under the National Rural Drinking Water Programme (NRDWP). These laboratories are set up and equipped to conduct rigorous

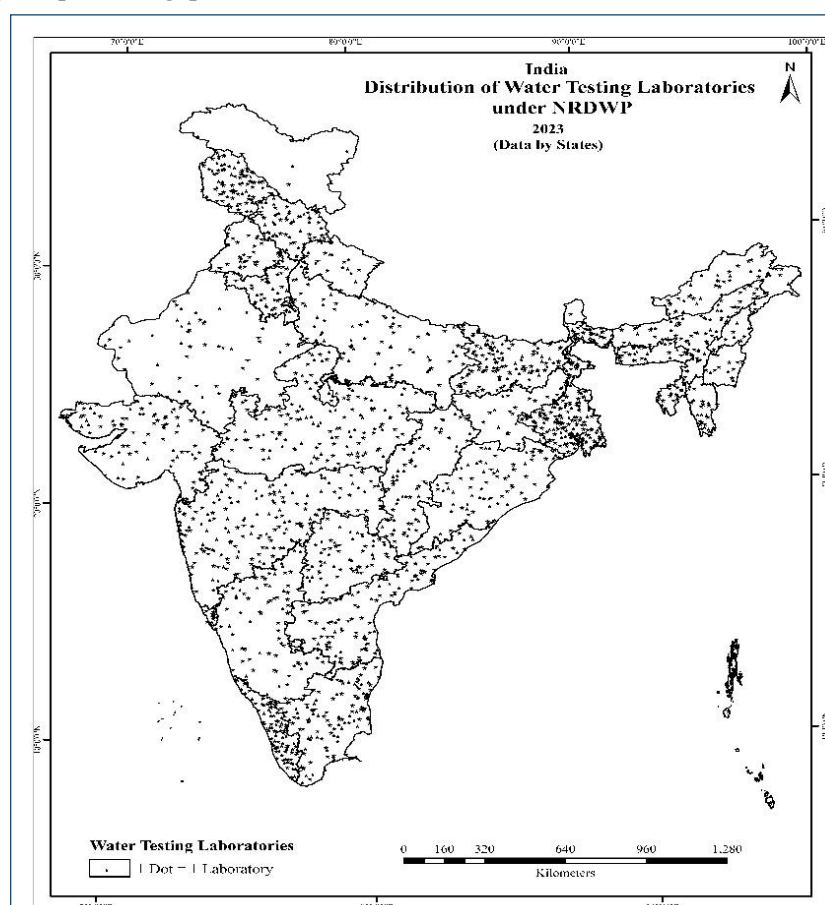


Map: 7

testing and analysis on water samples collected from a number of sources, such as hand pumps, tube wells, and community water delivery schemes. The primary goal is to evaluate the water's chemical, physical, and biological properties, finding any toxins and pollutants that could endanger the population's health. These laboratories provide rapid identification of any deterioration or pollution by regularly monitoring water quality, allowing for early interventions and remedial procedures. The data collected by these testing laboratories is critical in developing evidence-based policy, executing targeted interventions, and raising community knowledge about

water safety and hygiene practices. Water quality testing laboratories, as an essential component of the NRDWP, contribute considerably to protecting public health and

ensuring access to safe drinking water for millions of people in rural India.



Source: National Rural Drinking Water Programme Report, 2023.

Map 8

Table 3: Laboratories for Water Quality Testing, Sources Tested and Contaminated Sources in India under NRDWP

States	Total Laboratories	Sources Tested	Contaminated Sources
Andaman & Nicobar Islands	11	0	0
Andhra Pradesh	112	158	0
Arunachal Pradesh	49	8385	0
Assam	80	19073	4937
Bihar	123	2	0
Chhattisgarh	69	148108	1804
Dadra & Nagar Haveli and Daman & Diu	0	0	0
Goa	14	0	0
Gujarat	81	1789	63
Haryana	44	14617	529
Himachal Pradesh	69	45965	1
Jammu & Kashmir	92	0	0
Jharkhand	30	16001	643

<i>States</i>	<i>Total Laboratories</i>	<i>Sources Tested</i>	<i>Contaminated Sources</i>
Karnataka	79	58958	5628
Kerala	92	30170	22009
Ladakh	6	0	0
Lakshadweep	0	0	0
Madhya Pradesh	155	128708	525
Maharashtra	177	0	0
Manipur	13	1894	0
Meghalaya	30	4624	0
Mizoram	27	0	0
Nagaland	12	0	0
Odisha	77	501	68
Puducherry	2	0	0
Punjab	34	4169	721
Rajasthan	54	0	0
Sikkim	2	41	0
Tamil Nadu	113	0	0
Telangana	75	101752	6516
Tripura	21	4624	853
Uttar Pradesh	81	16	0
Uttarakhand	27	0	0
West Bengal	220	0	0
Total	2071	589555	44297

Source: National Rural Drinking Water Programme Report, 2023.

Table 3 and Map 8 show the total number of water testing laboratories in India's various states and union territories. According to the data, the country has a total of 2071 water testing laboratories. West Bengal has the most water testing laboratories (220), followed by Maharashtra (177) and Madhya Pradesh (155) among the states. Dadra & Nagar Haveli, Daman & Diu, and Lakshadweep, on the other hand, currently have no data on water testing laboratories. The availability of such laboratories varies greatly across states, with some having a substantial network and others having a comparatively low number. Improving and expanding the reach of water testing facilities throughout all regions is critical for successfully monitoring water quality, identifying potential contaminants, and taking the required precautions to protect public health from waterborne diseases and contamination-related threats.

Table 3 represents the sources of drinking water tested and the number of contaminated sources in various Indian states and union territories under the NRDWP. The data demonstrates the efforts done to monitor water quality and identify potential health hazards linked with drinking

water sources. Surprisingly, some regions, including Andaman and Nicobar Islands, Dadra & Nagar Haveli and Daman & Diu, Goa, Jammu & Kashmir, Ladakh, Lakshadweep, Maharashtra, Mizoram, Nagaland, Puducherry, Rajasthan, Tamil Nadu, Uttarakhand, and West Bengal, reported zero contaminated sources among the tested ones, indicating relatively good drinking water quality in those areas. Certain states, on the other hand, indicated concerning levels of pollution, such as Kerala, which had a substantial number of 22,009 polluted sources out of 30,170 analysed. Assam, Karnataka, and Telangana also reported a significant number of contaminated sources, signifying possible health risks for their populations. Overall, the data emphasises the need for continued water quality monitoring and the need for targeted measures in high-contamination areas to maintain safe drinking water for all.

Conclusion and Recommendations

The study's data and analysis illustrate India's National Rural Drinking Water Programme's (NRDWP) progress

and challenges in delivering safe and enough drinking water to rural people. While states such as Tamil Nadu, Kerala, and Telangana have made commendable strides in increasing piped water supply coverage and maintaining good water quality, states such as Uttar Pradesh, Bihar, and Jharkhand continue to face significant challenges in providing safe drinking water to their rural communities. Regional differences in clean water availability are evident, and the government must prioritise targeted initiatives and greater funding in states with poor coverage and water quality challenges. The government must allocate targeted investments and resources to upgrade water infrastructure in low-coverage states to meet the challenges they face. This includes expanding groundwater supply projects, creating new piped water supply schemes, and guaranteeing adequate maintenance and operation of existing systems. To improve the living conditions and public health of their rural populations, special emphasis should be paid to states such as Uttar Pradesh, Bihar, and Jharkhand, where coverage rates are frighteningly low. While some states have good water quality, others have contamination issues that endanger the health of their rural residents. Improving water quality monitoring systems is critical for identifying and addressing pollution sources as soon as possible. The government should prioritise the establishment of more water testing facilities, particularly in areas with a limited network, as well as urge regular water quality checks. In states with a large number of contaminated water sources, such as Kerala, Assam, Karnataka, and Telangana, targeted interventions and restoration efforts should be implemented.

Finally, India's National Rural Drinking Water Programme (NRDWP) is crucial in delivering safe and sufficient drinking water to rural people. The data analysis demonstrates advances and discrepancies in piped water delivery coverage, surface and groundwater

supply schemes, and water quality across states and union territories. To attain the aim of universal access to safe drinking water, the government should prioritize targeted investments and infrastructure development in low-coverage states, as well as strengthen water quality monitoring activities across the country to safeguard the well-being and health of rural populations. By solving these issues, India would be able to make considerable improvements in the living conditions and overall well-being of its rural population.

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