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Progress in clean water and sanitation in North-East India: A District-Level Analysis

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Abstract

Access to clean water and basic sanitation facilities is a fundamental right of human beings. Despite significant progress in socio-economic conditions, many people have been deprived of Clean Water and Sanitation in North-East India since independence. This study examines the progress and disparities in achieving access to clean water and sanitation facilities in North-Eastern states based on secondary data extracted from NITI Aayog's SDG 6 reports published in 2021-22 and 2023-24. The study covers 120 districts across 8 states, viz, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura commonly known as Ashtalakshmi holds a unique position in India's socio-economic and cultural landscape. The t-test result confirms the significant progress in access to clean water and sanitation facilities in the study area during the investigation period. Further, the ANOVA analysis documented the significant inter-state disparities in achieving the different parameters under SDG 6 target in the North-Eastern states. To the best of our knowledge, this is the first empirical exercise to investigate the inter-state and intra-state disparities in SDG goal 6 achievement in the North-East region of the country. Thus, it provides valuable insights into the progress and inequalities in access to water, sanitation, and hygiene practices at the district level, informing policymakers and stakeholders to enhance access to safe water and adequate sanitation for all in the study area.

Keywords: North-East India, NITI Aayog, SDG 6, clean water, sanitation

Introduction

Access to clean water and sanitation is a global public health issue (Biswas *et al.*, 2022) ^[2]. India, as a developing country, has consistently been under crisis to provide adequate clean water and sanitation services to its citizens due to its large population and diverse geographical conditions. Access to clean water and sanitation is a fundamental human right, essential for maintaining health, dignity, and quality of life (WHO, 2019) ^[9]. Despite significant progress in socio-economic development, many regions in India continue to struggle with providing adequate water and sanitation facilities to their populations. The North-East region, comprising eight states with diverse cultural, geographical, and socio-economic characteristics, is one such area where access to clean water and sanitation remains a challenge (Kumar *et al.*, 2020) ^[4].

The Sustainable Development Goals (SDGs), particularly Goal 6, emphasize the importance of ensuring the availability and sustainable management of water and sanitation for all by 2030 (United Nations, 2015) ^[8]. India, as a signatory to the SDGs, has committed to achieving these targets, and the government has launched several initiatives to improve access to clean water and sanitation, such as the Swachh Bharat Mission (SBM) and the Jal Jeevan Mission (JJM), (Ministry of Jal Shakti, 2020) ^[6].

However, progress in achieving these goals has been uneven, with significant disparities across states and districts (NITI Aayog, 2022) ^[7]. Understanding the progress and challenges in access to clean water and sanitation at the district level is crucial for targeted policy interventions and effective resource allocation. This study aims to analyse the progress in clean water and sanitation in North-East India, focusing on district-level disparities and achievements. The primary objective of this study is to measure the progress made towards achieving the SDG-6 targets for 120 districts across 8 states in the North-East region in India. To fulfill this objective, the study used district-level data on SDG 6 and sub-indicators published by NITI Aayog on the SDG Report for 2020-21 and 2023-24.

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The study also examines the inter-state variations in clean water and sanitation across the North-Eastern region of India. By examining the trends and patterns in SDG 6 indicators, this study seeks to provide valuable insights for policymakers, stakeholders, and researchers to enhance access to safe water and adequate sanitation for all in the region.

Literature Review

Access to clean water and sanitation is a critical aspect of human development, with significant implications for public health, economic productivity, and overall quality of life (WHO, 2019) ^[9]. The literature on water and sanitation highlights the complexities of achieving universal access, particularly in developing countries like India. India faces significant challenges in providing clean water and sanitation to its population, with a substantial proportion of households lacking access to improved water sources and sanitation facilities (Kumar *et al.*, 2020) ^[4]. The country's water scarcity, inadequate infrastructure, and socio-economic disparities exacerbate these challenges (Meetei, 2024) ^[5]. Poor water and sanitation conditions have severe health implications, including the spread of water-borne diseases like diarrhea, cholera, and typhoid (WHO, 2019) ^[9]. Studies have shown that improved water and sanitation facilities can significantly reduce the incidence of these diseases and improve overall public health (Fewtrell *et al.*, 2005) ^[3].

The SDGs, particularly Goal 6, emphasize the importance of ensuring universal access to clean water and sanitation by 2030 (United Nations, 2015) ^[8]. India, as a signatory to the SDGs, has committed to achieving these targets, and the government has launched several initiatives to improve access to clean water and sanitation (Ministry of Jal Shakti, 2020) ^[6]. District-level disparities in water and sanitation access are significant in India, with rural areas often facing greater challenges than urban areas (NITI Aayog, 2022) ^[7]. Studies have highlighted the need for targeted interventions and effective resource allocation to address these disparities and ensure universal access to clean water and sanitation (Kumar *et al.*, 2020) ^[4].

Effective policy and governance are critical in ensuring access to clean water and sanitation. Studies have shown that strong institutional frameworks, community participation, and adequate funding are essential for successful water and sanitation programs (Meetei, 2024) ^[5]. The role of policy and governance in addressing water and sanitation challenges is particularly important in the context of India's federal system, where states and local governments play a significant role in implementing water and sanitation programs (Ministry of Jal Shakti, 2020) ^[6].

The literature review highlights the complexities of achieving universal access to clean water and sanitation in India, particularly in the context of district-level disparities and socio-economic challenges. The study's focus on progress in clean water and sanitation in North-East India, with a district-level analysis, will contribute to the existing literature by providing valuable insights for policymakers, stakeholders, and researchers.

Data and Methodology

Variables of the study

Drinking water, Sanitation, and Hygiene are the major indicators of SDG 6 (Clean Water and Sanitation for all).

We have taken seven indicators based on NITI Aayog's report on SDGs. The selected dimensions and indicators of SDG 6 are shown in Table 1.

Data Type and Source

This study is based on district level secondary data collected and prepared by the Government agency. The relevant data on SDG 6 score and its 7 components as mentioned in Table 1 has been manually collected from NITI Aayog's report of Sustainable Development Report 2020-21 and 2023-24. The score values are expressed in percentage form. The score represents degree of achievements in the respective indicators against the target figure i.e. 100%.

Table 1: Indicators of SDG 6

SL. No.	Particulars
1	% of rural population using an improved drinking water source
2	% of rural population getting safe and adequate drinking water within premises through Piped Water Supply (PWS)
3	% of population living in households that use an improved sanitation facility
4	Toilets constructed against the target-SBM (G)
5	% of schools with a functional toilet facility for girls
6	% of GPs/ Villages verified as ODF in the district
7	Stage of groundwater extraction (%)

Source: NITI Aayog Report

Study Area

The present study covers 120 districts across 8 North-Eastern states of India viz, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura commonly known as Ashtalakshmi holds a unique position in India's socio-economic and cultural landscape. The decision to focus on Sustainable Development Goal 6 (SDG 6) Clean Water and Sanitation in the North-Eastern states of India is grounded in both empirical relevance and developmental urgency. These states, despite being endowed with abundant water resources, exhibit significant disparities in access to safe drinking water and sanitation services. This uneven distribution underscores the need for region-specific analysis and targeted policy interventions. Given the ecological sensitivity, socio-cultural diversity, and infrastructural challenges unique to the Northeast, studying SDG 6 achievements provides critical insights into the effectiveness of national programs such as the Jal Jeevan Mission and Swachh Bharat Abhiyan within these contexts.

Methods

Line graphs are used to present the patterns and trends of achievements in different indicators during the study period. To investigate the improvement in achievement towards SDG 6 during the study period between 2020-21 to 2023-24, we have employed a T-test for SDG 6 and all indicators. Further, to evaluate the inequality across the states and districts, we employed ANOVA analysis for 2020-21 and 2023-24.

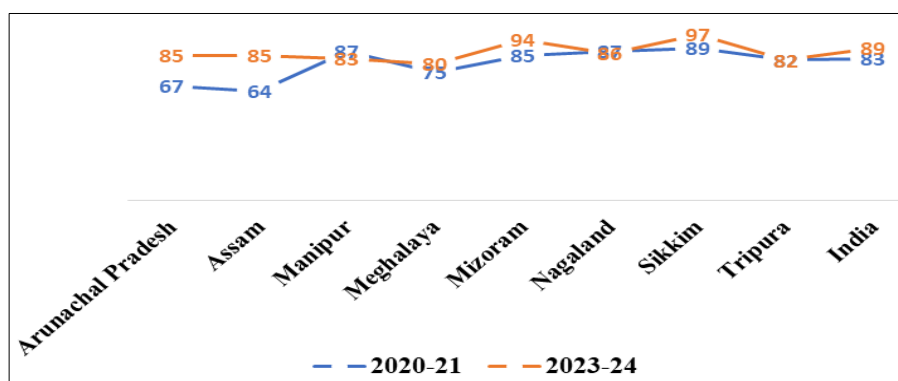
Results and Discussion

This section presents the data analysis and interpretation of the results in line with the objectives of the paper.

Figure 1 presents the state-wise SDG 6 score during the study period. Sikkim and Mizoram recorded the highest achievement in clean water and sanitation practices (SDG 6)

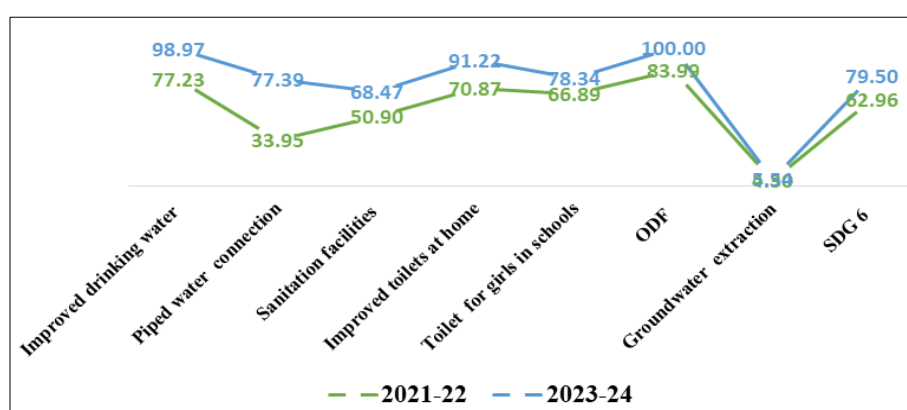
in the region during the latest year under consideration, well above the national average and other states' scores are below the national average. From Figure 1, it is evident that the SDG 6 score has increased significantly in the cases of Assam and Arunachal Pradesh. Meghalaya, Mizoram, and Sikkim maintained single-digit improvements, while Tripura

showed a stagnant position during the study period. However, Manipur and Nagaland reported negative growth to the extent of 4% and 1% respectively. The analysis of SDG 6 scores in North-East India reveals a mixed picture. Tripura's stagnant position and Manipur and Nagaland's decline in SDG 6 scores are concerning.



Source: Authors' work

Fig 1: State-wise SDG 6 score during 2020-21 and 2023-24



Source: Authors' work

Fig 2: Achievement in sub-indicators of SDG 6 during 2020-21 to 2023-24

Figure 2 presents the achievements in sub-dimensions of SDG 6 during the study period in the North-Eastern states, showing improvement in access to clean water and sanitation facilities during the study period. From Figure 1, we can see that the region has fully achieved Open Defecation Free (ODF) practices. It refers to communities that have successfully transitioned from open defecation

practices to using toilets. Improved drinking water facilities have also been covered to the extent of 98% households. This finding is similar to the existing research conducted by Biswas *et al.* (2024) ^[1]. However, pipe water connection, sanitation facilities and toilets for girls at schools remain low in the region.

Table 2: T-test on SDG 6 score between 2020-21 to 2023-24

Indicators	Obs.	Mean (2023-24)	Mean (2020-21)	T-Value	P-Value
SDG 6	120	79.5	62.95	6.2149	0.0000*
Improved drinking water	120	98.96	77.22	6.3947	0.0000*
Piped water connection	120	77.39	33.95	16.1058	0.0000*
Sanitation facilities	120	68.46	50.90	3.9968	0.0000*
Improved toilets at home	120	91.22	70.86	5.1193	0.0000*
Toilet for girls in schools	120	78.34	66.89	3.7367	0.0000*
Open Defecation Free	120	100.00	83.98	4.9918	0.0000*
Groundwater extraction	120	5.53	4.29	1.2365	0.2175

Source: Author's calculation. * Significant at 1% level.

This table presents the results of a paired t-test conducted to assess whether there has been a statistically significant improvement in SDG 6 (Clean Water and Sanitation) and its individual components across 120 districts of North-Eastern states between 2020-21 and 2023-24. The t-test compares

the mean scores of each indicator across the two years, using 120 districts, and evaluates whether the observed changes are statistically significant. The results show a clear and substantial improvement in the overall SDG 6 score, which increased from 62.95 in 2020-

21 to 79.5 in 2023-24. The t-value of 6.2149 and a p-value of 0.0000 indicate that this improvement is highly significant at the 1% level. This suggests that, on average, North-Eastern states have made considerable progress in achieving SDG 6 targets over the study period.

Looking at individual components, the most dramatic improvement is seen in piped water connections, where the mean score rose from 33.95 to 77.39, with a t-value of 16.1058 the highest among all indicators. This reflects a major expansion in infrastructure and access to piped water across states. Similarly, improved drinking water saw a notable increase from 77.22 to 98.96, with a strong t-value of 6.3947, indicating widespread enhancement in water quality and availability.

Sanitation facilities improved from 50.90 to 68.46, and improved toilets at home rose from 70.86 to 91.22, both showing statistically significant gains. The provision of toilets for girls in schools also improved, with the mean increasing from 66.89 to 78.34, reflecting efforts to promote gender-sensitive sanitation infrastructure. The Open

Defecation Free (ODF) status reached a perfect score of 100.00 in 2023-24, up from 83.98, suggesting near-universal coverage and success in eliminating open defecation.

Interestingly, groundwater extraction is the only indicator that did not show a statistically significant change. The mean increased slightly from 4.29 to 5.53, but the t-value of 1.2365 and p-value of 0.2175 indicate that this change is not statistically significant. This suggests that groundwater management remains a challenge, with limited progress in controlling extraction rates.

In summary, the t-test results confirm that there has been statistically significant and meaningful improvement in most components of SDG 6 between 2020-21 and 2023-24. The data highlights successful interventions in water supply and sanitation infrastructure, while also pointing to areas like groundwater extraction where further attention is needed. These findings can inform future policy decisions and resource allocation to ensure balanced and sustainable progress across all dimensions of SDG 6.

Table 3: ANOVA Output for Inter-state variations in SDG 6 and its components for 2023-24

Variables	2020-21		2023-24	
	F	Prob.> F	F	Prob.> F
SDG 6	3.51	0.0019*	40.01	0.0000*
Improved drinking water	4.28	0.0003*	3.89	0.0008*
Piped water connection	4.54	0.0002*	35.96	0.0000*
Sanitation facilities	22.61	0.0000*	4.02	0.0006
Improved toilets at home	3.77	0.0010*	228.47	0.0000*
Toilet for girls in schools	3.23	0.0037*	9.03	0.0000*
Open Defecation Free	3.35	0.0028*	3.21	0.0035
Groundwater extraction	8.89	0.0000*	5.23	0.0000*

Source: Author's Calculation. * Significant at 1% level. ** Significant at 5% level.

The ANOVA output presented in Table 3 offers a statistical examination of inter-state variations in Sustainable Development Goal 6 (SDG 6) which focuses on clean water and sanitation and its key components across two time periods: 2020-21 and 2023-24. The analysis uses F-values and p-values to determine whether differences among states are statistically significant. A higher F-value indicates greater variation among states, while a lower p-value (typically below 0.01 or 0.05) confirms that these differences are unlikely to be due to chance.

The overall SDG 6 score shows a dramatic increase in inter-state variation over time. In 2020-21, the F-value was 3.51 with a p-value of 0.0019, indicating moderate but significant variation. By 2023-24, the F-value surged to 40.01 with a p-value of 0.0000, suggesting that disparities among states in achieving SDG 6 have widened considerably. This trend is echoed in several components of SDG 6, particularly in piped water connections and improved toilets at home. The F-value for piped water connections jumped from 4.54 to 35.96, and for improved toilets at home, it skyrocketed from 3.77 to an astonishing 228.47. These figures highlight a growing inequality in infrastructure development and access to basic sanitation services across states.

Some components, however, show a different trajectory. Sanitation facilities, for instance, had a very high F-value of 22.61 in 2020-21, indicating substantial variation, but this dropped to 4.02 in 2023-24. This suggests that states may have converged in their efforts to improve sanitation infrastructure, possibly due to targeted national programs or policy interventions. Similarly, the variation in Open Defecation Free (ODF) status remained relatively stable,

with F-values of 3.35 and 3.21 in the respective years, indicating consistent but moderate differences among states. Other indicators, such as toilets for girls in schools and groundwater extraction, also show significant variation across states, with increasing F-values over time. The rise in the F-value for school toilets from 3.23 to 9.03 suggests that while some states have made notable progress, others are lagging behind. Groundwater extraction, a critical issue for water sustainability, also shows persistent and significant variation, with F-values of 8.89 and 5.23 in the two years, respectively.

In summary, the ANOVA results reveal that while some aspects of SDG 6 have seen reduced disparities among states, others especially those related to household-level infrastructure have experienced a sharp rise in inequality. These findings underscore the need for more nuanced and region-specific policy interventions to ensure equitable progress toward clean water and sanitation for all.

Conclusion

In this study, we employed a composite index utilising seven indicators categorised under the main components of Sustainable Development Goals (SDGs) 6, composed by NITI Aayog, to assess the access to clean water and sanitation facilities across North-Eastern states. The composite index was developed to highlight SDG 6 inequalities at the district level, allowing us to identify areas in need of targeted interventions. While no studies provide a comprehensive picture of clean water and sanitation facilities (SDG 6) in the states of the North-Eastern region, the use of this composite index provided a comprehensive

understanding of the availability of clean water and sanitation facilities and disparities in North-East India. Our study reveals significant variations in clean water and sanitation facilities coverage, particularly at the state and district levels.

Despite significant progress in improving clean water and sanitation services in India, challenges persist, particularly in the North-Eastern region and among marginalized communities. To effectively address these challenges, context-specific and community-led interventions are crucial, taking into account local social, economic, and environmental factors. This approach will help ensure that solutions are tailored to the unique needs of each community, ultimately contributing to universal access to clean water and sanitation.

Our study's findings have significant policy implications, highlighting the importance of sustained efforts to enhance access to clean water and sanitation, particularly in underserved areas, and the need for targeted support for marginalized communities. By providing district-level insights into clean water and sanitation facilities in North-Eastern states, this research contributes to achieving universal access and advancing Sustainable Development Goal 6 in India.

References

1. Biswas S, Adhikary M, Alam A, Islam N, Roy R. Disparities in access to water, sanitation, and hygiene (WASH) services and the status of SDG-6 implementation across districts and states in India. *Heliyon*. 2024;10(18):e37646. <https://doi.org/10.1016/j.heliyon.2024.e37646>
2. Biswas S, Dandapat B, Alam A, *et al.* India's achievement towards Sustainable Development Goal 6 (Ensure availability and sustainable management of water and sanitation for all) in the 2030 Agenda. *BMC Public Health*. 2022;22:2142. <https://doi.org/10.1186/s12889-022-14316-0>
3. Fewtrell L, Kaufmann RB, Kay D, Enanoria W, Haller L, Colford JM. Water, sanitation and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis. *Lancet Infect Dis*. 2005;5(1):42-52.
4. Kumar P, Singh R, Kumar A. Water and sanitation in North-East India: challenges and opportunities. *J Water Health*. 2020;18(3):453-64.
5. Meetei AT. Water scarcity and public health concerns in rural India: a case study of Nongpok Sekmai and surrounding villages. *Discov Water*. 2024;4:80. <https://doi.org/10.1007/s43832-024-00145-2>
6. Ministry of Jal Shakti. Jal Jeevan Mission: Har Ghar Jal. Government of India; 2020.
7. NITI Aayog. SDG India Index 2021-22. Government of India; 2022.
8. United Nations. Transforming our world: the 2030 Agenda for Sustainable Development. United Nations; 2015.
9. World Health Organization (WHO). Progress on household drinking water, sanitation and hygiene 2000-2017: Special focus on inequalities. Geneva: WHO; 2019.