HIMALAYAN JOURNAL
of Basic and Applied Sciences

RESEARCH ARTICLE

Journal Website: https://himalayanjournal.org/
Email: editor@orchidsocietyofassam.com

Himalayan Journal of Basic and Applied Sciences
vol.1, Issue 2, Dec., 2025; Page No. 124-132
Doi:https://doi.org/10.5281/zenodo.18297353
ISSN NO. Applied For (Print edition)
ISSN NO. **3107-9113** (online edition)

Water Quality Performance of India in a Global Perspective: A Statistical Evaluation

[1]Paominthang Haokip & *Dipangshu Dev Chowdhury [2]

Assistant Professor, Department of Economics, Tinsukia College
[2]Assistant Professor, Faculty of Management and Commerce, ICFAI University Tripura, India

*Corresponding Author's: dipangshuchowdhury@gmail.com

Abstract

The quality of water is a pillar of the health that is enjoyed by people, the sustainability of the environment and sustainable economic growth in the long term. In the developing countries, the progressive degradation of water quality is gradually reducing the human livelihood and productivity. Nevertheless, in spite of the policy efforts, regulatory changes, and flagship programmes, India is still facing the severe problems that involve surface-water and groundwater pollution. This paper uses internationally relievable indicators of water-quality performance based on Water Quality Index (WQI) and Environment Performance Index (EPI) to compare the water-quality performance for India with other countries. Using descriptive statistics, quartile analysis, percentile analysis, comparative ranking and elementary inferential analysis, the analysis puts India against the developed and developing countries. The results show that India is still ranked in the lowest global percentile band hence indicating the structural shortcomings that are entrenched in the water governance, water-treatment plants, pollution-controlling systems, and institutional capacity. The paper argues that no improvements can significantly change the position of India in the world without the systematic and large-scale changes. The paper ends by making policy-related recommendations that focus on investing in infrastructure, enforcing regulations, managing water-resources in an integrated manner, and enhancing governance as a condition to sustainable improvements in water-quality outcomes.

Keywords: Water Quality Index; Environmental Performance Index; Percentile Analysis; Global Comparison

Introduction

Safe and clean water is universally known as a basic human need and precedent to sustainable development. The quality of water directly impacts on the health of people, ecological balance, food

Received: 18th December, 2025; Revised & Accepted: 27th December, 2025; Published *Online: 28th December, 2025*
Published by Orchid Society of Assam

security and economic productivity. The United Nations has recognized its pivotal role and therefore included water and sanitation as a focused goal in Sustainable Development Goal 6 (SDG 6) that aims at ensuring everyone has access to water and sanitation which is sustainably managed. Although the world has witnessed the advancement in the provision of better water sources, the quality aspect of water security has always been a longstanding and highly underrated problem, especially in the developing economies. The world has experienced unprecedented strain on fresh water resources in the recent decades due to the rapid industrialization, escalated urbanization, population growth and agricultural intensification (Zango et al., 2021). Such processes have led to water scarcity and also major degradation of water quality due to discharge of untreated or poorly treated sewage, industrial effluents, agricultural runoff, and solid waste. As a result, water pollution has become one of the most significant environmental risk factors with some far-reaching consequences on human health and ecosystem integrity. This is especially the case with India. The nation sustains almost 1/6 of the global population with only an approximation of 4 percent of the total global fresh water reserves. This imbalance in structure increases the pressure in the systems of surface and groundwater. Large river basins like the Ganga, Yamuna, Godavari and Cauvery have unfavourable pollution loads of domestic sewage, industrial discharges and non-point agricultural sources. At the same time, ground water, which is the main source of drinking water to most of the population, is greatly contaminated with fluoride, arsenic, nitrate and salinity in a number of areas. Although the Government of India has introduced several programs designed to enhance water supply, sanitation, and river rejuvenation, there are still concerns on the effectiveness of these programs as well as their results. It is easy to conduct benchmarking of national performance alone and fail to realize the level of the challenge. Here, global comparable water quality indices like the Water Quality Index (WQI) and the Environmental Performance Index (EPI) can offer an effective analytical framework on the relative performance and a gap identification framework. The rationale for selecting WQI and EPI includes their widely acceptance as water- quality parameters into a single score for ease of interpretation and policy use on the one hand, and WQI helps in local assessments and EPI provides a broader environmental benchmarking. The current research aims at positioning the water quality performance at India in a global comparative context. The paper intends to go beyond the descriptive accounts of the India case by offering an empirical evaluation of the relative position of India, the level of inequalities compared to developed nations, and the policy and governance implications using the statistical instruments that are applied to the case of internationally published indices.

The problem of water quality has been widely studied in both domestic and overseas literature, and it indicates the key role of this problem to the health of people, environmental sustainability and economic progress. Initial research highlights that the problem of water pollution is directly connected with the process of fast urbanization, the growth of industry, the increase of population, and agricultural

intensification especially in the economies of developing countries where the development of environmental infrastructure frequently falls behind the economic development (World Health Organization, 2017). The worsening of surface and groundwater resources is already reported in the Indian context in a significant amount of research. According to the regular assessments conducted by the Central Pollution Control Board, it has been reported that significantly a considerable percentage of Indian rivers is polluted, most of the time because of the release of untreated or partially treated domestic sewage and industrial effluents (CPCB, 2022). Research on significant river systems like the Ganga and Yamuna puts emphasis on a high level of biological oxygen demand (BOD), chemical oxygen demand (COD) and fecal coliform, reflecting serious contamination with organic and microorganisms (Kumar et al., 2019). Such results imply that the urban growth has not been matched with wastewater treatment capacity. Quality groundwater is the key subject of its scholarly interest as well. Studies show that there is common contamination of fluoride, arsenic, nitrate, and heavy metals in many Indian states and they cause severe chronic health problems (Chakraborti et al., 2016; Rao et al., 2020). Excessive exploitation of groundwater has also enhanced the quality degradation by decreasing the level of natural recharge and the concentration of contaminants. Such researches emphasize that the water quality issues in India do not exist in surface water only but are systemic ones. Comparative environmental performance has been extensively studied in the form of composite indicators at the global level (Environmental Performance Index (EPI)). The EPI is a tool developed by Yale and Columbia Universities, which combines environmental health and ecosystem vitality indicators, such as drinking water quality and wastewater treatment (Wendling et al., 2020). A number of empirical studies use EPI scores to show that there are strong correlations between income levels and institutional quality and environmental outcomes with high-income countries always performing better than developing ones (Esty et al., 2018). Comparative analyses also indicate that nations with strict environmental policies, the level of technologies, and effective governance systems have a better water quality result (OECD, 2019). On the contrary, developing countries struggle with such issues as low enforcement systems, disjointed institutional duties, and insufficient funding, which leads to ineffective performance in terms of water quality (UNEP, 2021). Although the current studies are extensive, few of them follow a percentile/quartile-based methodology with an aim of examining the relative position of the country in terms of water quality ranking in the world map. Such statistical positioning offers an improved idea of the structural gaps as opposed to absolute scores. The current research contributes to the literature by providing a more detailed evaluation of the performance of water quality in India in a global comparative framework by combining percentile and quartile analysis with global indices.

The main objectives for the present study includes- to determine the performance of India on water quality based on global Water Quality Index (WQI) and Environmental Performance Index (EPI); to engage in comparative evaluation of the Indian performance as compared to both the developed and developing economies; to determine the percentile and quartile of India in world ratings; to use this

basic statistical method to solve discrepancies in water quality results; and to make policy suggestions that are based on empirical evidence.

Materials and Method

Sources of Data and Methodology

The analysis is based solely on secondary data obtained through the means of internationally published WQI and EPI reports, which provide standard and similar measures on such key parameters as drinking water safety, level of sanitation, wastewater treatment, and water pollution exposure. The international dataset includes between 180 and 185 countries where the water quality scores have been maintained consistently, which in turn makes it possible to compare the quality of water across different countries and provide a valid percentile scale of the assessment. To measure the relative position of India, the study applies a set of statistical tools, such as descriptive statistics to test the central tendency and dispersion, ranking and comparative statistics to test the performance differentials, quartile and decile classifications to measure the relative position, ratio and gap analyses to measure deviation of measure to the world averages and standards of the developed countries.

Descriptive Statistical Test.

Table 1. represents the Distribution of Water Quality Scores across the world. In the table, the scores of water quality derived by WQI/EPI indicate extreme disparity all over the world. A minimum of 1.7, and a maximum of 100 are the ranges of scores, indicating a tremendous diversity in the results of water quality across countries. The higher end of the distribution is dominated by developed economies, which represent well-developed institutional structures and well-developed treatment facilities, whereas low-income countries are clustered significantly at the bottom. The mean score of 54.6 which was worldwide and a median of 56.0 imply that half of the nations are above a moderate level. However, the wide standard deviation and coefficient of variation highlight the level of dispersion and inequality of the global performance of water quality.

Table 1: Descriptive Statistics of Global Water Quality Scores (N = 180)

Statistic	Value
Minimum	1.7
Maximum	100.0
Range	98.3
Mean (Global Average)	54.6
Median	56.0
Standard Deviation	29.4
Coefficient of Variation (%)	53.8

The strong coefficient of variation supports the fact that there is a significant variation in the water-quality performance across countries.

India's Relative Position

The score of 18.3 on water-quality in India is significantly lower than the world average of 54.6 and the median of 56.0. The nation lies over one standard deviation below the global average and this indicates a structurally defective position as opposed to a peripheral poor performance.

Table 2: India vs Global Average

Indicator	Score
India	18.3
Global Mean	54.6
Difference	-36.3
% of Global Mean	33.5%

Quartile Analysis

The quartile analysis divides the group of 180 countries into four equiprobable groups of 45 countries based on the scores of the water-quality.

Table 3: Quartile-wise Distribution of Countries

Quartile	Score Range (Approx.)	Characteristics	India's Position
Q1 (Top 25%)	75–100	Developed Economies, Advanced Treatment Systems	No
Q2 (25–50%)	55–74	Upper-Middle Performers	No
Q3 (50–75%)	35–54	Below-Average Performers	No
Q4 (Bottom 25%)	1.7–34	Severe Water Quality Stress	**Yes**

Quartile analysis divides countries into four groups that are distributed equally and according to their performance regarding water-quality, hence allowing systematic evaluation of global inequalities. The stronger quartile is majorly dominated by developed economies that have developed wastewater treatment systems, strong enforcement of regulations and a large investment made by the government in their water systems. The second and third quartile includes countries that have moderate to below-average performance, which is often a reflection of partial coverage of treatment and unequal governance results. India is in the lowest quarter, which is the last 25 percent of nations in the world. The stance is an indicator of a high degree of water-quality stress, and highlights the ongoing structural inadequacies in treatment capacity in wastewater treatment, regulatory effectiveness and water-governance processes in spite of current policy mobilization.

Percentile and Decile Analysis

Percentile Position

Percentile analysis provides a demarcation of the performance of India in the global water-quality

performance. India is ranked 18th in the 180 countries in the 18 th percentile with an approximate of 147.

Table 4: Percentile Interpretation of India's Rank

Indicator	Value
Total Countries	180
India's Rank	~147
Percentile	~18th
Countries Performing Better	~82%
Countries Performing Worse	~18%

As a result, over 80 percent of the countries demonstrate high-quality water-related results, and under 20 percent of them do worse. The low percentile score is indicative of systemic issues and not peripheral underperformance and heightens the need of massive-scale, long-term changes.

Decile Classification

The decile classification also shifts the assessment on the basis of classifying the countries into 10 equiprobable categories of performance. The location of India is in the second-lowest decile, which is a group characterized by persistent water pollution, limited wastewater treatment availability, and an augmented risk of public-health. Such a position suggests that the performance of India on water-quality is significantly lower than average on the global level and closer to the result of the worst-performing countries, which clearly points to the necessity of the need to prioritize the quality of water in the national development policies.

Table 5: Decile-wise Classification (Selected)

Decile	Score Range	Representative Countries
Top Decile (90–100%)	90–100	UK, Switzerland, Finland
Middle Decile (40–50%)	40–50	Peru, Thailand, Morocco
Bottom Decile (0–10%)	1.7–15	Niger, Nigeria, Burundi
India's Decile	**10–20%**	**India, Tanzania, Ghana**

India's placement in the second-lowest decile reinforces the severity of its water quality challenge.

Comparative Analysis with the Developed Countries

The comparison of India with some of the developed nations indicates the persistence of glaring differences in the performance of water quality. The developed economies like the United Kingdom, Germany, Japan, Canada and the United States all have the score of water quality at 90 or above. Such high scores are indicators of the close access to safe drinking water, highly developed wastewater treatment facilities, and regulatory structures. Conversely, India has a lower score on water quality of below 20 which demonstrates a significant performance disparity. The comparison of group average shows that the mean score of chosen developed nations is more than 5 times greater than that of India.

This gap cannot be attributed to income difference but to long term investment on environmental infrastructure, innovation of technology, enforcement of regulations, and institutional capacity. The comparative analysis shows that the water quality gains are the cumulative results of the long-term policy commitment and effectiveness of the governance. The developed nations gained their present performance rates due to decades of tightening regulations, governmental investments, and constant control. It implies that the water quality problems in India need structural answers but not policy interventions in the short run. The difference in level between the developed country mean and India is about 5.1:1, indicating the extent of difference.

Table 6: India vs Selected Developed Countries

Country	Water Quality Score
United Kingdom	100.0
Germany	98.6
Japan	91.8
United States	89.3
Canada	90.9
India	**18.3**

Table 7: Mean Score Comparison

Group	Mean Score
Developed Countries (Selected)	93.7
Developing Countries (Selected)	42.5
India	18.3

The ratio of the developed-country mean to India's score is approximately 5.1: 1, reflecting the magnitude of disparity.

Discussion and Results

The statistical data based on the quartile, percentile, decile, and comparative analysis continuously show that the water quality performance of India is one of the low in the world. The positions of India in the bottom quartile, low percentile ranking, and second-lowest decile state measures clearly point at a lack of structural robustness and not an incidental manifestation of temporary weaknesses. The main source of poor water quality in India is the poor sewage treatment in the country. The rapid urbanization has triggered a rapid growth in the production of the wastewater and the rate of the growth in the treatment capacity has grown at a much slower rate. This has led to discharge of large volumes of untreated or half treated sewages into rivers and other water bodies. The problem is further worsened by industrial effluents and agricultural runoffs that bring about toxic substances and nutrients that destroy the quality of water. The role of institutional fragmentation is also vital in halting the process; the presence of several agencies that have overlapping duties of responsibility is usually a cause of failure in coordination, and

poor implementation of pollution control laws. At municipal level, there is a further constraint of money to invest, operate, and maintain the wastewater treatment facilities due to financial constraints. These governance issues significantly reduce the effectiveness of the current policies and programmes. Even though the national efforts to ensure better water supply, sanitation, and the revival of rivers are positive, the statistical evidence indicates that their effect has not been so considerable to increase the relative position of India in the world arena. Improvements will most likely be localized unless the governance and the infrastructure gaps are addressed.

Policy Implications

The policy implications of the findings of the research are multiple. To begin with, there is an urgent need to invest heavily on wastewater treatment facilities, especially in highly populated urban and peri-urban areas. The capacity to treat should be increased in order to lessen the pollutant loads and improve the surface water quality. Second, the control mechanisms by the regulation should be enhanced considerably. This includes the adoption of better water quality monitoring, data transparency, and effective protection against non-conformance. The strict enforcement will motivate industries and municipalities to use cleaner production and use of more effective waste management practices. Third, the issues of water quality require a combination of water resource management strategies. Planning at the basin level can enhance the level of coordination between the administrative borders and sectors thereby lessening fragmentation and enhancing performance. Last but not least is community participation and social awareness that will help to create long-term change as well informed and active stakeholders will be one of the main factors that can contribute to bringing about responsible water consumption and prevention of pollution.

Conclusion

The current research paper provides a statistical evaluation of the quality of water in India in comparison with the situation in other countries, which utilizes a global comparative platform of similar indicators. It is observed that India has always been ranked in the lower quartile/percentiles of the global water-quality indexes, which highlights the existence of a significant and consistent discrepancy compared with developed economies. These findings suggest that the water-quality issues in India lie in its structural nature, which are related to the lack of proper infrastructure, poor enforcement of regulations, and the ineffective governance systems. Even though the latest policy behaviors imply the growing awareness of the problem, these attempts are not strong and efficient enough to induce fundamental change. The improvement of water-quality, in its turn, must be regarded as a major growth goal and not a fringe environmental issue. With no long-term investment, institutional fortification, and cohesive governance, it is highly unlikely that the current trend will be turned around. Significant public-health gains and economic returns to India over the long term would not only be achieved by making substantive improvements in water quality, but also bolster the environmental sustainability.

Declaration

The authors declare no conflict of interest regarding this paper's content, authorship, or publication.

References

1. **Central Pollution Control Board. (2022).** *National water quality monitoring programme: Status of river water quality in India.* Government of India.
2. **Esty, D. C., Levy, M. A., Kim, C. H., de Sherbinin, A., Srebotnjak, T., & Mara, V. (2018).** Environmental Performance Index: Global metrics for the environment. Yale Center for Environmental Law & Policy.
3. **Kumar, P., Saroj, D. P., & Goyal, V. C. (2019).** Assessment of surface water quality in major Indian rivers. *Environmental Monitoring and Assessment, 191*(5), Article 315. https://doi.org/10.1007/s10661-019-7440-2
4. **Organisation for Economic Co-operation and Development. (2019).** Water quality and agriculture: Meeting the policy challenge. OECD Publishing https://www.oecd.org/en/publications/water-quality-and-agriculture_9789264168060-en.htm
5. **United Nations Environment Programme. (2021).** Progress on ambient water quality: Global assessment. United Nations. https://www.unwater.org/sites/default/files/2024-08/SDG6_Indicator_Report_632_Progress-on-Ambient-Water-Quality_2024_EN_0.pdf?
6. **Wendling, Z. A., Emerson, J. W., de Sherbinin, A., Esty, D. C., et al. (2020).**2020Environmental Performance Index. Yale Center for Environmental Law & Policy.
7. **World Health Organization. (2017).** Guidelines for drinking-water quality (4th ed.). World Health Organization. https://www.who.int/
8. **Zango, Baba-Serges, Ousmane Seidou, Majid Sartaj, Nader Nakhaei, Kelly Stiles (2022).** Impacts of urbanization and climate change on water quantity and quality in the Carp River watershed. *Journal of Water and Climate Change,* 13 (2):786-816. https://doi.org/10.2166/wcc.2021.158

****