WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 13, Issue 7, 1292-1303. Research Article ISSN 2277–7105

EXPLORING GROUNDWATER QUALITY INDEX FOR SUSTAINABLE WATER MANAGEMENT IN BASTI DISTRICT IN UP, INDIA

Sneha Khadse[1]* and N. D. Jausja[2]

[1]Research Scholar, Nirwan University Jaipur.

[2]Faculty of Basics and Applied Sciences, Nirwan University Jaipur.

Article Received on
20 February 2024,

Revised on 11 March 2024,
Accepted on 31 March 2024

DOI: 10.20959/wjpr20247-31929

***Corresponding Author**
Sneha Khadse
Research Scholar, Nirwan University Jaipur.

ABSTRACT

In the pre-monsoon and post-monsoon seasons of 2023, this research carried out a thorough evaluation of the water quality in many blocks of the Basti district, with a particular emphasis on bacteriological and chemical investigations. The appropriateness of the water for drinking and other uses was assessed by the analysis of 500 samples that were gathered from various sites. The findings indicated that the water quality in the tested blocks varied, with some places showing good results and others showing bad conditions. The results of the bacterial examination showed that the proportion of good samples decreased over the post-monsoon season, indicating a considerable reduction in water quality. Chemical study also revealed differences in water quality indicators, emphasizing the influence of seasonal variations. In order to guarantee that people in the Basti district have access to clean and drinkable water, our results highlight the need of ongoing monitoring and management of water resources.

KEYWORDS: *Groundwater quality, Water management, Basti District, Sustainable development, India, Water quality index.*

1. INTRODUCTION

The most significant natural resource utilized for drinking is groundwater. In addition, it is employed in household, industrial, and agricultural operations. Freshwater makes up only 3 percent of all the water on Earth. The amount of water that is available for drinking is less than 1%. The greatest quantity of groundwater used in the industry is in agriculture. When water is used excessively, two issues arise at the same time. The first is a lower groundwater

table, and the second is the maximum amount of water given to human society returns as wastewater, contaminating ponds, lakes, rivers, and streams in addition to groundwater through leaching. Both natural and man-made causes can contaminate groundwater. Both household and industrial waste are thrown on the ground, either partially or completely treated, or in their solid or liquid state. The solid waste seeps through the earth in form of leachate. While some contaminants reach the ground and mingle with the groundwater, others are absorbed by the soil. In a similar vein, groundwater was contaminated by liquid waste.

Water pollution causes over 1.7 million fatalities annually, or 1 in 6 deaths, which equates to nearly 16% of all deaths in poor nations. Human health is negatively impacted by water pollution in addition to the water's quality. Development of the economy and social prosperity are greatly threatened by water contamination. Water pollution is one of the main causes of many illnesses. For the growth and survival of several biota species, groundwater is a vital source of nutrients. In certain parts of the nation, the low quality of groundwater is caused by industrial and seasonal activities. As a result, in order to minimize groundwater contamination and maintain control over polluting agents, ongoing groundwater monitoring is required. Since the last several decades, the water quality index (WQI), which aids in determining the overall quality condition of a water supply, has been used to estimate the quality of both surface and groundwater worldwide. Numerous researchers have examined the effects of industry on the quality of groundwater in various parts of India. The goal of the current study was to evaluate the groundwater quality from hand pumps in the Basti area of Uttar Pradesh, India, using the Water Quality Index.

1.1.Study area

The district of Basti is arranged in the northeastern area of Uttar Pradesh (U.P), generally between the longitudes of 820 17' and 830 20' east and the scopes of 260 23' and 270 30' north. The exploration region uncovered that Gonda is situated on the west side and Sant Kabir Nagar is situated on the east side. The Basti district traverses 2,688.00 square kilometers.

- **Geography**

The Ghaghara River divides Basti from Faizabad and Ambedkar Nagar, with the district of Sidharth Nagar located on the northern border. Basti is a rural, underdeveloped region of Uttar Pradesh where there are several issues with drinkable water for cultivation and drinking. Additionally, people utilize the water, which they believe is unfit for human

consumption. As a result, the water should be treated, and only then could people use the cleansed water for household purposes. To determine the "assessment of groundwater quality as in Basti district and all of its blocks," a general examination of issues pertaining to drinking water and groundwater was conducted.

- **Physiography**

The district's northern boundary is parallel to that of Siddharta Nagar district. There are little ponds and nalas in this region. The Ami River flows along the boundary to the northeast. The Garia River, at a considerable distance, regularizes the district's eastern boundary. The Kuwana and Ghaghara rivers are the principal waterways in the district's central and southern regions. In addition, the area is home to several other rivers, nalas, and ponds. The dirt transported by the Ghaghara and its tributaries makes up the entire district. This terrain, which is located in the north rage of the Ghaghra River, is mainly plain and productive. The typical direction of the water flow is northwest to southeast. Numerous large and tiny nalas and Ghaghara-like rivers drain the region. The district boundaries of Basti and Faizabad are formed by the river Ghaghara, which flows through the district's southern corner and into the tahsil Harraiya, Basti. The district boundaries are also formed by the river Kuwana, which flows through the tahsils of Basti and Bhanpur. Tahsil Harraiya, Basti is traversed by the Manwan River, which flows from northwest to southeast. The boundaries of the districts Basti and Siddharth Nagar are formed by the split Ami River in the north, while the district Sant Kabir Nagar is bordered by the Garia River in the east, which runs through Tahsil Basti.

Figure 1: Map of Basti District, Uttar Pradesh India.

2. Literature review

Gond, S., et.al., (2023) One normal regular outrageous that significantly affects the continuous environmental change is dry spell. The assessment of dry season changeability under past and future expected climatic situations is introduced in this work utilizing the normalized precipitation evapotranspiration index (SPEI). To characterize dry season in view of SPEI dry spell events, seriousness, force, and recurrence as per the edge of SPEI < −1, a probabilistic strategy run hypothesis is carried out. The climate factors were downscaled utilizing the Measurable Downscaling Model (SDSM). Utilizing CanESM2 of the CMIP5 model, three situations are utilized to look at dry season inconstancy under anticipated environmental change: ordinary focus pathways RCP 2.6, RCP 4.5, and RCP 8.5 north of a long time from 2019 to 2050. Out of the three situations, a dry season occasion with greatest seriousness and more dry spell occasions connected to RCP 4.5 and RCP 8.5, though succinct stations Kanpur, Moradabad, Azamgarh, and Chitrakoot show higher most extreme seriousness and recurrence of dry season events under RCP 2.6. The adjustment of climatic variables and the noticed time of the SPEI time series were assessed utilizing the Mann-Kendall (MK) test. Out of 16 areas, except for Lucknow and Meerut, the outcomes show a critical lessening in the pattern of precipitation during the storm season as well as every year. Furthermore, 83% of the stations show a positive pattern of SPEI at each timescale, demonstrating that the majority of the review districts are in danger of dry spell. Three areas, in particular Saharanpur, Meerut, and Aligarh, likewise showed a positive pattern, demonstrating a decline in drying conditions over the verifiable period.

Bhargava, M. B. (2021) showed a drive for water resilience made possible by a comprehensive strategy for lake management and restoration at the institutional and physical levels. Building a city's water resilience is an ongoing, flexible process, and healthy urban lakes are essential to this effort. The constant intake of wastewater, which needs to be properly treated to maintain a healthy lake ecology, provides enough water for the lakes' production and storage. The study illustrates a few basic treatment methods that are affordable and simple for the local population to use in addition to providing them with training. Additionally, cutting-edge biotechnological therapy approaches might be tested with the combined activities. The initiative concentrated on the lake and the beach scale, but maintaining the lake basin's rainwater system is equally crucial to lake restoration. The way the lakes are arranged geographically throughout the city represents the watershed of a

network of lakes. Planning and development at the local level must incorporate basin-level rainfall management in order to effectively manage a system of lakes.

Sarkar, R., et.al., (2020) has endeavored to decide the progressions in the assortment of macrophytes and zooplankton of the exploration locales all through winter (Nov-Dec, 2017) as well as the varieties in the physicochemical quality of two metropolitan lakes (developed limit: Lake An and normal limit: Lake B) in Chandannagar. Temperature, pH, straightforwardness, conductivity, DO, Body, absolute disintegrated solids (TDS), complete suspended solids (TSS), all out alkalinity, all out hardness, and chloride were among the limnological parameters that were estimated from two areas that were gathered in three phases. In view of this finding, it is expressed that over the exploration period, there were observable changes in the different water quality measurements of two metropolitan lakes. Lakes An and B had water temperatures of 22.0 and 21.3 °C, separately. Lake B has the most noteworthy pH esteem (7.9). Water in Lake B was murkier than that in Lake A. Lake B had the most noteworthy upsides of complete alkalinity (181.15 mg/l), all out hardness (145.66 mg/l), conductivity (218.50 µS/cm), DO (8.47 mg/l), Body (5.69 mg/l), TDS (135.19 mg/l), TSS (67.60 mg/l), and chloride (58.94 mg/l). While contrasting Lake B with Lake A, the most measure of macrophytic vegetation was found in Lake B. As per research on the zooplankton populace, Lake B's most prominent rotifer frequency proposes the degree of pollution.

Singh and Nayak (2018) The land inequality was computed using data from the 2010–11 Agricultural Census Input Survey and the Gini coefficient. Using metrics from four economic regions—the eastern, western, Bundelkhand, and western—agricultural sustainability was also assessed. Additionally, the operational landholdings' level of agricultural sustainability was determined. According to the computed agricultural sustainability indices for each economic zone, farmers in the western region were the least sustainable, while those in the Bundelkhand region were the most sustainable. Farmers in the Bundelkhand region have adopted sustainable management practices by making efficient use of all available agricultural resources, including livestock, agricultural machinery, credit, biological insect-pest control, and sustainable seed use. This has allowed them to create a sustainable agricultural production system. To put it another way, these resource-poor farmers have adapted their agricultural system so that, given the resources at their disposal, their overall returns should be maximized. According to the current study, micro-level policy measures are

necessary to reduce the usage of chemical fertilizers. In addition to harming the health of the soil, overuse of chemical fertilizers is the cause of chronic illnesses like cancer. As a result, there are benefits to using chemical fertilizers sparingly. This is good for the soil and people's health in addition to lowering input costs. In addition, two main causes of the disparity among the operating landholdings are the perpetually growing population and land fragmentation. Participation in the community can help with this. The current study also discovered that locations with large yields—like the western region—are the least sustainable. As a result, the current analysis indicates that Uttar Pradesh's level of sustainability would rise with careful use of common property resources, such as land and water.

3. Research methodology

The unpolished finished forceps tips ought to be disinfected in a fire and afterward permitted to cool. Holding the sterile film channel exclusively by its edge, cautiously eliminate it from its bundling. In the wake of embedding the film channel into the channel gadget, blend the example by over and over shifting the example holder. Put the example in the channel pipe (100 ml). In the wake of drawing the example through the channel and applying a vacuum to the pull jar, separate the vacuum. Utilizing the sterile forceps, dismantle the separating hardware and eliminate the film channel, being mindful so as to contact just the channel's edge. Remove the cover from an E. Coli medium plate that has previously been embedded, and lay the film, framework side up, on the agar. To forestall air rises from being caught between the layer and the agar, bring down the film, starting at one edge. Put the example number or one more exceptional identifier on the Petri plate. For 22-24 hours, brood E. Coli medium plates at 35 ± 0.5°C.

3.1. Sample collection

To conduct a comprehensive investigation on the water quality in this region, a total of 500 samples were collected from various locations inside distinct blocks of Basti, with a minimum of 2-3 kilometers separating each sample from another. Sample points have been given to the sample collecting area. The sample was taken out of plastic bottles that had been autoclave sterilized, washed with acid water, and then twice rinsed with distilled water.

4 RESULT AND DISCUSSION

A) Bacteriological grades

1) Excellent – 00

2) Satisfactory - <1(cfu/100ml)

3) Unsatisfactory - 1< (cfu/100ml)

B) Chemical grades

Color - hazen 5.00

Odor – Unobjectionable

Turbidity (NTU) - no more than 5 NTU

Ph - 6.5 to 8.5 - No relaxation

Total hardness - 350 to 650mg/lit

Alkalinity - 250 to 650mg/lit

Chloride - 300 to 1000mg/lit

Conductivity - 0.04 to 0.08

4.1.Bacteriological analysis of Pre-Monsoon 2023

Block Name	Year	Total Samples	Satisfactory	Unsatisfactory
Bahadurpura	2023	45	30	15
Bankati	2023	36	25	11
Basti	2023	32	20	12
Dubaulia	2023	41	26	15
Gaur	2023	30	16	14
Harrayya	2023	33	19	14
Kaptanganj	2023	34	24	10
Kudraha	2023	39	20	19
Parasrampur	2023	35	16	19
Ramnagar	2023	45	28	17
Rudhauli	2023	31	20	11
Sultauwa Gopalpur	2023	30	16	14
Saughat	2023	24	19	5
Vikramjyot	2023	45	26	19
Total		**500**	305	195

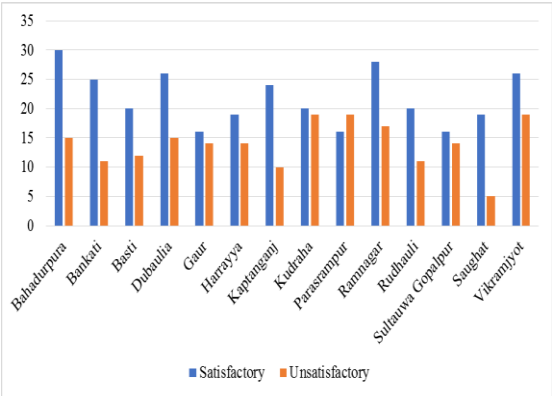

Figure 1: Bacteriological analysis of Pre-Monsoon 2023.

The information on the water quality evaluations carried out in 2023 across several blocks, showing the total number of samples collected as well as the number of samples classified as acceptable and unacceptable. With varying numbers of samples from each block, a total of 500 samples were evaluated. The analysis's goal was to evaluate each block's water quality by classifying samples according to predetermined guidelines. There are clear variances in the water quality across the tested blocks. Compared to other blocks, Bahadurpura, Dubaulia, and Ramnagar had greater percentages of acceptable samples, suggesting comparatively superior water quality. In contrast, there are more subpar samples in blocks like Parasrampur and Kudraha, which may indicate problems with the quality of the local water.

The information emphasizes how crucial it is to keep an eye on and control water quality in order to guarantee that communities have access to clean, drinkable water. Authorities can improve water quality and protect public health and environmental sustainability by addressing the issues that lead to poor samples and putting targeted actions into place.

4.2. Chemical analysis 2023

Block Name	Year	Total Samples	Satisfactory	Unsatisfactory
Bahadurpura	2023	45	31	14
Bankati	2023	36	18	18
Basti	2023	30	25	5
Dubaulia	2023	30	21	9
Gaur	2023	28	15	13
Harrayya	2023	32	20	12
Kaptanganj	2023	37	22	15
Kudraha	2023	36	19	17
Parasrampur	2023	35	26	9
Ramnagar	2023	41	25	16
Rudhauli	2023	32	27	5
Sultauwa Gopalpur	2023	38	30	8
Saughat	2023	40	26	14
Vikramjyot	2023	40	27	13
Total		**500**	**332**	**168**

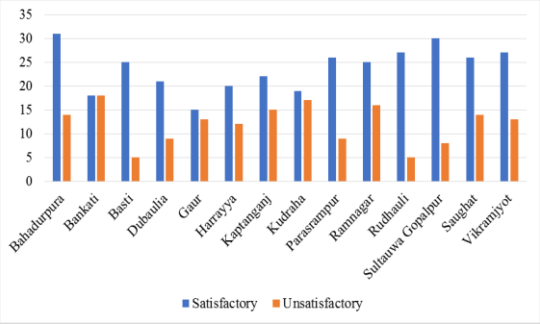

Figure 2: Chemical analysis.

The information above is from a 2023 water quality assessment that was carried out across a number of blocks. It includes the total number of samples that were taken and the number that was classified as acceptable and unsatisfactory. With varying numbers of samples from each block, a total of 500 samples were evaluated. The assessment's classification of samples according to predetermined criteria was intended to examine each block's water quality. The water quality varies across the examined blocks; some blocks have greater percentages of good samples than others. Blocks like Bankati and Kudraha have a more evenly distributed distribution of acceptable and unsatisfactory samples, while Bahadurpura and Sultauwa Gopalpur show comparatively large numbers of satisfactory samples. Rudhauli is notable for having a high percentage of good samples. These results highlight the need of continuous water quality management and monitoring in order to guarantee communities have access to safe drinking water and to resolve any possible issues that may be found during these evaluations.

Comparison

- **Overall comparison**

Parameter	Bacterial Analysis		Chemical Analysis	
	Pre-Monsoon	Post-Monsoon	Pre-Monsoon	Post-Monsoon
Satisfactory (%)	85.15%	55.36%	85.45%	63.14%
Unsatisfactory (%)	54.25%	45.65%	70%	88.1%

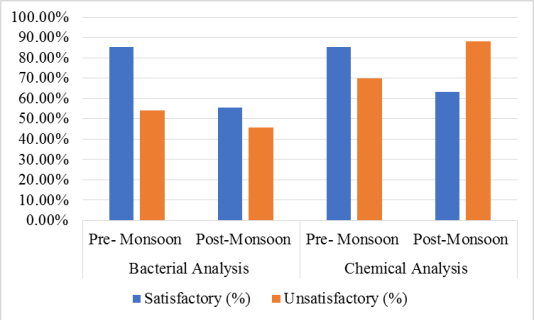

Figure 3: Overall analysis.

The comparison of water samples taken during the pre-monsoon and post-monsoon seasons, as determined by chemical and microbiological analysis. Between the pre-monsoon and post-monsoon seasons, the proportion of good findings for bacterial analysis drops from 85.15% to 55.36%, showing a significant deterioration in water quality. On the other hand, throughout the same time period, the proportion of poor outcomes rises from 54.25% to 45.65%. Similar to this, there are only minor variations in the proportion of good findings in

chemical analysis between the pre- and post-monsoon seasons, ranging from 85.45% to 63.14%. Nonetheless, the proportion of subpar outcomes rises sharply from 70% to 88.1%, suggesting a significant decline in the quality of the water throughout the post-monsoon phase. These results underline the need of monitoring and addressing environmental variables impacting water safety by pointing to a possible link between seasonal variations and water quality.

5 CONCLUSION

The evaluation of the pre-monsoon and post-monsoon water quality in several Basti district blocks in 2023 provided important new information on the condition of the area's water resources. Water's fitness for eating and other uses was assessed by chemical and bacterial studies. The data revealed differences in the quality of the water in various blocks, with some parts showing good findings and others showing bad circumstances. Comparing the post-monsoon season to the pre-monsoon period, bacterial examination revealed a significant drop in water quality, as shown by a drop in the proportion of good samples and an increase in unsatisfactory samples. Chemical examination also showed variations in the parameters of water quality, with certain blocks showing comparatively high percentages of excellent samples and others showing a more evenly distributed range of suitable and bad samples. The influence of seasonal fluctuations on water quality was highlighted by a comparison of pre-monsoon and post-monsoon examinations, with a significant decline seen during the post-monsoon period. These results highlight how crucial it is to manage water resources continuously in order to guarantee that people have access to clean, drinkable water. Improving water quality and preserving public health and environmental sustainability in the Basti area require addressing the causes of substandard samples and putting focused actions into place.

REFERENCES

1. *Balan, I.N., Shivakumar, M. and Kumar, P.D.M., An assessment of ground water quality using water quality index in Chennai, Tamil Nadu, India, Chronicles Young Scient, 2012; 3(2): 146 - 150.*
2. *Bhargava, M. B. What will it take to make Indian cities water resilient? Case of integrated lake basin management at Indore. In Natural Resource Governance in Asia, 2021; 373-393. Elsevier.*

3. *C. R. Ramakrishnaiah , C. Sadashivaiah and G. Ranganna , Assessment of water quality index for the ground water in Tumkur Taluk, Karnataka State, India, E ñ Journal of Chemistry, 2009; 6(2): 523 ñ 530.*
4. *Cude, C.G., Oregon water quality index: a tool for evaluating water quality management effectiveness, J. American Water Resou. Assoc, 2001; 37(1): 125-137.*
5. *G. Srinivas Rao, G. Nageswararao, Assessment of ground water quality using water quality index, Arch. Environ. Sci, 2013; 7: 1-5.*
6. *Gond, S., Gupta, N., Dikshit, P. K. S., & Patel, J. Assessment of drought variability using SPEI under observed and projected climate scenarios over Uttar Pradesh, India. Physics and Chemistry of the Earth, Parts A/B/C, 2023; 131: 103440.*
7. *I. Nanda Balan, M. Shivakumar, and P. D Madan Kumar, An assessment of ground water quality using water quality index in Channai, Tamil Nadu, India, Chronicles of young scientists, 2012; 3, 2: 146-150.*
8. *Mnisi, L.N., Assessment of the state of the water quality of the Lusushwana River, Swaziland, using selected water quality indices. M.Sc. Thesis, University of Zimbabwe, Harare, 2010.*
9. *N. K Dhakad, Deepak Shinde and Preeti Choudhary, Water quality index of ground water (GWQI) of Jhabua Town, M.P (India), Journal of Environmental Research and Development, 2008; 2: 443 – 446.*
10. *Pawar R. S, Panaskar D and V.M Wagh, Characterization of ground water quality index of Solapur Industrial belt, Maharasta, India, IJREI, 2014; 2, 4: 31-36.*
11. *Rao C.S, Rao B.S Hariharn A.V.L.N.S.H and Bharathi N M, Determination of water quality index of some area in Gunter Dristict, Andhra Pradesh, Int. J.,Appl. Pharma. Tech I, 2010; (I): 79-86.*
12. *Sadat, N. S. M., Ebrahimi, K. and Liaghat, A. M. Groundwater quality assessment using the water quality index and GIS in Saveh- Nobaran aquifer, Iran. Environmental Earth Science, 2014; 71: 3827-3843. DOI 10.1007/ s12665-013-2770-8*
13. *Sahu P, Sikdar PK, Hydro chemical framework of aquifer in and around East Kolkata wetland, West Bengal, India, 2008.*
14. *Saleh, H. N., Valipoor, S., Zarei, A., Asghari, M. Y. F. B., Mohammadi, A. A., Ghalehaskar, F. A. S. and Khaneghah, A. M. Assessment of groundwater quality around municipal solid waste landfill by using Water Quality Index for groundwater resources and multivariate statistical technique: A case study of the landfill site, Qaem Shahr City, Iran. Environ Geochemistry Health, 2020; 42: 1305-1319.*

15. *Sarkar, R., Ghosh, A. R., & Mondal, N. K. Comparative study on physicochemical status and diversity of macrophytes and zooplanktons of two urban ponds of Chandannagar, WB, India. Applied Water Science, 2020; 10: 1-8.*
16. *Shweta Tyagi, Bhavtosh Sharma, Prashant Singh and Rajendra Dobhal, Water Quality Assessment in Terms of Water Quality Index, American Journal of Water Resources, 2013; 1(3): 34-38.*
17. *Singh, S., & Nayak, S. Land inequality and agricultural sustainability in Uttar Pradesh, India: a regional analysis. Asian Journal of Science and Technology, 2018; 9(11): 12-32.*
18. *Toure, A., Wenbiao, D. and Keita, Z. Comparative Study of the physicochemical quality of water from wells, boreholes and rivers consumed in the commune of Pelengana of the Region of Segou in Mali. Environmental Science an Indian Journal, 2017; 13(6): 1-12.*
19. *Vaiphei, S. P., Kurakalva, R. M. and Sahadevan, D. K. Water quality index and GIS-based technique for assessment of groundwater quality in Wanaparthy watershed, Telangana, India. Environmental Science and Pollution Research, 2020; 27: 45041-45062. https://doi.org/10.1007/ s11356-020-10345-7*
20. *Yogendera K, Puttaiaha ET, Determination of water quality index and sustainability of an urban water body in shimoga town Karnataka. Proc. of Taal: The world Lake conference, 2007; 12: 342-6.*