Article ID No. 2704 DOI No. https://doi.org/10.5281/zenodo.18318062

Empowering Students through Water Quality Monitoring and Sustainable Purification Practices: A Case Study from Barrackpore

Project Conducted by the students of
Nawabganj Balika Vidyalaya
Kalitala Road, Ichapur, North 24 Parganas

Supervisor Teachers:
Ms. Tanusree Goswami, Mrs. Sumita Dey,
Dr. Paramita Bhakta, Ms. Purabi Majumdar

Participating Students:
Ms. Ankita Bhattacharjee, Ms. Ankita Modak, Ms. Momtaj Khan, Ms. Prerana Ghosh, Ms. Chandra Roy, Ms. Ayantika Mukherjee, Ms. Preeti Dutta, Ms. Utsarika Bhattacharjya

Ms. Tanusree Goswami
Assistant Teacher,
Nawabganj Balika Vidyalaya
tanusree1978@gmail.com

Mrs. Sumita Dey
Assistant Teacher,
Nawabganj Balika Vidyalaya
sumitade01@gmail.com

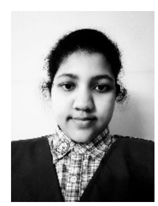
Ms. Purabi Majumdar
Assistant Teacher,
Nawabganj Balika Vidyalaya
purabi.majumder@gmail.com

Dr. Paramita Bhakta
Assistant Teacher,
Nawabganj Balika Vidyalaya
Paramitabhakta1970@gmail.com







Abstract:

This student-led investigation evaluated water quality from various sources in Barrackpore, West Bengal, using accessible testing methods. The study examined physical, chemical, and biological parameters and compared the results to packaged liquids to identify key contaminants. The results showed different levels of impurities, highlighting specific issues in local water sources. Based on this analysis, the project researched and tested low-cost purification techniques suitable for community use and schools. This effort not only provides a practical assessment of local water safety but also greatly promotes environmental awareness and encourages the adoption of sustainable water management practices among students and the broader educational community. The main goal is to empower stakeholders with knowledge and tools to improve local water security through simple, effective methods.

Keywords: Water Quality, Barrackpore, West Bengal, Contaminants, Low-Cost Purification, Environmental Awareness, Sustainable Water Practices, Student Investigation.

1. Introduction:

Water is the foundation of life, and its quality directly influences the health of ecosystems and communities. As global concerns over water scarcity and pollution intensify, localized monitoring and sustainable management have become essential. Educational institutions, especially schools, can play a transformative role in this effort by engaging students in hands-on scientific inquiry and environmental stewardship.

This study explores the chemical, physical, and biological characteristics of water from various sources in and around Nawabganj Balika Vidyalaya, Barrackpore. By aligning water quality assessment with national and international standards, the project investigates the safety, usability, and ecological impact of untreated water. It also identifies common contaminants—including microorganisms, heavy metals, and industrial residues—and examines how local geology and human activities influence water conditions.

Through student-led sampling, testing, and analysis, the initiative not only evaluates water quality but also empowers learners to apply low-cost purification techniques such as alum treatment and solar disinfection. The integration of scientific methodology with community relevance fosters awareness, critical thinking, and sustainable practices—positioning students as active contributors to environmental resilience.

2. Literature Review:

2.1 Drinking Water Quality, Assessment, and Management

Regulatory Frameworks and Quality Standards

The foundation for ensuring potable water quality rests on established guidelines. Globally, the World Health Organization (WHO) [1] provides comprehensive *Guidelines for Drinking-Water Quality,* which serve as a benchmark for health-based targets. These global standards are adapted and enforced at the national level. In India, water quality is governed by the Bureau of Indian Standards (BIS)[2] through the *Indian Standard Drinking Water Specification (IS 10500:2012),* which sets mandatory limits for physical, chemical, and microbiological parameters to safeguard human health.

[1] https://www.who.int/publications/i/item/9789240045064
[2] https://www.bis.gov.in/other/DrinWatIS10500.pdf.

2.2 Water Quality Assessment and Monitoring Techniques:

Evaluating the quality of water sources is essential for regulatory compliance and proactive public health measures. Various methodologies have been developed for this purpose, including traditional chemical and biological methods for water pollution studies. More contemporary assessments often employ the Water Quality Index (WQI), a mathematical tool used to simplify complex water quality data into a single, easily understandable number. Research has extensively used the WQI to assess water bodies across India, including studies focused on groundwater quality and the health of major rivers, such as the River Yamuna[3], as well as broader assessments of rivers [9, 10]. However, achieving effective *Water Quality Monitoring in India* faces persistent *Constraints*, underscoring the need for advancements in techniques and specific assessment methods for complex cationic and anionic contaminants. Ultimately, robust quality assessment is intrinsically linked to understanding its *Impact on Human Health.*

2.3 Contamination Challenges and Regional Context:

Contamination of drinking water sources remains a significant challenge, with studies analysing various contamination sources and the subsequent need for treatment techniques [6]. The problem is particularly acute in regions like South Asia, where a UNICEF review highlighted the prevalent water quality issues, encompassing both microbiological and chemical contamination [20]. Contamination requires both large-scale municipal intervention and localized solutions to protect end users.

2.4 Water Treatment and Household Management Strategies:

A critical theme in the literature is the effectiveness of accessible, decentralized treatment systems. Given that microbial contamination often occurs during collection, transport, or storage, managing *Water in the Home* is crucial for accelerated health gains from improved water supply [3]. Point-of-use (POU) water treatment systems, applied at the household level, are advocated as a means of *Expanding Access* to safe water [4].

One widely studied POU method is Solar Water Disinfection (SODIS), which leverages solar ultraviolet radiation to inactivate pathogens. Extensive research has confirmed the effectiveness of SODIS on various model microorganisms [5]. A review of the current status of *Solar Disinfection of Water* highlights its potential and prospects as a simple, low-cost solution [17]. Furthermore, a

[3] https://pubmed.ncbi.nlm.nih.gov/36257401/

broader focus on implementing comprehensive *Water Quality Solutions* encompasses these localized efforts.

2.5 Sustainable Alternatives: Rainwater Harvesting

Ultimately, the literature examines sustainable, alternative water sources to mitigate scarcity and supplement existing water supplies. Rainwater Harvesting (RWH) is proposed as a *Sustainable Solution to the Water Crisis in India*. The potential *Benefits of Rainwater Harvesting in Urban India* are particularly significant, offering a method to recharge groundwater, reduce storm runoff, and provide a decentralized, readily available source of water for non-potable and potentially potable uses after treatment.

3. Aims & Objectives:

(i) Investigate Water Sources: Students will identify and collect water samples from multiple locations inside and outside the school campus to understand source diversity and potential risks.

(ii) Conduct Basic Water Quality Tests: Using accessible tools and techniques, students will measure key parameters such as pH, turbidity, temperature, TDS, and microbial presence to evaluate water safety.

(iii) Analyse Contaminants and Their Effects: Students will explore how variations in pH, suspended solids, chemical pollutants, and bacteria affect water usability and ecosystem health.

(iv) Map Human and Natural Influences: Through observation and discussion, students will identify local human activities (e.g., waste disposal, overuse) and natural factors (e.g., rainfall, soil composition) that impact water quality.

(v) Explore and Apply Purification Methods: Students will experiment with low-cost purification techniques such as alum treatment and solar disinfection (SODIS), assessing their effectiveness through comparative testing.

(vi) Reflect on Water Use, Treatment, and Reuse: By synthesising their findings, students will propose strategies for safe water use, treatment, and reuse—both within the school and in the broader community.

4. Methodology:

4.1 Study Location:

- Barrackpore, North 24 Parganas, West Bengal
- Coordinates: Latitude 22.7661° N, Longitude 88.3516° E

4.2 Demographic Context (Census 2011):

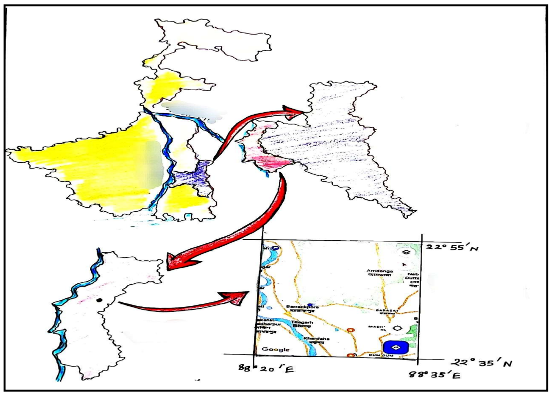


Figure-1: Map of west Bengal, North 24 PGS and Barrackpore

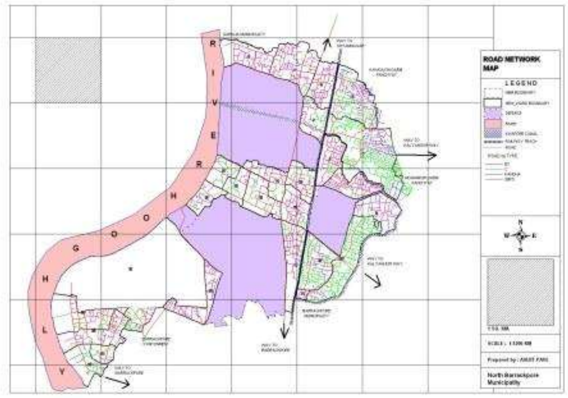


Figure-2: Map of North Barrackpore Municipality

Table 1: Demography of the studied area:[4]

Total Population	Male	Female	Rural	Urban	Density	Literacy Rate	Sex Ratio Female: Male
194,333	99,434	94,899	94,278	100,055	11,058	88.76%	950: 1000

Sampling and Assessment of Water Quality:

4.3 Sampling Strategy:

- *Five water sources selected:* tap, tubewell, pond, river, and rainwater
- *Represented diverse water types:* Treated (tap), Groundwater (tubewell), Surface water (pond and river) and Atmospheric input (rainwater)

4.4 Purpose: Assess variability and potential risks across sources

4.5 Collection and Testing: Samples collected in clean containers.

4.6 Parameters analyzed:

(i) Physical: temperature, turbidity, colour, odour; (ii) Chemical: pH, TDS, hardness, iron, arsenic and (iii) Biological: total coliform presence

4.7 Purification methods tested: (i) Alum treatment and (ii) Solar disinfection (SODIS)

4.8 Tools and Techniques Used:

(i) Literature review and field survey; (ii) Random sampling and content analysis; (iii) Data interpretation using Microsoft Word and Excel; (iv) Alignment with BIS and WHO water quality standards.

[4] Census 2011

5. Survey Conducted by the Students:

(I) Active participation in sampling, testing, and documentation;

(II) Emphasis on experiential learning and environmental awareness.

(III) Laboratory Testing of Ph and TDS of Different Samples of Traditional Drinks


PIc. 1: Collecting water from the Ganga


Pic. 2: Measuring the temperature of the water from the pond


Pic 3: Collecting Rainwater


Pic. 4 Measuring the TDS of collected water


Pic. 5: Measuring the pH of the collected water


Pic 6: Measuring the TDS in different temperatures

5.1 Results: Results are given in the following Table (No-2):

Table 2: Water Quality Test Analysis for Samples Collected from Different Sources

	Parameters	School Tap Water	School Tubewell Water	School Pond Water	River Water	Rain water	Permissible Unit
Phys Physical tests	Colour	Colourless	Colourless	Greenish	Opaque	Colourless	Colourless
	Odour	No Significant Odour	Odourless	Fishy Smell	No Significant Odour	Odourless	Odourless
	Temperature	32^0C	29^0C	35^0C	33^0C	28^0C	$10^0C – 25^0C$
	Suspended Solid	Absent	Absent	Present in large amounts	Present in large amounts	Absent	Absent
chemical tests	pH	7.42	7.22	7	5	5	6.5 – 8.5
	Total dissolved solids (ppm)	209	215	299	131	16	500
	Turbidity (NTU)	0.62	1.19	NA	NA	NA	5
	Total Hardness (mg/L)	116	96	NA	NA	NA	(75 – 115)

	Iron (mg/L)	0.18	0.48	NA	NA	NA	1
	Arsenic (mg/L)	0.00	0.01	NA	NA	NA	0.01
Bacterial	Total Coliform	0	0	NA	NA	NA	0
	Treatment Method used	Purification using ALUM			Purification using the SODIS Method		

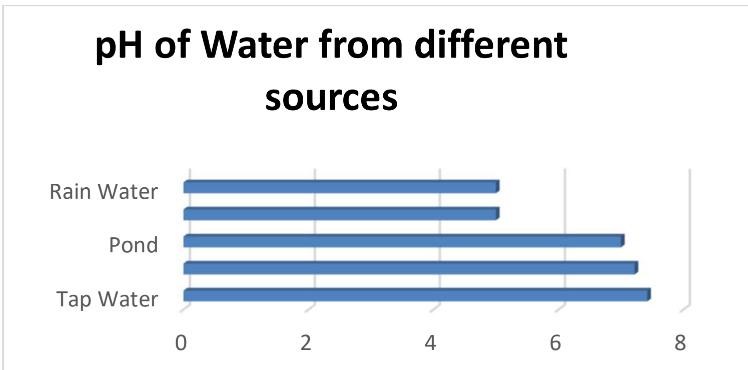


Figure 3A: Bar Graph of pH of water from different sources

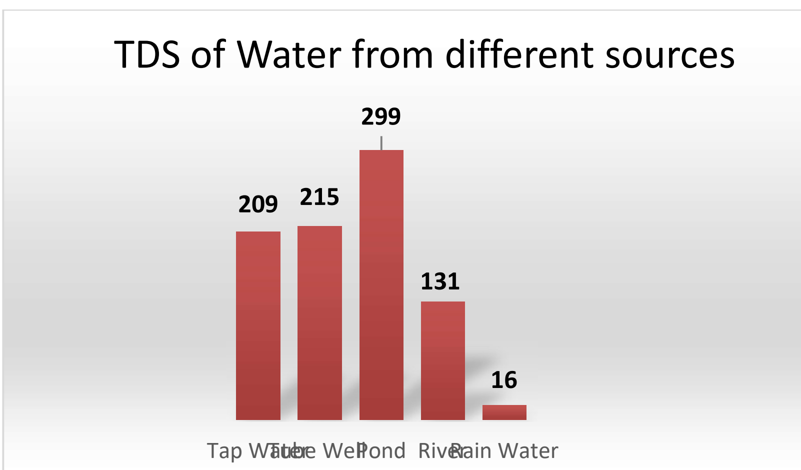


Figure 3B: Bar Graph of TDS of water from different sources

5.2 Water Quality Test Results Discussion:

5.2.1 Tap and Tubewell Water

- Met most safety standards
- Minor concerns: elevated hardness and iron levels

5.2.2 Pond and River Water:

- High contamination: suspended solids, poor clarity
- Unsuitable for direct use without treatment

5.2.3 Rainwater:

- Very low TDS but acidic pH
- Requires purification before consumption

5.2.4 Microbial Safety:

- No coliform detected in tap and tubewell
- Biological data missing for other sources—needs follow-up testing

5.2.5 Purification Methods:

- Alum reduced turbidity effectively in tubewell water
- SODIS improved rainwater safety and clarity

5.2.6 Overall Insight:

- Surface and rainwater pose higher risks
- Simple treatments can enhance safety
- Student-led testing promotes awareness and practical solutions

5.3 Improving the Water Quality:

To purify the water traditionally, following two methods were adopted:

5.3.1 Water Purification Using ALUM:

Procedure:

(I) Alum was crushed in a mortar, and 30 mg of alum was added to 3 litres of tubewell water.

(II) Water was stirred rapidly for 2 minutes and then slowly for 10 minutes. It was then allowed to rest without disturbing for approximately 2 hours.

(III) After the particles and contaminants had settled down, clear water at the top was decanted into a separate container.

(IV) The decanted water was now disinfected by boiling before using for drinking purposes.

(V) The purified water was tested.

5.3.2 Water Purification Using the SODIS Method:

SODIS (SOLAR DISINFECTION) is a method of purifying water for drinking by using sunlight. The UV rays from sunlight are used to kill any harmful bacteria present in water.

December 31, 2025 Online Version ISSN 2394-885X [IJISRR - International Journal of Research;] Vol-11; Issue- III

Procedure:

(I) A bucket was cleaned and covered with a piece of white cloth. Rainwater was collected in the bucket.
(II) Two plastic bottles were cleaned properly after removing the wrapper from the bottles.
(III) ¾th part of the bottles were filled with the collected rainwater, and they were shaken well for aeration.
(IV) After that, the bottles were filled with rainwater with no air gap.
(V) The bottles were then placed horizontally in direct sunlight for 6 hours.
(VI) The water was then boiled before being used for drinking purposes.


Pic 7: Preparing Filter Bed


Pic 8: Preparing Filter Bed


Pic 9: Filter Bed prepared

Table 3: Water Quality Analysis Before and After Treatment:

	Parameter	School Tubewell water	The treatment method used	Observation after treatment of Tubewell water
Physical	Colour	Colourless	Water Purification	Colourless
	Odour	No Significant Odour		No Significant Odour
	Temperature	29^0C		32^0C
	Suspended Solid	Present in absent	Using ALUM	Present in small quantities
Chemical	pH	7.22		7
	Total dissolved solids (ppm)	225		129

5.4 Result Discussion after Treatment:

After treating the school tubewell water with alum, several changes in water quality parameters were observed. The temperature increased from 29°C to 32°C, likely due to environmental exposure during the purification process. Suspended solids, initially present, were visibly reduced to small quantities, indicating effective settling. The pH slightly decreased from 7.22 to 7.00 but remained within the safe range. Most notably, total dissolved solids (TDS) dropped from 225 ppm to 129 ppm, confirming a significant improvement in water clarity and purity.

TABLE 4: Water Quality Test Analysis for Packaged Drinking Water of Different Brands:

	Parameters	Drink no.1	Drink no.2	Drink no.3	Drink no.4	Drink no.5	Distilled water from the Lab
Physical	Colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
	Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
	Suspended Solid	Nil	Nil	Nil	Nil	Nil	Nil
Chemical	pH	6	7	7	7	6	6
	TDS	118	35	92	85	46	7

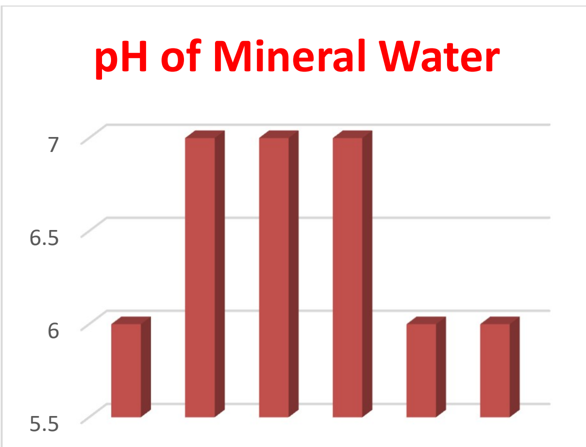


FIG: 4A Bar Graph of pH of different Mineral Waters

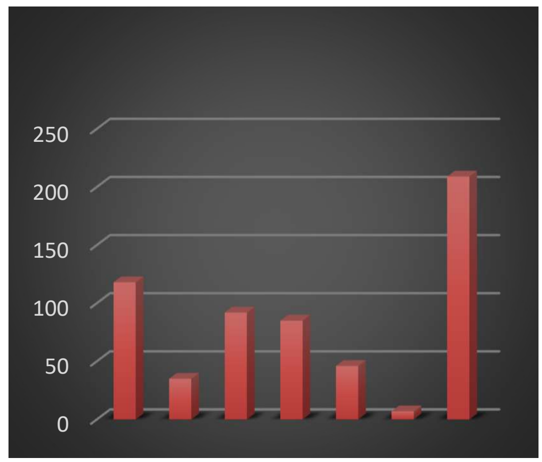


FIG: 4B Bar Graph of TDS of different Mineral Waters

5.4.1 Result Discussion:

water safety cannot be guaranteed from natural sources. Packaged water maintains controlled purity and consistent quality, as it is processed, filtered, and regulated to meet safety standards. Its pH and TDS levels remain within a narrow, predictable range, making it reliable for immediate consumption without additional treatment. This consistency is especially beneficial in settings where water safety cannot be guaranteed from natural sources.

Table 5: Water Quality Test of Different Brands of Soft Drinks:

	Parameters	Black Cold Drink	Packaged Orange	White Soft Drink	Packaged Litchi Juice	Packaged Soda Water	Packaged Mango Juice
Physical	Colour	Black	Orange	Colourless	White	White	Orange
	Odour	Characteristic Smell	Orange Smell	Characteristi c Smell	Litchi Smell	Characteristic Smell	Mango Smell
	Suspended Solid	Absent	Absent	Absent	Absent	Absent	Present
Chemical	pH	3	4	4	4	4	5
	TDS	565	183	201	344	228	443

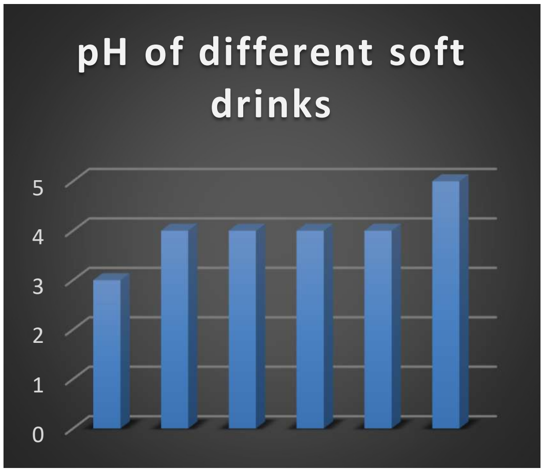


Fig: 5A Bar Graph of pH of different Soft Drinks

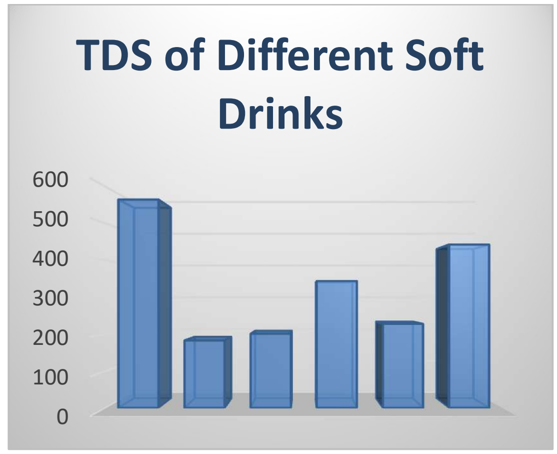


Fig: 5B Bar Graph of TDS of different Soft Drinks

Table 6: An Interesting Fact

Propaties	Black Tea	Milk	Coconut Water	Green tea
Colour	Deep yellow	White	Turbid	Light yellow
Odour	Characteristic smell	Odourless	Odourless	Characteristic smell
Suspended solid	Absent	Absent	Small amount	Absent
TDS	232	109	137	476
pH	6	7	5	7

Table 7: Water Quality Test of Different Traditional Drinks

	Parameters	Mustard Oil	Sunflower Oil	Kerosene Oil
Physical	Colour	Deep Yellow	Light Yellow	Colourless
	Odour	Pungent Smell	Odourless	Characteristic Smell
	Suspended Solid	Clear	Clear	Clear
Chemical	pH	NA	NA	NA
	TDS	0	0	0

5.4.2 Result Discussion:

- Soft drinks are **highly acidic and mineral-loaded**, often with artificial additives and strong flavors.
- Natural drinks are **milder, more balanced**, and retain organic properties, making them healthier and more hydrating.
- The data support promoting natural beverages over soft drinks for better health and sustainability awareness among students.

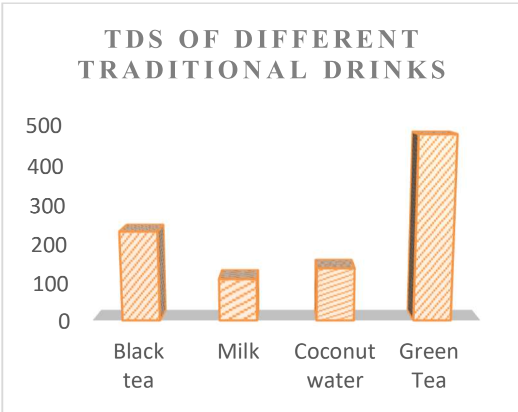


Fig-6A: Bar Graph of TDS of different Traditional Drinks

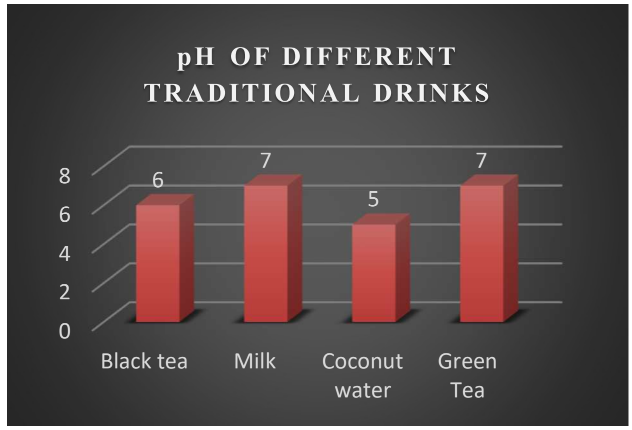


Fig- 6B: Bar Graph of pH of different Traditional Drinks

Table 8: TDS Reading of Water from Different Sources in Different Temperatures

	30ºC	35ºC	40ºC	45ºC	50ºC	55ºC	60ºC
Tap water	91	55	60	69	86	110	98
Tubewell	-	14	15	14	18	77	107
Rainwater	-	13	15	14	17	73	84
River water	39	48	56	60	71	73	78

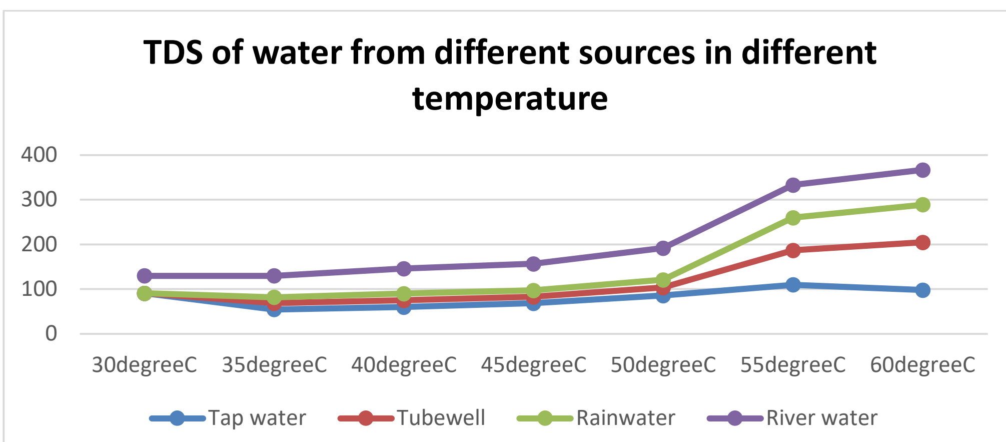


Figure- 7: TDS of water from different sources at different temperatures

5.4.3 Result Discussion:

- Higher temperatures improve water responsiveness
- Untreated sources like groundwater and rainwater benefit most from thermal activation

6. Limitations in Performing Water Quality Studies in a School:

(I) Limited Laboratory Infrastructure: Schools may lack advanced equipment for testing parameters like fluoride, arsenic, or microbial strains.
(II) Restricted Budget and Resources: Financial constraints can limit access to reagents, purification tools, and external lab collaborations.
(III) Time Constraints: Academic schedules may restrict the duration and continuity of sampling, analysis, and reflection activities.
(IV) Limited Sample Diversity: Access to varied water sources (e.g., industrial discharge, deep aquifers) may be restricted due to location or permissions.
(V) Data Accuracy and Replication: Inconsistent sampling techniques or a lack of calibration tools can affect the reliability of results.
(VI) Dependence on External Labs: Advanced testing often requires outsourcing, which may delay results or incur additional costs.

7. Suggestions for Further Study:

(I) Expanded Chemical Analysis: Investigate additional parameters such as fluoride, nitrate, phosphate, and heavy metals (e.g., lead, mercury) to deepen understanding of health risks.
(II) Seasonal Variation Studies: Monitor water quality across different seasons to assess the impact of rainfall, temperature, and human activity on contamination levels.
(III) Microbial Diversity Profiling: Use advanced techniques (e.g., PCR, microbial cultures) to identify specific bacterial strains and their sources.
(IV) Impact of Storage Practices: Study how different storage containers and durations affect water quality, especially in school and household settings.
(V) Comparative Efficacy of Purification Method: Test and compare multiple low-cost purification techniques (e.g., biosand filters, ceramic filters, UV pens) under controlled conditions.
(VI) Linking Water Quality to Health Outcomes: Collaborate with health professionals and Laboratories to correlate water quality data with reported cases of waterborne diseases.
(VII) Educational Outreach Modules: Develop interactive learning tools, games, and workshops to promote water stewardship among students and local communities.

8. Conclusion:

The comprehensive assessment of water samples from diverse sources around the school campus reveals significant variability in physical, chemical, and biological parameters, underscoring the need for vigilant water quality monitoring. While tap and tubewell water generally met acceptable standards, rainwater and surface sources like ponds and rivers exhibited concerning deviations, particularly in pH and turbidity. The study's comparative analysis of packaged drinks and edible liquids further highlighted the importance of scrutinizing everyday consumables for hidden health risks.

Purification techniques such as alum treatment and solar disinfection (SODIS) proved effective and accessible, offering practical solutions for improving water safety in educational and community settings. The integration of scientific inquiry with student-led reflection and dramatization fostered deeper awareness and engagement, transforming data into dialogue and action. Ultimately, this project affirms that sustainable water management begins with informed observation, collaborative learning, and the empowerment of young stewards to safeguard one of our most vital resources.

References:

Ahmed, W., Huygens, F., Goonetilleke, A., & Gardner, T. (2012). Solar disinfection of water: A review of the current status and prospects. *Journal of Environmental Health, 74*(6), 28–32. https://www.neha.org/sites/default/files/publications/jeh/JEH3.12-Feature-Solar-Disinfection-of-Water.pdf

Bharti, N., & Katyal, D. (2011). Water quality index for assessment of water quality in rivers. *International Journal of Environmental Sciences, 2*(1), 1–10. https://www.sciepub.com/reference/284937

Bhardwaj, R. M. (2005). *Water quality monitoring in India—Achievements and constraints.* United Nations Statistics Division. https://unstats.un.org/unsd/environment/envpdf/pap_wasess5a2india.pdf

Bureau of Indian Standards. (2012). *Indian standard drinking water specification (IS 10500:2012).* BIS. https://www.bis.gov.in/wp-content/uploads/2020/10/PM-IS-10500.pdf

Dutta, R., & Saikia, J. (2025). A mini review on water quality assessment methods for cations and anions. *ISAR Journal of Science and Technology, 3*(6), 1–8. http://isarpublisher.com/backend/public/assets/articles/1750942529-ISARJST-1762025.-GP.pdf

Ghosh, N. C., & Singh, R. D. (2010). Rainwater harvesting: A sustainable solution to water crisis in India. *Current Science, 98*(1), 1–6. http://ijraset.com/research-paper/rainwater-harvesting-systems-in-urban-and-rural-india-

Gupta, S., Kumar, A., Ojha, C. S. P., & Singh, G. (2012). Water quality assessment of River Yamuna using water quality index. *International Journal of Environmental Sciences, 3*(1), 1–10. http://www.cwejournal.org/vol3no3/passessment-of-water-quality-characteristics-along-the-course-of-the-yamuna-river-indiap

Kumar, M., Puri, A., & Singh, A. (2011). Groundwater quality assessment using water quality index. *Environmental Monitoring and Assessment, 184*(1), 1–13. https://link.springer.com/article/10.1007/s13201-021-01376-7

Mehta, P., & Sharma, S. (2015). Assessment of drinking water quality and its impact on human health. *International Journal of Environmental Sciences, 5*(4), 89–94. http://www.ijesci.com/archives/2015/vol5/issue4/assessment-of-drinking-water-quality.pdf

Mintz, E., Reiff, F., & Tauxe, R. (2001). Not just a drop in the bucket: Expanding access to point-of-use water treatment systems. *American Journal of Public Health, 91*(10), 1565–1570. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1446826

Mishra, A., & Singh, V. P. (2012). A review of water quality monitoring techniques. *Environmental Monitoring and Assessment, 184*(10), 1–17. https://www.researchgate.net/publication/341795626_Review_on_water_quality_monitoring_technologies

Palaniappan, M., Gleick, P. H., Allen, L., Cohen, M., Christian-Smith, J., & Smith, C. (2010). *Clearing the waters: A focus on water quality solutions.* Pacific Institute. http://pacinst.org/wp-content/uploads/sites/21/2013/02/clearing_the_waters3.pdf

Sharma, S., & Bhattacharya, A. (2017). Drinking water contamination and treatment techniques. *Applied Water Science, 7*(3), 1043–1067. https://link.springer.com/article/10.1007/s13201-016-0455-7

Singh, R. P., & Agrawal, M. (2011). Potential benefits of rainwater harvesting in urban India. *Environmental Science & Technology, 45*(10), 4302–4309. https://pubs.acs.org/doi/abs/10.1021/es104031k

Sobsey, M. D. (2002). *Managing water in the home: Accelerated health gains from improved water supply.* World Health Organization. https://iris.who.int/handle/10665/67319

Tiwari, T. N., & Mishra, M. (1985). Preliminary assignment of water quality index of major Indian rivers. *Indian Journal of Environmental Protection, 5*(4), 276–279. https://www.sciepub.com/reference/62993

Trivedy, R. K., & Goel, P. K. (1986). *Chemical and biological methods for water pollution studies.* Environmental Publications. http://catalog.hathitrust.org/Record/007163471

UNICEF. (2019). *Water quality in South Asia: A review of existing knowledge.* UNICEF Regional Office for South Asia. https://www.unicef.org/rosa/media/1761/file/Water%20Quality%20in%20South%20Asia.pdf

Wegelin, M., Canonica, S., Alder, A. C., Suter, M. J. F., Bucheli, T. D., Haefliger, O. P., Zenobi, R., McGuigan, K. G., Kelly, M. T., Ibrahim, P., & Larroque, M. (2007). Effect of solar water disinfection (SODIS) on model microorganisms. *Journal of Water Supply: AQUA, 56*(4), 245–256. https://iwaponline.com/aqua/article/56/4/245/30743

World Health Organization. (2017). *Guidelines for drinking-water quality* (4th ed.). WHO Press. https://www.who.int/publications/i/item/9789241549950