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Evaluation of *E. coli* and total coliform by membrane filtration method as an indicator of water quality of Ranchi lake (Bada Talab)

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Abstract
The findings of the microbiological examination of the Ranchi Lake water (Total Coliform and *E. coli*) are summarized in all of the material presented in this study. On display were samples taken at the collecting site over various seasons. The microorganism analysis investigation was conducted continuously from November 2021 to October 2022. Site 1 (in front of Seva Sadan Hospital), Site 2 (in front of Himanshu-Hiramani Edppa House Purani Ranchi), Site 3 (in front of Modern English School), Site 4 (in front of Shri Siyaram Narsingh Mandir), and Site 5 (near Swami Vivekananda statue) were the five specific locations from which water samples were collected and analyzed at seasonal intervals. After a year of analyzing various seasons from November 2021 to October 2022, it was discovered that S1 had the greatest levels of *E. coli* and Total Coliform in each of the three season's winter, summer, and rainy.

Keywords: Microbiological, lake water, *E. coli*, total coliform, sample

Introduction
Water is a crucial solvent that is used for industrial processes, hydroelectric power production, irrigation, aquaculture, drinking, washing, bathing, cooking, and as a coolant (N. Okafor, 2011) [1]. It is essential to the survival of humans, animals, and plants. The ongoing pollution of water bodies, including rivers and lakes, is a major issue worldwide and particularly in emerging nations. The interplay of physicochemical and biological processes for self-purification was deemed ineffective due to the large amount of contaminants entering the water bodies (D.O. Omole, and E.O. Longe, 2008) [2]. Microorganisms enter water bodies like rivers through sewage, the discharge of untreated or inadequately treated industrial effluents, and the dumping of human and animal waste (S. Singh, and L.M. Mosley, 2003) [3]. Numerous water-borne illnesses, including as cholera, diarrhea, typhoid, giardiasis, and amoebiasis, are more common in rural areas with limited access to clean water when untreated water is used (Wen X *et al*., 2020) [4]. The water quality is determined by the quantities of *Escherichia coli*, total coliform, and fecal coliform. The entire coliform category is composed of a wide variety of bacteria. Particular kinds of total coliforms that are mostly seen in feces are called fecal coliforms. *Escherichia coli* belongs to the fecal coliform subgroup of bacteria. Most outbreaks have been caused by a specific strain of the bacterium known as O157:H7 (Wells, J G *et al*., 1983) [5]. A class of aerobic and facultative anaerobic, Gram-negative, rod-shaped, non-spore-forming, motile or non-motile microorganisms known as coliform bacteria digest lactose and produce gas and acid in 48 hours when maintained between 35 °C and 37 °C (Li and Liu, 2018) [6]. These unique bacterial groupings are found in the environment and are usually found in the microflora of the feces of all warm-blooded animals, including humans (Martin *et al*., 2016) [7]. Total Coliform (TC) is the name given to the whole coliform bacterial population; of this, a subset is known as Fecal Coliform (FC), of which *E. coli* bacteria make up a portion (Brackett *et al*., 1993) [8].
Fecal contamination is indicated by the presence of FC and *E. coli*, whereas the presence of TC in water indicates environmental contamination. Nevertheless, it is not always simple to identify the negative effects of human activity on the environment unless a comparative analysis is conducted under two different scenarios, i.e., both with and without human

activity, in order to completely comprehend or identify the parameters of eco-restoration of river water quality (Mukherjee, P)

Materials and Methods

The findings of the microorganism analysis was conducted at the Ranchi Lake water (Total Coliform and *E. coli*). Samples gathered at the collecting site over various seasons were displayed. Over the course of single year, from November 2021 to October 2022, the microorganism analysis study was conducted continuously. Site 1 (in front of Seva Sadan Hospital), Site 2 (in front of Himanshu-Hiramani Edppa House Purani Ranchi), Site 3 (in front of Modern English School), Site 4 (in front of Shri Siyaram Narsingh Mandir), and Site 5 (near Swami Vivekananda statue) were the five specific locations from which water samples were collected and examined at seasonal intervals.

Total Coliform and *E. coli* Microorganism Analysis (IS 15185: 2016) Concurrently conducted Optional Rapid Test and Reference Standard Test are two elements of commonly used membrane filtration-based processes. Two to three days after the membrane is cultured on a chosen medium and the typical lactose-positive colonies are further biochemically described, coliform bacteria and *E. coli* are found and enumerated. The two incubation stages of the Rapid Test allow for the detection and counting of *E. coli* in 21±3 hours. When using the Rapid Test and the Standard Test simultaneously, the *E. coli* test will yield the highest result.

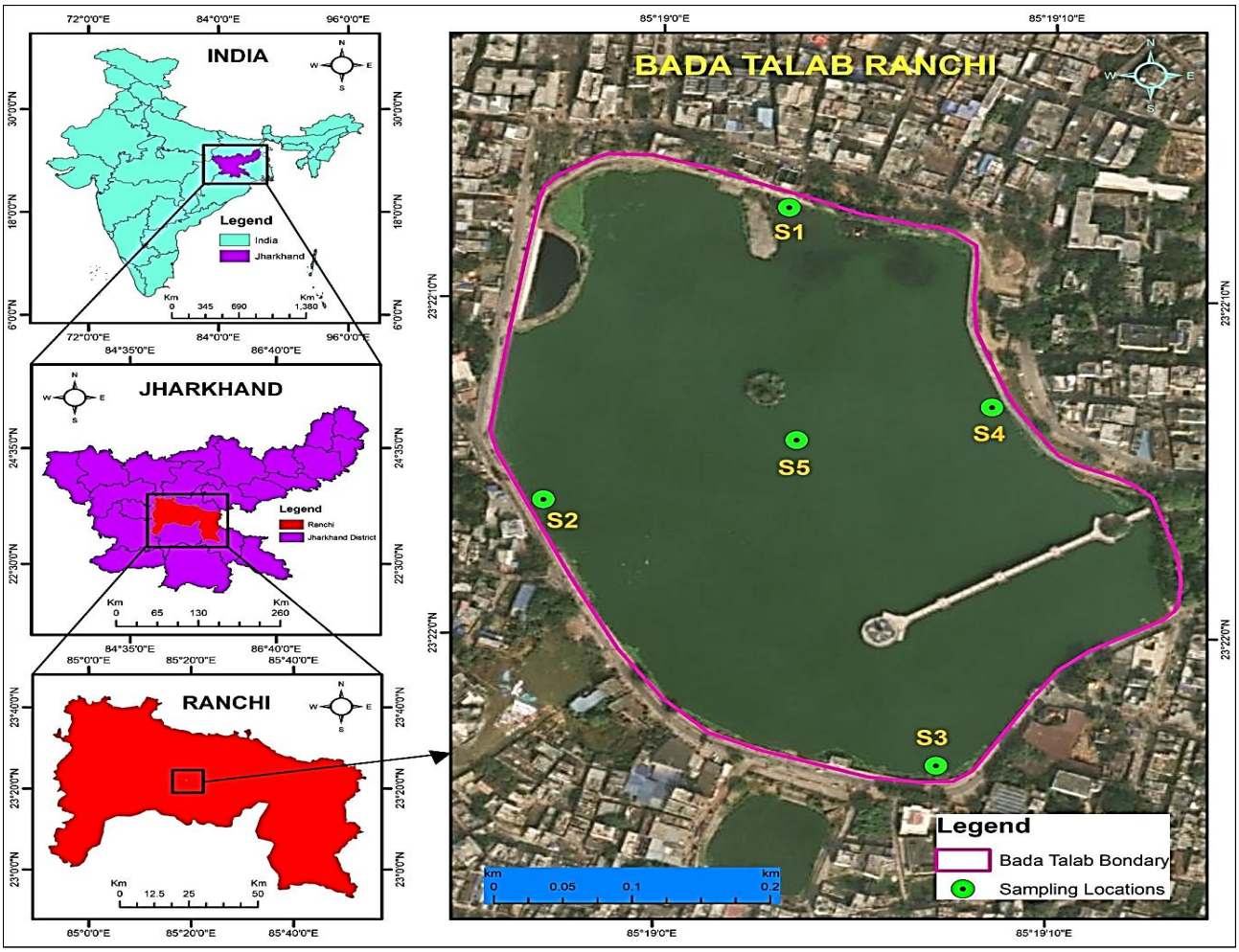

Fig 1: Geographic information system (GIS) map of Ranchi lake (Bada talab 2024)

Results

Microorganisms of two criteria, total coliform and *E. coli*, were analyzed from five distinct lake sites throughout the winter months of November 2021 to February 2022 as shown in table 1. Total Coliform (/100 ml) was found to have a high of 14,000 in SITE-1, followed by a sequential decrease in all Sites, with 13000 in SITE-2, 2600 in SITE-3, 2400 in SITE-4, and 2100 in SITE-5. The highest number of *E. coli* (/100 ml) was 2600 in SITE-1, 1000 in SITE-2, 296 in SITE-3, 268 in SITE-4, and 130 in SITE-5.

Total Coliform and *E. coli* throughout the summer months of March 2022 to June 2022 is shown in table 2. The maximum amount of total coliform (/100 ml) was recorded in SITE-1, and all other sites had a continuous decline, with SITE-2 having 11,000, SITE-3 having 1800, SITE-4 having 1700, and SITE-5 having 1500. SITE-1 had the most *E. coli* (/100 ml), followed by SITE-2 with 1800, SITE-3 with 768, SITE-4 with 258, and SITE-5 with 135.

During the rainy months of July 2022 to October 2022, the microorganisms of the two criteria Total Coliform and *E. coli* were analyzed at five distinct locations surrounding the lake. The highest level of total coliform (/100 ml) was found in SITE-1 after a gradual decline in other Sites, including 14000 in SITE-2, 3500 in SITE-3, 2800 in SITE-4, and 2200 in SITE-5.

SITE-1 had the highest *E. coli* count (/100 ml), followed by SITE-2 with 2400, SITE-3 with 798, SITE-4 with 297, and SITE-5 with 138.

Discussion

Depending on rainfall and water availability, the microbial count tends to rise in the fall after declining during the monsoon. The monsoon season in Bangladesh typically lasts from mid-May until late October. Its high humidity and heavy rains function as a complicated variable that affects the water microbiology (Kay, D *et al*., 2004 and Sikdar *et al*., 2018) [10, 11]. The fecal coliform count serves as the basis for the water quality guidelines. The European Economic Community Council states that no Salmonella is acceptable, that the TC count should be 500 CFU/100 mL with a maximum of 10,000 CFU/100 mL, and that the FC and fecal streptococci counts should be 100 CFU/100 mL. The development of industries and human activities throughout time has a negative effect on the health of the environment; bacteria can thrive and multiply there because they get different nutrients from sewage wastes and industrial effluents. The issue of fecal contamination frequently poses a concern to river water getting untreated discharges from sewage canals connecting to the river in poor nations like India where sewage water discharge is not always properly managed (Strauss, 1996) [13]. The Buriganga River had the greatest levels of bacterial contamination, which is consistent with a 2009 research that found a high degree of pollution and a prior study that found seasonal variations in Dhaka. In another investigation, both Dhanmondi Lake and the Turag River had high physicochemical characteristics (Saha *et al*., 2009 and Razzak *et al*., 2013) [14, 15].

Table 1: Total Microorganism Counts in Water Samples Taken During the Winter Season (November 2021 to February, 2022)

S. N.	Microorganism Test	Site-1	Site-2	Site-3	Site-4	Site-5
1.	Total *Coliform* (/100 ml)	14000	13000	2600	2400	2100
2.	*E. coli* (/100 ml)	2600	1000	296	268	130

Table 2: Total Microorganism Counts in Water Samples Taken During the Summer Season (March 2022 to June, 2022)

S. N.	Microorganism Test	Site-1	SITE-2	SITE-3	SITE-4	SITE-5
1.	Total *Coliform* (/100 ml)	12000	11000	1800	1700	1500
2.	*E. coli* (/100 ml)	2300	1800	768	258	135

Table 3: Total Microorganism Counts in Water Samples Taken During the Rainy Season (July 2022 to October, 2022)

S. N.	Microorganism Test	SITE-1	SITE-2	SITE-3	SITE-4	SITE-5
1.	Total *Coliform* (/100 ml)	15000	14000	3500	2800	2200
2.	*E. coli* (/100 ml)	2800	2400	798	297	138

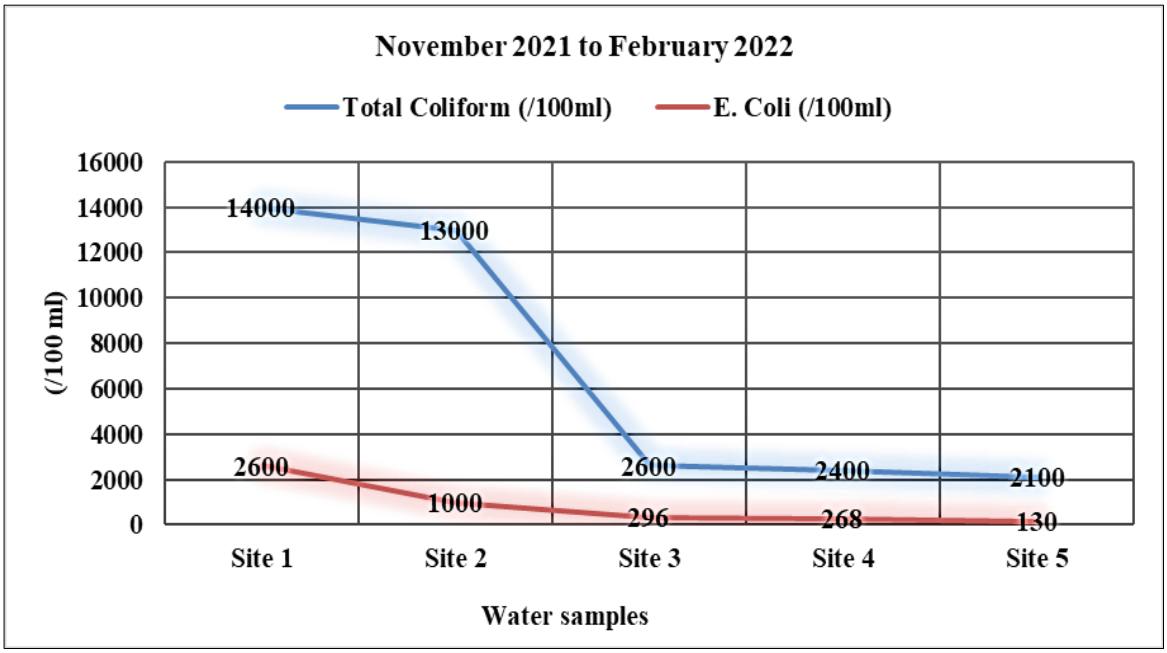

Fig 1: Total number of Coliform and *E. coli* in 100 ml collected water (Nov-2021 to Feb 2022)

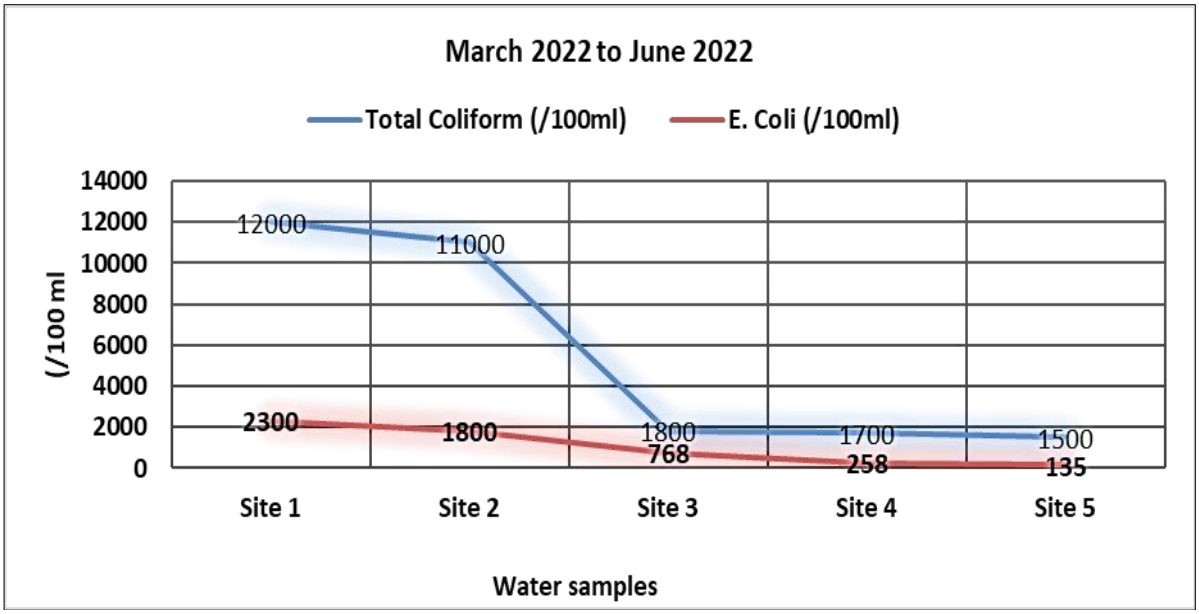

Fig 2: Total number of Coliform and *E. coli* in 100 ml collected water (March-2022 to June-2022)

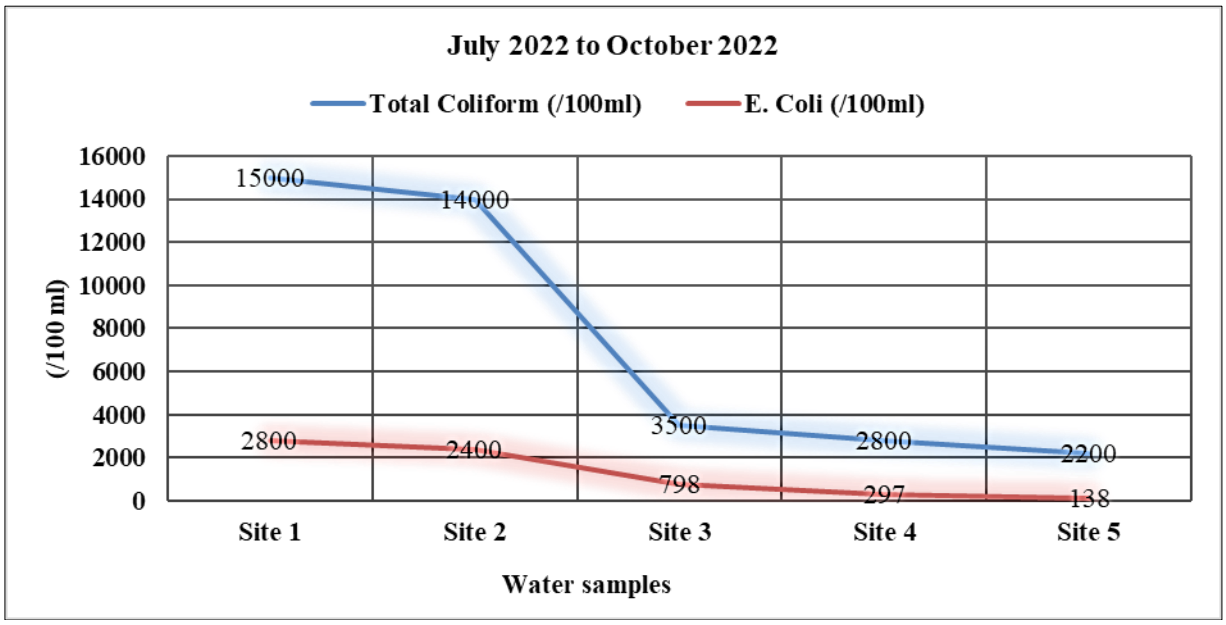

Fig 3: Total number of Coliform and *E. coli* in 100 ml collected water From July-2022 to October-2022)

Conclusion

Following a first year of analyzing various seasons from November 2021 to October 2022, it was discovered that S1 had the greatest levels of *E. coli* and *Total Coliform* in each of the three season's winter, summer, and rainy.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this document.

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