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Evaluation of Water Quality of the Surface Water Bodies in Gorakhpur City

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ABSTRACT

Growing population, intensive agriculture, climate change, water pollution and depleting natural water resources are the main factors of water scarcity in India. More than 80 percent of sewage water generated by human activities is discharged into rivers and oceans without any control, resulting in environmental pollution and greatly affecting human health. Eighty percent of diseases and 50 percent of child deaths worldwide are related to polluted water. Water plays an important role for living beings and humans. Therefore, regular water quality monitoring is considered a top priority for all countries in the world. Water quality monitoring not only helps countries assess and predict pollution, but also provides information for planning the sustainable use of water resources. Rivers are an important component of both urban and rural aquatic ecosystems, and rapidly increasing pollution in rivers seriously threatens the safety of these ecosystems. The degradation of surface water quality due to increasing pollution and climate change has become a serious concern worldwide. Such degradation threatens the use of water resources, especially drinking water supplies, and economic development.

Key words : *Surface water quality, Water pollution, Gorakhpur*

Introduction

The problem of water pollution is a global problem, which affects human health and living beings through natural and human processes. At present, the toxic pollutants generated by human activities pollute potable water, under which urban water sewage, agricultural, industrial, waste and pollutants generated by human activities are very harmful for environmental degradation. Population growth and economic development have steadily increased since the 1990s, leading to a decline in surface water quality in Asia, Africa and Latin America (UNEP, 2016).

The World Water Development Report 2021 on "Valuing Water" looks at the current status and bitter sweet approach to valuing water across different sectors and approaches and identifies ways in which to help attain sustainability. Most of the other state capitals remained in the same condition. India's population is second only to China and the second most populous country in South Asia, and it also represents 1/25 of the world's available water resources (UNEP, 2008). Industrial growth, Soil erosion, animal waste, and the use of pesticides on water quality are causing severe water pollution (Raibahadur, 1999). As summer approaches in India, water becomes as precious a commodity as gold. The country has 18 percent of the world's population, but only 4 percent of its water resources, Sewage and water discharge from industrial establishments are the main sources of water pollution in the metropolitan area (Carpenter, 1998). Various scholars have worked under water quality Samant

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Rai (2009), Kumar and Daya (2009), Rajak (2009), Parmar and Parmar (2010), Chauhan (2012), Kumar (2021) etc. Some have analyzed the water quality index.

Study Area: Gorakhpur metropolis is a rapidly emerging city in the Purvanchal of Uttar Pradesh, which is situated on the banks of the confluence of the Rapti and Rohini rivers. The population of this city was 64148 in 1901 at the beginning of the twentieth century, which increased to 673446 in 2011. Thus, the expansion of Gorakhpur metropolis is located at 26041' to 26050' north latitude and 83020' to 83027' east longitude. According to the 2011 census, the total population is 673446 population density 4588 per square kilometer, sex ratio 903, total literacy 83.9 percent, in which male literacy is 88.1 percent and female literacy is 78.7 percent. Along with the regional expansion of the city, the number of wards increased, the number of wards in 1961 was 15,17 in 1981,30 in 1991,35 in 1994,60 in 1995. Presently there are 70 wards in this city but according to Gorakhpur Master Plan 2022. There is a proposal to have 80 wards.

Objective

- Quantitative information on physical, chemical and biological characteristics of water has been obtained through statistical methods.
- There is a positive relationship between surface water quality index and population growth.

Materials and Methods

Sample location

Selection of surface water of Gorakhpur metropolis, under which a sample of 16 selected ponds of zone and ward was collected, in which Ramgarh Tal is the main area of the metropolis, selection of its 2 places is 1, Padleganjat the north of Ramgarh Tal 2, Sahara State, at south of Ramgarh Tal. Selection of 5 ponds in 5 wards under Zone 01 e.g.

Water Quality Parameter: 9 parameters e.g. temperature, pH, biochemical oxygen demand (BOD), Hardness, Chloride, Alkalinity, Dissolved Oxygen (DO) were selected to assess the water quality of Pond water in Gorakhpur metropolis. The minimum pH value of selected site is 6.2 (Raiganj) and maximum pH value is 8.9 (Jharkhandi) while the average is 7.4 in pre-monsoon condition. Biochemical oxygen demand is identified minimum in Raiganj (4.9 mg/l) and maximum value found in Jharkhandi (7.5 mg/l). The average value recorded is 6 mg/l during pre-monsoon. Post-monsoon minimum BOD is found in Raiganj (4.7 mg/l) whereas maximum values is found at Jharkhandi (7.3 mg/l) with an average of 5.9 mg/l. The difference of BOD from pre-monsoon to post-monsoon is 0.1 mg/l. BOD's level as recommended by WHO.

Dissolved oxygen of different ponds of the metropolis is 7.3 mg/l (Jharkhandi) while the maximum value is 9.8 mg/l (Raiganj) during pre-monsoon; the average is 8.7 mg/l. During post monsoon, the minimum value is 7.6 mg/l (Engineering College) and maximum value is found 9.8 mg/l Raiganj with an average value of 8.6 mg/l.

Conductivity of selected station, i.e. Raiganj is 468.1µmohos/cm which is minimum during this period and maximum value is 542.9µ mohos/cmat Jharkhandi with an average 507.9 µmohos/cm during pre-monsoon period. Distribution of conductivity is found minimum at Manvela pond (466.7 µmohos/cm) and maximum at Jharkhandi Mahadev 545. µmohos/cm with an average 501.3 µmohos/cm during post monsoon season. Distribution of hardness found minimum at Raiganj (394.6 mg/l) maximum value at Jharkhandi (612.2 mg/l) with an average value of 499.3 mg/l. The minimum post-monsoon hardness value is 384.6 mg/l and the maximum value is 605.2 mg/l while the average hardness value is 452.7 mg/l.

Concentration of calcium was found below the WHO standard (50 mg/l) with an average of 48.2 mg/l and 47.5 mg/l during pre and post monsoon respectively. Whereas in case of magnesium the similar condition is found as the concentration of magnesium is also found below the standard (50 mg/l) of WHO. The level of alkalinity found above the permissible limit of WHO during both pre and post monsoon season. Spatial distribution shows that concentration of Alkalinity was found maximum at Jharkhandi (227.4 mg/l) whereas minimum was found at Raiganj (110.2 mg/l) with an average of 167.8 mg/l during pre-monsoon season, but during post monsoon season average concentration level of alkalinity reduces up to 166.4 mg/l.

The increase in TDS is caused by enhanced seepage and runoff of rain water. Spatial distribution shows that Raiganj has minimum concentration of TDS during both the season i.g. 582.4 mg/l during pre-monsoon and 588 mg/l during post monsoon, whereas it is found that Jharkhandi tal has highest

concentration of TDS, which is recorded 699.2 mg/l during pre-monsoon and 701.3 during post monsoon with an average of 700.2 mg/l. The concentration of DO, conductivity and TDS of selected water bodies is more than WHO standard of 5mg/l,300 mg/l,500 mg/l respectively during pre-monsoon and post-monsoon. The concentration of Calcium, Magnesium Chloride and Alkalinity during pre-monsoon is less than WHO standard, but the Level of total hardnessis above the WHO standard at Ramgarh Tal, Rustampur, Jharna Tola, Nakha, Mahesra Tal, Moti Pokharadue to high population density and water is polluted by domestic sewage.

The water quality index represents the quality of water in the form of a specific number. The integrated status of numerous water quality parameters that are appropriate to specific use is reflected in water quality index (WQI) and it is a single value which indicate to the water quality(Sisodia and Moundiotiya, 2006).

The water quality weighted arithmetic index method (Chauhan and Thakur, 2012) has been used for calculation of WQI in the present study.

$$\text{Quality rating (Qi)} = 100\left[\frac{Vn-Vi}{Sn-Vi}\right] \quad .. (1)$$

Vn= Sampling Parameter
Vi = Ideal value
Sn = Standard

The ideal value of surface water is pH value 7.0 and dissolved oxygen value is 14.6 mg per liter and other standards are zero.

The standard was used to find out the correlation between relative weight and the value prescribed by the World Health Organization (WHO).

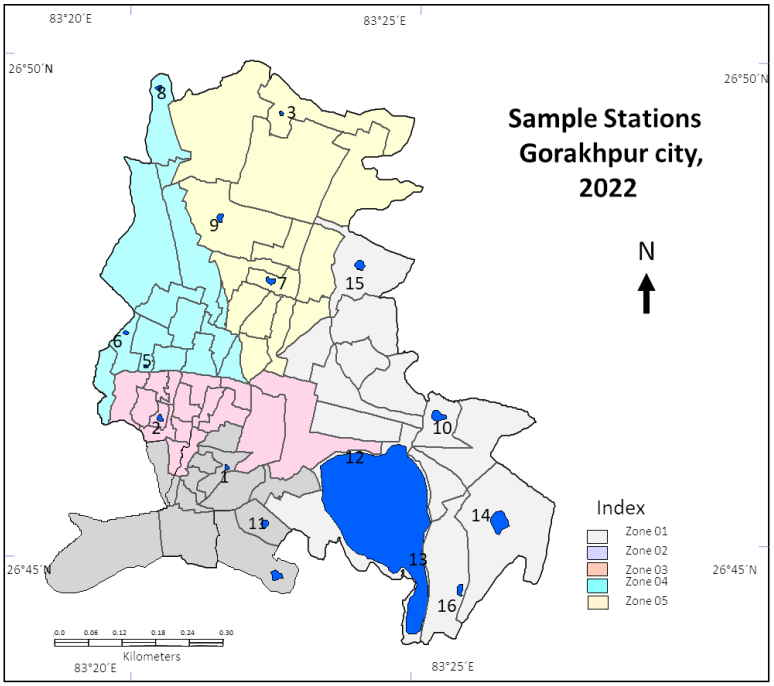
$$\text{Relative weight (Wi)} = 1/Si \quad .. (2)$$

Calculation of water quality index

$$\text{Water Quality Index (WQI)} = \Sigma W_i Q_i / \Sigma W_i \quad .. (3)$$

$$WQI = \Sigma W_i Q_i / \Sigma W_i = 20.4/0.53 = 37.71$$

The water quality index of pre-monsoon and



Sl. No.	Sample station	Sl. No.	Sample station
1	Talab Raiganj	9	Nakaha Talab
2	Muftipur Talab	10	Talab Jharna Tola
3	Manbela Talab	11	Talab Rustompur
4	Tal.Mahueesudharpu	12	Ramgarh Tal 01
5	SurajkundDham Tal	13	Ranghr Tal 02
6	Green City Talab	14	Tal. Engineering Co
7	Moti Pokhara	15	Tal.Jangal Salikram
8	Mahesara Talab	16	Tal Jharkhandi

Fig. 1. Evaluation of Water Quality of the Surface Water Bodies in Gorakhpur City.

post-monsoon standards are classified into different categories of good (less than 45), moderate (45-65), poor (65-85), severe (more than 85).

During Pre-monsoon water quality index is found good (less than 45WQI) which includes Raiganj Talab (37.71 WQI), Muptipur Talab (41.81WQI) and post monsoon Raiganj Talab (20.68WQI), Motipur Talab (28.68) due to low population density. Moderate water quality index (45-65) is pre-monsoon Muhsurdpur (53.32WQI), Surajkund Dham (59.69 WQI), Green City (46.20 WQI) Mahesra Taal (60.98WQI), Moti Pokhara (60.98WQI), Manbela Talab (48.69WQI) while during post-monsoon Water quality index of Moti Pokhara is moderate. Ramgarh Taal (S1: 81.44WQI, S2:81.60WQI) Engineering College (83.96WQI), Jharna Tola (71.93WQI), Rustampur (66.62WQI), Nakaha Talab (68.89WQI) during pre-monsoon caught having Poor water quality index (65-85WQI) while during post-monsoon Ramgarh Tal (S1:79.66WQI & S2: 80.15WQI), Engineering College (81.56WQI), Jharna Tola (67.58WQI), Rustampur (74.58WQI) are also within poor category of water quality. The water quality index is severe (more than 85 WQI) during Pre-monsoon at Shaligram (95.75WQI) and Jharkhandi Talab (103.11WQI) due to high population density, which has a great impact on water quality. While Jharkhandi Tal (97.28WQI), Jungle Shaligram (89.46WQI) water quality index is serious in post-monsoon.

Raiganj water area is the best in Gorakhpur metropolitan area during both pre-monsoon and post-monsoon period, in which there has been a huge decrease of 45.16 percent WQI because of fresh water dilution during monsoonal rain. The water quality index moderately decreases during pre-monsoon to post-monsoon period at Muhsurdpur (10.52 percent), Muftipur (31.40 percent), Suraj Kund Dham (16.18 percent), Mahesra Tal (28.09 percent), Moti Pokhara (1.75 percent) and Manvela (3.19 percent). There is a slightly decreases in water quality index from pre-monsoon to post-monsoon at Ramgarh Tal S1 (2.18 percent), Ramgarh Tal S2 (1.77 percent), Engineering College (2.85 percent), Jharna Tola (6 percent) while Rustampur water area increased by 11.94 percent. Mahadev Jharkhandi

Table 1. Water Quality during Pre & Post Monsoon, Gorakhpur city, 2022-23

S. No.	Pond/name of surface water bodies	pH		BOD (mg/l)		DO (mg/l)		Cond.µ mohos/cm		T. Hard. (mg/l)		Calcium (mg/l)		Magnesium (mg/l)		Chloride (mg/l)		Alkali. (mg/l)		T.D.S	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	Raiganj	6.2	5.1	4.9	4.7	9.8	9.7	468	455	394	384	39.3	34.2	21.5	21.5	31.5	28.4	112	110	588	582
2	Muftipur	6.4	5.5	5	4.9	9.7	9.5	472	448	398	389	40.5	37.5	22.5	22.5	35.7	32.5	119	117	690	685
3	Manbela	6.7	6.7	5.1	5.1	9.7	9.7	475	466	402	392	42.7	39.4	28.6	28.6	41.8	39.1	128	127	614	610
4	Mahueesudharpu	6.9	5.9	5.3	5	9.5	9.4	460	458	409	395	45.8	45.8	24.7	23.1	43.2	41.8	130	129	709	707
5	Surajkund Dham	7.1	6.5	5.5	5.3	8.9	8.5	488	478	309	403	47.6	47.6	24.9	24.9	48.6	47.5	138	137	635	633
6	Green City	7.1	6.9	5.7	5.5	9.1	9	492	484	420	407	49.3	49.3	24	23.4	51.2	49.4	145	145	646	645
7	Moti Pokhara	7.2	7.2	5.9	5.8	9.1	9.2	498	492	524	422	38.2	38.2	25.4	23.9	56.7	54.6	135	134	650	648
8	Mahesara	7.3	6.1	6	5.9	9	8.9	510	502	530	425	50.1	50.1	25.9	24.4	66.2	65.1	164	163	655	653
9	Nakaha	7.5	7.1	6.2	6	8.8	8.7	512	511	546	435	51.3	51.3	26.4	25	69.4	68.5	170	169	659	657
10	Jharna Tola	7.6	7.3	6.3	6.2	8.6	8.4	525	520	554	455	52.6	52.6	27.8	26.4	72.8	71.3	188	186	662	661
11	Rustompur	7.8	7.6	6.6	6.6	8.5	8.3	532	523	560	445	52.8	52.8	28.1	27.3	77.6	76.2	192	192	665	664
12	Ramgarh Tal S1	8	7.9	6.8	6.5	8.3	8	521	521	565	458	51.3	51.3	25.6	27.9	81.7	79.9	198	196	655	655
13	Ramgarh Tal S2	7.9	7.8	6.9	6.7	8.1	7.8	540	535	455	454	53.7	53.7	29.2	28.1	72.4	78.1	206	202	674	657
14	Engineering Co	8.2	8	6.5	6.4	7.9	7.6	541	538	598	571	42.3	42.3	21.6	20.7	88.5	86.1	215	213	680	678
15	Jangal Salikram	8.7	8.3	7.3	7.1	8.1	7.9	542	540	605	595	55.6	55.6	29.4	28.1	92.4	90.4	210	209	688	686
16	Jharkhandi	8.9	8.5	7.5	7.3	7.3	7.8	542	545	612	605	59.3	59.3	30.2	29.2	95.3	94.1	228	227	701	699
	WHO Standard	8.5	8.5	6	6	5	5	300	300	500	500	75	75	50	50	250	250	200	200	500	500

Source: Personal survey and analysis, 2022-23.

has decreased by 5.65 percent and Jungle Shaligram by 6.53 percent in pre-monsoon to post-monsoon conditions in serious water quality index.

Conclusion

The study of different ponds of Gorakhpur metropolis shows that the population density and water quality index have a positive relationship. The water quality index of Raiganj pond in Raiganj ward of the city is 37.71 WQI before monsoon and after monsoon is reduced up to 20.68 WQI, it is due to minimum population density. Gorakhpur metropolis is an emerging metropolis in eastern Uttar Pradesh, Under which education (Deendayal Upadhyaya Gorakhpur University, Madan Mohan Malviya University of Technology, Guru Gorakshanath University, Ayush University, Gorakhpur Women's University), Health (Baba Raghav Das Medical College, All India Institute of Medical Sciences, Hanuman Prasad Cancer Hospital, and District Hospital) and Population immigration is taking place due to availability of facilities. Due to which there is excessive population problem which causes high environmental pollution, as well as the problem of water pollution increases rapidly and the water quality index is affected. It is clear that rapid population growth in the metropolis has a positive relationship with environmental problems.

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Conflict of Interest: None

References

CPCB, 2009. Status of Water Quality in India- 2009. Delhi, Pp. 14-15.

Carpenter, S., Caraco, N.F., Correll, D.L., Howarth, R.W., Sharpley, A.N. and Smith, V.H. 1998. Nonpoint Pollution of Surface Waters with Phosphorus and Nitrogen. Issues in Ecology, Ecological Society of America, Massachusetts Avenue, available at http://esa.sdsc.edu/, accessed on 13- 08-2022.

Chauhan, N.B. and Thakor, F.J. 2012. A Study of Water Quality Index (WQI) of Heranj Lake, Dist. Kheda Gujarat. *Asian J. Exp. Biol. Sci., Society of Applied Science*. 3(3): 582-588.

Chauhan, N. B. and Thakor, F.J. 2012. A Study of Water Quality Index (WQI) of Heranj Lake, Dist. Kheda Gujarat. *Asian J. Exp. Biol. Sci., Society of Applied Science*. 3(3): 582-588.

Kumar, A. and Dua, A. 2009. Water quality index for assessment of water Quality of river ravi at madhopur (India). *Global Journal of Environmental Sciences.* 8(1): 49-57.

Kumar, J., Biswas, B. and Verghese, S. 2021. Assessment of Groundwater Quality for Drinking and Irrigation Purpose using Geospatial and Statistical techniques in a Semi-arid Region of Rajasthan, India. *J Geol Soc India*. 97: 416-427. Available at https://doi.org/10.1007/s12594-021-1699-x [assessed on 05/2022].

Parmar, K. and Parmar, V. 2010. Evaluation of water quality index for drinking purposes of river Subernarekha in Singhbhum District. *International Journal of Environmental Sciences*. 1(1): 77-81.

Ribaudo, M.O., Horan, R.D. and Smith, M.E. 1999. Economics of Water Quality Protection from Non-point Sources. Economics of Water Quality Protection, USDA/Economic Research Service, Washington, p. 1.

Razak, A., Asiedu, A.B., Entsua-Mensah, R.E.M. and deGraft-Johnson, K.A.A. 2009. Assessment of the Water Quality of the Oti River in Ghana, West. *African Journal of Applied Ecology*. 15.

Sisodia, R. and Moundiotya, C. 2006. Assessment of the water quality index of Wetland Kalakho lake, Rajasthan, India. *Journal of Environmental Hydrology*. 14: 1-23.

Samantray, P., Mishra, B.K., Panda, C.R. and Rout, S.P. 2009. Assessment of Water Quality Index in Mahanadi and Atharabanki Rivers and Taldanda Canal in Paradip Area. *India. J Hum Ecol*. 26(3): 153-161.

UNEP, 2016. A Snapshot of the World's Water Quality: Towards a global assessment, Nairobi, Kenya. Available at uneplive.unep.org/media/ docs/ assessments/ unep_wwqa_report_ web.pdf, assessed on 05/2022.

United Nations Environment Programme, 2008. *Water Quality for Ecosystem and Human Health* (2nd ed.). (2019)