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RESEARCH ARTICLE

Status Assessment of Physicochemical Parameters in Gomti River Water Quality at Lucknow City Area, Uttar Pradesh, India

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ABSTRACT

The present research focused on river drinking water status and quality at Lucknow city area, Uttar Pradesh, India. The complex array of potential point and nonpoint sources were divided into three major source areas representing liquid manure, dry manure and domestic waste in feedstuff storage areas to river. Assessing the physicochemical characteristics trend and quantifies the impact from sources. Total 5 (upstream, midstream and downstream) samples were collected from up to downstream of Gomti river about 15 km during pre and post monsoon at 2014, 2015 and 2016. The values of pH, TSS, TDS and turbidity were higher in the post monsoon compared to pre-monsoon and other find out values for hardness, alkalinity were higher in pre monsoon. The status of river water quality were gradually increasing year by year because big difference in between 2014 to 2016 values. Results indicated that uncontrolled sewage and waste mismanagement causes a big problem because river water in Lucknow city is a primary source for drinking and irrigation water around it. Due to lack of proper treatment of Gomti River, River water is not suitable.

Keywords- River water, season variation, physicochemical, health risk and Lucknow city.

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INTRODUCTION

Sampling area is located in north east of Lucknow city having geological information 26.8467° N, 80.9462° E. About 26 sewage outlets (Nalla) are merged and large amounts of liquid, solid manure and domestic wastes are generated and drained without appropriate treatment in river. In this study, surface water had already contaminated through some anthropogenic activity such as sewage, solid waste and poultry dairy. River surface water is the basic need of every person in daily life. Unfortunately due to injudicious and unplanned urbanization and industrialization for the past decades in few parts of the country, the resource is either being depleted or degraded in quality (Murhekar, 2011; Parihar, 2012; Haribhau, 2012; Manimaran, 2012; Antony, 2012). About 80% of the diseases of the world population and more than one third of the deaths in the developing countries are due to contamination of water (WHO and UNCED, 1992). Anthropogenic processes, which can alter or modify the natural system of hydrological cycle (Shukla et al., 2015).

Industrial discharges, urban activities, agriculture, ground water pumpage and disposal of waste all can affect ground water quality. Contaminants can be human induced, as from leaking fuel tanks or toxic chemical spills. Pesticides and fertilizers applied to lawns and crops can accumulate and migrate to the water table. Soil can eventually end up in water drawn from a well or, a well might have been placed in land that was once used for something like a garbage or chemical dump site (Tiwari et al., 2015a).

High concentrations of dissolved solids shorten the life of hot heaters because domestcally river water is used in domestic purposes. Iron imparts a bitter astringent taste to water and a brownish color and nitrate (as nitrogen) occurs naturally in mineral deposits, soils, seawater, freshwater systems, the atmosphere and biota. More stable form of combined nitrogen in oxygenated water. Found in the highest levels in groundwater under extensively developed areas, which enters the environment from fertilizer, feedlots and sewage. Under surface water can get contaminated from industrial, dairy wastes, domestic and agricultural chemicals from the surface. Naturally occurring contaminants are present in the rocks and sediments. In sampling areas, surface water affected in many different types. Manage and prevention of surface water quality degradability in modern life and awareness to village's peoples.

Factors that affect metal mobility include pH, dissolved oxygen (DO), oxidation-reduction potential (ORP), specific conductivity, temperature, and soil conditions (McLean et al., 1992). High content of chromium may be due to various anthropogenic activities, industrial effluents, tanneries, old plumbing and household sewages (Warmate, 2011). Higher amount encountered particularly at few stations show that they are having high domestic sewage (Jameel, 2006). This study in important on the basis of human being because drinking water is a basic need of every life so government and NGO also take a solid action against this problems.

The main objective of this work is (i) Physicochemical characteristics of river water from 2014-16, (ii) Seasonal changes on pre and post-monsoon during same duration and (iii) Trends of river water characteristics.

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MATERIALS AND METHODS

Study area

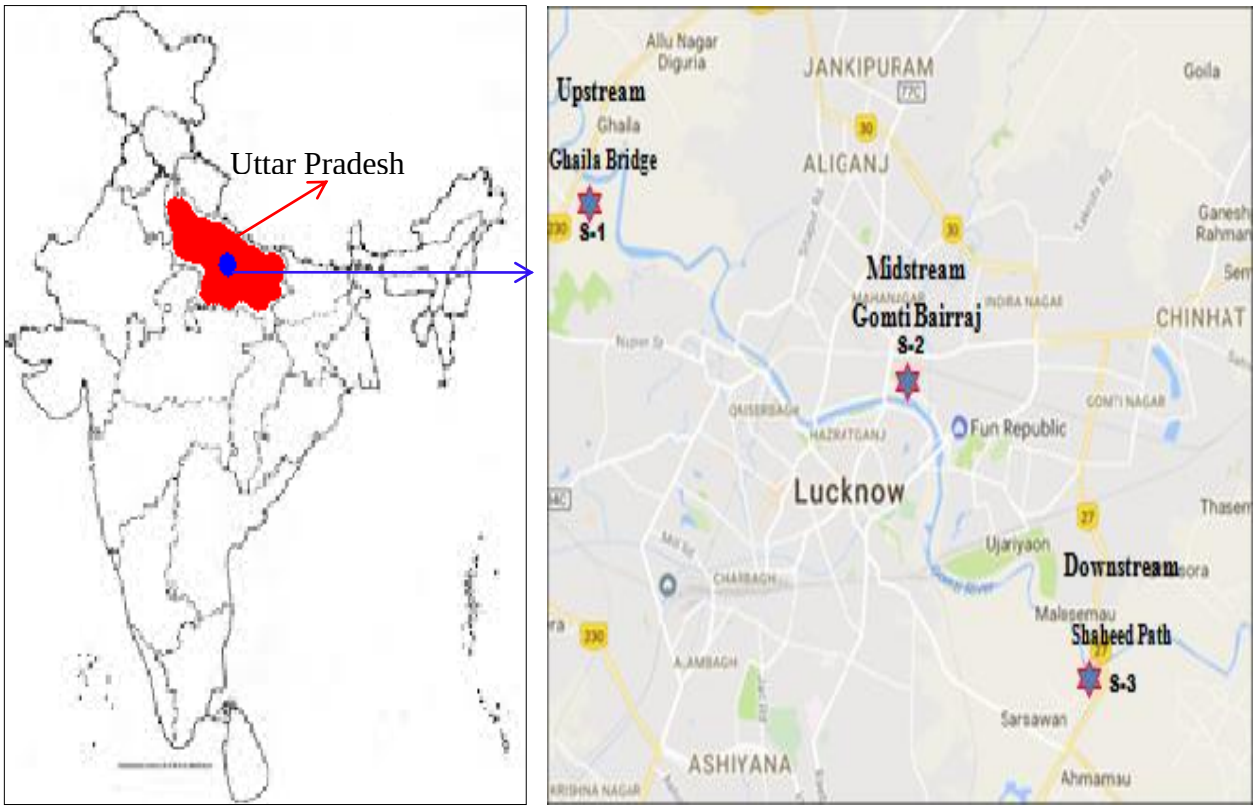

Fig-1: Map of the study area and showing the locations in Gomti River Lucknow

Samples were collected and analyzed from 5 locations (1 up, 3 mid and 1 downstream) of Gomti river stream, at Lucknow city about 15 km distance from up to down. The altitude and latitude is between (26.8467° N, 80.9462° E) of selected location. The Lucknow district forms a part of Central Ganga Plains and Lucknow city forms a part of Sai Gomti sub basin. General elevation of the city varies between 103 and 130 m above mean sea level showing southeasterly slope. In the Lucknow city average rainfall during mansoon season was 896.2 millimetres (35.28 in). Triplicate samples are collected in 5 L tarson sampling bottles and carried out in laboratory in ice box at about 4°C having preserved with HNO_3. Samples were collected in pre monsoon and post monsoon during 2014-16 continuous.

Analysis in laboratories and used methods

After sample collection and under preservation, the samples are analyzed in laboratory according to APHA/ AWWA-2012 (22nd Edition). Ion-selective electrode is used for pH and conductivity, turbidity by turbidity meter, argentometric titration method for the chloride; sulphuric acid titration method for total alkalinity; EDTA titration for total hardness, turbiditimetric method for sulfate; gravimetric method for TDS & TSS, DO for iodide titration method, open reflection digestion method for COD and 5 day dilution incubation method for BOD_5.

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Quality assurance procedure

Special precautions were taken during sampling and analysis of physico-chemical parameters. Before collecting the samples, the polythene containers are dipped overnight in 2% HCl and washed with double distilled water. All samples were analyzed triplicate form in laboratory.

RESULTS AND DISCUSSION

In Gomti river at Lucknow city 5 locations (1 up, 3 middle and 1 downstream) sample collected from two season (pre and post-monsoon) from 2014 to 2017 continuous and represented the average values with standard deviation of each location.

pH

Throughout the working period, pH has been analyzed and found average value for pre-monsoon and post-monsoon 2014, 2015, 2016. The values were 7.77-8.13, 7.77-8.00 and 7.87-8.33 for pre-monsoon, 7.50-7.80, 7.57-7.77 and 7.70-8.13 for post-monsoon. The average values were found of pH for 2014, 2015 and 2016 respectively shown in Table-1, 2 & 3. The range of pH was as per CPCB 6.5-8.5. The maximum value of pH found in post-monsoon than pre monsoon due to extra washing or drainage wastage mixed in monsoon season and values were increasing through 2014-17. But IS: 10500, 2012 as well as WHO, 1992 have guideline prescribed for pH 6.5-8.5.

Turbidity

Throughout the working period, turbidity has been analyzed by using turbidity meter and found average value for pre-monsoon and post-monsoon 2014, 2015, 2016. The values were range 11.67-23.00, 18.33-26.00 and 17.67-25.00 mg/L pre-monsoon and 14.67-25.00, 18.33-28.00 and 19.67-31.00 mg/L post-monsoon. The average values in all location in 2014, 2015 and 2016 for turbidity shown in Table-1. The status of river contamination year by year increases the value of turbidity because day by day increasing the garbage and liquid wastage. The maximum acceptable limit of turbidity was as per central pollution control board (CPCB), India 1.0 mg/L. The maximum value of turbidity found in post-monsoon than pre monsoon due to extra washing or drainage wastage mixed in monsoon season and values were increasing through 2014-17. But IS: 10500 as well as WHO have no guideline prescribed for turbidity.

Conductivity

Throughout the working period, conductivity has been analyzed by using conductivity meter and found average value for pre-monsoon and post-monsoon 2014, 2015, 2016. The values were 504.67-720.00, 510.67-793.33 and 418.33-705.67 uS/cm pre-monsoon and 499.00-692.67, 524.33-703.67 and 510.67-762.00 uS/cm post-monsoon. The maximum acceptable limit of conductivity was as per CPCB not described. The maximum value of conductivity found in post-monsoon than pre monsoon due to extra washing or drainage wastage mixed in monsoon season and values were increasing through 2014-17. But IS: 10500 have no guideline prescribed for conductivity while WHO prescribed the standard 400 uS/cm.

Total Suspended Solid (TSS)

Throughout the working period, TSS has been analyzed and found average value for pre-monsoon and post-monsoon 2014, 2015, 2016. The values were 6.40-14.73, 5.67-8.83 and 6.17-41.20 mg/L for pre-monsoon and 8.20-43.30, 8.50-10.83 and 9.33-15.83 mg/L

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for post-monsoon. The average values were found of TSS for 2014, 2015 and 2016 respectively. The maximum acceptable limit of TSS was as per CPCB not prescribed. The maximum value of TSS found in post-monsoon than pre monsoon due to extra washing or drainage wastage mixed in monsoon season and values were increasing through 2014-17. But IS: 10500 as well as WHO have no guideline prescribed for TSS.

Total Dissolved Solid (TDS)

Throughout the working period, TDS has been analyzed and found average value for pre-monsoon and post-monsoon 2014, 2015, 2016. The values were 411.00-601.33, 414.33-612.33 and 357.67-680.00 mg/L for pre-monsoon, 421.67-669.33, 424.33-594.33 and 462.33-682.67 mg/L for post-monsoon. The average values were found of TDS for 2014, 2015 and 2016 shows in Table-1, 2 & 3. The maximum acceptable limit of TDS was as per CPCB 500 mg/L. The maximum value of TDS found in post-monsoon than pre monsoon due to extra washing or drainage wastage mixed in monsoon season and values were increasing through 2014-17. But IS: 10500 as well as WHO have guideline prescribed for TDS 500 mg/L.

Total Alkalinity

Throughout the working period, alkalinity has been analyzed and found average value for pre-monsoon and post-monsoon 2014, 2015, 2016. The values were 172.67-225.00, 248.67-322.00 and 269.00-303.67 mg/L for pre-monsoon, 176.00-241.00, 271.00-331.67 and 227.00-333.67 mg/L for post-monsoon. The average values were found of total alkalinity for 2014, 2015 and 2016 respectively Table-1, 2 & 3. The maximum acceptable limit of alkalinity was as per CPCB not prescribed. The maximum value of alkalinity found in post-monsoon than pre monsoon due to extra washing or drainage wastage mixed in monsoon season and values were increasing through 2014-17. But IS: 10500 as well as WHO have guideline prescribed for alkalinity 200 mg/L.

Chloride

Throughout the working period, chloride has been analyzed and found average value for pre-monsoon and post-monsoon 2014, 2015, 2016. The values were 16.23-83.23, 15.14-36.67 and 14.70-32.97 mg/L for pre-monsoon, 12.83-20.23, 12.77-23.43 and 12.47-28.97 mg/L for post-monsoon. The average values were found of chloride for 2014, 2015 and 2016 respectively shown in Table-1, 2 & 3. The maximum acceptable limit of chloride was as per CPCB not prescribed. The maximum value of chloride found in pre-monsoon than post- monsoon due to storage of wastage mixed in summer season and values were increasing through 2014-17. But IS: 10500 as well as WHO have guideline prescribed for chloride 250 mg/L.

Total Hardness

Throughout the working period, total hardness has been analyzed and found average value for pre-monsoon and post-monsoon 2014, 2015, 2016. The values were 142.67-209.67, 195.33-278.33 and 184.00-305.00 mg/L for pre-monsoon, 141.33-196.33, 170.00-283.00 and 167.67-265.00 mg/L post-monsoon. The average values were found of total hardness for 2014, 2015 and 2016 respectively indicated in Table-1, 2 & 3. The maximum acceptable limit of total hardness was 200 mg/L. The maximum value of hardness found in pre-monsoon than post-monsoon due to extra accumulation of chemical drainage wastage mixed in summer season and values were

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increasing through 2014-17. But IS: 10500 as well as WHO have guideline prescribed for total hardness 200 and 100 mg/L.

Dissolved Oxygen (DO)

Throughout the working period, dissolved oxygen has been analyzed and found average value for pre-monsoon and post-monsoon 2014, 2015, 2016. The values were 4.20-8.13, 3.87-8.50 and 3.33-8.80 mg/L for pre-monsoon, 5.00-8.40, 4.13-8.73 and 4.20-8.20 mg/L for post-monsoon. The average values were found of dissolved oxygen for 2014, 2015 and 2016 respectively shown in Table-1, 2 & 3. The maximum acceptable limit of dissolved oxygen was as per CPCB more than 6.0 mg/L. The maximum value of dissolved oxygen found in post-monsoon than pre monsoon due to extra washing or drainage wastage mixed in monsoon season and values were increasing through 2014-17. But IS: 10500 as well as WHO have no guideline prescribed for dissolved oxygen.

Biogeochemical Oxygen Demand (BOD)

Throughout the working period, biogeochemical oxygen demand has been analyzed and found average value for pre-monsoon and post-monsoon 2014, 2015, 2016. The values were 6.50-9.27, 5.17-10.83 and 9.03-16.00 mg/L for pre-monsoon, 5.10-7.73, 5.40-1.07 and 8.43-15.00 mg/L for post-monsoon. The average values were found of biogeochemical oxygen demand for 2014, 2015 and 2016 respectively shown in Table-1, 2 & 3. The maximum acceptable limit of biogeochemical oxygen demand was as per CPCB less than 3.0 mg/L. The maximum value of biogeochemical oxygen demand found in pre-monsoon than post-monsoon due to extra time for biological activity of wastage mixed in summer season and values were increasing through 2014-17. But IS: 10500 as well as WHO have no guideline prescribed for BOD.

Chemical Oxygen Demand (COD)

Throughout the working period, turbidity has been analyzed by using turbidity meter and found average value for pre-monsoon and post-monsoon 2014, 2015, 2016. The values were 19.6-54.2, 20.4-56.3 and 23.1-75.4 mg/L for pre-monsoon, 14.8-43.6, 16.2-45.1 and 20.8-67.2 mg/L for post-monsoon. The average values were found of COD for 2014, 2015 and 2016 respectively indicated in Table-1, 2 & 3 and Figure 2&3. The maximum acceptable limit of COD was 250 mg/L. The maximum value of COD found in pre-monsoon than post- monsoon due to extra accumulation or storage of wastage mixed in summer season and values were increasing through 2014-17. But IS: 10500 as well as WHO have no guideline prescribed for COD 250 mg/L.

In the above description status of pollutants in Gomi River shows the gradually increasing order in most of the parameters and identified values were higher more than the prescribed limits but some cases values were less than prescribes limit like pH. Most cases values of find in higher in 2016 than previous years (Figure 2 &3). In these values also indicated the differences between the up and downstream most of the values of parameters increasing in all season and annually also. Seasonal changes find out due to rainy season and availability of water in river. Some parameters were higher in premansoon season but some parameters were higher in postseason. Comparison described by reference body for water IS-10500 and WHO.

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Table-1: Physicochemical parameters result of Gomti River at Lucknow City during Pre and post-monsoon 2014

Locations	pH	Turbidity (NTU)	Conductivity (uS/cm)	TSS (mg/L)	TDS (mg/L)	T-Alkalinity (mg/L)	T-Hardness (mg/L)	Chloride (mg/L)	DO (mg/L)	BOD (mg/L)	COD (mg/L)
Pre-Monsoon											
1	7.8	11	570	6.4	411	182	142	16.2	8.1	6.5	19.6
	±0.01	±0.52	±72	±0.98	±63	±25	±19	±1.91	±0.95	±0.74	±2.45
2	7.7	15	712	7.7	548	209	186	25.4	4.2	9.2	48.5
	±0.02	±1.98	±102	±1.03	±85	±43	±26	±3.65	±1.31	±0.98	±8.68
3	7.9	23	590	8.3	466	193	193	83.2	5.2	7.1	42.1
	±0.03	±4.65	±95	±1.6	±96	±36	±32	±2.88	±1.33	±0.91	±7.49
4	8.1	21	720	10.0	601	225	209	23.8	4.8	8.0	49.3
	±0.02	±3.12	±123	±1.8	±103	±39	±29	±5.45	±0.86	±0.77	±8.09
5	7.9	16	504	14.7	483	172	198	19.6	4.3	8.9	54.2
	±0.01	±2.10	±89	±2.6	±91	±33	±25	±2.43	±1.36	±1.02	±9.35
Avg	7.9	17	619	9.4	502	196	186	33.6	5.3	7.9	42.7
Min	7.7	11	504	6.4	411	172	142	16.2	4.2	6.5	19.6
Max	8.1	23	720	14.7	601	225	209	83.2	8.1	9.2	54.2
Post-Monsoon											
1	7.6	14	577	8.2	421	191	141	12.8	8.4	5.1	14.8
	±0.02	±0.46	±68	±0.88	±56	±23	±15	±2.12	±0.68	±0.45	±3.65
2	7.7	22	677	43.3	528	241	169	19.7	5.3	7.4	36.5
	±0.03	±2.31	±95	±8.68	±79	±40	±21	±3.45	±0.98	±0.87	±5.59
3	7.8	22	523	10.1	495	215	196	20.2	5.7	6.1	32.5
	±0.04	±3.45	±98	±1.65	±89	±46	±30	±4.46	±1.02	±0.92	±4.78
4	7.5	25	692	11.2	572	209	195	17.9	5.2	7.3	41.7
	±0.04	±4.49	±103	±2.46	±95	±48	±29	±3.98	±1.09	±0.79	±6.69
5	7.7	20	499	11.0	669	176	159	14.5	5.0	7.7	43.6
	±0.02	±2.65	±91	±1.09	±102	±38	±30	±4.25	±1.01	±0.65	±8.19
Avg	7.6	20	593	16	537	206	172	17.1	5.9	6.7	33.8
Min	7.5	14	499	8	421	176	141	12.8	5.0	5.1	14.8
Max	7.8	25	692	43	669	241	196	20.2	8.4	7.7	43.6

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Table-2: Physicochemical parameters result of Gomti River at Lucknow City during Pre and post-monsoon 2015

Locations	pH	Turbidity (NTU)	Conductivity (uS/cm)	TSS (mg/L)	TDS (mg/L)	A-Alkalinity (mg/L)	Hardness (mg/L)	Chloride (mg/L)	DO (mg/L)	BOD (mg/L)	COD (mg/L)
Pre-Monsoon											
1	7.8	18	510	5.6	414	268	195	15.1	8.5	5.2	20.4
	±0.02	±1.02	±85	±0.96	±75	±30	±28	±2.02	±0.91	±0.95	±3.39
2	7.7	22	793	8.8	533	322	216	36.7	3.9	10.8	56.3
	±0.06	±2.33	±110	±1.23	±88	±56	±36	±5.78	±1.10	±1.03	±8.78
3	7.9	26	664	7.3	501	278	235	33.6	4.5	7.5	39.7
	±0.05	±6.95	±106	±1.09	±81	±47	±31	±4.62	±1.03	±0.92	±6.49
4	8.0	23	746	8.2	612	301	278	22.5	4.3	6.9	36.4
	±0.05	±4.78	±130	±1.86	±115	±52	±27	±3.26	±0.88	±0.86	±5.58
5	7.8	20	627	7.2	534	248	224	17.4	3.9	9.8	46.5
	±0.03	±2.77	±1016	±1.08	±109	±46	±36	±2.98	±1.03	±1.07	±7.42
Avg	7.8	22	668	7.5	519	283	229	25.1	5.0	8.1	39.9
Min	7.7	18	510	5.7	414	248	195	15.1	3.8	5.2	20.4
Max	8.0	26	793	8.8	612	322	278	36.7	8.5	10.8	56.3
Post-Monsoon											
1	7.5	18	528	8.5	424	271	170	12.7	8.7	5.4	16.2
	±0.01	±0.86	±69	±1.03	±59	±38	±27	±1.46	±0.46	±0.96	±3.33
2	7.8	28	692	10.8	544	331	195	22.3	4.2	10.1	42.8
	±0.03	±4.57	±101	±2.43	±90	±46	±33	±3.65	±0.88	±1.98	±9.98
3	7.7	25	537	9.7	494	309	249	23.4	5.1	6.8	29.3
	±0.05	±5.56	±89	±2.00	±93	±51	±36	±3.09	±1.03	±0.78	±5.78
4	7.7	24	703	10.5	594	294	283	15.4	4.5	6.7	25.8
	±0.09	±6.32	±113	±1.78	±86	±42	±34	±5.46	±0.98	±0.66	±6.69
5	7.6	23	524	9.6	482	284	194	15.6	4.3	8.3	45.1
	±0.04	±3.38	±99	±1.66	±98	±46	±29	±3.24	±0.82	±1.02	±8.84
Avg	7.6	23	597	9.8	507	298	218	17.9	5.4	7.5	31.8
Min	7.5	18	524	8.5	424	271	170	12.7	4.1	5.4	16.2
Max	7.7	28	703	10.8	594	331	283	23.4	8.7	10.1	45.1

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Table-3: Physicochemical parameters result of Gomti River at Lucknow City during Pre and post-monsoon 2016

Locations	pH	Turbidity (NTU)	Conductivity (uS/cm)	TSS (mg/L)	TDS (mg/L)	Alkalinity (mg/L)	Hardness (mg/L)	Chloride (mg/L)	DO (mg/L)	BOD (mg/L)	COD (mg/L)
Pre-Monsoon											
1	7.8	17	418	6.2	357	269	184	16.1	8.8	9.0	23.1
	±0.03	±1.32	±81	±0.96	±49	±45	±23	±3.78	±0.98	±0.92	±6.65
2	7.9	23	672	8.9	502	303	228	32.9	5.5	13.2	75.4
	±0.05	±4.49	±135	±2.33	±99	±56	±32	±5.69	±1.02	±1.05	±10.77
3	8.0	20	705	8.1	541	272	231	26.1	5.2	15.1	68.3
	±0.06	±3.23	±125	±2.08	±111	±50	±28	±3.99	±1.00	±0.99	±12.58
4	8.1	25	705	9.4	680	272	305	18.3	5.2	16.0	71.4
	±0.06	±5.96	±118	±1.79	±19	±53	±30	±3.44	±0.35	±1.32	±13.34
5	8.3	20	622	41.2	567	292	201	14.7	3.3	10.9	65.2
	±0.04	±3.08	±103	±6.35	±74	±41	±36	±4.77	±0.77	±1.09	±11.16
Avg	8.1	21	625	14.7	529	282	230	21.6	5.6	12.8	60.7
Min	7.8	17	418	6.2	357	269	184	14.7	3.3	9.0	23.1
Max	8.3	25	705	41.2	680	303	305	32.9	8.8	16.0	75.4
Post-Monsoon											
1	7.7	19	510	9.3	462	227	167	14.6	8.2	8.4	20.8
	±0.01	±1.12	±88	±0.90	±66	±42	±28	±2.29	±0.48	±0.62	±2.29
2	7.9	30	709	15.8	531	297	211	28.9	6.0	13.1	67.2
	±0.03	±6.52	±107	±3.35	±97	±46	±19	±4.75	±0.29	±0.45	±10.45
3	7.9	26	546	13.4	534	278	201	22.4	5.8	14.3	62.1
	±0.05	±6.14	±91	±2.40	±100	±39	±31	±5.53	±0.99	±0.75	±13.25
4	8.1	31	762	12.6	682	333	265	18.7	5.50	15.0	54.7
	±0.02	±5.98	±119	±1.99	±132	±53	±36	±3.21	±0.96	±0.66	±9.98
5	8.1	25	608	11.8	535	325	193	12.4	4.2	10.4	57.4
	±0.03	±3.65	±104	±2.41	±105	±29	±28	±2.45	±0.97	±0.98	±9.66
Avg	7.9	26	627	12.6	549	292	207	19.4	5.9	12.2	52.4
Min	7.7	19	510	9.3	462	227	167	12.4	4.2	8.4	20.8
Max	8.1	31	762	15.8	682	333	265	28.9	8.2	15.0	67.2

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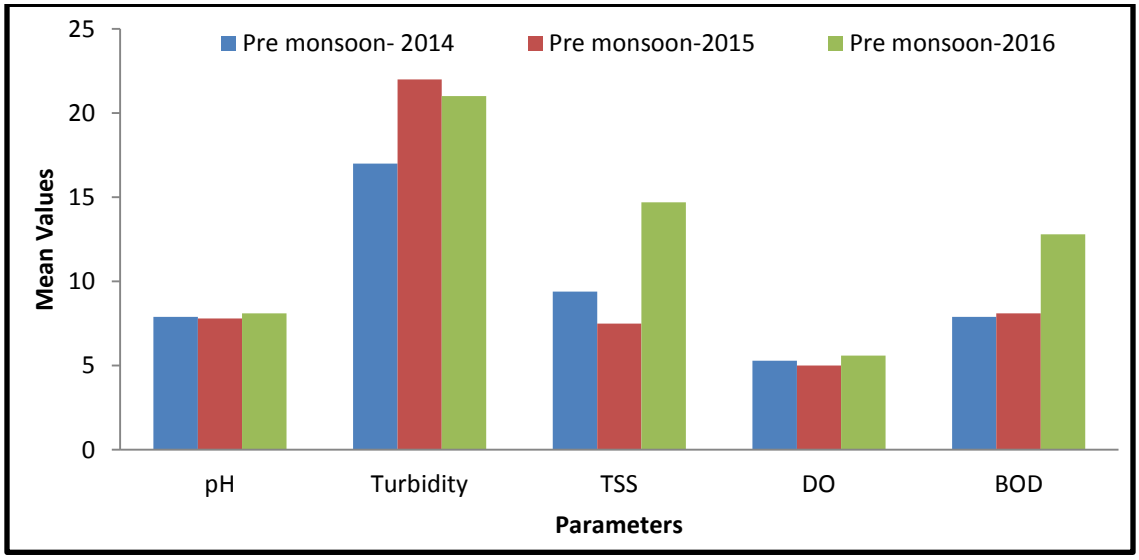
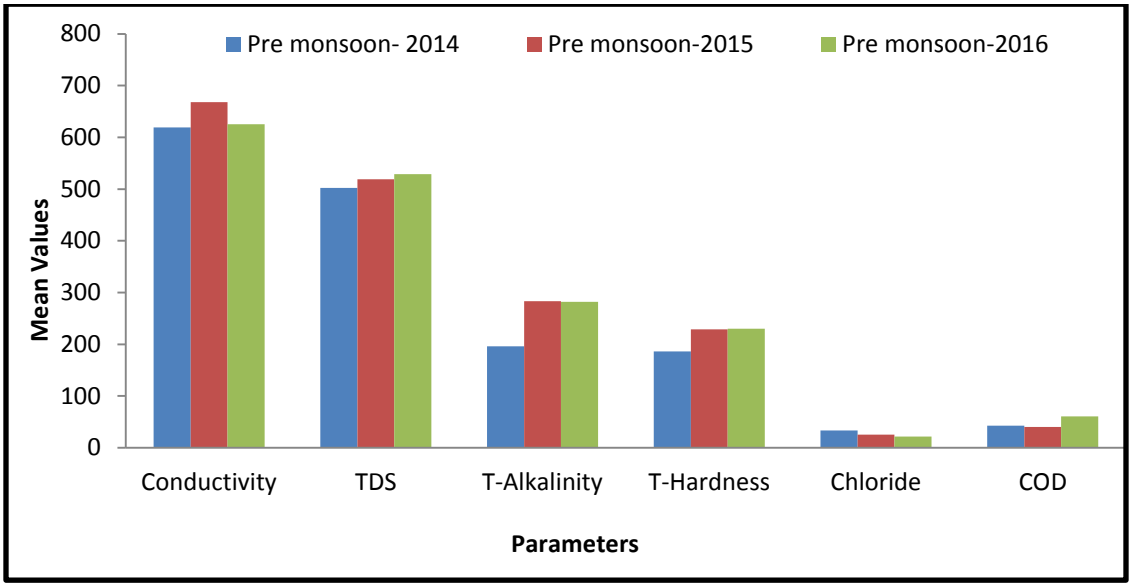


(a)



(b)

Fig-2: Average values of physicochemical parameters (a and b) in pre mansoon season 2014-16

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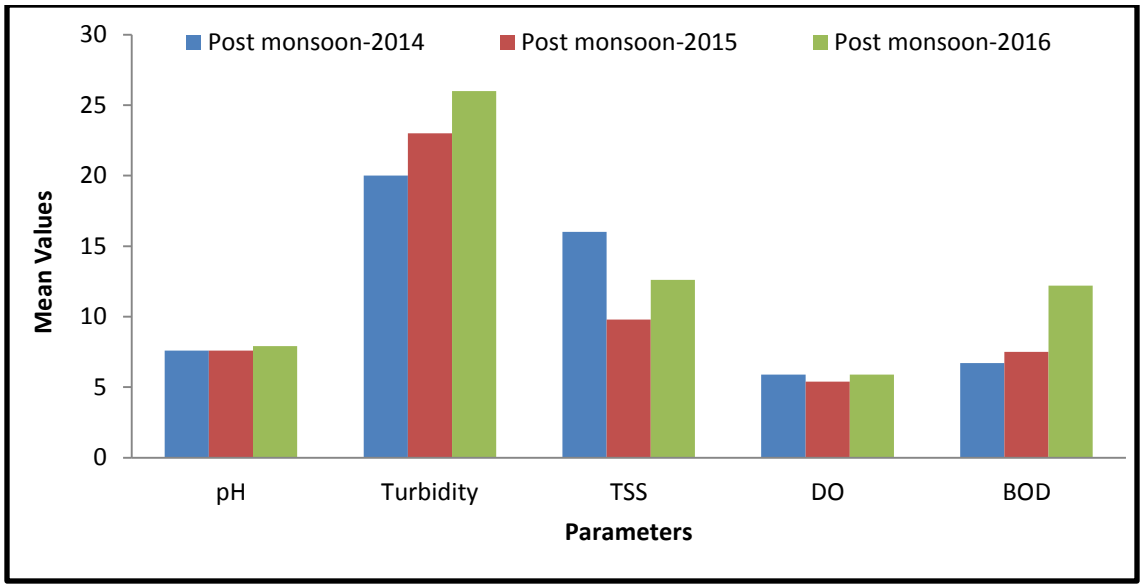
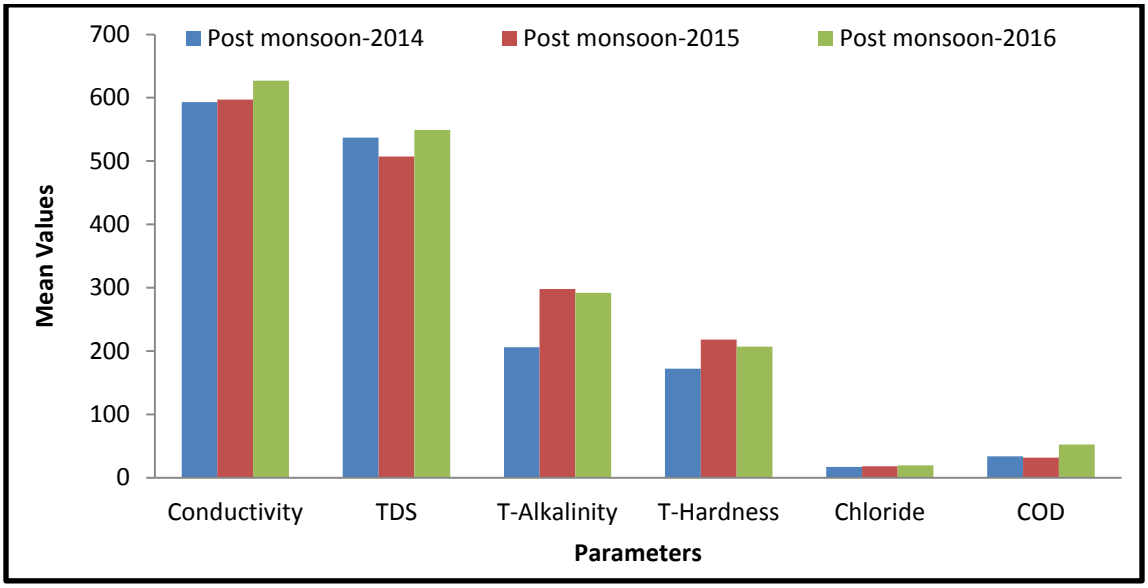


(a)



(b)

Fig-3: Average values of physicochemical parameters (a and b) in post mansoon season 2014-16

CONCLUSIONS

The Gomti river water samples were taken from busy areas, where public doing more activity. The water samples were subjected to the physico-chemical characteristics changing through year to year. The result of above work shows that the most of the concentrations are more than the permissible limit of IS: 10500 and WHO standard which are polluted by the interference of domestic wastage water, dumping of waste, solid wastage and percolation of domestic sewage by inhabitants. Even though, the condition is very depraved at present in Lucknow city, but if the same continues in future river water source will be completely polluted and become unfit for drinking directly and other purposes. This paper observation shows the status of contamination to the river environment.

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Hence, it is high time to preserve and protect this valuable river water sources. Thus flowing (liquid & solid) waste polluted materials should be avoided and they should not be release into the river because wastewater is disturb the water quality.

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