

River Water Pollution Assessment of Gangan River in Moradabad, Uttar Pradesh

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ABSTRACT

Water is a valuable resource for the survival of mankind. Fast industrialisation for sustainable development is causing major concern to the pollution of water because most of the industries are dumping their waste directly in to the rivers. Present work deals with the assessment of physico chemical parameters of Gangan River at Moradabad, Uttar Pradesh, India. Gangan river water at six different sites and at different depths was collected and analysed following standards methods of sampling and testing.

Keywords: River pollution, physicochemical parameters, industrial effluents, Gangan river, WHO standards

INTRODUCTION

Environmental pollution is one of the most acute problems that we are facing today [1]. India has seen the large-scale development in industrial and technological areas in last few decades. The rapid growing population, improved living standards, and the pressure on the present water resources are increasing day by day [2, 3]. The industrial revolution in developing countries improved the living standard of people that result the over exploitation of natural resources. Human activities have put a considerable pressure on the availability of basic human necessities such as clean water, air and land. Waste water from various industries, municipal corporations, urban and rural runoff, chemicals, surfactants, fertilizers, pesticides and herbicides in agriculture and the decomposition of vegetable and animal matter discharge into ground and surface water, making it unfit for human and animal consumption. Studies of literature [4-10] have shown that many industries are discharging their effluents into nearby rivers. Water sources are polluted by domestic wastage in rural areas whereas industrial wastages discharged into natural water sources in urban areas. This has attained hazardous conditions, especially in big cities where the population is large, the demand for water is very high, and industries are developing at a faster rate. But due to industrial revolution, water which is collected in the various water resources are highly polluted in various ways. Few organic and inorganic compounds, when

present in water above permissible limit are toxic and carcinogenic and cause several ailments in humans. Inorganic contaminants like heavy metals due to their non-degradable nature often accumulate through tropic level causing a deleterious biological effect. One of the major reasons of river water pollution in India is unplanned urban development without adequate attention to sewage and waste disposals [11-15].

Moradabad city in Uttar Pradesh, India is famous for Brass Metal Handicrafts not only in India but also in abroad since ancient times. This city is situated in western U.P. between 28°-21' to 28°-16' Latitude North and 78°- 4'to79° Longitude East. Presently it is an Industrial and Commercial city. Ram Ganga River flows in the north east and Gangan River is there in south west of the city. The brass industry in Moradabad is regularly discharging the effluents into the river Gangan. River Gangan receives almost all the domestic and industrial effluents of Moradabad city. The water of river Gangan is highly polluted by direct contamination of sewage and industrial effluents.

Quality of river Gangan water is degrading day by day hence there is an urgent need of analysing physicochemical parameters of river at a regular basis. In this study, an attempt was made to monitor the physicochemical water parameters of river Gangan and assess the extent of pollution by comparing the results with WHO standards.

MATERIALS AND METHODS

Sampling sites

For collection of water samples, six sites were selected in Gangan River near district Moradabad. The sampling sites are shown in Fig. 1 and summarized in Table- 1.

Table- 1: Water sampling sites in river Gangan

S.N.	Name of the Site	Noticed activities
1.	S-1 -- Near new Moradabad	Undeveloped colony of Moradabad developing authority (MDA) and cattle bathing activities noticed here.
2.	S-2 -- Before Gangan flyover Delhi road	Metal and Glass industries situated here.
3.	S-3 -- Lakri Fazalpur	It is a rural area and activities related with villagers like animal bathing, cloth washing and dumping of crop waste noticed here.
4.	S-4 -- Moradabad Chandausi road crossing	Animal activities noticed.
5.	S-5 -- Zero point bypass	Small scale industries situated.
6.	S-6 -- Near village Alirajapur	Cattle bathing activity noticed.

**Fig. 1: Map of sampling site**

Collection of water samples and Determination of physicochemical water parameters

Water samples were collected at each site at different depths. The samples were collected in wide mouthed polythene bottles and stored in ice box for analysis of various physicochemical parameters. The analysis of different physicochemical parameters namely temperature, pH, total hardness, turbidity, alkalinity, biological oxygen demand, chemical oxygen demand, dissolved oxygen, and total solids were done by using standard methods and procedures [16-18]. Each sample was analyzed in duplicate and the average of the results was taken for analysis.

RESULTS AND DISCUSSION

Analysis of physicochemical water parameters

Values of various physicochemical parameters of river Gangan at different sites are presented in Table- 2 showing the status of Gangan River water pollution at six different sites. The average values of each parameter are shown in Table 3.

Table- 2: Physico-Chemical Parameters of River Gangan

Physico-chemical parameters	SITE-1			SITE-2			SITE-3			W.H.O. Standard
	D1	D2	D3	D1	D2	D3	D1	D2	D3	
Temp. (°C)	21	19	17	21.4	20.9	19.5	22.1	21	20.5	--
pH	8.3	8.6	8.8	8.4	8.2	8.5	7.7	7.8	8	7.0-8.5(8.0)
TH(mg/L)	627	646	650	633	647	653	687	610	618	100
Turbidity(NTU)	39	44	49	43	51	57	47	53	59	5.0
Alkalinity(mg/L)	229	234	239	283	289	294	234	239	244	100
B.O.D. (mg/L)	13.9	14.4	14.9	15.6	16.1	16.6	17.6	18.1	18.7	6.0
C.O.D. (mg/L)	36.8	37.3	37.9	41	49	55	32.1	32.7	33.3	10.0
D.O. (mg/L)	4.8	3.9	3.7	4.5	4.3	3.9	4.4	4.1	3.9	5.0
T.S. (mg/L)	1505	1510	1517	1657	1661	1667	981	986	991	500

Table- 2 continued.....

Physico-chemical parameters	SITE-4			SITE-5			SITE-6			W.H.O. Standard
	D1	D2	D3	D1	D2	D3	D1	D2	D3	
Temp. (°C)	22.9	22	21.4	22.6	21.7	20	23	22.8	21.4	--
pH	8.3	8.4	8.6	8.5	8.7	8.9	8.3	8.5	8.7	7.0-8.5(8.0)
TH(mg/L)	656	667	673	657	661	672	686	694	703	100
Turbidity(NTU)	51	61	67	57	63	67	49	57	69	5.0
Alkalinity(mg/L)	307	313	319	361	367	373	333	339	344	100
B.O.D. (mg/L)	17.8	18.3	18.8	20.5	21.2	21.7	18.9	19.5	20.3	6.0
C.O.D. (mg/L)	49.1	49.7	50.1	67	73	79	58	64	69	10.0
D.O. (mg/L)	3.7	3.4	3.3	2.9	2.7	2.4	3.3	3.1	2.9	5.0
T.S. (mg/L)	2013	2019	2225	3140	3145	3153	3960	3967	3973	500

*D1- Sampling at water surface D2-Sampling at depth of 1 foot below the surface of water D3 - Sampling at depth of 2 feet below the surface of water

*T.H.(Total hardness), B.O.D.(Biochemical Oxygen Demand), C.O.D.(Chemical oxygen demand), D.O.(Dissolved oxygen), T.S.(Total solids)

Table- 3: Average value of Physico-Chemical Parameters of River Gangan at different sites

Physico-chemical parameters	Site 1 Average	Site 2 Average	Site 3 Average	Site 4 Average	Site 5 Average	Site 6 Average	Overall Average
Tem. (°C)	19	20.6	21	22.1	21.4	22.4	21.1
pH	8.6	8.4	7.8	8.4	8.7	8.5	8.4
TH(mg/L)	641	644	638	665	663	694	658
Turbidity(NTU)	44	50	53	60	62	58	54
Alkalinity(mg/L)	234	289	239	313	367	339	297
B.O.D. (mg/L)	14.4	16.1	18	18.3	21.1	19.6	17.9
C.O.D. (mg/L)	37.3	48.3	33	49.6	73	63.7	50.8
D.O. (mg/L)	4.1	4.2	4.1	3.5	2.7	3.1	3.6
T.S. (mg/L)	1511	1662	986	2086	3146	3967	2226

Temperature

Temperature was recorded to ±0.1°C accuracy, in the river immediately after collecting the samples. Fig. 3 shows average temperature of the Gangan river water at six different sites , which vary from 19°C to 22.4°C.These variations were mainly related with the temperature of atmosphere and weather conditions [19].

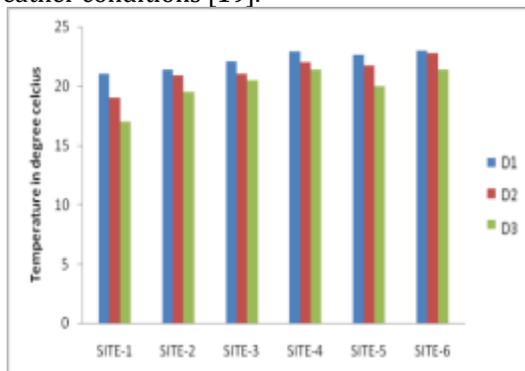


Fig. 3: Site- wise variation of temperature at different depths in Gangan River

pH

Hydrogen ion concentration (pH) is a logarithmic scale value used to express the alkaline, acidic or neutral nature of the solution. The pH of any aqueous system is suggestive of the acid base equilibrium achieved by various dissolved compounds [20]. In Gangan river the pH ranges from 7.8 to 8.7 (Fig. 4). In general the pH values are almost same at different depths of a particular site. The growth and development of flora and fauna of the water body very much depend upon the pH . Therefore, amount of pH is of great importance because most of the biological processes and biochemical reactions are pH dependent.

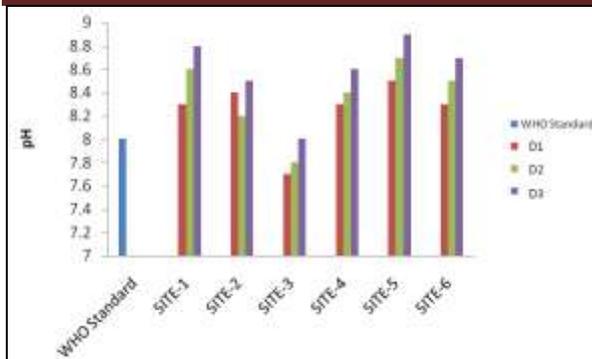


Fig. 4: Site- wise variation of pH values at different depths in Gangan river

Total hardness

Hardness of water is defined as the presence of significant concentration of salts of metallic cations may be Ca^{2+} and Mg^{2+} ions dissolved in water. Hardness is classified into two types. Carbonate hardness and Non- carbonate hardness. Carbonate hardness is due to the presence of magnesium and calcium carbonate and bicarbonate in water. Non Carbonate hardness in water occurs due to dissolution of salts of calcium other than carbonates and bicarbonates, such as Calcium Sulfates ($CaSO_4$) or Calcium Fluoride (CaF_2). It is expressed in terms of $CaCO_3$ concentration in mg/L.

In the present study the observed values of Total Hardness for Gangan river ranges from 638 mg/L to 694mg/L. It was also observed that total hardness changes at different depth at same site (Table- 2). At the surface the values are generally lower and increases at lower level.

Fig. 5 clearly shows that the Total Hardness content of water at all sites was observed lower at the surface and higher at lower level. This high value may be due to addition of salts of calcium and magnesium. Although hard water do not effect human health but it is unsuitable for domestic and industrial uses.

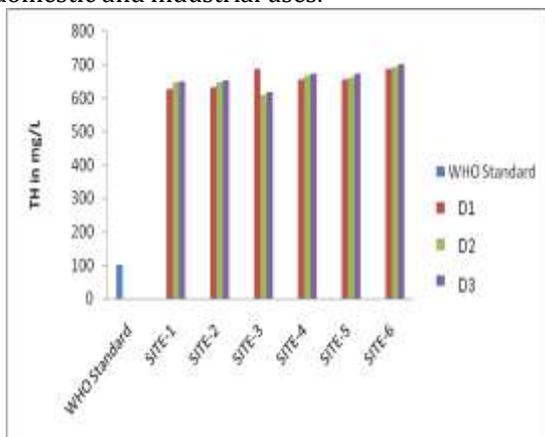


Fig. 5: Site- wise variation of total hardness in mg/L at different depths in Gangan river

Turbidity

Turbidity indicates the light-transmitting capability of water and waste water with respect to colloidal and suspended matter. In the present study the observed values of Turbidity for Gangan river ranges from 44 NTU to 62 NTU at different sites. The minimum value of Turbidity for Gangan River was 44 NTU at site-1 and the maximum value of Turbidity was 62 NTU at site-5. Fig. 6 inferred that the turbidity was lower at the surface and higher at lower surface. The high value of turbidity at lower level may be due to the inflow of clay, silt, and various other pollutants [21]. The probability of presence of pathogenic organisms is also increased in turbid water [22].

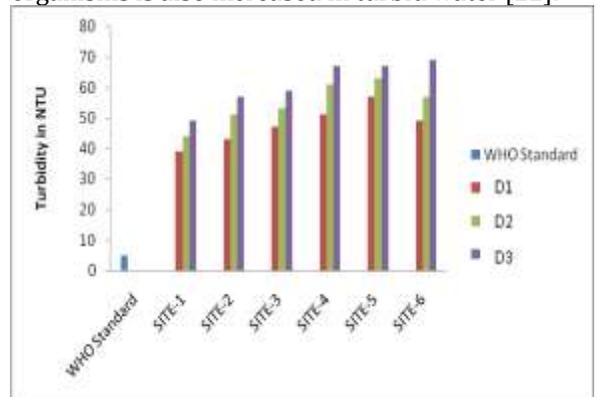


Fig. 6: Site- wise variation of turbidity in NTU at different depths in Gangan river

Alkalinity

Alkalinity is defined as the capability of water and waste water to neutralize H^+ ions. Observed values of Alkalinity for Gangan River at different depths is summarised in Table- 2. Values ranged from 234 mg/L to 367 mg/L at different sites (Table- 3). The minimum value of Alkalinity for Gangan River was 234 mg/L at site-1 and the maximum value of Alkalinity was 367 mg/L at site-5 (Fig. 7). The maximum value of alkalinity at site-5 may be due to high animal activity like cattle bathing and some small scale industries situated near the site.

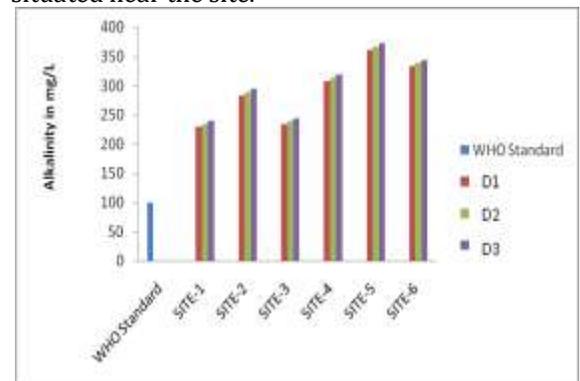


Fig. 7: Site- wise variation of alkalinity in mg/L at different depths in Gangan River

Biochemical oxygen demand (BOD)

Biochemical Oxygen Demand is a measure of organic material contamination in water, specified in mg/L (Table- 2). BOD is the amount of dissolved oxygen required for the biochemical decomposition of organic compounds and the oxidation of certain inorganic materials (e.g., iron, sulfites). In the present study the observed values of Biochemical Oxygen Demand for Gangan River ranges from 14.4 mg/L to 21.1 mg/L at different sites (Fig. 8). The minimum value of Biochemical Oxygen Demand for Gangan River was 14.4 mg/L at site-1 and the maximum value of Biochemical Oxygen Demand was 21.1 mg/L at site-5. Almost same values was observed at the surface and lower level of river at the same site. (Table-2)

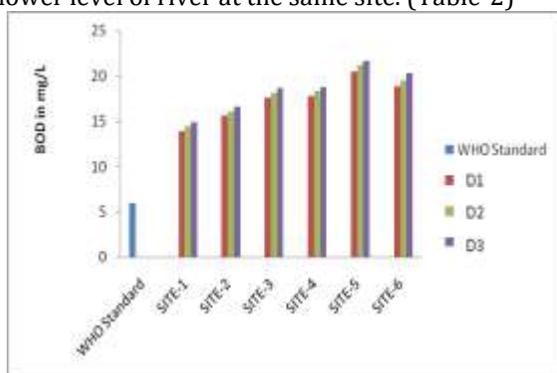


Fig. 8: Site- wise variation of biochemical oxygen demand in mg/L at different depths in Gangan River

Chemical oxygen demand (COD)

Chemical Oxygen Demand is the measurement of the amount of oxygen in water consumed for chemical oxidation of pollutants. In the present study the observed values of Chemical Oxygen Demand for Gangan River ranges from 33 mg/L to 73 mg/L at different sites (Fig. 9).

The minimum value of Chemical Oxygen Demand for Gangan River was 33 mg/L at site-3 and the maximum value of Chemical Oxygen Demand was 73 mg/L at site-5. It was also observed that the value of COD increases at lower level in river Gangan.

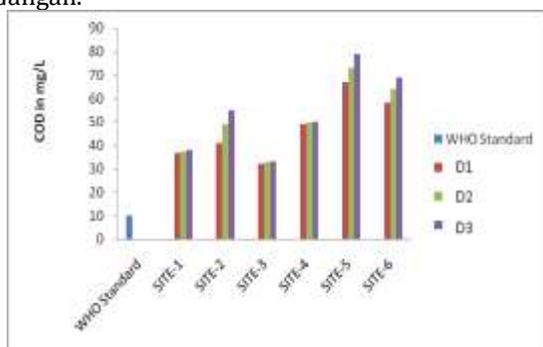


Fig. 9: Site- wise variation of chemical oxygen demand in mg/L at different depths in Gangan River

Dissolved oxygen (DO)

Dissolved Oxygen is defined as the amount of oxygen dissolved in a unit volume of water. It is essential for the maintenance of healthy rivers as the ability of water to sustain aquatic life is measured by DO.

In the present study the observed values of Dissolved Oxygen for Gangan River ranges from 2.7 mg/L to 4.2 mg/L at different sites. The minimum value of Dissolved Oxygen for Gangan River was 2.7 mg/L at site-5 and the maximum value of Dissolved Oxygen was 4.2 mg/L at site-2. Faryal et. al [22] also confirm the decrease and increase in the D.O. of different rivers. Fig. 10 shows the variation of DO in river Gangan at different sites at different depth.

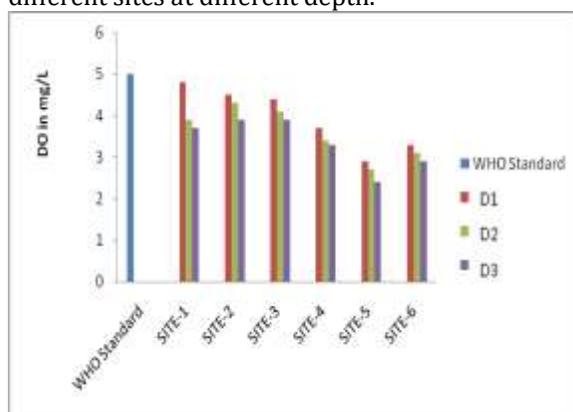


Fig. 10: Site- wise variation of dissolved oxygen in mg/L at different depths in Gangan River

Total solids (TS)

A total solid is the term applied to the material residue left in the vessel after evaporation of a sample and its subsequent drying. In the present study the observed values of Total Solids for Gangan River ranges from 986 mg/L to 3967 mg/L at different sites. The minimum value of Total Solids for Gangan River was 986 mg/L at site-3 and the maximum value of Total Solids was 3967 mg/L at site-6. The reason for maximum value at site-6 may be due to high animal and villagers activities. Fig. 11 indicate the variation in TS at different sites at various river water levels.

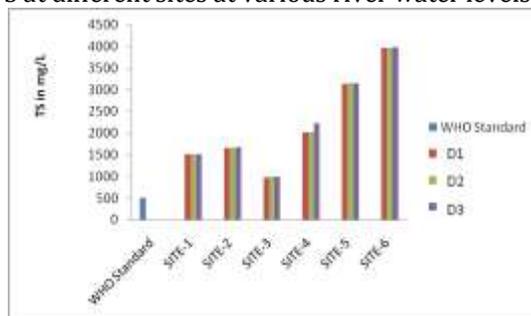


Fig. 11: Site- wise variation of total solids in mg/L at different depths in Gangan River

CONCLUSION

An environmental study ultimately depends on the results of chemical analysis of samples of water for pollutants. Policies of reduction of pollutants cannot be designed if the extent and identity of the pollutant is not known. Furthermore the general trend in the polluting factors should be known for effective designing of the treatment strategies. Analysis of the water sample becomes too difficult when the water is contaminated with large number of pollutants.

In river Gangan all physico-chemical parameters were found fluctuated at different depth and at different sites. Raised values of certain parameters clearly indicated pollution in river water. As expected, most of the values were less at the sites where mankind and industrial activities are very few Javed Faryal et. al also confirm that physico chemical properties of river water varies at different sites. [22].

The present investigation indicated that the river Gangan water was unsuitable for domestic and drinking purpose. To protect the river, the government authorities should make provisions in the company law for the deposition of domestic wastes, municipal wastes, agricultural runoff, and industrial wastes.

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Action is the foundational key to all success.

~ Pablo Picasso