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Physicochemical Parameters of Gomati River at Lucknow in Uttar Pradesh (India)

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Abstract: ***Gomati River originate from Madhoganj Tanda village in Pilibhit district, U.P. it passes through the district of Shahjahanpur, kheri, Hardoi, Sitapur, Janpur and ultimately merge in Ganga. River water is significant for every living organism as well as aquatic life. Water pollution is a major global problem. Modernization and urbanization have polluted the river water and degraded the status. All over the world we are seeing that drain is the main source of water pollution especially for rivers flowing within the city. This drain generally carries industrial effluent, domestic waste, sewage and medicinal waste resulting in poor water quality. Gomati River receives industrial as well as domestic waste from various drains of Lucknow city. As Gomati river is the only source of surface water near the communities. A total 20 parameters namely Temperature, pH, Turbidity, Conductivity, Total dissolved solids (TDS), Total suspended solids (TSS), Total solids (TS), Dissolved oxygen (DO), Biological oxygen demand (BOD) Chemical oxygen demand (COD), Alkalinity, Total hardness, Calcium as ca, Magnesium as Mg, Chloride, Fluoride, Sulphate as So4, Nickel as Ni, Lead as Pb, and Zinc as Zn where analysed and their variation is discussed to obtain the impact of effluents on water quality. From the result it was found higher than the permissible limit of WHO and BIS.***

Keywords: Gomati River, Water quality, Physico-Chemical Parameters, Heavy Metals.

I. INTRODUCTION

The Gomati a monsoon- and groundwater-fed river originates from Gomati Tall (formally known as Fulhaar jheel) near Madho Tanda, Pilibhit, India. It extends 960 kilometres (600 mi) through Uttar Pradesh and meets the Ganges near Saidpur, Kaithi, 27 kilometres (17 mi) from Varanasi district.

It meets a small river, the Gaihaaee, 20 kilometres (12 mi) from its origin. The Gomati is a narrow stream until it reaches Mohammadi Kheri, a tehsil of Lakhimpur Kheri district (about 68 kilometres (42 mi)from its origin), where it is joined by tributaries such as the Sukheta, Choha and Andhra Choha. The river is then well-defined, with the Kathina tributary joining it at Mailani and Saroyan joining it at a village in Sitapur district. A major tributary is the Sai River, which joins the Gomati near Jaunpur. The Markandey Mahadeo temple is at the confluence of the Gomati and the Ganges.

The Gomati River is polluted at several points of its course through the 940-kilometre (580 mi) stretch of alluvial plains in Uttar Pradesh. The major sources of pollution are industrial waste and effluent from sugar factories and distilleries and residential wastewater and sewage.

The river and its tributaries, such as Kukrail Drainage, collect large amounts of human and industrial

Pollutants as they flow through an area of about 18 million people

Gomati River faces multiple challenges in Lucknow from sewage pollution to groundwater extraction. From eight fish habitats in Gomati, only two can be found in the riverfront stretch.

As the population increasing day by day the demand of water for food production, domestic activities as well as industrial activities also increasing day by day.

The quality of water is soluble and insoluble substances vary from day to day. Any change in natural quality can will spoil the balance of the system and become unfit for human as well as animal bodies. The availability of water through surface and ground water resources has been getting sever day by day, we have only 1% of water available for drinking and agriculture. Gomati River is severely polluted. The quality of water in the River is severely affected by pollutants which enters through drains and is also domestic waste. The waste of Lucknow city Gomati River receives waste from sugar and distillery industries from Sitapur district. Lucknow city also contribute major effluents from distillery milk dairy, vegetable, oil, carbon, purring effluents directly into the River. Gomati River water is a source of surface water for the nearby communities and meets the requirement of portable water.

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The water quality of the River has deteriorated very rapidly due to drastic drop in oxygen level. It has also been told by Newspaper that the water quality of the River is very badly affected and its water for drinking and bathing is not appropriate. Flora and fauna are disappearing due to pollution, the amount of aquatic flora and fauna is becoming less and less. Some metals are important for the growth and health of living organisms and some metals may be considered toxic one. Its concentration exceeds due to the normal permissible limits. The quality of water was assessed based on its organic constituents , biological oxygen demand(BOD) , chemical oxygen demand(COD), dissolved oxygen(DO), and some other quality parameters hardness , chloride, sulphate, Alkalinity, etc. which plays an important role for the good water ecology. The current studies were analyzed with the objective of looking up and also monitoring the difference of pollution level of Gomati River. Heavy metals that affect the quality of river water as well as the ecosystem. The study shoes pollution status and adversity. The Gomati River in heavy metal analysis physicochemical characteristics in Uttar Pradesh. Life is possible on Earth due to the presence of water. About three fourth of the Earth surface is covered with water. Water is also found below the surface of the Earth. It is present in the form of water vapour about 70% of the human body is water, plant and animals contains water.

II. MATERIAL AND METHODS

A. *Water Pollution*

1) *Industrial Water Pollution:* Industry is a major source of heavy metal contribution. It produces pollutants that are extremely harmful to people and the environment. Many industrial facilities use fresh water to carry waste from the plant and into the rivers.
2) *Mercury:* It is a metal and can cause health and environmental problems. It is a non-biodegradable substance that is difficult to clean after contamination of the environment. Mercury is also harmful to animal's health because it can cause illness through mercury poisoning.
3) *Lead:* It is a metallic element and can cause health and environmental problems. It is difficult to clean a non-biodegradable substance after an environment is contaminated. It is harmful to the health of many animals including humans because it acts on physiological en enzyme.
4) *Asbestos:* This pollution can be a serious health hazard and can cause cancer. It can be a cause of diseases like intestinal cancer and lung cancer and liver cancer.
5) *Nitrates:* Increased used of fertilizers means that increasing that amount of nitrate from soil and in rivers and lakes can cause. Eutrophication which is very harmful to marine environments.
6) *Sulphur:* This is a non-metallic substance that is harmful to marine life. Oil does not dissolve in water. Instead it forms a thick layer on the surface of the water. It can stop marine plants receiving enough light from photosynthesis. It is also harmful for fish and marine birds.
7) *Petrochemicals:* It is made from gas or petrol and can be toxic to marine life. Some limited industries and major water pollution sources for surface water there are sugar, distilleries, paper pulp, leather tanneries, meat processing, pesticide etc. Hg poising was caused is Japan and disease known as minimart disease. This was happened by releasing mercury from electrochemical plant mercury converted to methyl mercury. The water being related to river and concreted by fish, in the form of methyl mercury. By eating this fish the mercury poising appeared is human and distance known as minimart.

III. SAMPLING

River front (1) Nishatganj (2) Medical Collage (3) Daligang (4) Kudiyaghat (5) Riverfront is the upstream of the river. The river water at this place is used as raw water supply for civil consumption to the old Lucknow city. Kudiyaghat is the last site, where the river leaves the city and other three sites in between these two sites were sampling sites was selected which cover the residential Lucknow region namely Medical Collage, five point is selected for sampling. The samples of water were collected from both the banks and middle stream of the river on each site. For collection of water sample, sampling bottles were soaked overnight in 10% HNO3, washed twice with double distilled water rinsed three times with stream water, leaving the last rinse for five minute to equilibrate. Water samples were collected in acidified HBPE bottles. Preservation and transportation of the samples to the laboratory were as per standard methods (APHA 1998). These samples were transported to laboratory in an ice box to avoid unpredictable changes in physicochemical characteristics of the samples.

Water samples were pre-filtered for remove suspended materials and preserved by adding 5 ml of concentrated H_2SO_4 to prevent biological activity. The containers were carefully filled just to overflowing, without passing air bubbles through sample or trapping air bubbles in sealed containers.

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Preparation of the containers included washing with detergent, rinsing with tap water, there ultrapure water (Millipore) and air-dried. Preservation and transportation of the water samples to the laboratory were as per standard methods. Each sample was identified clearly and indelibly by allocating a unique identification number. All analyses were undertaken within the shortest time possible (within 2 days) to minimize potential analyticlosses.

A. Site Selection

In the form of springs, In the Lucknow city Gomati enters west side.

B. Sampling Point

The Gomati River is tributary of Ganga River. About240 km the Gomati Enters Lucknow, through which it meanders for about 12 km. A 9 km stretch of theGomati was selected for the study. A total of five Sampling sites were selected namely Nishatganj, Riverfront, Daliganj, Kudiyaghat, and Medical Collage use have selected five major samplingpoints.

C. Study Area and Sample Collection

Water quality very much changed due to large quantities of sewage added into Gomati River.

Five sampling sites was selected which cover the residential Lucknow region namely Nishatganj (1), Riverfront (2), Daligang (3)), Kudiyaghat (4), Gaughat, and (5) Riverfront. The river water at this place is used as raw water supply for civil consumption to the city. Dilkusha garden is the last site, where the river leaves the city and other between these two sites was chosen where river receives effluents coming from urban homes and industries through various drains. The samples of water were collected from both the banks and middle stream of the river on each site. For collection of water sample, sampling bottles were soaked overnight in 10% HNO3, washed twice with double distilled water rinsed three times with stream water, leaving the last rinse for five minute to equilibrate. Water samples were collected in PEHE bottles. Preservation and transportation of the samples to the laboratory were as per standard methods (APHA 1998). These samples were carried to laboratory in an ice box to avoid unpredictable changes in physicochemical characteristics and analysis. The water sampling was done in March 2021 in Between 9.00 a.m. to 2.00 p.m. from both sides of River Gomati. Physicochemical parameters Namely Temperature, pH, Total Hardness, D.O. , conductivity, turbidity, TSS, TDS, TS, $mg^{2+,}$ alkalinity, Magnesium Chloride, calcium, Heavy metals namely Copper, Iron, Arsenic and Cadmium were analyse .



Fig: Sampling sites

Physicochemical Analysis of Water:

1) Temperature

a) Chemical Symbol: Not applicable [Physical parameter].
b) Units Used for Analytical Results: Degrees Celsius [°C].
c) Normal Method(s) of Analysis: Thermometry.
d) Occurrence/Origin: Generally climatologically influenced (in the absence of thermal discharges).
e) Health/ Sanitary Significance: None
f) Procedure: The Temperature of water records by the ordinary centigrade thermometer. The atmospheric temperature was recorded at the bank of river. The surface Water temperature was recorded by dipping the thermometer into water. To measure water temperature the thermometer was kept inside the water at desirable depth for five to ten minutes and finally an average rating was taken.

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2) T.S.S (Total Suspended Solids)

a) Chemical Symbol: Not applicable [Bulk parameter].
b) Units Used for Analytical Results: mg/l solids (Dried at stated temperature.
c) Normal Method of Analysis: Gravimetric Methods (Filtration, with drying at stated temperature).
d) Occurrence/Origin: Natural deposition in or discharges to water.
e) Health/Sanitary Significance: No direct significance.
f) Procedure

- Assemble filtering apparatus and filter (and begin suction).
- Wet filter with a small volume of reagent grade water to seat it. Stir sample with a stirrer to shear large particles.
- Wash filter with three successive 10 ml volumes of reagent grade water and continue. Suction for about three minutes after filtration for about three minutes after filtration is complete.
- Carefully remove filter from filtration apparatus and transfer to weighing dish.
- Dry for at least 1 hour at 103 to 105 0c in an oven.
- Cool in a dedicator balance temperature and weigh.

g) Calculation: TSS (mg/l) =Diff of wt. filter paper of sample (A-B) ×10^6 / ml of sample.

3) TDS (Total Dissolved Solids)

a) Chemical Symbol: Not applicable [Bulk parameter].
b) Units Used for Analytical Results: mg/l solids (Dried at stated temperature).
c) Normal Method of Analysis: Gravimetric Methods (Dried at stated temperature after filtration).
d) Occurrence / Origin: Natural or added solutes present in a water.
e) Health/Sanitary Significance: Principally organoleptic implications.
f) Procedure:

- A 100 ml sample is striated and filtered using what man filter paper no. 42
- The filtrate is transferred to a reweighed evaporating dish (silica crucible)
- The reaction mixture is evaporation to dryness on an oven
- Cooled in desiccators and weighed
- Heating and cooling is repeated until a constant weight is obtained

g) Calculation: Total Dissolved solid mg/l = (A-B) x 106/ ml sample

Where,
A = weight of dried residue + dish gm.
B = weight of dish gm

4) TS (Total Solids)

a) Chemical Symbol: Not applicable [Bulk parameter].
b) Units Used for Analytical Results: mg/l solids (Dried at stated temperature).
c) Normal Methods of Analysis: Gravimetric Methods (Dried at stated temperature).
d) Occurrence/Origin: Natural and added solids present in water.
e) Health/Sanitary Significance: Primarily of organoleptic concern.
f) Apparatus:

- Evaporating dishes ,dishes of 100 ml capacity made of one of the fallowing materials
- Porcelain – Generally satisfactory for all purpose
- High – silica glass
- Steam bath
- Desiccators, provided with a desiccant containing a color indicator of moisture concentration.
- During oven ,for operation at 103 to 105^0C
- Analytical balance, capable of weighing to .1 mg

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g) Procedure

- Dry evaporating dish at 104 ± 10^0C for 1 h, cool and store in a desiccators weight immediately before use.
- Pipette a measured volume into the re weight evaporating dish using a wide bare pipette. Choose a sample volume to yield between 100 mg and 200 mg dried residue. Evaporation to dryness in an oven at 104±10
- If necessary add successive portion the same dish after evaporation. To prevent splattering the oven temperature may be lowered initially by 20C below boiling point and raised to 1040C after evaporation for 1 hr .cool in a desiccators and weigh.
- Weigh the dish as soon as it has cooled avoiding reside to stay for long time as some residue are Calculation: Total solid mg/l = (A-B)x 106/ volume of sample

Where,
A = weight of dried residue + dish, gm
B = weigh of dish gm

5) Alkalinity

a) Chemical Symbol: Not Applicable [Bulk parameter]
b) Units Used for Analytical Results: mg/l CaCO3.
c) Normal Method of Analysis: Titration with Sulphuric Acid [A]
d) Occurrence/ Origin: The alkalinity of natural water is generally due to the presence of Bicarbonates formed in reactions in the soils through which the water percolates. It is a measure of The capacity of the water to neutralize acids and it reflects its so-called *buffer capacity* (it's inherent Resistance to pH change). Poorly-buffered water will have a low or very low alkalinity and will be Susceptible to pH reduction by, for example, "acid rain." At times, however, river alkalinity values Of up to 400 mg/l CaCO3 may be found; they are without significance in the context of the quality of The water.
e) Health/Sanitary Significance: There is little known sanitary significance attaching to Alkalinity (even up to 400 mg/l CaCO3), though unpalatability may result in highly alkaline Waters.
f) Apparatus

- Burette with Burette stand and porcelain title
- Pipettes with elongated tips
- Conical flask
- Measuring cylinders
- Beakers
- Dropper
- Stirrer

g) Chemicals Used

- Standard0.02N sulphuric acid.
- Phenolphthalein indicator.
- Methyl orange indicator.

h) Procedure

- Measure 50 ml or 100 ml of your sample into a 250 mL beaker or Erlenmeyer flask. Place your sample onto a stir plate (make sure to put a bar magnet in the flask).
- Measure initial pH of your sample. If the sample pH is below 8.3 (if above 8.3, do step 3 first), add several drops of methyl orange indicator. If the color of the solution turned yellow, titrate your sample with 0.02 N. If the sample pH is below 8.3 (if above 8.3, do step 3 first), add several drops of methyl orange indicator. If the color of the solution turned yellow, titrate your sample with 0.02 N.

i) Calculation

Phenolphthalein Alkalinity (mg/L as CaCO3) = Multiplying Factor (MF) x milliliter of 0.02N H2SO4 (added up to pH 8.3.)
Total Alkalinity (mg/L as CaCO3) =Multiplying Factor (MF) x milliliter of 0.02N H2SO4 (added up to pH approx. 4.5).
Where, M.F = Normality of H2SO4 ×Equivalent weight of CaCO3×100/ ml of sample taken.

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6) Chloride

a) Chemical Symbol: Cl^-

b) Units Used for Analytical Results: mg/l Cl.

c) Normal Method of Analysis: Titration (Mohr Method: Silver Nitrate).

d) Occurrence/Origin: Chloride exists in all natural waters, the concentrations varying very Widely and reaching a maximum in sea water (up to 35,000 mg/l Cl). In fresh waters the sources Include soil and rock formations, sea spray and waste discharges. Sewage contains large amounts Of chloride, as do some industrial effluents.

e) Health/Sanitation: Chloride does not pose a health hazard to humans and the Principal consideration is in relation to palatability.

f) Reagents Use:

- Standard AgNO3 (.0141N).
- Potassium chromate indicator solution

g) Procedure:

- A 50 ml sample is taken in a 150 ml Erlenmeyer flask.
- 1ml k2CrO7 indicator is added.
- The content is titrated against 0.0141 N AgNO3 until a persistent brick red tinge appears.
- A blank titrate is done using some amount of distilled water as the sample and some amount of K2CrO7 indicator.
- AgNO3 is standardized against NaCl (0.0141) y titration.

h) Calculation: Mg Cl/L = (A-B) x Normality of AgNO3x 35450/ ml sample.

7) Magnesium

a) Chemical Symbol: Mg.

b) Units Used for Analytical Results: mg/l Mg.

c) Normal Method of Analysis: Titration with EDTA [A]; Atomic Absorption Spectrometry.

d) Occurrence/Origin: Major constituent of geological formations.

e) Health/Sanitary Significance: Indirect (in conjunction with Sulphate, q.v.).

f) Procedure: Magnesium may be estimated as the difference between hardness and calcium as CaCO3 if interfering metal are present in non- interfering concentration in the calcium titration and suitable inhibition are used in the hardness titration.

g) Calculation: Mg/l = [total Hardness (as mg CaCO3) – calcium Hardness (as mg CaCO3/l)] x 0.243.

8) NICKEL as Ni

a) Chemical Symbol: Ni.

b) Units Used for Analytical Results: mg/l Ni.

c) Normal Method of Analysis: Atomic Absorption Spectrometry.

d) Occurrence/Origin: Principal sources are minerals and industrial wastes.

e) Health/Sanitary Significance: Very limited.

f) Procedure**:** 100 ml of water sample was mixed with conc. Nitric acid (10 ml) then cooled and filtered through Whitman 42 filter paper.



Fig: Atomic Absorption Spectrometer(AAS), running the water sample

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9) LEAD AS Pb

a) Chemical Symbol: Pb.

b) Units Used for Analytical Results: mg/l Pb.

c) Normal Method of Analysis: Atomic Absorption Spectrometry.

d) Occurrence/Origin: Leaching from ores; effluent discharges; attack on water pipes.

e) Health/ Sanitary Significance: Toxic cumulative poison.

f) Procedure: 100 ml of water sample was mixed with conc. Nitric acid (10 ml) then cooled and filtered through Whitman 42 filter paper.

IV. RESULTS AND DISCUSSION

Table 1: Physicochemical parameter of Gomati River in Lucknow. (January 2021)

Sr. No.	Parameters	Units	Nishatganj	River Front	Daligang	Kudiyaghat	Medical Collage
1.	Temperature	ºC	25	24	23	26	27
2.	T.S.S	mg/l	25	24	23	26	27
3.	T.D.S	mg/l	371.0	450.0	433.0	421.0	440.0
4.	T.S	mg/l	396	474	456	447	467
5.	Alkalinity	mg/l	116.0	108.0	128.0	100	132.0
6.	Chloride	mg/l	24.0	36.0	28.0	30.0	38.0
7.	Magnesium as Mg	mg/l	16.52	19.44	18.47	15.55	18.47
8.	Fluoride	mg/l	0.57	0.37	0.40	0.40	0.38
9.	Nickel as Ni	mg/l	0.310	0.332	0.0923	0.0521	0.604
10.	Lead as Pb	mg/l	0.530	0.750	0.604	0.724	0.403

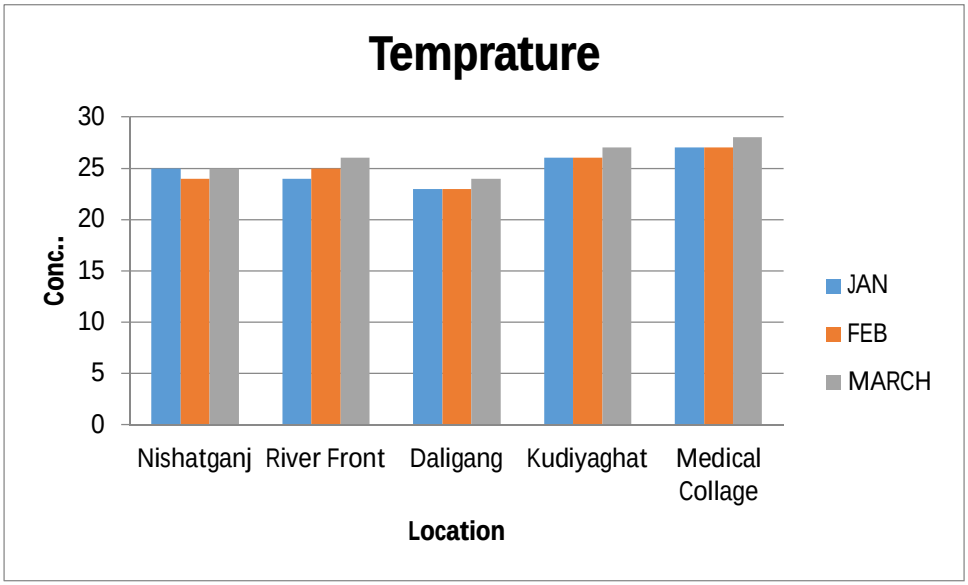
Table 2: Physicochemical parameter of Gomati River in Lucknow. (Feburary 2021)

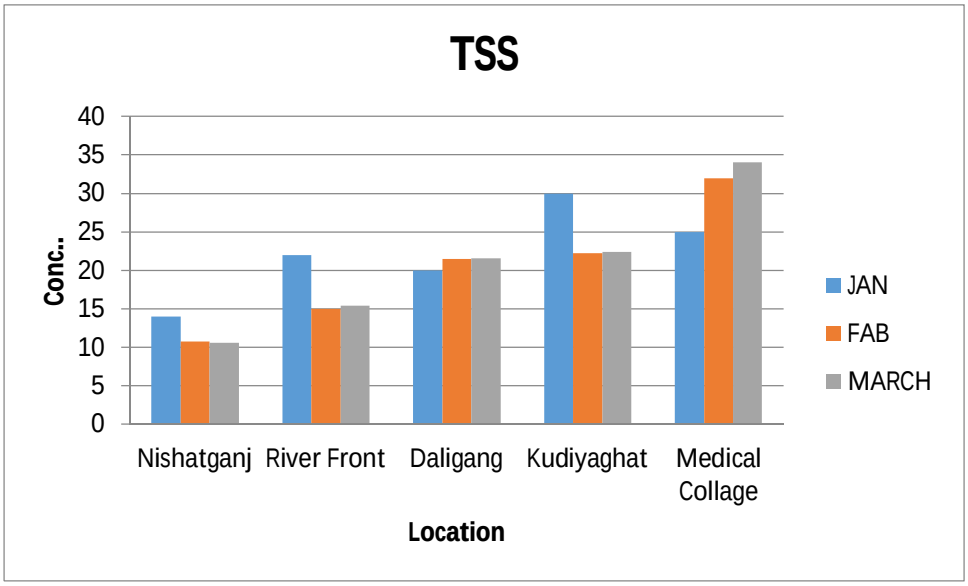
Sr. No.	Parameters	Units	Nishatganj	River Front	Daligang	Kudiyaghat	Medical Collage
1.	Temperature	ºC	24	25	23	26	27
2.	T.S.S	mg/l	10.8	15.0	21.5	22.2	32.0
3.	T.D.S	mg/l	10.8	15.0	21.5	22.2	32.0
4.	T.S	mg/l	426.8	473.0	451.5	377.2	452.0
5.	Alkalinity	mg/l	112.0	132.0	120.0	104.0	124.0
6.	Chloride	mg/l	28.0	30.0	22.0	22.0	24.0
7.	Magnesium as Mg	mg/l	15.55	17.50	17.5	14.58	17.50
8.	Fluoride	mg/l	0.46	0.38	0.43	0.47	0.42
9.	Nickel as Ni	mg/l	0.120	0.310	0.0823	0.0421	0.604
10.	Lead as Pb	mg/l	0.610	0.832	0.604	0.634	0.403

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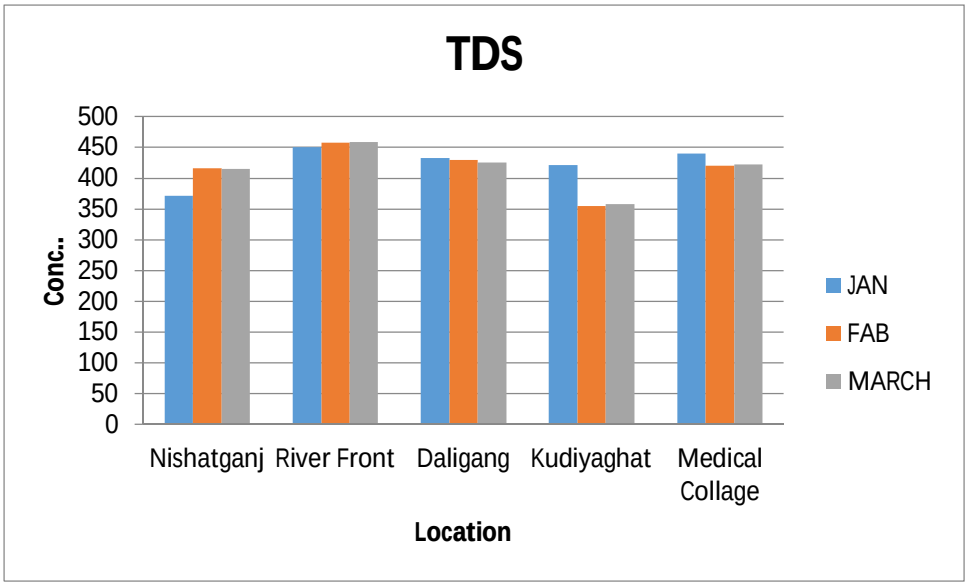
Table 3: Physicochemical parameter of Gomati River in Lucknow. (March 2021)

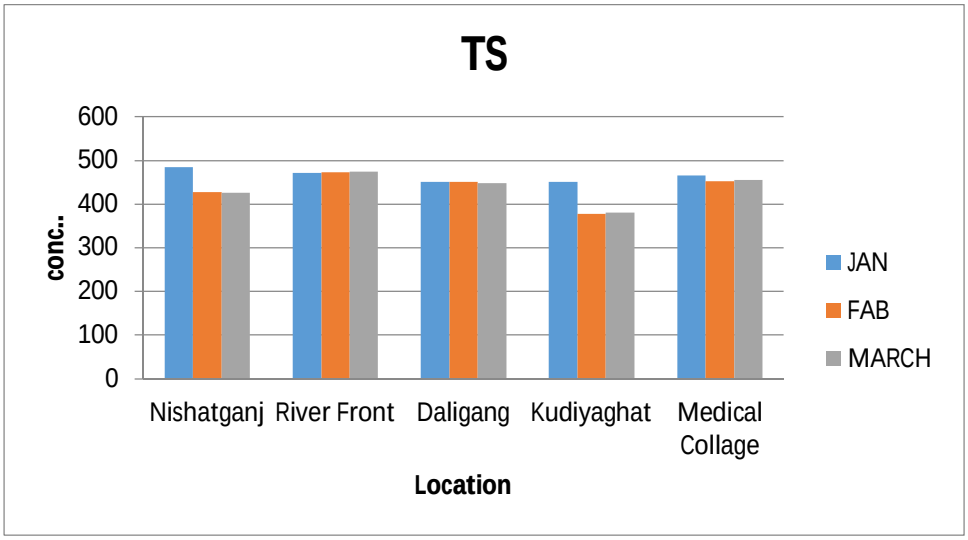
Sr. No.	Parameters	Units	Nishatganj	River Front	Daligang	Kudiyaghat	Medical Collage
1.	Temperature	ºC	25	26	24	27	28
2.	T.S.S	mg/l	10.6	15.4	21.6	22.4	34.0
3.	T.D.S	mg/l	415.0	459.0	426.0	358.0	422.0
4.	T.S	mg/l	425.6	474.4	447.6	380.4	456
5.	Alkalinity	mg/l	114.0	130.0	123.0	105.0	125.0
6.	Chloride	mg/l	28.01	30.10	22.02	22.03	24.05
7.	Magnesium as Mg	mg/l	15.56	17.52	17.51	14.59	17.40
8.	Fluoride	mg/l	0.47	0.37	0.44	0.46	0.43
9.	Nickel as Ni	mg/l	0.122	0.320	0.081	0.043	0.614
10.	Lead as Pb	mg/l	0.611	0.831	0.602	0.632	0.413

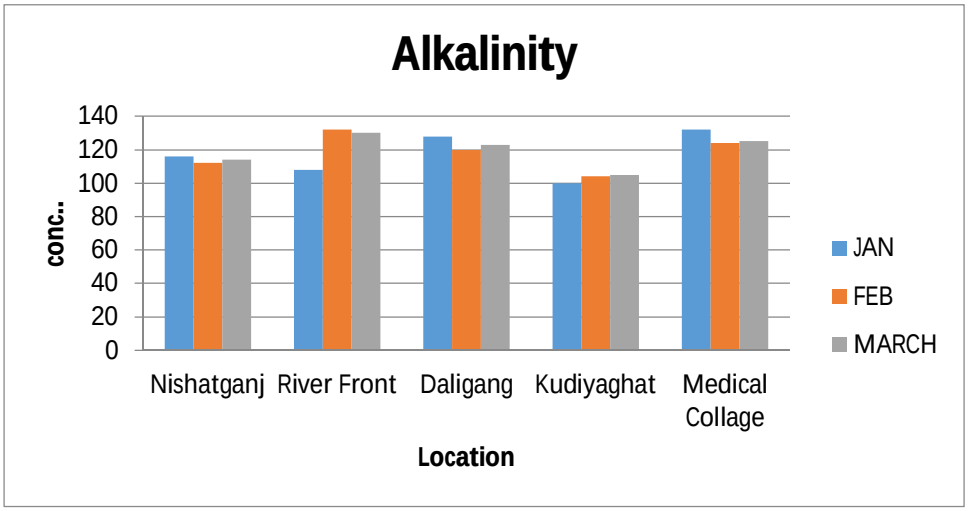




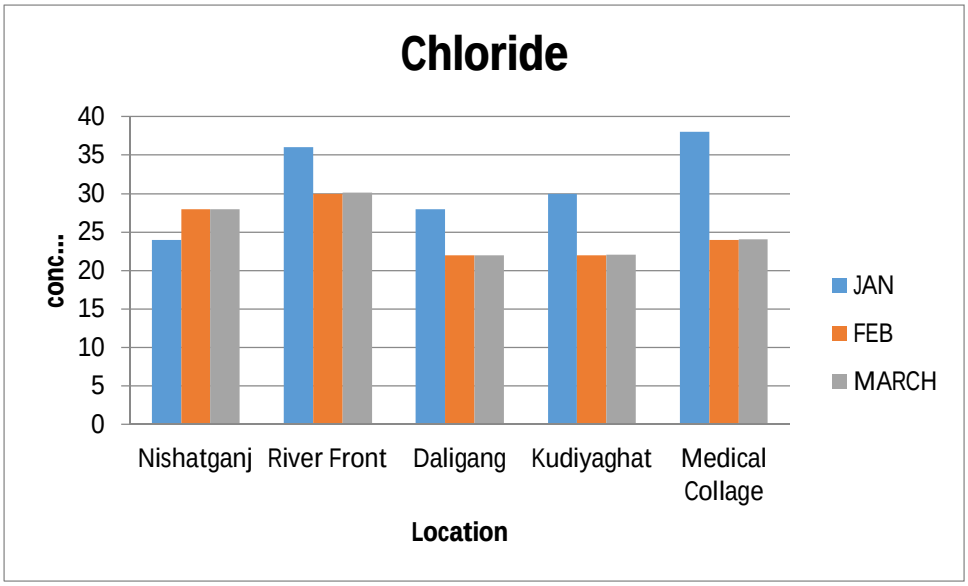
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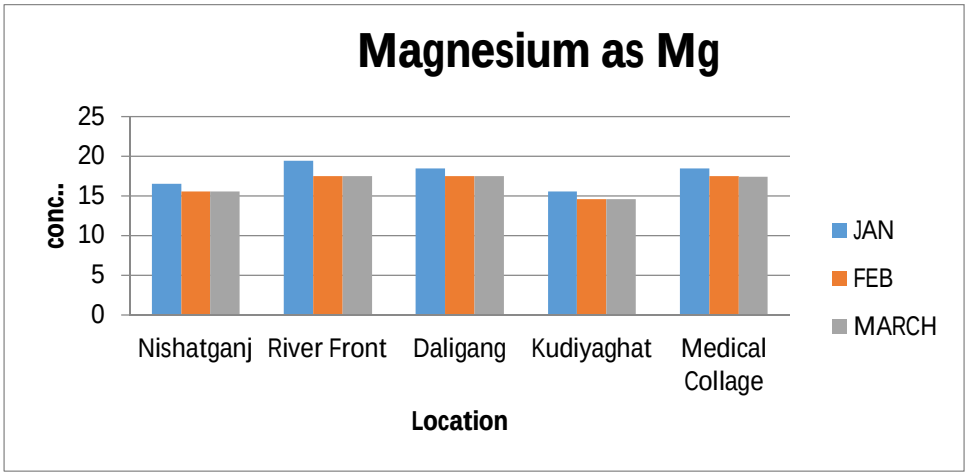


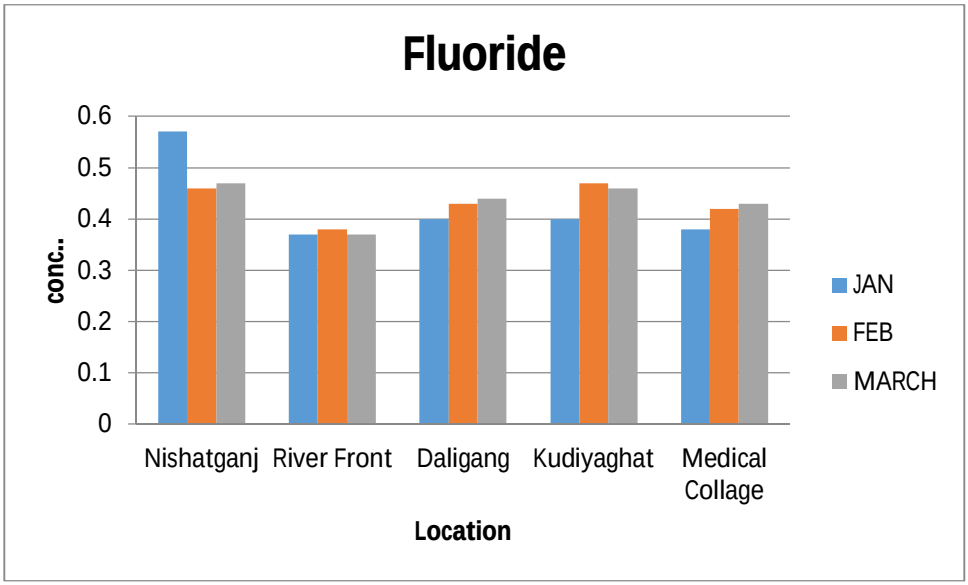




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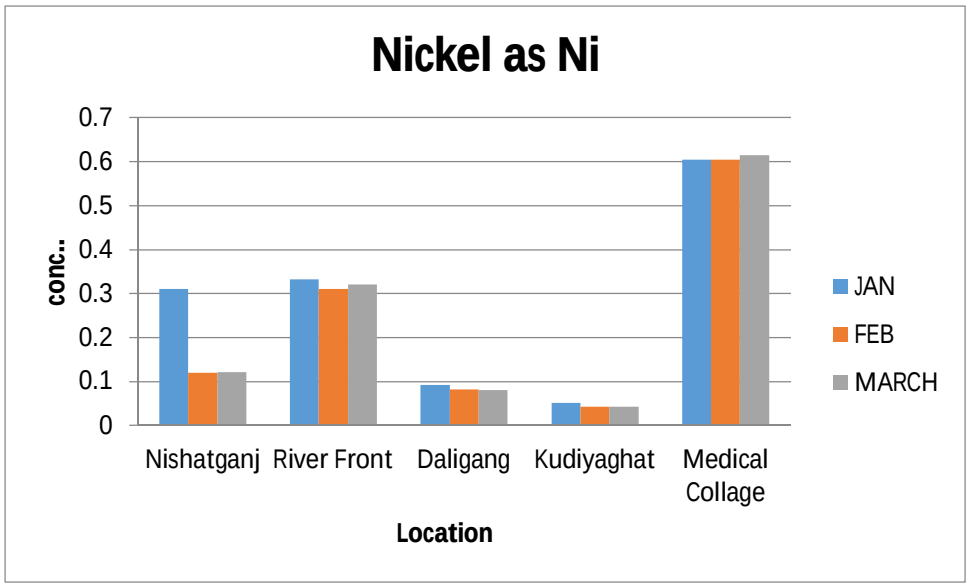


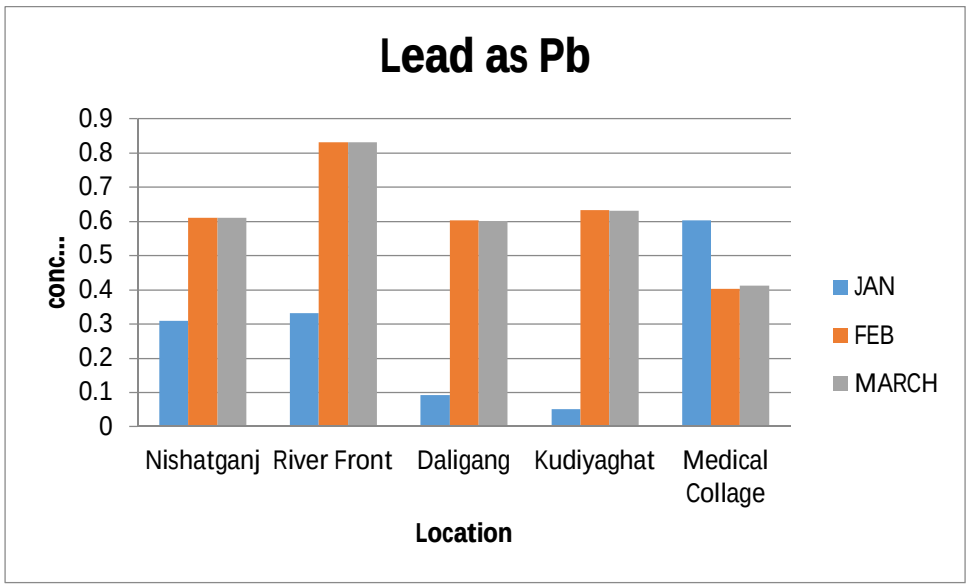




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V. CONCLUSION

The TS, TSS, TDS, and other Parameters at some of the sites were beyond
Permissible limit, water was polluted and is not suitable for beneficial uses without conventional treatments. The river is highly polluted due to discharge of domestic and industrial waste through several drains. The increase in value of chloride and total hardness were also due domestic discharges.

On the basis of analytical data, Gomati River water T.S from minimum (380 mg/l) to maximum (752 mg/l).The DO of the river in border line of required by aquatic organisms. The TSS released from minimum to maximum (10.6 mg/l to 34 mg/l) and TDS of the river water from minimum to maximum (355 mg/l to 559 mg/l).simultaneously in every order due to heavy discharge of various Nala without any further treatment. (Newspaper Reference).

Relevant the Gomati River is badly affected and not fit for drinking as well as bathing without any further Physico-chemical treatment.

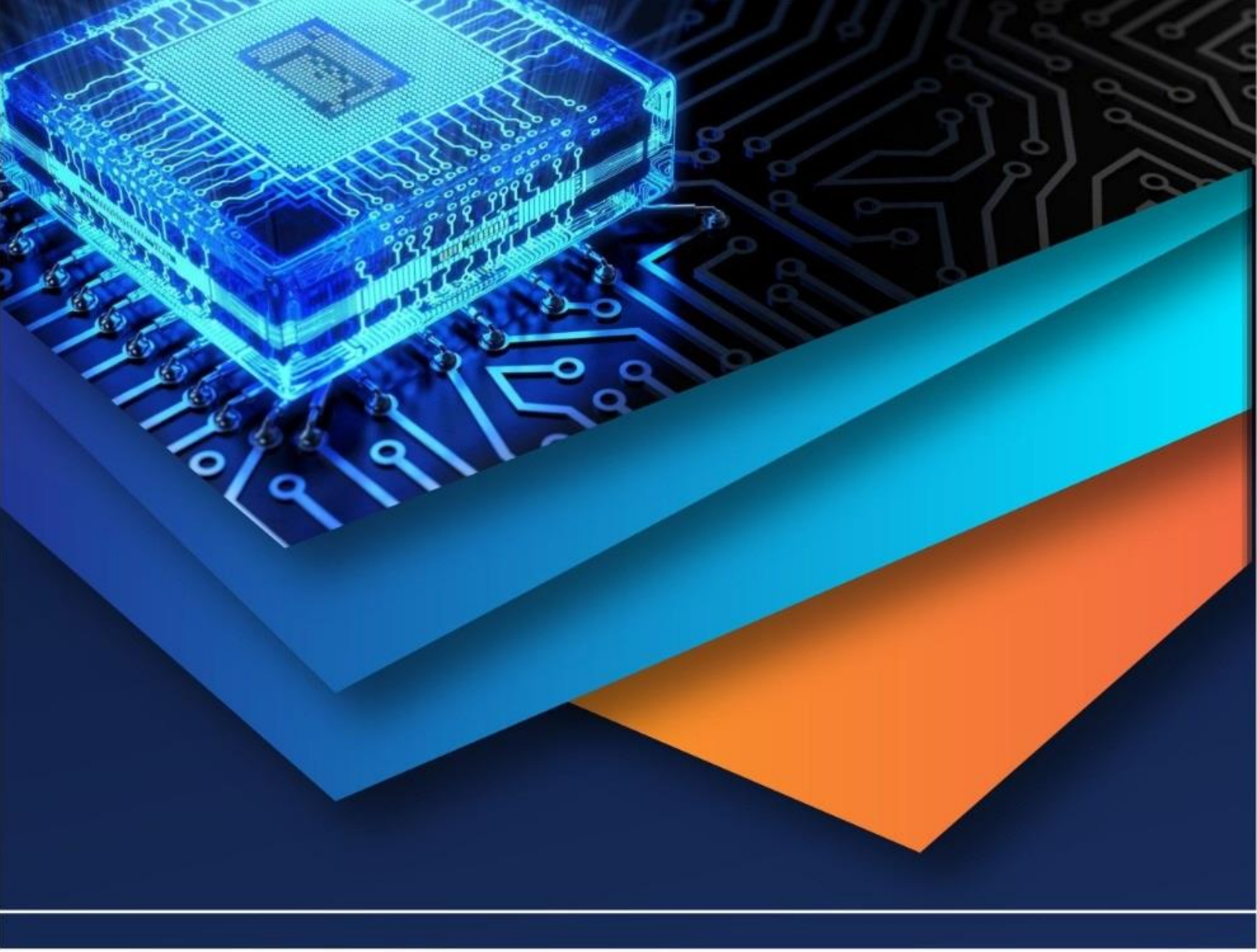
Government of U.P. and central government approaches to installation STP at, the end of Nala or that water discharge to Gomati will be less polluted and by left purification of river. The water of Gomati River will be improved and any be used for various purpose.

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