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Evaluation of Quality Parameter of Potable water in Rural and Urban area of Allahabad Region

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ABSTRACT

India is heading towards a freshwater crisis, mainly due to improper management of water resources and environmental degradation, which has led to a lack of access to safe water supply to millions of people. The freshwater crisis is already evident in many parts of India, varying in scale and intensity .Currently, about 20% of the world's population lacks safe drinking water according to United Nations Environmental Program (UNEP, 1999).Present study was undertaken to evaluate the quality of potable water including both ground as well as tap water in rural and urban area of Allahabad region.. A total of 25 ground water and 25 tap water samples were subjected to quantitative determination for various parameters like Alkalinity, Total Dissolve Solid, Acidity, Hardness, and anions Cl^-, NO_2^-. They were also subjected to microbiological analysis for total coliform count and fecal coliform. Most of the area were found to have their physicochemical parameter under the permissible limits. The water quality index on the basis of physicochemical parameters was calculated for different sites of ground water and Tap water collection. All the water collected from various areas were found to be of excellent and good quality. Most of the sample were found to contain fecal coliform bacteria but the counts are low and water can be made suitable for drinking after some of the household processing like boiling , filtering etc.

Keywords: Potable water, Physicochemical Parameter, water quality index, microbial safety, fecal coliform,

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INTRODUCTION

Water is one of the most important constituents amongst all the required factors of life, people can survive without food for a couple of weeks but they cannot survive without water for more than four days. Water is a vital resource for our survival and is also responsible for our economical growth. Having such an important role in our ecosystem the quality and suitability of water for various processes is a global issue as despite of being the most important necessity of life it can also be a carrier of many diseases.

Water quality can be defined on the basis of its physical, chemical and biological characteristics. It includes, physical parameters like color, turbidity, electrical conductivity, dissolve solids; chemical parameters like alkalinity, pH, acidity, chloride, nitrogen, sulfate, iron and manganese, hardness etc and biological parameters such as Dissolve oxygen, biological oxygen demand (BOD), chemical oxygen demand (COD) and other toxic microorganisms. Apart from this various parameters like toxic metals, radioactive metals etc are also determined to check the quality of water. Water quality is a measure of the condition of water according to the requirement of any biotic species including human need or purposes. On the basis of water quality it can be classified into four groups which includes: palatable water, potable water, infected water and contaminated (polluted) water. Potable water also known as drinking water belongs to the ground as well as surface water , which should be safe to drink, pleasant to taste and usable for domestic purposes. It is well known fact that the requirement of a human body is about 3 liters of water per day per capita for their healthy life. Safe drinking water is the key to a good and healthy life. According to [1], deterioration in water quality can be a potential factor in harming the human health, economic growth and social prosperity.

The surface and groundwater have deteriorated due to some natural and human factors. Groundwater is becoming polluted due to natural or anthropogenic ecological factors such as solid waste materials from industrial sewage disposal and barriers in surface water. Population growth, mainly in the developing

world, puts tremendous pressure on water bodies. Overuse of groundwater for drinking, irrigation, or domestic purposes has resulted in groundwater depletion and made the wells unfit for consumption.
Children and adults are the worst sufferers of water-borne diseases. About 36% of urban and 65% of rural people lacked safe drinking water [2]. More than 80% of all sicknesses or diseases in the human body occur due to polluted water, inadequate sanitation, and a lack of pure and safe drinking water [3]. It has been suggested that, by 2025, more than three billion people in the world will be facing water base vulnerability.
Providing safe and clean drinking water to all is a challenging issue in many parts of India, and it has been on top of the government plan for the last several years. The National Primary Drinking Water Regulations by U.S. Environmental Protection Agency's (EPA) has established maximum contaminant levels (MCLs) for various contaminants in water. The State Water Resources Control Board has set the standards (called "notification levels") for contaminants which are not specified by the EPA to ensure that the actual levels must be close to Public Health Goals.
Keeping in mind the importance of water quality in our daily life the study has been conducted in the Rural and Urban area of Allahabad region to estimate the safety level of ground and tap water in the study area.

MATERIAL AND METHODS

Collection and transportation of samples

Ground water and Tap water samples from 50 areas were subjected to quantitative determination for various parameters. A total of 25 ground water and 25 tap water samples were gathered in sterile container from different areas of Allahabad districts and have been transported to the laboratory in sterile condition with the help of ice box. Around 1500 ml samples were collected for analyses from all the sites. The bacteriological tests were analyzed on the same day of collection so that the growth or death of microorganisms can be avoided in the sample.

Experimental parameters

Physicochemical Parameter

Different parameters for quality of water were determined separately such as pH was analyzed pH meter; Alkalinity, Total Dissolve Solid, Acidity, Hardness, and anions Cl, NO_2^-were determined through the method Provided by Trivedy and Goel and APHA-AWWA-WPCF [4, 5].

Total coliform count

The enumeration of total coliform count in a water sample was done according to the method IS 5403:2013. Water sample was tested with the help of pour plate technique by plating it with violet red bile Agar medium (VRBA). The plates were incubated at 37C for 24 hours. The colonies were counted with the help of colony counter after incubation.

Detection of fecal coliforms

For detection of fecal coliform in the water sample the sample was plated by using Mac conkey Agar Medium with the help of serial dilution and pour plate technique according to IS method. The plates were incubated at 37C for 24 hours. The colonies were counted with the help of colony counter after incubation

Water Quality Index

The calculation of WQI has been made using the Weighed Arithmetic Index method [6, 7] in the following steps:
The method has been widely used by using the following formula-

$$WQI=\sum QiWi / Wi$$

The water quality rating scale (Qi) against each parameter is calculated by using the following equation-

$$Qi=100(Vi-Vo/Si-Vo)$$

Where,Viis the concentration of ith parameter in the examined water
VO is the standard value of the parameter (except pH=7.0 and D.O=14.6mg/l)
Si is estimated the standard value of the ith parameter
The unit weight (Wi) is calculated by using the following formula

$$Wi=K/Si$$

Where, K=Proportionality constant and its also be calculated by using the following equation

$$K=1/\sum(1/si)$$

Besides water quality, the present work concentrates on the physico-chemical parameters with the BIS, 2012 standard in drinking water [8]. The researchers rely on the physico-chemical data collected from India's Central Groundwater Year Book (2018-2019) for this analysis [9].

Table 1:- Water Quality Index, BIS.

WQI Value	Rating of water quality	Grading
0-25	Excellent	A
26-50	Good	B
51-75	Poor	C
76-100	Very Poor	D
>100	Unsuitable	E

Table 2: Various water quality parameters with their permissible limits according to WHO and Indian standard

Area	Con	TDS	TH	NO_2	Alkalinity	Cl^-	Pb	pH	TcF	FCF
WHO Standard	400-200 µs/cm	300-500mg/l	200 ppm	45 ppm	-	250 ppm	<0.01 mg/L	6.5-8.5	0	0
Indian Standard	300 µs/cm	500 mg/l	200-300 ppm	45 ppm	200 ppm	250 ppm	<0.01 mg/L	6.5-8.5	0	0
EPA guidelines	-	-	<200 ppm	50 mg/l	-	250 ppm	<0.01 mg/L	6.5-8.5	0	0s

Note. tcf=total coliform; fcf=fecal coliform

RESULT AND DISCUSSION

The sample collecting sites for ground water which includes Peepal gaon , Bamrouli uparhar, Gadopur , Kareli gaon , Rampur nani etc were coded from S1-S25 and for tap water which includes Mundera ADA, Couphatkha, Darbanga colony, Minajpur, Rambagh, Teliyarganj etc were coded as T1-T25**.**

Table 3: Coding of various sample collecting sites for Ground water and Tap water

S.no	Ground water	S.no	Tap water
S1	Peepal gaon	T1	Mundera ADA
S2	Bamrouli uparhar	T2	Chouphatkha
S3	Gadopur	T3	Darbanga colony
S4	Kareli gaon	T4	Minajpur
S5	Rampur nani	T5	Rambagh
S6	Hadiya ratipur	T6	Teliyarganj
S7	Khathula	T7	Naini ADA
S8	Sarlapur	T8	Bamrauli
S9	Jhalwa	T9	Kareli
S!0	Mandari gaon	T10	Dariyabad
S11	Karahi	T11	Khuldabad
S12	Andhava	T12	Lukarganj
S13	Bagwatpur	T13	Sobatiyabagh
S14	Bajha	T14	Allapur
S15	Gayasdinpur	T15	Daraganj
S16	Umari	T16	Rajruppoor
S17	Phaphmau padhila	T17	Purana Katra
S18	Saidabad	T18	Ashok nagar
S19	Karchana	T19	Subedarganj
S20	Chaka	T20	Sulem saria
S21	Bahariya	T21	Bairhana
S22	Jasra	T22	Shanti puram
S23	Uruwa	T23	Jhalwa
S24	Arail	T24	Jayantipur
S25	Bamaila	T25	Neemsarai

Electrical conductivity of water sample

Electrical conductivity also known as salanity is a tool to assess the purity of water as it measures the capability of water to transmit electric current. The most important reason of salinity is the concentration of cations in a high amount like calcium, sodium and magnesium as well as anions like chloride, phosphate and nitrate [10,11].According to WHO standard the safe limit of Electrical conductivity is 200-400 µs/cm. As per BIS standard it should be below 300 (µs/cm).In case of Ground water samples from different areas it was found that all the samples were having the electrical conductivity below 400 µs/cm

(Table 4). The highest level of EC was found in the sample collected from S 15 ie. Gayasdinpur 356 µs/cm and the lowest was found to be as 109 µs/cm in the sample collected from S21 ie. Bahariya. The electrical conductivity of ground water collected from Gyasadinpur, Phaphamau, padhila, Chaka were found to be slightly higher than the standard limit.

The electrical conductivity were found to be higher in case of Tap water samples. The highest level of EC was found in the sample collected from T 13 ie. Sobatiyabagh as 437µs/cm and the lowest was found to be as 145µs/cm in the sample collected from T 21 ie. Bhairana (Table 5).T6, T10.The electrical conductivity of Tap water collected from T6, T10, T12,T13, T15, T19, T22 and T 25, were found to be slightly higher than the standard limit.

Total Dissolve Solids of water sample

High amount of total dissolve solids are responsible for inferior quality and lower palatability as well as unfavorable physiological reaction.TDS should be below 500 mg/l as per BIS standard and according to WHO standards also it must be 300-500 mg/l for a safe potable water. The highest TDS was found to be as 771 mg/l for S21 (Bahariya) sample and lowest as 198 mg/l for S 7 (khathula) sample (Table 4) in case of ground water samples.

In case of tap water samples the range of TDS was found to be between 190 to 648 mg/l in the samples collected from different areas. The lowest TDS was found in the water collected from T20 (Sulem Sarai) area and the highest was found in the sample collected from T 9 (Kareli) area.

Total Hardness of water sample

Carbonate, bicarbonate, calcium, and magnesium are the major constituents that measure the hardness of potable water. As per WHO standards the total hardness must be below 200 ppm and it must be below 300 ppm according to BIS standard. It was observed that in case of ground water sample the TH of all the samples were found among the range of 77-298ppm. The highest TH was found in the sample collected from S13 (Bagwatpur) and the lowest as 77ppm was found in the sample collected from S7 (Kjathula) area.

In case of tap water samples the range of TH was found to be between 39 to 462 mg/l in the samples collected from different areas. The lowest TDS was found in the water collected from T17 (Purana Katra) area and the highest was found in the sample collected from T 7(Naini ADA) area.

Nitrates in water sample

Nitrate should be below 45 mg/l as per BIS standard and WHO standards. According to EPA guidelines it must be below 50 mg/l for safe potable water. The highest Nitrate was found to be as 28 mg/l for S25 (Bamaila) sample and lowest as 2.80 mg/l for S5 (Rampur Nani) sample (Table 4) in case of ground water samples. No nitrate was detected in the sample collected from S7 (Khathula) area.

In case of tap water samples the range of Nitrate was found to be between 2 to 28.04 mg/l in the samples collected from different areas. The lowest TDS was found in the water collected from T4 (Minajpur) area and the highest was found in the sample collected from T19 (Subedarganj) area. No nitrate was detected in the sample collected from T11 (Khuldabad) area.

Alkalinity of water sample

Alkalinity is the measure of optimum dose of coagulant and is an important parameter in evaluating the water quality. It affects the taste of water and a bitter taste is observed due to excess alkalinity. Although, some alkalinity is desire in drinking water which is helpful in neutralizing the acids like citric acid and lactic acid produced in the body. The permissible limit for Alkalinity according to BIS is 200 ppm for potable water. The alkalinity of ground water samples were ranged from 36- 267 ppm. Most of the samples were found to have the alkalinity below the permissible limit.

In case of tap water the range was between 24- 133 ppm in the samples collected from different areas of Allahabad. All the samples were found to have their alkalinity below the permissible limit.

Chloride (Cl) in water sample:

Chlorine (CL-) is a toxic element. Chloride is one of the key inorganic anions in fresh water and wastewater. The major forms of chlorides are NaCl, KCl, CaCl2, and HCl in surface and underground water. It serves as an indicator of pollution. Still, when it receives one electron or combines with other cations, it forms chloride, which becomes essential to living organisms. In water 4-10 mg/L chloride concentration indicates water purity. Chloride is related to pH, TA, EC, TDS, Free CO2, and bicarbonates. A high concentration of chlorides is harmful to humans and aquatic life because it slows down growth and reproduction**.**

As per WHO, BIS and EPA guidelines the permissible limit of chloride in potable water should be below 250 ppm. It was found the the range of chloride present in the ground water sample collected from different areas was 25-165 ppm. The highest was found in the water collected from S21 (Bahariya) area and the lowest was found from the S2 (Bamrauli Uparhar) area.

In case of tap water samples the range of chloride was found to be between 31 to 165 ppm in the samples collected from different areas. The lowest chloride was found in the water collected from T14 (Allahpur) area and the highest was found in the sample collected from T 19(Subdarganj) area.

Lead (Pb) in the water samples

Lead present in drinking water can caused various health problems like hearing loss, anemia, kidney impairment, hypertension, immune system dysfunction, and toxicity to the reproductive organs. Low levels of exposure can interfere with thought processes and lower children's IQ and also cause attention and behavioral problems.

Lead was found in non detectable limits in all the samples of ground water and most of the Tap water samples collected from various areas. Only Minajpur (T4) and Jhalwa(T23) areas were found to have lead as 0.22 ppm and 0.02 ppm respectively. The reason of presence of lead in some samples is may be due to some faulty fittings and pipelines in that particular area.The safe limit of Pb in drinking water must be below 50 ppm. Hence the water from all the sources were found safe in terms of lead.

Table 4- Mean Value of Physicochemical and Bacteriological Parameters for ground water quality

Area	Con	TDS	TH	NO_2	Alkalinity	Cl^-	Pb	pH	TCF	FCF
S1	165.0	237.0	134.0	6.46	97.00	34.00	N.D.	7.2	0.90×10^2	-
S2	145.00	598.66	196.00	11.00	78.00	25.00	N.D.	7.20	1.29×10^2	0.14×10^2
S3	175.00	255.33	111.00	8.34	90.00	67.00	N.D.	7.40	-	-
S4	118.00	245.00	118.00	7.70	97.00	84.00	N.D.	6.90	0.45×10^2	0.11×10^2
S5	163.00	212.00	98.00	**2.80**	**36.00**	39.00	N.D.	7.30	0.36×10^2	0.09×10^2
S6	211.00	341.00	123.00	18.00	47.00	45.00	N.D.	7.20	0.52×10^2	-
S7	114.00	**198.00**	**77.00**	**.00**	57.00	101.00	N.D.	7.40	0.47×10^2	-
S8	129.00	358.00	156.00	5.60	78.00	73.00	N.D.	7.30	0.20×10^2	-
S9	154.00	400.00	134.00	21.00	81.00	135.00	N.D.	6.80	0.45×10^2	-
S!0	245.00	498.00	176.00	13.00	129.00	125.00	N.D.	7.30	0.35×10^2	-
S11	202.00	346.00	155.00	6.00	113.00	143.00	N.D.	7.50	0.63×10^2	$.28\times 10^2$
S12	264.00	421.00	135.00	12.00	179.00	154.00	N.D.	7.10	0.54×10^2	-
S13	119.00	679.00	**289.00**	9.00	99.00	91.00	N.D.	6.80	2.11×10^2	$.32\times 10^2$
S14	214.00	421.00	124.00	4.30	169.00	111.00	N.D.	7.40	-	-
S15	**356.00**	659.00	241.00	21.00	240.00	134.00	N.D.	7.60	1.56×10^2	$.07\times 10^2$
S16	243.00	456.00	165.00	16.00	190.00	127.00	N.D.	7.30	0.34×10^2	$.11\times 10^2$
S17	**312.00**	690.00	256.00	22.00	235.00	126.00	N.D.	7.40	0.31×10^2	0.03×10^2
S18	209.00	378.00	121.00	15.00	131.00	152.00	N.D.	7.20	0.16×10^2	-
S19	243.00	486.00	108.00	13.00	168.00	162.00	N.D.	7.30	0.26×10^2	-
S20	**321.00**	654.00	232.00	8.00	**267.00**	143.00	N.D.	7.50	0.12×10^2	-
S21	**109.00**	**771.00**	261.00	7.90	89.00	165.00	N.D.	7.30	0.34×10^2	0.2×10^2
S22	128.00	286.00	94.00	15.30	113.00	78.00	N.D.	7.20	0.89×10^2	.
S23	142.00	290.00	132.00	11.00	124.00	62.00	N.D.	7.10	2.01×10^2	0.36×10^2
S24	123.00	456.00	185.00	16.00	186.00	113.33	N.D.	7.20	0.20×10^2	0.03×10^2
S25	221.00	564.00	208.00	**23.00**	207.66	146.00	N.D.	7.30	0.28×10^2	0.01×10^2

Note. tcf=total coliform; fcf=fecal coliform; N.D.= Non Detectable

pH of the water samples

pH is one of the important characteristics of drinking water as it can control the other chemical parameters. The permissible limit range of pH for drinking water is 6.5-8.5.The pH was ranged in the ground water sample from 6.8- 7.6 which is under the permissible limit , hence we can say the ground water samples collected from various regions of Allahabad was found to be safe limit.

In case of Tap water samples the pH of the water collected from various area is in the range of 6.8-7.4, which is found to be in a safe limit. hence it can be concluded that all the tap and ground water found in urban and rural area of Allahabad is found to have safe limit of pH.

Total Coliform Count in water samples

The coliform count act as the primary microbiological indicator for to determine the fecal contamination in water. Coliform count in all the samples were found in the range of 10^2 cfu/ ml except the water collected from S3 (Gadopur) and S14 (Bajha) area in case of ground water sample. In case of tap water collected from various region of Allahabad it was found that all the samples were having high coliform count in the range of 10^2-10^3cfu/ml. Results shown that all the water samples collected from Allahabad region were not microbiologically safe for drinking purpose as per WHO guidelines except the water collected from S3 (Gadopur) and S14 (Bajha) area.

Fecal Coliform Count in water samples

In case of ground water samples the area Bamrauli uparhar, Kareli gaon, Ramur nani, Karahi, Bagwatpur, Gayasdinpur, Umari, Phaphamau padhila, Bahariya, Uruwa, Arail and Bamaila were found to contain Fecal

coliform in their water samples. In case of Tap water the area Chouphatka, darbhanga colony, Minajpur, Rambagh, Teliyarganj, Kareli, Khuldabad ,Sobatiyabagh, Daraganj, Rajrupur, Purana Katra, Bairana, Jhalwa, Jayantipur, and Neemsarai were found to contain Fecal coliform in their water samples. According to the present study it was revealed that most of the tap water sample were found to have fecal coliform in them , this may be because of the old and poor conditions of these pipelines. Most of them have leakage and breakage in some places which allows the contamination to come inside [12].

Table 5:Mean Value of Physicochemical and Bacteriological Parameters for Tap water quality

Area	Con	TDS	TH	NO_2	Alkalinity	Cl^-	Pb	pH	TCF	FCF
T1	276.66	445.00	126.00	22.53	88.00	43.00	N.D.	7.10	1.37×10^2	-
T2	244.33	412.00	98.00	8.26	57.00	41.00	N.D.	6.80	1.09×10^3	0.24×10^2
T3	211.66	352.00	132.00	27.00	**24.00**	34.00	N.D.	7.10	4.46×10^2	0.65×10^2
T4	299.33	456.00	174.00	2.00	128.00	37.00	0.22	7.20	2.45×10^2	0.31×10^2
T5	218.33	365.00	187.00	18.33	111.00	41.00	N.D.	7.30	1.36×10^2	0.89×10^2
T6	**351.33**	557.00	192.00	24.33	152.00	55.00	N.D.	7.00	0.72×10^2	0.15×10^2
T7	288.00	490.00	**462.00**	22.06	120.00	62.00	N.D.	7.10	0.47×10^2	-
T8	254.00	390.00	155.00	17.33	109.00	75.00	N.D.	7.30	1.20×10^2	-
T9	402.00	**648.00**	178.00	21.78	92.00	111.00	N.D.	7.20	1.45×10^2	$.26\times 10^2$
T!0	**371.00**	510.00	165.00	27.86	95.00	142.00	N.D.	7.10	0.35×10^2	-
T11	198.00	342.00	124.00	0.00	133.00	92.00	N.D.	7.20	2.63×10^2	$.59\times 10^2$
T12	**343.00**	447.00	131.00	24.66	75.00	134.00	N.D.	7.10	0.54×10^2	-
T13	**437.00**	641.00	124.00	16.75	115.00	42.00	N.D.	6.80	2.11×10^2	$.12\times 10^2$
T14	211.00	322.00	87.00	20.06	121.00	31.00	N.D.	7.10	0.83×10^2	-
T15	**312.00**	437.00	112.00	18.90	43.00	55.00	N.D.	7.10	2.56×10^2	$.77\times 10^2$
T16	192.00	296.00	92.00	20.83	121.00	45.00	N.D.	7.40	0.34×10^2	$.11\times 10^2$
T17	186.00	402.00	**39.00**	14.70	44.00	44.00	N.D.	7.10	1.31×10^2	0.63×10^2
T18	288.00	593.00	113.00	33.43	108.00	53.00	N.D.	7.10	2.16×10^2	-
T19	**316.00**	387.00	143.00	28.06	83.00	165.00	N.D.	7.40	0.26×10^2	-
T20	277.00	**190.00**	135.00	18.00	96.00	88.00	N.D.	7.20	1.12×10^2	-
T21	**145.00**	601.00	126.00	25.16	122.00	93.00	N.D.	7.30	2.34×10^2	0.45×10^2
T22	**390.00**	455.00	125.00	31.81	78.00	104.00	N.D.	6.80	0.89×10^2	.
T23	256.00	391.00	232.00	37.81	95.00	75.00	0.02	7.10	1.01×10^2	$.06\times 10^2$
T24	276.00	422.00	129.00	18.20	115.00	93.00	N.D.	7.00	1.20×10^2	0.13×10^2
T25	**301.00**	289.00	241.00	20.72	78.00	112.00	N.D.	7.20	3.28×10^2	0.81×10^2

Note. tcf=total coliform; fcf=fecal coliform, N.D.= Non Detectable

Water Quality Index (WQI):

The most widely used technique to assess the water quality for ground as well as surface water is water quality index (WQI) model. It applies aggregation approach by reducing vast amounts of water quality records into a single value or index. The WQI model uses local water quality criteria to assess water quality (surface and groundwater) all around the world.WQI models includes four stages of assessment like parameter selection, parameter sub-indices, parameter weightings, and aggregation of the sub-indices to determine the water quality index. In the present study, the method of Brown et al. was used to calculate overall water quality to assess the water quality of research area. The result has been tabulated in Table 6.

The water quality index on the basis of physico chemical parameters was calculated for different sites of ground water and Tap water collection. It was found that ground water collected from Peepal gaon, Bamrouli uparhar, Kareli gaon, Rampur nani, Hadiya ratipur, khathula, Sarlapur, Jhalwa, Mandari gaon, Andhava, Bagwatpur, Saidabad, Jarsa and Uruwa were of excellent quality and water samples collected from Gadopur, Karahi, Bajha Gayasdinpur, Umari, Phaphmau padhila, karchana, chaka, Bahariya, Arail and Bamaila were of good quality.

In case of tap water collection sites, Mundera ADA, Chouphatkha, Darbanga colony, Minajpur, Teliyarganj, Naini ADA, Dariyabad, Khuldabad , Lukarganj, Sobatiyabagh, Allapur, Daraganj, Purana Katra, Ashok nagar, Sulem saria, Jhalwa, Jayantipur and Neemsarai were found to have water of excellent quality .Water samples from Rambagh, Bamrouli, kareli, Rajrupur, Subedarganj, Bairana, and Shanti puram were found to be of good quality according to the WQI.

The results are in accordance with Rawat and Siddiqui, 2019 as according to their study on analysis of drinking water in Allahabad it was revealed through the physiochemical analysis of the samples taken from the 20 locations across the city that all the samples were containing parameters well within the permissible limits recommended by the BIS and WHO [13].

Table 6: Water Quality index of Different areas

S.no	Ground water	WQI	Water Quality	S.no	Tap water	WQI	Water Quality
S1	Peepal gaon	16.33	Excellent	T1	Mundera ADA	17.34	Excellent
S2	Bamrouli uparhar	18.57	Excellent	T2	Couphatkha	17.3	Excellent
S3	Gadopur	26.8	Good	T3	Darbanga colony	16.98	Excellent
S4	Kareli gaon	11.08	Excellent	T4	Minajpur	17.46	Excellent
S5	Rampur nani	19.16	Excellent	T5	Rambagh	26.64	Good
S6	Hadiya ratipur	19.99	Excellent	T6	Teliyarganj	15.84	Excellent
S7	Khathula	23.19	Excellent	T7	Naini ADA	20.46	Excellent
S8	Sarlapur	21.59	Excellent	T8	Bamrauli	26.73	Good
S9	Jhalwa	21.99	Excellent	T9	Kareli	25.08	Good
S!0	Mandari gaon	21.33	Excellent	T10	Dariyabad	21.24	Excellent
S11	Karahi	33.16	Good	T11	Khuldabad	16.11	Excellent
S12	Andhava	16.53	Excellent	T12	Lukarganj	19.24	Excellent
S13	Bagwatpur	19.62	Excellent	T13	Sobatiyabagh	23.01	Excellent
S14	Bajha	28.03	Good	T14	Allapur	15.92	Excellent
S15	Gayasdinpur	47.5	Good	T15	Daraganj	15.74	Excellent
S16	Umari	28.29	Good	T16	Rajruppoor	31.52	Good
S17	Phaphmau padhila	37.08	Good	T17	Purana Katra	12.84	Excellent
S18	Saidabad	21.32	Excellent	T18	Ashok nagar	21.54	Excellent
S19	Karchana	27.03	Good	T19	Subedarganj	35.42	Good
S20	Chaka	38.4	Good	T20	Sulem saria	21.38	Excellent
S21	Bahariya	25.06	Good	T21	Bairhana	29.14	Good
S22	Jarsa	19.61	Excellent	T22	Shanti puram	26.98	Good
S23	Uruwa	13.19	Excellent	T23	Jhalwa	23.03	Excellent
S24	Arail	28.32	Good	T24	Jayantipur	12.4	Excellent
S25	Bamaila	31.38	Good	T25	Neemsarai	23.36	Excellent

CONCLUSION

The water samples collected from different regions of Allahabad were found excellent and good quality on the basis of physicochemical parameters. Some of the areas were having some physic chemical parameters beyond the safe permissible limit but they can be used after giving a minor household treatments like boiling, filtering etc. These physicochemical parameters are found in higher range due to faulty and malpractices like sewage water disposal, wastewater disposal from industries, overexploitation of ground water etc.

Most of the samples were found unsuitable for drinking on the basis of their microbiological condition. Almost all the sample were found to contain fecal coliform bacteria could be an important factor of water borne diseases. The reason for fecal contamination in ground water samples may be because of sewage disposal which penetrates into ground water and mix with it. The reason for contaminated tap water is poor and old pipelines condition and also because of the cross contamination with sewage disposal pipes due to faulty layouts. Microbial condition of water can also be improved on boiling and filtering the water at household level. Hence it can be concluded that although the water is of good quality on the basis of physicochemical parameters but it should be consumed after boiling and filtering for drinking and cooking purposes. It can be safely use for irrigation and other purposes.

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