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AGRA DISTRICT: AN ANALYSIS OF THE GROUNDWATER QUALITY RESEARCH AND POTENTIAL MANAGEMENT

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ABSTRACT

This present investigation is just an attempt to present the quality of potable water in the Agra district. Its purpose is to analysis the groundwater in the Agra district in the present and subsequent perspective based on its physical and chemical quality and its potable characteristics based on standards. Where it is not potable, attention has been drawn to related initiatives and suggestions. In the present research paper, an in-depth study has been done considering the basis of different blocks of the Agra district. In which reference has been taken to Jal Nigam Agra, Government of India Annual Report 2019, various national/international research papers of various repute, as well as primary, secondary, and tertiary data and samples of various dailies, etc. have been used. The water samples have been analyzed as per LBL approved standard date (APHA 2005). Regional Chemical Laboratory of CGWUB, Lucknow standard methods have been followed and adopted for chemical analysis of various constituents in water samples.

INTRODUCTION

Agra is a famous city, district, and tehsil in Uttar Pradesh province. It is situated on the banks of river Yamuna at 27.18°N 78.02°E. This city held a special place in Indian history. Agra is also very famous for its historical buildings. Its average elevation above sea level is about 171 m (561 ft). It is surrounded by Mathura in the north, Dholpur in the south, Firozabad, Shikohabad in the east, Fatehabad in the southeast, and Bharatpur in the west. Agra is the third-largest city in Uttar Pradesh. The Taj Mahal is a special identity of Agra, which is situated on the banks of the river Yamuna. Agra is one of the major tourist destinations in entire India including Uttar Pradesh.

Life is not possible without water. Water is the basis of life. We mean water in our daily life in its liquid state. It is the largest amount in the human body. Except for fat, water content is the highest in the body. About 70 percent of the human body is water. Various studies have revealed the hard fact that only 1% of the water on earth is potable.

About three-quarters of our earth is surrounded by water. But 97 percent of the water is not potable. Due to the pressure of the increasing population, the problem of potable water is going to emerge in front of us in the future. If we do not become aware of it soon or in time, then our life can be in trouble. In the present research paper, there is only an attempt to overcome the drinking water crisis of the increasing population. Groundwater will naturally be able to overcome the future water crisis. There is hope for the possible future possibilities.

STUDY AREA

Agra is very famous for the Taj Mahal and the city of love. The famous second-century AG geographer Ptolemy also marked it as Agra on the world map. Agra district is located in western Uttar Pradesh, India in the city category Agra, Uttar Pradesh, India with GPS coordinates of 27° 10' 36.0120" N and 78° 0' 29.0592" E. Its height is 169 meters above sea level. And Agra has situated on the banks of river Yamuna.

It is situated at a distance of 378 km west of state capital Lucknow, 206 km south of national capital Delhi, 58 km south of district Mathura and 125 km north of Gwalior.

Agra is one of the most populous cities in Uttar Pradesh. It is the 24th most populous city in India. Its area is 10863 sq km, with a population of 4418797 in which 2364953 male and 2053844 female population. Language Hindi, Total village is 906. District Agra is divided into six tehsils and 15 development blocks.

Mainly the economy of Agra is based on agriculture, while the main basis of the economy of Agra city is small-scale industry, commerce, and trade. Wheat, Paddy, Bajra, Potato, Mustard, Petha, etc. are the major crops. About 40 percent of the total economy of Agra is dependent on industry directly and indirectly.

OBJECTIVES

The objective of the present paper is to make an in-depth

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study of the quality of groundwater available in the Agra district and its potable characteristics from the present and future perspectives. At the same time, efforts have been made to explore those possibilities which will make groundwater potable. Efforts have also been made to identify those efforts which help resolve the related problems and in its overall development.

DATABASE AND METHODS

In the presented research paper, at the block level of Agra district, Jal Nigam Agra, Regional Pollution Board, Uttar Pradesh, Municipal Corporation Agra, Annual Report 2019, references to various research papers, primary, secondary and tertiary samples of various daily national/international newspapers, etc. have been used.

Determination of pH, EC, CO3, HCO3, Cl, F, NO3, SO4, PO4, SiO2, T.H., Ca, Mg, Na&K.

Water samples were analyzed according to NABL-accredited standard methods (APHA 2005)

Regional Chemical Laboratory of CGWB, Lucknow. Adherence to Standard Methods (Table-1)

It has been adopted for the chemical analysis of various components in water samples.

TDS cal = EC * 0.65 mg/l for Total Dissolved Solids (TDS)

where EC is in µS/cm at 25º C method
Mohr's method for Chloride (CI)
Nitrate (NO3) Spectrophotometric method
Total Hardness (T.H.) Titrimetric method
Calcium (Ca) Titrimetric method
Magnesium (Mg) Evaluation from TH and Ca
Sodium (Na) Flame emission photometric method
Potassium (K) Flame emission photometric method

RESULT AND DISCUSSION

It is known that groundwater is the source of 60% of irrigation water and about 85% of drinking water in India. In such a situation, the rapidly falling level of groundwater is emerging as a big challenge.

Considering the results obtained from the above tests, there is a need for more corrective measures for groundwater so that it can be made irrigation and potable.

The guidelines set by BIS (2012) for parameters in various analyses to make water potable, minimum, maximum, mean, and standard deviation of various components determined during chemical value analysis is shown by the following table :

TABLE - 1 Hydro-Chemical Data of Ground Water in Uttar Pradesh (an overview)

S. No.	Constituents	Minimum	Maximum	Average	Std. Dev.
l	pH	7.2	8.95	7.98	0.31
2	EC µS/cm at 25 °C	165	21410	817	1182.82
3	$C0_3$ mg/l	nil	144	7.3	21.16
4	$HC0_3$ mg/l	12	793	281	84.32
5	Cl mg/l	7.0	5602	87.88	325
6	F mg/l	nd	5.9	0.45	0.5
7	$N0_3$ mg/l	nd	246	9.9	21.85
8	$S0_4$ mg/l	nd	2240	44	324.53
9	$P0_4$ mg/l	nd	1.082	0.3	0.14
10	TH (as $CaC0_3$) mg/l	50	7550	262	379.43
11	Ca n1g/l	2	840	41	45
12	Mg n1g/l	1.3	1308	38	68
13	Na mg/l	4	1340	74	112
14	K mg/l	0	860	6.8	31

The various blocks of the Agra district exhibiting high values of E.C. (>5000 µS/cm at 25°C) are tabulated in following Table-

TABLE -2 The blocks exhibiting high values of E.C. (>5000 µS/cm at 25°C µS/cm)

SI.No.	District	Block	Conductivity in µmho/cm at 25°C
1	Agra	Achbncra	6900
2	Agra	Alcola	9104
3	Agra	FatehpurSikari	9419

Total Dissolved Solids (TDS):

A total load of dissolved solids in water is determined theoretically by taking into account the EC of that particular water body.

Thus,
TDS cal = EC * 0.65 mg/l
where EC is in µS/cm at 25º C

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According to the report released by Agra Jal Nigam, 3500 samples were taken from 200 villages of 15 development blocks in the last 11 months. Of them, 80 percent had fluoride of more than 2-2.5 ppm as against 1-1.5 ppm, while 50 percent were found to have almost double the arsenic content, which was 1-1.25 ppm as against .5 ppm.

Even the Total Dissolved Solids (TDS) were found at 2000-2200 ppm, while the maximum permissible limit was 1600 ppm. In some villages, the hardness of water was found to be 1.25-1.5 times more than acceptable.

Source: Jal Nigam Agra, UP

Chloride (Cl):

The chemical data reveals that the concentration of chloride ions ranges from 7.0 to 5602mg/l with an average value of 88 mg/l. From Table no it is clear that 95 % of water samples fall within the acceptable limit prescribed by BIS (2012) and only 1.3 % of samples exhibit Chloride values > 1000 mg/l.

The various blocks exhibiting high values of Cl(>1000 mg/l) are tabulated in the following table below-

TABLE-3 Blocks exhibiting high values of Cl (>1000 mg/I)

SI.No.	District	Block	Cl (mg/I)
1	Agra	Achhnera	2163
2	Agra	Akola	2765
3	Agra	Etmadpur	1312
4	Agra	FatehpurSikari	3049

Nitrate (NO3):

The concentration of Nitrate has been found to vary widely. Water samples fall within the permissible limit of 45 mg/l (BIS 2012) and the samples have a higher level of Nitrate concentration with the highest value of 49 mg/l recorded at Achhnera and Fatehpuri Sikari block of Agra District.

The various blocks exhibiting high values of nitrate concentration (>45 mg/l) are tabulated in the following table

TABLE -4 Blocks associated with high values of nitrate (>45 mg/I)

SI.No.	District	Block	$N0_3$
1	Agra	Achhnera	49
2	Agra	FatehpurSikari	49

Total Hardness (T.H.):

The concentration of Total Hardness has been found to vary widely. Water samples fall within the permissible limit of 600 mg/l (BIS- 2012). The highest value of 3050mg/l was recorded at the Fatehpuri Sikari block of Agra district.

The various Blocks exhibiting high values of T.H. concentration (>600 mg/l) are tabulated in table below-

TABLE -5 Blocks exhibiting high values of Total Hardness (>600 mg/I)

SI.No.	District	Block	Hardness as $CaCO_3$
1	Agra	Achhnera	1500
2	Agra	Akola	2500
3	Agra	Bichpuri	650
4	Agra	Etmadpur	650
5	Agra	FatehpurSikari	3050
6	Agra	Jagner	650

Calcium (Ca):

The concentration of Calcium has been found to vary widely. The water samples fell within the acceptable limit of 75 mg/l (BIS- 2012) and the only samples has a higher level of calcium concentration. Only water samples exhibited calcium values >200 mg/l recorded at the Fatehpuri Sikari block of Agra district.

The only Blocks exhibiting high values of Calcium concentration (>200 mg/l) are tabulated in following table

TABLE -6 Blocks exhibiting high values of Calcium (>200 mg/l)

SI.No.	District	Block	Ca Hardness (mg/I)
I	Agra	Fatehpw-Sikari	460

Magnesium (Mg) :

The main sources of magnesium in groundwater are (i) rainwater (ii) evaporate deposits & (iii) weathering of magnesium silicate minerals. The source of magnesium in igneous rocks is olivine, pyroxenes, amphiboles, dark-colored micas, etc. Among the sedimentary rocks, the sources are chlorite, serpentine biotite, amphiboles, staurolite, etc. Mg is one of the constituents responsible for the hardness of the

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water. The lower concentration of Mg is not harmful but a higher concentration is laxative. The concentration of Magnesium has been found to vary widely. It ranges from 50 mg/l to 492 mg/l in water samples falling within the acceptable limit of 30 mg/l (BIS- 2012). The water samples exhibited Mg values >100 mg/l with a maximum value of 456 mg/l recorded at Fatehpur Sikari block of Agra district

The various Blocks exhibiting high values of Magnesium concentration (>100 mg/l) are tabulated in the following table-

TABLE-7 Blocks exhibiting high values of Magnesium (>100 mg/I)

SL.No.	District	Block	Sample Location	Source	Mg Hardness in mg/I
1	Agra	Achhnera	Block Office	H/P-IM-II	288
2	Agra	Akola	Block Office	H/P-IM-II	492
3	Agra	Bichpw·i	Block Office	H/P-IM-II	120
4	Agra	Fatehpw·Sikari	Block Office	H/P-IM-II	456
5	Agra	Jagner	Block Office	H/P-IM-II	108
6	Agra	Saiyan	Block Office	H/P-IM-II	108

Sodium (Na):

It is found in varying concentrations in all natural waters. It is found in evaporates and seawater in high concentrations. It occurs among silicate minerals in feldspar, mica, amphiboles, and pyroxenes. The main sources of sodium in groundwater are (i) rainwater, (ii) evaporate deposits, (iii) weathering of rock minerals present in the soil and (iv) disposal of sewage and industrial wastes containing sodium. The higher concentration of Na in drinking water is harmful, especially to those suffering from cardiac, and renal diseases in the circulatory system of the human body. The analysis result of shallow groundwater indicates that sodium ranges from 400 mg/l to 900mg/l. Water samples exhibit sodium concentration up to 100 mg/l and 1.22% of samples were found to be associated with extremely high levels of Na concentration >500 mg/l with a maximum value of 900 mg/l recorded at Akola block of Agra district.

The various Blocks exhibiting high values of Sodium concentration (>500 mg/l) are tabulated in the following table-

TABLE-8 Blocks exhibiting high values of Sodium (>500 mg/I)

Sl.No.	District	Block	Na in mg/l
1	Agra	Akola	900
2	Agra	Etamadpur	815
3	Agra	Fatehpur-Sikari	780

Potassium (K):

Although potassium is more abundant than sodium in sedimentary rocks, its concentration in natural waters is quite low due to greater resistance to weathering of potassium-bearing minerals. The main sources of K in natural waters are (i) rainwater, (ii) weathering of Potash silicate minerals, and (iii) potash fertilizers. K enters into the structure of clay and clay-bearing minerals during weathering. In Illite, K ions are incorporated in spaces between crystal layers where these are not removable by further ion-exchange reactions (Buckman & Brady, 1960). Usually, the concentration of K in water from a natural source is small but a high concentration of this ion if present may be attributed to pollution.

Potassium is an essential plant nutrient. It plays an important role in the maintenance of cellular organization and in keeping the protoplasm in a proper degree of hydration by stabilizing the emulsions of highly colloidal particles. K deficiency causes water imbalance. The carbohydrate metabolism is also affected by inadequate supplies of potassium.

The analysis result of shallow groundwater indicates that Potassium ranges from 0 to 860 mg/l. The samples were found to be associated with the extremely high level of K concentration >30 mg/l with a maximum value of 860 mg/l recorded at the Achhnera block of Agra district.

TABLE-9 Blocks exhibiting high values of Potassium (>30 mg/l)

SI.No.	District	Block	K in mg/I
1	Agra	Achhnera	860
2	Agra	Fatehpur-Sikari	39

CONCLUSION

Overall, the groundwater was found suitable for drinking based on tests and analysis done in the Agra district.

Because water is the basis of life. There is a need to be aware of the increasing population and the need to make food and water potable to meet the needs. This more effective step needs to be taken by the government and scientists. In the future, groundwater will be the biggest reservoir to meet the needs. Its quality and conservation need to be made effective.

By and large, the chemical quality of groundwater in the phreatic zone in Uttar Pradesh is found to be suitable for

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drinking purposes as per available analyzed chemical parameter data (as per BIS 2012). The presence of some constituents beyond the permissible limit at some locations renders the water unfit for public water supply.

Considering the parameters responsible for the suitability of groundwater of Agra, Uttar Pradesh it is observed that it is generally fit for irrigation purposes as per Electrical conductivity, Residual Sodium Carbonate, Sodium Adsorption Ratio except at a few places where corrective measures are to be taken before agricultural usage.

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