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ASSESSMENT OF GROUND WATER QUALITY USING WATER QUALITY INDEX IN SAMASTIPUR DISTRICT

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ABSTRACT

Ground water is only the source of fresh water for drinking. Water quality is tested for about 10 physico-chemical parameters of several water samples collected from various locations of Samastipur District. Water were collected at different sites along the Budhi Gandak belt from Pusa to Jitwarpur in Samastipur district of Bihar state during winter season (January and February) of 2018. Parameters such as pH, conductivity, TDS, DO, total hardness, alkalinity, sodium, potassium, calcium, magnesium and chloride as well as heavy metals such as Cu, Zn, Fe and As have been studied. TDS of some samples exceeded the maximum permissible limit of WHO. The samples were analysed using Multiparameter Test Kit, which provide quick and easy water quality testing in the field. The combined effect of all parameters was expressed in terms of Water Quality Index (WQI). The data base obtained from water quality testing is used as attribute data base for preparation of thematic maps showing the spatial distribution of various water quality parameters. Thematic maps of the Water Quality Index were also developed.

Key Words: *Gandak, Ground water, Water quality, Water quality parameters.*

INTRODUCTION

Contamination of drinking water has become a challenge worldwide. Hence, ground water is under stress and needs to develop the ground water resources. The availability of a water supply adequate in terms of both quantity and quality is essential to human existence. Early people recognized the importance of water from a quantity view point. Civilization developed

around water bodies that could support agriculture and transportation as well as provided drinking water. Recognition of the importance of the water quality developed more slowly. The mean daily intake of water by man is estimated to be 3% of the body weight. Thus, water for drinking purposes must not contain harmful substances that causes adverse effects, but at the same time should be aesthetically acceptable to the consumer. The water covers about three quarters of our planet and it is said to note that particularly in rural areas about 70% of the world population survive without clean water.

Water is a chemical compound and may occur in a liquid form or in a solid form or in a gaseous form. All these three forms of water are extremely useful to man, providing luxuries and comforts, in addition to fulfilling his basic necessities of life. Every one of us knows how important and precious the water is. Whenever there is no water in our taps, we become helpless. No life can exist without water, since water is as essential for life as air is. It has been estimated that two-third of human body is constituted of water. Water is absolutely essential not only for survival of human beings, but also for animals, plants and all other living beings. Further, it is necessary that the water required for their needs must be good, and it should not contain unwanted impurities or harmful chemical compounds or bacteria in it. The precious ground water resources are now-a-days contaminated by varieties of man-made activities, which are inevitably coming up in the process of development. Ground waters are contaminated mainly due to infiltration of pollutants in to the soil sub-strata. Site-specific characteristics such as soil type, depth of the aquifer, weather, season and the recharge rate of an aquifer all influence the probability and severity of a particular contamination incident.

MATERIALS AND METHODS

Water quality refers to different physico-chemical parameters for testing and analysis. The WQI has been calculated to evaluate the suitability of groundwater quality of Mehsana district area for drinking purposes. Water samples of bored tube wells were collected from 9 different sites of different regions along the Budhi Gandak belt from Pusa to Jitwarpur in Samastipur district during winter season (i.e., January and February) in 2018. The samples were collected in precleaned polythene bottles with necessary precautions. The pH and DO were measured at the sampling sites. The other parameters like total hardness (TH), calcium, magnesium, sodium, potassium, iron, copper, zinc and arsenic were estimated by using standard methods.

Parameters	**Methods**
Electrical Conductivity (EC)	Conductivity/TDS meter
Total Hardness (TH)	EDTA Titration.

Total Dissolved Solids (TDS)	Conductivity/TDS meter
Dissolved Oxygen (DO)	DO meter
Total Alkalinity (TA)	Neutralising with standard HCl Titration.
pH	pH meter
Calcium	EDTA Titration.
Magnesium	By Calculation
Sodium	Flame photometer
Potassium	Flame photometer
Chloride	Titration by $AgNO_3$
Copper	UV – Visible Spectrophotometer
Zinc	UV – Visible Spectrophotometer
Iron	UV – Visible Spectrophotometer
Arsenic	UV – Visible Spectrophotometer

RESULTS AND DISCUSSION

The pH of water is an important indication of its quality and provides significant information in many types of geochemical equilibrium solubility calculation14. The pH of the groundwater in the study area varied from 7.33 to 7.65. The pH values of the samples under study are well within the limits prescribed by BIS and WHO for various uses of water including drinking and other domestic supplies.

The EC varied from 540 to 951 µScm-1. All the samples were above the permissible limit of WHO. The TDS of the groundwater in the study area varied from 355 to 572 mg/L. Out of 9 samples, 4 samples were found to be above the maximum permissible limit of WHO. As water moves through soil and rock, it dissolves very small amounts of minerals and holds them in solution. Calcium and magnesium dissolved in water are the two most common minerals that make water "hard" along with their carbonates, sulphates and chlorides in groundwater15. Total hardness in the study area varied from 130 to 237 mg/L in the groundwater.

Dissolve Oxygen is an important parameter for water purity. DO content varied from 3.8 to 4.7 mg/L. The presence of carbonates, bicarbonates and hydroxides is the main cause of alkalinity in natural water. The alkalinity value in the groundwater varied from 142 to 170 mg/L. The calcium content of water samples fluctuated in the range of 45 to 87 mg/L. The results show that nearly 33% of the samples exceeded the limit of WHO. The magnesium concentration varied from 21.2 to 37.2 mg/L. All the samples were within the permissible limit of WHO. The sodium concentration varied from 8.60 to 41.63 mg/L in the study area. All the samples fall within the permissible limit of WHO.

The main sources of potassium in ground water include rain water, weathering of potash silicate minerals, use of potash fertilizers and use of surface water for irrigation. It is more abundant in sedimentary rocks and commonly present is felspar, mica and other clay minerals. The potassium concentration ranged from 4.05 to 11.57 mg/L in the groundwater samples. When compared with European Union (EU) standards, the concentration of potassium exceeded in two sample location. The potassium concentration in water is low because of high degree of stability of potassium bearing minerals.

The chloride concentration in the study area ranged from 58.4 to 135.2 and hence all the samples under study fall within the desirable limit of 250 mg/L of WHO. The limits of chloride have been laid down primarily from taste considerations. However, no adverse health effects on humans have been reported from intake of waters containing even higher content of chloride.

The amount of Copper in drinking water arises from corrosive action of water, leaching Cu from copper pipes. The copper content in water samples under study ranged from 0.022 to 0.78 mg/L. Excess copper in human body causes sporadic fever, coma and even death. The water samples under study are free from copper hazard. Zinc enters in the drinking water from the deterioration of galvanized iron. Accumulation of zinc in human body causes vomiting, renal damage, cramp, etc. The Zn content in water samples varied from 0.26 to 0.75 mg/L and hence water samples are free from zinc contamination.

The iron limit in water supplies for potable use have not been laid down from health consideration but due to the fact that iron in water supplies may cause discoloration of cloths, plumbing fixtures and porcelain wares besides imparting bitter taste. In drinking water, iron may be present as Fe2+, Fe3+ and Fe(OH)3 in suspended or filterable forms. However, excessive concentration may cause problems like rapid increase in respiration, hypertension and drowsiness. The iron concentration in water samples under study ranged from 0.35 to 1.80 mg/L. All the samples in the study area exceeded the permissible limit of WHO. This indicates high content of iron in groundwater of the study area.

In typical ground water environments, arsenic may be present in both the As(III) and As(V) states. As(III) is generally more mobile in water than As(V), and has higher toxicity. Due to the withdrawal of excessive amounts of groundwater, problems of increased iron, fluoride and arsenic contamination have been reported in different parts of India. Two (i.e., S3 and S6) out of nine groundwater samples in the study area were found to have arsenic contamination, exceeding the maximum permissible limit of 10 ppb set by WHO. The results

obtained by us regarding the various water quality parameters have been incorporated below –

Sample No.	pH	EC	TDS	TH	DO	TA	Ca	Mg	Na	K	Cl^-	Cu	Zn	Fe	As
S1	7.35	650	432	168	4.5	180	45	21.2	10.0	7.2	144.0	0.021	0.024	1.12	0
S2	7.38	538	348	142	4.0	150	51	20.5	8.61	6.75	65.5	0.020	0.31	0.09	0
S3	7.49	854	500	228	3.5	192	81	30.7	24.50	6.92	59.9	0.045	0.54	0.82	15
S4	7.29	946	555	235	4.5	143	85	35.6	14.16	10.74	110.5	0.035	0.61	1.14	0
S5	7.39	639	428	186	4.2	218	42	30.5	9.85	11.54	122.2	0.052	0.31	0.84	0
S6	7.32	861	543	243	4.2	186	84	37.2	16.25	8.54	71.6	0.058	0.89	1.80	50
S7	7.63	585	384	345	128	3.5	26	32.2	40.0	4.65	85.0	0.065	0.64	0.45	0
S8	7.50	900	510	215	4.7	225	75	30.4	19.5	5.43	123.8	0.028	0.58	0.54	0
S9	7.31	699	463	189	4.3	175	65	28.7	28.8	3.9	68.9	0.062	0.54	0.38	0
WHO	6.5-9.2	300	500	500	-	200	75	50	200	-	250	1	5	0.30	10
ICMR	6.5-9.2	-	500-1500	300	-	-	75	50	-	-	200	0.05	0.1	0.1	-

*all parameters are expressed in mg/L except pH, EC in µScm-1 and Arsenic (in ppb)

CONCLUSION:

The physico-chemical properties studied revealed that the groundwater from Pusa to Jitwarpur in Samastipur district have high electrical conductivity values which indicates the presence of high ionic concentrations. Besides, some samples showed high content of TDS which may cause aesthetic problems and nuisance. However, other physico-chemical parameters were well within the respective maximum permissible limits. As far as heavy metals concern, iron was found much above the maximum permissible limit of WHO in almost all the samples. Surprisingly, arsenic was found above the permissible limit of WHO in a couple of samples which is a matter of great concern and is a potential health risk to the people living in this area. Thus, it calls for an urgent need of an efficient planning and implementation of programmes of water resources appraisal, development, management and remediation besides frequent monitoring to check further increase in the concentration of heavy metals especially arsenic in the study area.

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