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Research Article

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Water quality index assessment of ground water in Koilwar block of Bhojpur (Bihar)

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ABSTRACT

The present work is aimed at assessing the water quality index (WQI) for the ground water of Koilwar block. This has been determined by collecting ground water samples to a comprehensive physico chemical analysis. In the present study Sixty water samples(six water samples from one village) are taken from ten different villages of Koilwar block and 11 water quality parameters are have been considered: Temperature, pH, Total hardness, Iron, Chloride, Fluoride and Total dissolved solids, Calcium, Magnesium, Sulphate and alkalinity. The WQI for these samples ranges from 40.67- 69.59. The analysis reveals that the ground water of the Koilwar block needs some treatment before consumption and it is also needs to be protected from contamination.

Key words: Ground water, water quality index, physico-chemical analysis, Koilwar block (Bhojpur).

INTRODUCTION

Globally, there is increasing awareness that the water will be one of the most critical natural resources in future. Water scarcity is increasing worldwide and pressure on the existing water resources is increasing due to growing demand of different sectors such as domestic, agriculture and industrial, hydropower etc. Therefore evaluation of water quality is important research topic in the recent years. It is difficult to understand the phenomena fully because the chemistry of water reveals much about the metabolism of the ecosystem and explain the general hydro biological relationship. Environment leading to water quality and depletion of aquatic biota. It is therefore necessary that the quality of drinking water should be checked at regular time interval because due to use of contaminated drinking water, human population suffers from a variety of water borne disease. [1] Ground water is used for domestic and industrial water supply and irrigation all over's the world. In last few decades, there has been a tremendous increase in the demand for the fresh water due to rapid growth of population and their accelerated pace of industrialization. Human health is threatened by most of agriculture developed activities particularly in relation to excessive application of fertilizers and unsanitary condition. According to WHO, about 80% of all the diseases in human beings are caused by water? Once the groundwater is contaminated, its quality cannot be restored by stopping the pollutants from their sources. It therefore becomes imperative to regulate monitor the quality of groundwater and to device ways and means to protected. Water quality index is the one of the most effective tools. [2-5] WQI is defined as a rating reflecting the composite influence of different water quality parameters. WQI is calculated from the point of view of suitability of ground water for human consumption. [6] WQI is an arithmetic tools used to transform

large water quality data into a single cumulatively derived number. It is represent a certain level of water quality while eliminating the subjective assessment of such quality. [7-9] to summarized the vast amount of analytical data regarding water quality into useful, easy to understand and convenient management tools for the assessment of water quality, the concept of WQI was developed and proposed first by Horton. [10] It is a single number like a grade that express the overall water quality at a certain area and time based on several water quality parameters .When theirs specific characterization and limitations are considered. [11-13] In present paper we evaluate the WQI of Koilwar.

EXPERIMENTAL SECTION

Figure1 - Location of Bihar in India

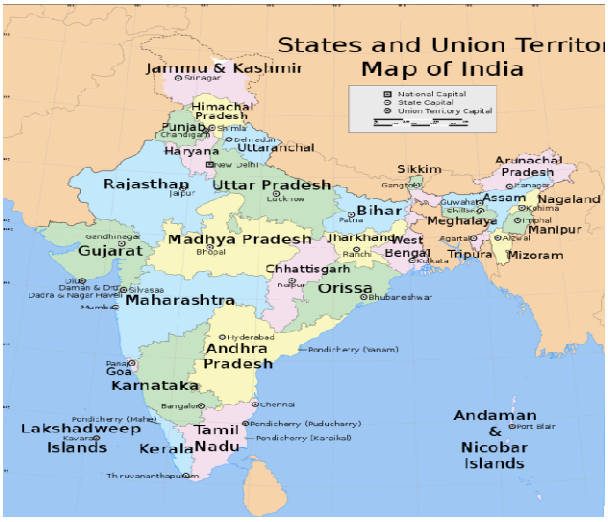


Figure 2- Location of Bhojpur in Bihar

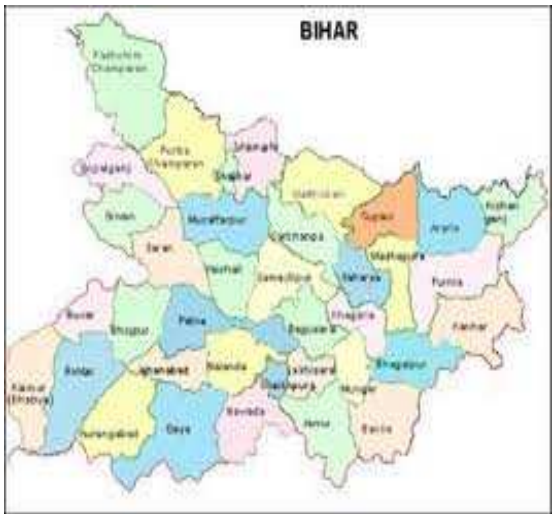
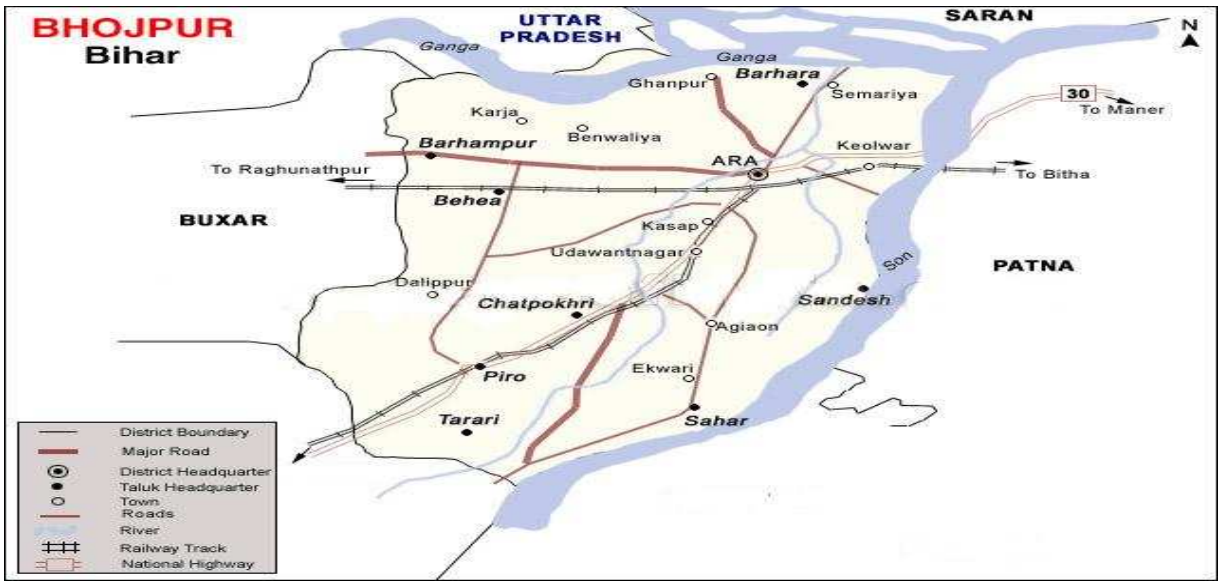


Figure 3- Location of Koilwar Block in Bhojpur district (Bihar)



STUDY AREA- Koilwar is a block of Bhojpur district. It is a part of Patna Division. Bhojpur district (Plate I) falls within 25^0 00'' to $25^0$30'' N and $84^0$15" to 84^0 45''E, the area is bounded by river Son in the east, Dharmawati-Gangi rivers in west and river Ganga in the the North. Its area spread over a total geographical area of 33.95 sq/Km. Ara block having 203395 population and this adopts tropical monsoon climate.[14] People of Koilwar block are

mainly work in agricultural activities. The main sources of water supply in the area is hand pumps , bore holes and manually operated hand pumps, dug wells. The precipitation which is the sole source of ground water recharges in the study area is very low due to rain fall.

WATER SAMPLING - In present investigation sixty water samples taken from ten different villages were collected. The water samples were collected in polythene bottles which were cleaned with acid water, followed by rinsing twice with distilled water. The water samples are chemically analyzed. [15] The analysis of water was done using procedure of standard methods.

METHODOLOGY- The pH was measured by using Eutech-cybernetics PH meter. [16] Total hardness, calcium, magnesium were measured by EDTA titration methods. [17] Total alkalinity was determined by volumetrically by silver nitrate titrametric methods using potassium chromate as indicator. [18]. Sulphate was determined nepthalometrically using ELICO-52 Nepthalometer. [19] Fluoride content in water was measured by ELICO-52 Spectrophotometer. The Physico-chemical analysis was carried out according to standards methods. [20, 21, 22] Temperature and TDS were observed with thermometer and with the help of digital water kit. [23] Iron was determined by spectrophotometer. [24]

Calculation of Water Quality Index -The calculation of WQI was made using weighed Arithmetic method in following steps- [25] Let there be water quality parameters and quality rating (qn) corresponding to nth term parameter is a number reflecting relative value of this parameter in the polluted water with respect to its standard permissible limits value. qn values are given by the relationship .

$qn = 100 (Vn – Vi) / (Vs – Vi)$

Where Vs- standard value, Vi- ideal value, in most cases Vi = 0 except in certain parameters like pH, dissolved oxygen etc., calculation of quality rating for pH and DO (Vi was not zero).

$q\ pH = 100 (V\ pH – 7.0) / (8.5-7.0)$ and $q\ DO = 100 (V_{DO} – 14.6) / (5.0-14.6)$

Calculation of Unit Weight –The unit weight (Wn) to various water quality parameters is inversely proportional to the recommended standards for the corresponding parameters.

$Wn = k / Sn$

where Wn= unit weight for the nth parameter, Sn= standards permissible value for nth parameter, k= proportionality constant

The unit weight (Wn) values in the present study are taken study are taken. [26]

Calculation of WQI -

WQI $= \sum qn\ Wn / \sum Wn$

where n= i-n

The suitability of WQI values for human consumption are rated as follows [27]:

0-25 = Excellent, 26-50 = Good, 51-75 = Bad, 76-100 = Very bad and above it = Unfit

RESULTS AND DISCUSSION

Temperature- Temperature of water is basically important because it effects biochemical reactions in aquatic organisms. A rise in temperature of water leads to the speeding up of chemical reactions in water**,** reduces the solubility of gases and amplifies the taste and odours. The average temperature of the present study ranged from 27.2-28.3 ^{O}C**.**

pH- The pH value of natural water changes due to biological activity and industrial contamination. Higher pH includes the formation of trihalomethanes which are toxic. The pH values of present investigation were within the WHO limits.

Alkalinity- Alkalinity is an important if it is less than 100 ppm is desirable for domestic use; however in large quantities it imparts bitter taste to water. In the present investigation is found in range of 173-304 and above the limit.

Hardness- Hardness is a measure of the ability of water to cause precipitation of insoluble calcium and magnesium salts of higher fatty acids from soap solution. In present study it is obtained in the range of 213-372. In present investigation calcium and magnesium content are found in 68-128 and 07-21 mg/l.

Chloride – Chloride occurs in all types of natural water. The high concentration of chloride is considered to be an indication of population due to high organic waste of animal origin. Chloride values obtained in the study are found in the range between 12-32mg/l.

Sulphate- Sulphate ions do not affect the taste of water, if present in low concentrations. The sulphate ion concentration in the present study is varied 08-18 mg/l.

Fluoride – The concentration of fluoride content present in water is higher and low then various problems are arises in human, animal and plants and also it a source of water pollution.[28] In study it varies in the range of 0.18-1.09.

Iron – In present study it is found in the range 0.23-0.32.

The calculation of Water Quality Index (WQI) is taken in Table – 2 and found the seven village water have good water quality index (WQI) , that indicates the water quality is good . Further it's also indicates that three villages water samples are bad in water quality index parameter.

Table 1- Physico- chemical parameters of water samples collected form ten villages of koilwar block

PARAMETER	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Temp.	27.6	28.3	26.4	27.2	27.4	28.1	27.9	27.3	27.6	27.2
pH	7.3	7.2	7.8	7.6	7.9	7.9	7.6	7.2	7.5	7.3
TA	294	304	207	173	239	290	248	269	280	235
TH	285	372	333	213	270	288	350	225	245	334
TDS	406	510	466	324	266	412	478	370	541	310
Ca^{2+}	87	128	111	70	115	68	88	113	98	93
Mg^{2+}	12	17	10	08	07	12	21	07	10	13
Cl^{-}	32	21	12	14	29	13	18	33	18	16
F^{-}	0.21	0.26	0.28	0.07	0.18	0.86	0.81	1.09	0.29	0.73
Fe	0.30	0.27	0.25	0.23	0.28	0.27	0.32	0.42	0.26	0.31
So_4^{2-}	15	08	06	08	06	15	10	09	17	18

Where S1-Daulatpur, S2- Jalpura, S3- Narbirpur, S4- Mathurapur, S5- Dhandiha, S6- Gopalpur, S7-Deoria, S8- Dhandha, S9- Kusihan, S10- Chandi

Table 2- Water quality index (WQI) of water samples of Koilwar Block

Parameter	WHO standards	Unit weight	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
pH	8.5	0.0699	1.40	0.93	3.72	2.80	4.20	0.47	0.56	0.84	1.21	3.78
TA	120	0.0078	1.93	2.00	1.36	1.14	1.57	1.91	1.63	1.77	1.84	1.54
TH	500	0.0013	0.08	0.10	0.09	0.06	0.08	0.08	0.10	0.06	0.07	0.09
TDS	500	0.0008	0.06	0.08	0.07	0.05	0.04	0.06	0.07	0.06	0.08	0.05
Ca^{2+}	75	0.0053	0.61	0.90	0.78	0.50	0.81	0.48	0.62	0.80	0.70	0.66
Mg^{2+}	30	0.0068	0.27	0.38	0.23	0.18	0.16	0.30	0.48	0.16	0.23	0.29
Cl^{-}	250	0.0036	0.04	0.03	0.02	0.02	0.04	0.18	0.03	0.05	0.03	0.02
F^{-}	1.0	0.0040	0.08	0.10	0.11	0.02	0.07	0.34	0.32	0.43	0.12	0.29
Fe	0.30	0.0090	0.90	0.81	0.74	0.67	0.84	0.81	0.96	1.25	0.78	0.93
So_4^{2-}	200	0.0062	0.04	0.02	0.02	0.02	0.18	0.04	0.03	0.03	0.05	0.05
Wn		0.1148										
$\sum(Wn\,Xqn)$			5.41	5.35	7.14	5.46	7.99	4.67	4.80	5.45	5.11	7.70
WQI			47.1	46.6	62.19	47.56	69.59	40.67	41.81	47.82	44.51	67.07

Table 3- Water quality classification based on WQI value

WQI VALUE RANGE	WATER QUALITY	NO. OF STATION
0-25	Excellent	Nil
25-50	Good	07(S1,S2,S4,S6,S7,S8,S9)
51-75	Bad	03(S3, S5,S10)
75-100	Very Bad	Nil
ABOVE 100	Unfit	Nil

Where S1*-Daulatpur,* ***S2****- Jalpura,* ***S3****- Narbirpur,* ***S4****- Mathurapur,* ***S5****- Dhandiha,* ***S6****- Gopalpur,* ***S7****-Deoria,* ***S8****- Dhandha,* ***S9****- Kusihan,* ***S10****- Chandi*

CONCLUSION

In this study we have analyzed sixty water samples from ten villages of Koilwar block. The results observed that some parameters shown higher values and which don't within the limits of WHO standards also water quality index of three villages are bad in water quality. So highest priority should be given to water quality monitoring and there indigenous technologies should be adopted to make water fit for domestic and drinking purpose after treatment.

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