GROUNDWATER QUALITY ANALYSIS OF PALI BLOCK OF GORAKHPUR DISTRICT USING GIS

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ABSTRACT- Ground water plays a huge role in human existence and it is used for the purposes such as agriculture and drinking. In India, by far most of the populace is dependent on ground water. As a result of snappy advancement of populace, urbanization, industrialization and horticulture works out, ground water resource is being depleted. Thus, it is essential to screen the nature of water with the help of physio-chemical parameters.

This examination assesses the physio-chemical properties of ground water, for example, Electrical Conductivity (EC), pH, Fluoride (F), Total Hardness (TH), Total Dissolved Solid (TDS), Nitrate (NO3), IRON(F), ARSENIC(As) by gathering 13 water sample from handpumps (India Mark II) which is appropriated inside Pali Block of Gorakhpur in November, 2020. Each physio-chemical parameter was differentiated to the satisfactory least cutoff indicated by the BIS (IS 10500:2012). Global Positioning System is used for plotting the water test areas and planning of water quality is done by use of Inverse Distance Weighted (IDW) method of Interpolation in ArcGIS 10.3.1. This examination assesses water quality of Pali Block of Gorakhpur area.

Key Words: Physio-chemical, Inverse Distance Weighted (IDW), Water Quality Index (WQI), spatial distribution maps

1. INTRODUCTION

In the present situation, in a huge segment of the metropolitan territories in India, the step by step water demand is met by groundwater use, as the surface water is either missing or sullied. Groundwater is the essential source that is normally used for drinking and water framework purposes in provincial, metropolitan and semi metropolitan regions. All things considered, the examinations of physiochemical and organic boundaries lead to study the idea of groundwater. Hydro chemical characteristic of groundwater can in like manner be inspected for the groundwater assessment. Geographic Information System (GIS) arranging technique is the best agent contraption in the assessment of quality of groundwater and its utilization for water system, drinking and constructional needs. ArcGIS Software can accomplish better comprehension of groundwater quality by speaking to the information. There is an opportunity of changes in groundwater quality due to hydrology and geologic conditions over some vague time span. Moreover, foolish evacuation of waste or refuse are one among the fundamental components for groundwater pollution. The current examination is completed in the Pali block, situated in Gorakhpur region in Uttar Pradesh. Notwithstanding, the significant wellspring of drinking water for region is groundwater which is now debased because of modern foundations. The data of the groundwater is contrasted with Bureau of Indian Standards (BIS) and World Health Organization (WHO) guidelines to guarantee the nature of the water.

1.1 Objectives of present study

The objective of current examination are given underneath:

- To plot the GPS points of water sample locations.
- To survey the water quality parameters.
- To compute the Water Quality Index (WQI).
- To make spatial distribution map of various water quality parameters.

2. STUDY AREA

Pali is a Block situated in Gorakhpur area in Uttar Pradesh. Placed in the rural area of Uttar Pradesh, it is one of 19 blocks of Gorakhpur region. According to the organization register, the block number of Pali is 632. The block has 169 towns and there are absolute 22470 homes in this Block. It is in the 80 m elevation(altitude).

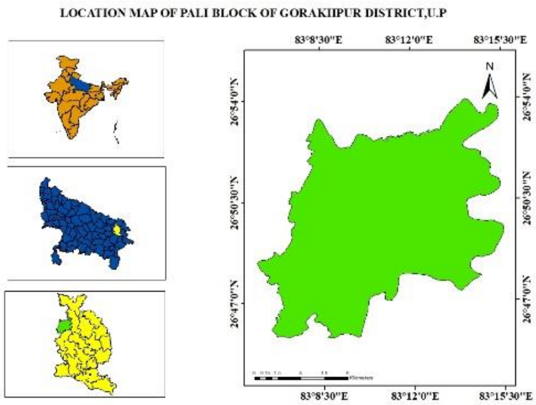

Figure 1 LOCATION MAP OF STUDY AREA

3. DATA AND SOFTWARE USED

3.1 Data Used

• Layout map of Pali block

• Ground water quality parameters

• Survey of India toposheet.: 63N/1, 63N/5

3.2 Instruments

• Global Positioning System

• Water quality field kit

• Digital pH-meter

• Digital conductivity meter

• UV-Visible Spectrophotometer

3.3 Software

• ArcGIS 10.3.1

• Microsoft package

4. METHODOLOGY

4.1 Sample Collection

A total of 13 ground water samples were accumulated from India Mark II handpump which is scattered inside Pali block of Gorakhpur district. Global Positioning System (GPS) was used for discovering the water test locations and spatial distribution mapping of water quality was done by the use of Inverse Distance Weighted (IDW) method of Interpolation in ArcGIS 10.3.1. Every sample was accumulated by 1 litre corrosive washed polyethylene HDPE bottle. The compartment was totally stacked up with water taking thought that no air bubble was stuck inside the water test. Careful step was also taken to keep from sample preserved during move to the examination office. Electrical conductivity (EC) and ability of hydrogen (pH) were settled on the actual field using progressed meters. Physical and Chemical parameters are assessed with the standard method of Ground water excellent recommended in standard procedure for the test of water and wastewater American Public Health Association (APHA 1995). The water sample were kept at a temperature underneath 4°C going before examination in the lab. The sampling locations are appeared in figure 2.

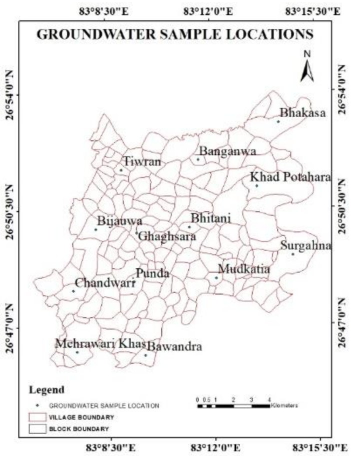

Figure 2 GROUNDWATER SAMPLES LOCATION MAP

Table 1 BIS (IS 10500:2012) STANDARDS FOR DRINKING WATER

S.NO.	PARAMETERS	ACCEPTABLE LIMIT (mg/L)	MAX ALLOWABLE LIMIT (mg/L)
1.	pH	6.5-8.5	No relaxation
2.	Electrical Conductivity (µS/cm)	Not Specified	----------
3.	Total Dissolved Solid	500	2000
4.	Total Hardness (as $CaCO_3$)	300	600
5.	Iron	0.3	No relaxation
6.	Arsenic	0.01	0.05
7.	Fluoride	1	1.5
8.	Nitrate	45	No relaxation

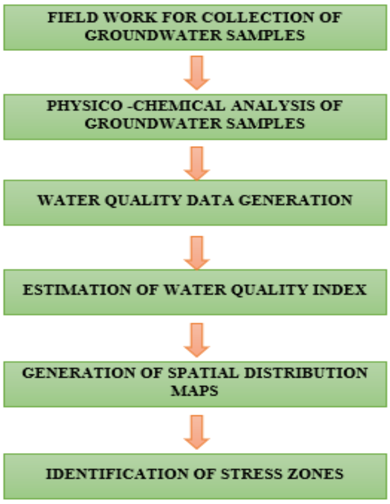

Figure 3 FLOW CHART OF METHODOLOGY

4.2 WATER QUALITY INDEX

Water quality index is probably the best procedure for giving water quality information to concerned inhabitants and technique makers. It propels into a critical limit for groundwater examination and the board. The water quality list summarizes colossal measures of water quality information in essential terms, for instance phenomenal, great, awful, etc.

Three steps are followed to figure WQI. In the underlying advance, a weight (wi) was designated to all of the parameters subject to their overall importance in overall nature of drinking water (Table 2). The parameter nitrate was assigned the most outrageous heap of 5 due to its critical importance in the assessment of water quality

In the second step the relative weight (Wi) is determined from the condition as follows:

$Wi = wi/\Sigma wi$

Where, Wi is relative weight, wi is every parameter's weight and n is number of parameters

Table 2 likewise gives determined relative weight (Wi) values for every parameter.

In third step, quality rating scale (qi) for every parameter is relegated by separating its focus by its individual standard in water test as per the rules set down in the BIS and the and the outcome increased by 100:

$qi = (Ci/Si) \times 100$

Where, qi is the quality ranking,
Ci denotes the concentration of respective water quality parameter of each water sample in mg/l, and Si denotes Indian drinking water level in mg/l for the parameters in accordance to the BIS 10500 :2012 guidelines.
The SI is calculated for the computation of WQI for the water quality parameters, according to the equation

$$\mathbf{SI_i = W_i q_i}$$

$$\mathbf{WQI = \sum SIi}$$

where, SIi is the subindex of the ith parameter,qi= concentration-based rating of ith parameter

Table 2 RELATIVE WEIGHTS OF WATER QUALITY PARAMETER USED IN COMPUTATION OF WQI

WATER QUALITY PARAMETERS	BIS std (Si)	WEIGHT (wi)	RELATIVE WEIGHT (Wi=(wi/Σwi)
pH	8.5	4	0.14815
TOTAL DISSOLVED SOLIDS	500	4	0.14815
TOTAL HARDNESS	300	2	0.07407
FLUORIDE	1	4	0.14815
NITRATE	45	5	0.18519
IRON	0.3	4	0.14815
ARSENIC	0.01	4	0.14815

The calculated WQI values are categorized into five categories, "excellent water" into "water unsuitable for drinking."

Table 3 CATEGORY OF WATER AS PER WQI VALUE

WQI VALUE	WATER QUALITY
< 50	excellent
50 - 100	good water
100 - 200	poor water
200 - 300	very poor water
> 300	unsuitable for drinking

5. RESULT AND DISCUSSION

Table 4 GEOCHEMICAL ANALYSED DATASET OF GROUNDWATER SAMPLES

S. No.	SAMPLE LOCATIONS	pH	E.C.	TDS	T.H	F	NO3	Fe	As
			μs/cm	mg/l	mg/l	mg/l	mg/l	mg/l	(ppb)
1	Bhakasa	7.9	395	237	147	1.56	0.4	1.9	0
2	Banganwa	7.5	358	215	141	1.25	0	0.9	0.68
3	Tiwran	7.4	346	208	161	1.32	0	0	0.94
4	Bijauwa	7.4	411	247	141	1.25	0.2	0.8	0
5	Ghaghsara	7.4	436	262	161	0.77	0.9	0.6	0
6	Bhitani	7.3	438	263	161	1.89	0.4	0.4	0
7	Surgahna	7.9	446	268	141	0.99	0	0.3	0
8	Punda	7.7	358	215	161	1.25	0	0.4	0.47
9	Chandwari	7.4	347	208	141	1.36	0.2	0	0.85
10	Mehrawari Khas	7.2	365	219	147	1.22	0.3	0.6	0
11	Khad Potahara	7.2	393	235	150	1.32	0.4	0.6	0
12	Mudkatia	7.3	489	293	185	1.4	0.2	0.3	0
13	Bawandra	7.1	450	270	130	1.4	0	0.3	0.35

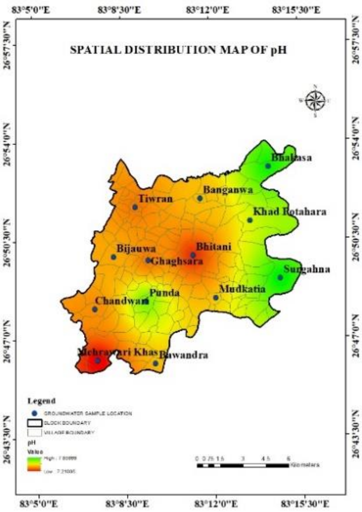

Figure 4 SPATIAL DISTRIBUTION MAP OF pH

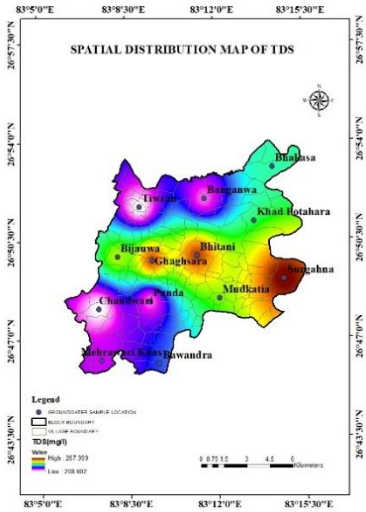

Figure 5 SPATIAL DISTRIBUTION MAP OF TDS

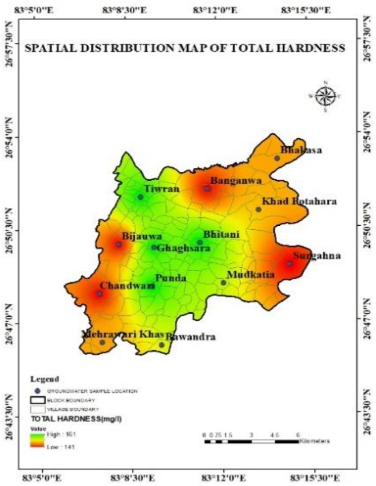

Figure 6 SPATIAL DISTRIBUTION MAP OF TH

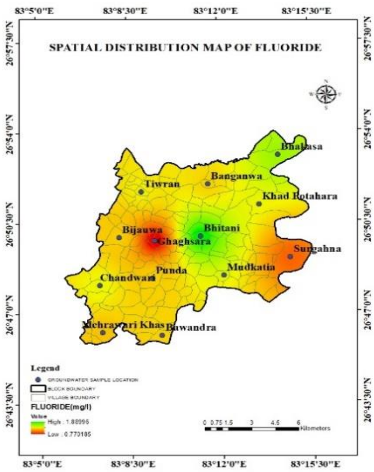

Figure 6 SPATIAL DISTRIBUTION MAP OF FLUORIDE

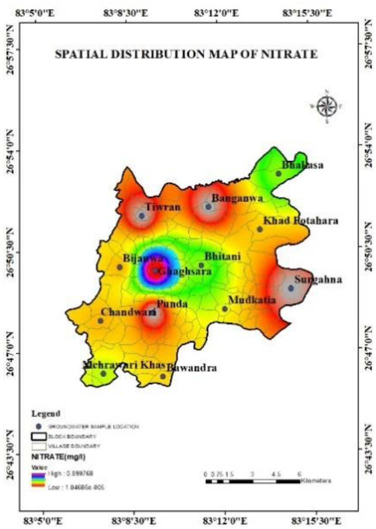

Figure 7 SPATIAL DISTRIBUTION MAP OF NITRATE

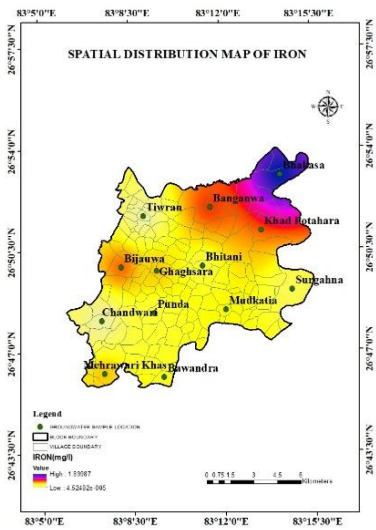

Figure 8 SPATIAL DISTRIBUTION MAP OF IRON

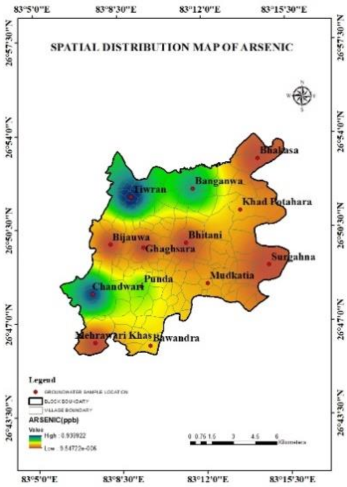

Figure 8 SPATIAL DISTRIBUTION MAP OF ARSENIC

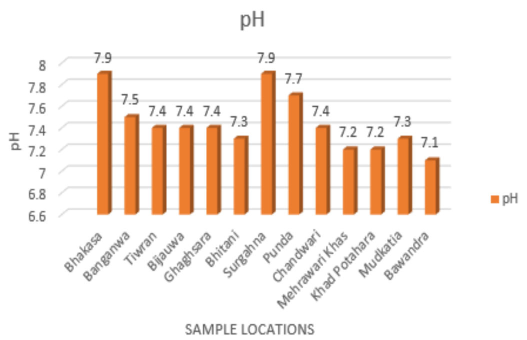

CHART 1 pH VARIATION

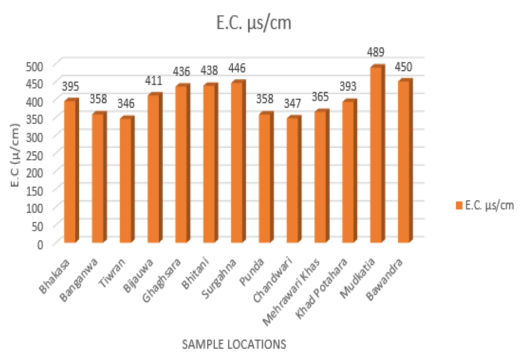

CHART 2 EC VARIATION

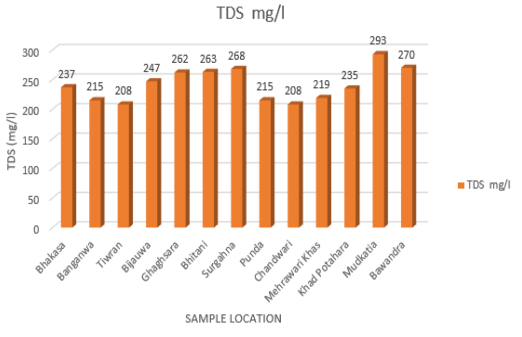

CHART 2 TDS VARIATION

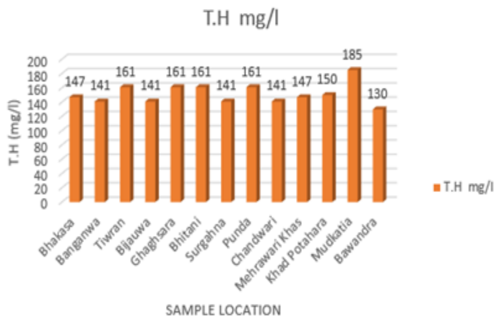

CHART 4 TOTAL HARDNESS VARIATION

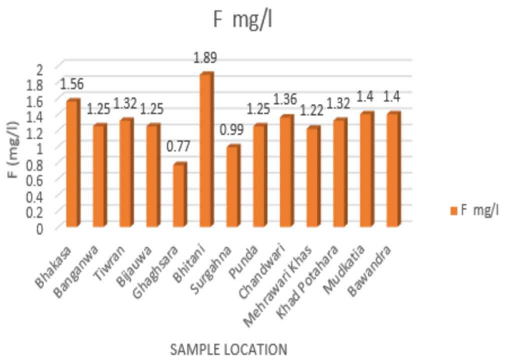

CHART 3 FLUORIDE VARIATION

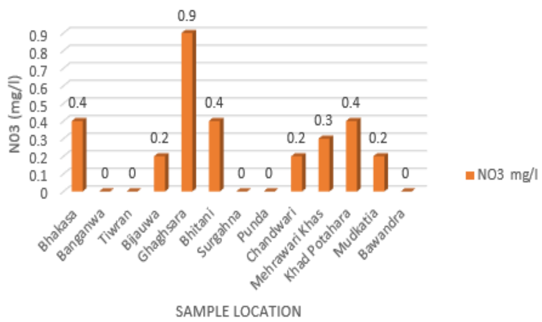

CHART 6 NITRATE VARIATION

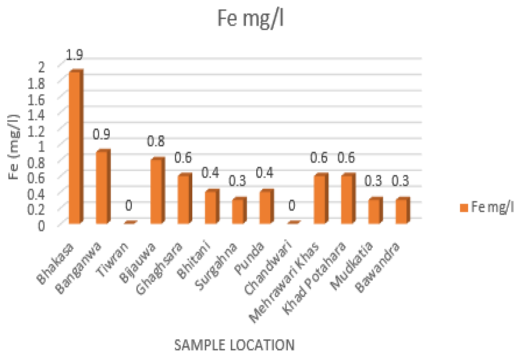

CHART 4 IRON VARIATION

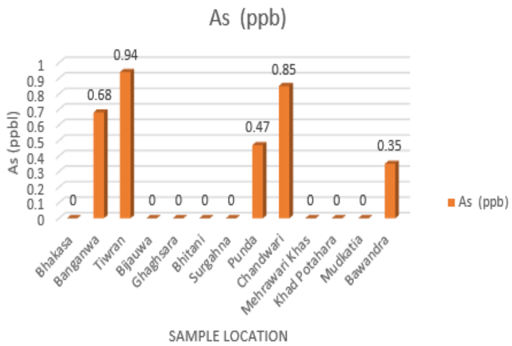

CHART 8 ARSENIC VARIATION

Table 5 WATER QUALITY INDEX

WATER SAMPLE LOCATIONS	WATER QUALITY INDEX(WQI)	QUALITY OF WATER
BHAKASA	141.44	POOR WATER
BANGANWA	86.79	GOOD WATER
TIWRAN	43.88	EXCELLENT
BIJAUWA	81.82	GOOD WATER
GHAGHSARA	65.94	GOOD WATER
BHITANI	72.31	GOOD WATER
SURGAHNA	54.58	GOOD WATER
PUNDA	62.77	GOOD WATER
CHANDWARI	43.99	EXCELLENT
MEHRAWARI KHAS	70.52	GOOD WATER
KHUD POTAHARA	72.27	GOOD WATER
MUDKATIA	61.61	GOOD WATER
BANWANDARA	59.65	GOOD WATER

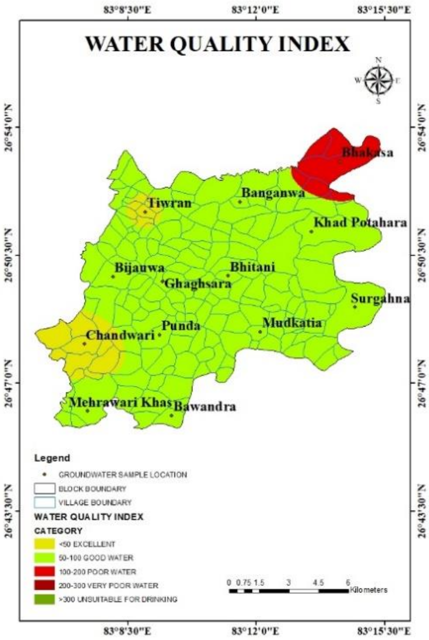

Figure 10 WATER QUALITY INDEX MAP

6. CONCLUSION

The present study investigates water quality parameters i. e pH, Electrical conductivity, Total dissolved solid, Total hardness, Nitrate, Fluoride, Iron and Arsenic of Pali block of Gorakhpur district, U.P to check the suitability for purpose of drinking. The parameters such as pH, Electrical conductivity, Total dissolved solid, Total hardness, Nitrate and Arsenic are within permissible limits as per BIS (IS 10500: 2012) Standards for drinking water. However, in some part of Pali block, the level of fluoride and iron exceeded permissible limit for drinking purpose. Hence, the water is not suitable for drinking directly, as it may result in bad health of the people living there. However, with some suitable treatments, it can be used for drinking purpose.

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