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Physio-Chemical Parameters of Surface Water of Hatia Region at Ranchi, Jharkhand

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Abstract: *Adequate supply of fresh and clean drinking water is a basic need for all human beings. In terms of public and environmental health, it is essential that water sources should be free from any physical, chemical and pathogenic microbes for safe drinking purposes. In India, Jharkhand has population of over 32 million with almost 54% of it living below the poverty line and most of them are directly dependent on surface water for their daily works like bathing, washing as well as drinking. In Ranchi main source of surface water is rainfall, it is approximately 1316 mm which creates surface water in this region and is also found in the form of surface runoff and stagnant water. In this research article we have closely monitored the surface water in Hatia region namely Basargarh pond Hatia for four months from the month of March to June 2019.*

Keywords: *Pond, Fluoride, Coliform, water pollution, Heavy metal, contamination,*

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I. Introduction

Hatia, is a well-known place in Ranchi, Jharkhand. It has a very dense population. This region is facing severe water crisis this year with underground water falling deeper than ever in the state, with ponds and hand pumps drying up in many areas, people are forced to depend on water supplied by tanks provided by the Ranchi Municipal Corporation. Surface water pollution with chemical, physical and biological contaminants by anthropogenic activities of great environmental attention all over[1, 2, 3]. As a resource, water is essential in maintaining the livelihoods of the people[4]. 70% of the earth's surface is covered with water, which amounts to 1400 million cubic kilometres (m km^3)[5]. However, 97.5% of this water being sea water, it is salty. Fresh water availability is only 35 mkm^3 [6]. Out of the total fresh water, 68.7% is frozen in ice caps, 30% is stored underground and only 0.3% water is available on the surface of the earth[7]. Out of the surface water, 87% is stored in lakes, 11% in swamp and 2% in rivers[7]. As all the sweet water is not extractable, only 1% of the total water can be used by human beings[8].

Though in general the main causes of water scarcity are climate change accompanied with high temperature, low precipitation and loss of vegetation cover but every geographical area should have some inborn causes related to its origin, structure, geographical location and setup. Ranchi, Hatia is one of the most known places of Jharkhand and densely populated rural zone, but water scarcity as well as water impurity is a regular phenomenon of Hatia. It is very essential to identify the causes of water scarcity and contamination of surface water of the Ranchi district which is totally dependent on surface water for the socioeconomic development of the district as water plays a significant role in human development. The present article is about a useful effort to identify the root causes of surface water contamination of Hatia, Ranchi district in Jharkhand, India.

Study Area:

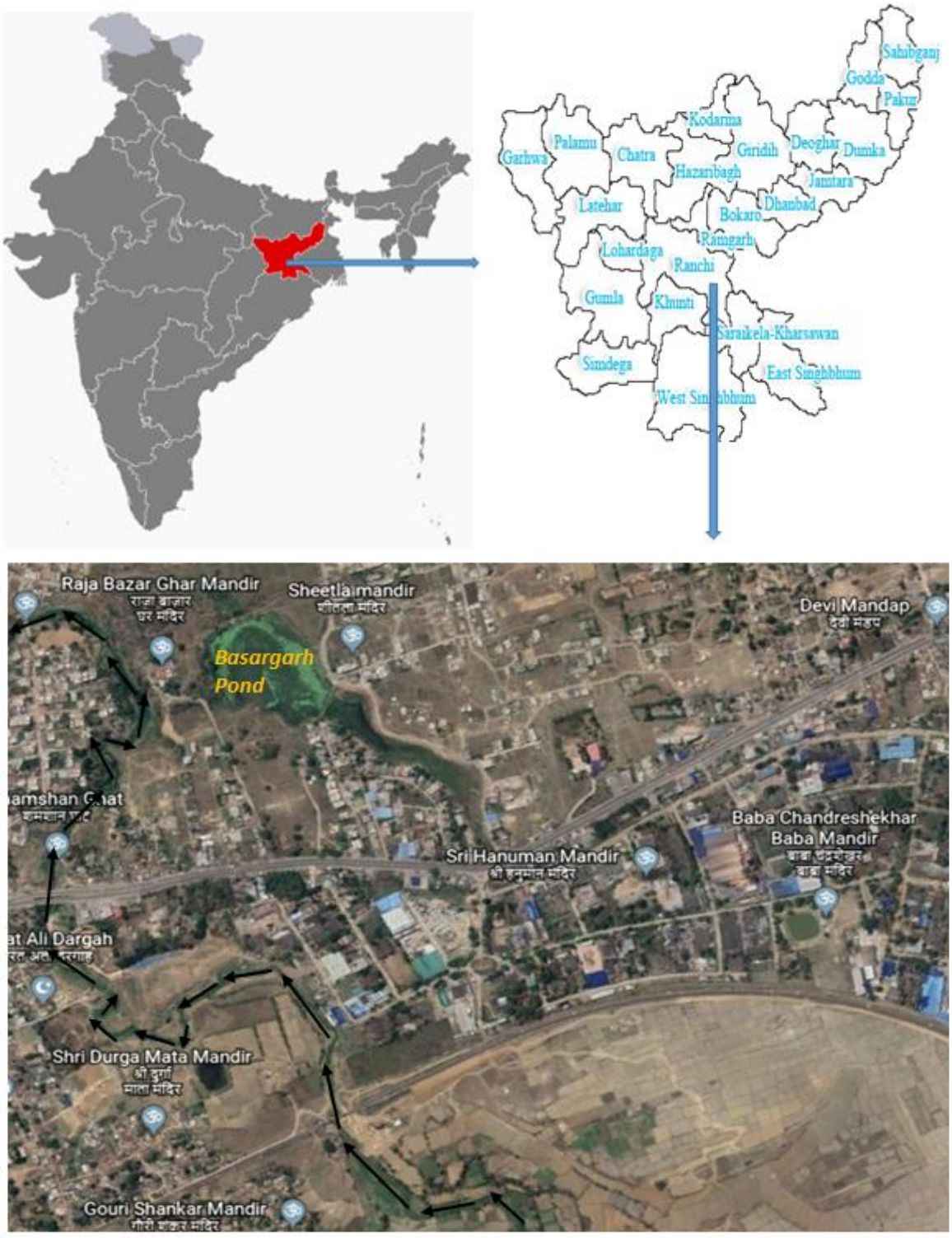

Figure 1:- Sampling location Basargarh Pond

Study area is situated at Hatia, Ranchi, Jharkhand, India. We have select sampling location that is Basargarh Pond which is situated in 85°18′41″ E and 23°16′40″ N.

In this paper an attempt has been made to study some important aspects of pollution in surface water from where its water is used by many industries dependent on those water sources. Attention has been paid to study the variation in the physical, chemical and bacteriological qualities of the surface water. When the surface water shows maximum variation in quality due to industrial activities, then the degree of pollution was determined indirectly in terms of chemical oxygen demand. The nature of pollution has been determined by the

various Physicochemicaland bacteriological analysis in Environmental Laboratories and Engineering Services Pvt. Ltd., Hatia, Ranchi, Jharkhand. It is hoped that this model of study may be extended to anysurface water for judging the acceptability of the water for the industrial use as well as human activities like bathing and washing (Not for drinking purpose).

II. Methodology

Four water samples were collected at the studied area from the month of March 2019 to June 2019 for the analysis of Physicochemical and bacteriological analysis.

Sampling technique & preservative for Heavy metals:

The site of selection was based on the objective of our study. Sampling and analysis was based on the standard APHA method, all the samples were collected by grab type of sampling. For physical and chemical analysis sample were collected by field boyof Environmental Laboratories and Engineering Services Pvt. Ltd., Hatia, Ranchi, Jharkhand and all the possible or essential In-situ measurements were done on the sampling site with preservatives 1:1 HNO_3,H_2SO_4 or HClfor heavy metal analysis in a sterile containers[9].

Sampling technique for Microbiology:

For the microbiological analysis all the samples were collected by Field boy, Environmental Laboratories and Engineering Services Pvt. Ltd., Hatia, Ranchi, Jharkhand. Samples were randomly collected from different sites within the study area using pre-sterilized 100 ml PET bottles with caps. The collected samples were carefully capped, placed on ice and transported to the laboratory for bacteriological analysis[10].

Experimental

Determination of physical and chemical properties of the surface water

Turbidity, pH, temperature, TDS, TSS, conductivity, hardness, alkalinity, chloride, sodium, potassium, DO, BOD, COD, Sulphate, Fe, Mn, Mg, F, As, oil & grease etc. Properties of surface water were determined by using the standard method in the Environmental Laboratories and Engineering Services Pvt. Ltd., Hatia, Ranchi, Jharkhand laboratory.

III. Result and Discussion

The result of the physical-chemical quality of the four collected water samples in different location of the study area in the pre-monsoon season of year 2019 from Hatia region shown in Table 1. In table 1 we see that the temperature of water was drastically increased from March to April and gradually decreases from April to May and slightly increases from May to June. In case of pH it remains almost constant in surveyed area at the time of analysis period in between 7.38 to 7.65 and then slightly decrease at the month of June that is 6.53. Conductivity and turbidity remains constant in collected sample except May in this case the conductivity increases up to 294 µS and 49NTU respectively which is highest in this collected sample which is shown in the table. It is only due to slightly rain fall during at the month of May. The table reveals that the total alkalinity & hardness due to excessive loss of water vaporization and contamination due to increase in manmade activity and water dependency in surveyed area.

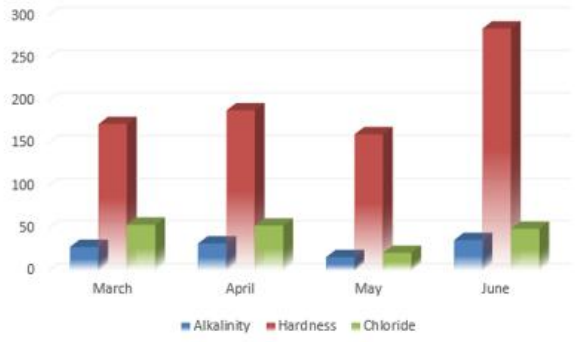

Fig 2: Comparative study of alkalinity, Hardness and chloride in surveyed area.

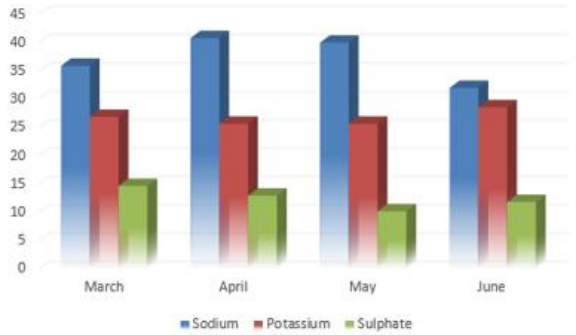

Fig3: Comparative study of Sodium, potassium and sulphate in surveyed area.

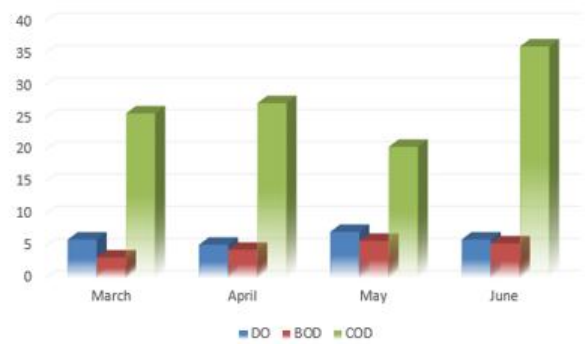

Fig4: Comparative study of DO, BOD and COD in surveyed area.

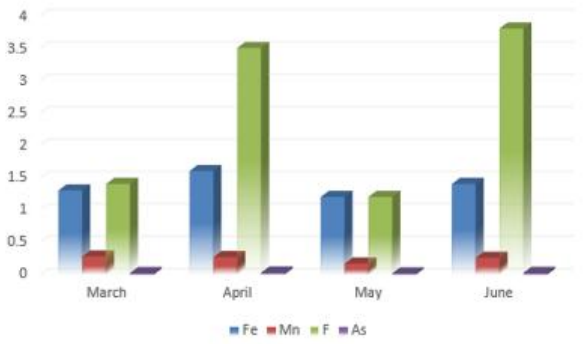

Fig5: Comparative study of Iron, Manganese, Fluoride and arsenic in surveyed area.

Figure: - 2, 3, 4 and 5 shows the comparative study between the analysed data of Basagarh pond in pre-monsoon season, from table 1 and fig 2and 3 we can clearly identify that the hardness level and sodium, potassium and sulphate level gradually increases from March to April and drastically decreases from April to May due to slightly rainfall at the month of May and very high in June due to excessive summer and evaporation of surveyed area. Similar pattern shows with alkalinity and chloride. Data shows that highest level of alkalinity and hardnessare 36 and 284 respectively, this is only due to excessive evaporation due to summer.

According to table no. one and figure number four dissolved oxygen decreases from March to April and opposite for biochemical oxygen demand whereas dissolved oxygen and BOD also decreases from May to June. This up and down of the value of DO and BOD is due to slightly rain full in the month of May, that's why DO and BOD increases from April to May and decreases from May to June.

The study shows that as the summer increases from May to June then the alkalinity and hardness increases and from June to July, hardness gradually decreases due to some shower of rain in survey area and similarly alkalinity gradually increase due to immobilization of soil minerals after rain.

In figure number five iron, fluoride and arsenic concentration is slightly increase whereas manganese remain same due slight rain at the month of April. In this period of analysis we found that fluoride concentration was drastically high in the surveyed area. After that all the parameters from figure four are gradually decreases due to slightly rainfall at the month of May and then increase in next month due to summer but after the rain fall the concentration of fluoride was very high with respect to IS 10500:2012. Oil and Greases are not present at the studied period.

Microbiological analysis

Total and faecal coliform counts were obtained by using the Most Probable Number (MPN) method (APHA 23 edition). The presumptive, confirmatory and completed tests were carried out using Lactose broth, LES endo agar (LES) for total coliform and EC broth for Faecal coliform and azide dextrose and (PSE) agar for faecal Streptococci. The total heterotrophic count of the collected water samples was also done. Microbiological properties of surface water were determined by using the standard method in the Environmental Laboratories and Engineering Services Pvt. Ltd., Hatia, Ranchi, Jharkhand laboratory.

Bacteriological analysis of water at this location was also done and indicated that the pond was highly contaminated with coliform bacteria.

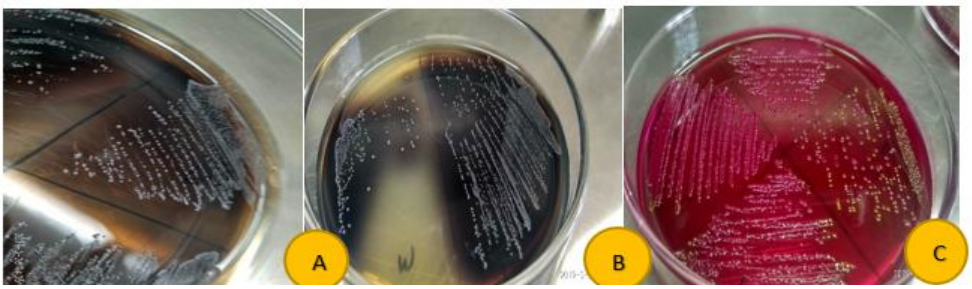

Fig6: -Bacteriological analysis of water sample
Figure A and B – Colony of faecal Streptococci (Faecal coliform)
Figure C – Colony of Total coliform

The presence of a group of bacteria known as coliforms in water samples serve as indicators of water pollution. Among them pink with metallic sheen colony represent the colony of Escherichiacoli, pink to red colony represent the colony of Enterobacteraerogenes and colourless to very light pink colony represent the colony of SalmonellaTyphi in LES endo agar which was shown in figure 6C.Pfizer selective enterococcus (PSE) agar is used for the isolation of faecal streptococci (Faecal coliform), in this media an esculin, a glycoside, is hydrolysed by Enterococci to escalating and dextrose. Escalating reacts with ferric ammonium citrate to form a dark brown to black coloured complex and the result was the formation of blackening around the colony of Enterococcusfaecalis which was shown on figure 6A and 6B. All these microbes and other intestinal pathogens are responsible for gastrointestinal disorder.

Table 1:- Physio-chemical and bacteriological analysis report of Basargarh Pond.

Sl.No.	Parameters	March 2019	April 2019	May 2019	June 2019
Physio-chemical Parameters					
1.	pH	7.4	7.38	7.65	6.5
2.	Temperature	21.5°C	24°C	24.5°C	26.5°C
3.	Conductivity	260	224	294.0	260
4.	Turbidity	45	45	49	47
5.	TSS	65	60	110.0	83
6.	TDS	160	147.6	190.0	160
7.	Alkalinity	28	32	16	36
8.	Hardness	172	188.0	360	284.0
9.	Mg	108	142	128	186
10.	Chloride	54	52.95	20.99	49.3
11.	Sodium	35.8	40.7	39.9	31.9
12.	Potassium	26.8	26.6	25.6	28.5
13.	DO	6.0	5.2	7.2	6.0
14.	BOD	3.2	4.4	5.8	5.4
15.	COD	25.6	27.2	20.4	36.0
16.	Sulphate	14.62	12.93	10.17	11.81
17.	Fe	1.3	1.6	1.2	1.4
18.	Mn	0.28	0.26	0.17	0.26
19.	F	1.4	3.5	1.2	3.8
20.	As	0.02	0.031	0.02	0.027
21.	Oil & Grease	BDL	BDL	BDL	BDL
Microbiological Parameters					
22.	Total Coliform (MPN/100ml)	140	175	210	110
23.	Faecal Coliform (MPN/100ml)	20	43	75	31
24.	Total Plate count (CFU/100ml)	$3.6 X10^4$	$4.8 X10^4$	$5.8 X10^5$	$2.7 X10^4$

IV. Conclusion

Water from this source analysed in this study is used for drinking, cooking, laundry and bathing purposes. If they are contaminated, there is a greater risk of water-borne diseases such as cholera, diphtheria, hepatitis A, salmonellosis and shigellosis among other. Physio-chemical parameter shows that the water in this surveyed area was highly contaminated with fluoride so, this water is not recommended for drinking purpose.

Recommendation

Adequate monitoring and surveillance of these water sources should therefore be carried out regularly. In cases where surveillance is not carried out, the water should be purified using chlorine, boiling or other water purification methods. Prevention of these diseases is often better and cheaper than their treatment hence, all efforts geared towards prevention of outbreak of an epidemic should be taken very seriously by all stakeholders and government and relevant agencies.

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