ASSESSMENT OF GROUND WATER QUALTIY NEAR LINED OMTI NALA & UNLINED MOTI NALA: A CASE STUDY IN JABALPUR CITY

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ABSTRACT: The present work was carried out to assess the water quality of ground water near Lined Omti Nala& Unlined Moti Nala within the range of 1.0 meter to 5.0 meter beside the nala in Jabalpur city based on weighted arithmetic water quality index (WQI). In order to determine the quality of its water for drinking and other purposes, the twelve physicochemical parameters which includes pH, Total dissolved solids, total hardness, calcium, magnesium, Dissolved oxygen (DO), BOD, alkalinity, chloride, fluoride, nitrate, & coliforms were analyzed.This has been verified by collecting the water samples from 5 different locations in the area where there is motorized supply or hand pump system that are used for drinking purpose. The outcome obtained was compared with M.P Pollution Board Parameters. Accordingly, the obtained result shows that most of the physical properties were within the acceptable range where as some parameters are at alarming state as compared to the M.P Pollution Board Parameters for drinking purposes, thereby suggesting the need for precautionary measures and treatment for use of the particular ground water. Biological analysis of water was performed by MPN.

Keywords - **Water Quality Index (WQI) , Ground Water , DO, BOD , Coliforms .**

INTRODUCTION :

Water is indispensable and one of the precious natural resource of our planet. Ground water is an important natural source of water which is used all over the world. Ground Water is usable in the fields like irrigation, industries and domestic purpose (P.M. Makode et al). Ground water quality depends on the quality of discharged water, atmosphere, surface water, and on geochemical processes held on sub-surface.

There is increasing awareness that the water will be one of the most critical natural resources in future. Water paucity is increasing worldwide and stress on the existing water resources is increasing due to rising demand of different sectors such ashousehold, cultivation and trade, hydropower etc. Therefore evaluation of water quality is important research topic in the recent years.

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 inhabitants undergo from a variety of water borne virus(P.M. Makode et al). 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.

According to WHO, about 80% of all the diseases in human beings are caused by water. As the groundwater is infected, its value cannot be restored by stopping the pollutants from their sources. It therefore becomes crucial to regulate oversee thequality of groundwater and to device ways and means to protected. Water quality index is the one of the most effectual tools(P.C. Mishraet al,S. Naik et al, D.F. Singh et al, T.N. Tiwariet al).WQI is defined as a rating reflecting the compound influence of dissimilar water quality parameters. WQI is intended fromthe viewpoint of suitability of ground water for individual consumption (C.R. Ramakrishanaiah et al). WQI is an arithmetic tool used to alter large water quality data into a single cumulatively derived figure. It represents a certain rank of water quality while eliminating the subjective assessment of such quality (N. Giljanovicet al, W.W. Milleret al)to summarize the huge amount of analytical data regarding water quality into useful, easy to comprehend and convenient management tool for the consideration of water quality, the idea of WQI was developed and proposed first by Horton (R.K. Horton et al). It is a single number like a position that express the overall water quality at a certain region and time based on several water quality parameters when their specific classification and boundaries are considered(W.R. Ott et al, D. Hollock et al, S.F. Pesce et al). In present paper we evaluate the WQI .

The following steps are mainly linked with the development of any WQI:

- Parameter selection.
- Conversion of the parameters of different units to a common extent.
- Weightage assignment to each parameters.
- Calculation of sub-indices to produce a final index.

STUDY AREA :

Location:	23°10′N 79°56′E
Altitude:	411 m (1348 ft.) Above Sea Level
Area:	122.00 km^2

The Jabalpur city is located in Jabalpur district of Madhya Pradesh state, on the right bank of Narmada River . Study area of Jabalpur city falls in Survey of India Topo Sheet 55M/16, and occupies approximate area of 122.0 Sq. km, falls between 79^0 55' 37" to 79^0 57' 54" longitude and 23^0 09' 10" to $23^0$11' 06" latitudes. The city of Jabalpur is a rock basin surrounded by "Karia Pathar" ridge to the north, Seeta Pahari and Khandari hills to the east, Madan Mahal hills to the south-west with alluvial plain toward westand north-west. The study area of the Jabalpur city is shown in Figure – 1.

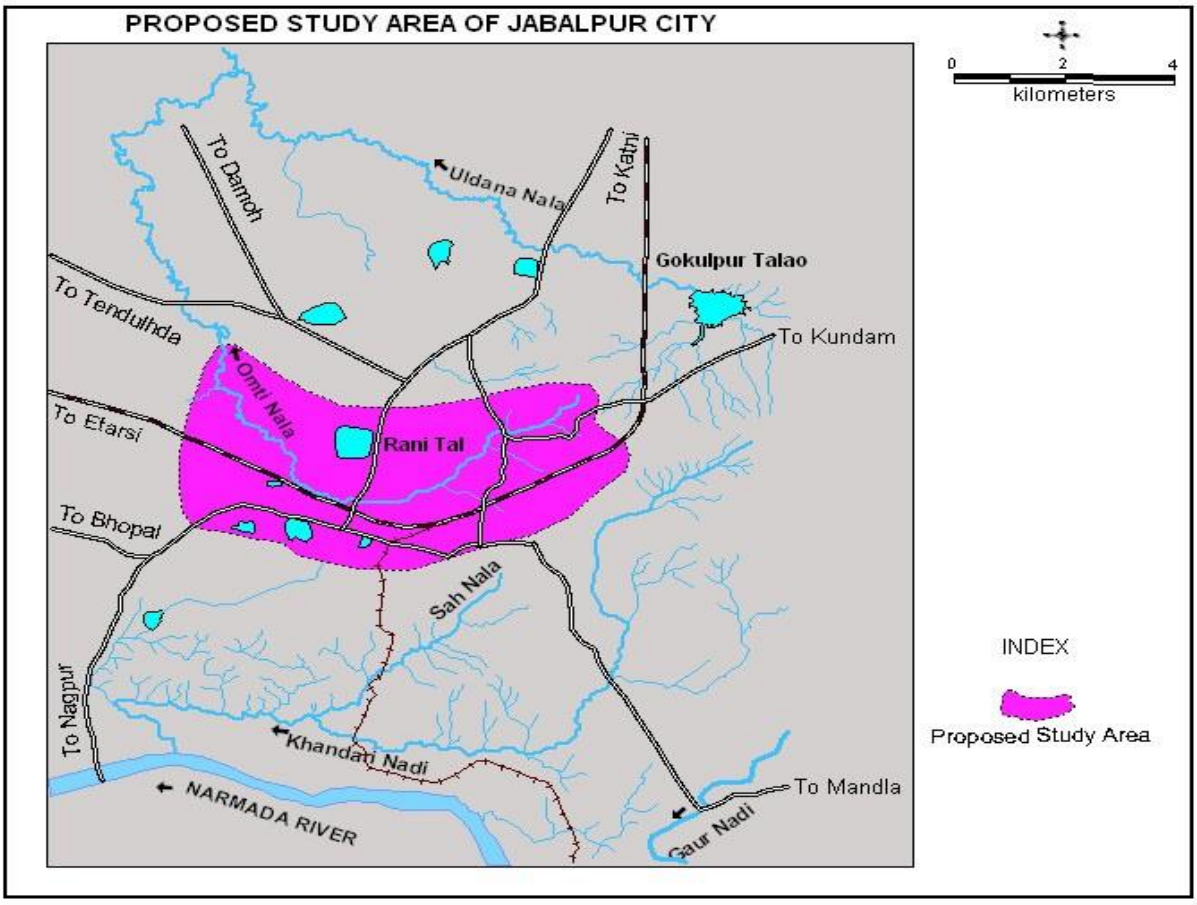

Figure 1: Study area of Jabalpur city, Madhya Pradesh

METHODOLOGY :

Surface water samples from various sites in the study areas were collected and analyzed for their physical, chemical and biological characteristics following standard water quality procedures. Assessment of surface water quality was done using Water Quality Index. The samples were collected in plastic containers of 2 liters capacity for physicochemical analysis after pumping out sufficient quantity

of water from the source such that, the sample collected served as a representative sample. For E. coli analysis, samples were collected in sterilized glass bottles from the source. The samples thus collected were transported to the laboratory (Bodhi et al).

WQI COMPUTATION EQUATIONS :

For calculating WQI:

For the calculation of water quality index eleven parameters were considered. Values used for each parameter are the exact values analyzed under present investigation. The water quality index has been calculated by using the standards method of drinking water quality(BIS 2012et al). The calculated values were compare with the standard and recommended by the WHO, BIS and ICMR. The weighted arithmetic index method (Brown et al., 1972) has been used for the calculation of water quality index of the water body in the following steps:-

Firstly each parameter is assigned a weight (wi) according to its relative importance in the overall quality of water for drinking and various purposes as shown in Table I. The maximum weight of 5 has been assigned to the parameter nitratedue to its importance inwater quality assessment. The water quality parameter E-Coli is not included for the calculation of WQI. Hence no weight is assigned to the parameter E-Coli.

In the second step, the relative weight (Wi) is computed from the following equation:-

$$\sum Wi = \frac{wi}{\sum_{i=1}^{n} w_i}$$

where Wi is the relative weight, wi is the weight of each parameter and n is the number of parameters. Relative weights are presented in Table II.

Table I

CHEMICAL PARAMETER	INDIAN STANDARD (UPPER LIMIT)	WEIGHT [w(i)]
pH	8.5	4
TOTAL DISSOLVED SOLIDS mg/l	500	4
TOTAL HARDNESS mg/l	300	3
CALCIUM mg/l	75	2
MAGNESIUM mg/l	30	2
DISSOLVED OXYGEN mg/l	5	5
BOD mg/l	5	5
ALKALINITY mg/l	200	3
CHLORIDE mg/l	250	3
FLUORIDE mg/l	1	4
NITRATE mg/l	45	5
Coliforms (MPN Index / 100ml)	NIL	
		$\sum w = 40$

Table II

CHEMICAL PARAMETER	INDIAN STANDARD (UPPER LIMIT)	WEIGHT [w(i)]	RELATIVE WEIGHT [W(i)]
pH	8.5	4	0.1
TOTAL DISSOLVED SOLIDS mg/l	500	4	0.1
TOTAL HARDNESS mg/l	300	3	0.075
CALCIUM mg/l	75	2	0.05
MAGNESIUM mg/l	30	2	0.05
DISSOLVED OXYGEN mg/l	5	5	0.125
BOD mg/l	5	5	0.125
ALKALINITY mg/l	200	3	0.075
CHLORIDE mg/l	250	3	0.075
FLUORIDE mg/l	1	4	0.1
NITRATE mg/l	45	5	0.125
		$\sum w = 40$	$\sum = 1$

In the third step, a quality scale (qi) for each parameter is assigned by dividing its concentration in each water sample by its respective standard limit value according to the guidelines of BIS (Bureau of Indian Standards) and the result is multiplied by 100.

The equation for qi is:

qi = (Ci/Si) X 100

where qi is the quality rating, Ciis the concentration of each parameter in each water sample in mg/l and Siis the Indian standard limit for each parameter in mg/L according to BIS 10500:1991 (reaffirmed in September 2003).

For computing the WQI, the Sub-Index (SI) is first determined for each chemical parameter, which is then used to determine the WQI as per the following equations:

SIi = Wi x qi
WQi = S.SIi
SIi is the sub index of ith parameter, qiis the quality rating. The computed WQI values are presented in following TablesIII (a , b , c , d , e)collected from various locations as mentioned below :-

Sample 1: It was collected on Dec. 11, 2017 from Gohalpur at 09:00 a.m.

Sample 2: It was collected on Dec. 11, 2017 from Behorbagh,Ghamapur at 09:30 a.m.

Sample 3: It was collected on Dec. 11, 2017 from Ganjipura at 10:10 a.m.

Sample 4: It was collected on Dec. 11, 2017 from Rameshwaram Colony, Vijay Nagar at 10:50a.m.

Sample 5: It was collected on Dec. 12, 2017 from Sneh Nagar, Veersawarkar at 12:00p.m.

Figure 2: Imageshowing points of sampling, Jabalpur, Madhya Pradesh
Red & Yellow Line indicates Omti & Moti Nala.

Table III (a)

SAMPLE 1						
PARAMETERS	OBSERVED VALUE (Vi)	STANDARD VALUE (Si)	UNIT WEIGHT (wi)	Wi	QUALITY RATING (Qi)	Wi X Qi
pH	8.2	8.5	4	0.1	80.0	8.0
TOTAL DISSOLVED SOLIDS mg/l	722	500	4	0.1	144.4	14.44
TOTAL HARDNESS mg/l	272	300	3	0.075	90.66666667	6.8
CALCIUM mg/l	68.13	75	2	0.05	90.84	4.542
MAGNESIUM mg/l	24.88	30	2	0.05	82.93333333	4.146666667
DISSOLVED OXYGEN mg/l	4.6	5	5	0.125	104.1666667	13.02083333
BOD mg/l	0.3	5	5	0.125	6	0.75
ALKALINITY mg/l	470	200	3	0.075	235	17.625
CHLORIDE mg/l	75	250	3	0.075	30	2.25
FLUORIDE mg/l	1.14	1	4	0.1	114	11.4
NITRATE mg/l	7.14	45	5	0.125	15.86666667	1.983333333
			40			∑WiQi =84.958

COLIFORMS are present : 350 (MPN Index/100ml)

Table III (b)

SAMPLE 2						
PARAMETERS	OBSERVED VALUE (Vi)	STANDARD VALUE (Si)	UNIT WEIGHT (wi)	WI	QUALITY RATING (Qi)	Wi X Qi
pH	7.95	8.5	4	0.1	63.333333	6.333333
TOTAL DISSOLVED SOLIDS mg/l	460	500	4	0.1	92	9.2
TOTAL HARDNESS mg/l	148	300	3	0.075	49.33333333	3.7
CALCIUM mg/l	26.45	75	2	0.05	35.26666667	1.763333333
MAGNESIUM mg/l	20.008	30	2	0.05	66.69333333	3.334666667
DISSOLVED OXYGEN mg/l	5.7	5	5	0.125	92.70833333	11.58854167
BOD mg/l	0.8	5	5	0.125	16	2
ALKALINITY mg/l	312	200	3	0.075	156	11.7
CHLORIDE mg/l	40	250	3	0.075	16	1.2
FLUORIDE mg/l	1.21	1	4	0.1	121	12.1
NITRATE mg/l	6.83	45	5	0.125	15.17777778	1.897222222
			40			∑WiQi =64.817

COLIFORMS : <1.8 (MPN Index/100ml)

Table III (c)

SAMPLE 3						
PARAMETERS	OBSERVED VALUE (Vi)	STANDARD VALUE (Si)	UNIT WEIGHT (wi)	WI	QUALITY RATING (Qi)	Wi X Qi
pH	7.65	8.5	4	0.1	43.333333	4.3333333
TOTAL DISSOLVED SOLIDS mg/l	468	500	4	0.1	93.6	9.36
TOTAL HARDNESS mg/l	168	300	3	0.075	56	4.2
CALCIUM mg/l	36.07	75	2	0.05	48.09333333	2.404666667
MAGNESIUM mg/l	19.03	30	2	0.05	63.43333333	3.171666667
DISSOLVED OXYGEN mg/l	3.4	5	5	0.125	116.6666667	14.58333333
BOD mg/l	0.5	5	5	0.125	10	1.25
ALKALINITY mg/l	340	200	3	0.075	170	12.75
CHLORIDE mg/l	35	250	3	0.075	14	1.05
FLUORIDE mg/l	1.02	1	4	0.1	102	10.2
NITRATE mg/l	3.79	45	5	0.125	8.422222222	1.052777778
			40			∑WiQi =64.356

COLIFORMS :<1.8 (MPN Index/100ml)

Table III (d)

SAMPLE 4						
PARAMETERS	OBSERVED VALUE (Vi)	STANDARD VALUE (Si)	UNIT WEIGHT (wi)	WI	QUALITY RATING (Qi)	Wi X Qi
pH	8.05	8.5	4	0.1	70	7.0
TOTAL DISSOLVED SOLIDS mg/l	1031	500	4	0.1	206.2	20.62
TOTAL HARDNESS mg/l	256	300	3	0.075	85.33333333	6.4
CALCIUM mg/l	64.128	75	2	0.05	85.504	4.2752
MAGNESIUM mg/l	23.42	30	2	0.05	78.06666667	3.903333333
DISSOLVED OXYGEN mg/l	2.7	5	5	0.125	123.9583333	15.49479167
BOD mg/l	0.5	5	5	0.125	10	1.25
ALKALINITY mg/l	468	200	3	0.075	234	17.55
CHLORIDE mg/l	120	250	3	0.075	48	3.6
FLUORIDE mg/l	1.27	1	4	0.1	127	12.7
NITRATE mg/l	5.24	45	5	0.125	11.64444444	1.455555556
			40			$\sum$WiQi =94.249

COLIFORMS :<1.8 (MPN Index/100ml)

Table III (e)

SAMPLE 5						
PARAMETERS	OBSERVED VALUE (Vi)	STANDARD VALUE (Si)	UNIT WEIGHT (wi)	WI	QUALITY RATING (Qi)	Wi X Qi
pH	8.15	8.5	4	0.1	76.667	7.6667
TOTAL DISSOLVED SOLIDS mg/l	1071	500	4	0.1	214.2	21.42
TOTAL HARDNESS mg/l	120	300	3	0.075	40	3
CALCIUM mg/l	31.26	75	2	0.05	41.68	2.084
MAGNESIUM mg/l	10.25	30	2	0.05	34.16666667	1.708333333
DISSOLVED OXYGEN mg/l	2.7	5	5	0.125	123.9583333	15.49479167
BOD mg/l	0.8	5	5	0.125	16	2
ALKALINITY mg/l	504	200	3	0.075	252	18.9
CHLORIDE mg/l	225	250	3	0.075	90	6.75
FLUORIDE mg/l	0.76	1	4	0.1	76	7.6
NITRATE mg/l	6.7	45	5	0.125	14.88889	1.86111
			40			$\sum$WiQi = 88.568

COLIFORMS :<1.8 (MPN Index/100ml)

The computed WQI values are classified into five types, “excellent” to “unsuitable for drinking”.Table IV shows the percentage of water samples that falls under different quality.

Table IV

WQI VALUE	Water Quality
< 50	Excellent
50 - 100	Good Water
100 - 200	Poor Water
200 - 300	Very Poor Water
> 300	Water Unsuitable for drinking

CONCLUSION :-

Water quality index (WQI) is the most efficient technique to communicate water quality. Water quality index (WQI) <50 means absolute absence of pollutants. When 50<WQI<100, indicates the water is under consideration and fit for human use and100<WQI<200 reflects that water is of poor quality and should not be used for drinking purpose. WQI>300 reflects that it is totally unsuitable for human, wild animals and cattle's. In the present study it was found that 1 sample which is of Moti Nala contains pathogenic organisms and remaining 4 sampleswhich wereof Omti Nala is of good quality to use whereas there is no such sample where water is poor in quality.

At present the banks of Omti Nala are protected by lining work which has shown abundant transformation of pollutants and health causing pathogens which is done by Municipal Corporation, Jabalpur under Jawahar Lal Nehru Urban Development Scheme.

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