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Assessment of Water Quality Index Study of River Chambal at Gandhisagar, Mandshour Madhya Pradesh, India

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Abstract: ***Water is one of the earth most important resources that use for Human life and it's quality is totally depend on geological environment.***
Chambal is an important river in Mandshour M.P. Hence made to WQI and Pollution or change in the quality of water. The Quality Index (WQI) Is an important tool to determine the drinking water quality in rural, urban, agriculture and industrial area.
WQI follows four step parameter selection, sub-indices, establishing weight, and final index aggregation. Assessment of WQI of River Chambal includes physic-chemical parameter viz. Biological Oxygen Demand, Dissolved Oxygen, P^H, Total Hardness, Total alkaline ions and solids thate indicate the extent of pollution.
Keywords: BOD, COD, DO, Water quality index, River Chambal gandhisagar

I. INTRODUCTION

Mandshour district is located on border of Malwa region on Madhya Pradesh between 24.071955 North latitude and 75.069404 East longitude. Total geographical area of district is 50 sq. km. Average maximum temperature is 104□F and minimum 55□F. Mandshour is also famous for Pashupatinath Templea hindu situated on the bank of the shivana river.
River Chambal in Gandhi sagar sanctuary .The Gandhi sagar dam is the first of the 4 dams built on the Chambal river.
All metabolic reactions occur in the water Water, the most vital component, is necessary for the continuity of life . The water quality is affected by geological formations, anthropogenic activities, current trends of urbanization, over-exploitation of resources and exorbitantly increasing population [1] River water pollution is challenging issue in India due to continuous urbanization and rapid industrialization for sustainable development [2]. Most of the industries are disposing off their waste directly to the nearby stream without making any treatment and violating the provisions for standard laid out for the same [3].On national and state levels several policies and regulations like Water Act, 1974 (Prevention and Control of Pollution) to regulate pollution discharges and restore water quality of aquatic resources including the prescription of monitoring activities. Now a day's water quality assessment as major concern as it is getting deteriorated by human activities [4] .
The water quality is affected by geological formations, anthropogenic activities, current trends of urbanization, over-exploitation of resources and exorbitantly increasing population [5].
The water quality of river can predict by using the Water Quality Index. Basically a WQI attempts to provide a mechanism for presenting a cumulatively derived, numerical expression defining a certain level of water quality [6].It is introduced as a mathematical instrument to convert the water quality dataset into a single number which represents the water quality and biasesof individual water quality experts [7]

II. MATERIALS AND METHODS

1) *Study Area:* The criteria of study area is River Chambal at Gandhisagar, Mandshour D/S (126 KM from City) of ujjain Division. table-2.
2) *Sampling Station:* Chambal River 100 Meter D/S at Gandhi sagar

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Figure: 1: View of River Chambal at, Gandhi sagar , Mandshour

1) *Physico-chemical Parameters:* In this study, the water quality standards of different physico-chemical parameters All the parameters like pH, Temperature, Conductivity, Turbidity, Fecal coliform, Total dissolved solids, BOD, COD, TA, TH, Calcium, Potassium, Sodium, Magnesium, Nitrate, Sulphate, Phosphate, Chloride , Fluoride, and Boron dissolved and their statistical interpretation for domestic and agriculture purpose were evaluated for water of River Chambal at Gandhisagar, Mandshour D/S (KM from City) of ujjain Division.
2) *pH:* An important parameter which represents acidicand alkaline nature of water. Permissible limit for pH in water is 6.5 – 8.5 [8]. It is vital for varied biochemical reactions [9][10]. Less pH causes tuberculation and corrosion while higher pH causes Incrustation and sediment deposit [11].
3) *Temperature:* The Temperature in water governs biological activity and growth of living organisms. It also influences the different kinds of organisms that can live in water bodies
4) *Turbidity:* Turbidity represents cloudiness of theliquid which is formed by the accumulatingindividual particles which are not visible by the naked eyes like smoke in air. Permissible limit for turbidity is 5-10 NTU
5) *Total Dissolved Solids (TDS):* TDS measures the total concentration of dissolved in a sample of water,including minerals, salts, or metals. In PPM and mg/lit, it is represented. TDS originates from natural sources, sewage, urban runoff, chemicals used in water treatment processes, industrial wastewater and nature of hardware used in water transmission [12] .Permissible limit is 1500 mg/lit. [13].
6) *Chemical Oxygen Demand (COD):* The measure of the capacity of water to consume oxygen during the process of decomposition of organic matter and oxidation of inorganic compounds like Ammonia, nitrite. It also means the oxygen mass absorbed in the solution volume. It is expressed in mg/lit. Ideally Chemical Oxygen Demand should be zero.
7) *Biochemical Oxygen Demand (BOD):* BOD measures the oxygen utilized for the biochemical degradation of organic material (carbonaceous demand) and oxidation of inorganic material such as sulphides and ferrous ions during a specified incubation period. The permissible limit for BOD is 3-5 ppm which represents a moderately clean level
8) *Fecal Coliform:* A group of total coliforms that are present in animal intestines and faeces. Faecal coliform bacteria may occur in ambient water as a sign of overflow of domestic sewage. At the same time, it may cause some waterborne diseases such as typhoid fever, viral and bacterial gastroenteritis. The optimal amount of coliform in 100 ml must not be measurable
9) *Calcium:* The optimal amount of coliform in 100 ml must not be measurable. The main source is an erosion of rocks such as limestone and minerals like calcite. The good limit for Ca is 75-200 mg/lit. Extra amount of calcium concentration causes less absorption of essential minerals in the human body.
10) *Magnesium:* Magnesium is present in seawater in amount of about 1300ppm. The greater concentration in water makes unpleasant taste. The main source of Mg in water is by the erosion of rocks and minerals like dolomite or magnetite. The permissible limit of Magnesium is 30-150 mg/lit.

11) *Sodium:* Water and sodium balance are closely interdependent good limit for sodium in drinking water must be in the range of 30 to 60 mg/lit. Higher concentrations are caused by hypertension, renal and heart-related diseases.
12) *Potassium:* Potassium is an essential mineral that is needed by all tissuesin the body As well as for humans, the lower potassium concentration is advantageous for plant species. Hypertension, diabetes, adrenal insufficiency, kidney and heart-related diseases are caused by a higher concentration of potassium
13) *Chloride:* Chlorides is naturally occurring element in natural water resources. As we all know, the concentration of chloride ions about 19400mg/l in ocean water. The maximum permissible limit of Chloride ion by WHO 1991 is 200 ppm and the maximum allowable limit is 600 ppm.[14] It is considered an essential water quality parameter by affecting its usability and aesthetic property with taste and make it unfit for drinking purpose. The main source of Chloride concentration is the formation of rocks and soil with sewage wastes
14) *Sulphate:* Sulphate is present in almost all drinking natural water sources [15]. The sources for sulphate concentration are rocks and geological formation. The excess amount of sulphate content causes a laxative effect. The permissible limit for sulphate is 200-400 mg/lit
15) *Nitrate:* Maximum permissible limit of nitrate is 50 mg/lit.[13] The higher concentration of nitrate causes blue-baby disease or methemoglobinemi
16) *Phosphate:* The admissible phosphate level is 0.005 to 0.05 mg/lit. The main source of phosphate is sewage and industrial waste disposal in freshwater. Basically, it promotes the growth of micro-organism. [16]
17) *Fluoride:* The controlled addition of fluoride in water supplies to maintain public health is known as water fluoridation. This fluoridated water is used to prevent cavities by maintaining the concentration of fluoride in water. Required level is 1.0-1.5mg/lit. Excess concentration causes fluorosis and deformation in joints
18) *Boron Dissolved:* Permissible concentration of boron in the surface water is 1-5 mg/lit for a day. It is an essential nutrient present in plants.

III. WATER QUALITY CRITERIA FOR IRRIGATION

The WQI is the one of the most widely used of all existing water quality procedures [17].Therefore, WQI is simplified way of representing water quality information The WQI has been calculated by using the standards of drinking water quality recommended by the World Health Organization(WHO), Indian Council of Medical Research (ICMR, 1975) and Bureau of Indian Standards (BIS) has been used for the calculation of WQI of the water body. [18][19] .Quality of water is an important aspect in any appraisal of salinity or alkalinity conditions in an irrigated area. Good soil and water management practices result in good quality of water are ideal for agriculture.

A. Sodium Absorption Ratio(SAR)

SAR is an vitalparameter given by Richard in 1954[21] .The basic concept behind the SAR is to find out the soil alkalinityof water used for irrigation purposes[22]

SAR (Sodium Absorption Ratio) = $\frac{Na}{\sqrt{\frac{Ca+Mg}{2}}}$

Note: Ca^{2+}, Mg^{2+} and Na^{+} are expressed in mg/l.

B. Chloro alkaline indices (CAI)

Chloro alkaline indices are used to calculate the base exchange proposed by Schoeller[23] .Chloro alkaline indices are used to calculate ion exchange between the water and its surrounded area.

It is measured by the following equation

$$CAI = [Cl^- - (Na^+ + K^+)/Cl^-$$

Note: all ionic concentrations are measured in mg/l.

- CAI >0: No Base Exchange reaction
- CAI <0: Exchange between sodium and potassium in water with calcium and magnesium in the rocksby a type of Base Exchange Reactions [20].

Table:-1
Classification of Water samples on the basis of basis Statistical Analysis

Statistical Analysis Parameters	Categories	Range
SodiumAbsorptionRatio(SAR)	Excellent Good Fair Poor	0-10 10-18 18-26 >26
ChloroAlkanine Indices(CAI)	Base Exchange Reaction Cation Exchange Reaction	Negative Value Positive Value
Sodium Percentage(%Na)	Excellent Good Permissible	0-20 20-40 40-60

Table:-2
Interpretation of Langelier Saturated Index (LSI) Test Result

S.No.	LSI Index	Appearance	Water Condition Issues required
1	-4.00	Very severe corrosion	Conditioning required
2	-3.00	severe corrosion	Conditioning usually suggested
3	-2.00	Moderate corrosion	Some conditioning is suggested
4	-1.00	Mild corrosion	Required some conditioning
5	-0.50	Slight corrosion	May need some conditioning
6	0.00	Balanced	Conditioning not suggested
7	0.50	Faint Scale Coating	Conditioning not suggested
8	1.00	Slight Scale Coating	Some visual appearance shown
9	2.00	Mild Scale Coating	Should consider some conditioning
10	3.00	Moderate Scale Coating	Should use some conditioning
11	4.00	Severe Scale Coating	Usually conditioning required

Table:-3
Statistical Analysis of Various Water Sample Readings Water Quality during Year -2019-2020

S. N	Characteristic	Unit	*April*	May	June	*July*	Aug.	Sept.	*Oct.*	Nov.	Dec.	*Jan.*	Feb
1	Date of Sampling	-	10.4.19	10.5.19	21.6.19	5.7.19	13.8.19	10.9.19	16.10.19	3.11.19	12.12.19	30.1.20	27.2.20
2	Appearance	-	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
3	Temperature	^{o}C	34	38	30	23	22	22	24	25	22	23	--
4	Turbidity	NTU	3.8	8.3	6.4	7.6	9.4	9.6	4.6	7.6	4.3	3.1	3.8
5	Colour	PCS	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourle	Colourles
6	Odour	T. No	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourles	Odourless
7	pH	pH Unit	7.78	7.86	7.96	7.77	7.88	7.78	7.94	7.84	7.86	7.86	7.84
8	Sp. Conductivity	µMhos/cm.	310	494	348	334	282	288	274	282	252	254	294

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9	T. Solids	mg/1	226	354	244	240	224	228	212	208	194	226	238
10	D. Solids	mg/1	210	342	226	226	206	208	198	198	182	208	222
11	S. Solids	mg/1	16	12	18	14	18	20	14	10	12	18	16
12	Amm. Nitrogen	mg/1	0.412	0.422	0.348	0.426	0.284	0.288	0.102	0.126	0.122	0.13	0.16
13	Nitrite Nitrogen	mg/1	0.058	0.008	0.006	0.007	0.004	0.006	0.001	0.001	0.001	0.0018	0.004
14	Nitrate Nitrogen	mg/1	0.82	1.236	0.98	0.818	0.862	0.878	0.884	0.894	0.686	0.589	1.32
15	Phosphate (PO_4)	mg/1	BDL	BDL	BDL	BDL	0.03	0.03	0.026	0.028	BDL	BDL	BDL
16	Chloride	mg/1	42	72	54	25	38	42	28	34	32	34	46
17	Sulphate (SO_4)	mg/1	26.2	28.2	40.2	26.26	24.16	30.18	16.8	18.6	13.2	13.8	41.2
18	T. Alkalinity	mg/1	128	138	150	110	116	126	104	110	108	120	198
19	T. Hardness	mg/1	160	180	188	148	172	178	142	164	204	240	216
20	CalciumHardness	mg/1	82	110	100	90	110	114	94	102	120	128	124
21	Magnesium H.	mg/1	78	70	88	58	62	64	48	62	84	112	92
22	D. Oxygen	mg/1	7	7.2	7.4	7	7	7	7.4	7	7.1	7.3	7.2
23	B.O.D.	mg/1	2.4	2.6	2.4	2	2.4	2.2	2	2	2	2	2
24	C.O.D.	mg/1	18	10	19	12	14	18	10	10	10	12	14
25	Sodium	mg/1	30	30.2	48.2	21.4	19.4	22.2	12.2	13.2	11.4	12.4	45.4
26	Potassium	mg/1	1	1	1.8	1.6	1	1	0.8	1	1	1.1	1.2
27	T. Coliform	MPN/100m	58	94	58	49	63	63	47	49	49	47	49
28	F. Coliform	MPN/100m	8.2	6	9.1	4	6	6	1.8	1.8	4	1.8	4
29	T.K.N.	mg/1	--	--	--	--	--	2.8	3.36	3.36	3.36	2.8	3.36
	CATEGORY		B	B	B	A	B	B	A	A	A	A	A

Source:- MADHYA PRADESH POLLUTION CONTROL BOARD ,BHOPAL

IV. CONCLUSION

Under the Gandhi Sagar Dam project, water in Neemuch and Mandshour districts is used for agriculture and drinking water. The suitability of water for irrigation is evaluated based on Sodium Absorption Ratio, Chloro alkaline indices I, % Na, and salinity hazards. Most of the samples fall in the suitable range for irrigation purpose based on Sodium Absorption Ratio, Chloro alkaline indices, % Na and KR values, but very few samples that are exceeding the permissible limits. These variations are observed to be in different kind of geological areas and different anthropogenic activities were carried in the study area.

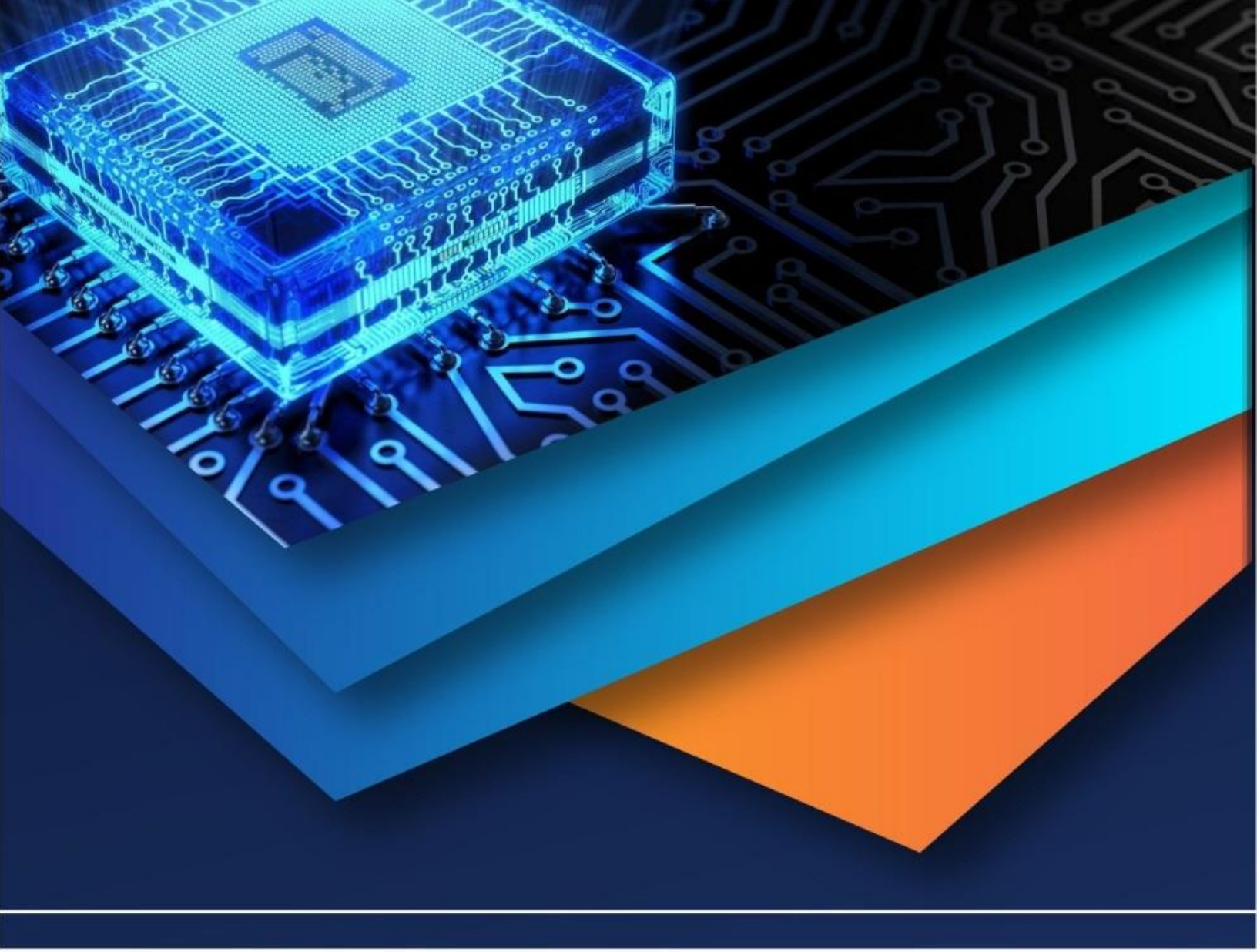
This study will be helpful in sustainable development of water sources in Neemuch and Mandshour .

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