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Development of Water Quality Index of Sindh River by using Weighted Arithmetic Method at Dabra, M.P., India

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Abstract:- The Sindh River of Dabra, M.P, India, has significant monetary and conventional ties to the local people. The purpose of this study is to determine the water quality index of the Sindh River in Dabra town, M.P. The samples were taken from five different locations of Sindh River and analyzed for various physicochemical parameters like pH, Turbidity, EC, Total hardness, Alkalinity, Acidity, Chlorides, TDS, TSS, Dissolved Oxygen, BOD, COD, MPN, Sulphate, Nitrate and phosphate. The Water Quality Index (WQI) is used to analyze the environment of water in terms of pollutant load classification and class identification. The Water Quality index (WQI) result at every point shows that the water of the Sindh River at Dabra is unfit for consumption cause possibly due to excessive effluent discharge, home sewage and other human activities.

Keywords:- *Sindh River, Water Quality Index, Weighted Arithmetic Mean Method, Physico-chemical parameters.*

I. INTRODUCTION

Because of the growth in human population and urbanization, sewage disposal issues have become a serious issue in the metropolitan world. River water are under pressure from a variety of sources, including sewage wastewater discharge and disposal methods, which may result in the introduction of excessive nutrient loads, harmful chemicals, and pathogens that cause disease historically , sewage effluents were released by outfall [1]. Almost all rivers have been unthinkingly utilized for the discharge of domestic and industrial effluent much in excess of their assimilative capacity leaving them badly contaminated [2-3] the negative effects of sewage pollution on public health, the environment, socioeconomics food quality and , and aesthetics are widely established[4-5].Pollutants from sewage effluents can have a negative impact on accept water quality depending on the volume of discharge, chemical composition, and the saturation of the water. It is also affected by pollution from both point and non- point sources. Dirt that enters a water channel in a different way, such as a pipe or ditch, is referred to as the source of the pollution point. Discharge from a sewage treatment facility an industry, or a city storm drain are example of this group while non- point source is defined as pollution that does not come from a single different source. This topic includes the immersion of nitrogen compounds in fertile agricultural soils. River pollution in India has achieved crisis proportion as a result of uncontrolled urbanization and fast industrialization [6-8].Heavy metal pollution from industrial activity is a significant cause of pollution in the environment, regulating in substantial pollution of suspended matter [9].

Most India rivers are pollution by organic and inorganic pollution, viruses and bacteria, and so on [10, 11]. Large volumes of sewage are generated in urbanized areas of India and are frequently discharged into water bodies without proper treatement [12, 13, 14], While agricultural practices in watersheds are also major sources of river pollution [15].

Water quality of any given location or source may be examined using physical, chemical and biological factors; it is regarded dangerous and inappropriate for various human uses and other agricultural operations when it exceeds well-defined limitations [16; 17]. As a result, the appropriates of water for its intended use may be classified or defined in terms of the water Quality Index (WQI), which is one of the most effective methods for describing the state of water quality. It is estimated based on the suitability of surface water for human consumption [18].

As a result the goal of this study is to assess water quality at several places (polluted and non- polluted) along the Sindh River in Dabra, M.P.

II. METHODOLOGY

A. Study Area and Sampling Sites

The suggested research endeavour will focus on the Sindh River Basin. The basin is an interstate basin that straddles the line of longitude 78°22’15”E and Latitude 25°50'09" N. Sindh River is just 5 kilometers (3 miles) from Dabra. Dabra is a significant town in the Indian state of M.P. The Sindh River is the largest in the Madhya Pradesh state's Malwa region. In the present study, a total of five sampling sites were selected, covering an area of approximately 10 km. The S1 station is a reference site, which is the under highway bridge of the Sindh River at Dabra town in Gwalior District. On the Sindh River, two stations (S2 and S3) were chosen upstream and downstream of the right bank village (Kotra) and two stations (S4 and S5) were chosen upstream and downstream of the left bank village (Chandpur).

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Table 1: Description of Sampling point Location

Station	Description
S1	Under the highway bridge of Sindh River Dabra
S2	Upstream of Right bank village (Kotra) of Sindh River
S3	Downstream of Right bank village (Kotra) of Sindh River
S4	Upstream of Left-bank village (Chandpur) of Sindh River
S5	Downstream of Left-bank village (Chandpur) of Sindh River

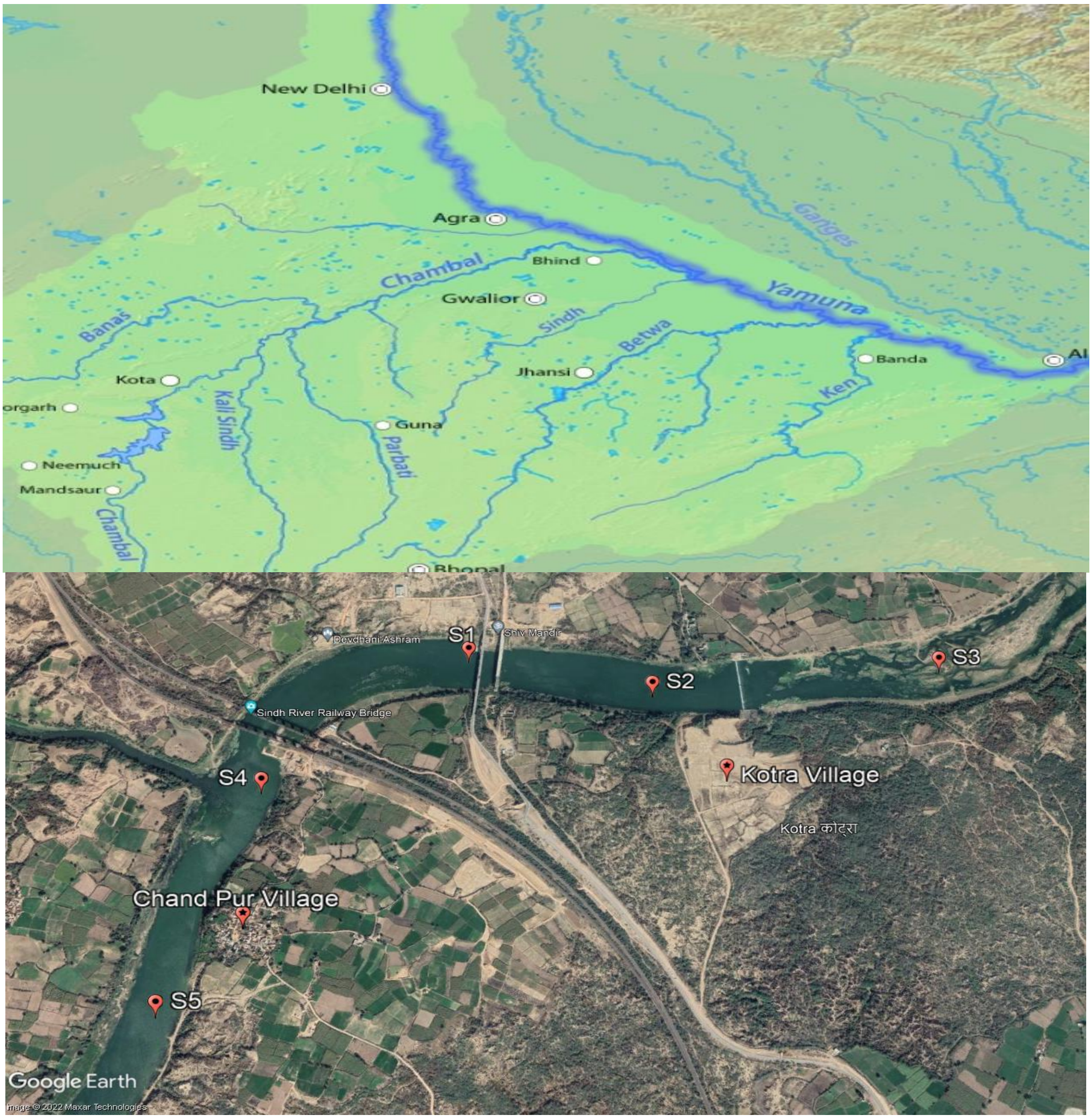

Fig. 1. Map of Study Area

B. Sampling Procedure and Methods of Analysis

In April and July 2021, Grab sampling was performed to gather water samples from all five sampling locations (S1-S5). A total of 10 samplings were carried out, during the investigation. Water samples were collected in polyethene bottles at a depth of 15-20 cm below the surface water. To assess the quality of surface water, a total of sixteen Physico-chemical parameters were examined in the laboratory. pH, turbidity, conductivity, alkalinity, acidity, total hardness, chloride content, total dissolved solids, suspended solids, DO, BOD, COD, sulphate, nitrate, phosphate and MPN were all measured using established procedures in the lab. The APHA manual's Standard Methods, C.N. Sawyer and CPCB manual were used to conduct the Physico-chemical examination of water. The table 2 shows the standard methods used to determine each of the water parameters in the water samples. The weighted arithmetic index method was used to generate the river water quality index.

Table 2: Method adopted for various Physical and chemical

parameters

S. No.	Parameter	Method
1	pH Value	pH meter
2	Electrical Conductivity (EC)	Conductivity meter
3	Acidity	Titrimetric method
4	Total dissolved solids (TDS) & Total Suspended Solids	Gravimetric method
5	Alkalinity	Titrimetric method
6	Total Hardness	Titrimetric method
7	Chloride	Argentometric Titrimetric method
8	Turbidity	Digital Turbidity meter
9	DO	Titrimetric Method
10	BOD (Biochemical Oxygen Demand)	Titrimetric Method
11	COD (Chemical Oxygen Demand)	Closed Reflux method (Titrimetric)
12	MPN	Multiple tube technique
13.	Sulphate	Turbidimetric method
14.	Nitrate	Ultraviolet Spectrophotometric Screening Method
15.	Phosphate	Stannous Chloride Method

Table 3: Permissible Standards of water quality parameters

S.No.	Parameter	Standards for Drinking Water
1.	pH Value	8.5*
2.	Electrical Conductivity	300***
3.	Acidity	200*
4.	Total Suspended Solids	30***
5.	Total dissolved solids	500*
6.	Alkalinity	200*
7.	Total Hardness	200*
8.	Chloride	250*
9.	Turbidity	5*
10.	DO	5*
11.	BOD	6**
12.	COD	10**
13.	MPN	0*
14.	Sulphate	200*
15.	Nitrate	45*
16.	Phosphate	0.4*

All units are in milligram per litre excluding pH, EC (µS/cm), Turbidity (NTU) and MPN
*BIS **WHO ***ICMR

C. Calculation of Water Quality Index

The weighted arithmetic water quality index approach categorized water quality based on the stage of purity using the frequently observed water quality indicators. Numerous scientists have used the procedure, and the WQI was derived using the equation below.

$$WQI = \sum Q_iW_i / \sum W_i$$

The quality rating scale (Qi) for each parameter is calculated as follows:

$$Q_i = 100[V_i – V_o/S_i- V_o)]$$

Where,

Vi denotes the estimated concentration of ith parameter in the analyzed water
In pure water, Vo is the optimal value for this metric.
With the exception of pH = 7.0 and DO = 14.6 mg/l, Vo = 0.
Si is the standard value for the ith parameter.
The following formula is used to compute the unit weight (Wi) for each water quality parameter

$$W_i = K/S_i$$

Where,

K is the proportionality constant and may be determined using the following equation:

$$K = 1/ (\sum (1/S_i))$$

The table below shows the WQI rating depending on water quality

Table 4 Water Quality Rating of Weighted Arithmetic Method

WQI Value	Water Quality Rating
0-25	Excellent water quality
26-50	Good water quality
51-75	Poor water quality
76-100	Very Poor water quality
>100	Unsuitable for drinking purposes

III. RESULT AND DISCUSSION

The result of the physico-chemical analysis of the sample collection at various stations in April and July month is summarized in Table-5 and 6 resp. pH, TDS, Total Hardness, Alkalinity, Acidity, Chlorides, BOD, Sulphate, Nitrate and Phosphate are that parameters come within the permissible limit at all stations as per recommended Standards. TSS, EC, DO and MPN are that parameters which not come within the permissible limit at all stations. The turbidity is observed maximum at Station S4 (10 NTU) in July. Except in April at Station S2, all the observed value of COD was above the permissible limit at all Stations in April and July month. The water quality indices obtained for the five stations in April and July are shown in Table 7 and graphically in Figure 2. The water quality index (WQI) is maximum at Station 5 in April 2021 and minimum at Station 2 in July 2021. The range of WQI was varied from 85.57 to

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99.09 in month of April and it varied from 84.16 to 97.10 in month of July so it comes under the D category i.e. very poor water quality.

Table 5: Physico-chemical analysis of water samples of Sindh River (April 2021)

S. No.	Parameter	S1	S2	S3	S4	S5
1.	pH Value	8.3	7.6	7.9	7.8	8.1
2.	Electrical Conductivity	450	425	446	490	468
3.	Turbidity	6	4	7	5	7
4.	Total Suspended Solids	60	40	38	40	60
5.	Total dissolved solids	180	160	172	220	200
6.	Alkalinity	162	124	132	120	146
7.	Acidity	12	10	16	12	18
8.	Total Hardness	128	164	172	184	198
9.	Chloride	30	26	28	28	34
10.	DO	7.1	7.5	6.5	6.8	6.3
11.	BOD	5.9	5.1	5.4	5.5	5.9
12.	COD	11.6	9.4	12.6	11.2	12.9
13.	MPN	1100	210	460	240	1100
14.	Sulphate	86.1	71.2	76.4	78.5	92.9
15.	Nitrate	9.8	5.4	7.6	8.4	10.6
16.	Phosphate	0.345	0.311	0.33	0.32	0.35

All units are in milligram per litre excluding pH, EC (µS/cm), Turbidity (NTU) and MPN

Table 6: Physico-chemical analysis of water samples of Sindh River (July 2021)

S. No.	Parameter	S1	S2	S3	S4	S5
1.	pH Value	7.81	7.51	7.77	8.01	7.69
2.	Electrical Conductivity	421	353	337	436	381
3.	Turbidity	7	6	8	10	7
4.	Total Suspended Solids	40	40	80	60	80
5.	Total dissolved solids	360	320	240	460	340
6.	Alkalinity	122	116	128	130	156
7.	Acidity	28	24	22	24	32
8.	Total Hardness	120	158	150	176	194
9.	Chloride	30	24	26	36	32
10.	DO	7.4	8.3	7.7	7.8	7.4
11.	BOD	3.8	3.5	3.7	4.1	4.2
12.	COD	11.3	11.2	13.8	11.4	12.8
13.	MPN	2400^{+}	240	1100	460	1100
14.	Sulphate	84.5	74.2	78.7	88.6	86.5
15.	Nitrate	10.8	8.3	12.4	9.8	12.2
16.	Phosphate	0.319	0.28	0.321	0.311	0.325

All units are in milligram per litre excluding pH, EC (µS/cm), Turbidity (NTU) and MPN

Table 7. WQI values at all stations in April and July 2021

Stations	April	July
S1	96.87	91.86
S2	85.57	84.16
S3	94.32	97.10
S4	89.37	95.38
S5	99.09	95.69
Average	93.04	92.84

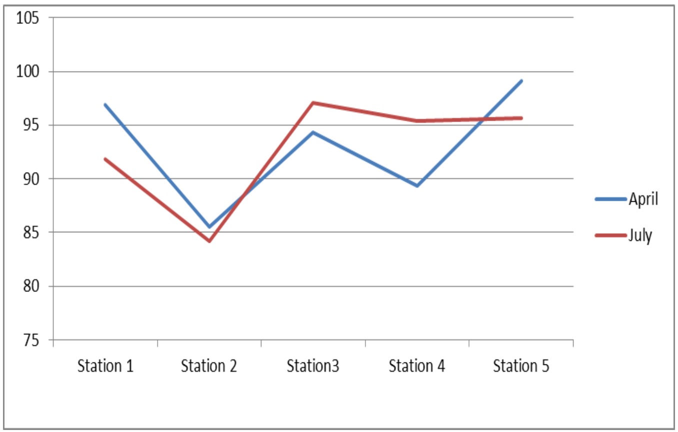

Fig. 2. Variation of WQI of all stations in April and July 2021.

IV. CONCLUSION

This Study provides useful basic data on water quality indicators and contributes to a better understanding of the pollution of Sindh River water and its potential impact on the biological system. Recent research has made an effort to analyze several physicochemical characteristic and the general behaivour of river water samples at various sampling sites. The Water Quality Index is a highly useful instrument for determining the quality of drinking water. Sindh River's water quality index ranges from 84.16 to 99.09, indicating that the river's water quality is very poor. This might be caused to excessive effluent discharge, home sewage, and other human activities. The study suggests that there is an urgent need for more comprehensive research to monitor water quality and to identify corrective actions to safeguard the study area's vital natural water sources.

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