Research Paper

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Dam Water Quality Index (Dwqi) for Tillar Dam of Pacheti Village, District-Agar-Malwa, Mp, India

Chemistry

KEYWORDS : Dam water quality index, DWQI, Dam water, Physico-chemical parameters.

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ABSTRACT

The present investigation reveals the quality of Tillar dam water for public consumption to determine the dam water quality index (DWQI) of Pacheti, District-Agar-Malwa. Physico-chemical parameters of dam water were monitored seasonally during the study period. The parameters investigated were turbidity, pH, total alkalinity, total dissolved solids, hardness, sulphate, chloride, fluoride and nitrate. Seasonal DWQI were determined using mean value of the parameters. Results obtained from the study revealed that DWQI during each season is well within the permissible limit and the dam water is safe for drinking, human consumption and irrigation.

Introduction

Water is the most vital resource for all kinds of life on this planet, but it is being adversely affected both quantitatively and qualitatively by all kinds of life. Comprising over 70 % of the Earth's surface, water is the most precious natural resource on our planet[1]. Water is main source of drinking water in our life. The small amount of water i.e. less than 1.2 % is fit for human consumption which signifies the importance of this essential commodity on the earth1. Water is necessary for humans, animals, plants. The various purposes water essential in our life like drinking domestic, irrigation etc. Approximate 70-71% of water has become polluted in India3. The Physicochemical characteristic of dam water determines whether the water is fit for human consumption or not. The present study will be also helpful for Pacheti and Agar-Malwa peoples depended upon this dam for their domestic needs like drinking, washing, animal drinking, and irrigation purpose.

Study Area and Experimental

Agar Malwa[8] is the 51st district and a municipality in the state of Madhya Pradesh, India, formed in 2013 by excluding a part of Shajapur District. It is situated along the Indore-Kota SH-27 highway. It was formerly a cantonment region at the time of India's independence because of the favorable weather and the availability of water. As of 2015 India census agar had a population of 4.80 lacks. Males constitute 52% of the population and females 48%.

The study was conducted seasonally from Oct. 2013 to Sep. 2014. Water samples from Tillar dam were collected seasonally in clear pre-sterilized polythene bottles without air bubbles. Physico-chemical characteristics were determined as per the standard methods[5].

Calculation of Dam Water Quality Index (DWQI)

The dam water quality index (DWQI) is calculated using weighted arithmetic index method as suggested by Brown et al[2]. The quality rating / sub index (Qi) corresponding to the ith parameter is calculated by using following expression-

$$Qi = \sum_{i=1}^{n} [\{ Mi (-) Ii / (Si - Ii) \}] \times 100$$

Where Mi = estimated values / of the ith parameter in the laboratory, Ii,= ideal values of the ith parameter and Si = standard values of the ith parameter. The sign (-) indicates the numerical difference of the two values, ignoring the algebraic sign. All the ideal values (Ii) are taken as zero except for pH=7, DO=14.6 and fluorides=1.5.

In the present study unit weight (Wi) was calculated by a value inversely proportional to the recommended standard (Si) of the corresponding parameter.

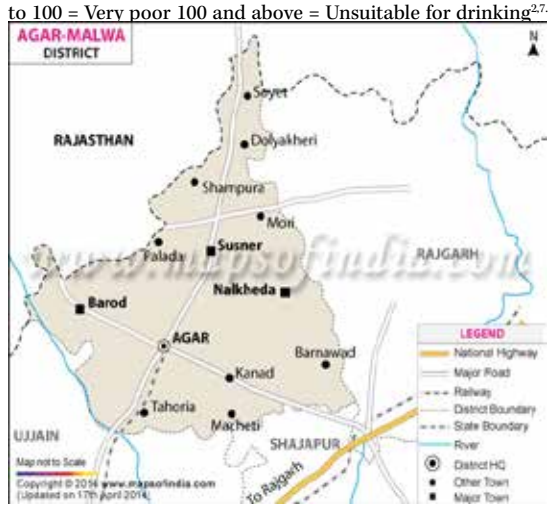
$$Wi = 1 / Si$$

The overall dam water quality index (DWQI) is calculated by aggregating the quality rating (Qi) with unit weight (Wi) linearly.

$$WQI = \{ (\sum_{i-1}^{n} Qi\ Wi) / (\sum_{i-1}^{n} Wi) \}$$

Generally, water quality index (WQI) is discussed for a specific and intended use of water. In this study, the WQI of dam water for drinking purpose is considered and the permissible DWQI for the drinking water is taken as 100. Status of water quality based on WQI is as follows:

From - 00 to 25 = Excellent, 26 to 50 = Good, 51 to 75 = Poor, 76 to 100 = Very poor 100 and above = Unsuitable for drinking[2,7].



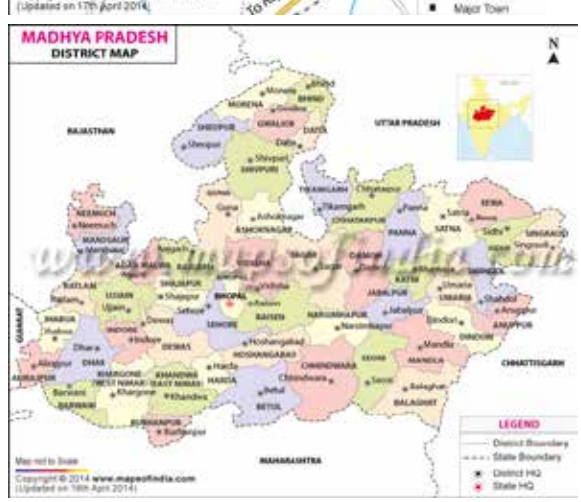


Figure 1- Madhya Pradesh and Agar-Malwa Map

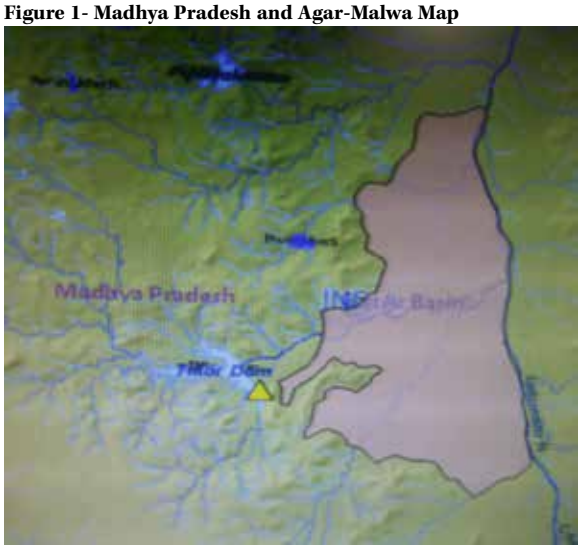


Figure 2- Tillar Dam on Google Map and Real Location of Tillar Dam

Results and Discussion

Turbidity: Turbid waters are unfit for human consumption and causes adverse health hazards on human beings due to the presence of pathogenic micro organisms. The turbidity values of dam water are within the standard permissible limit[6].

Chloride: The main sources of chloride in water are discharge of domestic sewage, industrial effluents, and agricultural biocides in water. During present study the minimum average total alkalinity value recorded was 171.3 mg/l and the maximum recorded was 300.1 mg/l. Both these values are much higher than that of the standard permissible limit[6].

Alkalinity: The main source for alkalinity is due to weathering of rocks. Higher alkalinity value contributes sour and saline taste to water. Although, alkalinity is not harmful to human beings yet the water supplied with less than 100 mg/l is desirable. It is important in calculating the dose of alum and the fluoride values of this investigation are too low and well within the standard permissible limits[6].

Hydrogen ion concentration (pH): The pH value of natural water changes due to biological activity and industrial contamination. pH has no adverse effects on health. The average pH values of this investigation are too low and well within the standard permissible limits[6].

Total dissolved solids: According to WHO the maximum allowable limit of total dissolved solids in groundwater for domestic purpose is 1500 mg/l. Source water may also contain various types of ions of high concentrations causing acute pollution. Usually TDS in water does not harm human beings, but high concentration can cause heart and kidney diseases.

Sulphate: Gypsum and other common minerals are the main source of sulphate in water. High concentration of sulphate around 1000mg/L causes gastro intestinal irritation. The sulphate values of this investigation are well within the standard permissible limit[6].

Total Hardness (TH): Hardness in water is primarily caused by the presence of calcium and magnesium salts and entry of industrial and other domestic effluents into the water source. Hardness has no adverse effect on human health however; some evidence has been given to indicate its role in heart disease. The minimum average total hardness value, recorded 347.5 mg/l during winter season, is well within the standard permissible limit but the maximum value i.e. 481.2 mg/l during summer is much higher than that of the permissible limit[6].

Nitrate: Nitrate values are used to assess the self purification property of the water source. The main source of nitrate in water body is decaying plant and animal materials. The nitrate values of this investigation are well within the standard permissible limit[6].

Fluoride: Fluoride is an essential element for human body. Fluoride is an essential element for human body. Most of fluoride enters into human body only during water consumption fertilizers. It is an indicator of organic pollution.

In this study dam water quality index (DWQI) is calculated as per the procedure explained above for different sampling periods and stations using mean values of selected physicochemical parameters during the study period.

The results obtained are represented in table-1 to 3.

Table-1
Determination of DWQI of Tillar Dam during winter season

S. No.	Parameters	Mean value	Standard permissible value (Si)	Ideal value (I)	Unit weight (Wi)	Quality rating (QI)	QI*WI
1	TDS	801.9	500	0	0.00	160.38	0.32
2	Sulphate	83.5	150	0	0.00	55.67	0.37
3	pH	7.43	8.5	7	0.12	28.67	3.37
4	Total alkalinity	203.1	120	0	0.01	169.25	1.41
5	Total hardness	347.5	300	0	0.00	115.83	0.39
6	Fluoride	0.9	1.5	1	0.67	20.00	13.33
7	Chloride	171.3	250	0	0.00	68.52	0.27
8	Turbidity	3.47	10	0	0.10	34.7	3.47
9	Nitrate	26	45	0	0.02	5.77	1.28
				∑Wi= 0.92		∑QiWi = 24.21	
DWQI = ∑QiWi / ∑Wi = 24.21 / 0.92= 26.31							

All parameters are in mg/l except pH and turbidity. Turbidity is in NTU

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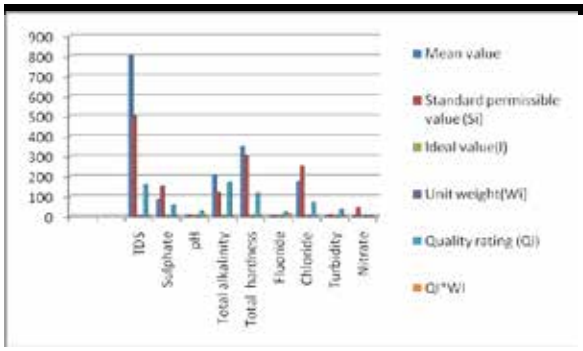


Table-2
Determination of DWQI of Tillar Dam during summer season

S. No.	Parameters	Mean value	Standard permissible value (Si)	Ideal value (I)	Unit weight (Wi)	Quality rating (QI)	QI*WI
1	TDS	996	500	0	0.00	199.2	0.40
2	Sulphate	100.7	150	0	0.00	67.13	0.45
3	pH	7.32	8.5	7	0.12	21.33	2.51
4	Total alkalinity	301.3	120	0	0.01	251.08	2.09
5	Total hardness	481.2	300	0	0.00	160.5	0.53
6	Fluoride	0.7	1.5	1	0.67	60.00	40.00
7	Chloride	238.8	250	0	0.00	95.52	0.38
8	Turbidity	1.02	10	0	0.10	10.2	1.02
9	Nitrate	30.13	45	0	0.02	66.95	1.49
				∑Wi= 0.92		∑QiWi = 48.87	
DWQI = ∑QiWi / ∑Wi = 48.87/ 0.92= 53.12							

All parameters are in mg/l except pH and turbidity. Turbidity is in NTU

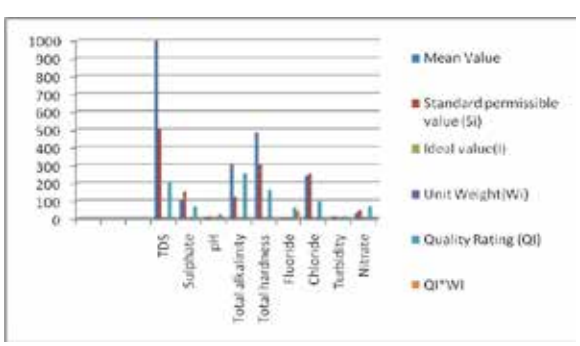
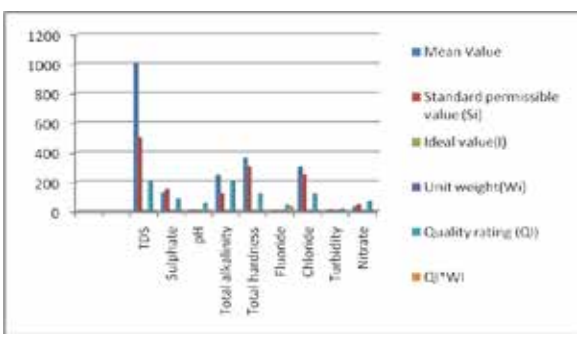


Table-3
Determination of DWQI of Tillar Dam during Rainy season

S. No.	Parameters	Mean value	Standard permissible value (Si)	Ideal value (I)	Unit weight (Wi)	Quality rating (QI)	QI*WI
1	TDS	1001	500	0	0.00	200.2	0.40
2	Sulphate	126	150	0	0.01	84.00	0.56
3	pH	7.36	8.5	7	0.12	54.00	6.35
4	Total alkalinity	244.1	120	0	0.01	203.41	1.69
5	Total hardness	359.2	300	0	0.00	119.73	0.40
6	Fluoride	0.78	1.5	1	0.67	44.00	29.33
7	Chloride	300.1	250	0	0.00	120.04	0.48
8	Turbidity	1.51	10	0	0.10	15.10	1.51
9	Nitrate	30.40	45	0	0.02	67.55	1.50
				∑Wi= 0.93		∑QiWi = 42.22	
DWQI = ∑QiWi / ∑Wi = 42.22 / 0.93= 45.39							

All parameters are in mg/l except pH and turbidity. Turbidity is in NTU



The results obtained from the study (table-1 to 3) revealed that the DWQI of Tillar dam is well within the permissible limit (100) of water quality index and the status of dam water is 'good' during all the sampling periods. During the study period the minimum DWQI 26.31 was recorded in winter, while the maximum DWQI (53.12) was recorded during summer. Intermediate condition was observed during rainy season during which DWQI calculated was 45.39.

Conclusion

The results obtained from this study clearly indicate usability of Tillar dam water for drinking and other domestic purposes. The study also indicates the helpful and usefulness of DWQI in estimating the drinking water quality of dam water. It is also useful and helpful for a Pacheti and an Agar-Malwa person's to understand the drinking water quality.

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