

WATER QUALITY INDEX AND SUITABILITY OF WATER OF KOHARGADDI DAM AT DISTRICT BALRAMPUR, INDIA

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ABSTRACT

The physico-chemical characteristics of Kohargaddi dam water were studied during July 06-June 07. Seasonal variations in water quality parameters in rainy, winter and summer seasons. The result revealed that there were significant seasonal variations in some physico-chemical parameters and "WQI". The result indicate poor status of water during rainy and winter season, however very poor status was reported during the summer season. Therefore water of Kohargaddi dam is not suitable for human or cattle consumption.

KEY WORDS : Physico-chemical parameters, water quality index, Kohargaddi dam.

INTRODUCTION

Kohargaddi dam is one of the most important dams of district Balrampur at Indo-Nepal Border. Actually, estate of Balrampur constructed this dam to solve the water problem for irrigational purposes during pre independence in the foothills of Himalayas. As we know that near by foot hills of Himalayas water crises exist as a serious problem because bore-well and tube wells are not success here. Therefore, the excess water from hills downstream is collected in the catchments area in form of kohargaddi dam.

Kohargaddi dam is situated at 82°-36' east and 27°-36' north latitude at Pachperwa town of District Balrampur. It is about 8 km in length having 120 meter water level. The height of the dam is 36 m, which discharges about 24,000-cumex minimum water every month. This dam is utilized to irrigate 50, 340 Acres unirrigated land of district Balrampur. It covers about 126 km catchments area. Local inhabitants' viz. Tharus and their pets also use this water for drinking purposes. Now a question arises whether water is suitable for various life purposes of living being like plant and animals. The present study was therefore undertaken to see the physico-chemical water quality index and status of water in

different seasons of the year 2006-07. In this consideration we have analysed the suitability of water.

MATERIALS AND METHODS

The samples were collected in cleaned polythene bottle in the morning (8:00am) from July 2006 to June 2007. Physico-chemical analysis of water samples were carried out by standard method (APHA, 1998).

Water Quality Index System (WQI)

A water quality index, common with many other indices systems, related a group of water quality parameters to a common scale and combines them into a single number in accordance with chosen method of computation, the desired use of WQI is to assess water quality trends for management purpose even through it is not meant for an absolute measure of the degree of pollution or the actual water quality.

$$WQI = \frac{\sum_{i=1}^n q_i w_i}{\sum_{i=1}^n w_i}$$

The water quality index was calculated considering nine important physico-chemical

parameters using ICMR and ISI standards by following formula:

Where W_i is a unit weight factor, given by the formula $W_i = K/S_i$

S_i is the slandered value of i^{th} parameter and K is proportionality constant.

The unit weight W_i for all the 9 chosen parameters with standard values one given is Table 2.

The quality rating q_i is determined as follows: $q_i = 100 (V_i - V_{10}) / (S_i - V_{10})$

Where,

q_i = Quality rating for the n^{th} water quality parameter.

V_i = Estimated value of the n^{th} parameter at a given sampling station.

S_i = Standard permissible value of n^{th} parameter.

V_{10} = Ideal value of the n^{th} parameter in pure water.

All the ideal values (V_{10}) are taken as zero for the drinking water except for pH = 7.0 and DO = 14.6 mg/L.

RESULT AND DISCUSSION

The values of various physico-chemical parameters in

Table 1. Physico-chemical properties of Kohargaddi dam Balrampur.

S. No.	Properties	Seasons		
		Rainy	Winter	Summer
1	Water temp(°C)	25.2	22.3	30.5
2	pH	7.3	7.9	8.1
3	Dissolved Oxygen (DO)	6.3	7.2	4.3
4	Total Dissolved Solid (TDS)	61.2	50.7	30.2
5	Total hardness	40.2	32.0	52.1
6	Calcium	17.5	21.3	29.2
7	Magnesium	14.1	10.9	21.3
8	Sulphate	11.3	18.0	13.9
9	Chloride	15.3	16.8	21.4
10	Nitrate	9.0	6	13

Table 2. Drinking water standards recommending agencies and unit weights (all values except pH in mg./L.)

S.No	Properties	Standards (S_i)	Recommending agency	Unit Weight (w_i)
1	pH	6.5-8.5	ICMR and ISI	0.219
2	Total Dissolved Solid	500	ICMR and ISI	0.003708
3	Dissolved oxygen(DO)	0.5	ICMR	0.37
4	Total hardness	500	ICMR and ISI	0.00618
5	Calcium	75	ICMR and ISI	0.02472
6	Magnesium	30.0	ICMR and ISI	0.0618
7	Sulphate	150	ICMR and ISI	0.01236
8	Chloride	250	ICMR and ISI	0.007416
9	Nitrate	45	ICMR and ISI	0.0412

different seasons of kohargaddi dam water are presented in Table 1. Table 2 indicates the drinking water standards as recommending agencies and unit weights (W_i).

Water temp.

The temperature of water was found to be in the range between 22.3 to 30.5°. It was minimum in winter (22.3°C) and maximum in summer (30.5°C).

pH

It monitors seasonal variations associated with recharge and can be an indicator of changing water quality due to land use changes. The pH value ranged from 7.3 (Rainy season) to 8.1 (summer season). The lowers value of pH during rainy season maybe due to dilution of alkaline substances or atmospheric CO_2 .

DO

The DO was varied from 4.3 to 7.2 mg/L during study. The DO found to be to be maximum (7.2 mg/L) in winter and minimum (4.3 mg/L) in summer.

TDS

TDS is an indicator of overall water quality, mineralisation and used for comparison of water quality overtime. TDS was ranged from 61.2 mg/L (in Rainy season) to 30.2 mg/L (summer season).

TDS is the term used to describe the inorganic salts and small amounts of organic matter present in solution of water.

Table 3. Water quality rating for drinking proposes.

Water level (WQI)	Water quality rating
0-25	Excellent
26-50	Good
57-75	Poor
76-100	Very poor
>100	Unfit for dinking

Table 4. Calculation of WQI in Rainy season of Kohargaddi dam.

S.No.	Parameters	Measured value(V _i)	Standard Value(S _i)	Ideal Value(V ₁₀)	Unit weight factor (w _i)	Quality rating(q _i)	q _i w _i
1	pH	7.3	7.0-8.5	7.0	0.219	20	4.38
2	Dissolved Oxygen(DO)	6.3	5	14.6	0.37	86.458	31.99
3	TDS	61.2	500	0	0.003708	12.24	0.04538
4	Total hardness	40.2	300	0	0.00618	13.40	0.0828
5	Calcium	17.5	75	0	0.02472	23.33	0.5767
6	Masnerium	14.1	30	0	0.0618	47.00	2.90
7	Sulphate	11.3	150	0	0.01236	7.53	0.093
8	Chlovide	15.3	250	0	0.007416	6.13	0.0454
9	Nitrate	9.0	45	0	0.0412	20	0.8240

So - $WQI = \frac{\sum_{i=1}^n q_i w_i}{\sum_{i=1}^n w_i}$
 $WQI = \frac{40.93728}{0.746384} = 54.8475$

$\sum w_n = 0.746384$ $\sum q_n w_n = 40.93728$

Table 5. Calculation of WQI in Winter season of Kohargaddi dam.

S.No.	Parameters	Measured value(V _i)	Standard value(S _i)	Ideal value(V ₁₀)	Unit weight factor (w _i)	Quality rating(q _i)	q _i w _i
1	pH	7.9	7.0-8.5	7.0	0.219	60.0000	13.14
2	DO	7.2	5	14.6	0.37	77.0833	28.5208
3	TDS	50.7	500	0	0.003708	10.1400	0.03760
4	Total hardness	32	300	0	0.00618	10.6666	0.06591
5	Calcium	21.3	75	0	0.02472	28.40000	0.7020
6	Magnesium	10.9	30	0	0.0618	36.3333	2.2451
7	Sulphate	18.0	150	0	0.01236	12.0000	0.14831
8	Chloride	16.8	250	0	0.007416	6.7200	0.0498
9	Nitrate	6	45	0	0.0412	13.3333	0.5493

$WQI = \frac{45.4588}{0.746384} = 60.90$ $\sum w_n = 0.746384$ $\sum q_n w_n = 45.4588$

Table 6. Calculation of WQI of Kohargaddi dam in Summer season.

S.No.	Parameters	Measured value(V _i)	Standard value(S _i)	Ideal value(V ₁₀)	Unit weight factor (w _i)	Quality rating(q _i)	q _i w _i
1	pH	8.1	7.0-8.5	7.0	0.219	73.3333	16.0599
2	DO	4.3	5	14.6	0.37	107.2916	36.6978
3	TDS	30.2	500	0	0.003708	6.04	0.0224
4	Total hardness	52.1	300	0	0.00618	17.3666	0.1073
5	Calcium	29.2	75	0	0.02472	38.9333	0.962431
6	Magnesium	21.3	30	0	0.0618	71.0000	4.3878
7	Sulphete	13.9	150	0	0.01236	9.2666	0.1145
8	Chloride	21.4	250	0	0.007416	8.5600	0.0634
9	Nitrate	13	45	0	0.0412	28.8888	1.1902

$WQI = \frac{62.605731}{0.746384} = 83.8887$ $\sum w_n = 0.746384$ $\sum q_n w_n = 62.605731$

Hardness

It is the indicator of hydrogeology and aesthetic quality of water. During study; the hardness was ranged from 52.1 mg/L (maximum in summer) to 32.0 mg/L (minimum in winter).

Calcium

It is an important element influencing flora of

ecosystem, which plays important role in metabolism and growth. The average of it varied from 17.5 mg/L (minimum in Rainy season) to 29.02 (maximum in summer season).

Magnesium

Its level varied from 10.9 to 21.3 (mg/L). The maximum value (21.3 mg/L) during summer while

Table 7. WQI of Kohargaddi dam with the status of water quality in different season.

S.No.	Seasons	WQI	Status
1	Rainy	54.8475	Poor
2	Winter	60.90	Poor
3	Summer	83.8887	Very Poor

minimum value (10.9 mg/L) during winter.

Sulphate

It is the indicator of hydrogeology and solution of fertilizer into water. During the study Sulphate ranged from 11.3 (minimum in rainy season) to 18.0 (maximum in winter season).

Chlorides

It is the indicator of contamination with animal and human waste. The chloride contents varied from 15.3 mg/L to 21.4 mg/L indicates non pollution status of the water body. Maximum value was recorded in summer while minimum value recorded in rainy season.

Nitrates

One indicator of seasonal variations associated with recharge and solution of fertilizer, contamination from animal or human wastes.

It ranged from 6-13 mg/L. The maximum value was recorded in summer (13 mg/L) and minimum value during winter (6 mg/L).

The water quality rating for drinking purposes of any water system is given in table 3.

The water quality index (WQI) of Kohargaddi dam during various seasons is calculated. The calculation is given in table 4 for Rainy season, table 5 for winter season and table 6 for summer season.

The values of WQI of Kohargaddi dam have been calculated. The pH value of water indicates its alkaline nature. It varied between 7.3-8.1, however, the recommended values of pH by ISI is 6.5-8.5 and by ICMR 7-8.5. It is well known fact that alkalinity itself is not harmful to human beings. However, sometimes it is harmful to various zooplankton and phytoplankton. Its application for irrigation, sometimes change the nature of soil.

So the, quality rating of the water is established from WQI, it is established from different physico-chemical parameters reported in different seasons of the water body. The present result are much above than 50 indicating that water is not suitable for different use of various life process

of human being and cattle. The value of water quality during summer season is maximum (83.89) i.e. very poor status and it is almost unfit for potable purposes of cattle and human being both. The reason for poor water quality status is due to accumulation of various types of pollutants in water. Ultimately, they get deposited in the form of small water pool.

CONCLUSION

Analysis of Kohargaddi dam's water in three seasons Rainy, Winter, Summer during July 2006- June 2007, revealed that the water of dam is not suitable for different purposes like irrigation and potable purposes. These results indicate that water of Kohargaddi dam is completely unsuitable for human beings and cattle.

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