International Journal for Environmental Rehabilitation and Conservation
Volume II No. 2 2011 [16 – 22] [ISSN 0975 - 6272]

Evaluation of present water quality status of Sapta Sarovars at Ujjain

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Received: April 29, 2011 | **Accepted**: September 12, 2011 | **Online**: December 27, 2011

Abstract

In the present investigation Assessment of physico-chemical parameters were carried out during the period July 2008 to June 2009 from seven sarovars namely the Rudra Sagar, Pushkar Sagar, Kshir Sagar, Goverdhan Sagar, Ratnakar Sagar, VishnuSagar and Purushotam Sagar located in Ujjain , an ancient city of central India in the Malwa region of Madhya Pradesh. Sites I, II, II IV, VI and VII were subjected to various anthropogenic activities of man, passing through the urban residential areas while sites V were located in a forested village and have heavy human disturbances. Parameters studied were Temperature, pH, Conductivity, Total solid, free CO_2, DO, BOD, Alkalinity, Hardness and Chlorides.

Keywords: *Physicochemical parameter* | *Saptasarovar* | *Water quality* | *DO* | BOD

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Introduction

Water is one of the most vital natural resources. Compared with other resources water is generally very utilizable resource. Hence we can say that Water is one of the most important components for survival of any kind of living organism. It covers nearly three fourth of the surface of the earth. Fresh water is the most precious resource on earth. Today, the easy availability of fresh water is a major problem as 80% rivers are getting polluted. Singh *et al*.(2002).There are serious water quality problems in the cities, towns and villages using these waters. Water borne diseases are rampant, fisheries are on decline, and even cattle are not spared from the onslaught of pollution. Ujjain is situated on a unique geographical location (Latitude 23°-11" N Longitude 75°-45" E) from where tropic of cancer passes. It is the 'Greenwich Mean Time' of India for Panchang. The tilting of earth at angle of 23½ ◦ on its axis and geographical line of tropic of cancer has special cosmic influence making it fit for absolute time location. Ujjain city is situated on the bank of river Kshipra, the only river that travels straight from south to north. Water intended for human consumption

should be safe and wholesome *i.e*. free from pathogenic agent and harmful chemicals, pleasant to taste and useable for domestic purpose (Parashar *et al*., 2006). Present study comprises of interpretation and analysis of water samples collected from seven polluted water bodies of Ujjain city and found that heavy pollution occurred due to urbanization, anthropogenic activities; increased human Interventions in the water bodies have been ascertained.

Sampling Sites:

Sampling Site I (Rudra Sagar):Rudra Sagar is situated on the west side of the Mahakaal Temple Complex. Being part of the Sapta Sarovar the tank has a great religious and historical significance.

Sampling Site II (Pushkar sagar): is situated at Naliabakhal is one of the Seven Holy Tanks of the city Ujjain. Due to rapid urbanization and absence of public drainage system in the city this water body is converted in to a collection tank of dirty water.

Sampling Site III (Kshir sagar): is situated at Nai sadak in the city Ujjain.

Sampling Site IV (Goverdhan sagar): this sampling site is in main city situated at Nikas Chourha.

Sampling Site V (Ratnakar sagar): this sampling site is situated in odasa village.

Sampling Site VI (Vishnu sagar): is situated in ankpat behind the temple ram laxaman

Sampling Site VII (Purushotamsagar): is situated Near the Ankpat Darwaja it is also called as Solah Sagar

Material and method:

Water samples were collected from different location of Sapt sarover in Ujjain city. Monthly sampling was done for a period of twelve month from July-2008 to June 2009.The water samples were collected between 7.00 a.m. to 9.00 a.m. in plastic container as possible to avoid unpredictable changes in physico-chemical characteristics from each sampling sites. The testing of samples was done according to the procedure prescribed by APHA (1998), S.K. Mati (2004) and Trivedy and Goel (1986). The pH, electrical conductivity and turbidity were estimated at sampling sites. DO was fixed at the sampling site and other parameters were measured according to standard procedure given by APHA (1998), Trivedy & Goel (1986) and S.K. Matti (2004) in the laboratory.

Result and discussion:

The physicochemical characteristic provides a fair idea of the water quality of any water body. The physico-chemical analysis carried out from the different site during different seasons has been presented in table 1.

Temperature is one of the most important factor which influence chemical, physical and biological characteristics of water bodies. The present study revealed that temperature varied from 26.22±3.19 °C to 27.41±3.43 °C however maximum temperature was found at sampling site VII and minimum was at sampling site VI. Average value of temperature was found 26.62±0.43 °C during study period. Similar pattern were observed

for temperature by Prasad (1952), Sivakumar *et al*. (2003) during their study on water quality of the river Ambarapalaym. pH is an important parameter which is important in evaluating the acid-base balance of water.The pH values ranged from 7.50±0.12 to 8.20±0.20. Maximum pH was found at sampling site VII and minimum was at sampling site I. Average value of pH was found 7.94±0.23 during study period. Ellis (1937) has observed that a pH range of 6.7 to 8.4 is suitable for the growth of aquatic biota.Alkaline Ph was also obserbed by Shaikh and Yeragi (2004) in river Tansa while Varma (1998) have observed acidic nature of ph during his study.Turbidity of water is an important parameter, which influences the light penetration. The turbidity value of sapta sarovars varied from 67.21±4.58 JTU to 75.28±8.97 JTU however maximum turbidity was found at sampling site VI and minimum was at sampling site IV. Average value of turbidity was found 72.11±2.57 JTU during study period. Similar pattern for turbidity was observed by Shrada *et al*. (2011), during physiochemical study on water quality of narmada river and Singh *et al*. (2002) during Hydrobiological studies of two ponds of satna M.P. Electrical Conductivity measures the capacity of a substance or solution to conduct electrical current. In the present study, lowest conductivity value (171.76±16.74 µmhos/Cm^2)was observed at Station-VI and highest value of conductivity (212.70±61.74 µmhos/Cm^2)was observed at Station-I. Average value of conductivity was found 200.86±14.15 µmhos/Cm^2 during study period. Similar study was made by Abida, (2008), Badrinath (1980) and Saksena *et al.* (2008).Total Solid was found highest in monsoon period and minimum in winter. The concentration is high during the monsoon, which may be due to addition of solids from the runoff water. Caroline (1992).Total solid varied from 1525.36±68.97 mg/l to 1814.40±49.06 mg/l however maximum total solid was found at sampling site VI and minimum was at sampling site II. Average value of total solid was found 1642.67±131.74 mg/l during study period. Chacko Ganapathy, (1949) and Fokmare *et al*. (2002) has made the same observation Alkalinity of water is a measure of weak acid present in it and of the cations balanced against them. In the present investigation also, total alkalinity level reduced in the post-rainy months. Higher level of alkalinity 272.31±32.62 mg/l was found at sampling site II during study period and lower 159.54±1309 mg/l at sampling point I. Average value of alkalinity was found 207.51±36.04 mg/l during study period. Similar observation has also been reported by Singh and Rai (1999); Garg *et al.* (2010). The alkalinity varies in accordance with the fluctuation in the pollution load (Parashar *et al*. 2006).Hardness is very important parameter in decreasing the toxic effect of poisonous element.The water hardness was higher in monsoon but it was highest during summer season which might have caused increased concentration of salts by excessive evaporation as also observed by Jitendra *et al*. (2008). Hardness varied from 178.52±5.74

mg/l to 198.45±45.32mg/l however maximum hardness was found at sampling site III and minimum was at sampling site I. Average value of hardness was found 187.62±6.54 mg/l during study period. Present observations are in agreement with similar ones made by Das, (2000); Mahor (2009). Chloride is one of the important indicators of pollution. Chlorides are present in sewage, effluents and farm drainage. Main sources of chloride in any water bodies are sediments, sewage and trade and industrial effluents, if present. Sewage bring with urine, which is rich in chloride content. Chloride varied from 24.04±1.80 mg/l to 42.84±2.45 mg/l. The value of chloride concentration in the present study was highest at sampling station II and lowest at sampling station III. Average value of chloride was found 35.24±6.84 mg/l during study period Rajkumar, 2004; Rai (1974) also reported similar findings in their study on different water bodies.Dissolve oxygen is a one of the important parameter in water quality assessment its presence is essential to maintain variety of forms of biological life in the water and the effect of waste discharge in a water body is largely determined by the oxygen balance of the system. Dissolved oxygen is regulator of metabolic activities of organisms and thus governs metabolism of the biological community as a whole and also acts as an indicator of trophic status of the water body (Saksena and Kaushik, 1994). The mean value of the dissolved oxygen ranged between (9.71±0.53 mg/l) to (11.76±0.79 mg/l). Lowest DO means maximum pollution due to effluent and human activities. Annual average value was observed at all sampling site 10.98±0.71 mg/l. Dissolved oxygen concentration more than 5.00 mgl/1 favours good growth of flora and fauna (Das, 2000). The dissolved oxygen ranged from 3.41 to 6.21 mgl/1 in Seetadwar lake (Tewari and Mishra, 2005), from 5.30 to 9.00 mgl/1 in Deoria tal (Rawat and Sharma, 2005) and from 3.00 to 6.00 mgl/1 in Kandhar dam (Surve et al., 2005). Biological oxygen demand is a measure of the oxygen in the water that is required by the aerobic organisms. The biodegradation of organic materials exerts oxygen tension in the water and increases the biochemical oxygen demand (Abida, 2008). In this study value of BOD varied from (2.57±0.41) mg/l to (5.38±0.67) mg/l in sapta sarovar water samples. Average value of BOD for all sampling site was observed 4.28±1.17 mg/l. Desirable limit for BOD is 4.0 mg/l and permissible limit is 6.0 mg/l according to Indian standards. BOD demand below 3 mg/l or less is required for the best use. Fokmare and Musaddiq (2002) recorded high value of biochemical oxygen demand (BOD) as 20.00 mgl/1 in river Purna. Rajkumar *et al*. (2004) and Jitendra *et al*. (2008) also reported maximum BOD value in winter and minimum in summer in their study. The chemical oxygen demand (COD) ranged from (12.56±0.35) mg/l to (20.23±0.82) mg/l (Table 1). And average value was found 16.17±2.31 mg/l. The test is commonly used to indirectly measure the amount of organic compounds in water. Most applications of COD determine the amount of organic pollutants found in surface water,

making COD a useful measure of water quality. It is expressed in milligrams per liter (mg/l), which indicates the mass of oxygen consumed per liter of solution (Clair 2003). COD is the measure of the oxygen required for chemical oxidation of organic matter. In this study maximum value of COD was found at Station-II and minimum value at Station-IV. Vyas et al.(2006) and Das (2000) also suggested a similar finding during his study.The pH, alkalinity and free carbon dioxide are interrelated in aquatic ecosystems. Most of the free carbon dioxide in water comes from the decomposition of organic matter and from respiration of organisms (Singh and Rai 1999). In polluted water, the free carbon dioxide is generally high. In Chambal river, free carbon dioxide ranged from non traceable amount at all stations. the maximum value of free CO_2 was found 4.10±0.52 mg/l at sampling station VIII and minimum 2.68±0.48 mg/l was at sampling station I . average value was recorded as 3.42±0.43 mg/l. Good oxygen saturation and low free carbon dioxide indicate no pollution load in the river at all Stations.

Parameter	Site I	Site II	Site III	Site IV	Site V	Site VI	Site VII	Average
pH	7.50 ± 0.12	7.90 ± 0.14	8.10 ± 0.20	8.00 ± 0.19	7.80 ± 0.15	8.10 ± 0.21	8.20 ± 0.20	7.94 ± 0.23
Temperature (°C)	26.55 ± 2.65	26.30 ± 2.79	26.52 ± 2.92	27.00 ± 2.60	26.36 ± 3.12	26.22 ± 3.19	27.41 ± 3.43	26.62 ± 0.43
Conductivity (μmhos/Cm^2)	212.70 ± 61.74	202.24 ± 31.03	212.24 ± 77.86	206.56 ± 33.72	205.34 ± 28.81	171.76 ± 16.74	195.21 ± 54.53	200.86 ± 14.15
Turbidity (JTU)	74.31 ± 13.81	72.19 ± 13.02	71.29 ± 10.76	67.21 ± 4.58	72.42 ± 13.10	75.28 ± 8.97	72.10 ± 13.20	72.11 ± 2.57
Total Solid (mg/l)	1537.29 ± 51.34	1525.36 ± 68.97	1703.45 ± 74.59	1517.90 ± 48.37	1590.85 ± 27.40	1814.40 ± 49.06	1809.49 ± 46.01	1642.67 ± 131.74
BOD (mg/l)	2.57 ± 0.41	5.38 ± 0.67	3.17 ± 0.42	4.78 ± 0.56	3.52 ± 0.51	5.24 ± 0.62	5.35 ± 0.65	4.28 ± 1.17
COD (mg/l)	14.97 ± 0.41	20.23 ± 0.82	15.82 ± 1.32	12.56 ± 0.35	15.85 ± 1.35	16.82 ± 1.38	16.95 ± 1.42	16.17 ± 2.31
DO (mg/l)	9.71 ± 0.53	11.76 ± 0.79	11.10 ± 0.47	10.45 ± 0.42	10.90 ± 0.43	11.35 ± 0.46	11.65 ± 0.56	10.98 ± 0.71
Free CO_2 (mg/l)	2.68 ± 0.48	3.27 ± 0.32	3.33 ± 0.39	3.58 ± 0.41	3.35 ± 0.33	3.65 ± 0.46	4.10 ± 0.52	3.42 ± 0.43
Alkalinity (mg/l)	159.54 ± 1309	272.31 ± 32.62	187.17 ± 6.13	195.25 ± 6.32	192.20 ± 3.24	225.46 ± 30.42	220.68 ± 30.05	207.51 ± 36.04
Hardness (mg/l)	178.52 ± 5.74	191.72 ± 44.69	198.45 ± 45.32	185.65 ± 42.21	182.60 ± 41.56	190.45 ± 43.25	185.98 ± 42.55	187.62 ± 6.54
Chloride (mg/l)	32.41 ± 1.51	42.84 ± 2.45	24.04 ± 1.80	35.65 ± 1.24	30.45 ± 1.15	38.68 ± 1.35	42.65 ± 1.68	35.24 ± 6.84

Table 1: Physico-chemical characteristics of Sapta sarovar at different sampling stations during 2008-09

Acknowledgement: authors are thankfull to head of the department of School of studies in Environment Management, Vikram University Ujjain for providing lab facility for the present study.

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