RESEARCH ARTICLE

Water quality studies of Vaigai reservoir with special reference to physico-chemical parameters

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Mary AA, Rose MRD. Water quality studies of Vaigai reservoir with special reference to physico-chemical parameters. AGBIR.2023;39(4):581-583

In the present study aims at the assessment of various physical and chemical parameters of Vaigai reservoir water. Sampling was carried out from two sampling sites. The samples were analyzed in the laboratory as per the standard protocols. The annual mean values of each parameter from the two sampling sites were compared with W.H.O and I.S permissible limits. The physico-chemical parameters showed very few fluctuations and most of them were within the permissible limits of standards indicating better quality of reservoir. The results conclude the suitability of Vaigai reservoir water for various human needs. However, regular monitoring for its water quality maintenance is need of the hour to prevent its further deterioration.

Key Words: *Physical and chemical parameters; Dissolved oxygen; Total dissolved solids; Water*

INTRODUCTION

Water is the basic constituent of life. It is indispensable, limited and vulnerable resource in the community. It is the primary need for life on earth and availability of water makes the earth incredible planet. Water fills depressions in the earth crust to form lakes, seas and oceans. Approximately 96.5% of the total water existed on the earth is from the seas and they are saline in nature. Its salinity is approximately around 35%. The remaining 2.5% is on the fresh water on the earth having less than 1% of ocean's salinity [1]. 87% of the total fresh water is present in lakes, 11% in swamps and only 2% in rivers.

Dams are also called as artificial Lakes. In order to avoid scarcity of water and to fulfill the various demands of mankind, Dams have been constructed across the rivers and they form a store house of water on the upstream side of the barrier and hence they are called as reservoirs. The stored water can be utilized for irrigation, hydroelectric power generation and aquaculture. Enrichment of water resource enhances the aesthetic as well as ecological value of the geographical area [2].

MATERIALS AND METHODS

Samples were collected from two sampling sites of Vaigai reservoir *viz*, Station1 [S1] and Station2 [S2], so that by and large the water sample may represent the totality of its water chemistry. Samples were collected from 5-8 cm depth in acid polyethylene bottles of 1 L capacity. Samples were properly labeled immediately after their collection and brought to the laboratory for the physical and chemical examination. Samples were stored at 4°C prior to their assessment. The physico-chemical parameters of the samples were analyzed in the laboratory as per the standard protocols [3-16]. The water temperature was measured by using mercury filled Celsius thermometer of 0-50°C range and 0.2°C least count. A digital pH meter was used to measure the pH and the electrical conductivity was measured using a conductivity meter. Turbidometry was followed for the determination of turbidity. Total dissolved solids were calculated by drying the sample on a drying oven at 180°C. Water colour was studied by visual comparison method. The various chemical parameters of the samples collected were studied as follows. Dissolved oxygen and BOD were estimated by Winkler's iodometric method with azide modification. The carbonates and bicarbonates were determined by phenolphthalein and methyl orange methods respectively. EDTA method was followed to assess the calcium, magnesium and TH. The flame emission photometer was used to determine the sodium and potassium. Phosphate was measured by stannous chloride method and the fluoride by spectrophotometry [SPADNS] method, chloride by argentometry, nitrate by brucine method and sulphate by turbidimetric method shown in Table 1.

TABLE 1

The instruments and methods of analysis used for different water quality parameters

Parameter	Instrument used	Method used	Method reference
pH	pH meter	Potentiometry	American Public Health Association (1998)
EC	Conductivity meter	Potentiometry	Trivedi and Goel (1986)
TDS	Drying oven	Evaporation	American Public Health Association (1998)
Turbidity	Turbidimeter	Calibration	American Public Health Association (1998)
Total hardness	Burette	Titration (EDTA method)	Trivedi and Goel (1986)
Calcium	Burette	Titration (EDTA method)	Trivedi and Goel (1986)
Magnesium	Burette	Titration (EDTA method)	Trivedi and Goel (1986)
Total alkalinity	Burette	Titration	American Public Health Association (1998)
Sodium	Flame Photometer	Calibration	American Public Health Association (1998)
Potassium	Flame Photometer	Calibration	American Public Health Association (1998)
Chloride	Burette	Titration (Argentometry)	American Public Health Association (1998)
Nitrate	Spectrophotometer	Brucine method	American Public Health Association (1998)
Sulphate	Turbidimeter	Calibration	American Public Health Association (1998)
Phosphate	Spectrophotometer	Stannous chloride method	American Public Health Association (1998)
Fluoride	Spectrophotometer	SPADNS	American Public Health Association (1998)
DO	Burette	Winkler's Iodometry	American Public Health Association (1998)
BOD	Burette and Incubator	Winkler's Iodometry	American Public Health Association (1998)

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Received: 03-May-2023, Manuscript No. AGBIR-23-97625; **Editor assigned:** 08-May-2023, Pre QC No. AGBIR-23-97625 (PQ); **Reviewed:** 29-May-2023, QC No. AGBIR-23-97625; **Revised:** 08-Jun-2023, Manuscript No. AGBIR-23-97625 (R); **Published:** 15-Jun-2023, DOI:10.35248/0970-1907.23.39.581-583

RESULTS AND DISCUSSION

Temperature

In the present study, the water temperature was high in 27.33°C at station2 during summer and the higher temperature usually depends on the season, geographical location, sampling time, atmospheric temperature and ionic strength of the river [17].

Turbidity

In the present investigation the turbidity value was high in 8.18 during monsoon season at station 2 and low in 1 during summer season at station1 and in this value with in the limit 1-5 NTU [18]. The high value of turbidity in December (6 NTU) and this may be due to low precipitation, runoff and flood water as well as gradual settling of suspended particles [19].

Water current

In the present studly, the water current was high in 3.9 at station2 during pre-monsoon and low in 1.7 at station2 during summer, is fluctuates seasonally and this was influenced by rainfall in the study area and is related with the studies [20].

Total dissolved solids

Water in nature contains both organic and inorganic solids varying qualitatively and quantitatively with the season. Total dissolved solids present in the water samples of Vaigai reservoir ranged from 29 mg/l to 77 mg/l during the study period. As per the water quality criteria specified by BIS and Indian Standards for drinking water specifications, the permissible limits of total dissolved solids are 500 mg/l to 2000 mg/l. In the present study the TDS values were lower than the specified range.

pH

The concentration of base and acids in the water determines its pH. Insects survive grow best in water with a pH 6 to pH 9.

In the present study the pH ranged from 6.4 to 7.1 during monsoon season (October to December), from 6.3 to 7.1 during post-monsoon season (January to March), from 7.21 to 7.2 during summer season (April to June) and from 7.11 to 7.29 during pre-monsoon (July to September). The maximum pH was 7.11 in pre-monsoon season at station 2. The minimum pH was 6.4 in monsoon season at station 2. Similar range of pH was observed in Gorewada reservoir [21].

Total alkalinity

Alkalinity of the water is the capacity to neutralize strong acids that gives primarily a function of carbonate, bicarbonate and hydroxide content and formed due to the dissolution of carbon dioxide in water. The value of total alkalinity in Vaigai reservoir high in 7.7 mg/l during monsoon season and low in 5 mg/l during post monsoon season this value within the specified range. Similar observation in Periyar lake where the alkalinity varied between 13.1 mg/l to 22.5 mg/l [22].

Electrical conductivity

The seasonal variations in river Mini and they recorded high EC during pre-monsoon and low during monsoon and this is in accordance with the present report at Vaigai reservoir [23].

Total hardness

Total Hardness is the sum of divalent cations, especially calcium and magnesium in surface waters. Total hardness is an important parameter in the detection of water pollution. Total hardness of the present investigation was 49-67 mg/l which was much lower than the prescribed limit and it was characterized as soft water as given by Kumazawa [24].

Calcium

Calcium is responsible for hardness of water and the addition of calcium in the freshwater system by rain adds the ionic strength [25]. In the present study the calcium ranged from 1.01 mg/l to 1.8 mg/l.

Magnesium

Magnesium is the eight most common elements in the Earth's crust and is mainly tied up within mineral deposits.

As per the Indian standards WHO and BIS (100 mg/l) they were much below the desirable limit. In Periyar lake recorded magnesium ions varied from 3.1 to 6.6 mg/l, which is quite below the standards prescribed and this is in par with the present work [26].

Ammonia

In the present study, the ammonia values ranged between 0.01 mg/l to 0.08 mg/l and were within low level. Harsi Reservoir recorded low levels of ammonia ranging from 0.026 mg/l to 1.08 mg/l and these findings support the present investigation [27].

Nitrate (NO_3)

In the present study nitrate fluctuated between 0.03 during pre-monsoon to 0.27 mg/l during monsoon at Vaigai reservoir. The concentration of nitrate in water during the study period was much lower than the standard limit (50 mg/l). The Nkam River in China has observed much lower values of nitrate in the water bodies and this in conformity with the present work [28].

Sulphate

Sulphate ion is one of the important anion present in natural water, which produces cathartic effect upon human beings when it is present in excess. In the present work the values of sulphate ranged from 0.43 during post-monsoon and 3.4 mg/l during pre-monsoon in Vaigai reservoir and it was below the desirable limit. A similar observation was reported (4.5 to 7 mg/l) in Nandrabad pond, Aurangabad [29].

Phosphate

The phosphate ranged from 0.01 mg/l to 0.02 mg/l during monsoon season (October to December), from 0.01 mg/l to 0.02 mg/l during post-monsoon season (January to March), from 0.01 mg/l to 0.03 mg/l during summer season (April to June) and from 0.01 mg/l to 0.02 mg/l cm during pre-monsoon (July to September). The maximum phosphate was 0.03 mg/l in summer season at station 2. The minimum phosphate was 0.01 mg/l in all the season at station 2.

The present study also coincides with the findings in Errarajan Lake of Bangalore [30].

Chloride

The present study at Vaigai reservoir showed value of chloride as 7.02 during monsoon season and 43.6 mg/l during pre-monsoon. As per the Indian Standards of water specification (IS10500; 1991) the optimum range of chloride is 250 mg/l to 1000 mg/l and the permissible limit prescribed by BIS and WHO is 500 mg/l. The values of the present study showed much lower chloride than the standard limit and depicts that the water of Vaigai reservoir is free from sewage water.

Iron

Iron is one of the most abundant metals found in aquatic environments and is an essential micronutrient for fauna and flora [31]. The permissible amount of iron in natural water is 0.7 mg/l to 3.01 mg/l. In the present study, the iron recorded 0.02 mg/l during monsoon to 2.1 mg/l during summer season within the permissible limit of the Vaigai reservoir.

Fluoride

The fluoride concentration in natural waters varies from 0.1 to 0.77 mg/L. the fluoride concentration was high during summer and low during pre-monsoon in both Upstream and downstream of Vaigai reservoir. The high fluoride during summer and low in pre-monsoon in Oxbow lake in Lubońn [32].

Dissolved oxygen

Dissolved oxygen refers to the volume of oxygen contained in water. Dissolved Oxygen is an important limnological parameter indicating water quality and organic production in the aquatic system [33]. In present investigation the dissolved oxygen values showed a minimum of 4.5 mg/l and maximum of 7.63 mg/l and they were slightly above the permissible limit.

Biological oxygen demand

Biological Oxygen Demand (BOD) is a measure of organic matter present in the ambient water that is required by the aerobic organisms. In the present study, BOD values ranged from 1.1 to 8 mg/l and this was below the permissible limit. In river Cauvery (6.0 mg/l) [34] and Das et al., [35] in Apra river (4 mg/l) found high BOD in downstream of the river and this is due to enhanced anthropogenic activity.

CONCLUSION

Present investigation ensures that many of the water quality parameters like water temperature, EC, TDS, turbidity, total hardness, alkalinity, DO, phosphates, chlorides, nitrates, sulphates, sodium, potassium, calcium, magnesium, iron and fluoride etc. were within the limits recommended by WHO and IS standards. It has been found that Vaigai reservoir is non-polluted and its water is safe and can be used for various human needs in all the seasons and it can be used for irrigation and aquaculture practices and also suitable for industrial purpose.

FUNDING

The authors acknowledge the financial support from University Grants Commission, New Delhi, India (F.No.43-412/2014(SR)). Dr. M. R. Delphine Rose, Associate Professor, Department of Zoology and Mrs. A. Anitha Mary, Assistant Professor, Department of Zoology extent their sincere thanks to the Management, Jayaraj Annapackiam College for Women, Periyakulam, India for providing research facilities under BSR and DST-FIST support equipments and the financial support under JACFRP.

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