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SEASONAL VARIATIONS IN PHYSICO-CHEMICAL PARAMETERS OF HATTIKUNI RESERVOIR , YADGIR DISTRICT, KARNATAKA



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ABSTRACT

The present investigation deals with the assessment of physico-chemical parameters of Hattikuni Reservoir, Yadgir District, Karnataka. The objective of the study was to study the seasonal variations in various physicochemical parameters. Sample for analysis were taken monthly from five sampling stations along the reservoir for a distribution of 12 months from January 2014 and December 2014 to study the various physicochemical parameters such as atmospheric and water temperature, pH, total dissolved solids, dissolved oxygen, free carbon dioxide, total hardness, chloride, calcium, magnesium, phosphate, sulphate and BOD .The results indicates that all parameters were within the permissible limits. The study also indicated that the reservoir can be used for irrigation and fisheries.

KEYWORDS :Hattikuni reservoir, physico-chemical parameters, seasonal variations.

INTRODUCTION

Water is one of the most important factor for all living organisms, imagine a form of life that can impossible without water. Approximately 71% of the earth surface covered by water in the form of oceans, glaciers, fresh water bodies, rivers, wells, lakes (Patel and Patel, 2012; Nirmala et al 2002).Out of which only 3% of water occupied by fresh water and less than 1% water is occupied by lakes and ground water.

Water is one of the abundantly available substance in nature, Which man has exploited more

than any other resources for the sustenance of life. Good quality of water is required for living organisms. The study of different water parameters is very important for understanding of the metabolic events in aquatic ecosystem. The causative factors responsible for degradation water quality need to be evaluated so as to take proper steps before the situation becomes worst and uncomfortable. Freshwater ecosystems are considered as one of the most important natural resources for the survivability of all the living organisms of the biosphere. Freshwater becomes a critical natural resource due to number of reasons. The increasing demands of freshwater is in all sectors like drinking, agriculture, aquaculture and industrial.

Analysis of physico-chemical parameters of water is essential to assess the quality of water for the best usage like irrigation, drinking, bathing, fishing, industrial processing and so on. Water is a driving force for all developmental activities and all life depend on it. It is of great importance for people and environment. Water is the essence of life on the earth and totally dominates the chemical composition of all organisms. Water is essential for the survival of human beings, animals and plants.

Water quality provides current information about the concentration of various solutes at a given place and time. Water quality parameters provide the basis for judging the suitability of water for its designated uses and to improve existing conditions. The Water of this water body too is used mainly for irrigation, and fish production. In addition to this, its water is also used for drinking, bathing animals and other domestic activities. A large number of major and minor carps are bred by fisherman and local villagers. The knowledge of a reservoir ecosystem is of considerable value in assessing the ecological nature of the reservoir, which can be studied by the assessment of the physical and chemical characters of the reservoir water. Hence, the present study is undertaken to analyse the physical and chemical nature of the reservoir water.

MATERIALS AND METHODS

Study area

Hattikuni is one of the Village in Yadgir District in Karnataka State. It is located 10 km away from the Yadgir District. Hattikuni Reservoir is a perennial fresh water body located 01 km away from Hattikuni village. It lies between Longitude and Latitudes of $16^{\circ}52'50''$ North and $77^{\circ}10'21''$ East respectively. Its water spread area is 2145 hectares.



Fig.1. A view of Hattikuni reservoir.

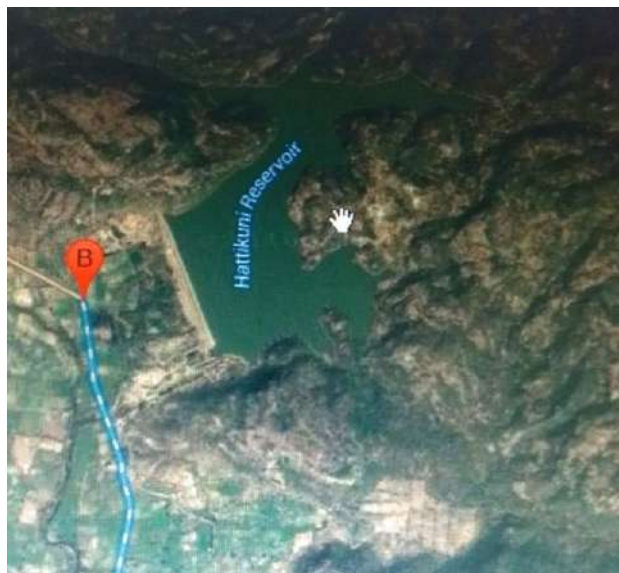


Fig. 2. Sattelite map showing Hattikuni reservoir

SAMPLE COLLECTION

The water samples for physico-chemical parameters were collected from Hattikuni Reservoir, Yadgir District, Karnataka state, at five different sites viz Station1, Station2, Station 3, Station 4 and Station 5, morning between 8 am to 11 am in the first week of every month from January 2014 to December 2014. The samples were collected in acid washed five liter plastic container from a depth of 5-10 cms below the surface of water. The parameters water and atmospheric temperature, pH and dissolved oxygen were monitored at the sampling site and other parameters like total dissolved solids, total alkalinity, total hardness, free carbon dioxide, calcium, magnesium, chloride, phosphate sulphate and BOD of the water were determined on monthly basis according to standard methods APHA (1998); Trivedi and Goal (1987).

HYDROGRAPHY

Temperature

Atmospheric and water temperature at each stations were recorded using centigrade mercury thermometer to the nearest 0.1^o C. The water temperature however, was recorded at the depth of about 5 cm below the water surface.

Hydrogen ion-concentration

pH recordings were made at five stations using a digital portable pH meter (ELICO model Li-120).
Dissolved Oxygen

Water samples were carefully drawn in 250 ml reagent bottles avoiding any kind of agitation before commencing estimation. The samples were fixed with manganous sulphate and alkali iodide and transported to the laboratory for further estimations.

Free carbon dioxide

Samples were collected in 250 ml reagent bottle for estimation of free carbon dioxide and phenolphthalein indicator was added immediately to know the presence or absence of free carbon dioxide. If color turns pink, it is noted as its absence and further, if it is present, sodium hydroxide was used to estimate the free carbon dioxide in the samples.

LABORATORY STUDIES

Hydrography

Water samples already collected for the purpose of estimation of various parameters were brought to the laboratory and subjected to analysis immediately as far as possible. Standards Methods for Estimation of Water and Waste water 20th Edition, 1998 (APHA, AWWA, WWCF, and WCPF) were referred for estimation of parameters viz., total dissolved solids, pH, dissolved oxygen, free carbon dioxide, total alkalinity hardness, calcium, magnesium, chloride, phosphorus and biochemical oxygen demand.

Total dissolved solids

The total dissolved solids were recorded using computerized UV visible Spectrophotometer (Computer based Dathelie. Secomom, France) and results were expressed in mg/l.

Dissolved oxygen

The dissolved oxygen content of water was estimated by the modified Winkler's method. The

results were expressed in mg/l.

Free carbon dioxide

Free carbon dioxide concentration was estimated by the titrimetric method using phenolphthalein indicator and sodium hydroxide (0.05 N) the values expressed in mg/l.

Total alkalinity

The total alkalinity was determined by titrimetric method using hydrochloric acid and thus carbonate and bicarbonate alkalinity was calculated. The values were presented in mg/l.

Total hardness

The total hardness of water is estimated by titrating the water samples with standard EDTA (0.01 N) using buffer solution and Erichrome Black-T indicator and the values were presented in mg/l.

Chloride

The chloride content was determined by titrating with silver nitrate and using potassium chromate indicator. The values were presented in mg/l.

Calcium

Calcium was determined by titrating with Ethylene Diamine Trichloro Acetic Acid (EDTA) and using murexide as indicator. The values are expressed in mg/l.

Magnesium

Magnesium was determined by EDTA and using Erichrome Black-T indicator. The values are expressed in mg/l.

Phosphate

Stannous chloride method was employed to determine the phosphate content of the samples. The resultant blue colour intensities were measured at 690 nm range using spectrometer (Elico model, CL-24). The values of phosphates presented in the samples were calculated referring to the standard graph and readings were expressed in mg/l.

Sulphate

The sulphate content in the water sample is determined by using nephelometer. The values are expressed in mg/l.

Biochemical Oxygen Demand (BOD)

The biochemical oxygen demand was estimated using computerized UV visible spectrophotometer (Computer based Dathelie, Secomom, France) and values were expressed in mg/l.

RESULTS AND DISCUSSION

The seasonal variations of physico-chemical parameters data of Hattikuni Reservoir, Yadgir District, and Karnataka, India have been presented in Table I, Table II and Table III.

Physico-chemical Characteristics

Atmospheric and Water Temperature:

Temperature is an important water quality parameter and is relatively easy to measure water bodies will naturally show changes in temperature seasonally. Temperature is one of the physical parameter, which is directly related with chemical reaction in the water and biochemical reaction in the living organisms. Temperature is physical factor that alters the water characteristic and considered as an important factor in controlling the fluctuations of plankton and functioning of aquatic ecosystem. (Wetzel, 1975; Dwivedi and Pandey, 2002; Singh and Mathur, 2005).

In the present investigation seasonal variability of atmospheric and water temperature have been observed. The maximum value of temperature was recorded during summer i.e. 40.00 °C and 31.00 °C in the month of May and minimum value of temperature was recorded during winter i.e. 30.00 °C and 20.00 °C in the month of December Kannan and Job (1980) also found similar results as observed In the present investigation Water temperature in summer, was maximum due to low water level, high temperature and clear atmosphere (Salve and Hiware, 2008). Minimum temperature was recorded in winter may due to high water level, lesser solar radiation, and atmospheric temperature.

HYDROGEN-ION-CONCENTRATION:

pH is defined as the intensity of the acidic or basic character of a solution at a given temperature. pH is the negative logarithm of hydrogen ion concentration.

Welch (1952) states that the limnological value of pH is a limiting factor works as an index of general environmental conditions. Most of the bio-chemical reactions are influenced by the pH.

In the present investigation, the pH range showed that the water of all the sampling stations of the reservoir was alkaline in nature. The maximum pH value was recorded during summer i.e. 8.40 in the month of April and minimum value was recorded during monsoon in the month of September i.e. 6.50. The maximum values of pH during summer might be low water levels and concentration of nutrients in water. The minimum pH values were due to dilution caused by the rainwater during monsoon. The factors like air temperature bring about changes the pH of water. The higher pH values observed suggests that carbon dioxide, carbonate bicarbonate equilibrium is affected more due to change in physico-chemical condition (Karanth, 1987; Tiwari et al., 2009).

The hydrogen ion concentration of fresh water varies considerably depending upon factors like concentration of carbon dioxide, carbonate and bicarbonate in water.

TOTAL DISSOLVED SOLIDS:

Solids refer to suspended and dissolved matter in water. Dissolved solids are an important parameter in drinking water. High concentration of total dissolved solids increase water turbidity this in turn decreases the light penetration, thus effects the photosynthesis.

In the present investigation, the maximum value of TDS recorded during monsoon i.e. 130.36 mg/l in the month of July and minimum value recorded during winter i.e. 109.44 mg/l in the month of December. The maximum values of solids were found due to mixing runoff rain water which carried mud, sand etc mixed in the reservoir water.

The maximum value of TDS during monsoon may due to addition of domestic waste water, garbage and sewage etc. in the natural surface water body (Verma et al., 2012).

DISSOLVED OXYGEN:

Dissolved oxygen is an important parameter in water quality assessment. Optimum

concentration of dissolved oxygen is essential for maintaining aesthetic qualities water as well as for supporting life. The concentration of dissolved oxygen regulates the distribution of flora and fauna.

In the present investigation indicated that the maximum value of dissolved oxygen was recorded during winter i.e. 8.10 mg/l in the month of January and minimum value recorded during summer i.e. 4.43 mg/l in the month of May. The maximum concentration of DO indicated higher autotrophic activity. The minimum concentration of DO may attribute to high temperature due to which oxygen holding capacity of water decreases.

FREE CARBON DIOXIDE:

Carbon dioxide plays an important role in the life of micro-organisms and plants and thus regarded as one of the essential components of the aquatic ecosystem. Excess amount of carbon dioxide is dangerous to animal kingdom.

In the present investigation, the maximum value of free oxygen was recorded during summer i.e. 2.0 mg/l in the month of May and minimum value recorded during winter i.e. 0.5 mg/l in the month of January. This may be depends upon alkalinity and hardness of water body. Maximum value of CO₂ could be related to the high rate of decomposition in the warmer months.

TOTAL ALKALINITY:

Alkalinity in most natural water is the function of bicarbonate and carbonates. Their salts get hydrolyzed in solution and produced hydroxyl ions. It also is used as productivity (Jhingran, 1982; Hulyal and Kaliwal, 2011).

In the present investigation, the maximum value of total alkalinity recorded during summer i.e. 165 mg/l in the month of may and minimum value was recorded during winter i.e. 109.20 mg/l in the month of January.

Maximum value of alkalinity is due to increase in bicarbonates in water (Hujare, M S. 2008) and Minimum value is due to high photosynthetic rate.

TOTAL HARDNESS:

Hardness of water is principally due to salts of Ca⁺⁺, Mg⁺⁺ mainly the carbonates and sulphates (Wadia, 1961). The increase in hardness can be attributed to the decrease in water volume and increase in the rate of evaporation at high temperature.

In the present investigation, the maximum value of hardness was recorded during summer i.e. 106.46 mg/l in the month of April and minimum value was recorded during winter i.e. 75.45 mg/l in the month of October.

CHLORIDE:

Chloride is one of the most important parameter in assessing the water quality. The chloride concentration is higher in organic wastes and its higher level in natural water is definite indication of pollution from domestic sewage.

In the present investigation, the maximum value of chloride recorded during summer i.e. 34.20 mg/l in the month of may and minimum during winter i.e. 29.03 mg/l in the month of January. was also reported (Sharma et al, 2007; Verma at al, 2002; Ramulu and Benarje, 2013).

Maximum value during summer could be due to higher concentration of chloride resulted from evaporation. Minimum value during winter could be due to high sedimentation on relatively stable environmental conditions.

CALCIUM:

Calcium is an essential and important nutrient for aquatic organisms being a cell wall constituent and regulatory factor for physiological function.

The range of calcium in the water is largely dependent on the solubility of calcium carbonate, sulphates and rarely fluorides.

In the present investigation, the maximum value of calcium recorded during summer i.e. 74.05 mg/l in the month of April and minimum during monsoon i.e. 53.00 mg/l in the month of August. Minimum value of calcium may be due to its absorption by living organisms. (Hulyal and Kaliwal, 2011). Found that the calcium content was maximum in summer and minimum in monsoon.

MAGNESIUM:

Magnesium is the important source of the water. It generally occurs in concentration lower than those of calcium. Magnesium is a necessary constituent of chlorophyll.

In the present investigation, the maximum magnesium was recorded during summer i.e. 24.00 mg/l in the month of May and the minimum magnesium was recorded during monsoon i.e. 18.50 mg/l in the month of July. Magnesium hardness particularly associated with the sulphate ion has laxative effect on persons unaccustomed to it (Parveen et al 2012)..

PHOSPHATES:

Phosphorous is a nutrient for plant growth and a fundamental element in the metabolic reaction of plants and animals. Presence of phosphates in water and the analysis of that water have a great significance. The presence of phosphates in large quantities in fresh water indicates pollution through sewage and industrial waters. It controls the algal growth and primary productivity.

In the present investigation, the maximum value of phosphate concentration was recorded during monsoon i.e. 0.600 mg/l in the month of August and minimum value was recorded during winter i.e. 0.400 mg/l in the month of January. The maximum value of phosphate may be due to rain, surface water runoff, agriculture runoff.

SULPHATE:

Sulphate ion does not affect the taste of water if present in low concentration. High concentration of SO_4^{2-} could cause a cathartic action on human beings and can also cause respiratory problems.

In the present investigation, the maximum value of sulphate concentration was recorded during summer i.e. 14.00 mg/l in the month of May and minimum value was recorded during winter i.e. 12.50 mg/l in the month of December.

Biochemical Oxygen Demand (BOD):

Bio-chemical oxygen demand is a parameter to assess the organic load in a water body. The role of Biochemical oxygen demand in water bodies and its importance in aquatic productivity is well recognized. As a factor abiotic occupies a highly important place in aquatic ecosystem.

In the present investigation, the maximum value of BOD concentration was recorded during summer i.e. 15.50 mg/l in the month of April and the minimum biochemical oxygen demand was recorded during winter i.e. 7.0 mg/l in the month of November.

The study also indicated that water present in the reservoir can be used for Drinking, irrigation and fisheries.

**Table 1. Seasonl variations in physic-chemical parameters of Hattikuni reservoir
(During January 2014 to December 2014)**

Paramaters ----- Months	Atomospheric Temp (°C)	Water Temp (°C)	pH	TDS (mg/L)	DO (mg/L)	CO₂ (mg/L)	Alkalinit y (mg/L)	Hardness (mg/L)
January	31.00	22.00	08.02	115.23	8.10	0.5	109.20	82.23
February	34.00	24.00	8.15	110.23	6.00	1.00	152.18	85.35
March	38.00	29.00	8.31	120.12	5.90	1.6	159.40	95.03
April	39.00	28.00	8.40	120.25	5.15	1.8	162.62	106.46
May	40.00	31.00	8.00	120.13	4.43	2.0	165.00	95.50
June	34.00	24.00	7.34	124.93	5.00	1.8	159.06	90.45
July	32.00	21.00	7.29	130.36	5.90	1.7	140.23	85.00
August	31.00	21.00	7.21	128.38	6.00	1.5	136.08	83.60
September	33.00	23.00	6.50	126.02	6.58	1.3	130.16	80.64
October	32.00	22.00	7.90	120.27	7.20	1.0	124.43	75.45
November	30.00	21.00	8.20	120.36	7.50	0.8	120.14	76.08
December	30.00	20.00	8.13	109.44	7.80	0.6	112.00	80.00
Maximum	40.00	31.00	8.40	130.36	8.10	2.0	165.00	106.46
Minimum	30.00	20.00	6.50	109.44	4.43	0.5	109.20	75.45

**Table I1. Seasonal variations in physico-chemical parameters of Hattikuni reservoir
(During January 2014 to December 2014)**

Paramaters ----- Months	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Phosphate (mg/L)	Sulphate (mg/L)	BOD (mg/L)
January	29.05	60.72	21.85	0.400	13.00	10.15
February	32.60	65.60	23.06	0.450	13.10	12.08
March	32.73	70.09	23.16	0.480	13.50	13.60
April	33.02	74.05	120.36	0.500	13.60	15.50
May	34.00	70.32	24.00	0.510	14.00	14.32
June	29.84	58.48	23.48	0.530	13.00	13.27
July	30.00	56.04	18.50	0.550	13.00.	12.84
August	30.46	53.00	19.50	0.600	13.05	11.37
September	32.20	62.86	20.80	0.550	13.50	10.90
October	31.04	68.40	21.36	0.500	13.20.	9.64
November	30.37	64.03	21.40	0.450	13.00	7.00
December	30.12	60.05	22.05	0.440	12.50	9.12
Maximum	34.00	74.05	24.00	0.600	14.00	15.50
Minimum	29.05	53.00	18.50	0.400	12.50	7.00

Table 11. Showing Seasonal mean of physico-chemical parameters of Hattikuni reservoir (During January 2014 to December 2014)

SI.NO	PARAMETERS	SEASONAL MEAN		
		MONSOON	WINTER	SUMMER
01	ATMOSPHERIC TEMPERATURE (°C)	32.5	30.75	37.75
02	WATER TEMPERATURE (°C)	22.25	21.25	28.00
03	pH	7.085	8.062	8.245
04	TOTAL DISSOLVE SOLIDS (mg/l)	127.42	116.3	117.68
05	DISSOLVED OXYGEN (mg/l)	5.87	7.65	5.37
06	FREE CARBON DIOXIDE (mg/l)	1.575	0.725	1.6
07	ALKALINITY (mg/l)	141.38	116.44	159.8
08	TOTAL HARDNESS (mg/l)	84.92	78.44	95.58
09	CHLORIDE (mg/l)	30.62	30.14	33.08
10	CALCIUM (mg/l)	57.59	63.3	70.01
11	MAGNESIUM (mg/l)	20.57	21.66	47.64
12	PHOSPHATE (mg/l)	0.557	0.447	0.485
13	SULPHATE (mg/l)	13.13	12.92	13.55
14	BOD (mg/l)	12.09	8.97	13.87

CONCLUSIONS

The present study show detailed physico-chemical characteristics in Hattikuni reservoir, Yadgir District, Karnataka. The water parameters indicate that the reservoir is rich in nutrients, although there is need continuous monitoring to maintain the quality of water. The results indicate that all parameters were within the permissible limits. The study also indicated that water present in the reservoir can be used for Drinking, irrigation and fisheries.

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