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Exploring Seasonal Dynamics: Physico-Chemical Traits of Thunga and Bhadra Rivers in Karnataka, India

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ABSTRACT

The aim of the present study is to investigate the water quality of the Thunga Bhadra River, a significant tributary of the Krishna River Basin in Karnataka, India.The surface water samples were put through a thorough Physico-Chemical investigation that included significant cations and anions in addition to general characteristics. The Water variables were plottedin spatial map using GIS and analysed by Pearson correlation. The temperature, pH, Dissolved oxygen, Electrical Conductivity, Hardness, Alkalinity, Turbidity, Total solids, Total suspended solids, Total dissolved solids, DO, BOD and COD. Most of the parameters like pH, conductivity, Turbidity; Dissolved solids are high at Bhadra riverduring the Monsoon in India. It is suggested that the Bhadra river possess highly fertile undisturbed water environment value

Keywords: Physico-chemical, PCA, Monsoon, Post monsoon, Pre monsoon, Thunga and Bhadra Rivers Subject classification codes: Natural environment and health

1. Introduction

Water is the most crucial and essential requirement of life in Earth. It is necessary for the life developing and supporting activities. Surface water generally available in rivers, lakes, ponds and dams are used for drinking, irrigation and power generation etc. Streams, rivers, wells and boreholes are the other main source of drinking water, which are usually not treated[1].The growth level of plants and animal are based on the quality and components of water. Aquatic organisms require a healthy environment to survive and have sufficient nutrients for their growth. The productivity depends on the physic-chemical characteristics of the water body. The maximum productivity can be obtained only when the physical and chemical parameters are at optimum level[2].

The quality of surface water is a very sensitive issue. Rivers play a most important role in controlling the global water cycle and in the hydrologic cycle they are the most vibrant agents of transport[3]. Rivers are vital and vulnerable freshwater ecosystems that are critical for the sustenance of all life. People use the river water for many purposes. The surface water quality is deteriorating due to anthropogenic activities, urbanization, transportation, animal and human excretions and domestic wastes[4]. Variation in the quality and quantity of river water due to natural and anthropogenic activities are widely case studied in several world rivers[5,6]. It is a common practice for people living along the river catchments to discharge their domestic waste as well as human excreta into rivers.

2. Materials and Methods

2.1 Study area

The Tunga and Bhadra River is located in the southern Indian state of Karnataka. The river originates at Gangamoola, a location in the Western Ghats, on a hill known as VarahaParvata. From here, the river travels

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through the Karnataka districts of Shimoga and Chikmagalur. It is 147km long and joins the Bhadra River at Koodli, a small settlement close to Shimoga City in Karnataka. From this point on, the river is known by its compound name, Tungabhadra. The today area of river is about 147km with latitude of SW1- (N13º25'18.6" E 75º15' 49.3") SW2- (N12º32'21.2" E 75º50'40.3") (Table. 1).Temperature ranges from minimum23ºC to maximum 31ºC.

2.2 Sample collection

Water samples were collected from Thunga and Bhadra sampling station (Figure. 1) during Premonsoon (April - May), Monsoon (July - August), Post monsoon (October - November) phase in year 2016 for the evaluation of Physico-Chemical parameters. Samples were collected during the first week of every month in sterile plastic containers, transported to the laboratory after addition of a preservative reagent Ethanol, and stored at 4ºC till analysis. They were then tested for various Physico-Chemical and microbiological parameters using standard methods.

2.3 Physico-Chemical parameters

Physico-chemical determinations on the water samples were carried out through standard methodologies[7]. Physico-chemical determinations on the water samples were carried out through standard methodologies of the American Public Health Association[7]. Electrical Conductivity (EC), pH, Temperature (Temp) and Turbidity (TDY) were measured in situ. Spectrophotometric determinations for the study were carried out with a UV Visible spectrophotometer (UV-Vis Double-beam Spectrophotometer, Systronics 2201). Besides, the following parameters were determined according to the methods in parentheses mentioned next to them: Dissolved Oxygen (Winkler's method), Total Dissolved Solids, Total Suspended Solids, and Total Hardness (EDTA titration method), Total Alkalinity (Acid titration method), Ammonia (Kjeldhal's titration method), Nitrite (Spectrophotometric method), Nitrate (Ultraviolet Spectrophotometric Screening Method), Phosphate (Stannous chloride Spectrophotometric method), Chemical Oxygen Demand (Closed reflux titration method), Biochemical Oxygen Demand (Bio-assay and Winkler's method), Chlorides (Argentometric Method), Sulphates (Turbidity method), Magnesium (EDTA titration method), and Sodium and Potassium (Flame Photometric Method). The results for all parameters, except pH and EC were expressed in mg/l[7].

2.4 Statistical analysis

The normality and inconsistency of similarities were assessed using the Livens and Shapiro- Wilk algorithm analysis.One-way ANOVA was used to determine how the soil variables varied, and Turkey's honestly significant differences were used to compare the means[8]. With a higher level of confidence, Pearson Correlation was used to examine the association between soil factors and microbial communities ($P<0.05$ was deemed significant, while $P<0.001$ was deemed very significant).The analyses were rank-normalized and the principal component analysis (PCA) was also performed to estimate thedeviations. The pairwise nonmetric multidimensionalscaling (MDS) plot was measured to visualize theuniface distances among the soil microbial communities andthe physico-chemical parameters. The points betweenthe exceedingly correlated physico-chemical parametersamong different samples where visualized using clusteranalysis. All the analyses were done using the Primer software (v 6.0).

3. Result

Results obtained during the present study shows that the physico-chemical nature of water of the river Thunga and Bhadra rivers has been analysed result so the Tables 2& 3.

3.1 Temperature

In the Thunga river, the temperature 26.8 ̊C Bhadra 27.7 ̊C in the premonsoon, Thunga 18 ̊C, Bhadra 19.5 ̊C monsoon, Thunga 21.4̊C, Bhadra 22.5 ̊C postmonsoonThunga ($F_{2,12}$ =6.83;P<0.010) Bhadra ($F_{2,12}$ = 8.84 P<0.004)Table 2 and 3 & Figure 2 & 3.

3.2 pH

pH premonsoon Thunga 6.97, Bhadra 7.4, monsoon Thunga 7.52 Bhadra 8.2, postmonsoonThunga 6.42 Bhadra 6.75 Thunga ($F_{2,12}$ =1.24;P<0.324) Bhadra ($F_{2,12}$ = 0.43 P<0.661)Table 2 and 3 & Figure 2 & 3.

3.3 Conductivity

Conductivity premonsoon Thunga 57 µS/cm, Bhadra 67 µS/cm, monsoon Thunga 78 µS/cm Bhadra 82 µS/cm, postmonsoonThunga 36 µS/cm Bhadra 40 µS/cmThunga ($F_{2,12}$ =2.63;P<0.113) Bhadra ($F_{2,12}$ = 0.54 P<0.598)Table 2 and 3 & Figure 2 & 3.

3.4 Turbidity

Turbidity premonsoon Thunga 1.7 NTU Bhadra 5.3 NTU, monsoon Thunga 12 NTU Bhadra 17 NTU, post monsoon thunga 5 NTU Bhadra 3.1 NTUthunga ($F_{2,12}$ =12.32;P<0.001) Bhadra ($F_{2,12}$ = 12.84 P<0.001)Table 2 and 3 & Figure 2 & 3.

3.5 Total solids

Total solids premonsoon Thunga 32 mg/l Bhadra 45 mg/l, monsoon Thunga 45 mg/l Bhadra 65 mg/l, post monsoon Thunga 17 mg/l Bhadra 29 mg/lThunga ($F_{2,12}$ =4.58;P<0.033) Bhadra ($F_{2,12}$ = 4.44 P<0.036)Table 2 and 3 & Figure 2 & 3.

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3.6 Total dissolved solids

Total dissolved solids premonsoon Thunga 30 mg/l Bhadra 43 mg/l, monsoon Thunga 30 mg/l Bhadra 57 mg/l, post monsoon Thunga 15 mg/l Bhadra 23 mg/lThunga ($F_{2,12}$ =4.70;P<0.031) bhadra ($F_{2,12}$ = 7.28 P<0.009)Table 2 and 3 & Figure 2 & 3.

3.7 Total suspended solids

Total suspended solids premonsoon Thunga 2 mg/l Bhadra 2 mg/l, monsoon Thunga 15 mg/l Bhadra 8 mg/l, post monsoon Thunga 2 mg/l Bhadra 6 mg/lThunga ($F_{2,12}$ = 23.38 P<0.000) Bhadra ($F_{2,12}$ = 4.97 P<0.027)Table 2 and 3 & Figure 2 & 3.

3.8 Hardness

Hardness premonsoon Thunga 14 mg/l Bhadra 24 mg/l, monsoon Thunga 10 mg/l Bhadra 18 mg/l, post monsoon Thunga 7 mg/l Bhadra 12 mg/lThunga ($F_{2,12}$ = 2.10 P<0.165) Bhadra ($F_{2,12}$ = 2.25 P<0.148)Table 2 and 3 & Figure 2 & 3.

3.9 Alkalinity

Alkalinity premonsoon Thunga 18 mg/l Bhadra 28 mg/l, monsoon Thunga 12 mg/l Bhadra 21 mg/l, post monsoon Thunga 10 mg/l Bhadra 17 mg/lThunga ($F_{2,12}$ = 5.85 ;P<0.017) Bhadra ($F_{2,12}$ = 2.81 P<0.099)Table 2 and 3 & Figure 2 & 3.

3.10 Chloride

Chloride premonsoon Thunga 5.3 mg/l Bhadra 5.5 mg/l, monsoon Thunga 6.8 mg/l Bhadra 7.5 mg/l, post monsoon Thunga 2.5 mg/l Bhadra 3.8 mg/lThunga ($F_{2,12}$ = 7.41 P<0.008) Bhadra ($F_{2,12}$ = 4.73 P<0.030)Table 2 and 3 & Figure 2 & 3.

3.11 Sulphide

Sulphide premonsoon Thunga 1.2 mg/l Bhadra 1.8 mg/l, monsoon Thunga 2 mg/l Bhadra 2.5 mg/l, post monsoon Thunga 0.8 mg/l Bhadra 1.2 mg/lThunga ($F_{2,12}$ = 7.05 P<0.009) Bhadra ($F_{2,12}$ = 3.30 P<0.072)Table 2 and 3 & Figure 2 & 3.

3.12 Fluoride

Fluoride premonsoon Thunga 0.2 mg/l Bhadra 0.24 mg/l, monsoon Thunga 0.5 mg/l Bhadra 0.38 mg/l, post monsoon Thunga 0.1 mg/l Bhadra 0.14 mg/lThunga ($F_{2,12}$ = 6.40 P<0.013) Bhadra ($F_{2,12}$ = 0.60 P<0.567)Table 2 and 3 & Figure 2 & 3.

3.13 Nitrate

Nitrate premonsoon Thunga 0.7 mg/l Bhadra 2.3 mg/l, monsoon Thunga 1.2 mg/l Bhadra 2.8 mg/l, post monsoon Thunga 0.5 mg/l Bhadra 1.7 mg/lThunga ($F_{2,12}$ = 5.87 ;P<0.017) Bhadra ($F_{2,12}$ = 0.66 P<0.534)Table 2 and 3 & Figure 2 & 3.

3.14 Nitrite

Nitrite premonsoon Thunga 0.01 mg/l Bhadra 0.02 mg/l, monsoon Thunga 0.06 mg/l Bhadra 0.04 mg/l, post monsoon Thunga 0.01 mg/l Bhadra 0.02 mg/lThunga ($F_{2,12}$ = 13.08 P<0.001) Bhadra ($F_{2,12}$ = 4.45 P<0.036)Table 2 and 3 & Figure 2 & 3.

3.15 Nitrogen

Nitrogen pre monsoon Thunga 1.1 mg/l Bhadra 1.6 mg/l, monsoon Thunga 1.4 mg/l Badra 1.8 mg/l, post monsoon Thunga 0.8 mg/l Bhadra 1.2 mg/lThunga ($F_{2,12}$ = 5.06 P<0.025) Bhadra ($F_{2,12}$ = 8.86 P<0.04)Table 2 and 3 & Figure 2 & 3.

3.16 Phosphate

Phosphate pre monsoon Thunga 0.05 mg/l Badra 0.11 mg/l, monsoon Thunga 0.08 mg/l Bhadra 0.16 mg/l, post monsoon Thunga 0.03 mg/l Bhadra 0.05 mg/lThunga ($F_{2,12}$ = 4.81P<0.029) Bhadra ($F_{2,12}$ = 3.89P<0.050)Table 2 and 3 & Figure 2 & 3.

3.17 Silica

Silica pre monsoon Thunga 0.32 mg/l Bhadra 0.45 mg/l, monsoon Thunga 0.48 mg/l Bhadra 0.57 mg/l, post monsoon Thunga 0.27 mg/l Bhadra 0.33 mg/lThunga ($F_{2,12}$ =1.83P<0.203) Bhadra ($F_{2,12}$ =2.44P<0.129)Table 2 and 3 & Figure 2 & 3.

3.18 Sulphate

Sulphate pre monsoon Thunga 5.3 mg/l Bhadra 6.4 mg/l, monsoon Thunga 7.2 mg/l Bhadra 8.7 mg/l, post monsoon Thunga 3.3 mg/l Bhadra 4.5 mg/lThunga ($F_{2,12}$ = 1.83P<0.203) Bhadra ($F_{2,12}$ = 2.17P<0.157)Table 2 and 3 & Figure 2 & 3.

3.19 Potassium

Potassium pre monsoon Thunga 0.7 mg/l Bhadra 1.3 mg/l, monsoon Thunga 2 mg/l Bhadra 1.7 mg/l, post monsoon Thunga 0.8 mg/l Bhadra 1.1 mg/lThunga ($F_{2,12}$ = 12.68 P<0.001) Bhadra ($F_{2,12}$ = 1.73 P<0.219)Table 2 and 3 & Figure 2 & 3.

3.20 Magnesium

Magnesium pre monsoon Thunga 0.6 mg/l Bhadra 2.4 mg/l, monsoon Thunga 1.5 mg/l Bhadra 2.9 mg/l, post monsoon Thunga 0.6 mg/l Bhadra 2.4 mg/lThunga ($F_{2,12}$ = 6.76 P<0.011) Bhadra ($F_{2,12}$ = 1.18;P<0.340)Table 2 and 3 & Figure 2 & 3.

3.21 Iron

Iron pre monsoon Thunga 0.05 mg/l Bhadra 0.37 mg/l, monsoon Thunga 0.08 mg/l Bhadra 0.52 mg/l, post monsoon Thunga 0.02 mg/l Bhadra 0.21 mg/lThunga ($F_{2,12}$ = 8.51P<0.005) Bhadra ($F_{2,12}$ = 4.35P<0.038)Table 2 and 3 & Figure 2 & 3.

3.22 Zinc

Zinc pre monsoon Thunga 0.03 mg/l Bhadra 0.08 mg/l, monsoon Thunga 0.08 mg/l Bhadra 0.18 mg/l, post monsoon Thunga 0.01 mg/l Bhadra 0.04 mg/lThunga ($F_{2,12}$

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= 7.89 P<0.006) Bhadra ($F_{2,12}$ = 9.73 P<0.003)Table 2 and 3 & Figure 2 & 3.

3.23 Dissolved oxygen (DO)

DO pre monsoon Thunga 6.8 mg/l Bhadra 6.1 mg/l, monsoon Thunga 5.6 mg/l Bhadra 4.7 mg/l, post monsoon Thunga 7.1 mg/l Bhadra 6.8 mg/lThunga ($F_{2,12}$ = 0.45 P<0.648) Bhadra ($F_{2,12}$ = 1.83 P<0.202)Table 2 and 3 & Figure 2 & 3.

3.24 Chemical oxygen demand (COD)

COD pre monsoon Thunga 13 mg/l Bhadra 18 mg/l, monsoon Thunga 17 mg/l Bhadra 22 mg/l, post monsoon Thunga 10 mg/l Bhadra 13 mg/lThunga ($F_{2,12}$ = 1.85 P<0.199), Bhadra ($F_{2,12}$ = 15.60 P<0.000) Table 2 and 3 & Figure 2 & 3.

3.25 Biological oxygen demand (BOD)

BOD pre monsoon Thunga 1.7 mg/l Bhadra 2.1 mg/l, monsoon Thunga 2.3 mg/l Bhadra 2.7 mg/l, post monsoon Thunga 1.2 mg/l Bhadra 1.9 mg/lThunga ($F_{2,12}$ = 2.00 P<0.178) Bhadra ($F_{2,12}$ = 1.55 P<0.252)Table 2 and 3 & Figure 2 & 3.

3.26. Principal Component Analysis

PCA was applied to the data set to compare the compositional pattern between the analysed water samples and to identify the factors reflecting each other. PCA was performed on the raw data set comprising all the 20 water quality parameters with 2 sites observations to identify the factors that contribute to ecological status of in the river basin. In site Thunga premonsoon and badra post monsoon were positively correlated with DO and negatively correlated with other parameters like phosphate, Nitrate, Silica, Sulphate, Turbidity.Thunga and badra Monsoon positively correlated with pH, Sulphate, Nitrate, Silica, Turbidity, Potassium, Conductivity and negatively correlated with Dissolved oxygen.Alkalinity, Hardness, Nitrate, Phosphate, Magnesium, Total Solids, Chloride These parametersPositively correlated with thunga Post Monsoon. These parameters negatively correlated with badra premonsoon (Figure. 4).

4. Discussion

A comparative study between the water quality parameters of the Thunga and the Badhra rivers the study portrays the eminence of water quality of the Thunga and Badhra. In the present study, Temperature is a limiting factor in aquatic environment and considerably affects various metabolic activities, growth, oxygen consumption, survival distribution and migratory behaviour of crustaceans. [9]The maximum value of Temperature during premonsoon at Bhadra 27.7 ̊C The water temperature was found to go more or less hand in hand During the monsoon Thunga has low value18 ̊C as the same result recorded[10]. According to water temperature may depend on the seasons, geographic location and sampling time.pH is the hydrogen ion activity and a measure of acidity and alkalinity of aquatic bodies. Substantial variations were recorded in the pH level (EGIS II Bangladesh)[11]. The maximum value of pH was recorded at Bhadra 8.2 premonsoon and the Minimum value 7.4 was recorded at Thunga monsoon. Same result was obtained Maximum values of pH during the summer may be due to increased photosynthesis of the algal blooms resulting in the precipitation of carbonates of calcium and magnesium from bicarbonates[12].

Electrical conductivity in natural waters is the normalized measure of the water's ability to conduct electric current. This is mostly influenced by dissolved salts such as sodium chloride and potassium chloride. The maximum value of conductivity was observed in Premonsoon 82 Bhadra river. During monsoon EC showed sharp declination in the river water due to huge dilution of the river water by the monsoon rainfall. Similar result was also observed by Meghla et al. The minimum value of conductivity was recorded 36 in the Thunga river at Postmonsoon. During summer, a high level of conductivity indicates the pollution status as well as trophic levels of the aquatic body.Turbidity is the measure of suspended matter in water. Suspended matter often includes mud clay and silt. The least value of turbidity 1.7 to 3.1 Bhadra monsoon the 4greatest value 5.3 NTU bhadra pre monsoon. Similar results were observed. During monsoon EC showed sharp declination in the river water due to huge dilution of the river water by the monsoon rainfall. Similar result was also observed by(Ajayan[19],Meghlaetal[12])

Total solids thunga has the highest value 12 monsoon and lowest value 5 postmonsoonBhadra has the highest value 65 monsoon and lowest value 29 post monsoon. The Water with a high total dissolved solids indicated more ionic concentration, which is of inferior palatability and can induce an unfavourable physiochemical reaction in the consumers[13]. Neilson et al.,[13] & Divya and Rajan[14] have reported that increase in value of TDS indicated pollution by extraneous sources. The high amount of dissolved, suspended and total solids of samples adversely affects the quality of running water and it is unsuitable for any other purpose of irrigation and drinking. In the present study, the Maximum and minimum range of Total dissolved solids was seen in pre-monsoon season was seen on station 1 of value 5.2 mg/l and minimum in station 2 of value 0.2 mg/l.

Total suspended solids the maximum value was recorded monsoon Thunga 15 mg/l, minimum value was recorded 2 mg/l premonsoon thunga badra and post monsoon ThungaHardness is the property of water which

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prevents the lather formation with soap and increases the boiling points of water. Hardness of water mainly depends upon the amount of calcium or magnesium salts or both. The maximum value was recorded 24 mg/l Bhadra at pre monsoon and the minimum value was recorded 7 mg/l Thunga at Postmonsoon. The water hardness on Thunga and Bhadra rivers was higher during summer months which might have caused increased concentration of salts by excessive evaporation[15].

Total alkalinity is the measure of capacity of water to neutralize the acids. Alkalinity increases as the amount of dissolved carbonates and bicarbonates increases[16]. Alkalinity was high 28 mg/l at Pre monsoon in Bhadra, low 10 mg/l at Post monsoon in Thunga. The maximum value of alkalinity due to confluence of domestic waste. It is the quantitative capacity of water sample to neutralize a strong acid to a pH increase dilution of river water may be responsible for lower values of alkalinity in rainy seasons[16].

Nutrients higher value in water is an indication of pollution in the river and it cause eutrophication as a nutrient, hence reducing water quality. High level of nutrients in stream water was due to excessive use of fertilizers in agriculture, decayed vegetable, animal matter, domestic effluents, and sewage of sludge disposal. Chloride is mainly present in sewage, effluents farm drainage and remains unaltered during purification of sewage[17]. Excess chloride would reduce the DO content of water, which turns harmful to aquatic organisms[18].

Chloride is generally due to the salts of sodium potassium and calcium. The least chloride value was observed in Thunga postmonsoon 2.5 mg/l, and greatest value was observed in Bhadra monsoon 7.5 mg/l. The chloride content in fresh water bodies have been investigated by quite a good number of researchers[19].

The highest sulphate concentration was observed at 8.7 mg/l Bhadra monsoon. The lowest concentration was observed at Thunga 3.3 mg/l postmonsoon. It could be due to considerable surface runoff from agricultural fields to the river water[20]. Fluoride with lower concentrations at an average of 1mg/L is regarded as an essential constituent of drinking water mainly because of its role in prevention of dental carries[21]. The maximum value 0.5 mg/l was recorded at Thunga monsoon and the minimum value 0.1 mg/l was recorded at Thunga post monsoon.

Most natural water are deficient in nitrate having a concentration usually below 5 mg/L, but certain polluted surface water and ground water may have substantially higher quantities. In this study high quantity 2.8 mg/l of nitrate was observed at Bhadra monsoon and low quantity 0.5 mg/l was observed at Thunga post mosoon[21].Similar study shows that the higher nitrate value recorded during monsoon season may be due to heavy rainfall, and runoff contaminated with fertilizers from the surrounding coconut gardens and paddy fields[22].In Thunga Nitrite which contains high 0.06 mg/l during monsoon and Bhadra river which contain low 0.01 mg/l during post-monsoon. In present study the Nitrite value are within under BIS desirable limit.

The Nitrogen is one of the most abundant elements, which support the growth of algae, and aquatic plants, which supply food and habitat for fish, shellfish and smaller organisms that live in water. But sometimes the high amount of nitrogen in the air and water can be harmful because it indicates pollution of the environment. In the thunga river, we can see from the experimental data that in post-monsoon season, the low amount of Nitrogen is 0.8 mg/l. In the bhadra river high amount of nitrogen 1.8 mg/l was observed in monsoon. The rainy season was period with the highest nitrate-nitrogen concentration which is known to support the formation of blooms. The importance of Silica in the production of algal growth is well recognized. In the present investigation the recorded value indicates high amount of silica was observed 0.57 mg/l in bhadra monsoon and low amount was observed 0.27 in thunga post monsoon

Potassium and Sodium are important cat ions occurring naturally in waters. Their major sources in water are the weathering of rocks. Both the sodium and potassium are highly soluble in nature and do not form any precipitating salts. They have a strong tendency to remain absorbed on soil particles, but can be easily exchanged by divalent cat ions like calcium and magnesium[21]. In this study Bhadra has maximum amount of sodium 8.7 mg/l in monsoon and Thunga has minimum amount of sodium 3.3 mg/l in postmonsoon. The potassium level was high 2 mg/l at Thunga in monsoon and low 0.7 mg/l at Thunga in premonsoon. Magnesium is also one of the important elements of usually it is found along with calcium but in very low concentration and contributes to hardness of water along calcium. It is main component of chlorophyll. Magnesium has greatest value 2.9 mg/l at bhadra during monsoon and least value 0.6 mg/l at Thunga during premonsoon and postmonsoon. Iron 0.02mg/l low at Thunga post monsoon and high 0.52 mg/l at Bhadra monsoon. Zinc 0.01 to 0.18 mg/l both thunga and badra river water showed mean ferrous iron concentration below the permissible limit of 1.0 mg/L.

Phosphorous is a vital element for all the living beings, especially for plant life. But if the quantity of phosphorous gets much higher in the water body it speeds up eutrophication of that river and lake. The standard limit of phosphorous for drinking water quality is 4-20 ppm[23, 24]. In the post-monsoon season the range of phosphorous is 0.03 mg/l low in thunga river and in monsoon, it is high 0.16

mg/l in the Bhadra river. Similar study shows that the higher phosphate value recorded during monsoon due to heavy rainfall[25].

The dissolved oxygen (DO) is one of the most important factors in any aquatic eco systems. All living organisms are dependent of Oxygen in one form or the other to maintain their biological process that produce energy for their growth and reproduction dissolved oxygen also plays a major role in dissolution and precipitation of inorganic substances in water. The main sources of dissolved oxygen are dissolution from atmosphere and the photo synthesis. The former depends on factors like temperature[25]. In the present study the greatest value 7.8 mg/l was recorded Pre monsoon in badra, The least value 4.7 mg/l was recorded Monsoon in badra. The same result was observedseasonal variation in dissolved oxygen content was found to be more during summer 7.36 mg/L and minimum dissolved oxygen was recorded during the rainy season[19].

Increased organic matter results in the excess oxidation of organic matter to carbon dioxide and the water creates an atmosphere of oxygen depletion and results in high BOD levels, The maximum value 2.7 mg/l was recorded Monsoon in badra, The minimum low value in post monsoon thunga 1.2 mg/l. Almost similar results were observed by (Bhargava 1982, Rao 1990) for the Ganga river water. Chemical oxygen demand is an indicative measure of the quantity of oxygen which can be consumed by reactions of oxidizing soluble and particulate organic matter in water [24, 25]. The low number of COD was measured 10 mg/l at Thunga post monsoon and high amount was measured 22 mg/l at Bhadra monsoon.

5. Conclusion

The analysis of different sample collected from Bhadra River at Koodli were subjected to physico-chemical analyses of river flows from the Shimoga and Chikmagalur districts. All of the minerals in the sample are within the BIS defined range. It may be inferred from the physico-chemical parameter analysis that the river water from Shimoga and Chikmagalur. However, the river water in this sampling region is not fit for human consumption. The river water treatment will therefore be introduced using the two water samples.

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TABLES

Code	Location	Latitude & Longitude	Environmental Setting
Surface Water			
SW1	Tunga River	N 13º 25’18.6” E 75º 15’ 49.3”	At Sringeri
SW2	Badra River	N 12º 32’21.2” E 75º 50'40.3”	At Balehonnur

Table. 1 Latitude and Longitude of Thunga and Bhadra rivers

Parameters	Premonsoon	Monsoon	Postmonsoon
Temperature (°C)	26.8	18	21.4
pH	6.97	7.52	6.42
Conductivity	57	78	36
Turbidity	1.7	12	5
Total Solids	32	45	17
Total dissolved solids	30	30	15
Total Suspended Solids	2	15	2
Hardness	14	10	7
Alkalinity	18	12	10
Chloride (mg/l)	5.3	6.8	2.5
Sulphate (mg/l)	1.2	2	0.8
Fluoride (mg/l)	0.2	0.5	0.1

Nitrate (mg/l)	0.7	1.2	0.5
Nitrite (mg/l)	0.01	0.06	0.01
Total Nitrogen (mg/l)	1.1	1.4	0.8
Phosphate (mg/l)	0.05	0.08	0.03
Silica (mg/l)	0.32	0.48	0.27
Sodium (mg/l)	5.3	7.2	3.3
Potassium (mg/l)	0.7	2	0.8
Magnesium (mg/l)	0.6	1.5	0.6
Iron (mg/l)	0.05	0.08	0.02
Zinc (mg/l)	0.03	0.08	0.01
Dissolved Oxygen	6.8	5.6	7.1
Chemical oxygen	13	17	10
Biological oxygen	1.7	2.3	1.2

Table 2: Variation in physic-chemical parameter of River Thunga

Parameter	**Premonsoon**	**Monsoon**	**Post monsoon**
Temperature	27.7	19.5	22.5
pH	7.4	8.2	6.75
Conductivity	67	82	80
Turbidity	5.3	17	3.1
Total Solids	45	65	29
Total dissolved solids	43	57	23
Total Suspended Solids	2	8	6
Hardness	24	18	12
Alkalinity	28	21	17
Chloride	5.5	7.5	3.8
Sulphate	1.8	2.5	1.2
Fluoride	0.24	0.38	0.14
Nitrate	2.3	2.8	1.7
Nitrite	0.02	0.04	0.02
Total Nitrogen	1.6	1.8	1.2
Phosphate	0.11	0.16	0.05
Silica	0.45	0.57	0.33
Sodium	6.4	8.7	4.5
Potassium	1.3	1.7	1.1
Magnesium	2.4	2.9	2.4
Iron	0.37	0.52	0.21
Zinc	0.08	0.18	0.04
Dissolved oxgen	6.1	4.7	6.8
Chemical oxygen	18	22	13
Biological oxygen	2.1	2.7	1.9

Table 3: Variation in physic-chemical parameter of River Bhadra

Figures

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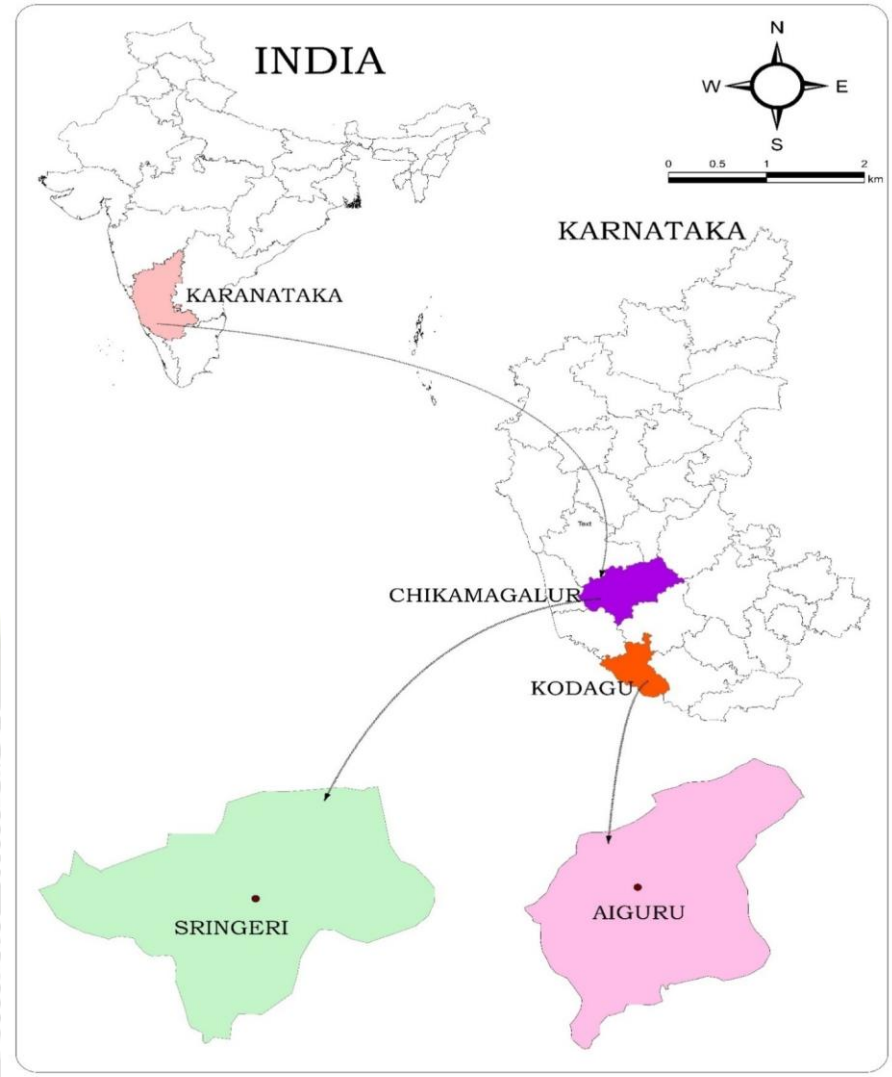

Figure1: Study Area and Sample Location.

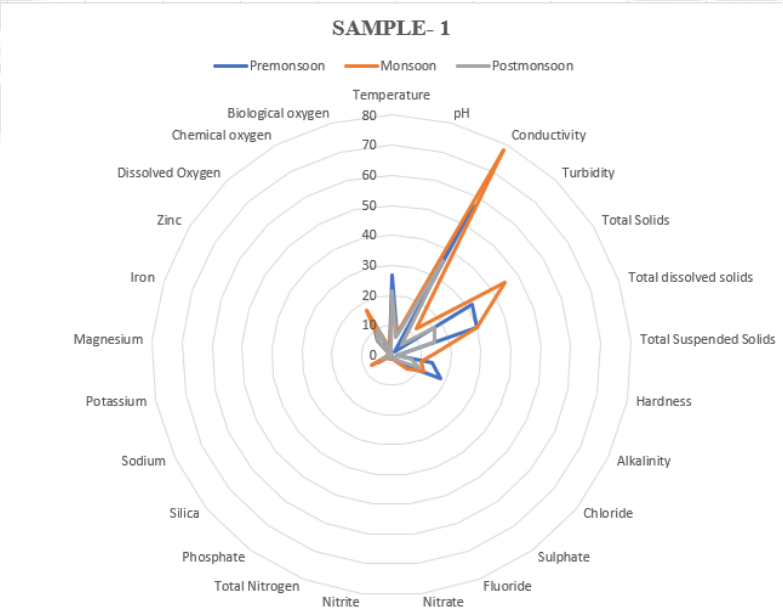

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Figure 2: Variation in Physic-Chemical parameter of River Thunga.

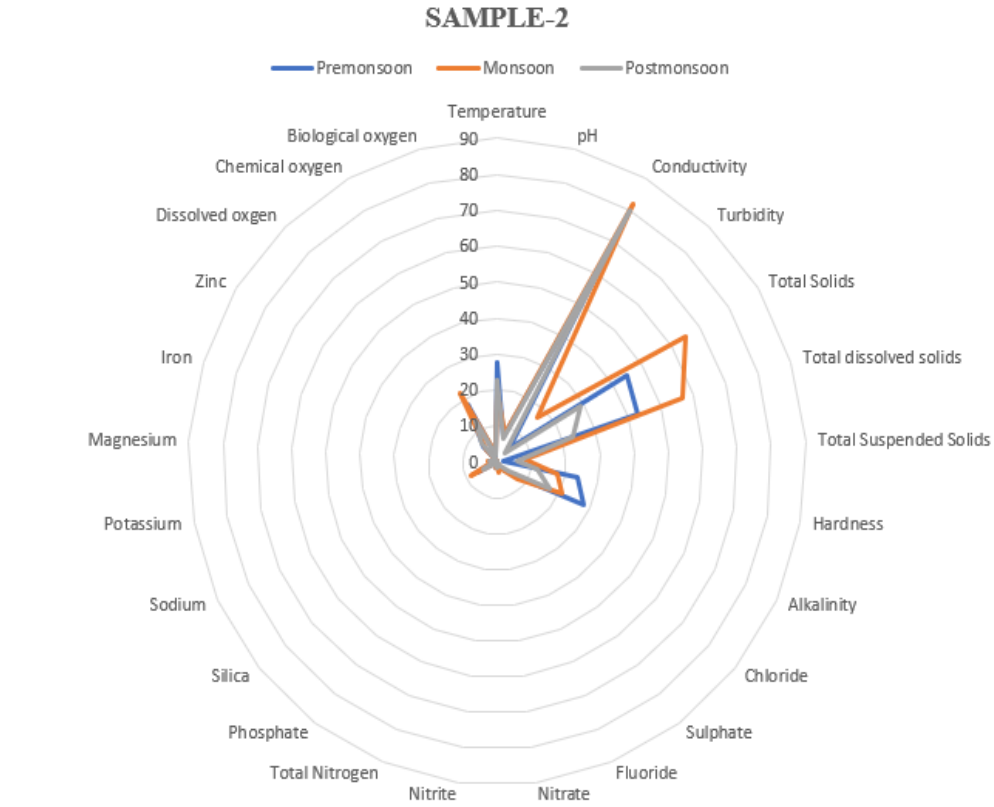

Figure 3: Variation in Physic-Chemical parameter of River Bhadra.

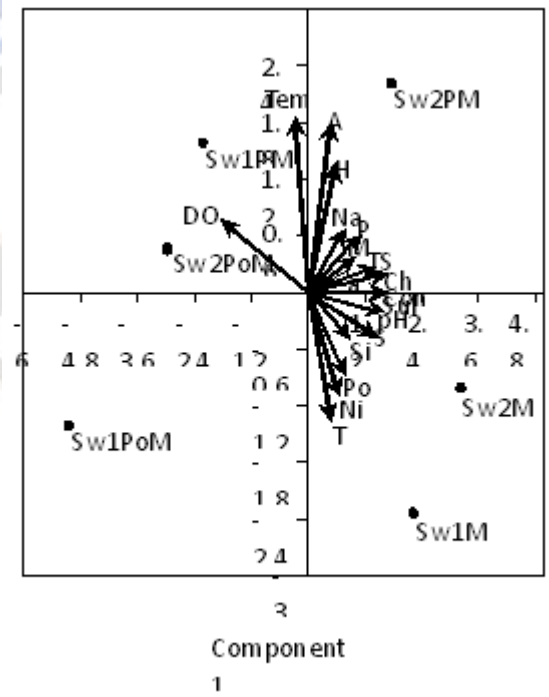

Figure.4: Principal Component Analysis of Thunga and Bhadra rivers showing relationship with water quality parameter.