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Article

Comparison of Extent of Pollution of Minor-Basavanna Canal Water with Respect to Water of Tungabhadra Dam, Hospet and its Suitability for Irrigation

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ABSTRACT

Canals are waterways channels, or artificial waterways, which are in many areas serving the basic needs of water, play a significant role in shaping the environmental and ecological balance of the region through which it flows. Despite of all these versatile contributory roles, knowingly or unknowingly are being used as a dumping site for disposal of municipal and small industrial waste. The main goal of this study was to compare extent of pollution of Minor-Basavanna canal water with respect to water of Tungabhadra Dam (T.B. Dam), Hospet, and ascertain its suitability for irrigation. The present study was divided into two study areas, i.e., T.B. Dam and Basavanna canal. Water samples were collected from four locations from January 2019 to December 2019. Attempts were made to study and analyze the physicochemical characteristics of the T.B. Dam and canal water such as temperature, pH, electrical conductivity, total dissolved solid, total alkalinity, dissolved oxygen, chemical oxygen demand, and biological oxygen demand, which were investigated to know the present status of the Basavanna canal water quality with compare to T.B. Dam water. During the present study, Basavanna canal water showed significant pollution, is due to human activities such as dumping wastes, anthropogenic activities, washing activities, and discharge of sewage along the canal.

Key words: Tungabhadra dam, Basavanna canal, Physicochemical parameters, Pollution.

1. INTRODUCTION

All plants and animals need water to survive. There can be no life on earth without water. Water is the precious gift of nature to the living beings. It is involved in a number of biological processes. Canals are an important part of earth's water cycle. The quality of irrigation water is a crucial factor for long-term soil productivity. Use of poor quality water for a long time can make the soil less productive or even barren depending on the amount and type of constituents present in canal water. Many areas in the country are facing a serious problem of not only scarcity of water but also of its poor quality. Low or marginally saline water sometimes appear to stimulate crop growth, because of the higher amount of nutrient ions present, however, excess of the soluble salts in water leads to their accumulation in the surface layer. The regular monitoring of water quality is necessary to observe the demand and pollution level of canal water. A number of water analyses are regularly conducted by different groups of chemists and biologists across the country [1-8]. Increasing population has led to the deterioration of surface and sub-surface water [9]. Chemical composition is the most invoked factor in characterizing water quality. Biological and physical factors are considered when discussing water quality. Chemical quality in major part of the Hospet taluk is fresh and suitable for both irrigation and domestic purposes. Basavanna canal water is polluted by various kinds of natural wastes, domestic wastes, and agricultural wastes and other factors creating water pollution problem particularly in fresh water system. To improve the production of crops, it is necessary to improve the quality of irrigation water. Use of poor quality canal water deteriorates soil properties [10-14] resulting in crop yield loss [15]. The present investigation reveals the quality of irrigation water's parameters such as temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), total alkalinity (TA), chemical oxygen demand (COD), dissolved oxygen (DO), and biological oxygen demand (BOD).

2. MATERIALS AND METHODS

2.1. Study Area

Hospet, also known as Hosapete, is a Municipal city in Bellary District in central Karnataka, India. It is located on the bank of Tungabhadra River. The city is spread over an area of about 70.12 km^2. Hospet city is situated at the geographical position of 15° 16′ 0″ North 76° 24′ 0″ East and an altitude of over 467 m above sea level. Karnataka state experiences four seasons. The winter in January and February is followed by summer between March and May, the monsoon season between June and September, and the post-monsoon season from October to December. The Basavanna canal is a man-made local minor canal, serving the irrigation needs of the local population, which takes its origin between high and low level right bank canals of Tungabhadra Dam (T.B. Dam) and flows about 16.5 km through the heart of Hospet City toward Malapanagudi (east). Within the city of Hospet, the canal flows approximately 10 km and badly polluted from disposal of untreated sewage, small industrial wastes, storm water drainage,

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cattle and dairy farming wastes, disposal of dead bodies of animals, and dumping of liquid and solid wastes. Basavanna canal water is used mainly for irrigation and domestic activities. Thus, it is quite imperative to characterize the quality of Basavanna canal water with a view to renovate so that it serves for a useful purpose to the society. The value and importance of freshwater resources necessitates that they may be well managed ecologically for meeting water quality standards. Hence, the present study was undertaken to compare extent of pollution of minor-Basavanna canal water with respect to water of T.B. Dam, Hospet, and ascertain its suitability for irrigation.

2.2. Sampling and Sampling Sites

A plastic bottle of capacity 2 l were used to collect the sample. The pH and temperature of water of the study areas were measured at the time of sample collection. The water samples were collected on a monthly basis from January 2019 to December 2019. The sampling was done during morning hours in between 10.30 am and 11.30 am. The water samples were collected at a depth of 1–2 feet from site. Immediately after collection, water samples were brought to the laboratory and kept at 4°C till used for analysis. Four sample sites at two study areas have been selected for the present study. The first study area, T.B. Dam represents Site 1 (S1). In second study area, i.e., Basavanna canal, three sites (S2, S3, and S4) have been selected along its path (Figures 1 and 2). A brief description of the location and the topographical details of each point are given in Table 1.

3. RESULTS AND DISCUSSION

Seasonal variations in the values of selected physicochemical parameters are presented in Tables 2-9 for all the selected sampling sites of the four study areas.

3.1. Temperature

Temperature of pure water may not be as important because of the wide range of temperature tolerance in aquatic life, but in polluted water, temperature can have profound effects on DO and BOD. The fluctuation in canal water temperature usually depends on the season, geographic location, sampling time, and temperature of effluents entering the stream. Long-term temperature increase can impact aquatic biodiversity, biological productivity, and the cycling of contaminants through the ecosystem. In the present study, at two study areas, the water temperature showed an upward trend from winter to summer followed by a downward trend from monsoon onward. The highest temperature in summer was recorded 32.5°C and can be due to high solar radiation, low water level, clear atmosphere, and high atmosphere temperature [16]. The lowest temperature was reported during winter season was 23.1°C (Tables 2 and Figure 3) due to cold low ambient temperature and shorter photoperiod [17].

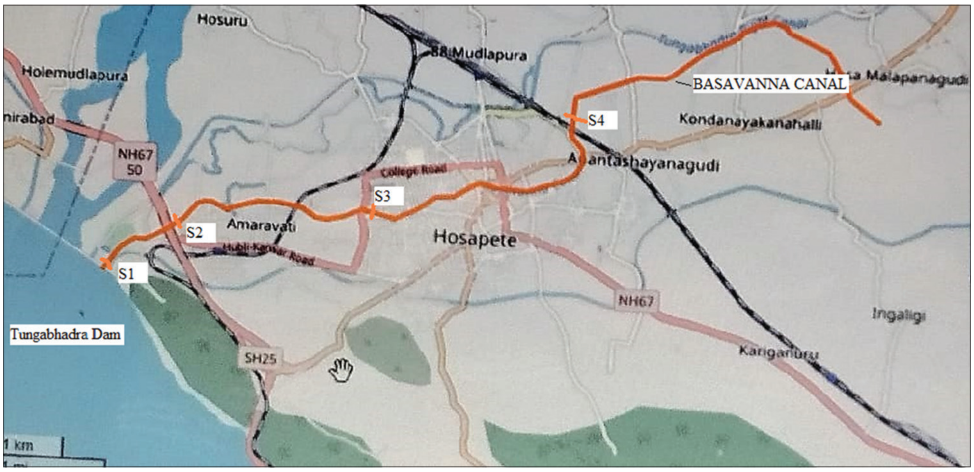

Figure 1: The image of Tungabhadra Dam, Basavanna canal, and water collection sites (S1 to S4) for the study.

Table 1: Location and the topographical details of sampling sites.

Study area	Sample site	Description of sampling point	Latitude	Longitude	Remarks
First	S1	Gate of the dam	15°25′36.65″N	76°20′21.95″E	Reservoir
Second	S2	Near T.B Dam Fish Farm (Upstream). Entering point of the Hospet city	15°15′56.88″N	76°20′53.83″E	Non-residential area No sewage discharge to the canal.
Third	S3	100 Bed Hospital Road (Midstream) Center of the Hospet city	15°16′09.96″N	76°22′24.90″E	Thickly populated slums at one side of the canal. Residential area domestic and solid waste, Washerman (Dhobhi Ghat), commercial area, scrap dealers, drum cleaners, automobile garages, cattle and dairy farmers. Sewage discharge to the canal
Fourth	S4	Railway Bridge (downstream) End of the Hospet city	15°16′50.77″N	76°23′55.48″E	Thickly populated slums at both sides of the canal. Cattle and dairy farmers, Agriculture activities, sewage discharge to the canal.

3.2. pH Value of Water Samples

The hydrogen ion concentration plays an important role in the biological processes of almost all aquatic organisms. The change in pH value alters the concentration of other substances in water to become a more toxic form. Low pH values indicate acidic water having corrosive properties. High pH values indicate alkaline properties. The values of pH for all collected water samples are within the permissible limits of 7.1–8.5 prescribed by the World Health Organization (WHO) [18] and Indian Standards Institution (ISI) [19] standards for drinking water and Bureau of Indian Standards (BIS) [20] for irrigation purpose. The pH values in the present investigation showed slightly alkaline condition. It is observed that in all seasons, the pH values of sample sites S1 and S2 are almost similar and lower than S3 and S4. This is due to the sites S1 and S2 are away from the city limits and less polluted. The pH values in site S1 and S2 are ranges from 7.2 to 7.6 shows that the river water is of alkaline nature. The high alkaline pH of sample sites S3 and S4 of Basavanna canal might be due to the excessive use of detergents by Washermen (Dhobhi Ghat) for washing of cloths, vehicles, cattles, and utensils and also microbial activities [21]. The regional and seasonal variation of pH values in two study areas are given in Table 3 and Figure 4. With some exception, the results of pH values revealed slight variations in its values. Higher pH values at two study areas during summer and winter could be ascribed to increased photo synthetic assimilation of dissolved inorganic carbon by planktons. A similar effect could also be produced by water evaporation through the loss of half bound CO_2 and precipitation of mono-carbonate. Lower pH values during rainy season were due to dilution of water by rain water flows.

Figure 2: Water samples collected from study sites a to d. (a) Pollution from slum habitations (b) Sewage discharge residential area (c) Degradable and non-degradable wastes disposal (d) Encroachment of canal by slums.

Table 2: The temperature of water samples at S1 to S4 in the month of January 2019– December 2019.

Month	Temperature (°C)			
	S1	S2	S3	S4
January-2019	23.2	23.1	23.4	23.6
February-2019	23.9	23.8	24	24.2
March-2019	26.5	26.6	26.9	26.9
April-2019	32.1	32.2	31.4	32.5
May-2019	30.6	30.6	30.9	31.1
June-2019	27.3	27.3	27.6	27.6
July-2019	27.6	27.6	27.8	27.9
August-2019	27.2	27.1	27.4	27.6
September-2019	25.3	25.1	25.6	26.1
October-2019	24.4	24.3	24.6	24.9
November-2019	24.1	24.1	24.6	24.7
December-2019	24.1	23.9	24.5	24.6

3.3. EC

The ability of water to conduct an electric current is known as conductivity and depends on the concentration of ions in water. It is an

Table 3: The results of pH values of water collected at study sites S1 to S4.

Month	pH			
	S1	S2	S3	S4
January-2019	7.4	7.3	8.1	8.2
February-2019	7.4	7.3	8.1	8.2
March-2019	7.5	7.5	8.2	8.4
April-2019	7.5	7.6	8.4	8.5
May-2019	7.5	7.5	8.3	8.4
June-2019	7.3	7.3	7.7	7.9
July-2019	7.1	7.2	7.7	7.8
August-2019	7.2	7.3	7.8	7.9
September-2019	7.1	7.1	7.8	7.8
October-2019	7.1	7.2	7.7	7.8
November-2019	7.1	7.1	7.8	7.8
December-2019	7.2	7.1	7.7	7.7

Table 4: The electrical conductivity values of the water samples at different study areas.

Month	Electrical conductivity (μmho/cm)			
	S1	S2	S3	S4
January-2019	575.35	587.56	1235.76	1212.22
February-2019	589.01	600.12	1256.33	1256.11
March-2019	741.56	756.76	1423.98	1534.21
April-2019	937.22	945.45	1898.12	1914.34
May-2019	942.13	998.34	1835.54	2101.32
June-2019	920.46	923.77	1723.76	1801.02
July-2019	984.21	914.44	1734.65	1845.22
August-2019	899.09	876.28	1613.34	1710.87
September-2019	899.67	878.87	1687.45	1719.87
October-2019	864.53	816.73	1532.12	1732.44
November-2019	853.24	822.43	1588.76	1723.77
December-2019	825.17	809.01	1527.66	1599.98

Table 5: Dissolved oxygen concentrations at studied sites.

Month	Dissolved oxygen (mg/L)			
	S1	S2	S3	S4
January-2019	8.2	8	4.7	4.9
February-2019	7.8	7.5	4.1	3.8
March-2019	6.6	6.3	3.5	3.1
April-2019	5.4	5.2	2.8	2.6
May-2019	5.2	5.5	2.6	2.6
June-2019	5.3	6.3	3.2	3.2
July-2019	6.6	6.2	3.8	3.4
August-2019	6.4	6.1	3.7	3.4
September-2019	6.7	6.5	3.5	3.4
October-2019	6.7	6.2	3.6	3.2
November-2019	6.3	6.3	3.4	3.2
December-2019	6.7	6.5	3.5	3.3

Table 6: Biochemical oxygen demand values at studied sites.

Month	Biochemical oxygen demand (mg/L)			
	S1	S2	S3	S4
January-2019	4.6	5.4	60	63
February-2019	4.8	5.7	63	67
March-2019	5.1	6.3	68	73
April-2019	7.3	8.9	87	91
May-2019	7.1	8.2	88	97
June-2019	4.7	4.9	35	44
July-2019	3.7	4.3	47	41
August-2019	3.9	4.4	39	43
September-2019	4.4	4.7	42	55
October-2019	4.5	4.9	49	50
November-2019	4.1	4.9	47	51

Table 7: Chemical oxygen demand values of water samples at sites S1 to S4 from January 2019 to December 2019.

Month	Chemical oxygen demand (mg/L)			
	S1	S2	S3	S4
January-2019	22	29	275	283
February-2019	25	33	289	283
March-2019	35	42	293	299
April-2019	43	50	312	317
May-2019	40	56	255	273
June-2019	14	19	247	259
July-2019	17	14	273	255
August-2019	12	12	281	275
September-2019	21	26	261	277
October-2019	22	26	273	273
November-2019	21	27	264	269
December-2019	22	25	266	271

index to represent total concentration of soluble salts in water. EC is an estimate of total dissolved salts in water and water with EC values between 2500 and 10,000 µmho/cm is not recommended for human consumption and normally not suitable for irrigation [22], except for very salt tolerant crops with special management techniques. It is observed that in all seasons, the EC values of sample sites S1 and S2 are almost similar and lower than S3 and S4. This is due to the sites S1 and S2 are away from the city limits and less polluted compared to the sites S3 and S4. The observed EC values of the water samples of two study areas were found to be high (ranging from 2101.32 to 575.35 µmhos/cm) (Table 4 and Figure 5) and it is detrimental to biotic growth. High EC in summer season represents water with high electrolyte concentration due to evaporation. High EC in rainy season is also due to floods and rains, which contains more electrolytes. The EC limit of value for irrigation water is specified [20] as 3000 (µ mho/cm). All samples were in desirable limit as prescribed for irrigation water standard.

Table 8: Total dissolved solids.

Month	Total dissolved solids (mg/L)			
	S_1	S_2	S_3	S_4
January-2019	83	97	630	665
February-2019	89	101	867	999
March-2019	159	170	962	997
April-2019	253	301	1647	1837
May-2019	195	295	1398	1771
June-2019	154	133	991	1071
July-2019	137	207	855	991
August-2019	133	155	791	856
September-2019	106	123	782	833
October-2019	111	127	779	727
November-2019	123	129	771	763
December-2019	125	131	783	799

Table 9: Total alkalinity values of water at studied sites throughout the year.

Month	Total alkalinity (mg/L)			
	S1	S2	S3	S4
January-2019	117	121	282	295
February-2019	129	133	287	319
March-2019	151	163	333	347
April-2019	169	179	335	373
May-2019	163	173	300	349
June-2019	147	147	253	277
July-2019	131	143	247	239
August-2019	159	149	243	277
September-2019	137	147	257	251
October-2019	135	145	263	279
November-2019	131	131	265	279
December-2019	133	142	269	270

3.4. DO

DO is needed for living organisms to maintain their biological process and it plays a key role for supporting aquatic life. DO test measures the amount of life-sustaining oxygen dissolved in the water. This oxygen is available for fish, invertebrates, and all other aquatic animals. Most aquatic plants and animals need oxygen to survive. Depletion of DO in water is due to high temperature or added materials, either organic or inorganic would increase microbial activity [23]. It was reported that DO concentration of at least 5 mg/L is required for maintaining a healthy aquatic life and DO concentration of less than 5 mg/L indicates pollution [24]. It is clear from the above data that the values of DO at the sampling sites S3 and S4 were much below the required permissible limits for domestic, irrigation, and other uses throughout the year. This indicates a high level of pollution. Along the Basavanna canal (S3 and S4), there is substantial sewage discharge from nearby housing societies. Besides, near the banks of the canal certain, anthropogenic activities, such as scrap dealers, drum cleaners, and automobile garages nearby contributes to impurities, which ultimately deplete DO levels in water. Due to this, the aquatic life in Basavanna canal is very adversely affected. Lower value of DO is an indication of contamination with organic matter. The variation in DO values could be due to many reasons. Our study shows seasonal variation in DO values that are affected by small industrial, human, and thermal activities. DO values have found maximum during winter and minimum during the summer (Table 5 and Figure 6). The lower values of DO at the sampling sites S3 and S4 compared to sites S1and S2 indicates higher pollution at the site due to anthropogenic activity, disposal of sewage from the surrounding area and effluents from small industrial units.

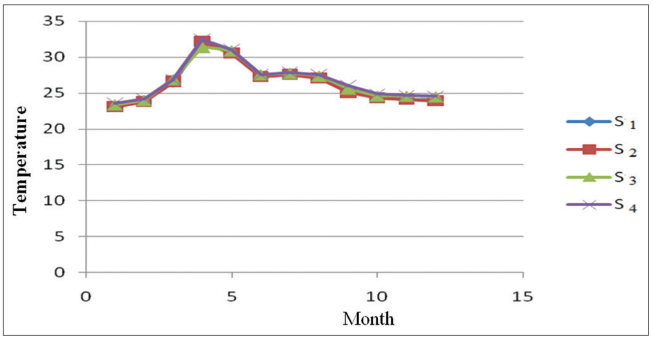

Figure 3: The temperature of water samples at S1 to S4 in the month of January 2019–December 2019.

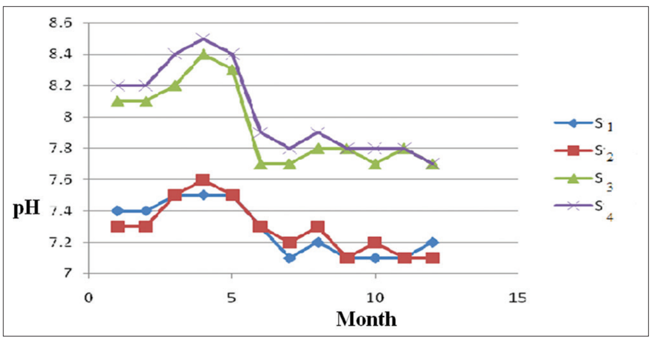

Figure 4: The graph of pH values of water collected at study sites S1 to S4 from January 2019 to December 2019.

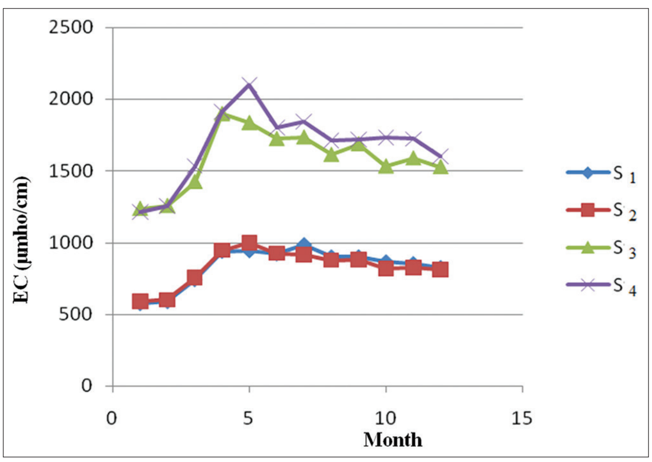

Figure 5: Electrical conductivities of water at sites S1 to S4 from January 2019 to December 2019.

3.5. Biochemical Oxygen Demand (BOD)

Domestic sewage and many other chemical pollutants are biodegradable types. Problem arises with the degradable type of pollutants when their input into the system exceeds the dispersal capacity. Any aquatic eco-system possesses the natural capacity to break down organic wastes and restore normal conditions gradually, but when the system is overloaded with excess amount of untreated sewage, disastrous consequences can follow. The decomposition of organic matter by the micro-organisms in the water is oxygen – consuming process. The amount of oxygen required for the oxidative degradation of organic matter by the microorganisms is known as BOD, the value of which is considered as a measure of the magnitude of organic pollution in water. The depletion of oxygen seriously affects life of the aquatic animals. In unpolluted waters/rivers, the BOD is usually 5 mg/L or lower. River water having BOD values more than 10 mg/L is considered as moderately polluted and when

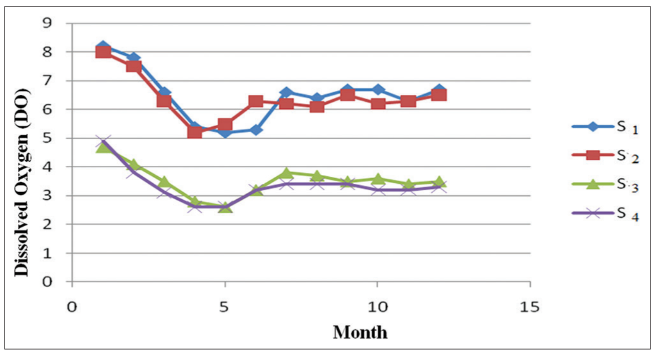

Figure 6: A graph of dissolved oxygen concentrations at studied sites.

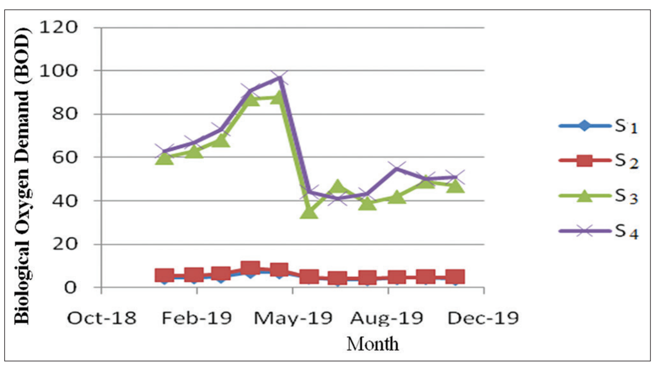

Figure 7: A graph of biochemical oxygen demand values (mg/L) at different months at different sampling sites.

the level is more than 20 mg/L it is said to be highly polluted [25]. It is clear from the above data (Table 6 and Figure 7) that the BOD values were substantially higher than the prescribed levels at the sampling points S3 and S4 compared to sampling points S1 and S2. This indicates a high level of pollution along the course of Basavanna canal. On comparison of the seasonal BOD values, it was observed that BOD values were higher during the summer season than during the monsoon and post monsoon season. This is due to lower water levels and saturation of impurities.

3.6. COD

COD is one of the most important parameters of water quality assessment employed for estimating the organic pollution of water. The COD is widely used as a measure of the susceptibility to oxidation of the organic and inorganic materials present in the water bodies. COD determines the amount of oxygen consumed in the chemical oxidation of chemical compounds using a strong chemical oxidant, such as potassium dichromate or permanganate [26] under reflux conditions. Higher values of COD indicate that there is high organic pollution leading to a depletion of DO. COD is an indicator of organic pollution in surface water. This is a danger to aquatic ecosystem. The COD values recorded in the entire sampling sites crossed the limit prescribed by the WHO guidelines (10 mg/L) for drinking water quality criteria [18]. The elevated level of COD lowers the concentration of the DO in a water body resulting in a bad water quality and stress to the resident aquatic life [27]. Higher values of COD at the sampling sites S3 and S4, compared to the S1 and S2 are due to the dense population of slums along the course of Basavanna canal which discharge sewage, and small industrial effluents increasing pollution to a very vulnerable state. A seasonal variation in the values of COD at both study areas (Table 7 and Figure 8) was observed. Higher COD values in the summer may be due to concentration of water as a result of evaporation, etc. Lower values of COD during the rainy season, compared to winter and post monsoon, were observed. This is due to dilution of water by rain water flows in the monsoon.

3.7. TDS

TDS is a measure of the solid materials dissolved in the canal water. This includes salts, some organic materials and a wide range of other materials from nutrients to toxic materials. A constant level of minerals in the water is necessary for aquatic life. Concentrations of TDS that are too high or too low may have limited the growth and lead to the death of many aquatic life forms [28] reported that increase in TDS value reflects the pollutant burden on the aquatic systems originating from both natural and extraneous sources such as sewage, urban runoff, industrial wastewater, and chemicals used in the water treatment processes, and hence, adversely affect the quality of water. High level of dissolved solids in water systems increases the biological and COD and ultimately depletes the DO level in the aquatic systems [29]. BIS standards say that the maximum desirable TDS is 500 mg/L and the maximum permissible level in absence of a better source of water is 1500 mg/L. The maximum TDS were recorded during summer at Site 4 and the minimum during winter at S1. A similar seasonal fluctuation in the values of TDS at all sampling sites (Table 8 and Figure 9) was observed. The maximum value of TDS in summer could be attributed to the increase in the load of soluble salts, mud, nutrients and surface runoff, fecal matter and sewage from the catchments area.

3.8. TA

TA is the acid neutralizing capacity of the water that generally imparted by the hydrolysis of salts such as carbonates, bicarbonates, and hydroxide [30] but may also include contributions from other basic compounds. Waters of low alkalinity (<24 mg/L as $CaCO_3$) have a low buffering capacity and can, therefore, be susceptible to alterations in pH [31], thus alkalinity is important for fish and aquatic life due to its buffering capacity against rapid pH changes [32] that occur naturally as a result of photosynthetic activity of plants. In the present investigation, the seasonal variations of TA were observed maximum in summer and minimum in winter at all the sample sites (Table 9 and Figure 10) and were predominantly caused by bicarbonates. Maximum values of TA in summer could be attributed to accelerated rate of photosynthesis leading to greater utilization of carbon dioxide, disposal of dead bodies of animals, clothe washing station, and urban discharge through open drains in the canal.

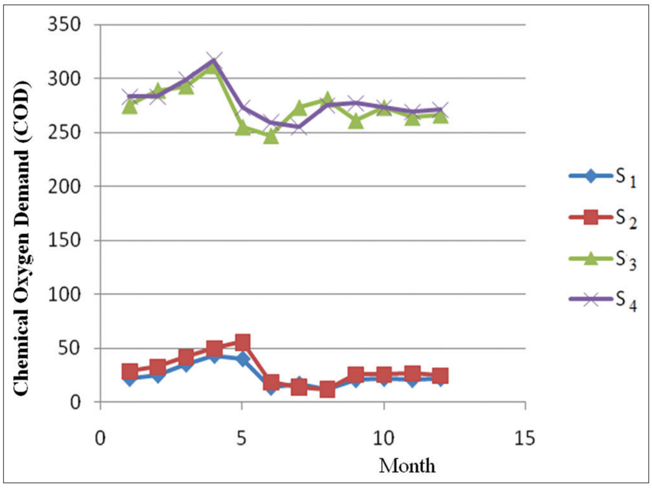

Figure 8: A graph of chemical oxygen demand values of at sites S1 to S4 versus different months.

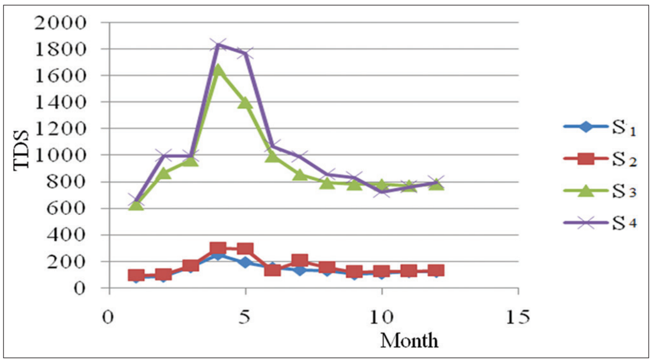

Figure 9: Graph of total dissolved solids values from January 2019 to December 2019 at studied sites S1 to S4.

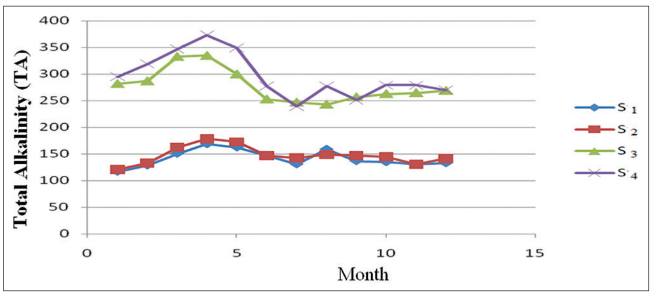

Figure 10: Total alkalinity values of water at S1 to S4 versus months.

Table 10: Physicochemical parameters.

Study Area	Sample site	Distance from T. B. Dam (in km)	Pollution Level	Odor	Physicochemical properties
First	S1	0	Non-polluted	Unobjectionable	All the values are within the permissible limits
Second	S2	1.5	Non-polluted	Unobjectionable	All the values are within the permissible limits
Third	S3	6	Highly polluted	Objectionable	pH and EC are within the permissible limits DO, BOD, COD, TDS, and TA are crossed the limits prescribed by the WHO, ISI, BIS, and ICMR guidelines
Fourth	S4	10	Highly polluted	Objectionable	pH and EC are within the permissible limits DO, BOD, COD, TDS, and TA are crossed the limit prescribed by the WHO, ISI, BIS, and ICMR guidelines

Table 11: Prescribed legal limits and guidelines.

Parameter	WHO [18]	ISI [33]	ICMR [19]
pH	7.0–8.5	6.5–8.5	6.5–9.2
EC	1.4 ds /m	1400µs/cm	250
TDS	500	500	1500–3000
BOD	5.0	5.0	-
COD	10.0	10.0	-
DO	5.0	5.0	5.0
TA	120	200–600	200–600
Odor	Unobjectionable	Unobjectionable	Unobjectionable

4. CONCLUSION

The present study concludes that all the physicochemical properties of sample sites S1 and S2 were within the permissible limits in all seasons prescribed by BIS, WHO, ISI, ICMR, and KNNL [18-20,33,34]. This is due to the fact that these sample sites were not comes under the city limits, and least affected by anthropogenic activities, disposal of sewage from the surrounding areas and effluents from small industrial units. The Hospet city limits and anthropogenic activities/sewage discharge were simultaneously starts after the sample Site S2 and ends at the sample site S4 respectively. All the physicochemical parameters of sample sites S3 and S4 were shown drastic variations compare to the sample sites S1 and S2. Raw domestic, small industrial, cattle, and dairy farming waste were discharged directly in the Basavanna canal at the city area in between the sampling site S2 and S4. Because of this, the canal water has been severely polluted compare to its origin S1. The canal looks like a "sewerage drain" than a water canal. The observed values of most of the important water quality parameters also indicate that the canal water is highly polluted (Tables 10 and 11).

This is an alarming situation as the water being extensively used by the people residing adjacent to the channel for the purpose of bathing, washing, cattle feeding, etc. It has also been reported that some of the people drink the water on account of which several water-borne diseases have been reported [35,36]. The values of these parameters were used to assess the suitability of Basavanna canal water by comparing with the WHO and Indian standards (ISI) for domestic purpose and BIS for irrigation purpose. The sample analysis at sites S3 and S4 reveals that Basavanna canal water is not fit for drinking or irrigation with respect to EC, TDS, TA, BOD, and COD, the concentrations of these parameters exceed the permissible limits (Table 11) of the WHO, BIS, ISI, and ICMR [18,19,33].

The results suggest urgent need for proper management measures and suitable tools to restore the water quality of this canal for a healthy and promising human society. It is advisable to take precautionary measures by the competent authority taking into consideration the anti-degradation policy which provides some suggestions for protection in its use for the required purpose. The Hospet city taluk government must consider and prohibited the people living around not to throw wastes, rubbish, sewer, and solid waste directly into the canal to sustain the beauty, recreational activity the irrigation water standards because it is a good source of irrigation and domestic purposes.

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6. REFERENCES

1. T. Chitra, A. Madheswari, S. Uthirasamy, (2020) A study on physico-chemical parameters of canal water at Rangampalayam, Erode district, Tamil Nadu. ***Indian Journal of Applied Research***, **10**: 1-5.
2. J. A. Nyantakyi, B. Fei-Baffoe, O. Akoto, (2020) Seasonal variations in physicochemical and nutrient water quality of river Tano in Ghana. ***International Journal of Environmental Chemistry***, **4**: 1-12.
3. N. Kamboj, R. S. Aswal, P. Singh, R. Dobhal, (2018) Evaluation of physico-chemical characteristics of Ganga canal at Haridwar. ***Asian Journal of Water Environment and Pollution***, **15**: 125-133.
4. R. Bhutiani, F. Ahamad, V. Tyagi, K. Ram, (2018) Evaluation of water quality of River Malin using water quality index (WQI) at Najibabad, Bijnor (UP) India. ***Environment Conservation Journal***, **19**: 191-201.
5. S. H. Ewaid, (2017) Water quality evaluation of Al-Gharraf river by two water quality indices. ***Applied Water Sci***, **7**: 3759-3765.
6. M. Bora, D. C. Goswami, (2017) Water quality assessment in

terms of water quality index (WQI): case study of the Kolong river, Assam, India. ***Applied Water Science***, **7**: 3125-3135.
7. K. S. Shah, G. S. Joshi, (2017) Evaluation of water quality index for river Sabarmati, Gujarat, India. ***Appl Water Sci***, **7**: 1349–1358.
8. J. Agano, Makori, P. O. Abuom, R. Kapiyo, N. Douglas, Anyona, G. O. Dida, (2017) Effects of water physico-chemical parameters on tilapia (*Oreochromis niloticus*) growth in earthen ponds in Teso North Sub-County, Busia County. ***Fisheries and Aquatic Sciences***, **20**: 5-10.
9. T. S. D. Pranavam, V. T. Rao, L. Punithavathi, S. Karunanithi, A. Bhaskaran, (2011) Ground water pollution in the palar river bed near Vellore, Tamil Nadu, India. ***Indian J Sci Tech***, **1**: 19-21.
10. M. R. Chaudhry, M. Iqbal, K. M. Subhani, (1986) ***Proceeding National Seminar on Drainage in Pakistan***. Vol. 14. Jamshoro: Held at Mehran University Engineering and Technology, p215-224.
11. H. M. Bhatti, (1986) Final Tech. Report of the PL-480 project. ***Ayub Agricultural Research Institute***, **33**: 66-70.
12. A. M. R. Ghafoor, M. Chaudhry, G. Qadir, H.R. Ahmed, (1997) Saline water management for irrigation in India. ***Agricultural Water Management***, **30**: 1-24.
13. M. R. Chaudhry, (2000) ***Proceeding Regional Groundwater Management Seminar.*** Vol. 1. Islamabad, p171-181.
14. A. S. Qureshi, I. Masih, Proc, (2002) ***International Workshop on Conjunctive Water Management for Sustainable Irrigated Agriculture in South Asia***. Vol. 3. Lahore, p73-81.
15. J. Akhtar, R. H. Qureshi, M. R. Chaudhry, M. Aslam, M. Khalid, M. Saqib, (2001) ***Proceeding National Seminar on Drainage in Pakistan Held at University of Agriculture***. Vol. 2. Faisalabad, p36-41.
16. O. P. Bohra, S. C. Bhargava, (1977) Abiotic factor, chlorophyll pigment and primary production in two lakes of Jodhpur. ***Geobios***, **4**: 215-216.
17. N. Swarnalatha, A. Narasingrao, (1998) Ecological studies of Banjaralake with reference to water pollution. ***Journal of Environmental Biology***, **19**: 179-186.
18. World Health Organization, (2004) ***Guidelines for Drinking-water Quality***. Vol. 1. Geneva: World Health Organization.
19. ICMR, (1973) ***Manual Standards of Water Quality for Drinking Water Supplies***. 2nd ed. New Delhi: Indian Council of Medical Research, p21.
20. Indian Standard Guidelines for the Quality of Irrigation Water, (1986) ***IS: 11624, Reaffirmed*** (***2001***) ***and*** (***2009***), ***UDC 631. 671. 03.626.810*** (***026***), ***Bureau of Indian Standards*** (***BIS***). New Delhi: Manak Bhaban, Bahadur-Shah Zafar Marg.
21. K. Venkatesharaju, P. Ravikumar, R. K. Somashekar, K. L. Prakash, (2010) Physico-chemical and bacteriological investigation on the river Cauvery of kollegal stretch in Karnataka. ***Journal of science Engineering and technology***, **6**: 50-59.
22. S. M. Kueli, W. R.I. Masambha, E. Fabiano, S.M. Sajidu, E.M.T. Malawi, (2009) Experimental performance analysis of wireless links for healthcare applications. ***Journal of Science and Technology***, **9**: 5.
23. H. C. Kataria, H. A. Quereshi, S. A. Iqbal, A. K. Shandilya, (1996) Assessment of water quality of Kolar reservoir in Bhopal (M.P.). ***Pollution Research***, **15**: 191-193.
24. A. T. Khanderkar, (1986) ***Industrial and Marine Pollution in Coastal Areas of Bangladesh Part Report of a Case Study in Bangladesh***. Bangkok, Thailand: ESCAP.
25. G. Paul, (1999) In: Dushan O. (Ed.), ***Environment and Pollution Paribes***, India: Dasgupta and Co. Ltd., p323.
26. China State Environment Protection Agency, (1998) ***Monitoring Methods for Water and Wastewater***, 3rd ed. Beijing: CESP, p354-361.
27. P. R. Kannel, S. Lee, Y. S. Lee, S. R. Kanel, S. P. Khan, (2007) Application of water quality indices and dissolved oxygen as indicators for river water classification and urban impact assessment, ***Environmental Monitoring and Assessment***, **132**: 93-110.
28. H. C. Kataria, S. A. Iqbal, A. K. Shandilya, (1996) Assessment of water quality of Kolar reservoir in Bhopal (MP), ***Pollution Research***, **15**: 191-193.
29. S. Suthar, J. Sharma, M. Chabukdhara, A.K. Nema, (2009) Water quality assessment of river Hindon at Ghaziabad, India: Impact of industrial and urban wastewater, ***Environmental Monitoring and Assessment***, **165**: 103-112.
30. B. D. Tripathi, M. Sikandar, S. C. Shukla, (1991) Physico-chemical characterization of city sewage discharged into river Ganga at Varanasi, India. ***Environment International***, **17**: 469-478.
31. D. Chapman, (1992) ***Water Quality Assessment; a Guide to the Use of Biota Sediments and Water in Environmental Monitoring***. Cambridge: Cambridge University Press.
32. E. Capkin, I. Altinok, S. Karahan, (2006) Water quality and fish size affect toxicity of endosulfan, an organochlorine pesticide, to rainbow trout. ***Chemosphere***, **64**: 1793-1800.
33. BIS, (1993) ***Indian Standard Specification for Drinking Water***, No. ISI 10500, New Delhi.
34. Neeravari Nigam Limited, (2015) ***Modernization of Vijayanagara Channels in Tungabhadra Project***, Karnataka: Karnataka Neeravari Nigam Limited.
35. G. Karaloc, F. U. Erkoc, H. Katrcoglu, (2003) Water quality and impacts of pollution sources for Eymir and Mogan Lakes (Turkey). ***Environment International***, **29**: 21.
36. APHA, (1985) ***Standard Methods for the Examination of Water and Waste Water***. 18th ed. Washington DC: American Public Health Association.

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