Studies on Environmental Status of Some Selected Surface Water Tanks in and Around Hospet City, Karnataka (India) Using Phytoplankton

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Abstract- *This study focuses on assessment of phytoplankton present and the water quality of selected water tanks in and around the Hospet city, Karnataka state. Surface water samples were collected in the identified three location of the selected water tanks and assessed for its water quality status based on its physico-chemical parameters (temperature, pH, total dissolved solids, and dissolved oxygen), Shannon-Wiener diversity index, and Palmer's pollution index. A total of 50 species belonging to four groups of phytoplankton were identified from the selected water tanks in the present study. The physico-chemical parameters in all the study locations showed significant differences ($p < 0.05$) but were within the permissible limits for freshwaters. The Shannon-Wiener diversity index was highest in the Daroji water tank to the lowest at Kampli tank water then Somalapura water tank. All the selected water tanks in and around the Hospet city indicate that the water is exposed to organic pollution. Continuous monitoring of the water tanks is necessary.*

Keywords- Surface water, phytoplankton, water tanks Shannaon-wiener diversity and domestic activity.

I. INTRODUCTION

Water is one of the abundantly available substance in nature. It is an essential constituent of all the animals and vegetable matter and forms about 75% of the matter of earth's crust. Water is the mother liquid of all forms of life. It is the vital essence, miracle of nature and the great sustainer of life. The essentiality of water for living systems is quite evident as without water, there is no life (Omar WMW, 2010).

Water pollution due to organic materials is one of the most significant issues in present days. Most of the freshwater bodies are under remarkable pressure from human communities and developmental actions in an around the water tanks. Increasing in the addition of nutrient into the water tanks from the surrounding has been deteriorating water quality of surface water ecosystems (Nativadad et al., 2014).

Physico-chemical constraints of any surface water tanks though, provide a good indication about the chemistry and quality of water. These parameters will not give the clear picture of the ecological condition of the surface water body due to lack of proper assimilation with ecological factors (Karr *et al.,* 2000).

Phytoplankton are free moving, unicellular, microscopic and colonial autotrophic organisms that grow in aquatic environments whose movement is more or less dependent upon water movements (Cecilia Medupin, 2011 and Suresh, 2015). Phytoplankton are also called as biotic communities, microscopic organism and minute species since these are living inside the water. The biotic community is the outcome of the integration and interaction of different physical, chemical and geo-morphological characteristics of any water body, biological assessment is a useful alternative in assessing those systems (Stevenson and Pan, 1999). Phytoplankton are considered as important component of aquatic flora, play a key role in maintaining equilibrium between abiotic and biotic components of aquatic ecosystem (Arfi, et al., 2003).

The surface water bodies are most important for all livening organism including other human activities like drinking and agricultural practices. Research studies on the phytoplankton counting aspects are of great significance in developing resources of a water tanks including all types of water body. A number of researchers have studied the phytoplankton diversity of lentic and lotic water bodies (Pawar et al., 2006; Tapashi and Mithra, 2011; Sayeswara et al., 2011; Vasantha et al., 2012, Suresh, 2015).

In India 80 % of the surface water is vulnerable to pollution as more than 95 % of the sewage in the country is not treated. Lotic water bodies like rivers and streams play a very important role in maintaining the biodiversity and over all ecological balance in nature. However, the water quality of fluvial systems is deteriorating due increase in the amount of raw sewage entering the rivers. The increase of pollution is caused by population growth and increasing urbanization. Related to this is the industrialization that also causing huge environmental problems (Zargar and Ghosh, 2006).

Karnataka state is endowed with 6.31 lakhs hectare of freshwater resources consisting of 4.15 lakhs hectare which includes ponds and tanks and 2.16 lakh hectare reservoirs. In addition, the state has 6000 kms of river stretch and 3000 kms length of canal. Water pollution is the introduction into fresh/ground/ocean waters of chemical, physical or biological material that degrades the quality of the water and affects the organisms living in it (Chandaluri, *et al.*, 2010).

The main objectives of the study are: collection of water samples using phytoplankton net at three different water tank in the Hospet city of Karnataka state. Since, no work have so far neither been done in enumerating phytoplankton nor in analysing water quality in the selected water tanks in and around the Hospet city. The present attempt made an endeavor to appraise the water quality parameters and to assess pollution status of the selected water tanks using Palmer's scale.

II. MATERIALS AND METHODS

a. Topography of the study area

Hospet is a town head quarter situated 66 Kms away from Ballary district in the Central part of Karnataka state, India. Hospet-Shimoga Highway (SH-25) passes through the study area. Almost all the villages of the area are connected by unmetalled and metalled roads and regular bus facility exits from Hospet to different villages. The study area falls in the survey of India topo map numbers 57 B/6 on 1:50000 scale. The area is bounded by 14.74° to 14.88° N latitude and 75.88° to 76° E longitude. The location map of the study area is represented in Fig. 1. Topography of the study area is generally undulating to rolling topography with frequent mound like structures. Soils of the area are affected by erosion. Isolated hills and hill ranges are also seen. The geology (rock) of the study area consists of metamorphic rocks like gray wacke, argillite and granodiorite and tonalitic gneisss. The study area received a maximum rainfall of 742 mm in the year 2005 and a minimum of 361.9 mm in the year 2003. The normal rainfall of the study area is 656.70 mm.

Kampli tank: It is a natural, perennial fresh water tank situated in the Hospet city and located 35 km away from Hospet. The water tank lies at $15^0.30^1$ N latitude and $76^0.6^1$ E longitude. The area of the tank is 20 acres and depth is about 8 feet. The colour of the tank is pale greenish. The tank is rectangular in shape. The Kampli tank received water from rainfall, city sewage and agricultural run-off. The water is used to grow the crops like paddy, sugarcane, banana and some vegetable crops. Besides this, water is also used for washing of vehicles, cattle washing and other domestic activities.

Daroji tank: It is artificial perennial tank. This tank lies at $15^0.24^1$ N latitude and $76^0.7^1$E longitude. The area of the tank is 92 acres and depth is about 18 feet. Daroji tank is situated 20 kms away from Hospet town to northern region. The tank is rectangular in shape and it receives water from rainfall. The water is used for irrigation and pisci culture purposes. The colour of the tank is pale reddish. Anthropogenic activities are practiced in the vicinity of the tank. The water is used to grow paddy, sugarcane jutes and vegetables. The catchment area received an average rainfall of 656.70 mm (Irrigation Department, 2004-05).

Somalapura tank: It is a natural perennial tank situated 18 Kms away from Hospet to western side. This tank is located at $15^0.31'$ N latitude and $76^0.8^|$E longitude. The area of the tank is 12 acres and depth is 6 feet. The colour of the water is pale greenish. The shape of the tank is circular. Main source of water to this tank is rainfall and seepage from hilly region. Water is used for drinking and irrigation. Paddy, sugarcane, cotton and vegetables are grown on the adjacent side of this tank. The average rainfall of this region is 656.70 mm (Irrigation Department, 2004-05).

Methods

The water samples for physico- chemical as well as phytoplankton analysis were collected at monthly interval for a year from January 2015 to February 2016 from three collection points taking randomly at the water tanks. The data thus generated were summed up as average data on the basis of seasons viz. summer (April to July), monsoon (August to October) and winter (November to March).

Grab surface water samples were collected in all the selected water tanks and were analyzed for the physico-chemical parameters (temperature, pH, total dissolved solids (TDS), and dissolved oxygen (DO)) in situ using and pH meter and conductivity meter. DO was estimated as per the standard method means Wrinkles methods (APHA 2012). The phytoplankton sampling was carried out by filtering 50 L of water through a planktonic net and was placed in 20 ml plastic vials to which 4% formalin was added for preservation. The preserved phytoplankton samples were scanned under compound microscope in the laboratory at magnifications of 75x to 300x and were further identified using the taxonomic keys Tenenbaum, *et al.* (2004). Shannon–Wiener diversity index (Shannon CE, Wiener, 1963), where it is calculated using the formula: H = -Sp diversity measure, whereas pii ln/pi, Lacdan, et al., 2014). H represents the proportion of total species belonging to the *ith* species. The Kruskal-Wallis test was performed to determine whether significant differences exist on the diversity index across the study sites. Values at $p < 0.05$ were significant.

III. RESULT AND DISCUSSION

Water quality data of the selected Kampli, Daroji and Somalapura water tanks were showed in the Table 1. The surface water temperatures recorded during the study period was between the range from 25.20(± 1.21)^{0}C at Somalapura tank during Winter Season to 28.90 (±1.38)^{0}C during monsoon at Daroji Tank. The maximum temperature was observed during monsoon the study period while the minimum was found during winter season. Yadav *et al.* (2013), Niroula *et al*. (2010) observations at urban ponds are agreement with the current results. The pH value of the selected water tank in and around the Hospet city during the study period was in between 7.24 (± 0.29) at Somalapura water tank during the summer season to 8.02 (± 0.52) during monsoon at Daroji water tank. In the present study Daroji water tank showing the maximum value of pH and were slightly higher towards alkaline range, it is extremely acidic during monsoon season.

In this present investigation dissolved oxygen concentration of the selected water tanks in and around the Hospet city was varied from 8.60 (± 2.89) mg/l during winter at Somalapura water tank to 6.10 (± 1.68) mg/l during monsoon at Kampli water tank. From the present study the results area revealed that and was noticed that the monsoon rain play key role in seasonal dynamics of studied physicochemical properties of the water samples. The runoff water during the rainy season carried large amount of organic matter in the form of community and home waste to the selected water tanks in and around the Hospet city. As the runoff water were rich in clay, silt and colloidal organic matter which also attributed for excessive plankton growth and thus increase turbidity during monsoon season (Radhika et al. 2004, Pathak and Limaye, 2012 and Dhanalakshmi et al. 2013). Total dissolved solids (TDS) was varied 198.6 (± 3.84) at Kampli water tank during monsoon season to 139.2 (± 2.36) mg/l during summer season at Somalapura water tank. The highest value was recorded during monsoon and the lowest was observed during summer season period. Raised ionic concentration due to nutrient deposition and organic pollution attributed highest electrical conductivity (Fokmare and Musaddique, 2001). In the present study TDS was higher during High during monsoon since TDS and EC are most correlated. Water temperature could raise the rate of microbial decomposition of the rain water carried organic load resulting reduction of dissolved oxygen content in water sample (Hulyal and Kaliwal, 2011; Ramulu and Benarjee, 2013) and on the other hand. (Dhanalakshmi et al., 2013) particularly during monsoon.

a. Statistical Analysis:

The statistical analysis of Pearson's correlation coefficient is presented in the Table 2. The surface water temperature was significantly positively correlated with total dissolved solids and temperature. On the other hand, surface water temperature showed strict negative relation pH in water tanks in all the selected water tanks also. The pH showed significant negative correlation with temperature and dissolved oxygen during the entire study period and all the selected water tanks in and around the Hospet city. Dissolved oxygen has positive correlation with temperature and showed negative correlation with pH. Due to the accelerated microbial decomposing activity the requirement of oxygen was increased (Anitha *et al.*, 2005) resulting lower value of DO during monsoon season. Runoff from the surrounding human settlement consisting domestic sewage rich in organic matters was the main cause of nutrient enrichment of the selected water tanks in and around the Hospet city (Verma *et al.*, 2012).

b. Phytoplankton Study:

A total of 50 phytoplankton individuals were collected in the present study. Of these, the most abundant taxon was Bacillariophyceae (24 or 48.0%), which was distantly followed by Chlorophyceae (12 or 24.0%), Cyanophyceae (8 or 16.0 %) and finally Euglenophyceae (5 or 10.0%). The relative abundance of the major taxa of phytoplankton are presented in Table 4 alongside that of species (Table 3).

In Kampli Tank, 50 species of phytoplankton have been identified and tank wise distribution has been given in Table 4. Based on the percentage composition, the algae belonging to Bacillariophyceae (29.2%) were dominant followed by Chlorophyceae (29.0%), Cyanophyceae (25.0%) and Euglenophyceae (20.0%) at Kampli water tank. Daroji water tank showed a maximum species compared to other two water tank in Hospet city. At Daroji water tank and Somalapura water tank also the Bacillariophyceae (37.5% and 33.3%) were dominant followed by Chlorophyceae (41.6% and 33.3%), Cyanophyceae (50.0% and 25.0%) and Euglenophyceae (60.0% and 10.0%).

In the current study, at Kampli and Somalapura water tank, the occurrence of Oscillatoria was indicating pollutants of organic and biological origin. The current study agreed with the observation of Gadag et al. (2005). The pollution level was observed to increase in the Kampli and Somalapura water tank in Hospet city onwards as it was confirmed by using Shannon-Weaver index (Table 3). The abundance of Navicula, Oscillatoria and Euglena were maximum at Kampli and Somalapura water tank these two tanks were indicating the highest degree of organic pollution. Unpolluted Daroji tank is characterized by abundance of green algal flora followed by Cyanophyceae and flagellates, as it was supported by earlier workers (More and Nandan, 2000; Nandan and Aher, 2005; Tas and Gonulal, 2007).

Distribution of phytoplankton depends partly upon the aquatic environment, their requirements and their range of tolerance. The organisms with many requirements and a limited range of tolerance are very narrowly distributed and usually rare (Amphorn Sakset and Wanninee Chankaew, 2013). The distribution of phytoplankton may explain disparities in Frequency in the present study. Among the phytoplanktons, 13 species (26.0%) occurred in Kampli tank, 22 species (44.0%) occurred in Daroji tank and 15 species (30.0%) in Somalapura water tank (See Table 4). The various phytoplankton taxa presented different presence performances: most species in the Bacillariophyceae class showed presence in all the selected water tanks (48.0%), the trends with the Chlorophyceae (24.0%), Cynaophyceae (16.0%) and Dinophyceae showed only 10.0%.

A study of dominance among the phytoplankton taxa shows that the Bacillariophyceae, followed by the Chlorophyceae, Cyanophyceae and Euglenophyceae were dominant in the selected water tanks in and around the Hospet city. However we believe that the habitat suffers frequent variability, and according to Tiwari et al., (2006), conditions are not ideal for any one competing species and the competitive advantage swings from one species to another before the latter has had the opportunity to replace the former.
The seasonal variation of species diversity index in 4 studied sectors is given in Table 3. The index is based on the principle that in clean water, the species diversity is high while, in polluted water the diversity becomes low. The Shannon-Weaver diversity index proposed as diversity index greater than (>4) is clean water; between3-4 is mildly polluted water; between2-3 is moderately polluted water and less than 2(<2) is heavily polluted water. The index computed in the present analysis showed that phytoplankton species diversity ranged from 2.188 in Kampli tank water representing moderately polluted water (medium the Shannon- Weaver index medium level of pollution), 2.924 in Somalapura tank water indicating mildly polluted water and 4.285 in Daroji tank water indication clean water in the Hospet city.

IV. CONCLUSION

In the present investigation, based on physico-chemical parameters and phytoplankton load was higher at Kampli and Somalapura tank water. Hence, Shannon-Weaver index values observed to be lower (Table 3) in Kampli and Somalapura water tank. The index was maximum at Daroji tank water, since the water is unpolluted due to absence of human anthropogenic activities in and around the tanks water. Comparatively, Somalapura tank water is mildly polluted when compared to Kampli and Daroji tank water because of there is no human activity in and around these tank water.

It is summarized from the results that selected water tank in and around the Hospet city, which are the most productive water tanks of Hospet city. Out of that Kampli and Somalapura are mildly polluted compared to Daroji water tank. The results show that the improvement of diversity index from Kampli water, Somalapura water tank to Daroji water tank, was due to the decline in pollution level. The findings of this investigation clearly revealed that in respect to domestic waste and human activity the pollution, phytoplankton perhaps were more tolerant to pollution. The study emphasizes the necessity of using phytoplankton as effective and appropriate method of biomonitoring for evaluation of river water quality.

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Table 1. Mean Value of seasonal variation in Physico-chemical Parameters of three water tanks in and around the Hospet city

Parameters	DENR EMB* (DAO 34)	**Location in and around the Hospet City Summer Season**		
		Kampali Tank	Daroji Tank	Somalapura Tank
Temperature (^{0}C)		26.81 ± 0.05	26.90 ± 0.05	26.20 ± 0.11
pH	6.5 – 8.5	7.89 ± 0.02	7.92 ± 0.02	7.24 ± 0.03
TDS (ppm)	1000	145.6 ±5.84	148.5±0.69	139.2±1.36
DO (ppm) minimum	5.0	7.1±0.09	7.3±0.02	7.8±0.03
Parameters	DENR EMB* (DAO 34)	**Location in and around the Hospet City Winter Season**		
		Kampali Tank	Daroji Tank	Somalapura Tank
Temperature (^{0}C)		25.01 ± 0.05	26.90 ± 0.05	25.20 ± 0.11
pH	6.5 – 8.5	7.56 ± 0.02	7.32 ± 0.02	7.96 ± 0.03
TDS (ppm)	1000	165.6 ±5.84	171.5±0.69	151.2±1.36
DO (ppm) minimum	5.0	8.1±0.09	8.3±0.02	8.6±0.03
Parameters	DENR EMB* (DAO 34)	**Location in and around the Hospet City Monsoon Season**		
		Kampali Tank	Daroji Tank	Somalapura Tank
Temperature (^{0}C)		27.08 ± 0.05	28.90 ± 0.05	27.20 ± 0.11
pH	6.5 – 8.5	8.01 ± 0.02	8.02 ± 0.02	7.96 ± 0.03
TDS (ppm)	1000	198.6 ±5.84	156.5±0.69	161.2±1.36
DO (ppm) minimum	5.0	6.1±0.09	6.3±0.02	6.8±0.03

Table 2 Correlation significance between selectd physico-chemical paremetrs

Kampli water Tank				
	pH	**DO**	**Temp.,**	**TDS**
pH	1.00			
DO	-0.08	1.00		
Temp.,	-0.48	0.69	1.00	
TDS	0.86	-0.72	0.61	1.00
Daroji water Tank				
	pH	**DO**	**Temp.,**	**TDS**
pH	1.00			
DO	-0.09	1.00		
Temp.,	-0.56	0.70	1.00	
TDS	0.79	-0.68	0.70	1.00
Somalapura water Tank				
	pH	**DO**	**Temp.,**	**TDS**
pH	1.00			
DO	-0.06	1.00		
Temp.,	-0.51	0.71	1.00	
TDS	0.82	-0.58	0.59	1.00

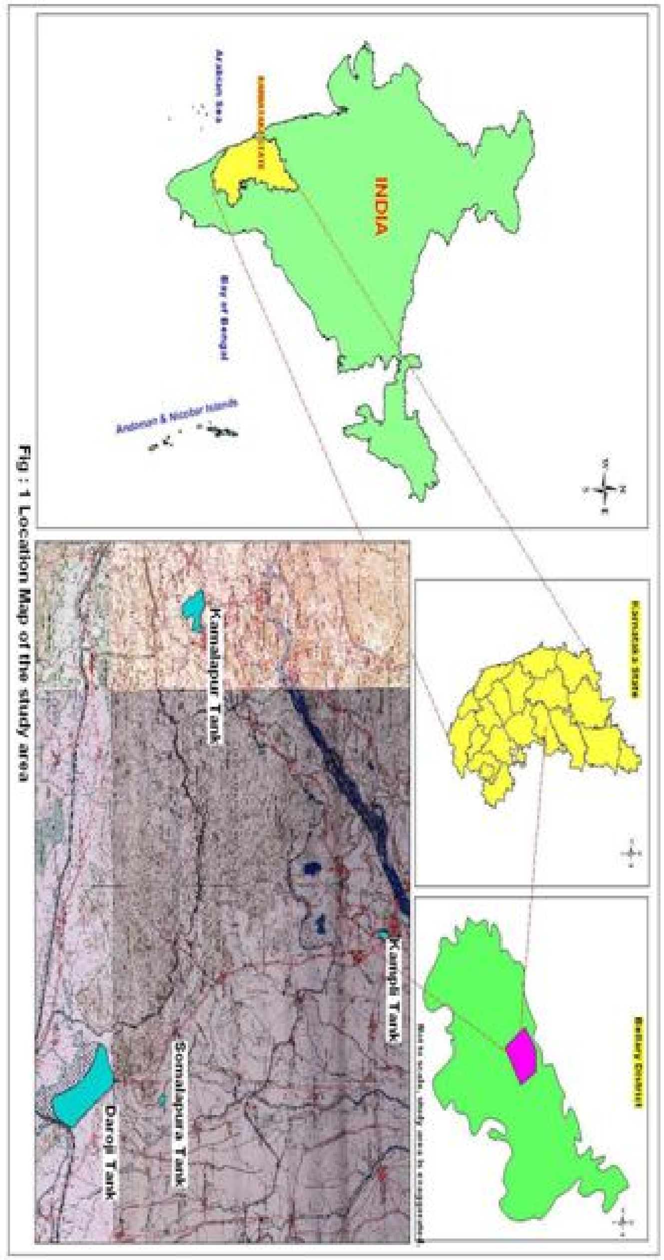

Figure.1 Location map of the study area.

Table 3 Phytoplankton Diversity of selected water tanks in and around the Hospet city

Locations in and around the Hospet City			
	Kampali Tank	**Daroji Tank**	**Somalapura Tank**
Phytoplankton diversity	*Ankistrodesmus* sp. *Scenedesmus* sp. *Spirogyra* sp. *Amphora* sp. *Cymbella* sp. *Cocconeis* sp. *Navicula* sp. *Nitzschia* sp. *Ociletoria sp.*	*Ankistrodesmus* sp. *Scenedesmus* sp. *Spirogyra* sp. *Amphora* sp. *Cymbella* sp. *Cocconeis* sp. *Nitzschia* sp.	*Ankistrodesmus* sp. *Scenedesmus* sp. *Spirogyra* sp. *Amphora* sp. *Cymbella* sp. *Cocconeis* sp. *Navicula* sp. *Nitzschia* sp. *Ociletoria sp.*
Shannon–Wiener diversity index (*H*)	2.188	4.285	2.924

Table 4 percentage presence of Phytoplankton Diversity in and around the Hospet city

Frequency %	Total count	Bacillariophyceae	Chlorophyceae	Cyanophyceae	Euglenophyceae
Kampli Tank	13 (26.0%)	7 (29.2%)	3(25.07 %)	2 (25.0 %)	1 (20.0 %)
Daroji Tank	22 (44.0%)	9 (37.5 %)	5 (41.6%)	4 (50.0 %)	3 (60.0 %)
Somalapura Tank	15 (30.0%)	8 (33.3%)	4 (33.33 %)	2 (25.0 %)	1 (20.0 %)
	50	24 (48.0 %)	12 (24.0 %)	8 (16.0%)	5 (10.0 %)

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