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Investigation of Lake Water Quality of Kolar Taluk, Karnataka

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A B S T R A C T

This study was conducted to investigate the current status of surface water quality in the areas viz., Lakshmisagara, Narsapura, Doddavallabhi, and Singehalli in Kolar taluk which are filled by treated waste water from KC valley project. The surface water quality has been assessed by collecting 26 surface water samples during March 2019, followed by analysis of physico-chemical parameters viz., pH, EC, TDS, TA, TH, major cations and anions like Ca, Mg, Na, K, Cl, F, SO_4^-, PO_4^-, NO_3^- as per Standard Methods and, irrigational water quality parameters of SAR, and %Na and Water quality index (WQI). Based on the results, conclusion was drawn on suitability of surface water for domestic and irrigation purpose. On the whole, WQI values revealed that 100% of the samples were categorized as good water, the surface water fall under good water is fit for irrigation purpose. Results of hardness, total alkalinity, TDS and nitrates exceeded the BIS desirable standard limits, may be due to the leaching of calcium, magnesium salts. Though all the samples were within desirable standard limit recommended for irrigation, lakes of these water bodies are to be monitored on regular basis to check the spatial and temporal impact on aquatic biodiversity as well on human health.

***Key words*:** Surface water, Treated waste water, Sodium absorption ratio, Soluble percent sodium, Water quality index, Kolar taluk

Water quality is one of the most important worldwide environmental concerns, Water pollution occurs due to industrial and agricultural activities, human-induced activities, and erosion. Discharge of untreated domestic and industrial wastewater is a major source of pollution which changes the hydro chemistry of water. In addition, the seasonal changes and non-point pollution sources caused by surface runoffs and ground water in urban areas impair the water quality. High amounts of nutrients and chemical concentrations cause various problems such as decreases in oxygen level, increases in algal blooms, and fish deaths and loss of biodiversity [1].

The evaluation of water quality is very important for public health and safety. All life and peripheral activities are ceased without water. In addition to drinking and personal hygiene, water is essential for agricultural production, industrial and manufacturing process, hydroelectric power generation, waste assimilation, recreation and wildlife etc. [2]. Water is absolutely fundamental to life. It is difficult to imagine a form of life that can exist without water on the surface of the earth, water in the form of oceans, glaciers, fresh water bodies, rivers, wells, lakes etc. When we look upon the utilization of fresh water, it is about 79 per cent of the water is used for irrigation purposes, 13 per cent water for industries and about 8 per cent only is used for domestic purposes [3]. Rain water is the nearest approach to chemically pure water, but it contains small amount of organic matter and dissolved gases, principally O_2 and CO_2 taken from the air [4].

Surface water typically transports three types of sediment namely: Dissolved load, suspended load and bed load. Chemical weathering in rocks produces ions in solution (e.g., Ca^{2+}, Mg^{2+} and HCO^{3-}), hence a dissolved load and suspended sediments make surface water look cloudy or opaque; the greater the suspended load, the muddier the water. Bed load (silt, sand and gravel) settle on the bottom of the channel. The Surface water quality (SWQ) assessment/measurement falls into the following two categories: Physical characteristic covers consists mainly temperature, colour, suspended solids and turbidity. Chemical characteristics include nutrients, minerals, metals, total solids, pH, Electrical conductivity, organic compounds, etc. [5-6]. Pollution of a river first affects its chemical quality as well destroys the community disrupting the delicate food web [7-8]. Diverse uses of the rivers are being seriously impaired due to pollution and even the polluters like industry suffer due to increased pollution of the rivers. River pollution has several dimensions and effective monitoring and control of river pollution requires the expertise from various disciplines. In India it is reported that about 70% of the available water is polluted while sewage constituting 84 to 92 percent of the waste water. Industrial waste water comprised 8 to 16 percent. Water is a need and a precious national asset, which require at most caring and management due to the fact that quantity of potable water is a scarce resource [9]. India too, there is an urgent need for appropriate planning, development and management of this natural resources otherwise lead to

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eutrophication, making the water unfit for consumption. Excessive macrophytic vegetation is an indicative of eutrophication of the surface water bodies [10-13]. Hence, monitoring is the foremost step, besides conservation of aquatic habitat [14]. An attempt was made to assess the quality of four lakes of Kolar district (viz., Lakshmisagara lake, Narasapura lake, Vallabbi lake and Singehalli lakes) and their suitability for irrigation.

MATERIALS AND METHODS

Kolar taluk is fall under Eastern dry agro-climatic Zone of Karnataka State, has semi-arid to arid climate and is categorized as drought prone and dryness and hot weather prevails in major part of the year. The climate of study area is quite agreeable and free from extremes. Kolar district is lies geographically between 12°45′ 54″to 13°35′45″ N latitude and 77°50′29″ to 78°3′18″E longitude. It is bounded by Bangalore and Tumkur districts on the west, Chikkaballapur district on North-west and a four seasons: summer from March to May; rainy season (or) south-west monsoon season from June to September; post-monsoon season covering the months of October and November and dry (or) winter season from December to February. Normal annual rainfall in Kolar taluk for the period 1981 to 2010 is 804 mm [15].

The samples were collected in pre-washed with distilled water and clean polythene bottles of 1L capacity. All the water samples were stored at 4°C in an insulated box containing ice packs and shifted to laboratory until processing and analysis. A total of 26 surface water samples were collected from 4 lakes, Lakshmisagara lake (5 samples), Narasapura lake (11 samples), Vallabbi lake (5 samples) and Singehalli lake (5 samples) during the month of March, 2019 (Fig 1) and analysed for physico-chemical parameters. To prevent changes in chemical equilibrium and adsorption on the inner surface of the water bottles, the samples were acidified with 1:1 HNO_3 without disturbing the sample volume. The sample bottles were sealed, labelled and transported to the laboratory under standard preservation methods as per standard methods [16]. During sample collection longitude, latitude values were recorded using a GPS system.

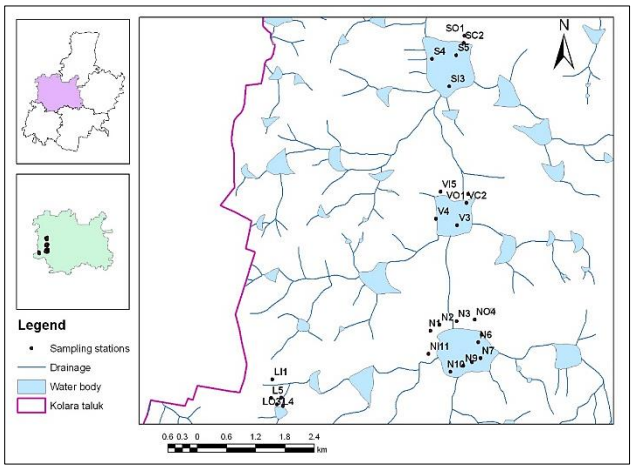

Fig 1 Geographical locations of lakes and sampling stations in the study area

Prior to sample collection, the required solutions and solvents have prepared by using the high purity chemicals and double distilled water and kept ready for processing the collected water samples for analysis. Physico-chemical characteristics of the surface water samples were determined using American Public Health Association, Standard Methods [16]. Electrical conductivity, pH and total dissolved solids for the collected samples were measured in the field immediately after sampling by using portable meters. Total hardness, total alkalinity, major cations (Ca, Na, Mg and K) and anions (HCO_3^-, Cl^-, PO_4^-, SO_4^-, F^- and NO_3^-) were measured in the laboratory using standard analytical procedure recommended by APHA.

RESULTS AND DISCUSSION

The surface water quality data of pH, EC, TDS, TA, TH, major cations and anions like Ca, Mg, Na, K, Cl, F, SO_4^-, PO_4^-, NO_3^- for 26 surface water samples of Kolar taluk was used to estimate irrigation water quality parameters (SAR, %Na and PI) and water quality index (WQI).

Sodium absorption ratio

Sodium adsorption ratio (or) sodicity is the measure of relative concentration of sodium with respect to calcium and magnesium in surface water. Based on SAR values, it can be classified as excellent (0-10), good (10-18), permissible (18-26) and unsuitable (>26) for agricultural purposes. The analytical results showed that all the samples were ranges between 2.95 to 4.21. and all the samples can be used for agricultural purposes as SAR value of all samples were under excellent category.

Table 1 Range and classification of SAR for irrigation purposes

SAR value	Suitability for irrigation	Number of samples	Percent of samples
0-10	Excellent	26	100
10-18	Good	0	0
18-26	Permissible	0	0
>26	Unsuitable	0	0

Source: [17-18]

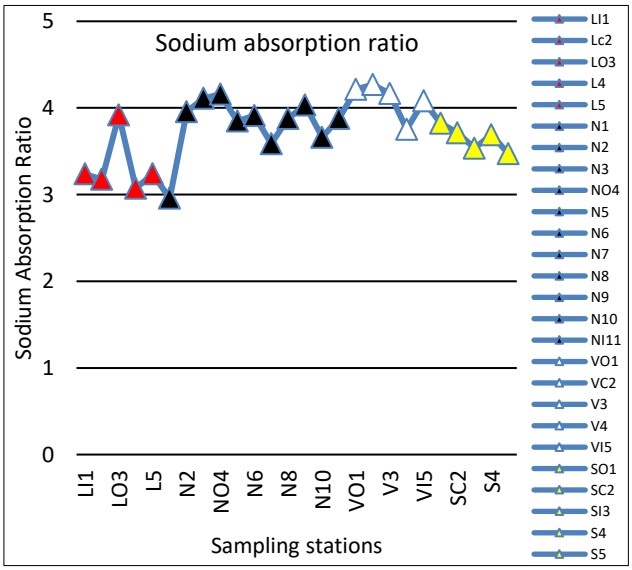

Fig 2 Distribution of SAR value in lake water samples

Soluble percent sodium (% Na)

Sodium concentration in excess reduces the permeability of soil, destroys the soil structure and affects the drainage of the area which eventually leads to reduction of crop production and plant growth [19]. Based on the %Na surface water can be grouped as excellent (<20), good (20-40), permissible (40-60), doubtful (60-80) and unsuitable (>80) for irrigation purposes. The study showed that, out of 26 samples, 6 samples are fall under the classification of permissible (20-40) and 20 samples

are under doubtful group. Hence, the surface water can be used for irrigation purposes.

Table 2 Range and classification of percent sodium for irrigation purposes

Percent sodium value	Suitability for irrigation	Number of samples	Percent of samples
<20	Excellent	0	0
20-40	Good	0	0
40-60	Permissible	6	15.43
60-80	Doubtful	20	84.57
>80	Unsuitable	0	0

Source: [20]

Water quality index (WQI)

Water quality index is an important tool which is used to assess the quality and suitability of water for drinking purposes in the urban, rural and industrial areas [21-22]. WQI is consists of obtaining one value that explains the overall effects of chemical compound effect of individual water quality characteristics for human consumption [23-24]. Water quality index is a very essential tool to determine the quality of water for human consumption. It represents the composite influence of different water quality parameters and it provides water quality information to policy makers [22]. For this study to calculate WQI, A total of 14 parameters were considered viz., pH, EC, TDS, alkalinity, calcium, magnesium, total hardness, chlorides, nitrates, phosphates, sulphates, fluorides, sodium, and potassium for 39 samples. The classification of water for drinking purposes can be classified as excellent (<50), good water (50-100), poor (100-200), very poor (200-300), and unsuitable for drinking (>300).

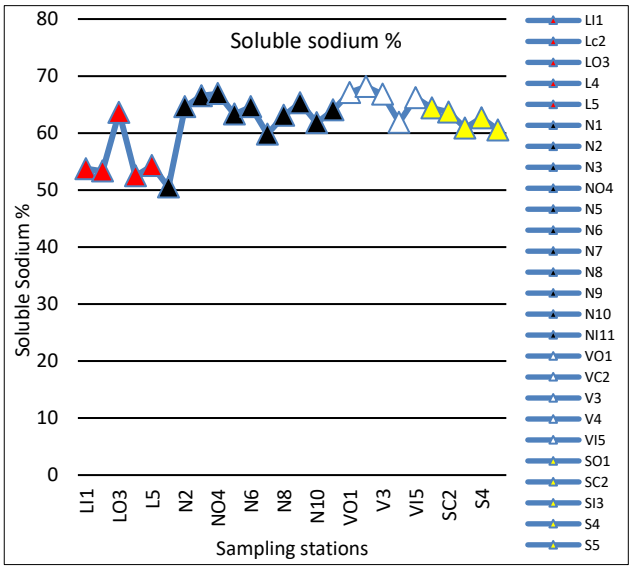

Fig 3 Distribution of percent soluble sodium value in lake water samples

Table 3 Assigned and Relative Weight for WQI Computation with BIS standards

Parameter	Sn	Ideal value (Vid)	Weight (Wi)	Relative Weight (Wi)
pH	8.5	7	4	0.091
EC	2000	0	3	0.068
TDS	500	0	4	0.091
TA	200	0	2	0.045
TH	300	0	3	0.068
NO_3	45	0	5	0.114
SO_4	200	0	2	0.045
PO_4	0.3	0	2	0.045
K	10	0	3	0.068
Na	200	0	3	0.068
F	1	0	5	0.114
Ca	75	0	3	0.068
Mg	30	0	3	0.068
Cl	250	0	2	0.045
			44	1.000

Source: [25]

Based on the above table WQI can be calculated for 26 samples based on 14 parameters. As per this classification all the 26 samples were falls under the suitability for irrigation and tabulated below:

Table 4 Range and classification based on WQI

WQI value	Suitability for irrigation	Number of samples	Percent of samples
<50	Excellent	26	100
50-1000	Good water	0	0
100-200	Poor water	0	0
200-300	Very poor	0	0
>300	Unsuitable for drinking	0	0

Source: [26]

CONCLUSION

This study was aimed to assess current status of physico-chemical characteristics of Lakshmisagara, Narasapura, Vallabbi and Singehalli tanks, which have received treated wastewater at Kolar taluk of Kolar District. A total of 26 surface water samples from different locations of the above tanks were collected and analyzed during March, 2019. The results indicated that majority of the physico-chemical properties like pH, EC, TDS, TA, TH, major cations and anions like Ca, Mg, Na, K, Cl, F, SO_4^-, PO_4^-, NO_3^- and as well as irrigation water quality parameters of SAR, RSC, %Na and PI and WQI, On the other hand, samples were considered suitable for irrigation purpose. The soluble percent sodium reveals that, out of 26 samples, 6 samples are fall under the classification of permissible (20-40) and 20 samples are under doubtful group.

Hence, the surface water can be used for irrigation purposes. And also, sodium absorption ratio reveals that all the samples were ranges between 2.95 to 4.21. Based on the classification, samples were under excellent group, so that water can use for agricultural purposes. The slightly higher level of residual sodium carbonate results may be due to the high concentration of carbonates and bicarbonates in water samples. WQI values reveals that 100% of the samples were categorized as excellent and are suitable for irrigation, whereas the physico-chemical like hardness, total alkalinity, TDS and nitrates exceeded the BIS desirable standard limits recommended for drinking water quality. Although, the quality of these selected lakes is good for irrigation, it is essential to maintain desired level of dissolved oxygen in order to ensure that there will be enough aquatic biodiversity as well as primary productivity. Further, it is suggested to monitor the water quality of these lakes season-wise and regular basis to ensure the impact on aquatic biodiversity as well on human health.

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