Experimental Investigation on Heavy Metal Contamination in Lake Water Sources of Musi Basin

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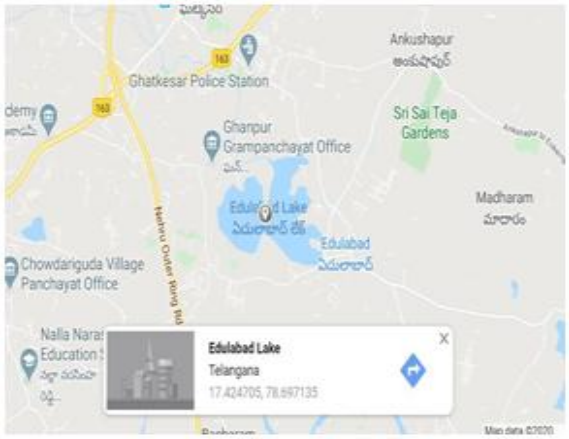
***Abstract*— Now days, the quality of surface waters is a very sensitive issue. Due to urbanization and industrial bloom, India is facing the threat to water quality. Thus, there is a steep increase in generation of waste. This waste is not properly collected, treated, disposed; leading to water contamination. To assess water quality specifically heavy metals and its suitability of musi lake water sources for irrigation purpose. The samples were collected from the musi basin lake water sources and analyzed for various physico-chemical parameters like pH, Turbidity, Electrical Conductivity(EC), Total Dissolved Solids (TDS), Total Hardness (TH), Total Alkalinity (TA), Sodium (Na+), Calcium (Ca2+) and Magnesium (Mg2+), Boron. To assess the suitability of lake water sources for irrigation, various indices like Sodium Adsorption Ratio (SAR), Residual Sodium Carbonate (RSC) were calculated and the quality of the lake water sources were found with reference to BIS (IS11624-1986).**

***Index Terms:* SAR, RSC, Water quality, Irrigation purpose, Physico chemical parameters.**

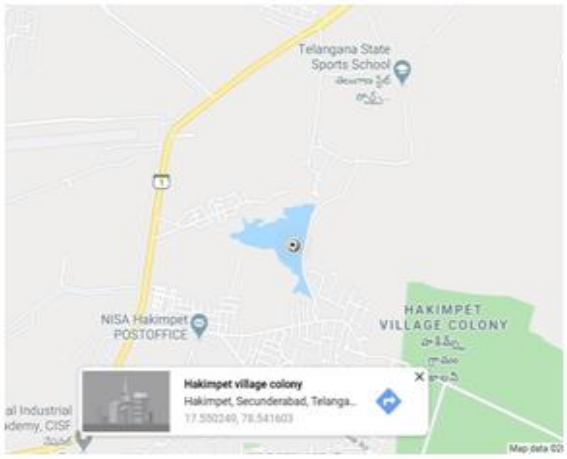
INTRODUCTION

Evaluation of surface water is important to assess its suitability for irrigation. Consumption of surface water for irrigation purposes depend on type and quantity of dissolved salts. Irrigation water quality and quantity have direct and indirect impact on soil characteristics especially in arid and semiarid regions that unfortunately depend on irrigation. Therefore, the irrigation water quality should be considered as an important too in the sustainable management of the soil resources and the agricultural production. Therefore, the control of quality of water is a necessity. Numerous water quality guidelines have been developed by many researchers for using water in irrigation under different condition.

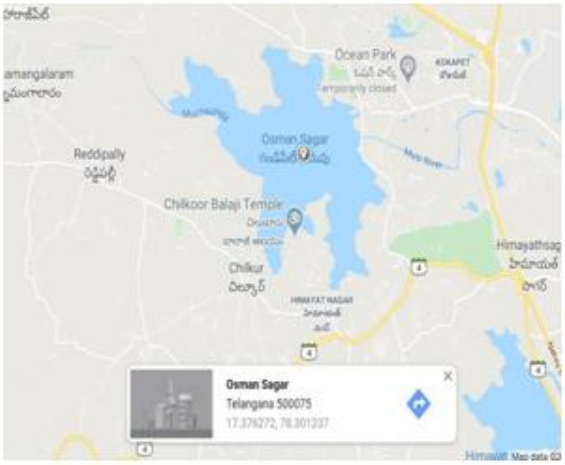
Edulabad Lake is located near Ghatkesar, Hyderabad. It is also known as Edulabad water reservoir.
Location Ghatkesar, Telangana, India
Coordinates 17.424705°N78.697135°E
Surface area 5km2



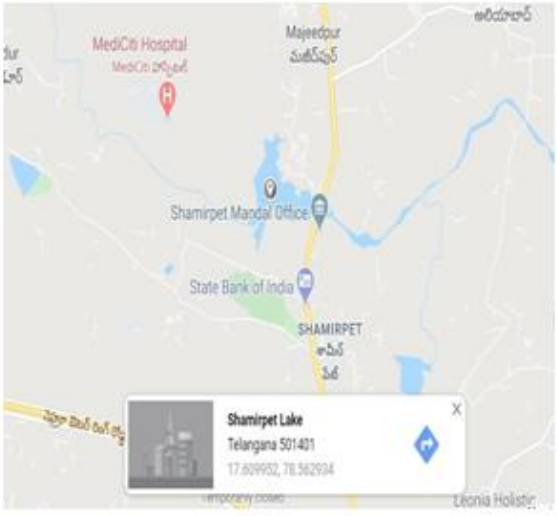
Hakimpet lake, located in hakimpet is surrounded by Medchal Mandal. The total area of Hakimpet lake is 1883 hectares.
Location Medchal, Telangana, India
Coordinates 17.550249°N 78.541603°E



Osman Sagar Lake is also known as Gandipet lake. Osman Sagar was created by damming the Musi River in 1920, to provide an additional source of drinking water for Hyderabad and to protect the city after the Great Musi Flood of 1908. It was constructed during the reign of the last Nizam of Hyderabad State, Osman Ali Khan, hence the name.
Location Rangareddy dist, Telangana, India
Coordinates 17.424705°N 78.697135°E
Surface area 49 km2



Shamirpet Lake is an artificial lake near Hyderabad, India, it is about 24 kilometers north of Secunderabad. The lake attracts many birds, making it a good bird watching spot. Surface area 80 acres.
Location Rangareddy dist, Telangana, India
Coordinates 17.609952°N 78.562934°E



II. WATER SAMPLING

The sample collection process has been co-ordinate with the laboratory in charge, so that analysts know, how many samples will be arriving, the approximate time of their arrival and the analyses that are to be carried out and can thus have appropriate quantities of reagent chemicals prepared. Surface water and subsurface water samples are collected in the field for chemical analyses are easily contaminated. Here presents a step-by-step detailed description of how to avoid sample contamination when field collecting, processing, and transporting surface water samples for laboratory analysis. Choose a sampling spot in mid lake, at least 15-20 cm (6-8 inches) deep if possible, and where you can reach it from a solid place on the bank (rocky, not soft/spongy spot) or from a large rock. We collected the sample from mid lake using bucket and rope and let it to immerse in to the water and then collected the sample. The sample bottle, use a black permanent marker to write on the dry bottles the sample location. Once the final sample is collected, seal the sample bottle immediately in a zipper lock bag place it in a dark place. The random samples are collected from various surface and subsurface water sources in musi basin.

III. WATER QUALITY CRITERIA FOR IRRIGATION AS PER IS: 11624-1986

The following chemical properties shall be considered for developing water quality criteria for irrigation:

a) Total salt concentration,
b) Sodium adsorption ratio,
c) Residual sodium carbonate or Bicarbonate ion concentration,
d) Boron content.

Total Salt Concentration: It is expressed as the electrical conductivity (EC). In relation to hazardous effects of the total salt concentration, the irrigation water can be classified in to four major groups.

Sl.no	Class	EC (μS/cm)
1	Low	Below 1500
2	Medium	1500-3000
3	High	3000-6000
4	Very high	Above 6000

Sodium Adsorption Ratio (SAR) – It shall be calculated from the following formula:

Na^+

SAR = $\frac{}{\sqrt{\frac{Ca^{2+}+Mg^{2+}}{2}}}$

Where, SAR = sodium adsorption ratio
Na = sodium ion concentration, me/l
Ca = calcium ion concentration, me/l
Mg = magnesium ion concentration, me/l
NOTE-me/l= milli equivalent/litre.

In relation to the hazardous effects of sodium adsorption ratio, the irrigation water quality rating is given.

Sl.no	Class	SAR range
1	Low	Below 10
2	Medium	10-18
3	High	18-26
4	Very high	Above 26

Residual sodium carbonate (RSC) shall be determined by the equation:
RSC = (HCO3-+ CO32-) – (Ca^{2+} + Mg^{2+})
Where RSC = residual sodium carbonate (me/l), CO32- = carbonate ion concentration (me/l),
HCO3-= Bicarbonate ion concentration (me/l),
Ca^{2+} = Calcium ion concentration (me/l),
Mg^{2+} = Magnesium ion concentration (me/l),
NOTE - me/l-milIi equivalent/litre
In relation to the hazardous effects of high bicarbonate ion concentration expressed as residual sodium carbonate, the irrigation water quality rating is given.

Sl.no	Class	RS Crange (me/l)
1	Low	Below1.5
2	Medium	1.5-3
3	High	3-6
4	Very high	Above 6

Boron Content: Boron, though a nutrient, becomes toxic if present in water beyond a particular level. In relation to boron toxicity, the irrigation water quality rating is given.

Sl.no	Class	Boron(ppm)
1	Low	Below 1
2	Medium	1-2
3	High	2-4
4	Very high	Above 4

To compare the quality of samples taken with water quality standards, few chemical parameters are required find as follows.

- pH
- Turbidity
- Electrical Conductivity
- Total Dissolved Solids
- Total Alkalinity
- Sodium
- Total Hardness
- Calcium
- Magnesium
- Boron

The above said determinations have been carried out as per guidelines given IS 10500:2012, the irrigation water quality indices given below are calculated, as per guidelines given in IS11624:1986

- Sodium Adsorption Ratio(SAR)
- Residual Sodium Carbonate(RSC)

IV. RESULTS AND DISCUSSIONS

Test results of various Chemical parameters for Edulabad lake water sources on musi basin are found and tabulated as below.

Parameter	Edulabad Lake water sources
pH	8.87
Turbidity	14.8
EC	1430
TDS	1151.5
TA	436
CO_3^{2-}	0
HCO_3^{-}	531.92
Na^{+}	174.25
TH	420
Ca^{2+}	136
Mg^{2+}	78.73
Boron	2.453

Calculated data of Irrigation Water Quality Parameters for Edulabad lake water sources on musi basin as follows.

Parameter	Edulabad Lake water sources
Total Salt Concentration (EC in µS/cm)	1430
SAR	4.78
RSC	-4.53
Boron (mg/l)	2.453

Hazardous effects on Edulabad lake water sources on musi basin are given below as per the guidelines IS 11624:1986

Parameter	Hazardous effect
Total Salt Concentration	Low

(EC in µS/cm)	
SAR	Low
RSC	Low
Boron (mg/l)	High

Test results of various Chemical parameters for Hakimpet lake water sources on musi basin are found and tabulated as below.

Parameter	hakimpet lake water sources
pH	8.52
Turbidity	48.7
EC	969
TDS	664.5
TA	264
CO32-	0
HCO3-	322.08
Na^+	92.36
TH	240
Ca2+	41.6
Mg2+	39.85
Boron	0.545

Calculated data of Irrigation Water Quality Parameters for Hakimpet lake water sources on musi basin as follows.

Parameter	hakimpet lake water sources
Total Salt Concentration (EC in µS/cm)	969
SAR	2.92
RSC	-0.08
Boron (mg/l)	0.55

Hazardous effects on Hakimpet lake water sources on musi basin are given below as per the guidelines IS 11624:1986

Parameter	Hazardous effect
Total Salt Concentration (EC in µS/cm)	Low
SAR	Low
RSC	Low
Boron (mg/l)	Low

Test results of various Chemical parameters for Osman Sagar lake water sources on musi basin are found and tabulated as below.

Parameter	Osman Sagar lake water sources
pH	7.67
Turbidity	150
EC	506
TDS	369
TA	208
CO32-	0
HCO3-	253.76
Na^+	46.97
TH	172
Ca2+	30.4
Mg2+	16.52
Boron	0.228

Calculated data of Irrigation Water Quality Parameters for Osman Sagar lake water sources on musi basin as follows.

Parameter	Osman Sagar lake water sources
Total Salt Concentration (EC in µS/cm)	506
SAR	1.76
RSC	1.28
Boron (mg/l)	0.23

Hazardous effects on Osman Sagar lake water sources on musi basin are given below as per the guidelines IS 11624:1986

Parameter	Hazardous effect
Total Salt Concentration (EC in µS/cm)	Low
SAR	Low
RSC	Low
Boron (mg/l)	Low

Test results of various Chemical parameters for Shamirpet lake water sources on musi basin are found and tabulated as below.

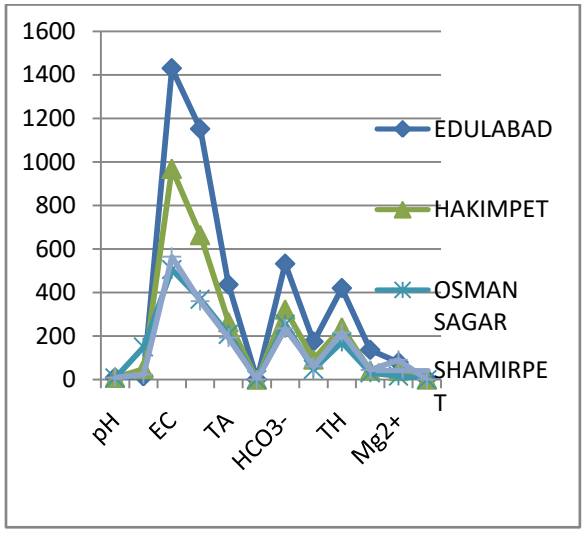
Parameter	Shamirpet lake water sources
pH	8.58
Turbidity	23
EC	564
TDS	359.5
TA	192
CO32-	0
HCO3-	234.24
Na^+	60.30
TH	216
Ca2+	44.1
Mg2+	90.53
Boron	0.282

Calculated data of Irrigation Water Quality Parameters for Shamirpet lake water sources on musi basin as follows.

Parameter	Shamirpet lake water sources
Total Salt Concentration (EC in µS/cm)	564
SAR	2.01
RSC	-5.81
Boron (mg/l)	0.28

Hazardous effects on Shamirpet lake water sources on musi basin are given below as per the guidelines IS 11624:1986

Parameter	Hazardous effect
Total Salt Concentration (EC in µS/cm)	Low
SAR	Low
RSC	Low
Boron (mg/l)	Low



4. CONCLUSION

Total Salt Concentration of samples of all four lakes falls under low hazardous range which suit for irrigation purpose.

• SAR indicates all four lake water samples falls under low hazardous range.

• RSC indicates all four lake water samples are suitable for irrigation.

• Boron indicates Edulabad lake water source falls under high hazardous range and other three lake water sources falls under low hazardous range.

• Analytical and calculated data reveals that the samples of all four lakes are suitable for irrigation except for Edulabad sample in case of Boron.

• All four lake waters suit for utilization for irrigation with proper management and water treatment practices.

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