International Journal of Lakes and Rivers.
ISSN 0973-4570 Volume 13, Number 2 (2020), pp. 121-130

http://www.ripublication.com/ijlr.htm

Datasets for Assessment of Water Quality Indices for Irrigation and Drinking for Hadoti Lakes, Rajasthan

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Abstract

In semi-arid areas, water availability plays an important role in the survival and sustenance of human life. The aim was to provide an assessment of urban lakes in the Hadoti region of Rajasthan. For assessing irrigation water quality, sodium absorption ratio, soluble sodium percentage, kelly ratio, sodium percentage, magnesium hazard, permeability index are determined. For drinking water assessment, water quality indexing is been done and the standards in accordance with drinking water parameters as laid by the Bureau of Indian Standards (BIS) are assessed. The estimated indices prove to be an important rating tool for water quality in terms of sustainable development associated with urban settings along with presence of lakes. The present dataset demonstrates the application of indices associated with water quality aspects as an important decision-making tool to policymakers for implementing best management practices, treatment, and associated sustainable development for urban lakes.

Keywords: Hadoti area, Urban Lakes, Water quality Index, Best Management Practices.

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1. DATA DESCRIPTION

This dataset contains 8 Tables and 2 Figures that present the quality of lake waters for Hadoti region in the state of Rajasthan, India. Figure 1 shows the sampling locations. Monitoring of physico-chemical parameters (like pH, turbidity, total hardness, sodium, potassium, calcium, alkalinity, nitrate, iron and fluoride) and their characteristics are shown in Table 1. Irrigation water indices are shown in Table 2 and the suitability ranges are shown in Table 6. Drinking water standards as per the Bureau of Indian Standards (BIS)[1] are used in Table 3 and the range for suitability is shown in Table 4. Table 5 and Table 7 represent the comparative results for the featured indices. Table 8 and Figure 2 shows the Pearson Correlation Matrix among the various parameters.

2. EXPERIMENTAL DESIGN, MATERIALS AND METHODS

2.1 Study Area Description

The study area involves Hadoti region (situated in the state of Rajasthan) which comprises of Kota, Bundi, Baran and Jhalawar districts. Kota has Kishore Sagar Lake, Jhalawar has Khandiya Lake, Bundi has Jait Sagar Lake and Baran has Dol Lake. All water bodies are situated in city limits and are facing constant human encroachments in their catchments due to increasing urbanization. Figure 1 shows the details of the study area. Samples were taken at definite intervals from each urban lake representing the seasonal variations from April 2019 to February 2020. Table 1 indicates Latitude and Longitude for collected samples/data.

Table 1: Latitude and Longitude for Urban Lakes in Hadoti Region

Urban Lakes	Latitude	Longitude
Kishore Sagar Lake	25.181	75.853
Dol Lake	25.107	76.510
Khandya Lake	24.575	76.170
Jait Sagar Lake	25.454	75.643

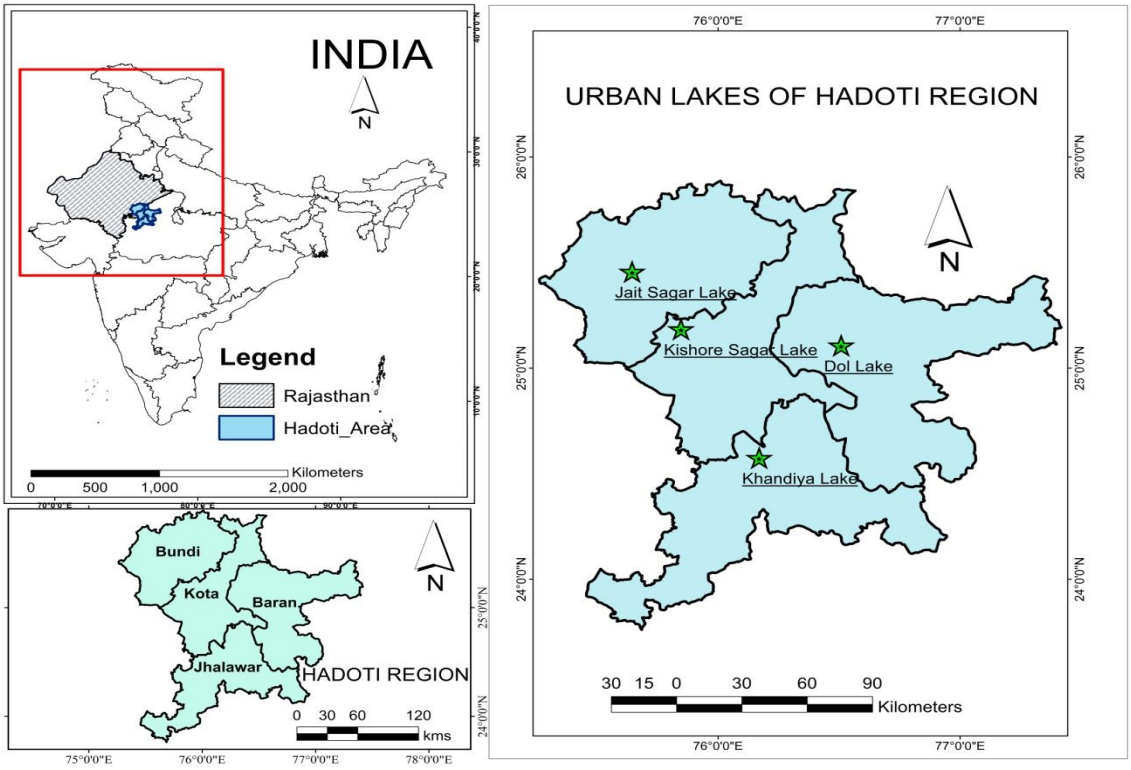

Figure 1 Urban Lakes in Hadoti Region

2.2 Analytical Procedures

All methods and sampling steps and procedures are performed as per the Standard methods for water and wastewater [4]. pH and EC are measured using portable meter (EIE Instruments - Soil and water analysis kit), hardness and alkalinity were performed by titration using EDTA and H_2SO_4 solutions with proper respective indicators. Turbidity was measured using turbidity meter (EIE Instruments - Model 335E). Sodium and potassium were measured using flame photometer (EIE Instruments- Model 049100). For iron and nitrate concentrations, UV Spectrophotometer (ThermoFischer Spectronic 200) was used and fluoride was determined using SPANDS method. For TDS measurements gravimetric methods were employed.

2.3 Data treatment and classification methods

2.3.1. Drinking water quality index

The Water Quality index (WQI) [2],[3] is calculated in the following steps:

1. Different weights (W_i) are assigned to all parameters based upon their importance and the parameter under consideration indicating harmfulness, if present. The

minimum weight assigned is one and the maximum being five. Following this, Relative Weights (RW_i) is calculated as:

$$RW_i = \frac{W_i}{\sum_1^n W_i}$$

where n is the number of parameters under consideration.

2. For Quality Rating Scale (q_i) is calculated as:

$$q_i = \frac{e_i - v_i}{b_i - v_i} \times 100$$

where v_i is the base value for each parameter under observation (0 for all parameters except for pH (7)), b_i is the standard value recommended in IS 10500 and e_i are the values observed experimentally.

3. The (SI_i)Sub Index is calculated for each parameter as:

$$SI_i = RW_i \times q_i$$

4. Finally, Water Quality Index (WQI) is calculated as:

$$WQI = \sum_1^n SI_i$$

2.3.2. Indices calculation for irrigation water[2]

Overall water quality of the parameters was assessed using indices such as SAR (Sodium Absorption Ratio), SSP (Soluble Sodium Percentage), KR (Kelly Ratio), Na % (Sodium Percentage), MH (Magnesium Hazard) and PI (Permeability Index) using Table 2 and Table 6.

Table 2: Parameters for lakes of Hadoti Region

	SampleNo./ Parameters	pH	Turbidity	EC	Total Hardness	T.D.S.	Nitrate	Iron	Na^+	K^+	$HCO3^-$	Ca^{2+}	Mg^{2+}	F^-
Kishore Sagar Lake, Kota	**KST 11**	7.60	13.00	421.00	148.00	313.00	3.00	0.00	22.00	2.79	129.00	49.00	29.00	0.29
	KST 12	7.94	15.00	450.00	175.00	772.00	1.00	0.00	24.00	2.95	137.00	26.00	27.00	1.50
	KST 13	7.80	15.60	343.00	100.00	240.00	5.00	0.00	28.00	3.10	130.00	70.00	30.00	0.27
	KST 14	8.20	14.00	345.00	150.00	234.00	4.00	0.00	21.00	3.30	110.00	80.00	50.00	0.13
	MAX	8.20	15.60	450.00	175.00	772.00	5.00	0.00	28.00	3.30	137.00	80.00	50.00	1.50
	MIN	7.60	13.00	343.00	100.00	234.00	1.00	0.00	21.00	2.79	110.00	26.00	27.00	0.13
	MEAN	7.89	14.40	389.75	143.25	389.75	3.25	0.00	23.75	3.04	126.50	56.25	34.00	0.55
	SD	0.25	1.14	54.14	31.34	257.35	1.71	0.00	3.10	0.22	11.56	23.95	10.74	0.64

Dol Lake, Baran	**DL 11**	6.90	12.00	189.00	88.00	144.00	19.00	0.05	33.00	2.70	148.00	49.00	19.00	0.15
	DL 12	7.95	10.00	195.00	95.00	1584.00	25.00	0.10	31.00	3.10	152.00	8.00	18.00	0.00
	DL 13	7.30	14.40	323.00	110.00	226.00	10.00	0.05	37.00	3.90	130.00	80.00	20.00	0.18
	DL 14	6.60	9.20	225.00	75.00	157.00	24.00	0.00	39.00	2.90	70.00	50.00	20.00	0.12
	MAX	7.95	14.40	323.00	110.00	1584.00	25.00	0.10	39.00	3.90	152.00	80.00	20.00	0.18
	MIN	6.60	9.20	189.00	75.00	144.00	10.00	0.00	31.00	2.70	70.00	8.00	18.00	0.00
	MEAN	7.19	11.40	233.00	92.00	527.75	19.50	0.05	35.00	3.15	125.00	46.75	19.25	0.11
	SD	0.58	2.32	62.03	14.58	705.09	6.86	0.04	3.65	0.53	37.89	29.57	0.96	0.08
Khandya Lake, Jhalawar	**KL 11**	7.50	11.00	386.00	110.00	412.00	12.00	0.00	26.00	1.90	198.00	117.00	25.00	0.21
	KL 12	7.69	10.00	410.00	145.00	698.00	10.00	0.10	21.00	2.20	148.00	34.00	15.00	0.75
	KL 13	7.70	11.50	412.00	140.00	289.00	13.00	0.00	25.00	2.80	170.00	120.00	22.00	0.17
	KL 14	7.30	11.70	505.00	70.00	354.00	15.00	0.00	29.00	2.60	180.00	120.00	70.00	0.15
	MAX	7.70	11.70	505.00	145.00	698.00	15.00	0.10	29.00	2.80	198.00	120.00	70.00	0.75
	MIN	7.30	10.00	386.00	70.00	289.00	10.00	0.00	21.00	1.90	148.00	34.00	15.00	0.15
	MEAN	7.55	11.05	428.25	116.25	438.25	12.50	0.03	25.25	2.38	174.00	97.75	33.00	0.32
	SD	0.19	0.76	52.51	34.49	180.31	2.08	0.05	3.30	0.40	20.85	42.52	25.02	0.29
Jait Sagar Lake, Bundi	**JS 11**	7.38	9.00	389.00	128.00	268.00	4.00	0.30	19.00	1.50	168.00	105.00	33.00	0.29
	JS 12	7.41	10.00	370.00	135.00	674.00	5.00	0.00	17.00	1.90	125.00	122.00	19.00	0.70
	JS 13	7.40	3.70	368.00	145.00	258.00	3.00	0.10	21.00	1.60	172.00	125.00	25.00	0.18
	JS 14	7.20	7.00	394.00	140.00	276.00	2.00	0.10	23.00	2.10	160.00	110.00	40.00	0.20
	MAX	7.41	10.00	394.00	145.00	674.00	5.00	0.30	23.00	2.10	172.00	125.00	40.00	0.70
	MIN	7.20	3.70	368.00	128.00	258.00	2.00	0.00	17.00	1.50	125.00	105.00	19.00	0.18
	MEAN	7.35	7.43	380.25	137.00	369.00	3.50	0.13	20.00	1.78	156.25	115.50	29.25	0.34
	SD	0.10	2.78	13.18	7.26	203.47	1.29	0.13	2.58	0.28	21.42	9.54	9.18	0.24

Table 3: Various Indices for Irrigation water

Acronym	Index	Expression
SAR	Sodium Absorption Ratio	$SAR = \frac{Na}{\sqrt{\frac{Ca+Mg}{2}}}$
SSP	Soluble Sodium Percentage	$\left(\frac{Na}{Ca+Mg+Na}\right) \times 100$
KR	Kelly Ratio	$\frac{Na}{Ca+Mg}$
Na %	Sodium Percentage	$\left(\frac{Na+K}{Ca+Mg+Na+K}\right) \times 100$
MH	Magnesium Hazard	$\left(\frac{Mg}{Ca+Mg}\right) \times 100$
PI	Permeability Index	$\left(\frac{Na+K+\sqrt{HCO_3}}{Ca+Mg+Na+K}\right) \times 100$

Table 4: IS 10500 standard values for parameters

Parameters	Standard Values as per IS 10500	Weight (W_i)	Relative Weights(RW_i)
pH	6.5–8.5	4	0.13
Total Hardness	300	4	0.13
T.D.S.	500	4	0.13
Nitrate	45	4	0.13
Iron	0.3	2	0.06
Turbidity	1	2	0.06
Total Alkalinity	200	2	0.06
Calcium	75	3	0.09
Magnesium	30	3	0.09
Fluoride	1	4	0.13
	Total	32	1.00

Table 5: Classification and Range in WQI for drinking purpose for the present study [3]

WQI Value	**Water Quality**
< 50	Excellent
50 - 100	Good
100 -200	Poor
200 - 300	Very Poor
> 300	Unsuitable for Drinking

Table 6: Comparative results for drinking WQI

Lake	**WQI Value**	**Water Quality**
Kishore Sagar Lake, Kota	**157.22**	Poor
Dol Lake, Baran	**116.63**	Poor
Khandya Lake, Jhalawar	**134.68**	Poor
Jait Sagar Lake, Bundi	**106.51**	Poor

Table 7: Classification and Range in Irrigation Indices for the present study [2]

Index	**Range**	**Water Quality**
SAR	0 - 10	Excellent
	10 -18	Good
	18 - 26	Doubtful
	> 26	Unsuitable
SSP	< 50	Good
	> 50	Unsuitable
KR	< 1	Suitable
	> 2	Unsuitable
Na %	< 20	Excellent
	20 - 40	Good
	40 - 60	Permissible
	60 -80	Doubtful
	> 80	Unsuitable
MH	< 50	Suitable
	> 50	Harmful and Unsuitable
PI	< 80	Good
	80 - 100	Moderate
	100 - 120	Poor

Table 8: Comparative Results for Irrigation Indices

Lake	SAR	SSP	KR	Na %	MH	PI	Water Class (Overall)
Kishore Sagar Lake , Kota	3.53	20.85	0.26	22.89	37.67	32.5	Excellent and Suitable
Dol Lake, Baran	6.09	34.65	0.53	36.63	29.2	47.36	Excellent and Suitable
Khandya Lake, Jhalawar	3.14	16.18	0.19	17.45	25.24	25.78	Excellent and Suitable
Jait Sagar Lake, Bundi	2.35	12.15	0.13	13.07	20.21	20.58	Excellent and Suitable

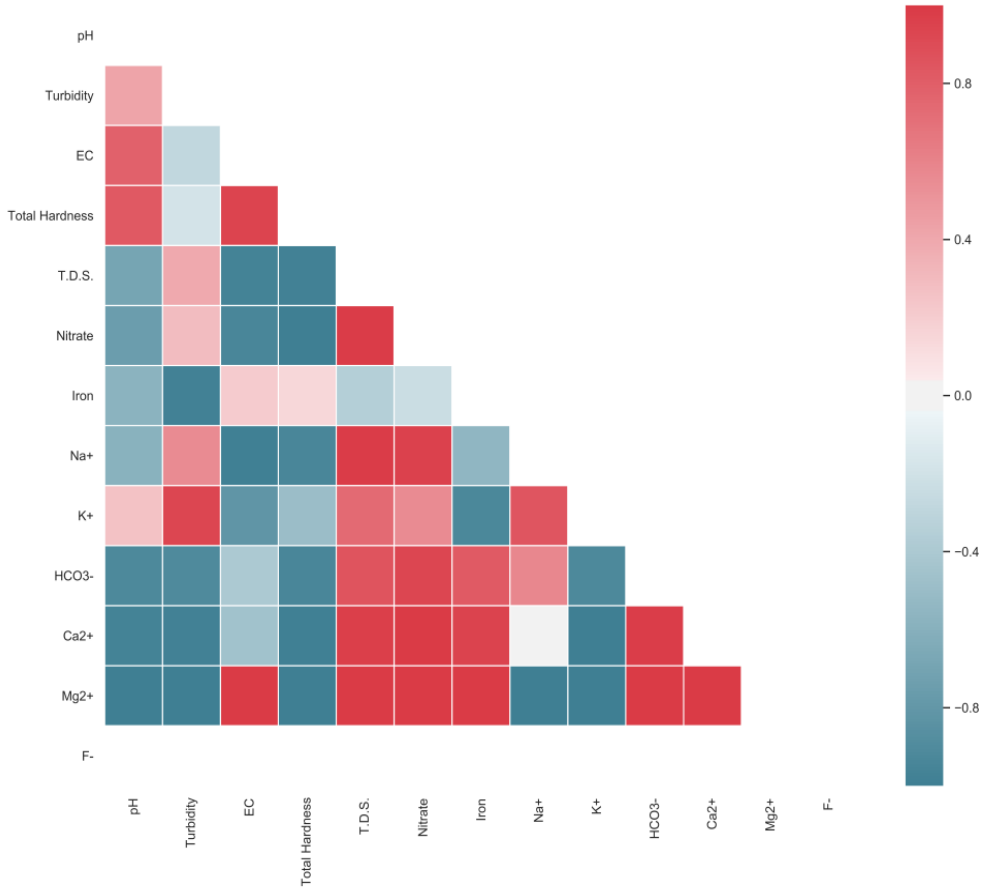

Figure 2: Correlation Matrix for quality parameters

Table 9: Correlation Matrix for quality parameters

Variables	pH	Turbidity	EC	Total Hardness	T.D.S.	Nitrate	Iron	Na+	K+	HCO3-	Ca2+	Mg2+	F-
pH	**1**												
Turbidity	0.673	**1**											
EC	0.662	-0.025	**1**										
Total Hardness	0.718	0.032	0.731	**1**									
T.D.S.	-0.570	0.199	-0.786	**-0.968**	**1**								
Nitrate	-0.633	0.064	-0.681	**-0.993**	**0.976**	**1**							
Iron	-0.654	-0.949	-0.121	0.055	-0.242	-0.168	**1**						
Na+	-0.485	0.317	-0.841	**-0.908**	**0.982**	**0.918**	-0.308	**1**					
K+	0.191	0.849	-0.543	-0.413	0.627	0.472	-0.754	0.743	**1**				
HCO3-	-0.056	-0.537	0.684	0.126	-0.328	-0.116	0.270	-0.497	-0.762	**1**			
Ca2+	-0.113	-0.780	0.643	0.404	-0.619	-0.444	0.640	-0.749	**-0.985**	0.858	**1**		
Mg2+	0.843	0.216	**0.960**	0.811	-0.796	-0.747	-0.304	-0.801	-0.334	0.459	0.429	**1**	
F-	**0.931**	0.398	0.736	0.922	-0.819	-0.871	-0.336	-0.737	-0.097	0.014	0.133	0.883	**1**

Value of the Data

- This dataset gives a brief idea about the water quality aspects of urban lakes for the study area which helps the decision-makers to devise a strategy for implementing best management practices.
- The dataset for physical and chemical parameters can help to identify various processes and mechanisms affecting the water chemistry of urban lakes.
- Stakeholders can use the data for future research related to monitoring studies with regards to assess impacts of urbanization for the study area.
- The results indicate that the water for the study area is fit for drinking and irrigation requirements and has the potential to be developed as recharge sites for groundwater development and further as stormwater detention ponds during the rainfall period.

Acknowledgments

The authors wish to acknowledge the laboratory support of Civil Engineering Department, Rajasthan Technical University, Kota.

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