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Chandlai Lake Water Quality Determination By Evaluation Of Water Quality Index

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Abstract - Water is valuable natural resource present on this globe and it is very significant for persistence of fauna and flora. Water quality is equivalently significant to the quantity present on earth. The variation of natural water quality is due to multiplicity of human practices and also because of environment. Sometimes variation in water quality producing threat to health of organism as well as environment. The water quality analysis is fundamental process to determine water quality. Water quality index is dependent on interactions between biological, physical, chemical parameters and all these parameters are used to produce single value that involves four steps (a) First step is selection of parameters (b). Second step is to computation of Weightage. (c) Third step is to calculate Quality Rating(d) Finally, fourth step is to calculate. The intent of present study was to determine the water quality of Chandlai Lake, and to fulfill the purpose this purpose water Quality Index is calculated by using the various physiochemical properties. There is always need of revised information at regular interval of time to verify the water quality in different ecosystem such as lakes, rivers. The availableness of studies relevant field, gives assistance in preparation of rules and regulations and also to take necessary precautions. Findings of research done once should not be useful for many years, so always recent and accurate and brief information is required for to categorize the quality of water.

Key words- Water Quality Index; Physiochemical properties; Chandlai Lake; Chloride; BOD ;

1. Introduction

Water is the most important component of ecosystem and it is essential for presence of life, residing on Earth. Mostly creature rely on water for their viability. The nature of water usually indicates to its chemical, biological and physiochemical characteristics. Speedy industrialization and unsystematic utilization of pesticides, and chemical fertilizers in farming causing contamination to water bodies. Water quality can be assessed by using many techniques for industrial, drinking and agriculture purposes. Water can be utilized for many purposes for instance, farming, drinking water, livestock farming and also for many other purposes. Lake water is polluted because of lack of proper sewage and water disposal practices. Water pollution responsible for many waters borne diseases. Regular watchfulness of aquatic

bodies are imperative to counter contamination and to take care of quality of lake water. Timely monitoring of variation of physiochemical parameters of water can prevent the pollution of water and it will help in maintaining biodiversity 0f aquatic bodies. The availability of good quality of water is can prevent occurrence of many diseases and also improving the quality of life of living organisms. The study gives knowledge, how environmental factors and physiochemical parameters affect water quality of lake. Physiochemical property of water gets changed after period of interval of time. and also because of activities such as domestic waste, horticulture etc. Physiochemical properties are useful to prepare water quality index, after that quality rating is gained and finally a single value of WQI is obtained, this indicates overall quality of water, this is imperative for those who wants brief information about water quality of any water and this WQI gets affected due presence various heavy metals and also because of atmospheric actives. Water Quality index is imperative way to distinguish water quality into different section like excellent, good, bad, preferable, superb, poor etc.. The dominant goal of this research is to figure out the water quality of Chandlai Lake by determination of water quality index.

2. Study area

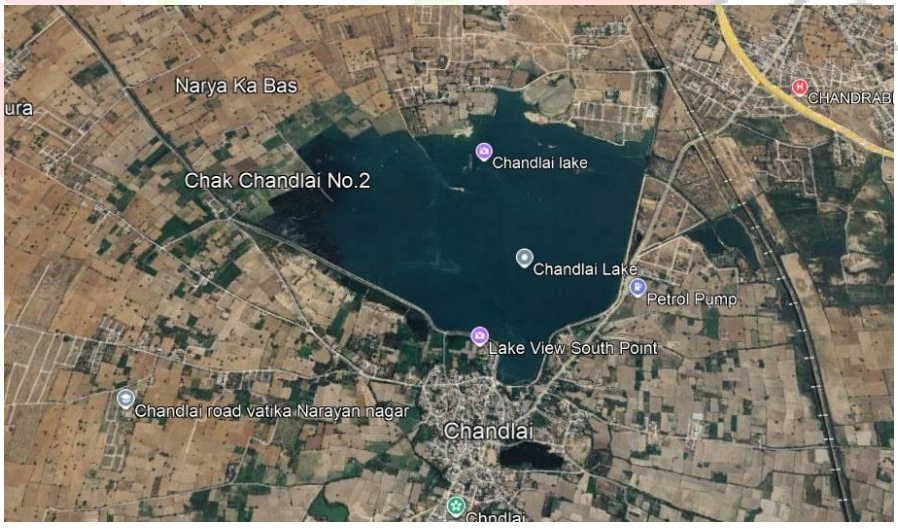
Chandlai lake is freshwater lake of Jaipur in Rajasthan, situated near Chandlai Village. Lake receives, the drainage water, household waste, agriculture waste, industrial waste throughout the year from the surrounding area.

Location - Lake situated near Chandlai village, in Jaipur Rajasthan.

Latitude- 26°41'45"N

Longitude- 75°52'36"E.

Area covered- 196 hectare



Map of Chandlai lake

3 Material and methods

Water sample were taken from lake over a period of a year in the representative month of the season viz.-January in winter, April in summer, July in monsoon, October in post monsoon. Nine physiochemical parameters were analyzed for this study, some parameters were tested using device, other were calculated in laboratory as per standard procedure of APHA.

The weighted arithmetic index method was applied for the computation of water quality index (WQI) of lake.

Following steps are used to calculate WQI

First step is selection of parameters.

Second step is to computation of Weightage (Wn), for this, Unit weight was evaluated by a value inversely proportional to the recommended standard value (Sn) of the corresponding parameter. And then summation of all values is done. After that we calculate the value of K that is proportional constant, by using following expression, $k=1/\sum (Sn)$. Later WI is calculated by using equation k/Sn .and next these results are used to calculate weightage (Wn) and its equation is $Wn=wn/\sum wn$.

Third step is to calculate Quality Rating and its expression is [$Qn= 100 (Vn – V_i) / (Sn – V_i)$]**, for** each parameter. Here Vi is ideal Value (i.e. 0 for all other parameters except the parameter Dissolved oxygen and pH (14.6 mg/L and 7 respectively.)

Finally, fourth step is to calculate WQI by using below written formula [$WQI =\sum Qn* W n / W n$]

Table 1- WQI values and Water quality status (modified) according to Brown et al ;2012

WQI values	**Status for water quality**
Value between 0 to 25	First class / Superb for human consumption
Value between 26 to 50	Preferable for human consumption
Value between 51 to 75	Inferior for human consumption
Value between 76 to 100	Bad for human consumption
Value above 100	Unsuitable water for human consumption

Table :2 Permissible water standards and Ideal values

(All units for parameters are in milligram per litre expect electrical conductivity and it is µmho/cm and for pH.)

S. No	**Parameter**	**Standard permissible limit (BIS 2012; WHO; US EPA 1986)**	**Ideal value(Vi)**
1	pH	8.5	7
2	Alkalinity	200	0
3	Dissolved oxygen	5	14.6
4	BOD	5	0
5	Chloride	250	0
6	Electrical Conductivity	250	0
7	Total hardness	200	0
8	Calcium	75	0
9	TDS	500	0

4 Results

The average value of the values observed for 4 seasons in a year was computed and listed in Table 3. WQI of the lake for four seasons, post monsoon, winter, summer and monsoon were calculated separately in tables 4, 5, 6 and 7 respectively. Final WQI values results were illustrated in table 8.

Table 3 -Seasonal variations of Physiochemical parameters of Chandlai Lake Water sample

S.no	Parameter	Winter	Summer	Monsoon	Post Monsoon
1	pH	7.5	7.8	7.6	7.7
2	Alkalinity	380	400	360	350
3	Dissolved oxygen	3.5	2.8	3.7	3.1
4	BOD	11.1	12.2	9.3	10.2
5	Chloride	260	280	250	240
6	Electrical Conductivity	1300	1500	1420	1380
7	Total hardness	385	336	390	380
8	Calcium	72	69	95	70
9	TDS	930	1100	1050	990

Table 4- Evaluation of WQI in winter of Chandlai Lake water

S.no	Parameter	Observed Value (Vn)	Standard value (Sn)	Unit Weight (Wn)	Quality Rating Qn)	Wn*Qn
1	pH	7.5	8.5	0.215	33.33	7.1
2	Alkalinity	380	200	0.009	190	1.71
3	Dissolved oxygen	3.5	5	0.366	115.6	41.97
4	BOD	11.1	5	0.366	222	80.58
5	Chloride	260	250	0.007	104	0.728
6	Electrical Conductivity	1300	250	0.007	520	3.64
7	Total hardness	385	200	0.009	192.5	1.73
8	Calcium	72	75	0.024	96	2.304
9	TDS	930	500	0.003	186	0.558
				Wn=1.006		∑WnQn= 140.32
	WQI					(∑Wn*Qn/∑Wn) =139

Table 5- Evaluation of WQI in summer of Chandlai Lake water

S.no	Parameter	Observed value Vn	Standard value Sn	Unit Weight W	Quality Rating Qn	Wn*Qn
1	pH	7.8	8.5	0.215	53.33	11.39
2	Alkalinity	400	200	0.009	200	1.8
3	Dissolved oxygen	2.8	5	0.366	122.91	44.61
4	BOD	12.2	5	0.366	244	88.57
5	Chloride	280	250	0.007	112	0.784
6	Electrical Conductivity	1500	250	0.007	600	4.2
7	Total hardness	336	200	0.009	168	1.51
8	Calcium	69	75	0.024	92	2.208
9	TDS	1100	500	0.003	220	0.66
				∑Wn=1.006		∑WnQn =155.73
	WQI					(∑Wn*Qn/∑Wn) =154

Table 6- Evaluation of WQI in monsoon of Chandlai Lake water

S.no	Parameter	Observed Value Vn	Standard value Sn	Unit Weight Wn	Quality Rating Qn	Qn*Wn
1	pH	7.6	8.5	0.215	40	8.54
2	Alkalinity	360	200	0.009	180	1.62
3	Dissolved oxygen	3.7	5	0.366	113.5	41.21
4	BOD	9.3	5	0.366	186	67.518
5	Chloride	250	250	0.007	100	0.7
6	Electrical Conductivity	1420	250	0.007	568	3.97
7	Total hardness	390	200	0.009	195	1.75
8	Calcium	95	75	0.024	126.6	3.03
9	TDS	1050	500	0.003	210	0.63
				∑Wn=1.006		∑QnWn =128.99
	WQI					(∑Wn*Qn/∑Wn) =128

Table 7- Evaluation of WQI in Post monsoon of Chandlai Lake water

S.no	Parameter	Observed value Vn	Standard value Sn	Unit Weight Wn	Quality Rating Qn	Qn*Wn
1	pH	7.7	8.5	0.215	46.66	9.97
2	Alkalinity	350	200	0.009	175	1.57
3	Dissolved oxygen	3.1	5	0.366	119.7	43.48
4	BOD	10.2	5	0.366	204	74.05
5	Chloride	240	250	0.007	96	0.67
6	Electrical Conductivity	1380	250	0.007	552	3.86
7	Total hardness	380	200	0.009	190	1.71
8	Calcium	70	75	0.024	93	2.23
9	TDS	990	500	0.003	198	0.594
				∑Wn=1.006		∑QnWn=138.15
	WQI					(∑Wn*Qn/∑Wn) =137.32

Table -8

Season	WQI value	Water Quality Status
Winter	139	Water unsuitable for drinking
Summer	154	Water unsuitable for drinking
Monsoon	128	Water unsuitable for drinking
Post monsoon	137	Water unsuitable for drinking

5 Discussion

pH- it is a major of intensity of alkalinity and acidity of water. Most biological and chemical reactions are directly depended upon the pH of water. It very important indication of water quality. Significant changes in the pH is due to the discharge of domestic waste and agriculture waste in water. In our research maximum pH of 7.8 was noticed during summer and the reason behind it is low water and minimum pH was observed is 7.5. during winter season. Its value gets different in 4.92 in dry season and 4.73 in rainfall. (Alice Makonjo Wekesa.,2022) However, the lake water was found slightly alkaline considering the average value of all 4 seasons. (Dhaswadikar.,2022) also made similar comparable observations. In a study the its value range from 7.8 to 7 .56 in April was offered in chosen aquatic bodies in Oyo n Logos state. (Bilewu et al.,2022)

Alkalinity-

Alkalinity is chemical estimation of water capability to neutralize acidic. Alkalinity is also a assess of a water buffering capacity. The highest value of alkalinity in our research is reported in summer season and it is 400 mg/l. attributable due to accumulate of organic matters produced by decay and decomposition of vegetation and also because of addition of bicarbonates and carbonates in lake water. The minimal value of alkalinity is calculated during post monsoon it 350 mg/l, low value is due to inflow of freshwater and dissolution of and 242mg/l in monsoon season. (Qureshimataua Umerfaraq et al.,2015) Research done in Sankari mining area, alkalinity range is found in between 163 to 394 mg/l (C.sakthivel.,2023)

Dissolved oxygen

Dissolved oxygen, is the amount of O_2 that is exists in water. In our study, the maximum level of dissolved oxygen was noticed is 3.7 mg/l in monsoon, the reason of this value, is turbulence of water, assisting in distribution of O_2 and lowest level of dissolved oxygen is observed during post monsoon season this is 3.1 mg/l, it is due to increase in temperature, augmentation of sewage and other waste in water. Dissolved oxygen range in between 4.73-22.50 mg/l was observed in Puliyanthangal lake of Raniket. (Maheswari M et al;2005). The finding of Venkateshwara (2019) are all consistent with this observation. Research perform experiment by C. Sakthivel, found DO value between 7.9 to 40 mg/l in two different areas. (C. Sakthivel.,2023)

BOD

Biochemical oxygen demand is the quantity of DO that is required for balance of organic matters those which are compostable through activity of aerobic microorganism. In our study the maximum value of BOD levels was reported during summer season, it is 12.2 mg/l and minimum level of BOD is observed 9.3 mg/l during monsoon season. In a research report BOD value are 8.55 mg/l in NIHORT,5.06 mg/ l in Berger and3.55 mg/l in U, I. (Bilewu et al.,2022)

Total dissolved solids

Total dissolved solids in the sum of all organic, inorganic substance contained in liquid. In our research study, highest TDS reported during summer as 1100mg/l and lowest value is calculated during post monsoon as 990 mg/l Research done in selected spring of Kenya, the result of TDS value is 25 mg/l. (Alice Makonjo Wekesa.,2022). A study done by Qureshimatwa et al;2015 in Chandloi lake water, TDS was calculated for 3 different season 1224 mg/l in monsoon,1008 mg/l in winter,1142 mg/l in summer season. Residential areas total dissolved solid ranges are available between 220to 475 mg/l. (C.sakthivel.,2023)

Total hardness

The total hardness of water of is the total of magnesium and calcium, it is expressed as calcium carbonate. Water with value of magnesium and calcium is considered as hard. In our finding total hardness of water was maximum during monsoon as 390 mg/l and minimum during summer as 336 mg/l. . Experiment done in some spring of manga sub country, the value of total hardness is 9.32 mgcaco3/l. (Alice Makonjo Wekesa.,2022) Total hardness of Trivini lake found the range between 69.33 to 193.67 mg/l (Rafiwallah m. khan et al., 2012) Hardness 297 mg/l of total hardness was observed at residential areas of Sankari and 228 mg/l was noticed at mining areas of Sankari. (C. Sakthivel.,2023)

Conductivity

Electrical conductivity is the capability of liquid to permit, the flow of electric current. It is related to concentration of salts, water and dissolved charged chemicals. When more inorganic chemicals, dissolved salts present in water, the more electric current is conducted. In our finding the maximum value of electrical conductance is observed during summer as 1500 umhos/cm and lowest reported during winter

as 1300 umhos/cm. Triveni Lake conductivity is ranged between 186.76 um hos /cm to 286.76 um hos/ cm. (Rafiullah M khan et al., 2012)

Chloride

In our study highest value of chloride was observed in summer as 280 mg/l due to repeatedly runoff, and filled with polluted water from surrounding areas and also due to evaporation of water and minimal value of chloride is observed during post monsoon as 240 mg/l. Chloride level in three separate spring is 1mg/l,2mg/l,3mg/l in chosen spring of Kenya (Alice Makonjo Wekesa.,2022) Estein et al .,2013 recorded the maximum level of chloride with value of 440.1 mg/l in summer and 411.3 mg/l in monsoon. 39 mg/l of chloride value was observed during research perform in Sankari residential area of Tamil Nadu. (C .Sakthivel.,2023)

Calcium

In our research, highest value of calcium was reported during monsoon season and it is is,95 mg/l and lowest value was calculated is 69 mg/l in summer season. A study done by Verma P U in 2012 the maximum concentration of ca+ noted in sample in period of rainfall was 94 mg/l. IN winter season lowest amount of calcium was recorded. (Solanki et al.,2012) A study done by S C Sakthivel, the value of calcium is found 273 mg/l in one area and 48 mg/l in another research area. (C .Sakthive.,,2023)

Water Quality Index

WQI is the established for Chandlai lake water by estimating various physiochemical parameters for four different seasons over a period of a year. Season wise WQI were represented in table 4,5,6,7 and final WQI depicted in table 8. Highest WQI in summer season and lowest in monsoon season. This water Quality assessment represents that pollutant load is higher in summer as compare to winter, monsoon and post monsoon season.Kohargaddi dam WQI is calculated results shows that dam water status in period of summer is very poor as compare to rainy and winter season (BB Mishra.et.,2008) Various sites are selected for evaluation of WQI and outcome were Amer (hand pump water) 221.58 , Jal Mahal (tube well water)74.90and Galta (hand pump water) 160.(Sharma .,2016) WQI of Dalvoy lake is also calculated by researchers ,and found it has not good quality. WQI of Chandolia lake, Ahmedabad was evaluated by researcher and found that water is unsuitable for public consumption. (Qureshimatva U M etal.,2015) Ground water of mining area of Sankari granite is tested and finding shows that its quality is decreasing day by day. (C.Sakthive.l,2023)

It is really indispensable to keep an eye on variation occur in physiochemical properties of water comes from any sources. ,so that we can categories its quality for different requirement's, like whether it is useful only industries, agricultural practices ,culturing of organisms living in water, or water directly useable for consumption. That's why research on Chandlai lake water quality is of great importance and these types of research should always be done for almost every aquatic bodies at regular interval of time.

Conclusion

According to results, WQI value is above hundred in all four season viz winter, summer, and monsoon, post monsoon. This indicates that water is not useful for consumption because of high contamination in all seasons and during monsoon water quality is also poor but less than remaining three seasons. So, it is recommended water purification system must be installed, so that lake water can be suitable for use by people, without causing any harm to their health. Directly discharged of domestic or other waste should be stopped. Water Quality technique can be useful for overall assessment of water quality and this help in deciding the various future water conservation and management plans.

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Author's contribution

Nivedita Kumari : Contributed to data collection, data analysis and an initial draft of the manuscript writing; Poonam Yadav : Contributed to writing; Gareema : contribute to editing and study design the manuscript ; Dr.Bharti Chouhan: Contributed to the research conception, final review and editing of manuscript.

Conflicts of interest-

The authors declare that they all have no conflicts of interest.

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