Journal of Applied Science and Education, 2024,
Vol. 04, Iss. 03, S. No. 078, pp. 1-10
ISSN (Online): 2583-1372

Water Quality Assessment of the Jaisamand Dam in Alwar, India

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How to cite this paper: A. K. Kakodia1, S. Lal, L.N. Jatolia and K. Tanwar, "Paper Title," *Journal of Applied Science and Education (JASE)*, Vol. 04, Iss. 03, S. No. 078, pp 1-10, 2024.

https://doi.org/10.54060/a2zjournals.jase.78

Received: 11/08/2024
Accepted: 26/10/2024
Online First: 25/11/2024
Published: 25/11/2024

Abstract

The physico-chemical and microbiological characteristics of Jaisamand Dam in Alwar are examined in this work. The adjacent rural villages rely on Jaisamand Dam for drinking water and irrigation. The Ruparail River and Siliserh Lake have been overflowing, creating the lake. The data collected throughout the year 2024. Low visibility, dissolved oxygen, and low fluoride levels, along with high temperature, pH, BOD, TDS, TSS, alkalinity, total hardness, chloride, DO, conductivity and alkalinity clearly indicate poor water quality.

Keywords

Physio-Chemical, microbiological, water quality index, pH, TDS etc.

1. Introduction

The water quality assessment of Jaisamand Dam in Alwar District reveals significant concerns regarding pollution and ecological health. Studies indicate that the water quality is compromised due to various anthropogenic activities, necessitating a

comprehensive evaluation of its physico-chemical and microbiological parameters. The physio-chemical parametric analysis of water was carried out by various researchers for underground water as well as for ground water [Verma et al. (2022,2023), Vohra et al. (2019), Lal et al. (2022), Kakodia et al. (2022, 2023)].

In order to identify current environmental conditions and processes, such as land use, drainage patterns, river reconnaissance surveys, and key interviews to characterize the barangay profile and the community's water use and practices, Enriquez and Tanhueco (2022) carried out an environmental analysis.

In order to inform fish farmers and environmentalists about the water quality factors that affect pond health and to boost fish yields to meet the rising demands of our nation's current situation, the evaluation of water quality and the role that dams play in maintaining fish population dynamics have been reviewed [Tiwari and Tiwari 2022]. Koszelnik et al. (2018) investigated and categorized four small retention reservoirs using a variety of physical and chemical indicators, including conductivity, pH level, dissolved oxygen, calcium hardness, general hardness, and alkalinity.

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Dhembare (2012) investigated the WQI of a dam's water used for irrigation and discovered that the water's suitability for irrigation was assessed using a range of quality indices, including Kelly's Index 0.26 to 0.75 ppm, Sodium Absorption Ratio [0.17 to 3.87 ppm], Soluble Sodium percentage [12.87 to 40.09 ppm], and Residual Sodium Carbonate [-0.3 to -8.0 ppm]. The physico-chemical characteristics of water samples taken from Jayakwadi dam in 2018–2019, including temperature, pH, DO, BOD, hardness, alkalinity, TDS, turbidity, chlorides, phosphates, chlorine, and nitrates, were examined by Sangawe et al. (2023).

Particularly during the summer and monsoon seasons, organic pollutants, agricultural runoff, and garbage disposal degrade the water quality of Kot Dam in Rajasthan, India [Singodia et al 2024]. The quality indicators and the impact of industrial pollutants on the surface water quality of Agyara Dam in Alwar, Rajasthan, were examined by Kumari and Kumar (2022). According to Dev et al. (2009), the drinking water in the Alwar region is of extremely low quality and should only be used for cooking and drinking after undergoing prior treatment. The most significant parameter, fluoride, was found to be between 0.45 and 3.6 ppm, which is higher than the allowable limit in the majority of the samples examined.

Higher values of the majority of the indicators clearly indicate that the water is not suitable for drinking since it is extremely polluted, according to Singh's (2019) study of the physico-chemical and microbiological characteristics of Jaisamand Lake during the 2017–18 year.

The water quality is changed according to time, seasonal variation, ecological development and pollution around the resources. The Jaisamand Dam water is mainly used for irrigation purposes. The underground water level and quality is also affected by the dam water. The underground water is the main source of drinking in Alwar Rajasthan. The main dams nearby city are Jaisamand, Siliserh, Agyara and vijay mandir. The authors have assessed the physio-chemical parameters of Jaisamand Dam in this article.

2. Material and Methods

2.1 Site Selection

The Jaisamand Dam is situated 10km south from Alwar city, and the location map is shown in **Figure 1**. Maharaja Jai Singh built Jaisamand Dam (Latitude and Altitudes are 27.49575 and 76.58977) 41T in 1910 AD.41T 41TIt features an earthen embankment that is 1.671 kilometers long and 10.6 meters high. The lake is typically 8.3 feet deep during the post-monsoon season. 41 Its average annual rainfall is 550 mm, and its productive area is 500 hectares. 41 For the past century, this reservoir's water has been utilized for drinking and cultivation. 41TDisposal of household garbage in this lake results in unfavorable changes to the water's physico-chemical and biological properties.

Water quality assessment in Alwar District, located in Rajasthan, India, is crucial due to the region's reliance on groundwater and surface water sources for drinking, irrigation, and industrial activities. The district faces several challenges related to water quality, such as salinity, hardness, contamination from industrial and agricultural activities, and limited access to clean water. A detailed water quality assessment typically includes analyzing various parameters, including physical, chemical, and biological indicators.

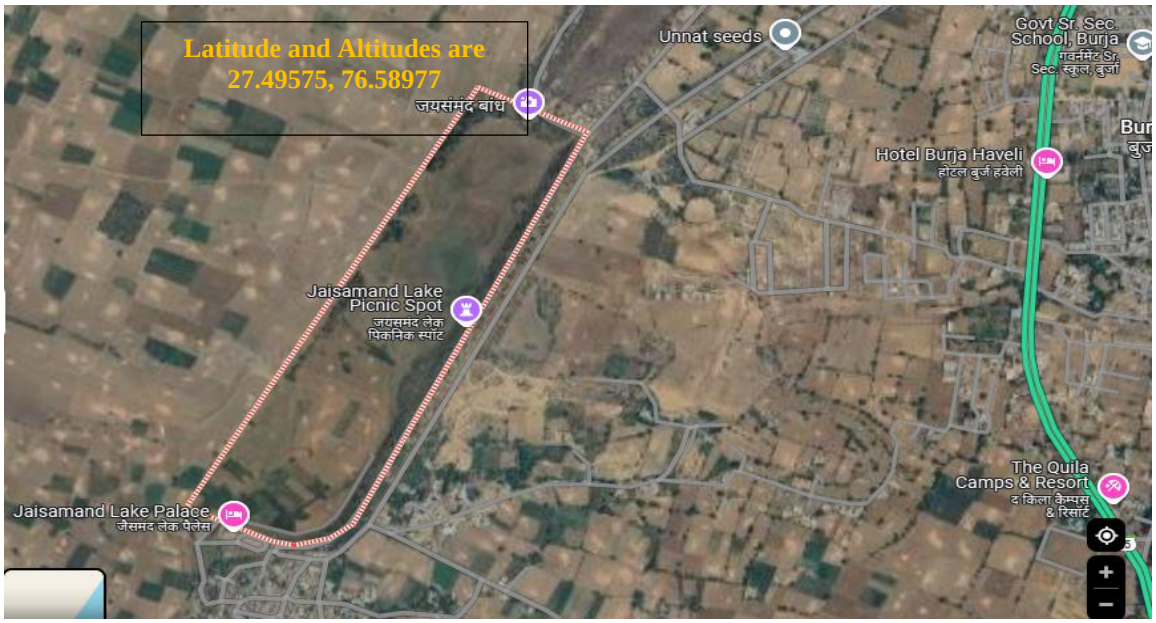

Figure 1 **Google map of Jaisamand Dam, Alwar [22]**

Widely used for domestic and agricultural purposes, groundwater quality often suffers from high salinity and nitrate contamination. The district has several reservoirs, including the Jaisamand Dam, Sariska Dam and Rajgarh Dam, which supply water for irrigation and drinking. The quality of surface water varies based on seasonal factors, pollution, and local waste disposal practices. The quality of harvested rainwater depends on the collection and storage methods.

2.2 Sampling Method

The important aspects in this analysis are the sampling method adoption, because the water properties depend upon the time, sampling bottle and pollution etc. **Table 1** shows the categories of containers used for preservation and maximum storage recommended for water. where P= Plastic (Polyethylene or Equivalent), G= Glass, P(A) or G(A)= Rinsed with 1+1 HNO3

Table 1. Classified the container used for preservation and maximum storage [recommended as per characteristic of testing of water [23]]

S. No.	Characteristic	Container	Preservation	Maximum Storage Recommended
1	PH Value	P, G	Analyse Immediately	0.25 Hours
2	Total Dissolved Solids (TDS)	P, G	Analyse Same Day	6 Hours
3	Turbidity	P, G	Analyse Same Day, Store in Tank	24 Hours
4	Chloride	P, G	Not Required	
5	Total Alkalinity	P, G	Cool ≤6 C	24 Hours

6	Total Hardness	P, G		
7	Sulphate	P, G	Cool ≤6 C	28 Hours
8	Iron	P(A), G(A)	For Dissolved Metals Filter immediately. Add HNO3 to PH 2	6 Months
9	Total Arsenic	P(A), G(A)	For Dissolved Metals Filter immediately, Add HNO3 to PH<2	6 Months
10	Fluoride	P	Not Required	28 Days
11	Nitrate	P, G	Cool<60C Analyse as soon as possible	48 Hours
12	Residual Chlorine	P, G	Analyse immediately	0.25 Hours
13	Presence/Absence of Bacteriological Contamination	G		

2.3 Water Quality Index (WQI)

For water quality index, authors have use the simple water quality index calculator from [24]. The ware quality is classified into five groups such as: Excellent (91-100), Good (71-90), Average (51-70), Fair (26-50) and poor (0-25) with the specific colour codings.

3. Result and Discussions

3.1 Climate Data or Weather data Analysis

Alwar experiences a long scorching summers and brief mild to warm winters due to its hot and semi-arid climate (Köppen climatic classification BSh). This area is thought to have a local steppe climate. Summer temperatures typically range from an average minimum of 28 °C to an average maximum of 41 °C. The average high temperature during the winter months is 21 °C, while the average low temperature is 8 °C. Alwar's monsoon season is brief. Because of the monsoon, the majority of the 67 cm of annual rainfall occurs in July and August [25]. The highest recorded temperature in Alwar was 50.6 °C on May 10, 1956, and the lowest was -0.8 °C on January 12, 1967. The Climate data of Alwar is shown in **Figure 2**.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C	29.0	35.0	39.9	46.4	50.6	47.3	43.8	41.2	40.1	40.6	35.6	29.7	50.6
Mean daily maximum °C	20.5	24.5	30.8	37.2	40.1	38.4	33.4	31.7	32.6	32.6	27.7	22.5	31.0
Daily mean °C	13.9	17.5	23.4	29.7	33.3	33.1	29.6	28.1	28.0	26.0	20.9	15.7	24.9
Record low °C	−0.8	2.4	7.3	11.2	15.7	20.7	20.6	20.1	16.8	12.0	6.1	1.4	−0.8
Average rainfall mm (inches)	14	17	12	12	19	72	190	223	86	15	7	5	672
Average rainy days	2	2	2	2	4	8	14	15	8	2	1	1	61
Mean daily sunshine hours	8.8	9.7	10.6	11.5	12.1	11.8	9.4	8.4	9.3	10.1	9.5	9.1	10.0

Figure 2. Climate data for Alwar (Source: India Meteorological Department [26], Climate Data[27])

Table 2. Assessed water data of Jaisamand Dam (sample were collected typical day (monthly average day) of every month at 8:00AM for year 2024)

Parame-ters. Months.'	Temp °C	pH	TDS mg/lit.	BOD mg/lit.	Alkalinity mg/lit.	Total Hardness ppm	Chlorides mg/lit	Fluo-rides mg/lit.	WQI
January	12.	7.1.	342	11	342	188	245	0.003	75
February	21.	7.1	1105	8.2	351	198	234	0.004	76
March	31	7.6.	1420	6.1	467	199	236	0.011	64
April	32	7.5	1458	6.1	534	201	254	0.023	61
May	35	7.5	1665	3.4	633	213	241	0.009	64
June	38	7.0	1867	3.2.	623	231	249	0.008	62
July	28	7.1	678	3.6	311	189	511	0.015	69
August	27	7.2	784	3.2	312	188	566	0.003	70
Septem-ber	25	7.3	698	8.6	567	187	433	0.019	67
October	22	7.4	643	8.2	568	156	431	0.009	70
Novem-ber	20	7.4	622	6.1	455	158	457	0.008	11
Decem-ber	17	7.1	345	11.2	350	189	278	0.009	70

The monthly average temperature of environment, pH, TDS, BOD, Alkalinity, total hardness, chloride and fluoride are assessed and presented in **Table 2**. The pH values from January to December for the year 2024 are presented in **Figure 3**. The lowest and highest pH values are observed in the months of June (7) and March (7.6) respectively. The average pH of the year is found to be 7.28.

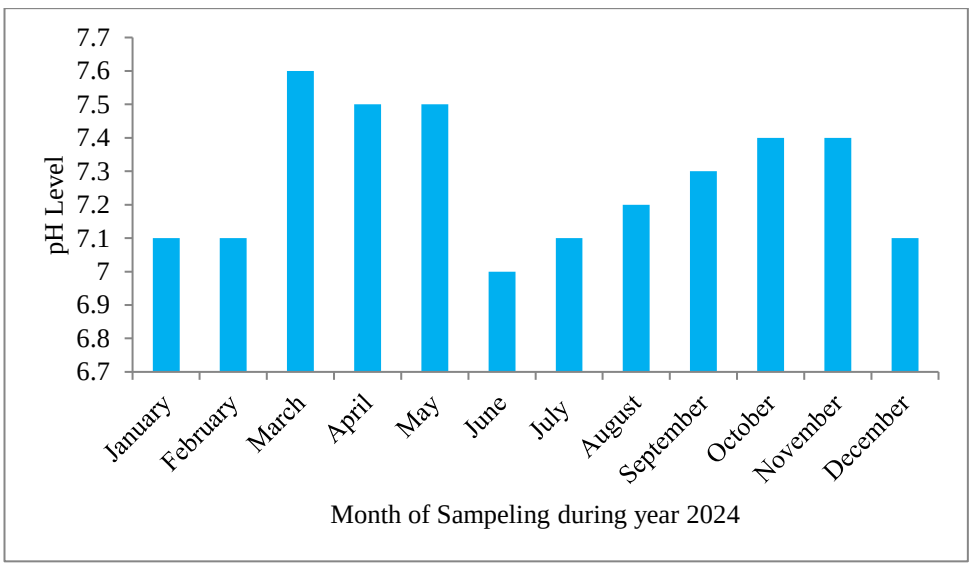

Figure 3: pH level of the. year 2024

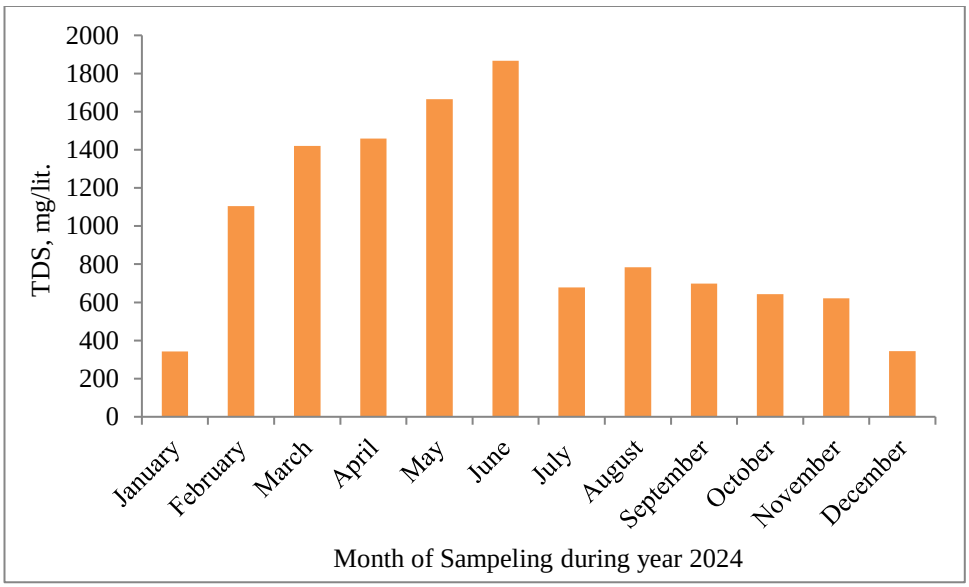

Figure 4. Monthly TDS level of the year 2024

The monthly average total dissolved solid (TDS) are shown in **Figure 4**, it is presented the 968.92mgg/ltr as average TDS of the year. The maximum and minimum TDS were observed in the months of June and January by 1867 and 342mg/ltr respectively.

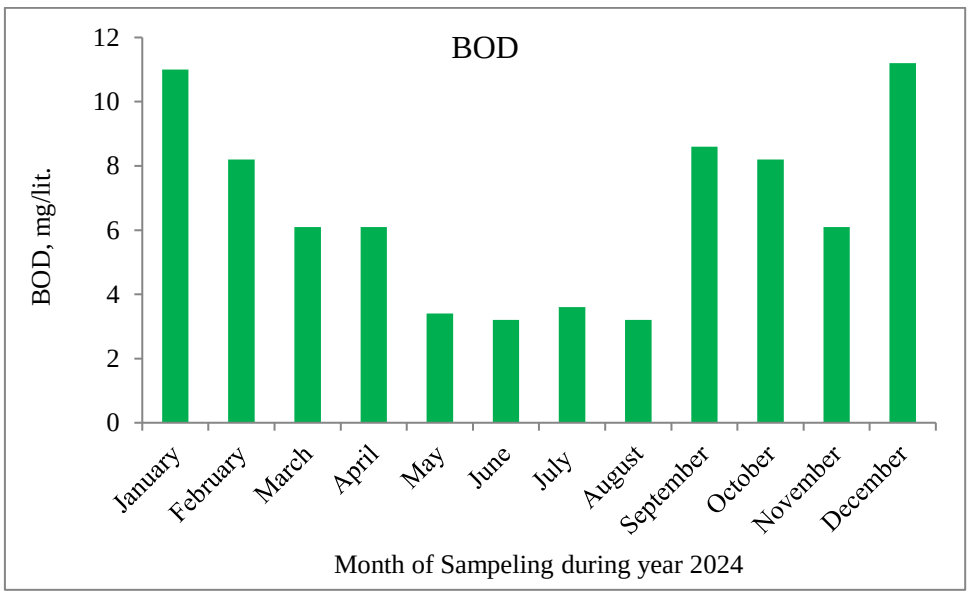

Figure 5. Monthly BOD of Jaisamand Dam water of the year 2024

The monthly average biological oxygen demand (BOD) of the Jaisamand dam is shown in **Figure 5**, it is assessed that the average BoD was 6.58mg/ltr of the year. The maximum and minimum BOD was observed in the month of December and June by 11.2 and 3.2mg/ltr respectively.

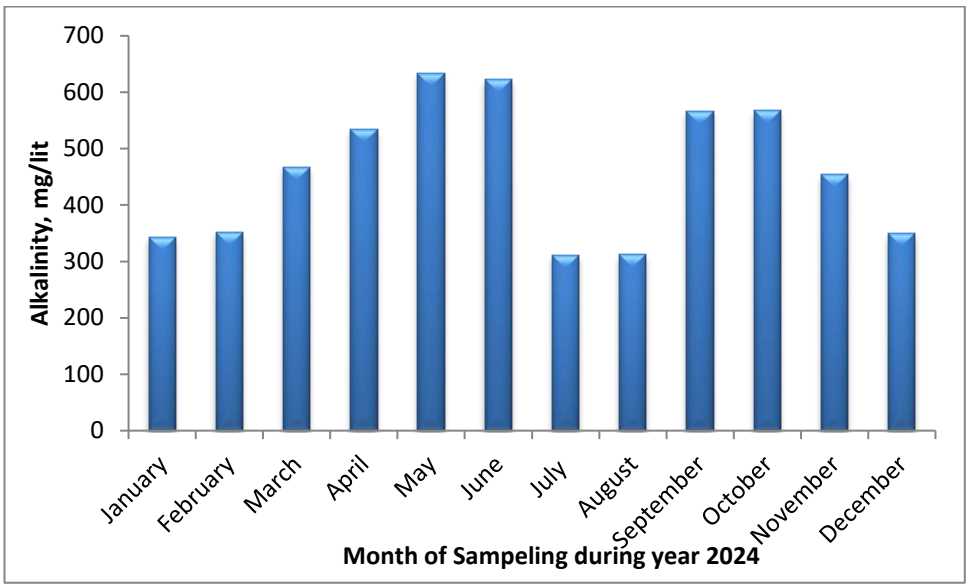

Figure 6. Monthly Alkalinity of Jaisamand Dam water of the year 2024

The monthly average Alkalinity of the Jaisamand dam is shown in **Figure 6**, it is assessed that the average Alkalinity was 459.42mg/ltr of the year. The maximum and minimum Alkalinity was observed in the month of June and January by 623 and 342 mg/ltr respectively.

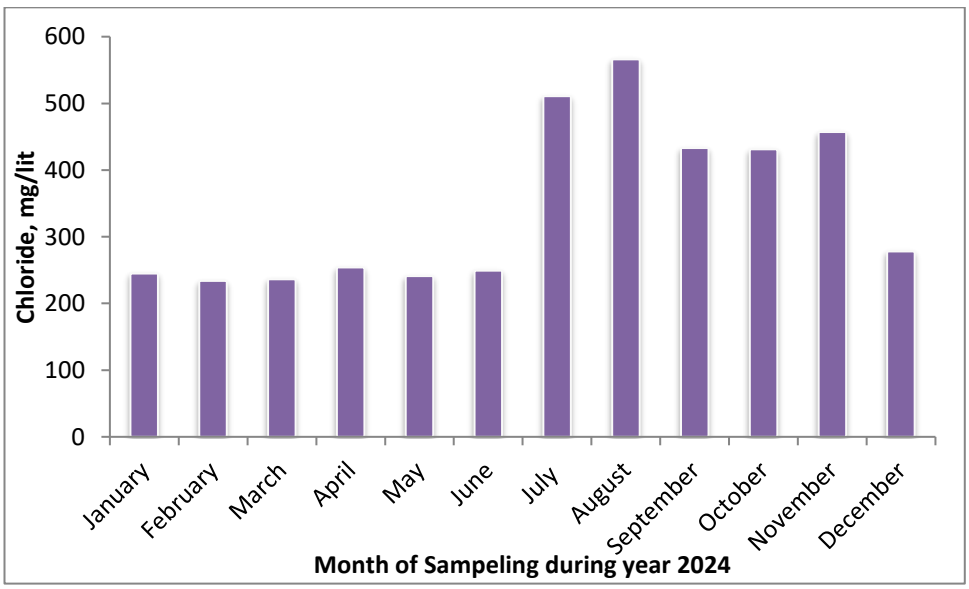

Figure 7. Chloride level in the water of Jaisamand Dam during the year 2024

Figure 7 presented the monthly variation of chloride in the water of Jaisamand Dam during the whole year of 2024. It is noticed that the maximum, minimum and average values of chloride were 566 (in the month of August), 234 (in the month of February) and 34.58mg/ltr.

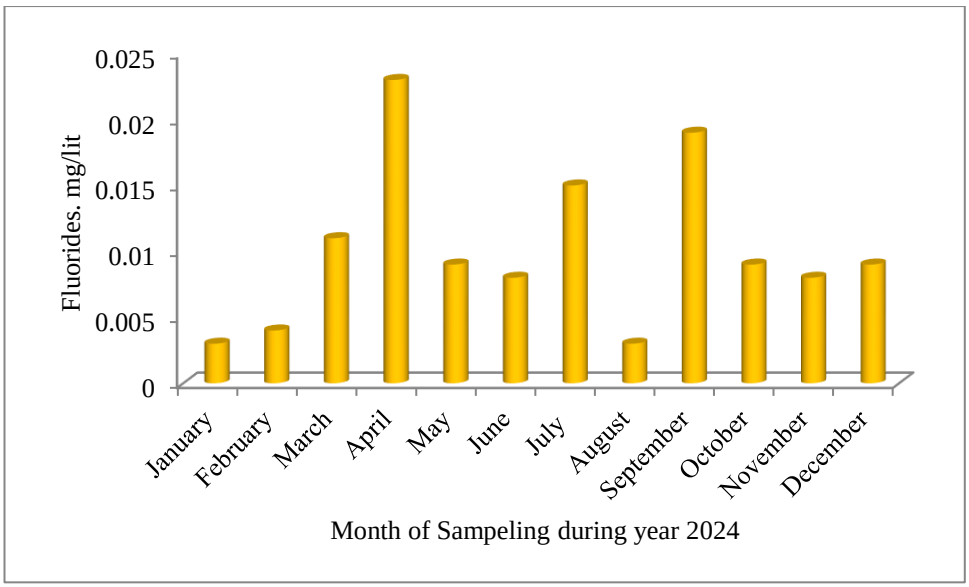

Figure 8. Fluoride level in the water of Jaisamand Dam during the year 2024

Figure 8 represents the monthly average fluoride of water of Jaisamand Dam during 2024. It is observed that the maximum and minimum fluoride was found in the months of April and January by 0.023 and 0.003mg/ltr. The average annual fluoride was assessed by 0.01mg/ltr.

The water quality index is observed as less than good quality and it comes into average quality water. So, it is useful for irrigation and fish farming.

4. Government and Institutional Efforts

- Central and State Monitoring: The Central Pollution Control Board (CPCB) and Rajasthan State Pollution Control Board (RSPCB) monitor water quality in Alwar.
- Community-Based Initiatives: There are also community efforts to improve water quality through rainwater harvesting, sanitation improvements and water filtration methods.

5. Recommendations

- Continuous monitoring of key water quality parameters like TDS, pH, nitrates, and bacteria levels.
- Strengthening regulation on industrial waste disposal and agricultural runoff.
- Educating the public on the importance of water quality, proper sanitation practices, and water conservation.

6. Conclusion

In conclusion, a comprehensive water quality assessment in Alwar is essential to ensure the sustainability of water resources and to protect the health of the population. This study on the water quality of Jaisamand Dam in Alwar, Rajasthan found that the water was polluted beyond the permissible limits set by the WHO and BIS. The study's findings included: Temperature (morning at 8AM): 12–38°C, pH: 7.0–7.6, Total alkalinity: 342–623 mg/l, Dissolved oxygen: 2–3 mg/l, Biological oxygen demand: 3–11 mg/l, Chemical oxygen demand: 14–45 mg/l, Calcium hardness: 156–231 mg/l, Turbidity: 14–31 mg/l, WQI:61-70 (Average Quality which is suitable for agriculture and fish farming) and found good in the month of January and February. The study concluded that the Dam's water quality was deteriorating due to pollution from chemicals used in agriculture purpose, sewage discharge from nearby villages and human activity.

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