



## Physico-chemical analysis of drinking water collected from different sites of Bisalpur dam during different seasons

Vijeya Gupta\*, Rakhi Sarraf

Faculty of basic and applied sciences, Maharishi Arvind University, Jaipur, Rajasthan, India

### Abstract

Water quality assessment is essential for ensuring the availability of safe drinking water and maintaining public health. The present study evaluates the physico-chemical characteristics of drinking water collected from three selected sites of the Bisalpur Dam, Rajasthan, during different seasons—summer, rainy (monsoon), and winter—over the period 2021–22 and 2022–23. Seasonal variations in key water quality parameters such as temperature, turbidity, pH, electrical conductivity, total solids, total dissolved solids, hardness, major ions (calcium, magnesium, chloride, sulphate), nutrients (nitrate and phosphate), dissolved oxygen, biological oxygen demand, chemical oxygen demand, and fluoride were analyzed using standard analytical methods. The results indicated noticeable seasonal fluctuations, with higher temperature, total solids, hardness, and BOD values during summer, while comparatively lower values were observed during winter. All analyzed parameters were found to be within permissible limits prescribed by WHO and BIS guidelines, indicating that the water quality of Bisalpur Dam remains suitable for drinking purposes throughout the study period. The findings highlight the importance of regular seasonal monitoring to ensure sustainable management of surface water resources supplying major urban and rural populations.

**Keywords:** Bisalpur dam, drinking water, physico-chemical analysis, seasonal variations etc

### Introduction

Water is one of the most vital natural resources required for human survival, ecosystem stability, and socio-economic development. The quality of drinking water directly influences human health, agricultural productivity, and industrial growth. However, increasing population pressure, urbanization, agricultural runoff, and climate variability have intensified stress on surface water resources, making water quality assessment a global concern (Kumar and Puri, 2012) [8].

Surface water bodies such as rivers, lakes, and reservoirs are highly vulnerable to seasonal and anthropogenic influences. Physico-chemical parameters including pH, temperature, turbidity, dissolved solids, hardness, and nutrient concentrations serve as key indicators of water quality and suitability for drinking purposes (APHA, 2012) [2]. Seasonal variations significantly affect these parameters due to changes in rainfall patterns, evaporation rates, runoff, and biological activity (Shaikh and Mandre, 2009) [12].

In India, surface water reservoirs play a crucial role in supplying drinking water to rapidly expanding urban centers. Bisalpur Dam, constructed across the Banas River in Rajasthan, is one of the most important multipurpose projects providing drinking water to major cities such as Jaipur and Ajmer, as well as irrigation water to extensive agricultural command areas. Given its significance, continuous monitoring of water quality is essential to ensure safe supply and to detect any early signs of deterioration (Vaidya and Gadha, 2012) [14].

Previous studies have emphasized that parameters such as dissolved oxygen, biological oxygen demand, total hardness, and nutrient load reflect the ecological health and pollution status of freshwater bodies (Meride and Ayenew, 2016; Mishra and Acharya, 2016) [9, 10]. Excessive concentrations of dissolved solids, nitrates, or fluoride can pose serious health risks, whereas acceptable levels indicate good water quality suitable for human consumption (WHO, 2017) [15].

The present study aims to assess the seasonal variations in physico-chemical characteristics of drinking water collected from different sites of Bisalpur Dam over two consecutive years. The findings provide baseline information on water quality status and contribute to sustainable water resource management in semi-arid regions like Rajasthan.

### Methodology

#### The Study Area

The Bisalpur Dam across Banas river, a tributary of Chambal river was constructed in the year 1999 to create irrigation and drinking water supply capacity. The dam is located in Tehsil Toda Raisingh, near Bisalpur in Tonk district of Rajasthan. The dam supplies drinking water to the tune of 11.1 TMC to Jaipur city and en-route villages and 5.1 TMC to Ajmer city and en-route villages. Besides, irrigation supplies from the dam is of the order of 8 TMC to 81000 ha command area in Tonk, Todaraisingh, Uniyara and Deoli tehsils through 51 Km long right main canal and 18.65 km long left main canal. The nearest town is Deoli which is situated on Jaipur-Kota NH-12. Nearest airport is Jaipur, which is 185 km away from Dam and nearest Railway station is Bundi, which is 85 km from Dam. Distance of Bisalpur Dam from district Headquarter Tonk is about 72 km. Nearest Highway to Project is Jaipur-Kota State Highway (SH 52). The Project site is 19 km from Santhali village on SH 52 and 25 km from Deoli Tehsil.

#### Collection of water samples

Water samples were collected during 3 seasons of year 2021-22 and 2022-23. Seasons for sampling were divided as summer (March to June), Rainy/Monsoon (July to October) and winter (November to February). The water samples were obtained using sanitized sampling vials with a volume of 250 ml, which were labelled with stickers. The specimens were transported to the laboratory under refrigerated

conditions and afterwards stored at a temperature of 4°C until they were to be utilized for further experimentation. Samples were collected at a distance of approximately two to three meters from the water's edge. The collection of water samples involved the utilization of pre-sterilized bottles, which were affixed to the distal end of an elongated bamboo pole. This procedure was conducted subsequent to the observation of visual cues on the water's surface, indicating the potential existence of organic substances. Upon reaching its maximum capacity, the cap was tightly affixed to the bottle. The sample bottle was affixed with a label containing pertinent information. These samples were brought to the laboratory and analysed by standard methods. During study 3 sites of Bisalpur dam were selected for the sampling. Those were mentioned as site 1, site 2 and site 3.

### Physico-chemical analysis of the collected water samples

The colour of water at different five blocks were observed by visual appearance only. A mercury-filled centigrade thermometer that was calibrated between 0°C and 100°C was used to obtain temperature readings. pH was taken with the help of an Aquasol digital pH meter on the sampling site. EC was taken with the help of an Aquasol digital EC meter on the sampling site. TDS of the collected water samples were determined by inserting calibrated TDS digital tester up to the mark in water. Total hardness was estimated by the EDTA (Ethyl diamine tetra-acetic acid) titrimetric method (Clesceri *et al.*, 1998) [5] and Aquasol total hardness testing kit (AE211). The calcium hardness was determined by titration method. (APHA, 1992) [1]. Nitrate was estimated by phenol disulphonic acid method. Total phosphorus was measured by spectrophotometric method. Turbidity method was used to determine sulphate in the collected water samples (APHA, 2012) [2]. Chloride ion was determined by Mohr's method, titration with standard silver nitrate solution in which silver chloride is precipitated first. The azide modification of Winkler's method was used for dissolved oxygen determination (Clesceri *et al.*, 1998) [5]. The difference in the dissolved oxygen measured initially and after incubation gave the BOD values of the samples (Clesceri *et al.*, 1998) [5].

### Results

Drinking water is one of the basic needs of life and essential for survival. Still more than one billion people all over the world do not have ready access to an adequate and safe water supply and more than 800 million of those unsaved live in rural areas. In India, ground water is being used as raw water for 85% public water supply (Kumar and Puri, 2012) [8].

The results of the water quality testing of Bisalpur dam are summarized in Table 1-3. The result of physicochemical analysis of three different sites of Bisalpur Dam i.e. Site 1, Site 2 and Site 3, in summer season in study period 2021-22 and 2022-23 is given in Table -1. Similarly, Table 2 includes the results of winter season, Table 3 of Rainy Season.

### Colour

Water color, as perceived by the human eye, is an intuitive and broadly applicable water measurement. Color is broadly applicable because it does not require knowledge of the inherent optical properties of water and can be directly measured by any optical imager with bands in the visible

spectrum. Water color is one of the oldest measurements of water quality (Gardner *et al.*, 2021) [7]. All the water samples collected from Site 1, Site 2 and Site 3 were found colorless during whole studied period, indicating good drinking water qualities of samples.

### Temperature

There was a general increase in temperature values which ranged between 13°C to 34°C. It was higher in summer, lower in winter and medium in rainy season. The highest temperature (34°C) was registered for Site 3 in year 2022-23 while the lowest temperature (13°C) was recorded for Site 1 in year 2021-22. The degree and annual variations in temperature of a water body have great bearing upon the condition. Temperature was found highest at Site 3 in both the studied periods in summer season while in winter it was recorded higher for Site 3 in year 2021-22 and for Site 2 in year 2022-23. For rainy season, values were higher for Site 3 in both the years. Temperature in this study was found within permissible limit of WHO. Similar results were obtained by Meride and Ayenew, (2016) [9] with average temperature 28.49 °C and with the range of 28–29 °C. Temperature showed variation with respect to season, also supported by Shaikh and Mandre, (2009) [12].

### Turbidity

Maximum turbidity 9 NTU was recorded for Site 3 and Site 2 in the year 2022-23 while lowest value 5 NTU reported for Site 1 in year 2021-22. For rainy season, highest value was 9 NTU for site 3 in the study period 2022-23 while lowest value 5 NTU was recorded for site 1 in year 2021-22. Similar results were obtained for summer season with lowest value 6 NTU and highest 9 NTU. Site 2 was recorded to have highest value of 9 NTU in year 2022-23 while Site 1 recorded to have minimum value of 6 NTU in year 2021-22 for winter season. According to present study, turbidity varied in the range 5 NTU- 9 NTU between various study sites under the WHO recommended values. Meride and Ayenew, (2016) [9] resulted with lower mean turbidity value for Wondo Genet Campus (0.98 NTU).

### Odor

All the water samples collected from Site 1, Site 2 and Site 3 were found odorless during all studied period, indicating good drinking water qualities of samples.

### pH

pH is an important water quality parameter in evaluating the acid–base balance of water. It is also the indicator of acidic or alkaline condition of water status (Meride and Ayenew, 2016) [9]. It is a measure of the intensity of acidity/alkalinity and the concentration of hydrogen ion. Among the exploration of the chemical factors, the pH plays an important role on the biotic life of a water system. The presence or absence of various ions can have direct relation with pH of the water. The alkaline nature of the water was all around the years (pH = 7.2 to 7.6). The values were lower in winter and higher in rainy and summer season. The current investigation ranges were 7.2–7.6 which is in the range of WHO standards (Vaidya and Gadhia, 2012) [14]. There is no remarkable variation of pH is found with reference to season. Present investigation was similar with reports made by another researchers' study (Edimeh *et al.* 2011; Aremu *et al.* 2011; Meride and Ayenew, 2016) [3, 6, 9].

### Electrical Conductivity (EC)

The electrical conductivity is a measurement of capability of water to transmit electric current in a water body. It represents the total concentration of soluble salts/mineral salts in water, thereby making it sour and unsuitable for drinking. Electrical conductivity (EC) values fluctuated with slight increase observed from year 2021-22 to 2022-23 at all the sites. For winter, highest EC was 600  $\mu\text{S}/\text{cm}^3$  for site 3 in study period 2022-23 while lowest value (575  $\mu\text{S}/\text{cm}^3$ ) was recorded for site 1 in year 2021-22. Site 3 found to have maximum value of EC i.e. 596  $\mu\text{S}/\text{cm}^3$  in year 2022-23 and site 2 was reported with lowest EC (545  $\mu\text{S}/\text{cm}^3$ ) in year 2021-22 in summer season. In case of rainy season, values were again highest (578  $\mu\text{S}/\text{cm}^3$ ) for site 3 in year 2022 while lowest (564  $\mu\text{S}/\text{cm}^3$ ) for site 1 in period 2021-22. The current investigation indicated that EC value was 545-600  $\mu\text{S}/\text{cm}^3$ . Similar value was reported by Soylak *et al.* (2002)<sup>[13]</sup> drinking water of turkey. These results clearly indicate that water in the study area was not considerably ionized and has the lower level of ionic concentration activity due to small dissolve solids. Concerned to season, it was found maximum in winter season compare to rainy & summer.

### Total Solids (TS)

The minimum and maximum values of total solids were 320 and 553 mg/l. This indicates that the dissolved solids were never excessive during the survey period. For summer season, maximum TS were reported for 553 mg/l for site 2 in year 2022 while and minimum (320 mg/l) for site 1 in year 2021. For winter these values are 453 mg/l (highest for site 2) and 315 mg/l (lowest for site 1) in the study period 2022-23 and 2021-22, respectively. The values were recorded highest (376 mg/l) for site 2 in year 2022 while lowest (333 mg/l) for site 3 in year 2021, for rainy season. Similar work was done by Mishra and Acharya, (2016)<sup>[10]</sup>, noted maximum of these solids during summer while the highest values were recorded in rains.

### Total Dissolved Solids (TDS)

The mean concentrations of total dissolved solids (TDS) are an important parameter in gravity flow water. Excessive amounts of dissolved solids in water can have adverse effects on the environment. The TDS ranges from (345 – 381) mg/L. Maximum TDS 593 mg/L was recorded for Site 2 in the year 2022-23 while lowest value 334 mg/L reported for Site 1 in year 2021-22. For rainy season, highest value was 381 mg/L for site 2 in the study period 2022-23 while lowest value 345 mg/L was recorded for site 3 in year 2021-22. Similar results were obtained for summer season with lowest value 452 (site 1, year 2021) and highest 593 mg/L (site 2, year 2022). Site 2 was recorded to have highest value of 483 mg/L in year 2022-23 while Site 1 recorded to have minimum value of 334 mg/L in year 2021-22 for winter season. The highest mean TDS value (538 mg/L) was observed in the summer season and annual mean was recorded as 435.56 mg/L. Similar study was conducted by Vaidya and Gadhia, (2012)<sup>[14]</sup>, found TDS in the range 472.31 to 972.50 mg/l which was within the desirable limit. The concentration of TDS (114.7 and 121.2 mg/l) was observed by Meride and Ayenew, (2016)<sup>[9]</sup> was also in accordance of current study. The highest mean TDS value (538 mg/L) was observed in the summer season while Shaikh and Mandre, (2009)<sup>[12]</sup> found quite maximum ranges in monsoon season.

### Total Suspended Solids (TSS)

Total Suspended Solids (TSS) values fluctuated from year 2021-22 to 2022-23 at all the sites. For winter, highest TSS was 6 mg/l for site 2 in study period 2021-22 while lowest value (3 mg/l) was recorded for site 1 in year 2022-23. Site 1 found to have maximum value of TSS i.e. 6 mg/l in year 2022-23 and site 3 was reported with lowest TSS (3 mg/l) in year 2021-22 in summer season. In case of rainy season, values were again highest (6 mg/l) for site 2 in year 2022 while lowest (3 mg/l) for site 1 in period 2021-22. Overall mean for TSS was maximum for Site 1 in summer season and annual mean was recorded as 4.45 mg/l. The TSS values of all study sites ranged between 3-6 mg/l and the values were within the permissible WHO and BIS limits. Results were supported by the study of Bhandari and Nayal, (2008)<sup>[4]</sup>.

### Total Hardness (TH)

Hardness generally represents the concentration of calcium ( $\text{Ca}^{2+}$ ) and magnesium ( $\text{Mg}^{2+}$ ) ions, because these are the most common polyvalent cations. Other ions, such as iron ( $\text{Fe}^{2+}$ ) and manganese ( $\text{Mn}^{2+}$ ), may also contribute to the hardness of water, but are generally present in much lower concentrations. Waters with high hardness values are referred to as "hard," while those with low hardness values are "soft". Total Hardness varied from 96 mg/l to 143 mg/l definite seasonal variation. It was higher in summer, lower in winter and medium in rainy season. The highest TH (143 mg/l) was registered for Site 1 in year 2022-23 while the lowest TH (96 mg/l) was recorded for Site 1 in year 2021-22. TH was found highest at Site 1 in the studied period 2022-23 in summer season while in winter it was recorded higher for Site 2 in year 2022-23. For rainy season, values were higher for Site 1 in the year 2022-23. Mean values for both the studied periods was found highest for Site 1 in summer season. Annual mean was recorded as 123.06 mg/l. Values were under the limits of drinking water quality guidelines of WHO and BIS. Little maximum range was found in summer season compare to monsoon & winter. Similar results were observed by Shaikh and Mandre, (2009)<sup>[12]</sup>.

### Calcium

Calcium was found in varied range throughout study period. In rainy season, maximum value was recorded as 76 mg/l at site 1 in year 2022 while minimum value was 60 mg/l for site 3 in 2021. Highest value in winter season was found to be 55 mg/l (site 2, 2022) and lowest was 45 mg/l (site 1, 2021). For summer these values were maximum 70 mg/l (site 1, 2021) and minimum 50 mg/l (site 1, 2022). Highest mean as calculated as 73 mg/l for site 1 in rainy season and annual mean was 58.67 mg/l. Results were under the limits of WHO and BIS guidelines showing good water quality for drinking purpose. Meride and Ayenew, (2016)<sup>[9]</sup> also supported the results of present study.

### Magnesium

Magnesium, in rainy season reported with maximum value as 35 mg/l at site 1 in year 2022 while minimum value was 20 mg/l for site 2 in 2021. Highest value in winter season was found to be 25 mg/l (site 3, 2022) and lowest was 11 mg/l (site 1, 2021). For summer these values were maximum 32 mg/l (site 1, 2021) and minimum 21 mg/l (site 3, 2021). Highest mean as calculated as 32.5 mg/l for site 1

in rainy season and annual mean was 24.5 mg/l. All values were as per guidelines of WHO and BIS, indicating its good drinking water quality. Vaidya and Gadhia, (2012) <sup>[14]</sup> also found magnesium below the desirable limit in their study.

### Nitrate

Nitrate is a colorless, odorless and tasteless compound. Nitrate (NO<sub>3</sub>) is highly soluble (dissolves easily) in water and is stable over a wide range of environmental conditions. It is easily transported in streams and groundwater. Nitrates are used as feed by plankton (microscopic plants and animals that live in water), aquatic plants, and algae, which are then eaten by fish. Nitrite (NO<sub>2</sub>) is relatively short-lived in water because it is quickly converted to nitrate by bacteria. In addition, nitrates from agricultural runoff and the oxidation of ammonia are problematic in drinking water. In the study area nitrate level varies between 0.3 – 0.9 mg/L. Values were found higher in rainy season. All values are under permissible limits. The results of Meride and Ayenew, (2016) <sup>[9]</sup> were in accordance with present study with nitrate range from 1.42 to 4.97 mg/l in Wondo Genet campus with an average value of 2.67 mg/l. These results indicate that the quantity of nitrate in the study site is acceptable in Wondo Genet campus.

### Phosphate

Phosphate is the natural source of phosphorous, an element that provides a quarter of all the nutrients that plants need for their growth and development. It was Non-Traceable in all the selected sites in all the seasons during the study period. Phosphates are not toxic to people or animals unless they are present in very high levels. Digestive problem could occur from extremely high level of phosphate (Kumar and Puri, 2012) <sup>[8]</sup>. It was non-traceable in the present study.

### Sulphate

Sulfates are a combination of sulfur and oxygen and are a part of naturally occurring minerals in some soil and rock formations that contain groundwater. The mineral dissolves over time and is released into groundwater. Sulfate (SO<sub>4</sub>) occurs in almost all-natural water. Sulfate is one of the major dissolved constituents in rain. High concentrations of sulfate in drinking water cause a laxative effect when combined with calcium and magnesium. The Sulfate content in the water samples ranges from 46 – 80 mg/L which is under the permissible level. Results of present study were in accordance with study of Meride and Ayenew, (2016) <sup>[9]</sup>.

### Chloride

Chloride is a salt compound resulting from the combination of Chlorine gas and a metal. In the study area chloride value ranges between 67 to 110 mg/l. Chloride in surface and groundwater from both natural and anthropogenic sources, such as run-off containing road deicing salts, the use of inorganic fertilizers, landfill leachates, septic tank effluents, animal feeds, industrial effluents, irrigation drainage, and seawater intrusion in coastal areas. All values are under permissible limits. Soylak *et al.* (2002) <sup>[13]</sup> and Meride and Ayenew, (2016) <sup>[9]</sup> was reported similar value of drinking water of Turkey.

### Dissolved Oxygen (DO)

DO was found in range of 4 mg/l-7 mg/l in the study period of 2021-22 and 2022-23. In rainy season, maximum value was recorded as 7 mg/l at site 1 in year 2022 while minimum value was 6 mg/l for site 3 in 2021. Highest value in winter season was found to be 5.6 mg/l (site 3, 2021) and lowest was 4.5 mg/l (site 3, 2022). For summer these values were maximum 5.1 mg/l (site 2, 2022) and minimum 4 mg/l (site 3, 2021). Highest mean as calculated as 6.9 mg/l for site 1 in rainy season and annual mean was 4.65 mg/l. Results were under the limits of WHO and BIS guidelines showing good water quality for drinking purpose. DO found in studied water samples in the range 4 to 7 mg/L. Seasonal and site wise remarkable variation was not found. Present study supported by Mishra and Acharya, (2016) <sup>[10]</sup> and Shaikh and Mandre, (2009) <sup>[12]</sup>.

### Biological Oxygen Demand (BOD)

The range for BOD was 1.0- 4.7 mg/l in the present study. In rainy season, maximum value was recorded as 2.9 mg/l at site 1 in year 2022 while minimum value was 2.1 mg/l for site 2 and site 3 in 2021 & for site 2 in 2022. Highest value in winter season was found to be 1.9 mg/l (site 1, 2022) and lowest was 1 mg/l (site 3, 2021). For summer these values were maximum 4.7 mg/l (site 1, 2021) and minimum 3.5 mg/l (site 3, 2022). Highest mean as calculated as 4.30 mg/l for site 1 in summer season. As being the parameters of pollution, the higher load of them produce obnoxious conditions in the environment and they are directly concerned with the productivity (Mishra and Acharya, 2016) <sup>[10]</sup>. The range for BOD was 1.0- 4.7 mg/l in the present study. All values were as per guidelines of WHO and BIS, indicating its good drinking water quality. Similar study was done by Sarda and Sadgir, (2015) <sup>[11]</sup>.

### Chemical Oxygen Demand (COD)

The COD values were observed upto 1.7- 3.8 mg/l, displaying good water quality. For rainy season, highest value was recorded as 1.7 mg/l at site 2 in year 2022 while lowest value was 1.2 mg/l for site 3 in 2021. Maximum value in winter season was found to be 2.6 mg/l (site 2, 2022) and minimum was 1.7 mg/l (site 1, 2021). In summer these values were maximum 3.8 mg/l (site 2, 2022) and minimum 2.4 mg/l (site 1, 2021). Highest mean was recorded as 3.5 mg/l for site 2 in summer season and annual mean was 2.24 mg/l. Shaikh and Mandre, (2009) <sup>[12]</sup> supported the present study. In their study they found the COD values ranges from 2.8 to 6.2 mg/L. Seasonally no remarkable findings but borewell water sample showed less (within permissible limit) compare to remaining all studied water samples while beyond permissible limit was found in water samples of wells.

### Fluorides

High fluoride groundwater leads a health threat to millions of people around the world. Fluoride is a key aspect of water quality in rural water supply system, which potentially affects the sustainability of water if it exceeds its prescribed limit. India is among the 23 nations around the globe where health problems occur due to the consumption of fluoride contamination water and the extent of fluoride contamination in water varies from 1.0 to 400 mg/l (Kumar and Puri, 2012) <sup>[8]</sup>. In the study area Fluoride level varies between 0.2 – 0.8 mg/L. All are under permissible limits.

**Table 1:** Water parameters (Bisalpur dam) at different sites in Summer Season in the year 2021-22 and 2022-23

	2021-22			2022-23		
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
Colour	(colorless)	(colorless)	(colorless)	(colorless)	(colorless)	(colorless)
Temperature (°C)	30	30	32	30	31	34
Turbidity (NTU)	6	7	8	8	7	9
Odour	odourless	odourless	odourless	odourless	odourless	odourless
pH	7.6	7.5	7.4	7.5	7.4	7.5
EC ( $\mu\text{S}/\text{cm}^3$ )	553	545	560	584	569	596
TS (mg/l)	320	450	330	325	553	430
TDS (mg/l)	452	483	496	550	593	500
TSS (mg/l)	5	4	3	6	5	5
TH (mg/l)	141	134	130	143	138	142
Ca (mg/l)	70	64	60	50	55	53
Mg (mg/l)	32	28	21	30	24	28
Nitrate (mg/l)	0.9	0.8	0.6	0.9	0.9	0.8
Phosphate (mg/l)	NT	NT	NT	NT	NT	NT
Sulphate (mg/l)	56	53	64	63	57	69
Chloride (mg/l)	98	81	85	110	87	89
DO (mg/l)	4.5	5.0	4.0	4.8	5.1	4.3
BOD (mg/l)	4.7	4.1	4.1	3.9	3.6	3.5
COD (mg/l)	2.4	3.2	2.8	3.6	3.8	3.0
Fluorides (mg/l)	0.5	0.5	0.4	0.6	0.5	0.6

**Table 2:** Water parameters (Bisalpur dam) at different sites in Winter Season in the year 2021-22 and 2022-23

	2021-22			2022-23		
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
Colour	(colorless)	(colorless)	(colorless)	(colorless)	(colorless)	(colorless)
Temperature (°C)	13	17	15	15	17	18
Transparency						
Turbidity (NTU)	6	7	8	7	9	8
Odour	odourless	odourless	odourless	odourless	odourless	odourless
pH	7.3	7.4	7.2	7.4	7.5	7.4
EC ( $\mu\text{S}/\text{cm}^3$ )	575	586	594	584	590	600
TS (mg/l)	315	421	425	325	453	430
TDS (mg/l)	334	479	476	350	483	480
TSS (mg/l)	4	6	4	3	4	5
TH (mg/l)	96	101	98	100	105	104
Ca (mg/l)	45	51	48	50	55	53
Mg (mg/l)	11	18	21	14	20	25
Nitrate (mg/l)	0.4	0.3	0.3	0.6	0.4	0.3
Phosphate (mg/l)	NT	NT	NT	NT	NT	NT
Sulphate (mg/l)	59	48	46	64	50	51
Chloride (mg/l)	100	89	78	108	93	89
DO (mg/l)	5.1	4.9	5.6	5.4	5.0	4.5
BOD (mg/l)	1.4	1.2	1.0	1.9	1.6	1.5
COD (mg/l)	1.7	2.3	1.9	2.1	2.6	2.2
Fluorides (mg/l)	0.2	0.5	0.3	0.4	0.6	0.5

**Table 3:** Water parameters (Bisalpur dam) at different sites in Rainy Season in the year 2021-22 and 2022-23

	2021-22			2022-23		
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
Colour	(colorless)	(colorless)	(colorless)	(colorless)	(colorless)	(colorless)
Temperature (°C)	26	26	27	28	27	28
Transparency						
Turbidity (NTU)	5	7	8	6	8	9
Odour	odourless	odourless	odourless	odourless	odourless	odourless
pH	7.5	7.6	7.5	7.6	7.4	7.6
EC ( $\mu\text{S}/\text{cm}^3$ )	564	567	568	570	574	578
TS (mg/l)	340	366	333	350	376	340
TDS (mg/l)	352	378	345	358	381	350
TSS (mg/l)	3	4	4	4	6	5
TH (mg/l)	131	126	124	140	132	130

Ca (mg/l)	70	64	60	76	68	64
Mg (mg/l)	30	20	24	35	28	32
Nitrate (mg/l)	0.8	0.8	0.7	0.9	0.8	0.8
Phosphate (mg/l)	NT	NT	NT	NT	NT	NT
Sulphate (mg/l)	76	73	74	80	79	76
Chloride (mg/l)	83	68	67	91	79	76
DO (mg/l)	6.8	6.5	6.0	7.0	6.7	6.3
BOD (mg/l)	2.7	2.1	2.1	2.9	2.1	2.3
COD (mg/l)	1.4	1.4	1.2	1.6	1.7	1.4
Fluorides (mg/l)	0.8	0.5	0.6	0.8	0.6	0.7

## Conclusion

The present investigation provides a comprehensive assessment of the physico-chemical characteristics of drinking water from Bisalpur Dam across different seasons during the study period 2021–22 and 2022–23. The results clearly indicate that seasonal variation plays a significant role in influencing water quality parameters, with higher values of temperature, total solids, hardness, and organic load observed during summer, while comparatively lower values were recorded during winter.

All analyzed parameters, including pH, electrical conductivity, total dissolved solids, hardness, major ions, nutrients, dissolved oxygen, biological oxygen demand, chemical oxygen demand, and fluoride, were found to be within the permissible limits prescribed by WHO and BIS standards. The absence of detectable phosphate and the low concentrations of nitrate further indicate minimal nutrient pollution and good ecological condition of the reservoir.

Overall, the water quality of Bisalpur Dam remains suitable for drinking purposes throughout the year, supporting its continued use as a major drinking water source for Jaipur, Ajmer, and surrounding rural areas. However, regular monitoring is strongly recommended to detect any future changes due to increasing anthropogenic activities and climatic variability. Continuous assessment will help in maintaining water quality, ensuring public health safety, and promoting sustainable management of this vital surface water resource.

## References

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