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Assessment of water quality in freshwater Chacha Kota Banswara, Rajasthan

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Abstract
Ponds are known to have a higher species variety. Many aquatic creatures and plants call them home. The study aims to compare the water quality in the Chacha Kota to provide a baseline for managing and conserving this aquatic species and to help enhance the quality of water biodiversity. Chacha Kota is a small village/hamlet in Banswara Tehsil in Banswara District of Rajasthan State, India. It is a fish habitat, mostly for carp. Water samples were taken monthly from study locations from Dec 2019 to Nov 2020 during the study period. The samples were maintained per APHA's preservation protocol, and analysis was performed per established procedures. Major water parameters such as Temperature (16.35 °C to 32.45 °C.), DO (2.5 mg/l to 9.05 mg/l.), BOD (1.5 mg/l to 4.6 mg/l), Free CO_2 (0.15 mg/l to 5.65 mg/l), pH value (5.65 to 8.5), Total alkalinity (87 mg/l to 255.7 mg/l), Nitrate (0.487 mg/l to 0.825 mg/l) and Phosphate (0.215 mg/l to 1.86 mg/l) were recorded. Significant correlation coefficient (r) Temperature–alkalinity (0.9115), Temperature–BOD (0.957), Temperature–Free CO_2 (0.956), Temperature–Nitrate (0.943), Alkalinity–BOD (0.855) Alkalinity-Free CO_2 (0.927), Alkalinity-Nitrate (0.888), BOD-Free CO_2 (0.932), BOD-Nitrate (0.891), Free CO_2-Nitrate (0.958) was observed between the physico-chemical parameters.

Keywords: Physico-chemical parameter, Banswara, freshwater, Chacha Kota, Pisciculture, Rajasthan, water quality

Introduction
Freshwater resources such as ponds, rivers, and dams are used for various reasons, including agricultural, industrial, home, and environmental operations. Freshwater resources are highly vital to life on Earth. In our country, the number of dams, reservoirs, tanks, and so on is growing (Bhalerao, 2012) [1]. Water quality influences the ecological quality of a pond. Water sustains life on this planet, woven throughout the entire fabric of existence. Water is necessary for all living things, from bacteria to humans. All water resources are perilous due to uncontrolled development and industry (Sugunan, 1995) [2]. Water quality is defined by many physicochemical criteria, which vary significantly according to a variety of variables such as water source, kind of pollution, seasonal fluctuations, and human activities (Sharma *et al*., 2017; Singh *et al*., 2002; Parikh & Mankodi, 2012) [3-5]. Humans rely on water for home purposes, irrigation, sanitation, and waste disposal. The quality and quantity of surface water bodies such as lakes and tanks are determined by the climate, catchments, topography of the area, and the natural and manufactured inputs and outputs (Gray, 1994) [6]. This research aims to determine the physicochemical state of Chacha Kota. in terms of water physicochemical properties. As a result, some information is received via the physicochemical properties of water in the Chacha Kota.

Materials and Methods
Study area
Chacha Kota is a small Village/hamlet in Banswara Tehsil in Banswara District of Rajasthan State, India. It comes under Chacha Kota Panchayath. It is located 14 km East of Banswara District, in the backwater of Mahi Dam. The latitude and longitude of Chacha Kota Banswara are 23.5461° N and 74.4409° E. This pond's catchment area is 845 hectares.

Fig 1: Study Site Chacha Kota.

The villagers also acquire water from some of the natural water sources - One river, Two canals and Two springs. Chacha Kota is also surrounded by Two lakes. It also serves as its catchment region. This pond is made of dirt. It is helpful for irrigation and household usage. This pond has a total command area of 2,088 acres.

Collection of samples

Water samples were collected from research locations at monthly intervals from December 2019 to November 2020. Temperature, DO, BOD, Free CO_2, pH value, Total alkalinity, Nitrate, and Phosphate were among the physicochemical properties of pond water examined at the location. pH, Temperature, DO, Free CO_2, Total alkalinity, Nitrate, and Phosphate were determined following APHA, 1975 [7]; Golterman *et al*., 1978 [8] and Welch, 1948. The samples were fixed in the field and titrated in the laboratory.

Result and Discussion

Temperature: Surface water temperatures in the research region ranged from 16.35 °C to 32.45 °C at site A and from 20.4 °C to 30.10 °C at site B. Indian Major Carps survive in temperatures ranging from 20 °C to 37 °C. Still, most trout and salmon perish when temperatures surpass 25.7 °C (Gupta *et al*., 2006) [10]. Singh *et al*. (2017) [11] discovered comparable limnological values in wetlands in West Bengal's 24 South Parganas district. The water temperature does not fluctuate significantly due to the enormous size of the bodies of water.

pH: The pH varied from 5.65 to 8.5 at site A and 5.4 to 7.5 at site B in the present research. Juliva Fishery and Mori Beel have pH values ranging from 5.89 to 6.30 and 5.88 to 6.15, respectively. The pH is lower in somewhat undisturbed areas and higher in places where human activities are ongoing (Devi, 2022) [12]. The pH was higher where clothes were washed and lower where livestock waste was disposed of, but generally, the pH was the same and was slightly alkaline, which is ideal for fish culture.

Dissolved oxygen: DO levels in the current study varied from 2.5 mg/l to 9.05 mg/l at site A and 3.7 mg/l to 9.2 mg/l at site B. The greatest dissolved oxygen concentration was 9.36 mg/l in Pagara, while the lowest was 6.84 mg/l in Ladsore (Arasu *et al*., 2007) [13]. Summer's low dissolved oxygen levels might be attributed to high temperatures, which diminish oxygen solubility.

Total alkalinity: During the current study, monthly changes were detected, with total alkalinity increasing (255.7 mg/l) in April and decreasing (87 mg/l) in August at Chacha Kota sites A and B, with values ranging from 182 to 257 mg/L. The deterioration of plants and other organisms and organic waste may contribute to the increase in carbonate and bicarbonate, and so alkalinity. The concentration of nutrients enhanced the alkalinity of water throughout the summer (Shinde *et al*., 2010) [14], but it reduced during the monsoon owing to the dilution of rains (Ojha *et al*., 2019) [15].

Free CO_2: During the current study, free CO_2 levels increased by 5.65 mg/l in July and fell by 0.15 mg/l in December at site A and by 1.92 mg/l and 8.20 mg/l at site B. Free CO_2 levels at Banswara's Patela Pond ranged from 0.45 ppm in October to 3.30 ppm in August (Joshi, 2019) [16]. The concentration of free carbon dioxide is affected by organism respiration (plants and animals) and photosynthetic rate. More carbon dioxide will be used if photosynthesis is increased by 1.5 mg/l - 4.6 mg/l.

BOD: The maximum BOD value during the current study was 4.6 mg/l, while the lowest BOD value was 1.5 mg/l at site A and 0.98 mg/l-0.61 mg/l at site B. In Virla Reservoir, the concentrations ranged from 3.26 mg/l to 5.53 mg/l. It reached its lowest point in January and its most significant in August. It has a detrimental relationship with transparency and dissolved oxygen (Pathak & Mudgal, 2005) [17]. High temperatures do have a role in enhancing the rate of oxidation.

Nitrate: During the current study, the maximum nitrate value was 0.825 mg/l, while the lowest nitrate value was 0.487 mg/l at site A and 0.72 mg/l - 0.56 mg/l at site B. These findings are comparable to those of Rana *et al*. (2016) [18], who discovered that Nitrate levels ranged from 0.20 mg/lit to 0.21 mg/lit. Nitrates are mainly derived from anthropogenic sources. The high level of nitrates in water samples may be related to the accumulation of waste near water sources and the overuse of nitrogenous fertilisers in agriculture.

Phosphate: During the current study, the maximum phosphate value was 1.86 mg/l at site A, and the lowest phosphate value was 0.215 mg/l at site B. Because phosphorus in water is mainly obtained from home and industrial effluents and agricultural runoff, its high concentration implies pollution. Even though it is present in low quantities, this nutrient is required for autotrophic development and biological production in aquatic habitats (Borkar & Deshmukh, 2018) [19]. (Table 1).

Table 1: The monthly average of physico-chemical parameters in various samples collected from different sites at Chacha Kota of Banswara District, Rajasthan, from December 2019 to November 2020.

SN.	Parameters	Site A	Site B
1	Temperature	32.45 °C±16.35 °C	30.1 °C±20.4 °C
2	pH	8.5±5.65	7.5±5.4
3	DO	2.5 mg/l±9.05 mg/l.	9.2 mg/±13.7 mg/l
4	Total Alkalinity	255.7 mg/l±/l 87 mg/l	257 mg/l±182 mg/l
5	BOD	4.6 mg/l±1.5 mg/l	0.98 mg/l±0.61 mg/l
6	Free CO_2	5.65 mg/l±0.15 mg/l	8.20 mg/l±1.92 mg/l
7	Nitrate	0.825 mg/l±0.487 mg/l	0.72 mg/l±0.56 mg/l
8	Phosphate	1.86 mg/l±0.215 mg/l	1.40 mg/l±1.20 mg/l

Correlation between water quality parameters

Pearson's correlation analysis (r) determines how closely two quantitative variables are connected linearly. It expresses the magnitude of a linear pair of variables in one sentence. The value of the connection ranges from -1 to +1, with +1 being an absolute perfect positive linear relationship, 0 representing no linear relationship, and -1 describing a definite inverse relationship between the bivariates (Indu *et al*., 2015) [20]. The sign in front of the correlation coefficient value determines the direction of the association. Pearson correlation coefficients were calculated to understand better the linkage and relationship of various physical and chemical characteristics in the Chacha Kota in the Banswara District of Rajasthan. The Pearson correlation matrix was computed for several physicochemical characteristics (Temperature, DO, Free CO_2, pH value, Total alkalinity, Nitrate and Phosphate).

During the experiment, a substantial positive association and a documented negative correlation between BOD and DO were discovered, implying that as BOD increases, so does DO. Analysing the preceding data provides insight into a single parameter's impact on other parameters. These correlation coefficient values may be used to calculate the concentration of water quality indicators in water samples using an equation expressing linearity Y = Ax + B (Mgbemena *et al*., 2021) [21].

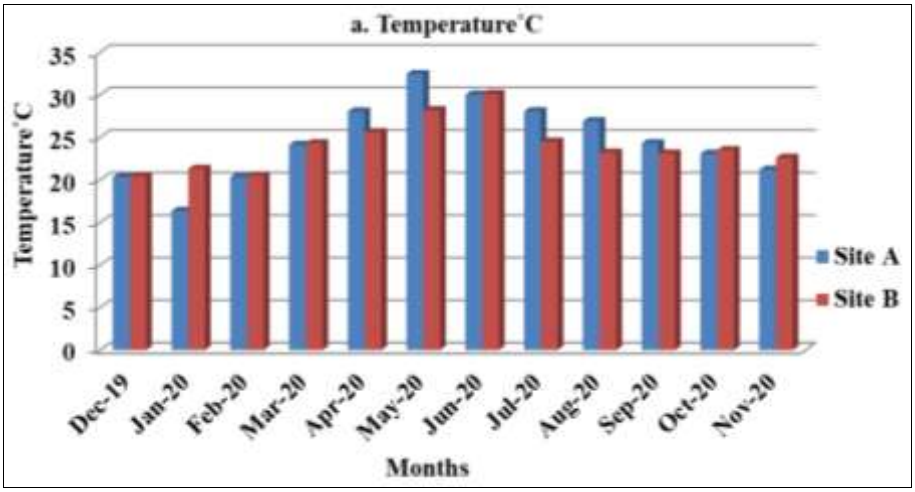
The relationship is legitimate when the parameters' correlation coefficients are truly equal to one. Such parameter dependency was discovered between various parameters measured, as evidenced by the correlation coefficient values presented in (Table 2). Temperature-pH (r =0.835), Temperature-alkalinity (r =0.9115), Temperature-BOD (r =0.957), Temperature-Free CO_2 (r =0.956), Temperature-Nitrate (r =0.943), pH-alkalinity (r=0.874), pH-BOD (r=0.866), pH-Free CO_2 (r=0.831) are all very significant and favourable correlations. This implies that the presence of alkalinity, BOD, free CO_2, and nitrate in the research locations significantly impacts temperature and pH.

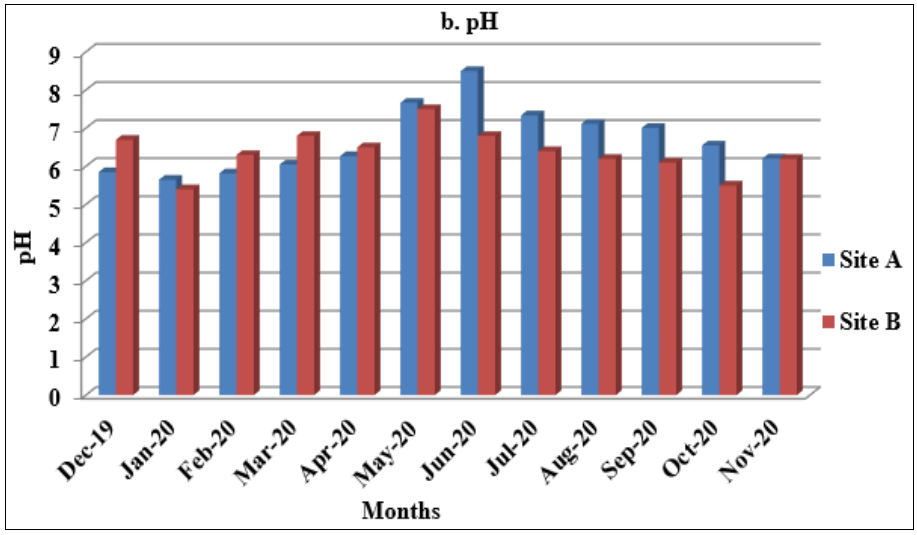
Alkalinity was positively and strongly linked with BOD (r = 0.855), Free CO_2 (r = 0.927), and nitrate (r = 0.888). BOD-Free CO_2 (r = 0.932), BOD-Nitrate (r = 0.891), Free CO_2 - Nitrate (r = 0.958). BOD and alkalinity have a substantial relationship with temperature, pH, free CO_2, and nitrate.

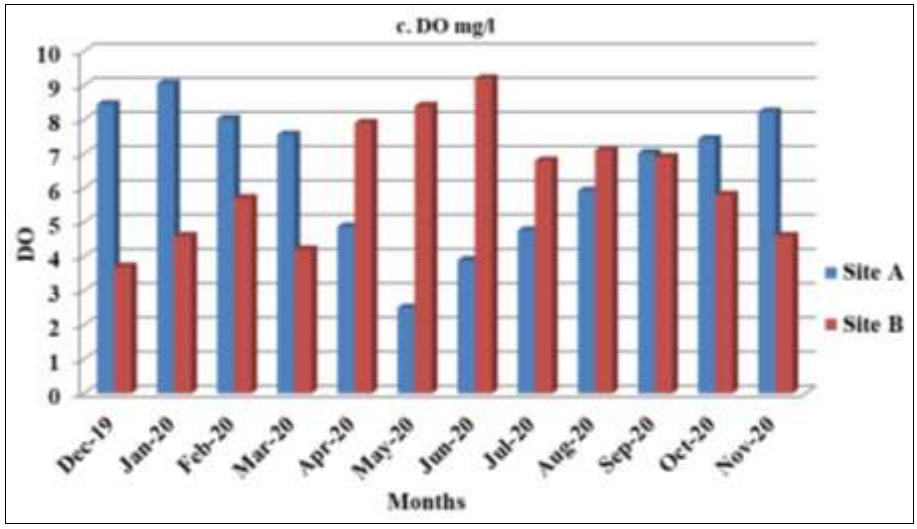
Figure 2 (a to g) depicts the monthly average of physicochemical parameters obtained from two locations in Banswara District (Raj) throughout the research period at Chacha Kota.

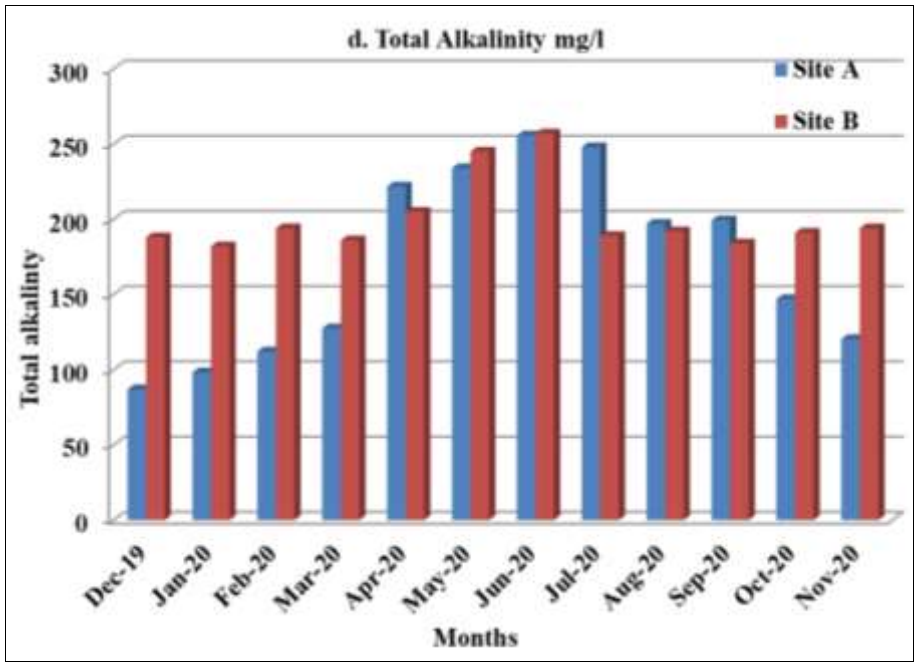
Table 2: Pearson's Correlation (r) values between the physico-chemical parameters at the two points sampled.

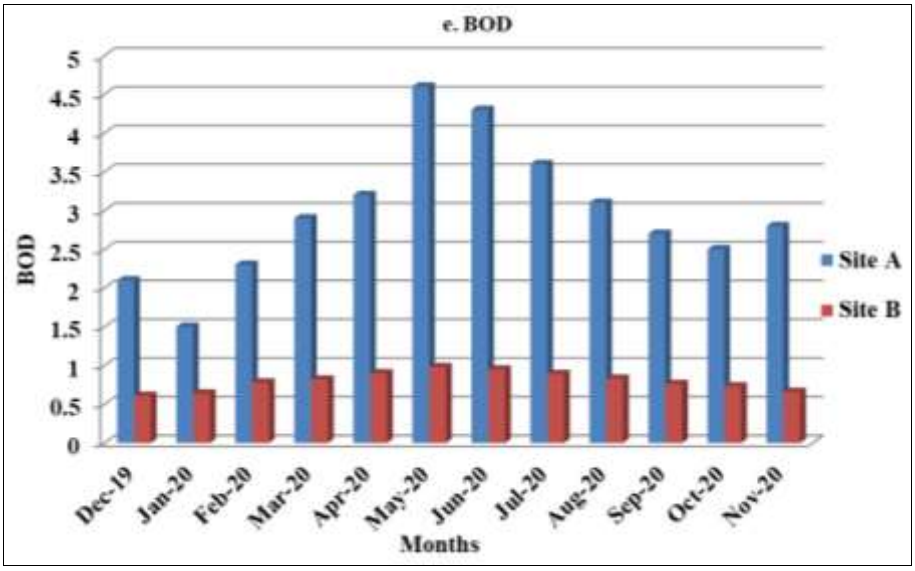
Parameters	Temperature	pH	DO	Total Alkalinity	BOD	Free CO_2	Nitrate	Phosphate
Temperature	1							
pH	0.835207	1						
DO	-0.96904	-0.83355	1					
Total Alkalinity	0.911582	0.874657	-0.91799	1				
BOD	0.957938	0.866073	-0.9463	0.855634	1			
Free CO_2	0.956005	0.831244	-0.97855	0.927919	0.93265	1		
Nitrate	0.943641	0.751361	-0.96597	0.88899	0.891682	0.958147	1	
Phosphate	0.481401	0.053855	-0.46441	0.283374	0.44367	0.459388	0.517988	1

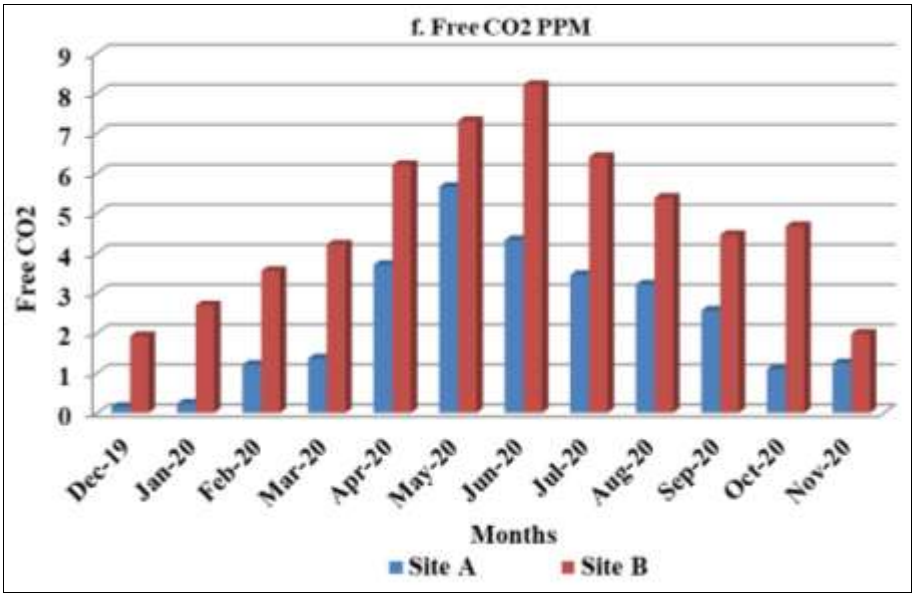



b. pH
pH
0
1
2
3
4
5
6
7
8
9
Dec-19
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Months
Site A
Site B


c. DO mg/l
DO
0
1
2
3
4
5
6
7
8
9
10
Dec-19
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Months
Site A
Site B


d. Total Alkalinity mg/l
Total alkalinty
0
50
100
150
200
250
300
Dec-19
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Months
Site A
Site B





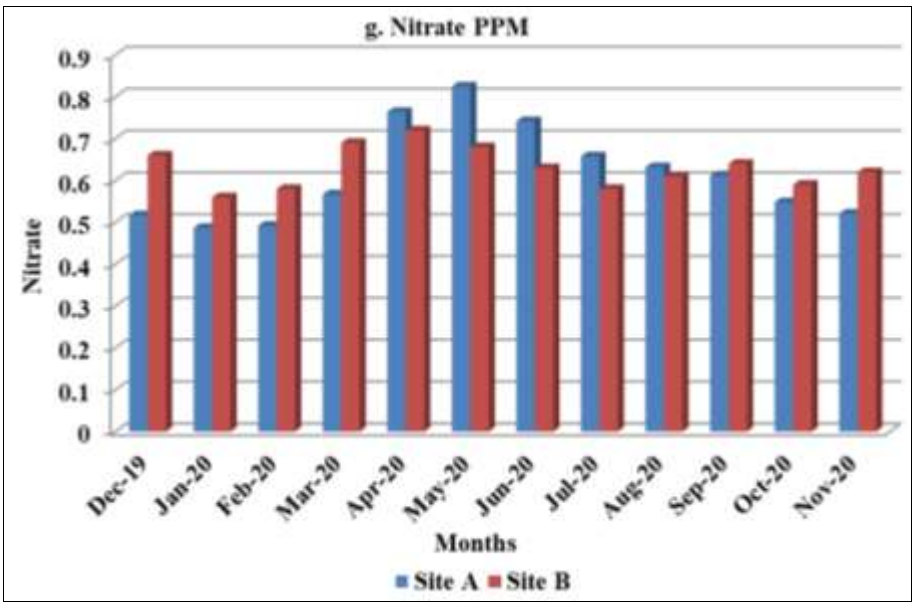


Fig 2 (a to g): The monthly average of physico-chemical parameters in various samples Collected from two sites at Chacha Kota of Banswara District, Rajasthan, from December 2019 to November 2020.

Conclusion

The water quality of Chacha Kota in Banswara tehsil (Banswara district, Rajasthan) was assessed, and a comparison of some significant physicochemical parameters such as temperature, pH, DO, BOD, total alkalinity, Nitrate, and Phosphate was performed. Analysing physicochemical properties is critical for testing water before it is utilized for home, agriculture, industrial, or other purposes.

As a result, testing the quality of residential and drinking water is essential. As a result, the Chacha Kota water must maintain adequate levels of these parameters (Temperature, BOD, pH, Total alkalinity, Free CO_2, and nitrate). This is due to sewage, municipal garbage, and home effluents dumped into the water body, as well as excessive face pollution and unsanitary human activities such as washing. As a result, the ponds are dangerous for human consumption, such as drinking, washing, bathing, and other activities. The following control procedures are necessary to safeguard the ponds' water bodies. Further research (based on water quality evaluation using physicochemical parameters) is also suggested, aiding fish culture and irrigation in Chacha Kota.

It would also help farmers maintain optimum water quality in fishponds to produce larger and healthier fish for human consumption while also generating a profit. To guarantee long-term usage, some fish species in restricted numbers in their natural water bodies should be transferred to artificial ponds, reproduced, and reintroduced into their natural habitat.

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