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Seasonal Variations in Physicochemical Parameters of Kishan Kareri Wetland in Chittorgarh District of Southern Rajasthan, India

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ABSTRACT: This Kishan Kareri wetland is one of the 44 wetlands of the state recently declared by the government of Rajasthan in the year 2023, known for its avifaunal and aquatic biodiversity. This study was carried out for physicochemical parameter variations during all four seasons of 2023. The water samples were collected from three different stations every month. Standard methods were applied during the sampling, collecting, and analyzing various parameters. Physicochemical parameters that were analyzed are temperature, transparency, pH, Electrical Conductivity, TDS, Hardness, DO, BOD, COD, and Alkalinity. This wetland is a pollution-free site. Minerals and nutrient levels in the water of this wetland are very high as it supports very rich biodiversity. Awareness of local NGOs, this wetland is very well managed and protected from any anthropogenic activities which make it a well-conserved, biodiversity-rich, and suitable habitat for aquatic biodiversity.

Keywords: Physicochemical parameter, Wetland, Aquatic birds, Biodiversity, Kishan Kareri.

INTRODUCTION

The wetland ecosystem is one of the most diverse and productive ecosystems in the world and is the most vital factor for the existence of all living organisms (Ramachandran *et al*., 2006). The health of wetlands and their ecological functioning are directly related to the survival of aquatic organisms (Ramesh *et al*., 2007). To conserve these valuable resources and prevent further deterioration, there is a need for regular monitoring of these ecosystems (Ramachandran *et al*., 2006). Some works on the water quality of various aquatic environments were those of Gogoi *et al.* (2019); Das *et al*. (2024); Rameshkumar *et al.* (2019); Singh *et al*. (2022). The very first step towards conserving and managing the wetland-like aquatic habitat is to monitor water quality parameters, their physicochemical parameters, and their fluctuations during various seasons. Till now, research related to physicochemical parameters and seasonal variations has been done at a high level in different parts of India and very few studies have been done on the wetlands of Rajasthan state in northern India, and even in Rajasthan, no work related to this has been done on Kishan Kareri wetland, an important wetland of southeastern Rajasthan. That is why in the present perspective, seasonal variations in the physicochemical properties of this wetland are studied so that its structural and functional aspects can be determined easily and can know more closely about the flourishing ecosystems here. In the future, it will be effective for the purposes related to the conservation of the ecosystem and habitat here.

MATERIALS AND METHODS

Study Area. The Kishan Kareri wetland is situated near Kishan Kareri village in the Chittorgarh district of southeastern Rajasthan, India. This wetland is located on the boundary line of Udaipur and Chittorgarh district, which is about 70 km from Udaipur and about 65 km from Chittorgarh at 24º49′19″ N and 74º28′51″ E, at the elevation of 481 m with a perimeter of around 2.87 km and surface area of around 0.47 km². This Kishan Kareri wetland is one of the 44 wetlands of the state recently declared by the government of Rajasthan in the year 2023, where many resident and migratory birds arrive during the winter season. Rainwater is the main source of water for such vegetation and avian diversity. There is a man-made island in the middle of the pond, which is planted with various types of vegetation, used as food and as a residence by different bird species. The minimum and maximum air temperature ranges between 10.67°C and 44.69°C, respectively. The highest temperature was observed during June and the lowest during January. The climatic seasons are divided into four groups winter, pre-monsoon or summer, monsoon, and post-monsoon which represent January to March, April to June, July to September, and October to December respectively.

Fig. 1. Google Earth Map of the study area showing three (1, 2, 3) water quality monitoring locations.

METHODS

The study was conducted every month from January 2023 to December 2023 for the analysis of physicochemical parameters. Three sampling points were selected based on representativeness, accessibility, distribution, number of water sources, safety, and other stresses observed in Kishan Kareri wetland, Station 1 (1), Station 2 (2), and Station 3 (3). The water samples were collected from 7:00 am to 10:00 am in a fresh plastic unsullied bottle. The bottle was dipped into the water, then the cap was opened and water was allowed to fill up then the cap was closed and the bottle was brought out. The most important, sensitive, and changeable water quality parameters such as Temperature, Transparency (Turbidity), pH, Electrical Conductivity, Total dissolved solids (TDS), Hardness, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Alkalinity have been analyzed. The estimation of water samples for various physicochemical analyses was done as per the standard procedure mentioned in APHA (2022, 2023).

RESULTS AND DISCUSSION

Physicochemical parameters are considered as one of the most important factors that are capable of influencing the aquatic environment and have shown wide temporal and spatial differences (Rameshkumar *et al.*, 2019). Physicochemical parameters of the water sample (Mean ± SD) of Kishan Kareri wetland determined during the investigation in various seasons (January 2023 – December 2023), are mentioned in Table 1.

Table 1: Results of various physicochemical parameters in Kishan Kareri Wetland.

Sr. No.	Physicochemical Parameter	Season 2023				Mean ± SD
		Winter	Pre-Monsoon	Monsoon	Post-Monsoon	
1.	Water Temperature (°C)	19.04	24.14	25.56	21.83	22.64 ± 2.85
2.	Transparency (cm)	58.28	26.25	18.34	14.11	29.24 ± 19.99
3.	pH	8.3	7.82	7.51	8.45	8.02 ± 0.43
4.	Electrical Conductivity (us/Cm)	292.89	342.11	252.67	280	291.91 ± 37.42
5.	Total Dissolved Solids (TDS) (mg/L)	186.22	204.67	176.78	192.44	190.02 ± 11.69
6.	Hardness (mg/L)	82	100.55	25.22	39.33	61.77 ± 35.36
7.	Dissolved Oxygen (DO) (mg/L)	7.6	5.1	4.38	4.44	5.38 ± 1.51
8.	Biochemical Oxygen Demand (BOD) (mg/L)	2.92	5.88	4.9	6.39	5.02 ± 1.53
9.	Chemical Oxygen Demand (COD) (mg/L)	8.3	8.81	8.01	15.37	10.12 ± 3.51
10.	Alkalinity as per $CaCO_3$ (mg/L)	184.52	237.78	65.27	125.41	153.24 ± 74.47

Water Temperature: Water temperature is one of the essential parameters since it influences the growth and distribution of flora and fauna (Shib Abir, 2014). Geographic heterogeneity in surface warming implies that local or regional factors contribute to diversity in lake thermal structure trends (O'Reilly *et al.*, 2015). This is because temperature affects the rate of O_2 consumption by biota and how soluble O_2 is in water (warmer water holds less O_2 than cooler water). Water temperature was recorded more or less similar in all the

stations and differs during seasons. The minimum and maximum temperatures recorded were 19.04ºC (average of monthly record) and 25.56 ºC (average of monthly record) respectively during the study period (January 2023 to December 2023) with a mean value of 22.64 ± 2.85 (Table 1). In the present investigation, minimum water temperature was obtained during the winter season and maximum during monsoon (Fig. 2).

Transparency: Water transparency is an important indicator of water quality. It is related to how light penetrates and attenuates in underwater ecosystems. In the study, transparency revealed a wide range of variation with a minimum of 14.11 cm (average of monthly record) and a maximum of 58.28 cm (average of monthly record) during the study period (January 2023 to December 2023) with a mean value of 29.24 ± 19.99 (Table 1). In the present investigation, the transparency of water was found maximum during the winter season, and the least transparency was obtained during post-monsoon (Fig. 3). It is due to the highest suspended matter in water that can be higher in winter than in other seasons. Suspended matter can include organic matter, mud, sand, clay, and minerals. It can be due to natural events like seasonal precipitation, erosion, or by anthropogenic activities.

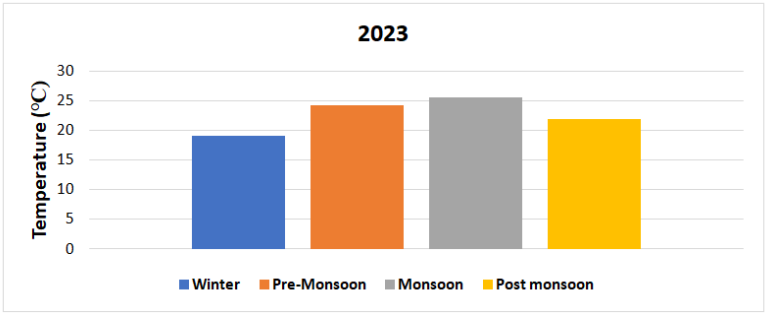

Fig. 2. Seasonal variations in Temperature during the study period in Kishan Kareri Wetland.

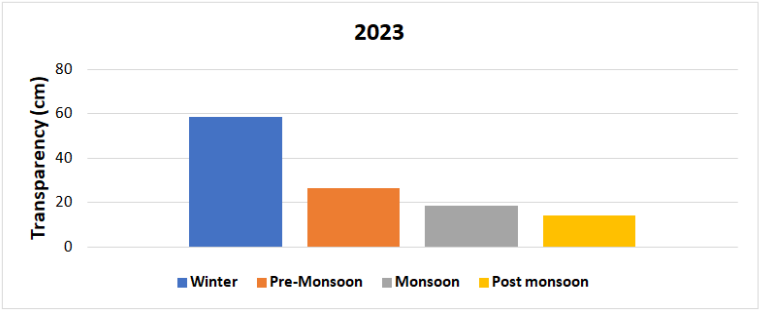

Fig. 3. Seasonal variations in Transparency during the study period in Kishan Kareri Wetland.

pH: pH is the measure of acidity and alkalinity and the concentration of hydrogen ions present in water. During the study period (January 2023 to December 2023), the pH of the Kishan Kareri wetland was observed near neutral to alkaline ranging from 7.51 to 8.45 which was considered to be favourable for aquatic life. The maximum pH was recorded during the post-monsoon season (December 2023) and the minimum pH was obtained during the monsoon season (September 2023) (Fig. 4), with a mean value of 8.02 ± 0.43 (Table 1). pH ranging between 5.0 and 8.5 is best for planktonic growth (Dixit, 2015).

Electrical Conductivity (EC): Electrical conductivity is a numerical expression of the ability of a water sample to carry an electric current. The values of EC were in the range of 252.67 µs/cm to 342.11 µs/cm during the present investigation (January 2023-December 2023) with a mean value of 291.91 ± 37.42 µs/cm (Table 1). Seasonal variations of the present investigations revealed that EC was high during pre-monsoon season and low during monsoon season (Fig. 5).

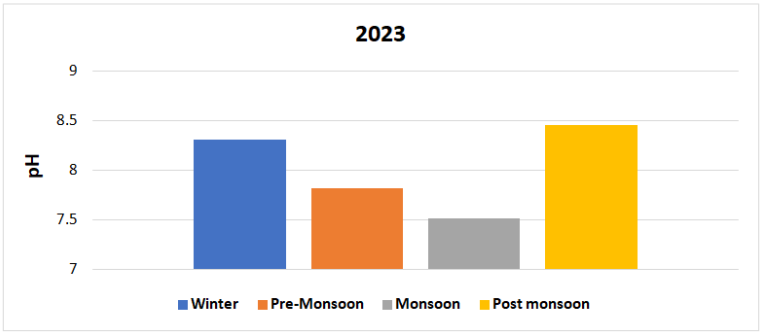

Fig. 4. Seasonal variations in pH during the study period in Kishan Kareri Wetland.

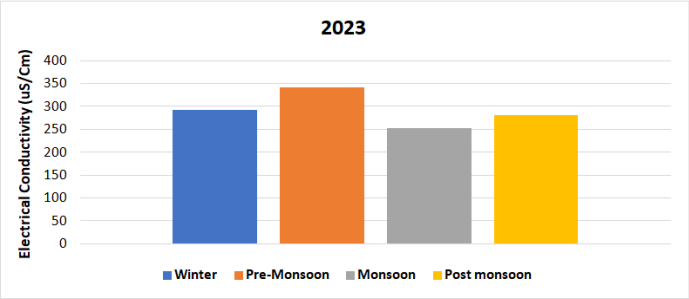

Fig. 5. Seasonal variations in Electrical Conductivity during the study period in Kishan Kareri Wetland.

Total Dissolved Solids (TDS): TDS is one of the important physicochemical parameters which is the measurement of all inorganic and organic substances in a water sample. In the present investigation (January 2023- December 2023), the TDS shows a wide range of variations with a minimum value of 176.78 mg/L and a maximum of 204.67 mg/L with a mean value of 190.02 ± 11.69 (Table 1). In this study, the total dissolved solids of the Kishan Kareri wetland were found maximum during the pre-monsoon season, and a minimum was obtained during the monsoon season (Fig. 6).

Hardness: The quantity of calcium and magnesium in water determines its hardness. The hardness of Kishan Kareri wetland water was in the range of 25.22 mg/L to 100.55 mg/L during the month (January 2023- December 2023) with a mean value of 61.77 ± 35.36 (Table 1). Seasonal variations of the present investigations revealed that hardness was high during the pre-monsoon season and low during the monsoon season (Fig. 7).

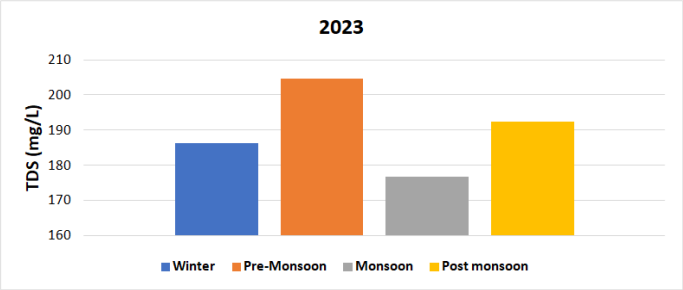

Fig. 6. Seasonal variations in TDS during the study period in Kishan Kareri Wetland.

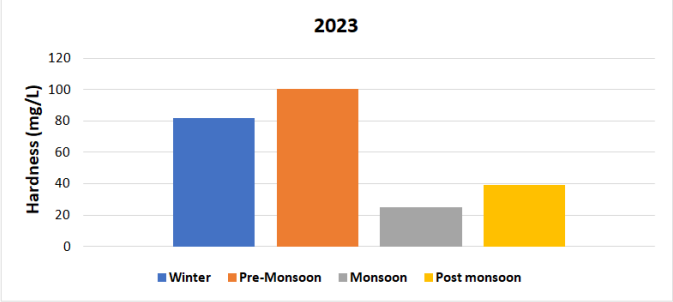

Fig. 7. Seasonal variations in Hardness during the study period in Kishan Kareri Wetland.

Dissolved Oxygen (DO): Dissolved oxygen is the best indicator to know about the health of a water body and its ability to support aquatic life. In the present investigation, we found high deviations in DO in various seasons of the year 2024. Minimum DO was recorded in the monsoon season (4.38 mg/L) and maximum in the winter season (7.6 mg/L) during the investigation. The overall mean during the entire study period was 5.38 ± 1.51 mg/L (Table 01). The DO of water of Kishan Kareri wetland was high in winter months and comparatively lower during monsoon months (Fig. 8). The high DO values in winter suggest that more oxygen production is due to the spread and growth of aquatic vegetation, and phytoplankton in water bodies, whereas in monsoon due to rainfall, the wetland area becomes flooded and little aquatic vegetation resulting in low DO values. As cold water contains more oxygen than warm water, therefore temperature increases, dissolved oxygen decreases in summer and monsoon and increases in winter (Nasim Ahmad, 2017).

Biochemical Oxygen Demand (BOD): BOD is an indication of the organic load and it is a pollution index, especially for water bodies receiving organic effluent (Ndimele, 2012). In the present investigation (January 2023- December 2023), the BOD value ranges between 2.92 to 6.39 mg/L with an overall mean of 5.02 ± 1.53 mg/L (Table 1). In the study, B.O.D. values of Kishan Kareri wetland water were reported high during the post-monsoon season followed by pre-monsoon, and least in the winter season (Fig. 9).

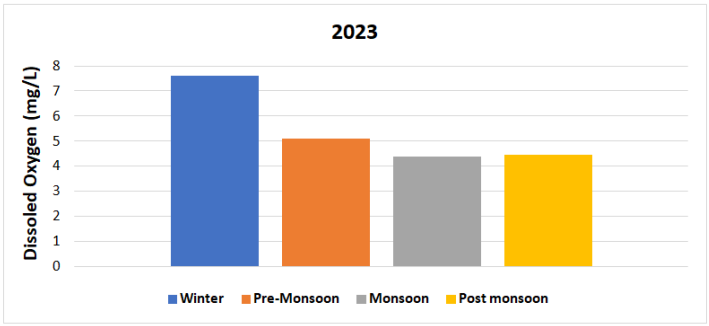

Fig. 8. Seasonal variations in DO during the study period in Kishan Kareri Wetland.

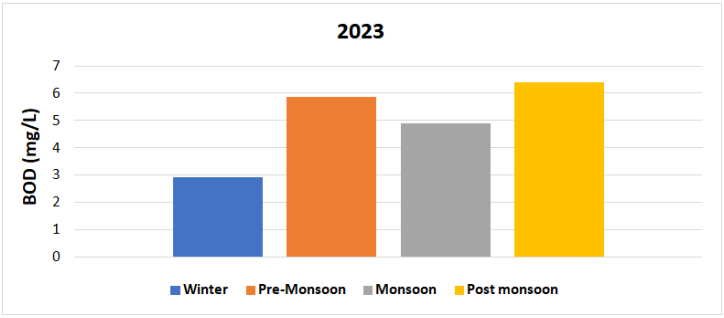

Fig. 9. Seasonal variations in BOD during the study period in Kishan Kareri Wetland.

Chemical Oxygen Demand (COD): The high COD values indicate that some degree of non-biodegradable oxygen-demanding pollutants were present in the water (Shib Abir 2014). Minimum COD was recorded in the monsoon season (8.01 mg/L) and maximum in the post-monsoon season (15.37 mg/L) during the present investigation. The overall mean during the entire study period was 10.12 ± 3.51 mg/L (Table 1). The COD of water of the Kishan Kareri wetland was high in post-monsoon months and comparatively lower during monsoon months (Fig. 10). In general, COD is usually higher than BOD because more organic compounds can be chemically oxidized than biologically oxidized, as observed in all studied seasons (Table 1).

Alkalinity as per $CaCO_3$: Alkalinity is a measure of the buffering capacity of water and is caused by calcium carbonate and bicarbonate and also to some extent due to phosphates and organic matter. Therefore, alkalinity analysis helps to know the buffering capacity of water to adjust pH (Naser, 2006). Total alkalinity was obtained in the range of 65.27 mg/L to 237.78 mg/l with a mean value of 153.24 ± 74.47 mg/L (Table 1). The highest value was shown during the pre-monsoon months and the lowest in the monsoon months during the study period (Fig. 11).

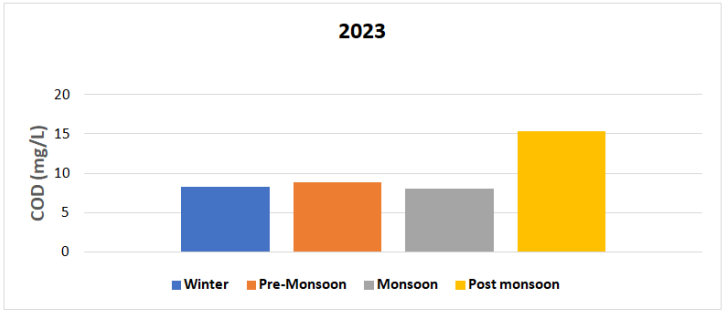

Fig. 10. Seasonal variations in COD during the study period in Kishan Kareri Wetland.

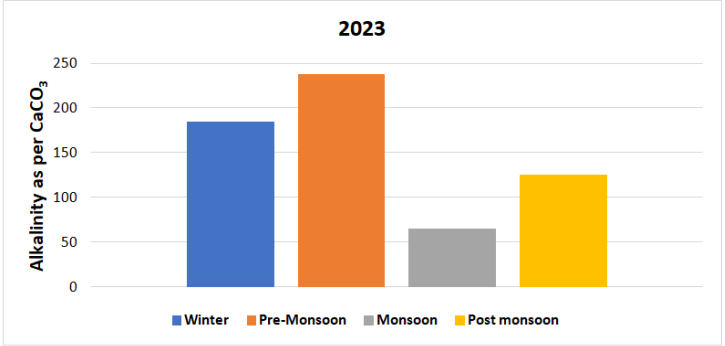

Fig. 11. Seasonal variations in Alkalinity as per $CaCO_3$ during the study period in Kishan Kareri Wetland.

CONCLUSIONS

Fluctuations in various physicochemical parameters were observed during winter, pre-monsoon or summer, monsoon, and post-monsoon seasons. The information on the physicochemical properties of water would form a useful tool for further ecological assessment and monitoring of this wetland. The results of the physicochemical parameters which play an important role in describing any wetlands flourishment, biodiversity of flora and fauna, ecological food chain, food web, availability of food resources, feeding and living conditions for aquatic species, as well as other bird species, of water, are within the normal range at various studied locations in the study area. There is no pollution, no waste is coming to the site. This wetland habitat has rich bionetwork and supports high levels of biodiversity.

In the end, it is concluded that the water of Kishan Kareri wetland is better enough to support highly rich biodiversity to form a complete ecosystem which strongly supports the fact that this wetland holds the potential to sustain flora, fauna, and threatened species of birds as more than 64 species of resident and migratory birds can be seen here in winter season.

FUTURE SCOPE

This is the first scientific study in the Kishan Kareri wetland forms the basis of research and it will greatly help in the improvement of biodiversity, management, conserving this unique location, and further development of this wetland.

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