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Physico-chemical analysis of the water samples collected from different water sources of Sri Ganganagar, Rajasthan

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Abstract
Water is essential for life. There are various components present in water which determines its qualitative nature. In the present study, water samples were collected from 3 different water sources of Sri Ganganagar (Ghagghar river, gang canal and buddha Johar) during different seasons (summer, rainy, post-rainy and winter) of 2 years during 2020-22. The collected water samples were subjected for determination of their physico-chemical properties like- temperature, pH, electrical conductivity, turbidity, dissolved oxygen, chloride and nitrate. All the obtained values were compared with standard parameters. Results revealed that all the collected water samples were found to be suitable for drinking purpose.

Keywords: Water, physico-chemical parameters, Sri Ganganagar, drinking purpose *etc.*

Introduction

Water is a common solvent utilised in biological activities and benefits the environment by fostering the existence of natural habitats for life. Water exists in a variety of shapes and conditions, covering an area of 1.4 billion cubic kilometres, according to the Biennial Report on Fresh Water Resources (Gleick *et al.*, 2004) [10]. Despite being so abundant, still-usable water is a rare commodity. Only 35 million cubic kilometres of water are fresh, and 97% of all water is marine. The majority of this fresh water is trapped in glaciers or other forms and is not readily accessible. Khilchevskyi and Karamushka, (2021) [11] state that rivers, Lakes, marshes, and wetlands are the most accessible sources of water, with respective percentages of 0.007, 0.001, and 0.0002. Only 0.76 percent of all fresh ground water is readily available to humans.

The Ganganagar district, which is in Rajasthan State's most northern region, is situated between latitudes 28º42'30" and 30º12'00" N and longitudes 72º39'15" and 74º18'30" E. The district, which has a total area of about 11154.66 sq km, is bordered to the south, east, north, and west by the districts of Bikaner and Hanumangarh in Rajasthan, Ferozpur in Punjab, and the international border with Pakistan.

Fig 1: Map of study Area Sri Ganganagar.

Materials and methods

Sample collection

Water samples were collected from the given sites during year 2020-2022. Samples were collected during different seasons like pre-Monsoon (March-June), Monsoon (July-October), and post-Monsoon (November-February). All the samples were collected in Borosil glass bottles (500 ml) which were cleaned and sterilized properly before collection. To avoid any kind of contamination during sampling extra care was taken and the bottles were rinsed several times with water being collected or filled.

Determination of physico-chemical parameters of the collected water samples

Parameter like temperature was determines in the field due to their unstable nature. A mercury filled centigrade thermometer calibrated from 0-100°C was used for temperature measurements. pH of the collected water samples was measured using pH meter. EC was also measured on site. EC was measured using digital conductivity meter. Nephelometric method was used to measure turbidity in water. UV spectrophotometric method was used for determination of nitrate. Chloride ion is determined by Mohr's method. The Winkler method with azide modification was used to determine DO in the collected water samples.

Results

Temperature: Results show that maximum water temperature was recorded during the rainy season (30.8 ºC - 32.8ºC) with the water temperature falling consistently from July to September. The immediate next lower water temperature was recorded during the summer season (28.37 ºC to 29.5 ºC) with consistent increase in temperature from March to June. Rainfall led to quenching of heat and a consequent decline in water temperature during the post-rainy season (21.9 ºC -24.05 ºC). Minimum water temperature was recorded during the winter season (14.3 ºC -15.4 ºC) with water temperature falling from December to January followed by increase in temperature in February. This trend of water temperature was consistent for all the three water bodies- Ghagghar river, Gang canal and Buddha Johar in both the years. The mean annual water temperature was nearly same for all the three water bodies (23.97 ºC - 25.39 ºC).

pH: Maximum water pH was recorded during the summer season (8.5-9.1) with consistent increase in water pH from march to June. This was followed by winter season where the mean pH values ranged from 8.3-8.4. pH values were relatively lower during the post rainy (8.1-8.3) and rainy season (7.73-7.9) with pH values in post-rainy season Increasing from October to November and decreasing from July to September during the rainy season. The mean annual water pH was nearly same for all the three water bodies (8.22-8.37).

EC: EC of water was the highest in Rainy season (511 µS/cm -532 µS/cm) followed by Post rainy season (436 µS/cm -451 µS/cm). EC values were comparatively lower in summer (425 µS/cm -437 µS/cm) and winter season (368 µS/cm -378 µS/cm). The mean EC was nearly same for all the three water bodies (437 µS/cm -448 µS/cm).

Turbidity: Out of all the three water bodies, maximum turbidity was found in the water of Buddha Johar in all the four seasons with nearly similar turbidity values in Ghaggar river and Gang canal. Maximum turbidity was seen during the rainy season (1.76 NTU-2.66 NTU) followed by post-rainy season (1.5 NTU -2.8 NTU). Turbidity values were relatively lower during winter (1.5 NTU -2.63 NTU) and lowest during summer season (1.55 NTU -2 NTU). The mean annual water turbidity for all the three water bodies ranged from 1.79 NTU to 2.66 NTU.

Dissolved oxygen: Maximum dissolved oxygen was found in summer season (11.07 mg/L-11.62 mg/L) with consistent increase in oxygen content from March to June. This was followed by winter season (10.1 mg/L -10.9 mg/L) where to increase in dissolved oxygen content was seen from December to February. Dissolved oxygen values were lowest in post-rainy (7.25-7.7 mg/L) and rainy season (5.6 mg/L -6.56 mg/L). The mean annual water dissolved oxygen for all the three water bodies ranged from 8.51 mg/L to 8.78 mg/L.

Chloride: Maximum chloride content was found in rainy season (207 mg/L -250 mg/L) and post-rainy season (205 mg/L -282 mg/L). The chloride content was relatively low during summer (168 mg/L -221 mg/L) and lowest during winter season (143 mg/L -208 mg/L). The mean annual chloride content for all the three water bodies ranged from 197 mg/L to 227 mg/L.

Nitrate: Out of all the three water bodies, maximum nitrate content was found in the water of Buddha Johar in all the four seasons with nearly similar nitrate content in Ghaggar river and Gang canal. Maximum nitrate content was found in rainy season (29.66 mg/L -37.36 mg/L) and summer season (19.5 mg/L -22.52 mg/L) followed by post rainy season (17.05 mg/L -21.80 mg/L). The nitrate content was lowest during winter season (14.36 mg/L -18.16 mg/L). The mean annual nitrate content for all the three water bodies ranged from 20.46 mg/L to 24.92 mg/L.

Table 1: Comparison of the obtained values with standard values of physico-chemical parameters of water

Parameters	BIS IS 10500:2012	WHO	CPCB	Year	Observed annual Mean value		
					Ghagghar river	Gang canal	Buddha Johar
pH	6.5-8.5	6.5-8.5	6.5-8.5	2020-21	8.24	8.26	8.29
				202-22	8.30	8.22	8.37
EC (µS/cm)	1500	<250	2000	2020-21	444.62	443.95	447.12
				2021-22	437.45	448.56	442.83
Turbidity (NTU)	<1	<5	<10	2020-21	1.76	2.00	2.61
				2021-22	1.80	2.66	1.79
Dissolved oxygen (mg/L)	>6	>6	>6	2020-21	8.71	8.74	8.61
				2021-22	8.78	8.51	8.76

Chloride (mg/L)	<250	<250	2000	2020-21	214.04	208.47	222.56
				2021-22	203.70	197.56	227.93
Nitrate (mg/L)	<45	<50	<100	2020-21	20.46	21.81	2.78
				2021-22	22.58	22.392	24.92

Discussion

Water is and will continue to be the impetus for sustenance and perpetuation of all forms of life on earth. Ground water is the ultimate source that has paved way for unfaltering perfectly orchestrated homeostatic system leading to existence of all the metabolic processes occurring within the ecosystem. Given the indispensable role of water, it is of paramount significance to maintain the quality of water to evade the jeopardy of mass extinction. However, the last few decades have witnessed gradual decline in ground water quality- be it due to change in natural climatic conditions or anthropogenic factors. Growing industrialization and urbanization in the last few decades has led to contamination of water resources and disturbed the homeostasis of both aquatic as well as terrestrial ecosystem. There are a number of factors that define the quality of water- temperature, pH, electrical conductivity, turbidity, dissolved oxygen, concentration of chloride and nitrate. Optimum value of these parameters is essential for water to be fit for human consumption as well as irrigation purpose. Slight variation in these factors may pollute the water making it unfit for use. The present thesis is an attempt to analyze the physico-chemical characteristics of water collected from three different sites of Ganganagar district of Rajasthan (namely Ghagghar river, Gang canal and Buddha Johar) over a period of two years (2020-2021, 2021-2022) and four different seasons (Rainy, Post rainy, Summer, Winter) and further extrapolate the findings to check suitability of water from these sources for human consumption and irrigation.

hotosynthesis produces oxygen and consumes carbon dioxide, which elevates the water pH while aerobic respiration consumes oxygen and lowers the pH. It is because of this very reason that increased algal biomass leads to alkalinity of the water bodies owing to increased photosynthetic efficiency (Weiner ER *et al.,* 2008). Seasonal variation has also been seen to induce pH fluctuation with pH values decreasing during the rainy season because of acidic nature of rainwater that dilutes the water bodies. On the contrary, summer season witnesses increased pH values due to increased photosynthetic activity coupled with algal bloom and high temperature (Dey S et al, 2021) [8].

Increase in temperature causes higher mobility of charged ions thus further augmenting the EC of water (Pal M *et al.,* 2015 [7]; Das R *et al.,* 2006) [6]. EC plays a crucial role in determining the efficacy of water for drinking and irrigation purpose. Consumption of water with high conductivity does not necessarily pose a health risk, it just increases the hardness of water due to dissolved salts and ions imparting metallic taste to the water and making it unpalatable. However, EC value of water is very important from irrigation point of view. Excess of salts in water can raise electrical conductivity to a high level thus triggering reverse osmosis inside the plants, in response to which plants reject water instead of imbibing it (Khan TA *et al.,* 2013) [5].

Increase in water turbidity has adverse effects on the aquatic ecosystem by deteriorating the health of aquatic fish by clogging their gills (Lowe ML *et al.,* 2015) [4], hampering photosynthesis by impeding light penetration to submerged aquatic plants and increasing susceptibility of aquatic organisms to pathogens (Bukola D *et al.,* 2015) [3].

There are a number of factors that control the amount of DO in water like temperature, rate of photosynthesis and respiration (Kulkarni SJ, 2016). Dissolved oxygen content is inversely proportional to water temperature. Water at 0° C holds 14.6 mg/l of oxygen which declines by almost 50% when water temperature reaches 30° C (Ficke AD *et al.,* 2007) [1].

Conclusion

From the results, it can be concluded that the collected water samples from different sources of Ganganagar district of Rajasthan are safe for drinking purposes according to standard parameters.

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