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Seasonal and Temporal Variations in Physico-Chemical and Bacteriological Characteristics of Chambal River in Kota City, Rajasthan

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ABSTRACT

The Chambal River is a tributary of the Yamuna River in Central and Northen India, and thus forms part of the greater Gangetic drainage system. The river flows north-northeast through Madhya Pradesh, running for a time through Rajasthan then forming the boundary between Rajasthan and Madhya Pradesh before turning southeast to join the Yamuna in Uttar Pradesh state. It is a legendary river and finds mention in ancient scriptures. The perennial Chambal originates at Janapav, south of Mhow town, near Manpur, Indore, on the south slope of the Vindhya Range in Madhya Pradesh. The Chambal and its tributaries drain the Malwa region of northwestern Madhya Pradesh, while its tributary, the Banas, which rises in the Aravalli Range, drains southeastern Rajasthan. It ends a confluence of five rivers, including the Chambal, Kwari, Yamuna, Sind, Pahuj, at Pachnada near Bhareh in Uttar Pradesh state, at the border of Bhind and Etawah districts. The Chambal River is considered pollution free, and hosts an amazing riverine faunal assemblage including 2 species of crocodilians – the mugger and gharial, 8 species of freshwater turtles, smooth-coated otters, gangetic river dolphins, skimmers, black-bellied terns, sarus cranes and black-necked storks, amongst others. The Chambal River is used for hydropower generation at Gandhi Sagar dam, Rana Pratap Sagar dam and Jawahar Sagar Dam and for annual irrigation of 5668.01 square kilometres in the commands of the right main canal and the left main canal of the Kota Barrage. The present article describes seasonal and temporal variations in physico-chemical and bacteriological characteristics of Chambal river in Kota City, Rajasthan.

KEYWORDS: *Chambal, bacteriological, seasonal, temporal, physico-chemical, Kota, Rajasthan, variations*

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INTRODUCTION

River Chambal originates from Barnagar (M.P) and joins River Yamuna after Udi at Jahika (U.P). From its origin onwards, tributaries Khan and Kshipra join Chambal before Nagda. More than one lakh of residents in and around the Nagda area rely on water from Chambal river for public use, industrial supply, power plant cooling and wastewater treatment. The river receives water from different units of Grasim Industries and sewage from Nagda town. Wastes after coming from the factory complex runsin a channel for about 3 km and joins River Chambal near Juna Nagda. Kota Barrage was built to channelize water from three former dams to the dry areas of Rajasthan and Madhya Pradesh for irrigation purposes through canals.[1]

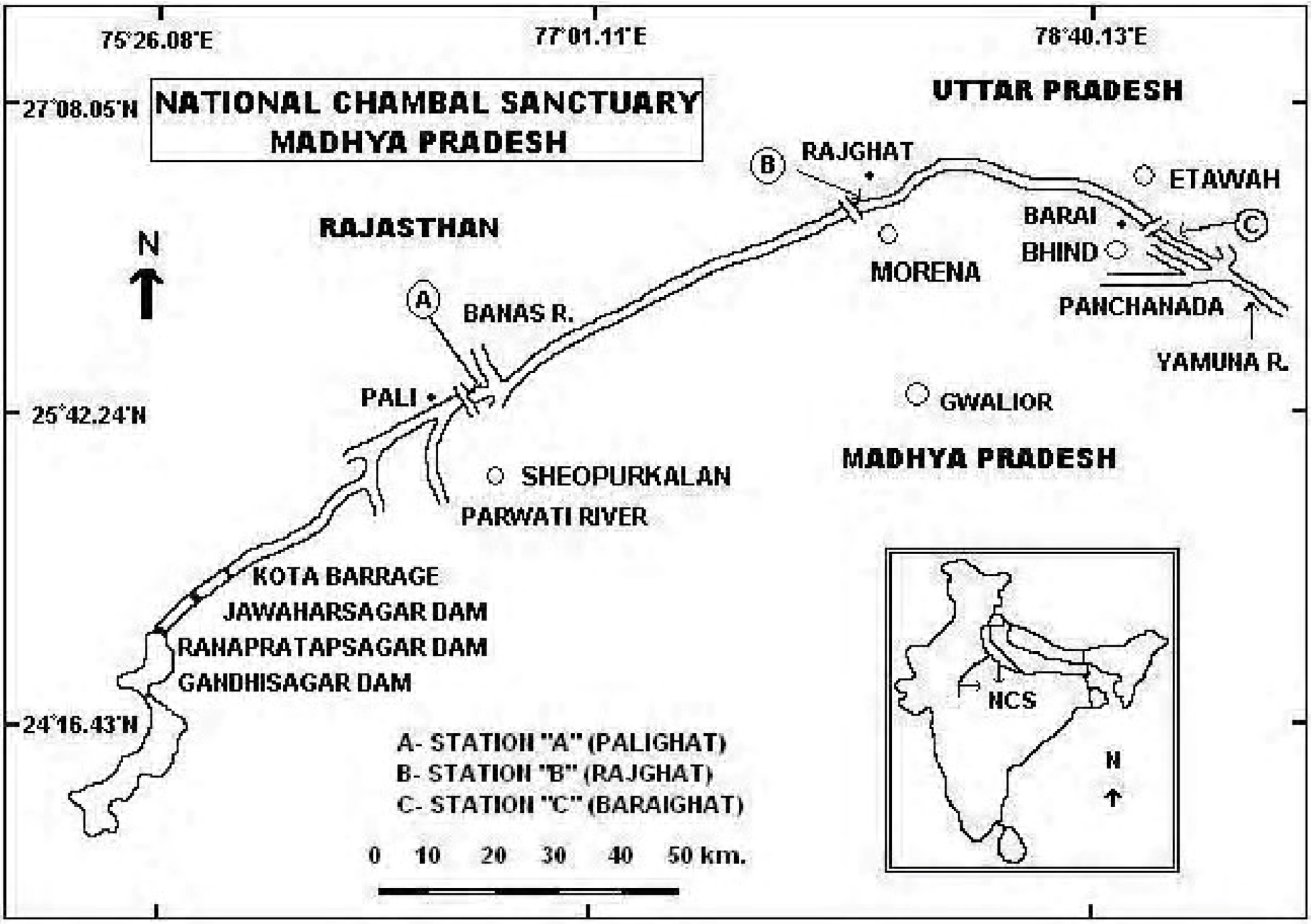


Fig. 1: National Chambal Sanctuary, Madhya Pradesh

The 19-gated barrage makes a bridge over Chambal River in Kota, where visitors assemble to enjoy the sight of the frothy white water. In the monsoon, the lock gates are opened, which makes for an even more interesting view. Visitors can also visit nearby tourist sites like Kansua temple with a four faced Shiva Lingam, Adhar Shila, Bhitria Kund, Budh Singh Bafna Haveli and Yatayat Park. Good water quality and healthy ecosystems are essential to maintain the aquatic biota. The freshwaters are usually productive but in industrial areas and urban centers there is some pollution with high levels of faecal coliforms, heavy metals, organic matter and industrial wastes, which contribute health hazards. Although water quality is to some extent is an index of water pollution. Indices presently used in laboratories are inadequate to indicate the damage that is done by the heavy metals, metalloids, organic and inorganic compounds, and blue green algae. Studies of physicochemical characteristics of water bodies in many many industrial areas have received considerable attention. [2,3]

Water samples were collected quarterly beginning from the month of June to May during the study period. All the five stations were from river flowing from the sites of Kota City, Rajasthan

Station 1: This station was taken as the reference station (control) owing to the absence of industrial discharges.

Station 2: Here in this part of river motor vehicles are washed constantly.

Station 3: It is about 1 km away from station 2.

Station 4: This station is located about 2 km away from station 3.

Station 5: This is poorly vegetated area.

Kota barrage study area sites

Water quality analysis

Sampling of water was carried out at the five study stations three times in the year from June May during the study period covering monsoon, winter and summer seasons. Water was collected in sterilized phosphate free pre-cleaned polythene bottles and processed within 6 hrs. The samples were analyzed by standard methods. for major physical and chemical water quality parameters like pH, electrical conductivity (EC), total dissolved solids(TDS), total suspended solids (TSS), total hardness (TH), dissolved oxygen (DO), biochemical oxygen demand (BOD) and chemical oxygen demand (COD). Student's 't' test was performed to compare the means as well as the seasonal differences in the effluent quality and also the water in the river.[4,5]

Results

A summary of physicochemical parameters of Chambal river water for the different stations are given below:-

pH: pH fluctuated between 6.8 to 11.5 at all the stations sampled. Station 3 recorded more values oriented to be more acidic than other stations in all the seasons. The highest pH value of 7.1 was recorded for this station in June. There was no distinct seasonal pattern in pH.

Temperature: Surface water temperature was considerably high in summer in all sampling stations. Low temperature was recorded in the month of January for all the sampling stations.

Total dissolved solids (TDS): The value of TDS was significantly higher in stations 2, 3, and 4. Station 1 and 5 recorded lower TDS values. The highest TDS value (680 mg/L) was recorded in station 4 in April, during study period. The lowest value of TDS was recorded in the station 1 in November. There were no significant differences in the values of COD in different stations neither there was any marked seasonal pattern.

Chloride: The chloride values varied between 1140mg/L and 2685mg/L. Again, stations 3 and 4 recorded higher values of chloride in all the seasons. Station 1 recorded much lower chloride values in all the months of sampling. No seasonal pattern in chloride fluctuation was observed.

Sulphate: It was fluctuated from 200mg/L to 950mg/L. Stations 3 and 4 recorded higher values of sulphate in the all seasons except in the months of monsoon. The value of sulphate was uniform and not too different from each other. The values of sulphate recorded in all sampling stations were uniform during monsoon season.[6,7]

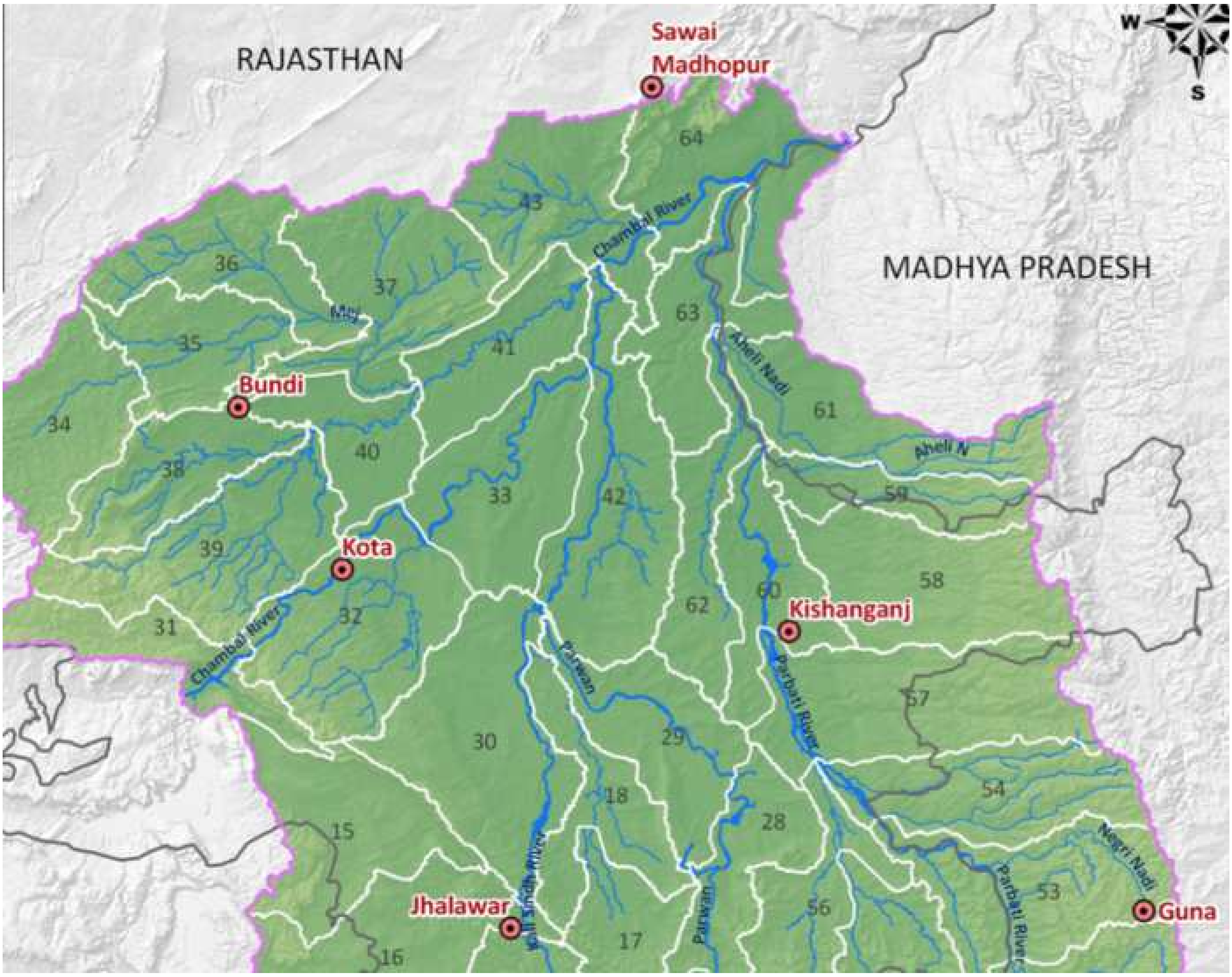
Total hardness (TH): It has been observed that calcium hardness (30-200mg/L) was nearly two fold greater than that of magnesium hardness (15-120mg/L). The total hardness fluctuated from 45mg/L to 320mg/L) in all sampling stations during all the seasons.[8,9]

Discussion

Kota –The land of Chambal

The physicochemical parameters exhibited considerable variations from sample to sample. The rainfall and relative humidity during the period of the study were typical of the tropical country with relatively high values in June/July. It was observed that the pH fluctuated between 6.8 and 11.5 in all the stations. It is obvious that only bleaching samples have pH with permissible limit, while other samples have higher pH values especially mixed effluents. These results are in accordance with the results of, who reported that textile wastes are highly alkaline. pH effluents affect physicochemical properties of water which in turn adversely affects aquatic life, plants and humans. This also changes soil permeability which results in pollution of underground water. Though pH has no direct effect on human health, all biochemical reactions are sensitive to variation of pH.[6]

For most reaction as well as for human beings neutral pH is considered as best and ideal. In the present study the pH values of water samples from stations 2, 3 and 4 were higher than the permissible limits. pH was positively correlated with conductance and total alkalinity. The EC values were found higher in stations 2, 3 and 4, which is due to dissolved salts present in the effluent. Very low conductivity was found at sampling stations 1 and 5. Water temperature did not show any marked seasonal variation. The influx of industrial effluents significantly lead to increase in total dissolved solids in stations 2, 3 and 4. Stations 1 and 5 recorded comparatively lower values of TDS. Dissolved solids values were high during summer period and low in rainy season, thus reflecting the seasonal pattern. TDS values of majority of the samples are much higher than the permissible limits, which predicts the presence of excess dissolved matter in the effluent.[10,11]



Chambal River: Origin, Tributaries, Basin, Dams and Concerns

High suspended solids are one of the major sources of sediments which reduce the light penetration into water and ultimately decrease the photosynthesis. [3] Consequently it reduces the DO level. The DO of the stretch of the river examined showed that it was poorly aerated, irrespective of the seasons. It may be due to nature of the effluents discharged into the water that exerts high demand on dissolved oxygen. Again, the raw effluents discharged into the water resulted in high COD and BOD values. Both, BOD and COD values in experimental stations 2, 3, 4 and 5 were high. It indices that almost all the samples are highly polluted. In addition, the higher levels of suspended solids in the waters increased BOD and COD, which depleted DO in waters. These results are in close agreement with those who also reported a high BOD and COD values in textile effluent. It shows that the effluents have high oxygen demanding materials, which causes depletion of dissolved oxygen. Moreover, high BOD and COD can also produce offensive color. Hence, the BOD of these effluents renders them unfit for irrigation and decrease the recreation value of water. The water samples from all the sampling stations were high in total hardness. Water hardness is the traditional measure of the capacity of water to react with soap. Hard water requires considerably more soap to produce lather. Hardness is one of the important properties of ground waters from utilizing point of view for different purposes. [7,9]

Villages of Chambal-Kota barrage

In the present study, water was very hard and crossed the permissible limits. It is well known that hardness is caused by variety of dissolved ions, predominantly calcium and magnesium. The high concentration of total hardness in waters may be due to dissolution of ions from sediment rocks, seepage and run off. In the present study, total hardness was positively correlated with chloride, calcium and magnesium. All the textile effluents have alarmingly high values of chloride contents. High chloride contents are harmful to metallic pipes as well as for agricultural crops. Moreover, it also affects microorganisms, which are important in food chains of aquatic life. In addition, bleaching effluents have high chloride contents. They are not easily biodegradable and are highly toxic. Total alkalinity is a measure of the ability of the water to neutralize strong acids. The constituents of alkalinity in natural systems include mainly carbonate, bicarbonate, hydroxide and other components. These components result from dissolution of mineral substances in soils and from atmosphere. [4,5]

In case of bacteriological analysis, bacterial genera were identified by laboratory testing in culture plates of water samples from these sites. The basic genera were pathogenic bacteria which were identified in laboratory by microscopic analysis from all study stations. These were *Salmonella, Neisseria, Brucella, Mycobacterium, Nocardia, Listeria, Francisella, Legionella, & Yersinia pestis*.[8]

Conclusion

The work presented here has extended the study to include measurement of a range of biological as well as physicochemical properties of soils which receive this polluted water for irrigation purposes, identification and chemical analysis of plants grown on soils receiving this water, and bacteriological analysis of soils. From the data obtained in this study, the physicochemical parameters monitored in stations 2, 3 and 4 showed high levels of dissolved and suspended solids. This must have been as a result of the nature of effluents discharged from the industries. Accordingly, water from these sampling stations is not free from the pollution and cannot be used for domestic purposes, drinking and even for agriculture without proper treatment.[10,11]

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