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Physico-chemical analysis of Kosi River within two districts (Nainital and US Nagar) of state Uttarakhand, India

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Abstract

This research is deals with water quality of Kosi River during 2021. Water samples were collected on a monthly basis from four sites namely Gargiya, Ringhor, Kosi Barrage, and Sultanpur Patti. Physico-chemical parameters such as temperature, total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), transparency, Velocity, dissolved oxygen (DO), pH, chlorides, and alkalinity were analyzed during the study. In present investigation sultanpur patti was found to be the most polluted as compared to others. It was also observed that manmade activities responsible for water quality degradation in Kosi River in general and at site-IV i.e. Sultanpur Patti in particular.

Keywords: Water Quality; River Kosi; Nainital; Udham Singh Nagar

1. Introduction

Water forms the main constituent of aquatic ecosystem. It provides habitat to many organisms like, phytoplankton, zooplankton, fishes, amphibians, mammals, and certain aquatic birds Griffith(1955). However, the water quality of rivers and other aquatic bodies is degrading at faster rate. There are various causes of water quality depletion such as deforestation, dumping of solid waste, discharge of agrochemicals, urbanization, industrialization, mining etc. The water quality data from many reservoirs around the world revealed that man-made activities are responsible for water quality depletion (Chaturvedi, et. al., 1981). Human actions render the water unsafe for use. Uttarakhand state is known for its natural resources. It is origin point of many important rivers such as Ganga, Yamuna, Alaknanda, Bhagirathi, Pinder, Kosi, Tons etc. The rivers are socio-economically important for the country (Badola and Singh, 1981).

The river Kosi originates from village Budha Peenath of Kausani region in the District Almora of state Uttarakhand. After traveling a distance of about 100 km in lower Himalayas it enters at Ramnagar in Gangetic plains. In the initial stretch through the Shivalik range of Himalayas, it takes water from a number of major streams, and a major portion is diverted into canals for irrigation. After Ramnagar, it flows to the Kashipur, where a number of polluting industries discharge their effluent in Kosi River. The main reasons of river pollution are domestic sewage and industrial discharge. Man made activities influence the water quality of river significantly (Muduli, et.al,2021). All the life forms have been influenced due to the water quality (Khanna,et. al,.1998). The known places situated near by Kosi River are Bhujan, Betal Ghat, Corbett National Park, Garjiya Devi temple, Ramnagar, Ringhor, Kashipur, SultanpurPatti and finally it meets to the Ramganga River in Chamraul in Uttar Pradesh. In District Udham Singh Nagar huge amount of industrial waste is discharged directly in to the Kosi. The current study is carried out to find out the water quality of Kosi River in two different districts of Uttarakhand state.

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2. Materials and Methods

The investigation was carried out by collecting water samples from four locations: Site-I i.e. Gargiya (coordinates 29.47° N, 79.15° E), Site-II i.e. Ringhor (coordinates 29.390N, 79.120E), Site-III i.e. Kosi Barrage (coordinates29.400N,79.120E), and Site-IV i.e.SultanpurPatti (29.240Nand80.100 E). The 10 physicochemical parameters were examined using APHA (2005) and Trivedi & Goel (1986) standard procedures. The site-I i.e. Gargiya is considered as reference site because it has the least influence from anthropogenicactivities when compared to other sites. Temperature, Transparency, velocity and pH were examined on the spot while TS, TDS, TSS, DO, Chlorides and Alkalinity were examined in the laboratory.

Figure 1 Map of the Kosi river showing study sites from Garjiya to Sultanpur Patti Physico-chemical Parameters

3. Results and Discussion

The results obtained for the investigation made throughout the year 2021 at four sites namely: Gargiya, Ringhor, Kosi Barrageand Sultanpur Patti are presented here. A total of 10physico-chemical parameters were monitored. The results of present study have been described below and presented in Table-1. Temperature is important for the dispersal of aquatic milieu. It also affects metabolic activities of aquatic organisms. During the current study, the lowest and highest annual me a value of temperature were observed as 17.26 °C and 19.70 °C at site-I i.e. Garjiya, and site-IV i.e. Sultanpur Patti, respectively. The current study discovered that temperature decreased from July to January and then gradually increased. Kumar, *et., al.* (2014) also found similar trend for temperature indifferent sites of Kosi River during the year 2013-14. Distribution and diversity of plankton are depended on temperature in aquatic ecosystem (Khanna and Singh, 2000). Total solids increase in aquatic ecosystem due to soil erosion, flood and discharge of sewage. During this study the overall lowest and highest mean value of total solids were observed as 966.49 mg/l and 1268.35 mg/l at site-II.e. Garjiya and Site-IVi.e. Sultanpur Patti, respectively. Total solids were higher at Site-IV i.e. Sultanpur Patti and it may be due to manmade activities like entry of sewer drains, discharge of industrial effluents. Khanna *et., al.*, 2002 studied on impact of paper mill effluent and illustrated that higher total dissolved solids were present due to the entry of industrial effluent. Total Solids were higher during the monsoon seasons and it is certainly due to high flood in the hilly region. Similar results also observed by Agarwal and Saxena, 2011 and Alam, *et al.* (2007). Kumar and Saini (2013) also found similar observation in Kosi River during the year 2013. Dissolved solids are solids substances which are in dissolved form in the water. During the study period the lowest and highest mean value of total dissolved solids were observed 263.14 mg/l and 468.56 mg/l at site-I i.e. Gargiya and Site-IV i.e. Sultanpur Patti, respectively. Kumar, et. al. (2019) also support our observations. During the present study the overall lowest and highest mean value of total suspended solids were observed 703.35 mg/l and 799.78 mg/l at site-I i.e. Gargiya and Site-IV i.e. Sultanpur Patti, respectively. Transparency is indicator of clarity of water. The overall lowest andhighest mean value of transparency were noted 8.78 cm and 17.77cm at site-IV i.e. Sultanpur Patti and site-I i.e. Gargiya, respectively. Khanna and Bhutiani (2005) also

pointed out that aquatic fauna depend on transparency for their survival. During our study period it was found that transparency was higher during the winter season and lower during the monsoon months. Transparency increases the sun light penetration in aquatic ecosystems by which aquatic plants make their own food. Joshi and Pathak (1991) also worked on sewage impacts on water quality and found low values of transparency due to discharge of sewage. Recently, Gitika *et al.*, 2022 worked on physico-chemical characteristics of aquatic reservoir and found low values of transparency due to algal growth. Jain, *et al.* (2018) also showed similar observations. Khanna and Bhutiani (2003) also worked on water quality of Ganga River in Satikund and illustrated that man made activities certainly deteriorating water quality in study area. Velocity is speed of waterand highest annual mean value (1.13m/s) of velocity of Kosi River was observed at Site-I i.e. Gargiya and lowest annual mean value of velocity (0.85m/s) at site-IV i.e. Sultanpur Patti. Duringthe study period it was also observed that highest values of velocity were recorded during the monsoon season and lowest during the winterseason. pH also effects aquatic organisms. Duringthe present study, the overall lowest mean value of pH was observed as 7.75 at site-I i.e. Gargiya and site-III i.e. Kosi Barrage. Highest mean value of pH was recorded as 8.01 at site-IV i.e. Sultanpur Patti. Kumar and Shyam (2018) support our observations. In the present study, the overall lowest and highest mean values of dissolved oxygen were observed 8.30 mg/l and 9.7 mg/lat site-IV i.e. Sultanpur Patti and site-I i.e. Gargiya, respectively. During our study period it was found that dissolved oxygen were higher during winter months and minimum during the summer season. It was found that dissolved oxygen showed negative correlation with temperature. Bhutiani, *et al.* (2021) also described that low dissolved oxygen in polluted sites. Kumar, *et.al.* (2017) studied on water quality of Ganga River during Kanwar Mela 2017 at Haridwar and concluded that the mass bathing and religious activities greatly influenced the dissolved oxygen of the River. During the present study, the over-all lowest and highest mean values of chlorides in Kosi River were recorded as 2.6 mg/l and 16.67mg/l at site-I i.e. Gargiya and site-IV i.e. Sultanpur Patti. High concentration of chlorides at site-IV may be due to entry of sewage, industrial effluent, dumping of solid waste at this site. Our results are supported by Matta, *et. al.,* (2020) they worked on this river and observed high number of chlorides at polluted site. Matta, *et. al.,* (2020) studied on water quality of Ganga River system, Uttarakhand and concluded that agricultural waste run off, untreated effluents and many other anthropogenic activities were identified as main contributor in decreasing the water quality of the river. During the study period, the overall mean values of alkalinity at Kosi River, the highest value (97.80mg/l) and lowest (90.36mg/l) at site-IV i.e. Sultanpur Patti and site-I i.e. Gargiya, respectively. Banerjee (2020) and Kumar, (2020) also studied on deterioration of water quality of riverine ecosystem at Patna and supported our observations. Joshi and Tripathi (2010) studied on Nanak Matha reservoir and found the similar results. Joshi (2022) studied on water quality of Nanak Sagar Dam in Uttarakhand and described that water quality is important factors for diversity and density of aquatic organisms.

Table 1 Annual mean values of physico-chemical parameters at four sites in Kosi River during the year 2021

Parameters	Site-I Gargiya	Site-II Ringhor	Site-IIIKosi Barrage	Site-IVSultanpur Patti	Mean Value	SD (±)
Temp.(0C)	17.26	17.88	18.63	19.70	18.37	±1.04
TS (mg/l)	966.49	977.62	1067.96	1268.35	1070.10	±139.75
TDS (mg/l)	263.14	268.95	335.86	468.56	334.13	±95.50
TSS (mg/l)	703.35	708.675	732.1	799.78	735.97	±44.33
Trans.(cm)	17.77	14.79	12.92	8.78	13.56	±3.76
Velocity	1.13	1.03	0.95	0.85	0.99	±0.11
pH	7.75	7.8	7.75	8.01	7.83	±0.12
DO (mg/l)	9.7	9.45	9.1	8.30	9.13	±0.60
Chl.(mg/l)	2.6	6.58	7.76	16.67	8.40	±5.93
Alka(mg/l)	90.36	93.11	91.69	97.8	93.24	±3.24

Table 2 Graphs (AtoJ) Showing physico-chemical parameters of Kosi River at selected Sites

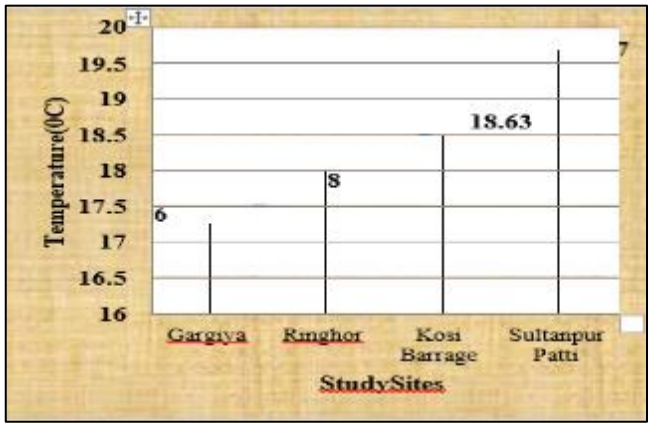
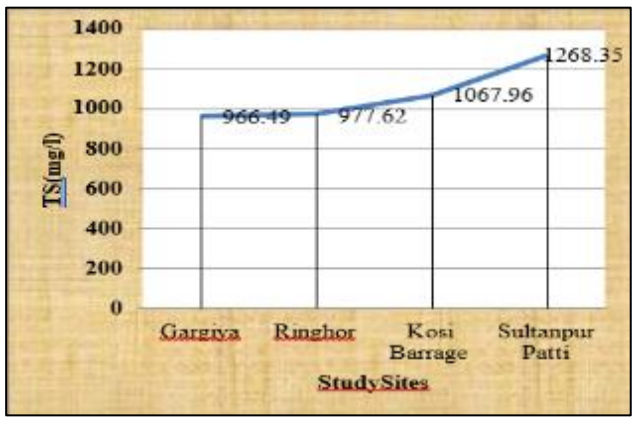


Figure (A)



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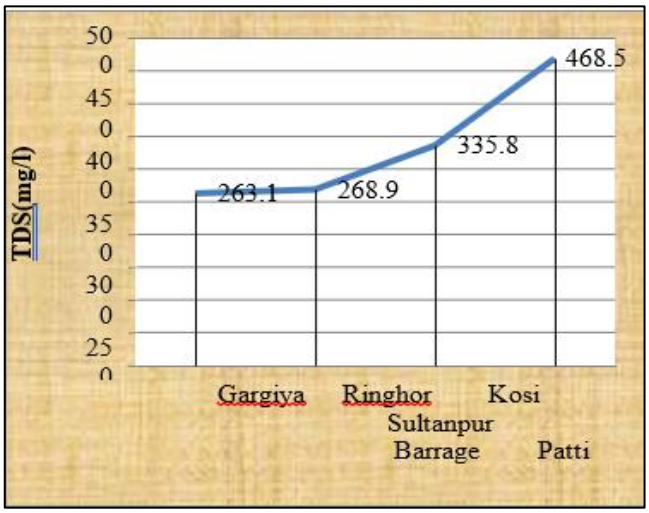
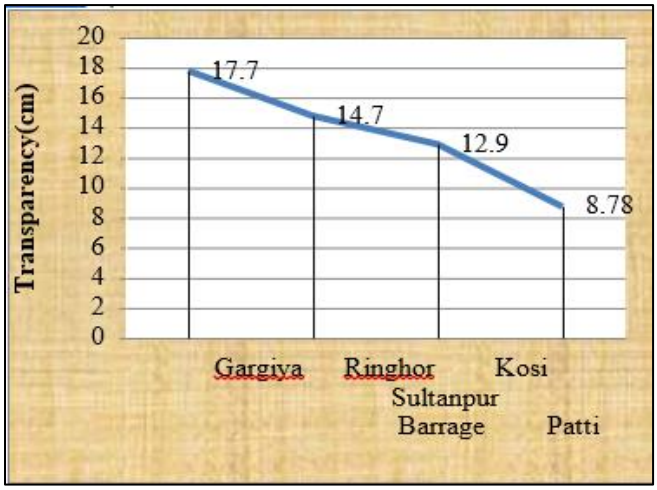


Figure (C)

Figure (D)



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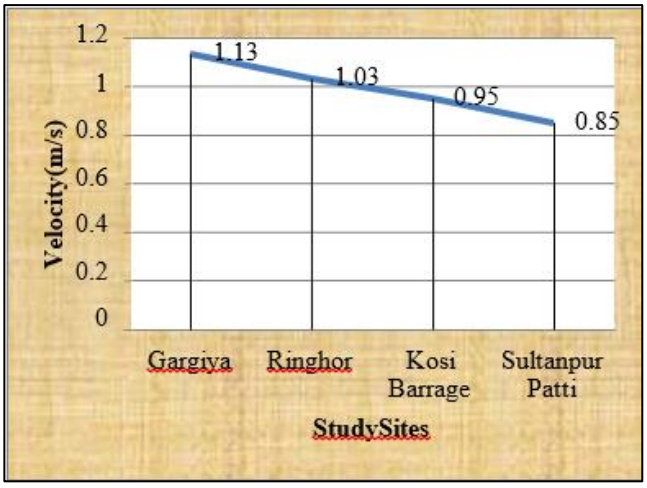

Figure (F)

Figure (G)

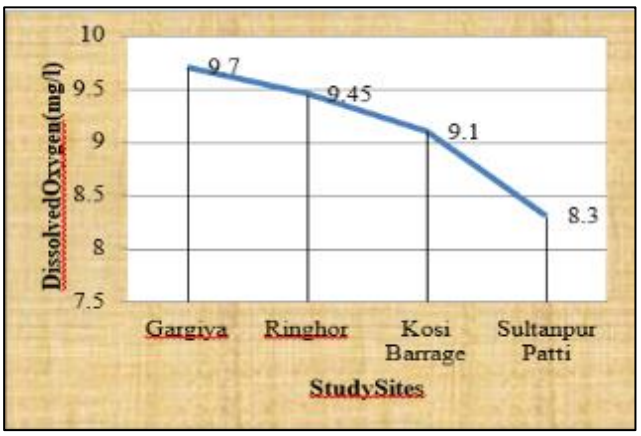

Figure (H)

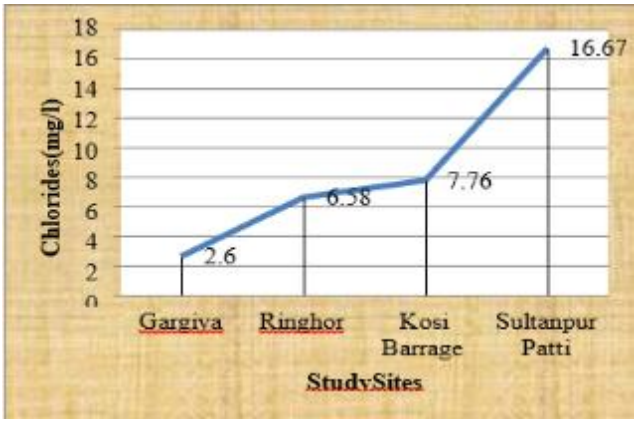

Figure (I)

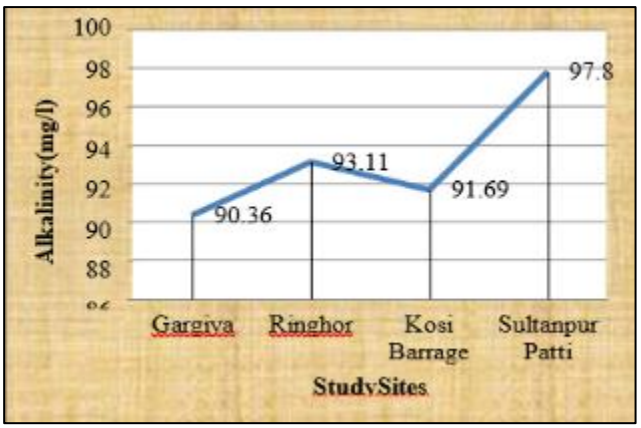

Figure (J)

4. Conclusion

This study showed that the water quality of Kosi River is variable at selected study sites. The obtained results for water quality showed that the sites which are located in District Nainital are comparatively unpolluted as compared to sites which are located in district Udham Singh Nagar. The Site-IV i.e. Sultanpur Patti is most polluted site as compared to other selected sites. The site-II.e. Gargiya has improved water quality. Continued monitoring is required to develop a databas e to analyzed the impact of anthropogenic activities on water quality of river. Preventive measures are also needed to minimize the impact of anthropogenic activities specially at site-IV i.e. Sultanpur Patti.

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