Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 12 [7] June 2023: 87-94

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD

ORIGINAL ARTICLE **OPEN ACCESS**

Monitoring the water quality of Song and Suswa river by physiochemical parameters

Shruti Saxena*, Shweta Negi[1] and D M Tripathi[2]
1*Shri Guru Ram Rai Univetsity, Dehradun Uttarakhand
[2] Govt Rishikesh (PG) college, Rishikesh, UK
*Corresponding author's Email: shrutigwl@gmail.com

ABSTRACT
The measurement of physico-chemical characteristics including pH, turbidity and dissolved oxygen in water bodies, is the conventional method for determining the water quality. It may vary depending on environmental conditions, however, adjustments to these characteristics may affect the water bodies. The main objective of this research study is to understand the water quality of both the rivers- Song and Suswa at Dehradun, Uttarakhand. The routine assessment needs of several water quality factors have increased during the last few decades for effective monitoring of various rivers' water quality. In Dehradun, Suswa and Song Rivers' water quality was evaluated in terms of their physico-chemical properties. Since September 2021 to August 2022, samples were taken monthly from four sampling sites. Four different sampling sites were used for each river, for a total of 48 water samples. The annual assessment of several variables viz., temperature, velocity, turbidity, conductivity, TDS, pH, total alkalinity, total hardness, free CO2, DO, BOD, phosphate, and nitrate was performed. During the course of present study, minor alterations in the physical and chemical qualities of the water sampled from examined regions were observed.
Keywords: *Water quality, Physicochemical characteristics, Song and Suwa river, Alkalinity, BOD*

Received 08.04.2023 Revised 15.05.2023 Accepted 17.06.2023

INTRODUCTION

Water is a vital natural resource that supports millions of aquatic species by serving as their home and a lifeline. The rivers serve as the most valuable supply system of freshwater for human beings. Typically flowing towards the ocean, lake or another river, rivers are naturally occurring streams of water flowing in one direction. The availability and distribution of freshwaters found in riverine systems have greatly influenced social, economic and political development. Rivers have had significant roles played in the evolution of human civilization. Further, the rivers contribute in the agricultural, industrial and urban sectors as well as the communities that live in the basin, yet indiscriminate activity puts a lot of pressure on the environment and the natural resources (25).The majority of rivers in the Garhwal area are glacier-fed, and their physicochemical and biological makeup varies with distance from glaciers. Their biodiversity reduces in comparison to non-glacial rivers since the former's temperature is influenced by the quantity of snowmelt and local climate regimes (20). As the populations and industrial centers have grown and intensified with the passage of time, the water quality of river systems deteriorated badly(3).Water quality of various effluents have shown that anthropogenic activities have a significant detrimental influence on the water quality in the downstream parts of the majorrivers(19). Aquatic habitat has gone under ecological stress since a few decades ago because of anthropogenic activities like rapid urbanization and industrialization, which either directly or indirectly poses immense danger to human health. The biomonitoring technique is used to assess how aquatic populations respond to anthropogenic stresses such as energy sources, water quality, habitat quality, flow regimes, and interactions between abiotic and biotic factors(22). Due to the multiple anthropogenic activities, the aquatic ecosystem frequently serves as a mirror for how the environment is changing. In recent years, human stress on inland aquatic resources such as lakes, reservoirs, estuaries, rivers and their floodplains, has increased significantly. Current information on the concentration of different solutes at a certain location and time is provided by water quality parameters (16). These factors serve as the foundation for determining whether water is suitable for its intended usage and for enhancing current circumstances. Many renowned limnologists, both from India and elsewhere (11); (10); (13); (15);(23); (27), have contributed significantly in the area of physicochemical characteristics of water.

The Song river emerges from several little rivulets in Dhanolti mountain range. It crosses Sahastradhara streams and then runs south through Doon valley basins before joining the Ganga close to Raiwala. The river Song, which is located at 30o28' latitude and 78o8' longitude, is immensely important to the people of Lachhiwala, Doiwala, Chiddarwala and Raiwala. It is so because of being the only trustworthy source of water across a distance of 42.5 Km. Another river- Suswa, running through Dehradun, is densely and badly impacted by urbanisation led enormous drainage of domestic and municipal wastes in it. Further, it is expected to become worse in the future ahead. These situational realisations provided sufficient background for conducting research studies to assess the water quality of this river. Urban garbage, swimming, washing of vehicles and clothes and dumping of sewage are the primary factors for river contamination and pollution. Furthermore, untreated sewage, hospital garbage and ordinary trash are dumped into this river from many sources. Considering the probable harmful effects of all these consequences, the physicochemical parameters including temperature, velocity, total solids, total dissolved solids, turbidity, pH, dissolved oxygen, free CO2, BOD, COD, alkalinity, Nitrate and conductivity of Song and Suswariver were studied. The outcomes of specific monitoring activities, defining the physicochemical qualities, are what determine how accurately the water quality is being assessed which may be whether in relation to the needs of intended water uses or to ascertain the effects of an activity on the water resource.

The objective of current study was to monitor seasonal fluctuations and their impacts on water quality measures in order to find any limiting factors that may adversely affect the productivity of the plants, animals and fish in this important river.

MATERIAL AND METHODS

Study Area

The state of Uttarakhand is located in northern India and its capital is Dehradun. The outer Himalayas, also known as the Shivalik hills, and the lesser Himalayas, often referred to as the Mussoorie range, are two sporadic Himalayan ranges that border Doon valley. It is surrounded by mountains from all sides with the northern range extending south from Ponta Sahib in the west to Haridwar in the east, and the southern range running towards south from Kalsi in the west to Muni Ki Reti (Rishikesh) in the east with Mussoorie at the centre in a semi-circular arch.The Yamuna and the Ganga, two of India's most formidable rivers, border Dehradun, which is located in the Doon Valley.

Song is a river in Dehradun district that drains the central and eastern part of Doon valley. Dehradun is between latitudes 30°01' N and 31°2'N and longitudes 77°34' E and 78°18'E. Song river originates from the base of Himalaya near Mussoorie (around Uniyalgaon) in Garhwal region of 30.18^0N; 70.14^0E.With a length of 190 Km (120 mi), Song is one of the biggest rivers draining to Doon valley. Its tributaries include Kali Gad, Bindal and Rispana rivers.

River Suswa originates in the midst of the clayey depression near the source of Asan, towards the east of the Asarori Dehradun road. Suswariver drains the eastern part of Dehradun city and merges with Song river before emptying into Ganga river. Song and Suswa rivers are the two main tributaries of Ganga.

Sampling Sites: Song river

Site 1-This study site is near Guthu village.

Site 2-This study site is near Maldevta temple, Shirpur.

Suswariver

Site 3-This syudy site is in Dudhali village.

Site 4-This study site is near Satyanarayantemple.

Water sample collection and processing

Water samples were taken from the study river at monthly interval over a period of one year (September 2021- August 2022). The standard procedures for the sampling and analysis of physicochemical qualities of the river under investigation, were followed as adopted by (28), (7), (21), (8),(14) and (1), (2), (29). Water samples for dissolved oxygen were collected in BOD (Biochemical oxygen demand) bottles and fixed on the sampling site. Pre-winter (September–November), Winter (December–February) , summer (March–May), and the rainy season (June–August), were the four different seasons during which water samples (about 1000 ml each) were taken.

Analytical methods

Table 1. Methods of determination of physicochemical parameters

Parameters	Analytical Methods
Temperature (° C)	Thermometer
Water depth(m)	Meter scale
Velocity (m s-1)	Float method BIS; IS 1194(1959)
pH (at 25^0C)	IS 3025 (Part-11) 1983, RA 2017, Electrometric Method
Turbity,(NTU)	IS 3025 (Part-10) 1984, RA 2017, Nephelometric Method
Total Hardness as $CaCO_3$	IS 3025 (Part-21) 2009, RA 2019, (a) Ethylenediamine tetra acetic acetate acid (EDTA) Method
Alkality as $CaCO_3$	IS 3025 (Part-23) 1996, RA 2019, Titramatric Method
Total dissolve solids (mg/l)	IS 3025 (Part-16) 1984, RA 2017, Gravimetric Method
Nitrate as NO_3	IS 3025 (Part-34) 1988, RA 2019,(a)Chromotropic acid Method
BOD (3 Days at 27^0C), (mg/l)	IS 3025 (Part-44) 1993, RA 2019
DO (mg/l)	SI 3025 (Part-38) 1989 RA 2019, titrimetric Method
Phosphate as PO_4	APHA 23rd Edi 2017.4500 P D Stannous Chloride Method
Free CO_2(mg/l)	Warburg's titrimetric method.
Conductivity, (µmho/cm)	IS 3025 (Part-14) 1984, RA 2019,

RESULT AND DISCUSSION

The physicochemical analysis and seasonal variation in physicochemical parameters have been presented in Table 1. Depending on the season of year and the study site, the physicochemical properties of a natural water body may change. These changes are caused by the human activity and the direct impact of sewage on the river.Temperature, pH, hardness, alkalinity, chloride, total dissolved solids, dissolved oxygen, and BOD all varied significantly (9). Same obesevation has been recordedamong 4 sites over the course of several months.. By comparing the estimated values of physical and chemical characteristics with the equivalent standard established for drinking water by the WHO, the water samples are evaluated for contamination. Anthropogenic sources are the main causes of surface water pollution and degradation in water quality, including untreated industrial effluents, inadequately disposed of household trash, and agricultural runoff (26).Very contaminated activities are present in the rivers Suswa and Song's catchment basins. Other human activities that release trash into waterways include household debris and agricultural waste. A 12-month water quality analysis has shown that the River Suswa is a contaminated river.The study explains the physico-chemical features of the Suswariver's monthly change. The water quality where the sample was obtained is impacted by human activity.Rising concentration levels of physical and chemical parameters a warning sign of contamination in suswa river (6). Significant threats are posed by this polluted water to the ecosystem, aquifers, people, aquatic life, and animal life.

In a well-established system, the water's temperature regulates the speed of all chemical processes and has an impact on aquatic life's development and reproduction. The Highest temperature recorded in summers and minimum in winters. Badola and Singh have seen a tendency in the river Alaknanda that is somewhat similar (4).

Temperature

Seasonal and daily variations in water temperature are possible. The variable time of collection and the seasonal impact may be held accountable for the variance in water temperature (18). The results showed that the temperature changed steadily from month to month, peaking in the summer and falling to its lowest level in the winter.From winter to summer, the water temperature trended upward; from summer to monsoon season, it trended downward. a finding that others have also made that is more or less comparable (12). Out of the two rivers sampled during the research period, At Suswa river sampling site-1, the highest temperature (20.33±0.446) was recorded and at Song river sampling site-2, itwas found the lowest (17.625±0.948). Altitude and latitude also affect the water temperature.

The table below presents river-specific observations for Physicochemical parameters(Mean±SEM).

Table 2: Physico-chemical characteristics of Song River and Suswa rivers

Parameter	Song River		Suawa River	
	S1	**S2**	**S1**	**S2**
Temperature (° C)	18.35±0.912	17.625±0.948	20.33±0.446	19.75±0.5018
pH (at 25^{0}C)	7.407±0.0299	7.3617±0.02458	7.025±0.0756	7.5±0.0386
Turbidity (NTU)	1.725±0.3436	1.2±0.297	42.175±1.324	0.65±0.3326
Total Hardness as $CaCO_3$	401.544±12.744	417.5608±3.8034	283.59±14.689	245.895±2.495
Alkality as $CaCO_3$	172.87±4.0657	128.2608±1.217	164.108±13.3288	199.889±2.719
Total dissolve solids	590.916±7.588	545.167±12.279	540±9.059	350.75±7.68
Nitrate as NO_3	2.2767±0.1027	3.1±0.136	2.100±0.102	1.414±0.094
BOD (3 Days at 27^{0}C), (mg/l)	1.8325±0.1916	3.119±0.1849	25.4025±0.566	2.061±0.2135
DO (mg/l)	7.365±0.1949	8.03±0.2308	2.438±0.131	4.49±0.1815
Phosphate as PO_4	0.8325±0.178	0.758±0.191	1.8±0.1269	0.866±0.2021
Free CO_2,(mg/l)	0.7467±0.1649	0.6167±0.18478	2.538±0.1996	1.34±0.2012
Conductivity, (µmho/cm)	709.167±8.54	650.1667±9.949	667.08±11.213	462±9.9347

pH

One of the key characteristics in determining the quality of water is pH, since it regulates the majority of chemical activities that take place in water. It reveals the acidity or basicity of water. It is one of the most important variables examined to determine the chemistry of water. pH represent the intensity of acidity or alkalinity of water. It plays a limiting role in the growth of flora and fauna of aquatic body(5).The ratio of H^+ ions to OH^- ions in water is measured by the pH value. The pH of the water under investigation indicated the highest pH (7.5±0.0386) at site 2 in Suswa river and its minimum (7.025±0.0756) at site 1. Further, Site 1 in Song river has the highest pH (7.407±0.0299) and the lowest pH (7.3617±0.02458).

Turbidity

The turbidity of the water in Song river was highest at site 1 (1.725±0.3436) and lowest(1.2±0.297) at site 2. The turbidity in Suswariver varied between sites 1 and 2 having the highest (42.175±1.324) and lowest (0.65±0.3326) values. Turbidity in water is caused by a variety of factors, including plankton and other microscopic organisms, suspended materials like clay and silt, finely divided organic and inorganic detritus, soluble colored compounds and the suspended material.

Total Hardness

At site 2, the overall hardness value was the highest (417.5608±3.8034) whereas, it was at its lowest (401.544±12.744)at site 1. The overall hardness was highest at site 1 (283.59±14.689) and lowest at site 2 (245.685±2.495)Suswa river. Its total hardness is determined by the concentration of alkaline earth metal cations that are present in it. The key cations that affect hardness are calcium and magnesium.

Total alkalinity

High levels of free carbonates indicate that the water is alkaline. Alkalinity of refers to its capacity to counteract a strong acid. Most naturally occurring fresh waters' primary factor in determining their alkalinity is carbonates and bicarbonates. The total alkalinity of the Song River varies between sites, with the minimum value (128.2608±1.217) at site 2 and the maximum value (172.87±4.0657) at site 1. In contrast, the total alkalinity of the Suswa River was found to vary between sites, with the minimum value (164.108±13.3288) at site 1 and the maximum value (199.889±2.719) at site 2.

Total dissolved solids

Solids in water are defined as the dissolved and suspended materials. They may be thought of as edaphically related characteristics that describe the chemical components of the water and are highly helpful in terms of productivity within the water body.The TDS of the sample may have increased due to the use of various pesticides and fertilizers on neighboring agricultural areas(24). The Maximum TDS (590.916±7.588) was reported at site 1 and minimum TDS (545.167±12.279) reported was at site 2 in Song River, whereas Suswa River was found to vary between sites, with the minimum value (350.75±7.68) at site 2 and the maximum value (540±9.059) at site 2. Increased total solids levels might make it more difficult for aquatic creatures to survive.

Nitrate

The content of nitrate, which is the byproduct of the oxidation of nitrogenous materials, may be influenced by the nitrification and denitrification processes carried out by microorganisms (Sinha et al., 2000).The study of the Song River found that the nitrate levels were highest at site 2 (3.1±0.136) and lowest at site 1 (2.2767±0.1027). The Suswa River's site II had the highest nitrate value (2.100±0.102l) and the lowest value at site 2 (1.414±0.094).

Biological Oxygen Demand (BOD)

The BOD test measures the amount of oxygen stream water microorganisms utilise to decompose organic waste. The amount of dissolved oxygen in rivers and streams is directly influenced by BOD. BOD causes the rate of oxygen loss in the stream to accelerate. In the Song River, site 2 had the maximum BOD (3.119±0.1849) while site 1 had the minimum (1.8325±0.1916). The BOD of Suswa River fluctuated between sites 1 and 2, reaching a maximum of (25.4025±0.566) and a minimum of (2.061±0.2135), respectively. Higher aquatic life forms often have less access to oxygen.

Dissolved oxygen

One of the most crucial parameters is DO. DO is the measurement of the amount of free, non-compound oxygen in water or other liquids. The amount of oxygen that dissolves in the water controls the variety of aquatic life (17). Due to its impact on the organisms that live in a body of water, DO is a significant criterion in determining the quality of the water, second only to the water itself. Too much or too little dissolved oxygen in the water can damage aquatic life and affect its quality. At site 2 Song River, the highest DO value was 8.03±0.2308, whereas site 1 Song River recorded the lowest value (7.365±0.1949). The highest DO value was found at site 2 ofSuswa River (4.49±0.1815) and the lowest at site 1 (2.438±0.131).

Phosphates

The measurement of phosphate can be useful in identifying the water quality since it is a necessary plant nutrient and may serve as a limiting factor for all other essential plant nutrients (Dugan 1972). In the current study, the concentration of phosphate in Song River water was greatest at site 1 (0.8325±0.178) and lowest at site 2 (0.758±0.191), whereas the concentration of phosphate in Suswa River was highest at site 1 (1.8±0.1269) and lowest at site 2 (0.866±0.2021).

CO2

Water naturally contains different concentrations of free carbon dioxide (CO2), however a lot of CO2 leads to acidic water conditions. Carbonic acid is produced when carbon dioxide dissolves in water (H2CO3). According to the observation, the value of CO2 was determined to be maximum (0.7467±0.1649) at site 1 in Song River and minimum (0.6167±0.18478) at site 2. At sampling site 1, CO2 was maximum (2.538±0.1996) and minimum (1.34±0.2012).

Conductivity

The ability of a material or solution to conduct electric current is measured by its conductivity. Resistance's opposite is conductivity. Water conductivity is increased by salt pollution and waste water contamination. At site 1 of Song River, the conductivity was at its highest (709.167±8.54), whereas at site 2, it was at its lowest (650.1667±9.949). Suswa River's conductivity was highest at site 1 (667.08±11.213) and lowest at site 2 (462±9.9347).

CONCLUSION

All water quality measurements were found to be within permissible norms, and the analysis showed that the Song River's water quality had gotten worse. This is a result of different contaminants getting into the water body. The increased pollution load is a concerning phenomenon, despite the fact that there were only minor differences in the physico-chemical parameters of the Song River at the two different sample locations.

The study explains the physico-chemical features of the Suswariver's monthly change. Human activity has an influence on the water quality at the sample location. The primary causes of pollution in the river Suswa are sewage and municipal drainage from the city of Dehradun, poor disposal of solid waste, and runoff from farmland. The investigation discovered considerable variations in phyisico-chemical modifications at two different locations. The water of the Suswa River is not fit for human consumption. Additionally, the study offers baseline information for Suswa river water quality management.

REFERENCES

1. Apha A. WPCF, (1998). Standard methods for the examination of water and wastewater. 1998;20:39–42.
2. APHA, (1998). AWWA,WPCF, standard methods for the examination of eater and wastewater, 20th ed. Washington D.C., New York

3. Arora J, Mehra NK. (2003). Species diversity of planktonic and epiphytic rotifers in the backwaters of the Delhi segment of the Yamuna River, with remarks on new records from India. ZOOLOGICAL STUDIES-TAIPEI-. 42(2):239–47.
4. Badola S, Singh H. (1981). Hydrobiology of the river Alaknanda of the Garhwal Himalaya [India]. Indian Journal of Ecology (India).
5. Bhutiani R, Khanna D, Rawat S. (2014). Recent Trend in Physico-Chemical Parameters of Song River at Nepali Farm District Dehradun, Uttrakhand, India. Int Jr of Res in Biosciences, Agriculture & Technology. 22(2):34–44.
6. Bhutiani R, Khanna D. (2007). Ecological study of river Suswa: modeling DO and BOD. Environmental monitoring and assessment. 125(1):183–95.
7. Golterman HL. (1969). Methods for chemical analysis of fresh waters.
8. Gopal B, Trivedy RK, Goel PK. (1984). Influence of Water Hyacinth Cover on the Physico-chemical Characteristics of Water and Phytoplankton Composition in a Reservoir near Jaipur (India). Int Revue Ges Hydrobiol Hydrogren. 69(6):859–65.
9. Gupta N, Sharma RC, Tripathi A. Study of bio-physico-chemical parameters of Mothronwala swamp, Dehradun (Uttarakhand). Journal of Environmental Biology. 2008;29(3):381.
10. Ismael AA, Dorgham MM. Ecological indices as a tool for assessing pollution in El-DekhailaHarbour (Alexandria, Egypt). Oceanologia. 2003;45(1).Hsieh CH, Davis AP. Multiple-event study of bioretention for treatment of urban storm water runoff. Water Science and Technology. 2005 Feb 1;51(3–4):177–81.
11. Kannan V, Job S. Diurnal depth-wise and seasonal changes of physico-chemical factors in Sathiar reservoir. Hydrobiologia. 1980;70:103–17.
12. Khanna D, Ashraf J, Chauhan B, Bhutiani R, Matta G, Singh V. Water quality analysis of River PanvDhoi in reference to its physico-chemical parameters and heavy metals. Environment Conservation Journal. 2009;10(1 & 2):159–69.
13. Khanna D, Bhutiani R, Matta G, Singh V, Tyagi P, Tyagi B, et al. (2010). Water Quality characteristics of River Tons at District-Dehradun, Uttarakhand(India). Environment Conservation Journal. 11(1–2):119–23.1.
14. Khanna D, Bhutiani R, Matta G.(2004). Water analysis at a glance. Pub ASEA. 108.
15. Khanna D, Sarkar P, Gautam A, Bhutiani R. (2007). Fish scales as bio-indicator of water quality of River Ganga. Environmental monitoring and assessment. 134:153–60.
16. Khanna DR, Singh RK. (2000). Seasonal Fluctuations in the Plankton of Suswa River at Raiwala (Dehradun). ECJ. 18;1(2 & 3):89–92.
17. Negi R, Mamgain S. (2013). River of Garhwal Himalaya Uttarakhand. Pakistan Journal of Biological Sciences. 16(22):1510–6.
18. Parashar C, Dixit S, Shrivastava R. (2006). Seasonal variations in physico-chemical characteristics in upper lake of Bhopal. Asian J Exp Sci. 20(2):297–302.
19. Popa P, Timofti M, Voiculescu M, Dragan S, Trif C, Georgescu LP. (2012). Study of Physico-Chemical Characteristics of Wastewater in an Urban Agglomeration in Romania. Romani A, Andrade P, editors. The Scientific World Journal. 2012:549028.
20. Rawat A, Gulati G, Maithani R, Sathyakumar S, Uniyal V.P. Bioassessment of Mandakini River with the help of aquatic macroinvertebrates in the vicinity of Kedarnath Wildlife Sanctuary. Applied Water Science 2020 10:36 https://doi.org/10.1007/s13201-019-1115-5
21. Schwoerbel J. (2016). Methods of hydrobiology:(freshwater biology). Elsevier.
22. Sharma M, Sharma S, Goel V, Sharma P, Kumar A. (2008). Water quality assessment of Ninglad stream using benthic macroinvertebrates. Life Science Journal.5(3):67–72.
23. Sharma RC, Rawat JS. (2009). Monitoring of aquatic macroinvertebrates as bioindicator for assessing the health of wetlands: A case study in the Central Himalayas, India. Ecological indicators. 9(1):118–28.
24. Sofi IR, Chuhan PP, Sharma HK, Manzoor J. (2018). Assessment of Physico-Chemical Properties of Water and Sediments of Asan Lake Dehradun, India. International Journal of Theoretical & Applied Science. ;10(1):68–76.
25. Shweta, andS Saxena. Assessment of The Freshwater Ecosystem Health In The Himalayan State Of Uttarakhand, India, Using Macro-Invertebrates As Bio-Indicators". Uttar Pradesh Journal Of Zoology pp 1049-1058 (2021).
26. Uddin MJ, Jeong YK. (2021). Urban river pollution in Bangladesh during last 40 years: potential public health and ecological risk, present policy, and future prospects toward smart water management. Heliyon. ;7(2):e06107.
27. Valecha V, Bhatnagar G. (1988). Seasonal changes of phytoplankton in relation to some physicochemical factors in lower lake of Bhopal. Geobios;
28. Welch PS. Limnological methods. 1948;
29. World Health Organization.(1993). Guidelines for drinking-water quality: volume 1: recommendations [Internet]. 2nd ed. Geneva: World Health Organization. Available from: https://apps.who.int /iris/handle /10665/259956

CITATION OF THIS ARTICLE

Shruti S, Shweta N and D M Tripathi. Monitoring the water quality of Song and Suswa river by physiochemical parameters. Bull. Env. Pharmacol. Life Sci., Vol 12[6] June 2023: 94-99.