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# Study on Status of Physico-Chemical Parameters of Lotic Water Body, Shipra in the Mountainous Region of Kumaun Himalaya, Uttarakhand, India

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**Abstract:** The present paper investigated the Physico-chemical parameters of the lotic water body Shipra, including its two sites (Site 1- Kainchi, Site 2- Garampani) for six months (October 2020-March 2021) of Nainital District in Uttarakhand. Monthly variations in the physical and chemical parameters at site-1 such as-- Atmospheric Temperature 14.1-26 C, Water Temperature 11-15 C, pH 7-8.3, Total Dissolved Solids 76-92 ppm, Transparency 36-78 cm, Dissolved oxygen 6.04-9.26 mg/l, Phosphate 0.25-0.43 mg/l and Nitrate 0.34-1.63 mg/l and similarly for site-2 Atmospheric Temperature 9-24 C, Water Temperature 10-18 C, pH 8.2-8.7, Total Dissolved Solids 111-132 ppm, Transparency 31-58 cm, Dissolved oxygen 8.05-9.26 mg/l, Phosphate 0.11-0.32 mg/l and Nitrate 0.32-0.55 mg/l were observed. All the parameters of site-1 and site-2 were within the acceptable limit except for the pH value at site-2.

**Keywords:** Lotic water body, Shipra, Physico-chemical parameters, Mountainous region, Water quality

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## Introduction

Earth is considered a watery planet, constituting about 70 per cent of the earth's surface. About 96.5 per cent of the earth's surface is covered with oceans carrying saline water. Freshwater represents only about 3 per cent of all water on earth; freshwater and swamps account for about 0.29 per cent of the earth's freshwater. Water in any form is a valuable resource for living and non-living organisms. Wherever there is a presence of water, human civilization tends to live nearby to have easy access to water along with the availability of food resources prevailing and sustained by water bodies. Water is considered life, regulating all biological and metabolic activities. Without adequate quantity and quality of sustainable freshwater, the development will not be possible (Kumar, 1997; Mahananda, 2010).

Water is considered the most precious substance on earth. India is a prosperous country if we consider it for rivers, streams, lakes, ponds, dams, etc. The utilization of water by human beings is immensely done. Water is used for drinking purposes and for day-to-day activities such as bathing, drinking, and carrying out irrigation in agricultural fields. Water is also used in generating electricity by various hydroelectric power stations. Water is the home of diverse living organisms, i.e., fishes, crabs and other organisms. Many people tend to practice various aquaculture practices to sustain their livelihood by improving their economic status and improving the economic status of India as a whole.

Water quality is determined when its physical and chemical characteristics are compared with water quality guidelines or standards to facilitate the provision of clean and safe water for human consumption, thereby shielding human health. These are usually based on scientifically assessed acceptable toxicity levels to either humans or aquatic organisms (Abdul-Kareem *et al.*, 2011). The Physico-chemical parameter of any aquatic ecosystem indicates the type, composition and diversity of biotic components of that ecosystem (Hutchinson, 1957; Ruttner, 1963) and if the quality of water degrades, it affects the life of plant, animal and human being. Therefore, it is essential to identify the sources that tend to contaminate water quality (Tobiszewski *et al*., 2015).

The water bodies are subjected to continuous change to their geological age and geochemical characteristics. This dynamic balance in the ecosystem is upset by human activities, resulting in pollution, which triggers more and more fish mortality, offensive odors, and bad taste in the drinking water. Therefore, nowadays, it is a significant concern for environmentalists and ordinary people to regularly monitor water quality because numerous sources could pollute and deteriorate water quality. The surface water bodies have become a dumping ground for industrial effluents and domestic wastes. According to the World Health Organization (WHO), the water for people should be free from pathogenic organisms and toxic substances (Kendre and Gawande, 2015).

In general, about 80% of water turns into wastewater after its utilization. There is sufficient evidence related to the mismanagement of industrial wastes in India (Khurshid, 1998; Singare, 2010, 2011; Lokhande, 2011). The sewage water seeps into the soil and pollute the groundwater or it flows through the rivers and streams and pollutes the surface water. This wastewater should be appropriately treated before discharging into any water body (Babu, 1997) has explained health problems identified in developing urban areas. Uttarakhand state has many rivers, lakes, streams, ponds, dams etc., for satisfying the requirement of water of the people. Streams are one of the most important sources of water, originating from the crevices of the mountainous hills, flowing with its full glory and making its way down the hilly slopes and giving an aesthetic beauty to a place where it is flowing and finally merges with the river. The streams and rivers present in Uttarakhand are mainly spring-fed and were once considered the natural and the purest form of water, is also facing the threat of getting polluted. Therefore, the present study aimed to study the physico-chemical parameters of the lotic water body named Shipra of Uttarakhand.

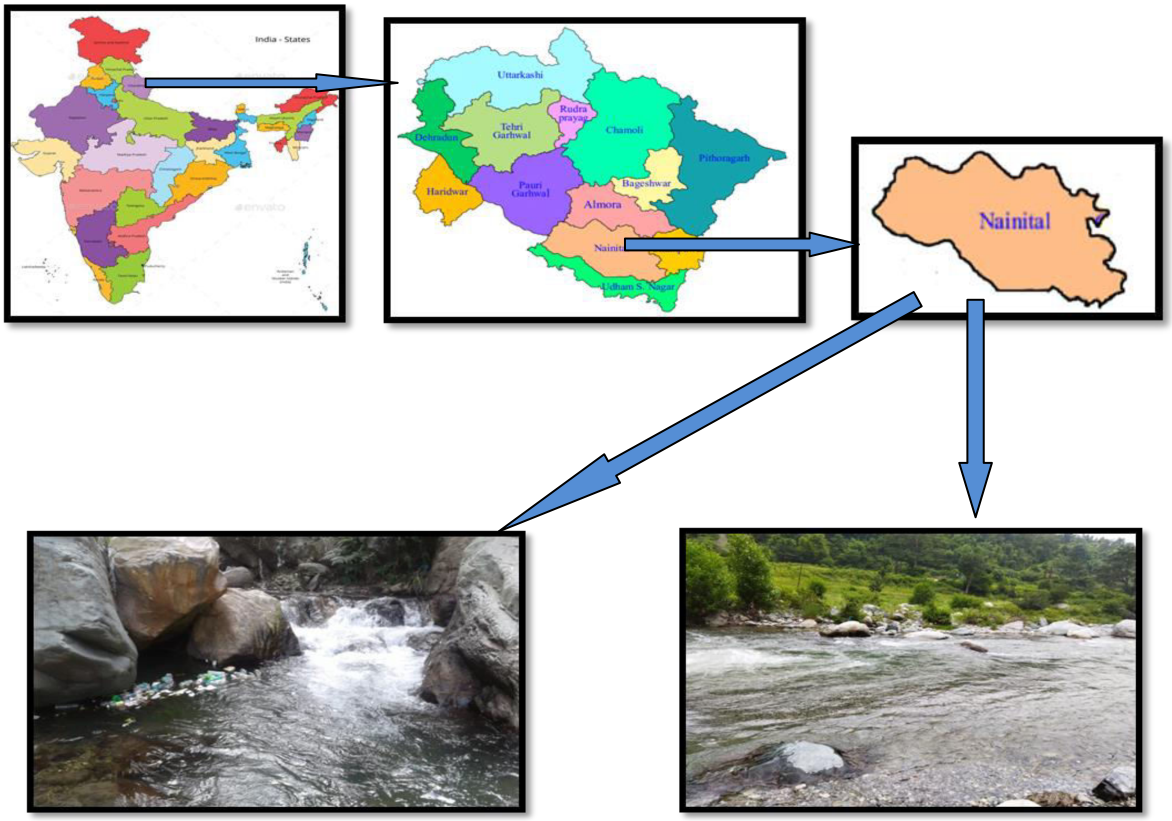
## Materials and Methods

*Study Area*:

Lotic water body (Shipra) flows in the northern direction and originates from Shyamkhet and flows through Bhowali, Niglaat, Kainchi, Garampani, and Khairna has a length of about 20 km. It flows forward and finally merges with river Kosi. The water is used by the nearby people for drinking purposes, washing, bathing, as well as for irrigation purposes, etc. Two sites were selected (Fig. 1) along the water body, Site-1 Kainchi (Latitude of 29°25'23" N and Longitude of 79°30'43" E), and Site-2 Garampani (Latitude of 29°29'46" N and Longitude of 79°28'51" E).

*Sampling and collection of data*:

The water samples were collected from both the study areas, between 8-12 AM in polyethylene bottles; some specific parameters were done on




**Lotic water body in Kainchi** **Lotic water body in Garampani**

Fig. 1: Study area.

the study sites, i.e., water and atmospheric temperature were measured with a thermometer. pH was measured using a digital pH meter, and total dissolved solids were measured by a digital TDS meter. Free carbon dioxide and dissolved oxygen were measured by following the standard methods of APHA (2012). For the determination of nitrate and phosphate concentration in water, the water sample was brought to the laboratory and analysed using YSI 9300 Photometer. The data collected were for six months (October 2020-March 2021).

## Results and Discussion

The Physico-chemical parameters of the water body (Shipra) of both the sites are represented in Tables 1, 2 and Figures 2-8.

*Atmospheric Temperature*:

Temperature measures the intensity of the amount of heat stored in a volume of water measured in Celsius (C). In general atmospheric and water temperature depends upon the geographical locations and meteorological conditions such as rainfall, humidity, cloud cover, wind velocity, etc. The atmospheric and water temperature go more or less hand in hand (Macan, 1958).

The minimum atmospheric temperature recorded for Kainchi was 14.1 C in December and the maximum recorded was 26 C in October. The minimum atmospheric temperature recorded for Garampani was 9 C in November and the maximum recorded was 24 C in March (Fig. 2).

*Water Temperature*:

Water temperature regulates the metabolism of the aquatic ecosystem. High water temperature stresses the aquatic ecosystem by reducing the ability of water to hold essential dissolved gases like oxygen; summer heat can cause fish kills in

Table 1: Physico-chemical parameters of the water body (Site 1- Kainchi, Shipra)

| Kainchi | At (C) | Wt (C) | pH | TDS (ppm) | Transparency (cm) | DO (mg/l) | Nitrate(mg/l) | Phosphate (mg/l) |
|---|---|---|---|---|---|---|---|---|
| **October** | 26 | 15 | 8.1 | 76 | 36 | 6.04 | 0.42 | 0.34 |
| **November** | 16 | 11.2 | 8.3 | 82 | 40 | 7.65 | 0.34 | 0.25 |
| **December** | 14.1 | 11 | 7.1 | 85 | 53 | 8.05 | 0.4 | 0.32 |
| **January** | 14.9 | 11.4 | 7 | 85 | 66 | 8.25 | 0.37 | 0.28 |
| **February** | 15 | 12.5 | 7.1 | 86 | 78 | 8.05 | 0.4 | 0.32 |
| **March** | 16.5 | 14.5 | 8.3 | 92 | 59 | 9.26 | 1.63 | 0.43 |

At (Atmospheric Temperature), Wt (Water Temperature), pH (Potentia Hydrogenii), TDS (Total Dissolved Solids), DO (Dissolved Oxygen)

Table 2: Physico-chemical parameters of the water body (Site - Garampani, Shipra)

| Garampani | At (C) | Wt (C) | pH | TDS (ppm) | Transparency (cm) | DO (mg/l) | Nitrate (mg/l) | Phosphate (mg/l) |
|---|---|---|---|---|---|---|---|---|
| **October** | 12 | 13 | 8.7 | 120 | 34 | 8.66 | 0.4 | 0.11 |
| **November** | 9 | 10 | 8.6 | 111 | 31 | 9.26 | 0.32 | 0.15 |
| **December** | 19 | 11.1 | 8.3 | 115 | 45 | 8.25 | 0.36 | 0.18 |
| **January** | 19.8 | 12.5 | 8.2 | 121 | 45 | 8.05 | 0.33 | 0.23 |
| **February** | 22 | 16 | 8.3 | 122 | 46 | 8.25 | 0.38 | 0.27 |
| **March** | 24 | 18 | 8.7 | 132 | 58 | 8.25 | 0.55 | 0.32 |

At (Atmospheric Temperature), Wt (Water Temperature), pH (Potentia Hydrogenii), TDS (Total Dissolved Solids), DO (Dissolved Oxygen)

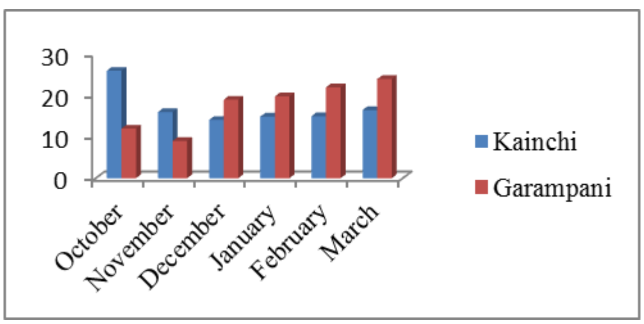



Fig. 2: Monthly variation of Atmospheric temperature at Kainchi and Garampani.

water bodies because high temperatures reduce available oxygen in the water (Kumar and Puri, 2012).

The minimum water temperature recorded for Kainchi was 11 C in December and the maximum recorded was 15 C in October. The minimum water temperature recorded for Garampani was 10 C in November and the maximum recorded was 18 C in March (Fig. 3).

*pH*:

pH is a valuable parameter that tells us about the status of the acidic and alkaline balance of water and serves as an important index of the degree of pollution. Several factors like respiratory activity, exposure to air, temperature fluctuations, etc., bring about a change in pH (Saxena, 1987).

The minimum pH recorded for Kainchi was 7.0

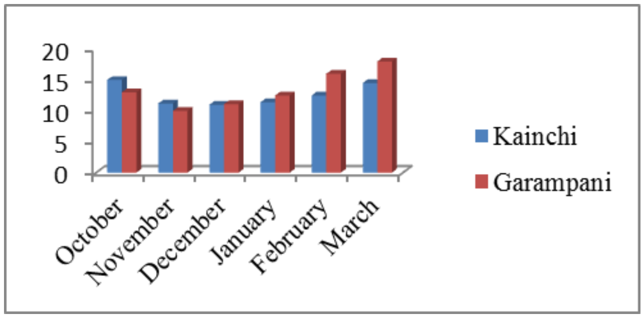



Fig. 3: Monthly variation of Water temperature at Kainchi and Garampani.

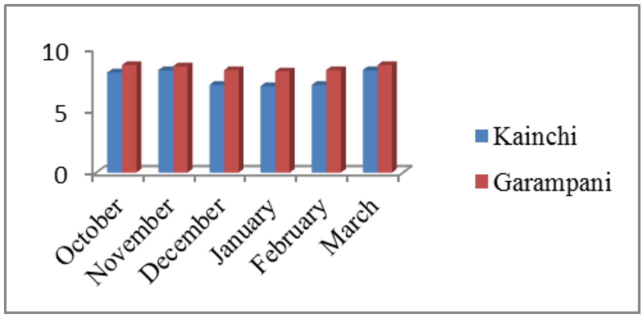



Fig. 4: Monthly variation of pH at Kainchi and Garampani.

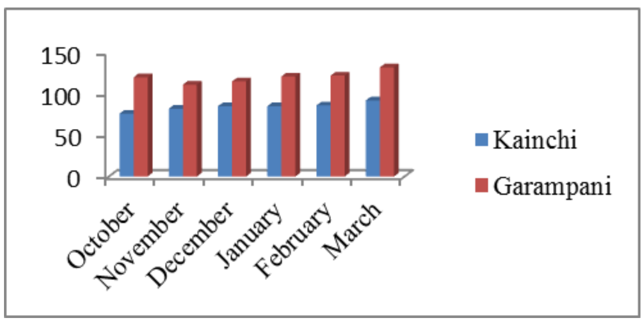



Fig. 5: Monthly variation of Total Dissolved Solids at Kainchi and Garampani.

in January and the maximum recorded was 8.3 in November and March. Whereas the minimum pH recorded for Garampani was 8.2 in January and the maximum recorded was 8.7 in October and March (Fig. 4).

*Total Dissolved Solids*:

Solids refer to the suspended and dissolved matter in water. They are very useful parameters describing the chemical constituents of the water and can be considered as edaphically related that contribute to productivity within the water body. (Goher, 2002)

The minimum total dissolved solids recorded for Kainchi was 76 ppm in October and the maximum recorded was 92 ppm in March. For Garampani, the minimum total dissolved solids recorded was 111 ppm in November and the maximum recorded was 132 ppm in March (Fig. 5).

*Transparency*:

Transparency usually tends to reflect the amount of light that can penetrate inside the water at a given depth. Transparency usually gives us information regarding the clarity of the water. Dissolved solids, wastes, clay, sand, silt and transparency can be affected. Water transparency determines the depth of the photic zone and consequently affects the lower limit of light penetration that influences the primary productivity of a water body. Plankton also

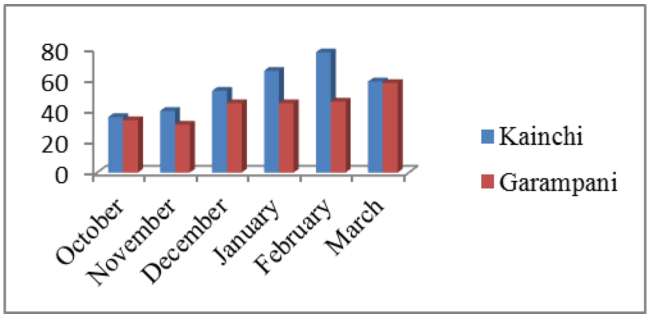



Fig. 6: Monthly variation of Transparency at Kainchi and Garampani.

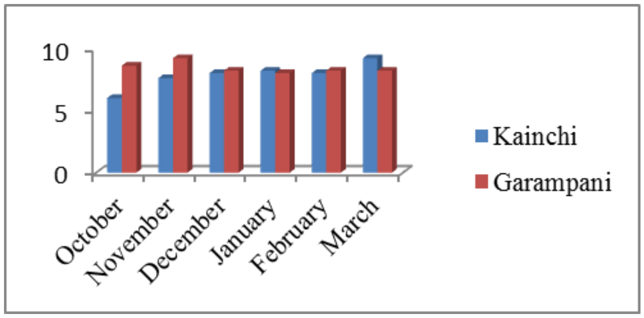



Fig. 7: Monthly variation of Dissolved Oxygen at Kainchi and Garampani.

reduces transparency in natural waters (Ramachandra and Solanki, 2007).

The minimum transparency recorded for Kainchi was 36 cm in October and the maximum recorded was 78 cm in February. Whereas for Garampani the minimum transparency recorded was 31cm in November and the maximum recorded was 58 cm in March (Fig. 6).

*Dissolved Oxygen*:

Dissolved oxygen (D.O.) is considered the most important parameter; it plays a vital role in many chemicals, biological reactions and metabolic processes of the biotic community and indicates the health of an aquatic community. It is highly susceptible to any changes in the environment. The dissolved oxygen content of any water body depends on the mixing and aeration of water, water temperature, duration of sunlight received and altitude of the area (Lamare and Singh, 2014, 2015).

The minimum dissolved oxygen recorded in Kanchi was 6.04 mg/l in October and the maximum recorded was 9.26 mg/l in March. For Garampani, the minimum dissolved oxygen recorded was 8.05 mg/l in January and the maximum recorded was 9.26 mg/l in November (Fig. 7).

*Nitrate*:

Nitrate is the most highly oxidized nitrogen compound present in natural waters which helps in the aerobic decomposition of organic nitrogenous matter. Significant nitrates are fertilizers, decaying vegetation and animal matter, domestic and industrial effluents and atmospheric fallout. Excessive nitrate concentration in drinking water is considered hazardous for infants because nitrates are reduced to nitrites in their intestinal tract, which may cause the blue baby syndrome.

The minimum Nitrate recorded in Kainchi was 0.34 mg/l in November and the maximum recorded was 1.63 mg/l in March. For Garampani, the minimum Nitrate recorded was 0.32 mg/l in November and the maximum recorded was 0.55 mg/l in March (Fig. 8).

*Phosphate*:

Phosphates are washed down into the nearby water bodies during rainfall and stimulate the

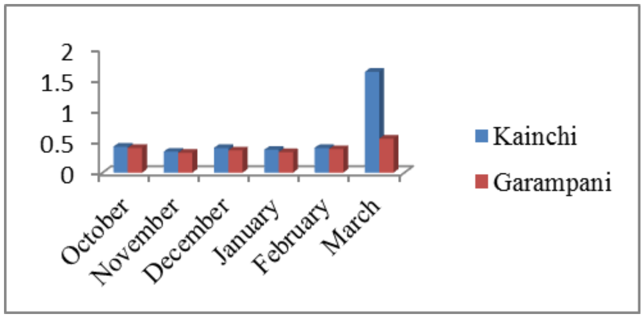



Fig. 8: Monthly variation of Nitrate at Kainchi and Garampani.

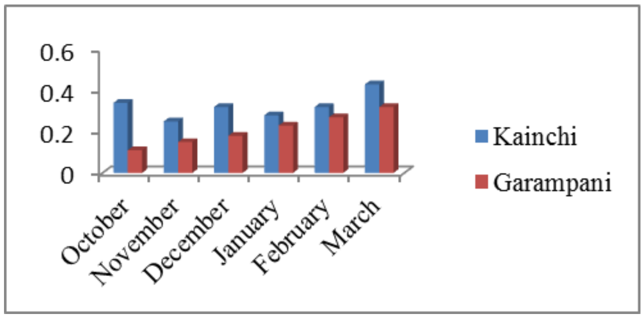



Fig. 9: Monthly variation of Phosphate at Kainchi and Garampani.

Table 3: Guidelines for drinking water (BIS, 2012; WHO, 2021)

| **BIS Standard for safe Drinking water (2012)** | | **WHO Guidelines for Safe Drinking Water (2021)** | |
|---|---|---|---|
| **Parameters** | **Acceptable limit** | **Parameters** | **Acceptable limit** |
| pH | 6.5-8.5 | pH | 6.5-8.5 |
| TDS | 500 mg/l | TDS | >600 mg/l |
| Nitrate | 45 mg/l | Nitrate | 50 mg/l |

phytoplankton growth and aquatic plants, which are a food for fishes. Its increased growth may cause an increase in the fish population and improve the quality of life water as a whole. However, if an excessive amount of phosphate enters the water bodies, algal and aquatic plants will grow rapidly and use large amounts of oxygen. This condition is known as Eutrophication or over-fertilization of receiving waters. The rapid growth of aquatic vegetation can cause the death and decay of vegetation and quality of life because of the decrease in dissolved oxygen levels. Phosphates are not toxic to people or animals unless present at very high concentrations. (Kumar and Puri, 2012).

The minimum phosphate recorded in Kainchi was 0.25 mg/l in November and the maximum recorded was 0.43 mg/l in March. For Garampani, the minimum phosphate recorded was 0.11 mg/l in October and the maximum recorded was 0.32 mg/l in March (Fig. 9).

Table 3 shows various drinking standards of water according to BIS (2012) and WHO (2021) guidelines for safe drinking water for only some of the parameters:

## Conclusion

A study of Physico-chemical parameters of the lotic water body, Shipra (Nainital district, Uttarakhand) was carried out by taking important parameters like temperature, pH, dissolved oxygen and phosphate, etc., from October 2020 to March 2021. In the present investigation, when the Physico-chemical parameters of both study sites were compared with guidelines for safe drinking water recommended by BIS (2012) and WHO (2012), the observed Physico-chemical parameter for site-1 (Kainchi) and site -2 (Garampani) was found within a range except pH at Site-2 (Garampani) indicating that the water is alkaline and the water body is vulnerable to various polluting sources. Certain organisms adapt themselves to specific pH, and a slight change in pH will cause the organism's death. However, other Physico-chemical parameters and biological parametric study should be considered for further conclusions in the water body.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