ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 8.4
IJAR 2023; 9(2): 217-221
www.allresearchjournal.com
Received: 08-12-2022
Accepted: 13-01-2023

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Assessment of Limnological studies of Kaliasot River, Madhya Pradesh, India

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Abstract
Water plays a crucial role in the human life. The present study was conducted to assess the Limnological characteristics of Kaliasot River. The samples were analyzed for physicochemical parameters (Water temperature, pH, TDS, EC, TA, DO, TH, CL, NO^{-3} and PO^{-4}). The results revealed that increased input of sewage from different sources lead to of polluted nature of Kaliasot River. On the basis of different physico-chemical characteristics the river can ban classified as eutrophic. Kaliasot river acts as major source of agricultural practices and routine monitoring needs to be done for its protection.

Keywords: Kaliasot, sewage, pH, TDS

Introduction
Water is an important component for survival of life on earth. Lakes and surface water reservoirs are the planet's most important freshwater resources and provide in numerable benefits. They are used for domestic and irrigation. They have important social and economic benefits as a result of tourism and recreation, are culturally and aesthetically important for people throughout the world (Seher, 2015) [20]. The indiscriminate release of chemical fertilizers, pesticides, industrial effluents are causing heavy and varied pollution in the aquatic environment leading to the deterioration of water quality which in turn depletes the aquatic biota. The use of the contaminated water by human population results in water borne diseases, so that quality of water must be tested for both the chemical as well as for the microbial contaminants (Smitha and Shivashanker, 2013) [21]. The water scarcity is going to be a crucial focus for governments in the next few decades, especially since the population is expected to reach approximately 9.7 billion by the year 2050 and 11.2 billion by 2100. On the other hand, if current water resources are not properly regulated, an eventual increase in world population will become problematic for many regions and countries. Overpopulation will strain current water resources to their limits, cause an increase in water pollution, and lead to an increase in civil and international conflicts over existing water supplies. Hence it is important to check the water quality regularly. The present study investigates physicochemical characteristics of Kaliasot River to access the degree of pollution caused by input wastes from catchment areas.

Study Area
A tributary of the River Betwa, the Kaliasot is a river in Central India. The river begins as an overflow from the Kaliasot Dam in Bhopal and flows southeast. It travels a distance of around 29 km from the source to the destination (before joining the river Betwa at Bhojpur). With the exception of the monsoon season, the river has very little flow from its source up to Bhojpur. Only one location, the river's confluence with the river Betwa near Mandideep, is regularly inspected for water quality. It is approximately 13 km from the village of Samardha to Bhojpur (where the River Betwa joins) is designated as polluted.

Methodology
The surface water samples of Kaliasot river were collected to assess the water quality. The samples were collected in polyethylene bottle from five selected sites and were analyzed for physicochemical parameters *viz*., water temperature, pH, TDS, dissolved oxygen, electrical conductivity, chloride, total hardness, alkalinity, calcium hardness, nitrate and orthophosphate by using standard methods as mentioned in the Workbook of Limnology (Adoni *et al.*, 1985) [23] and (APHA, 2009) [24].

Results and Discussion

The temperature plays an essential role in physical chemical and biological behavior of aquatic system (Dwivedi and Pandey, 2002) [22]. Water temperature being one of the most important ecological factors, has a considerable influence on the abiotic and biotic components of the ecosystem. It regulates metabolic activity and growth rate of organism, making it one among the most important limiting variables in aquatic ecosystems (Dheer, 1988) [1]. The seasonal differences in water temperature are caused by the effect of air temperature. The value of water temperature varied from 19 °C to 34 °C during the study.

pH gives an idea of the concentration of ionized hydrogen which in turn yields indirect information of the free CO2, alkalinity, dissolved oxygen phosphate, nitrate, regulates most of the biological processes and serves as means of several environmental conditions (Sheeja, 2005; Verma *et al*., 2006) [2, 3]. According to Bouslah *et al*., 2017 [4] one of the most important factors that serves pollution indicator is pH, whose measurement in surface waters is important as toxicity of many pollutants increases with respect to it. Water which has pH value of more than 9 or less than 4.5 becomes unsuitable for use Pawar (2012) [5]. During the present investigation the pH ranged from 6.9 to 8.7 units.

TDS are composed of carbonates, bicarbonates, chlorides, sulphates, phosphates and nitrates of sodium, potassium, calcium and manganese (Sudarshan *et al.*, 1991; Bhattacharjee *et al*., 2010) [7, 6]. During the present study the TDS ranged from 115 to 380 ppm.

It is an indirect assess to total dissolved Salts, elevated levels of which arise through weathering of certain sedimentary rocks naturally or may have an anthropogenic origin *viz*., industrial and sewage effluent (WHO 2004) [13]. It is the capacity of a substance or solution to conduct electrical current (Garg *et al.*, 2009) [17] elevated level of which indicates the pollution status as well as trophic levels of the aquatic body (Ahluwalia, 1999) [16]. Water bodies with low renewal capacities have higher conductivity (thus higher trophic level) Berg *et al.*, (1958) [18]. The value of Electrical Conductivity varied from 170 to 445 µscm^{-1}.

Alkalinity of water is its capacity to neutralize a strong acid and is normally due to the presence of bicarbonates, carbonates, hydroxides, phosphates, borates, silicates and organic acids. The excess of alkalinity could be due to the minerals, which dissolve in water from mineral rich soil. During the present study the total alkalinity ranged from 24 to 140 mgl^{-1}.

Chloride is an anion, which occur naturally in all natural waters in the form of Ca, Mg and Na salt, chlorine as such is non-toxic to human beings but its elevated levels can be considered as the "advance warning" of the existence of other toxic contaminants in water. Hence, concentration of chloride content is an indicator of pollution in fresh water (Kelly *et al.*, 2012) [8]. The source of chloride in the Kaliasote River were due to the runoff containing inorganic fertilizers coming from agricultural fields, animal feeds and irrigation drainage. During the present study period the Chloride ranged from 16 to 116 mgl^{-1}.

Dissolved oxygen is an important parameter to assess water quality of any aquatic ecosystem which reveals the nature of the whole aquatic system at a glance and reflects the biological and physical process existing there in (Trivedi *et al*., 1998) [10]. There are two main source of dissolved oxygen in water *i.e*., by diffusion from air and photosynthetic activity. The sufficient oxygen is necessary for the survival of aquatic fauna and for decomposition of organic matter by microorganisms (Islam and Meghla, 2010) [9]. During the present study the Dissolved Oxygen ranged from 4 to 9.6 mgl^{-1}.

Total hardness in water is the sum of the concentrations of alkaline earth metal (e.g. Ca^{++}, Mg^{++}) in combination with bicarbonates and carbonates (temporary hardness) apart from sulphates, chlorides and nitrates. In the study area**,** the value of Total hardness ranged from 109 to 245 mgl^{-1}.

The most significant inorganic Phosphorus in aquatic ecosystems is Orthophosphate which is probably < 5% in most natural waters (Prepas and Rigler, 1982 and Tarapchak *et al.*, 1982) [11, 12]. It plays a dynamic role in aquatic ecosystem and is taken up widely by phytoplankton (Goldman, 1965). During the present investigation the Phosphate ranged from 0.32 to 0.98 mgl^{-1}.

Nitrate concentration in surface waters is normally low but can reach high levels due to agricultural runoff and contamination with human and animal wastes and elicit eutrophication and point out the level of organic pollution (Uchchariya, 2012; Verma *et al.*, 2012) [14, 15]. During the present study the Nitrate ranged from 0.391 to 4.37 mgl^{-1}. The high nutrient input in the river kaliasot comes from the different sewage input nallahs that join the river from Bhopal, Mandideep and Misrod. A portion of nutrient input also comes from the agricultural fields that surround the Kaliasot river through their washouts during the monsoon season. According to Bouslah *et al.*, (2017) [4] discharge of wastewater, application of fertilizers, surface runoff from land and fertilizer polluted ground waters appear as sources of nitrates in surface waters, and due to the rapid oxidizing ability of nitrites into nitrates, these are always found in higher concentrations in surface waters.

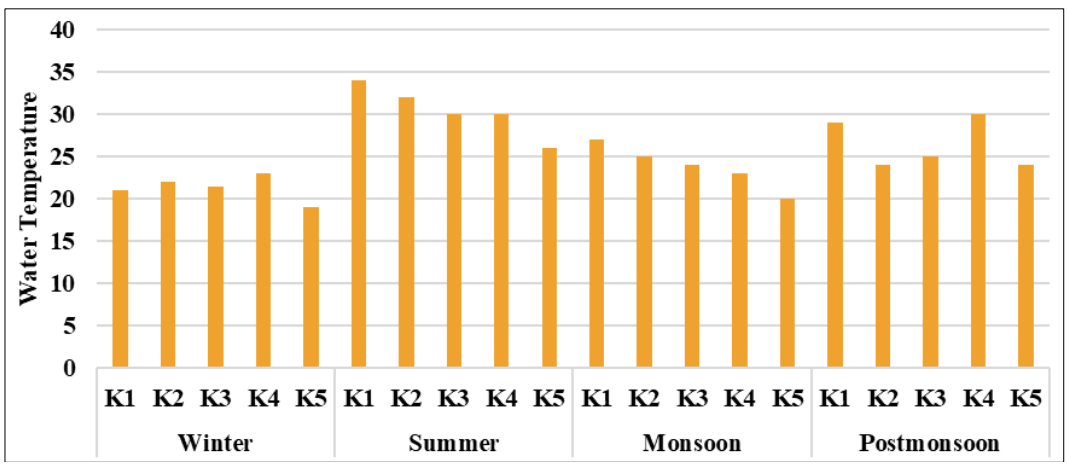

Fig 1: Water Temperature

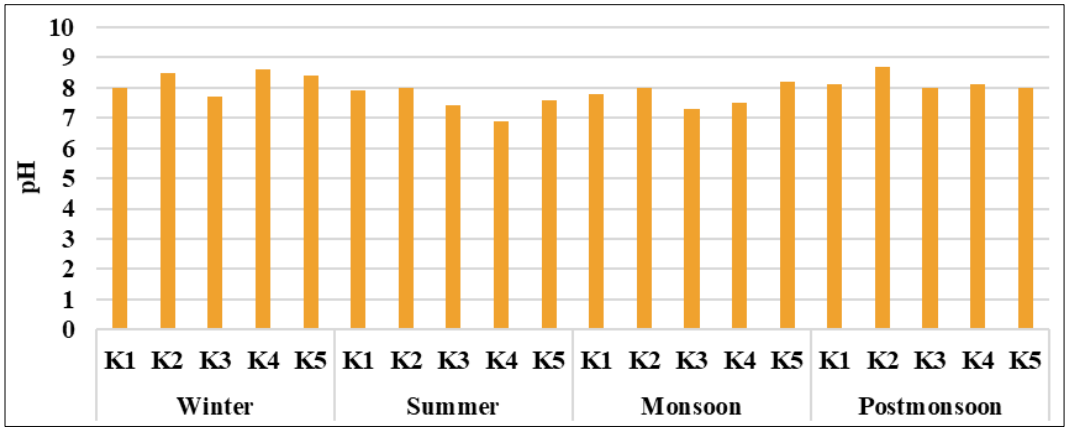

Fig 2: pH

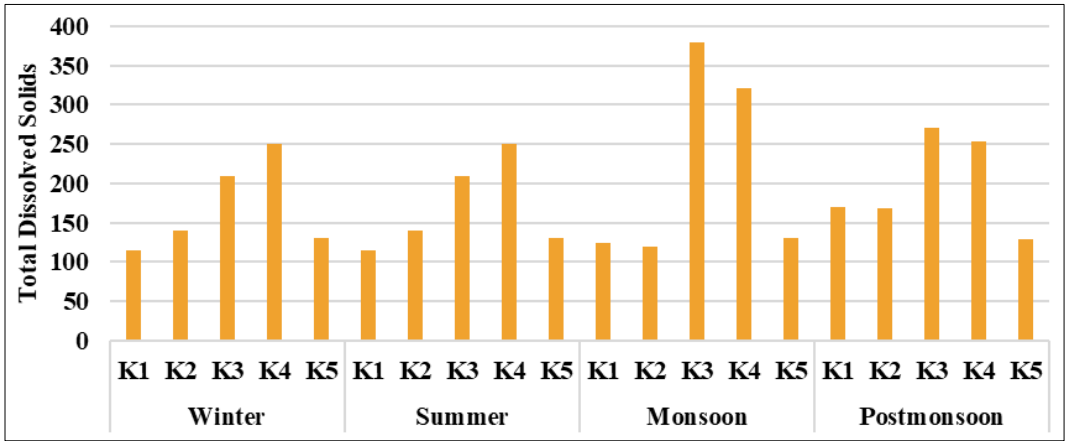

Fig 3: Total Dissolved Solids

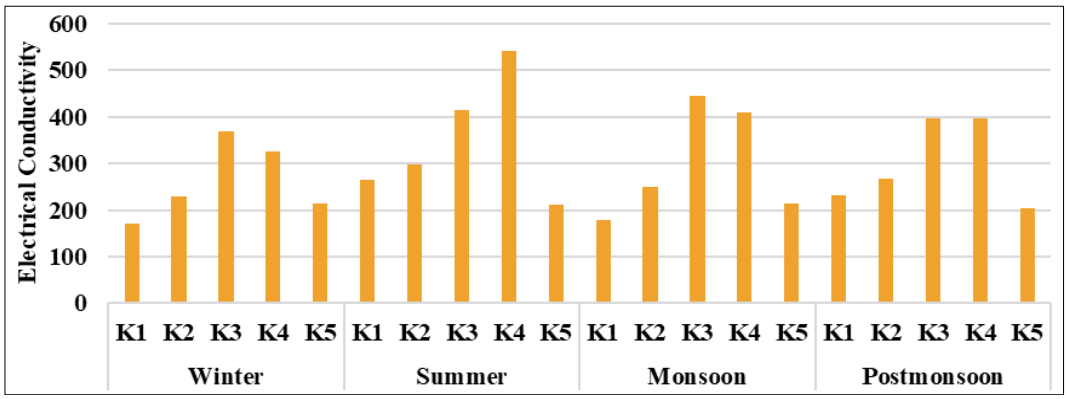

Fig 4: Electrical Conductivity

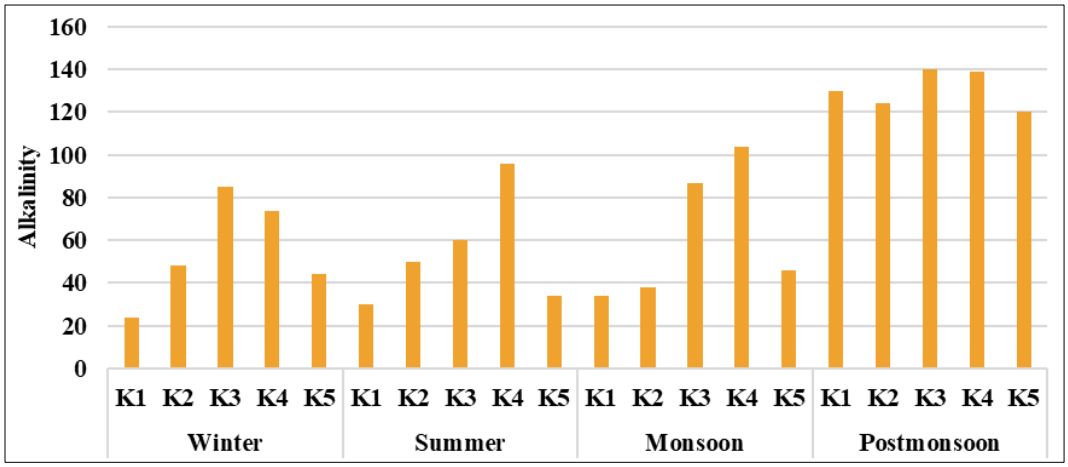

Fig 5: Alkalinity

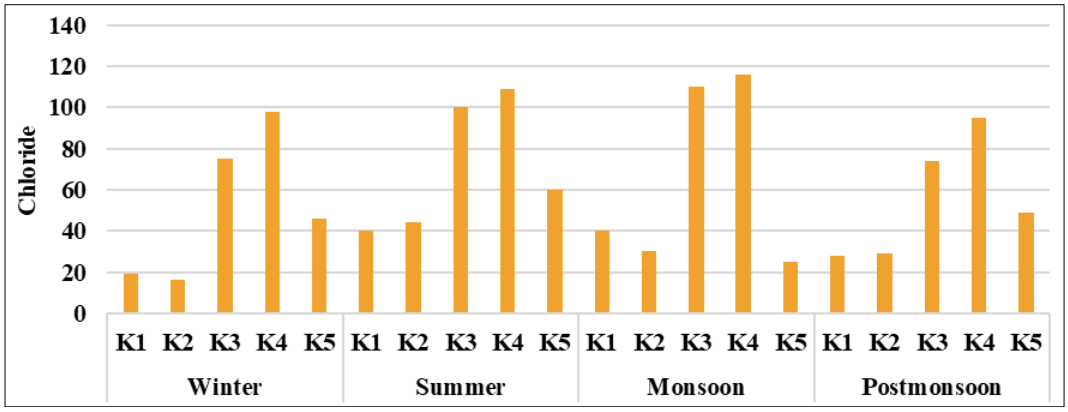

Fig 6: Chloride

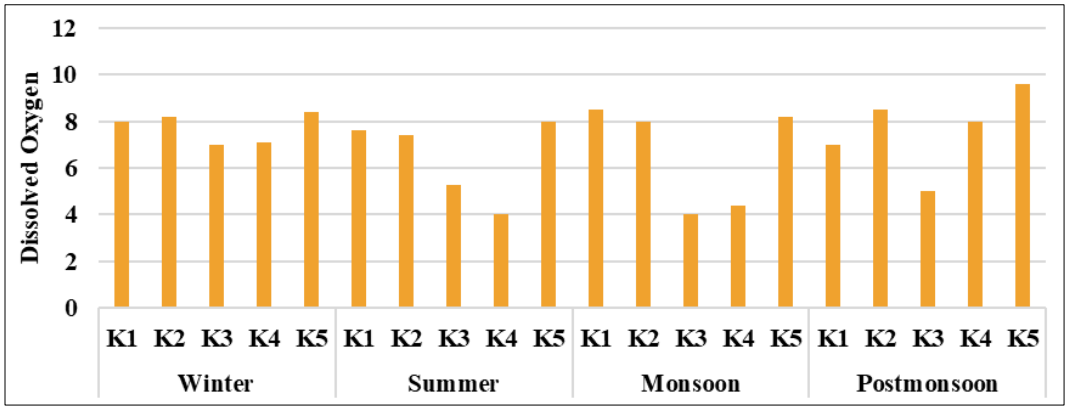

Fig 7: Dissolved Oxygen

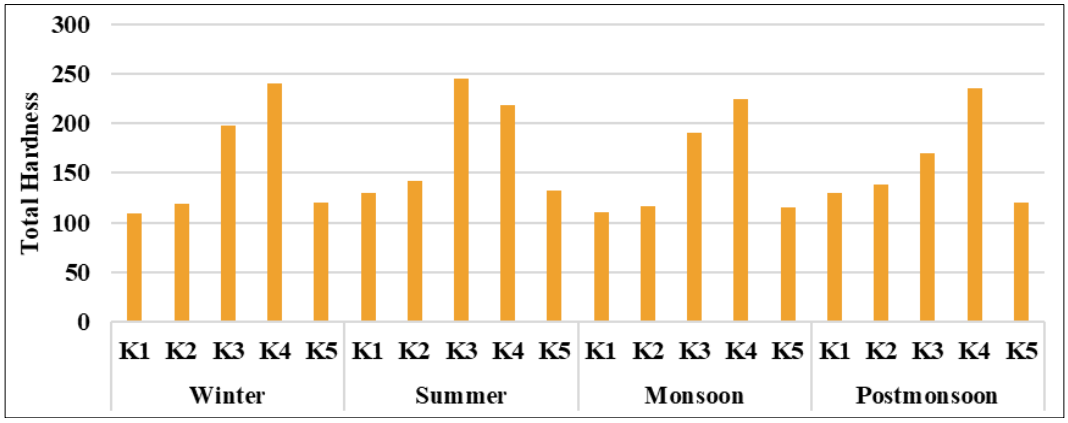

Fig 8: Total Hardness

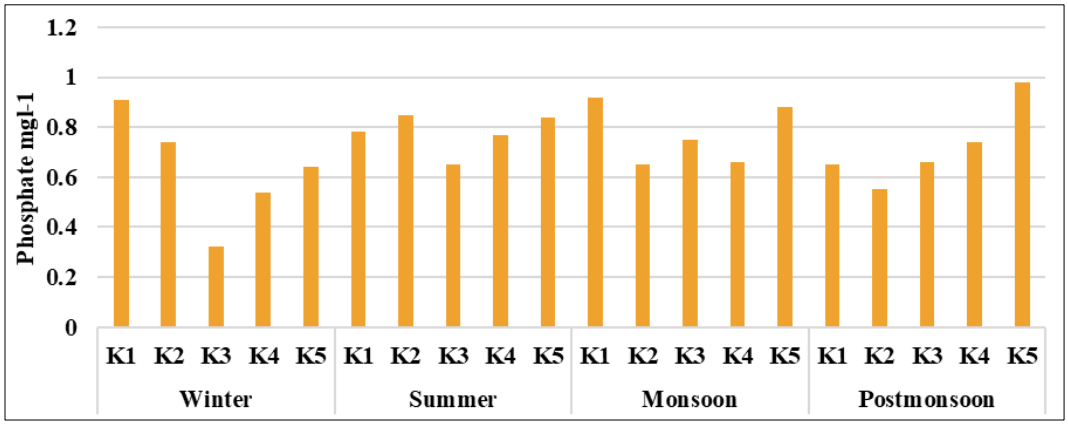

Fig 9: Phosphate mgl^{-1}

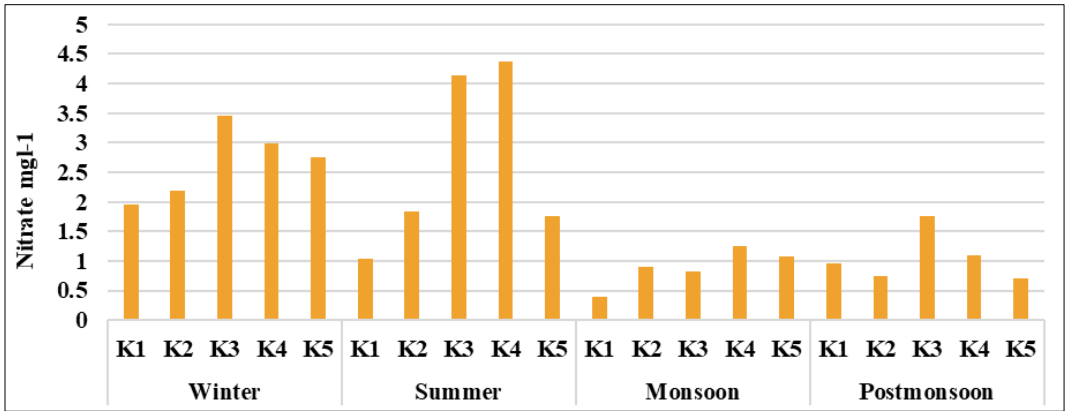

Fig 10: Nitrate mgl^{-1}

Conclusion

On the basis of the values accounted for the different physico–chemical characters the present condition of the Kaliasot can be categorized being eutrophic and the pollution level is at its extreme as it is fed by different sewage nallahs from Bhopal, Misrod and Mandideep. Kaliasot river acts as major source of agricultural practices and routine monitoring needs to be done for its protection.

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