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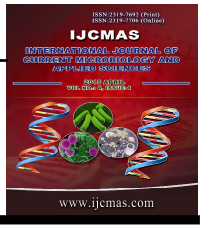

Original Research Article

A study on seasonal fluctuations in physico-chemical variables in spring fed Kosi River at Almora province from central Himalaya, India

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Keywords

Kosi River, Physico-chemical parameter, Central Himalaya, Seasonal fluctuation

A B S T R A C T

Present study was conducted with the qualitative estimation on seasonal fluctuation in physico-chemical parameters on Kosi River at Kosi, Almora, Uttarakhand, India. Various physico-chemical parameters such as temperature, transparency, conductivity, TDS, pH, total alkalinity, chloride, free CO_2 and DO were analyzed for various seasons from the period of January 2013 to December 2013. Some parameters were tested on the spot whereas some parameters were tested in the laboratory according to standard method. The present study indicates that assessments of physico-chemical parameters of river are necessary for its various beneficial purposes.

Introduction

India is an agricultural country and after monsoon all Indian states get dependent on water of rivers for irrigation, Thitame *et al.* (2010), Venkatesharaju *et al.* (2010). The increasing industrialization, urbanization etc., has made our water bodies full of chemicals, Kumar *et al.* (2014), Alam *et al.* (2010), Mandal, *et al.* (2011). This polluted water causes serious diseases and also harmful for crops. All the domestic waste and industrial waste are use to drain in rivers which cause pollution of water. This type of water if consumed by the human beings can cause serious health problems. The river ecology is mostly studied for two reasons, first for development of aquaculture and second one for measuring the extent of pollution (Verma, 2013 a).

The water quality index is very effective tool to find out how much an aquatic media contain pollutant. Most of the holy rivers of India take their origin from the Himalaya and passes through various places in Uttarakhand region (Verma, 2014 a). The Uttarakhand state is blessed with varied natural water resources such as of snow, spring and rain fed rivers and upland lakes (Verma, 2013 b). Uttarakhand, a hilly state, has a vast number of rivers, tributaries and lakes. Five major rivers of Uttarakhand are Kosi, Kali, Pindar, Gaula and Western Ramganga. The River Kosi originates from spring source at Rudradhari in District Almora, Uttarakhand and confluences to River Ramganga near village Chamrul. It is an important river of Kumaun region. It

flows in the central part of Almora District and Western part of Nainital District and continuously it enters the plains of the Western Uttar Pradesh and joins River Ramganga in Ramnagar of Uttarakhand.

In the recent decade various hydrological studies were carried out by Balodi (2001), Sukumaran and Das (2001), Nautiyal *et al.* (2004), Balodi *et al.* (2004), Rawat and Nautiyal (2005), Bisht *et al.* (2005), Nath and Roy (2006), Kumar *et al.* (2006), Khadse *et al.* (2008) and Jafari *et al.* (2011).

The main purpose of this study is to determine seasonal variations in physico-chemical parameters of this river water at selected sampling site Kosi in Almora District (Latitude $29^0$37' N Longitude $79^0$40'E). The aim of present research is to find out the present status of Kosi River at Kosi region in Almora District. The another aim is to identification of the main causes and sources of water pollution due to which the physico- chemical properties of Kosi River are altering.

Materials and Methods

Kosi sampling site was selected for the study. Kosi is a village located at the bank of river in Almora. Kosi River flows there and receives domestic wastages, garbage from nearby houses. As a result, the physico-chemical and biological parameters of river water are fluctuating gradually and such type of water is really harmful for human beings as well as for fishes and other aquatic biota. The Central Himalaya has diversified climatic conditions, (Verma, 2013c). For this study water samples were taken monthly from the selected sampling site. Some of the parameters like water temperature, pH, TDS, water transparency, conductivity, DO, CO_2 etc., were calculated on the spot whereas rest parameters were tested in laboratory according to standard method (APHA 1999; Welch, 1975).

Results and Discussion

Every water body contains lot of constituents either in dissolved or in suspended form. All those constituents have different types of physical and chemical properties in different proportions. These physical and chemical constituents also lead to different biological activities. Infect all physical and chemical parameters decide the variety, distribution and abundance of all aquatic animals and plants. At the site Kosi, variations in some physical and chemical parameters were recorded and are summarized in the table 1 and table 2.

The ambient temperature changes according to the season. In present study, the maximum air temperature 26.5 °C was recorded in the month of June and minimum temperature 14 °C was recorded in the month of January. In the present study the fluctuation in water temperature ranged between maximum 22.3°C in the month of June and minimum 11.2°C in the month of January. Similar results were observed by Odum (1971), Mithani *et al.* (2012), Khanna *et al.* (2013), Verma, (2014 b).

Velocity of the river water was recorded maximum during monsoon and minimum during summer. River velocity was maximum 0.578 m/sec in the month of August and minimum 0.35 m/sec in the month of March. The amount of total dissolved solids increases in monsoon due to more run off, soil erosion etc. Similar results were observed in his research by Verma, (2013 a).

The highest value of TDS 78 mg/l was recorded in the month of August and the lowest value 47 mg/l was recorded in the

month of December. Reverse phenomena of TDS happened in the case of water transparency, i.e. water transparency was maximum 245 cm in the month of January and minimum 25 cm in the month of August. This was similar as the research findings by Jhingran (1965), Upadhyay (1997).

The pH value was recorded maximum 8.8 in the month of January and minimum 7.5 in the month of August. Our findings were supported by research of Chacko and Srinivasan (1955), Kumar *et al.* (2006).

Dissolved oxygen is another important factor that influences the abundance of aquatic life and quality of water. The lack of DO leads anaerobic decomposition of organic matter, which in turns results in the formation of hydrogen sulphide and ammonium. According to WHO and Garnik Bamakanta *et al.* (2013) the standard value of DO is >5.00 mg/l. In present study, the maximum value 10.5 mg/l DO was recorded in the month of January and minimum 8 mg/l in the month of August. Khinchi, *et al.* (2011) also found same results in their study.

In the summer season due to the high temperature the respiration of aquatic organisms increases simultaneously the decay of organic matters takes place, which results to release a high amount of CO_2. Similar observation obtained by Bhatt *et al.* (1984), Verma (2013 a)

The alkalinity of water is its capacity to neutralize acids. In this study the highest concentration of alkalinity 75 mg/l was recorded in the month of December and lowest concentration 56mg/l was recorded in the month of August, similar findings was also recorded by Gangwar *et al.* (2012).

The highest concentration of chloride 5.5 mg/l was recorded in the month of July and lowest concentration 3.2 mg/l was recorded in the month of December. The desirable limit of chloride in water is 250 mg/l and the permissible limit of chloride in water is 400 mg/l. Abida *et al.* (2008), Sirajudeen *et al.* (2013) and Goyal *et al.* (2013) reported that the decomposition and mineralization of organic material causes the formation of cations and the conductivity in water. In this study the highest level of conductivity 165.95 µs/cm, was recorded in the month of August and the lowest value 100 µs/cm was recorded in the month of December.

The statistical correlations between different hydrological Parameters are shown in table 1. TDS is positively correlated with water temperature (r=0.667181). TDS is negatively correlated with transparency, alkalinity. TDS is negatively correlated with DO and pH also (Mohan *et al.*, 2013). TDS is equally correlated with conductivity. pH is positively correlated with DO (r=0.912855). Similar result was reported by Khanna *et al.* (2013). pH is negatively correlated with CO_2 (r= -0.9003). pH is negatively correlated with chloride, conductivity and air temperature. DO and CO_2 are negatively correlated (r= -0.98535). DO is negatively correlated with chloride, conductivity and air temperature whereas CO_2 is positively correlated with chloride, conductivity and air temperature. Alkalinity is negatively correlated with chloride, conductivity and air temperature. Chloride is positively correlated with conductivity and air temperature.

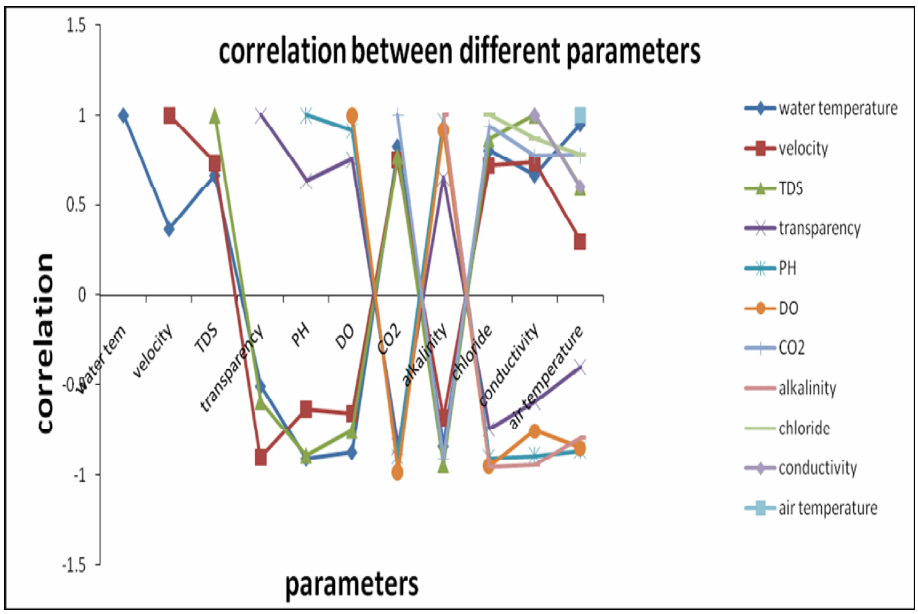
Therefore, the present study concluded that the water of study area can be used for drinking purpose and all the studied parameters were within the permissible limit as prescribed by safe water quality standards.

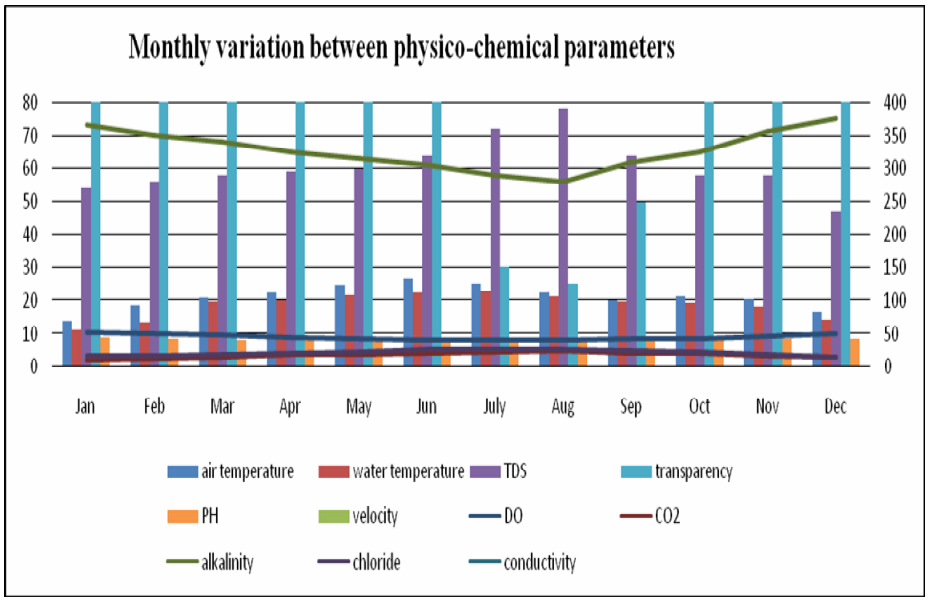
Table.1 showing correlation between different physico-chemical parameters in Kosi River during January 2013 to December 2013

	Water temperature	Air temperature	velocity	TDS	transparency	pH	DO	CO_2	alkalinity	Chloride	conductivity
Water tem	1										
Air tem	0.948972	1									
Velocity	0.368533	0.299115	1								
TDS	0.667181	0.597242	0.733143	1							
Transparency	-0.506151	-0.3998	-0.90028	-0.59455	1						
pH	-0.90678	-0.86401	-0.63369	-0.89175	0.634348	1					
DO	-0.8718	-0.85067	-0.65717	-0.75619	0.752522	0.912855	1				
CO_2	0.8262	0.774633	0.750301	0.77099	-0.84148	-0.9003	-0.98535	1			
Alkalinity	-0.83902	-0.79226	-0.68052	-0.94461	0.652767	0.968684	0.917347	-0.90622	1		
Chloride	0.802169	0.779617	0.718019	0.864614	-0.74229	-0.90574	-0.94724	0.937173	-0.95388	1	
Conductivity	0.667201	0.597246	0.733149	1	-0.59459	-0.89176	-0.7562	0.771013	-0.94463	0.864646	1

Table.2 showing physico-chemical parameters in Kosi River during January 2013 to December 2013

	Water temp	**Ambient temp**	**Velocity**	**T.D.S.**	**Transparency**	**pH**	**DO**	**CO_2**	**Alkalinity**	**Chloride**	**Conductivity**
January	11.2	14	0.373	54	245	8.8	10.5	2.4	73	3.4	114.89
February	13.5	18.4	0.379	56	320	8.4	10	2.8	70	3.6	119.40
March	19.7	21	0.35	58	200	8.2	9.8	3	68	3.8	123.4
April	20.2	22.4	0.365	59	180	8	9	3.7	65	4.1	125.53
May	21.5	24.8	0.386	60	175	7.9	8.4	4	63	4.5	127.65
June	22.3	26.5	0.389	64	160	7.8	8.2	4.2	61	5.3	136.17
July	21.7	25	0.545	72	30	7.6	8.1	4.5	58	5.5	153.19
August	21	22.4	0.578	78	25	7.5	8	4.8	56	5.4	165.95
September	19	20.2	0.463	64	50	8	8.4	4.3	62	5.1	136.17
October	18.2	21.4	0.45	58	80	8.2	8.6	4.1	65	4.6	123.4
November	17.1	20.4	0.435	49	110	8.4	9.2	3.6	71	4	104.25
December	14.1	16.5	0.395	47	140	8.6	10	3	75	3.2	100





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