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Evaluation of Seasonal Fluctuations of Dissolved Oxygen Content of Gonda Nallah and River Kharashrota near Kalinga Nagar Industrial Complex of Odisha in India

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***Abstract* –This study has been designed to evaluate the richness of dissolved oxygen of Gonda nallah and River Kharashrota near the industrial belt of Kalinga Nagar Industrial Complex during Pre-monsoon, Monsoon and Post-monsoon seasons. Dissolved oxygen is an important parameter for determination of water quality and its uses. The polluted water bodies experience low dissolved oxygen content. The health of the plants, animals and human-beings is influenced by the quality of the consumed water. The study area is situated at the Jajpur district of Odisha in India. In the present study the dissolved oxygen content was determined following standard methods of American Public Health Association. The analysis of experimental results expresses significant seasonal and sampling stations based fluctuations of dissolved oxygen content. The dissolved oxygen content of the Gonda nallah is less as compared to that of River Kharashrota. The low dissolved oxygen content of the River Kharashrota at SW 07 may be due to the influx of polluted water of Gonda nallah. Further study is necessary in this regard to improve the water quality of Gonda nallah and River Kharashrota.**

Keywords- Dissolved oxygen, Effluents, Pollution, River, Seasonal

I. INTRODUCTION

River water is an important form of surface water resources commonly being used by the people for domestic, industrial and agricultural activities. River water qualities are deteriorating due to rapid increase in the population, industrialization and deforestation. Industries are also depending on the river water for its use as industrial influents. In many instances, surface water quality of the industrial area has the chances of being affected by the industrial activities. Rivers are loaded with treated, partially treated or untreated effluents released by the industries.

The available river water resources are gradually deteriorating qualitatively and quantitatively over time [1], [2]. Dissolved oxygen (DO) content of the river water is a good predictor of the water quality and ecosystem metabolism. High dissolved oxygen content of the surface water reduces the stress of the living organisms present there and optimize their growth and ultimately the product qualitatively and quantitatively [3], [4]. Now a day, drinking water is a scarce natural resource and raw river water is being used as the drinking water [5], [6].

Environmental impact assessment is necessary for reducing the possible adverse impacts on the exposed living organisms. Seasonal assessment of surface water quality is an important aspect of estimating fluctuation of river water pollution [7], [8], [9]. Rivers are unable to self rejuvenate due to high load of pollutants. With continued pollution, self purification ability of rivers is diminishing and their water is becoming unfit for drinking, agricultural and other domestic uses. Hence, the water quality evaluation of rivers and their proper maintenance become necessary for the safety and healthy life of human beings.

The River Kharashrota is a major east flowing river of Jajpur district in Odisha. It is a branch of River Brahmani after Chakua [10]. The Kalinga Nagar Industrial Complex, famous for steel production of Odisha in India is situated on its northern side near Chakua – Jokadia stretch. The surface water of River Kharashrota is used by the villagers of villages such as Jokadia, Marthapur and Pahanga for their day to day activities. The surface water body, Gonda nallah receives many drainage channels from this industrial complex on both of its banks and ultimately drains into the River Kharashrota at Jokadia.

II. MATERIALS AND METHODS

The Gonda nallah and River Kharashrota near Jokadia was selected for the present study as it is situated nearer the Kalinga Nagar Industrial Complex in the Jajpur district of Odisha. Sampling sites were selected on the basis of its location in an industrial environment, utility of that water by the villagers, suspected sites of surface water pollution and possible negative effects. The study area of the present study is covered under the Survey of India toposheet No. 73 L / 1 and is bounded between the latitudes 20º 57' N - 21º 3' N and longitudes 85º 59' E - 86º 5' E.

In the present study, monitoring of the dissolved oxygen content of surface water of Gonda nallah and River Kharashrota was done to assess the water quality. The station codes and description of the water sampling stations are presented in Table 1.

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TABLE 1: Table showing the station code and description of the water sampling stations of the study area

Station code of water sampling sites	Description of the sampling station	Distance from the previous water sampling station in the upstream
SW 01	Gonda nallah	First sampling station
SW 02	Gonda nallah	500 metres
SW 03	Gonda nallah	500 metres
SW 04	Gonda nallah	500 metres
SW 05	Gonda nallah	500 metres
SW 06	Gonda nallah	500 metres
SW 07	River Kharashrota	500 metres
SW 08	River Kharashrota	500 metres
SW 09	River Kharashrota	500 metres
SW 10	River Kharashrota	500 metres
SW 11	River Kharashrota	500 metres
SW 12	River Kharashrota	500 metres

Water samples were collected in Pre-monsoon (February-May), Monsoon ((June-September) and Post-monsoon (October-January) seasons during February, 2012 to January, 2016. Water samples were collected in polythene bottles pre-sterilized with 2 percent nitric acid. Samples were collected from the sampling stations at 11.00 AM and the DO of the surface water samples were estimated following standard methods for the examination of water and wastewater [11].

III. RESULTS AND DISCUSSION

The seasonal fluctuations of dissolved oxygen content of surface water of Gonda nallah and River Kharashrota during Pre-monsoon, Monsoon and Post-monsoon seasons and their interactions are presented in Table 2. The analysis of variance indicates the significance of the values at p = 0.05.

The mean dissolved oxygen content of the surface water samples was found to be more during monsoon (7.346 mg/l) followed by post-monsoon (6.650 mg/l) and pre-monsoon (5.613 mg/l). The low mean dissolved oxygen content during pre-monsoon may be due to the decrease in solubility of oxygen with the increase in surrounding temperature. The high mean dissolved oxygen content during monsoon as compared to post-monsoon may be due to the dilution of pollutant load with the influx of oxygen rich freshwater runoff.

TABLE 2: Table for seasons, surface water sampling stations and their interactions in respect of dissolved oxygen (mg / l) of the water samples of the study area

	Pre-monsoon	Monsoon	Post-monsoon	Mean
SW 01	4.300	5.550	5.000	4.950
SW 02	4.550	6.400	5.650	5.533
SW 03	4.600	6.400	5.700	5.567
SW 04	4.700	6.450	5.900	5.683
SW 05	4.700	6.600	5.900	5.733
SW 06	4.850	6.600	5.950	5.800
SW 07	6.250	7.700	7.400	7.117
SW 08	6.400	8.150	7.450	7.333
SW 09	6.600	8.447	7.550	7.532
SW 10	6.750	8.550	7.650	7.650
SW 11	6.805	8.600	7.800	7.735
SW 12	6.850	8.700	7.850	7.800
Mean	5.613	7.346	6.650	
SE(m) (±) for seasons				0.006
CD(0.05) for seasons				0.036
SE(m) (±) for sampling stations				0.012
CD(0.05) for sampling stations				0.037
SE(m) (±) for interactions of seasons and sampling stations				0.020
CD(0.05) for interactions of seasons and sampling stations				0.059
CV				0.77

The mean dissolved oxygen content of the surface water samples of Gonda nallah ranged in between 4.950 mg/l (SW 01) and 5.800 mg/l (SW 06). The low dissolved oxygen content of the surface water samples from Gonda nallah may be due to the consumption of dissolved oxygen during oxidation, degradation and microbial decomposition of pollutants present in it. The mean dissolved oxygen content of the surface water samples of River Kharashrota were found to be more than that of Gonda nallah. The mean dissolved oxygen content of the surface water samples of River Kharashrota was minimum (7.117 mg/l) at SW 07, the confluence point of Gonda nallah and River Kharashrota. The low mean dissolved oxygen content at SW 07 may be due to the influx of polluted water from Gonda nallah in River Kharashrota. The mean dissolved oxygen content of the surface water samples of River Kharashrota increased gradually from SW 07 and reached 7.800 mg/l at SW 12 in the downstream. It may be due to the decrease in pollution level from SW 07 to SW 12 as the dissolved oxygen increases exponentially with the decrease in the pollutant levels.

Presence of requisite amount of dissolved oxygen is necessary for the survival of aquatic organisms [12]. Many green plants have the ability for environmental restoration [13]. The dissolved oxygen limit values are ≥ 6 mg/l (class I), ≥ 5 mg/l (class II) and ≥ 4 mg/l (class III) water qualities [14]. On the basis of the mean dissolved oxygen content of the surface water samples the water quality of Gonda nallah at SW 01 is class III, from SW 02 to SW 06 are class II and of River Kharashrota from SW 07 to SW 12 are Class I. The rate of growth, survival and mortality of freshwater organisms may be affected adversely with the depletion of dissolved oxygen level. The intestinal morphology of Nile tilapia was adversely affected when fishes were exposed to low dissolved oxygen level [15].

IV. CONCLUSION

The water quality of surface water bodies are changing overtime due to increase in population, industrialization and related anthropogenic activities [16]. The dissolved oxygen content is an important water quality parameter to evaluate the suitability of the water body for the growth and survival of the aquatic species. The concentration of dissolved oxygen in surface water resources is useful for determining the net ecosystem metabolism [17]. The dissolved oxygen concentrations of the surface water samples of Gonda nallah and River Kharashrota fluctuate with the variation of seasons and locations. The dissolved oxygen concentration of the surface water samples is minimum at SW 01 (Gonda nallah) and maximum at SW 12 (River Kharashrota). Further drop in the dissolved oxygen level of the surface water of Gonda nallah and river Kharashrota may create a condition of oxygen starvation in

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which aquatic organisms may not survive. Continuous study is necessary in this area to increase the replenishment of oxygen in the surface water of Gonda nallah and River Kharashrota.

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