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Human induced changes on certain physico-chemical and biological properties of water in a certain pond of Godda district (Jharkhand)

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Abstract
Investigation on Physico-chemical and Biological characteristics of water of a Rajkachari Pond of Godda district (Jharkhand) was conducted to evaluate the impact of human activities on benthic fauna of the pond ecosystem. Analysis of water indicated the acidic to alkaline (pH 6.2-8.4mg/l) medium, high dissolved oxygen (5.2-8.1mg/l), free Co_2 (3.1-4.3mg/l) low hardness (290-378mg/l) along with chloride, silicate, phosphate and nitrate. Overall analysis revealed a remarkable seasonal variation in physico-chemical characteristics of water probably due to human induced allochthonous input mainly due to encroachment, eutrophication and loads from domestic wastes, deposition of silt, town garbage and cleaning of vehicles. Certain effective measures were recommended to restore the productivity and perennial nature of the pond.

Keywords: Anthropogenic activities, physico-chemical properties, eutrophication

Introduction
Life cannot exist without water. It is a universal solvent essential to human well beings for various purposes such as cooking, drinking, agriculture and fisheries etc. It is useful for the artificial infiltrations of ground water bodies and support both flora and fauna directly or indirectly by balancing the pond ecosystem. Previously anthropogenic activities were insignificant and take care and not contaminate the pond water because at that time surface water body like lake, river, pond etc were utilized for drinking water purposes. Nowadays, such water bodies are under stress condition due to uncontrolled human activities and ultimately the quality and quantity of water has declined. Periodic monitoring of water quality in terms of its physicochemical characteristics is the first step for proper management and conservation of pond ecosystem.
Several investiagation have been reported that deserve special mention to the present work Ranjan et., al (2006) [13], Ahmed (2004) [1], Borkar (2015) [6], Kashyap (2016) [12], Prakah et., al (2019).

Study area
The Pond under investigation is developed by the Banali state of that area for the drinking purposes of the community. It is situated in the Northern-Eastern area about 800m away from the Godda market of Jharkhand state, India, Popularly known as Rajkachari pond. It is perennial in nature and rectangular in shape. The area of the pond is about 1.6 hectare having maximum depth of about 4.34m. Rajkachari pond is a good source of fish culture and fulfills fish demand of Godda district. The monsoon water runoff also enter pond through inlet.

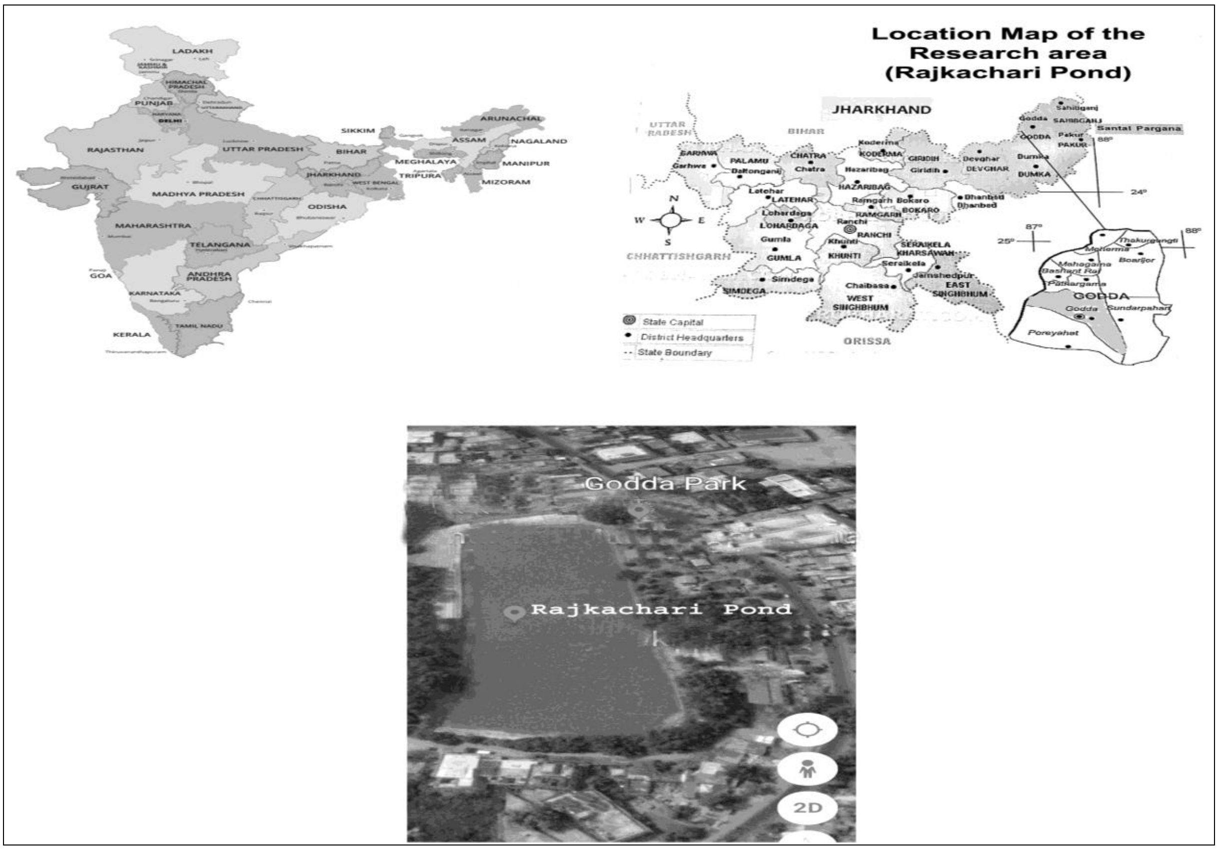

Fig 1: Map of Godda District (SantalPargana) Jharkhand

Fig 2: Glimpse of Rajkachari Pond showing festival Celebration

Materials and Methods

The Physical and chemical characteristics of the pond water are major determinants of biogenic productivity. Water samples for physico-chemical analysis were collected from limnetic zone of the Pond with a specially designed sampler (1.0 Litre capacity) bottle. Certain parameters like water temperature, transparency, pH, dissolved Oxygen, free Co_2, alkalinity were analysed on the spot and the sample were brought to the laboratory for further analysis. The collection time was generally in the morning hour between 9:00 to 11:00 A.M during first week of each month. The analysis was carried on with the help of standard method prescribed by Trivedy and Goel (2003) [18] and APHA (2005) [4].

Table 1: Monthly variation of physico-chemical parameters of the pond ecosystem, (January 2024 - December 2024)

Month 2023	AT0 (0°c)	WT0 (0°c)	Transparency (cm)	pH	DO2 (mg/l)	FCO2 (mg/l)	TDS (mg/L)	Alkalinity (mg/l)	TH (mg/l)	Sio2 (mg/L)	Cl (mg/l)	Po4 (mg/l)	No3 (mg/l)
Jan	19.6	18.5	28	7.4	8.1	3.1	290	175	21.5	17.4	42.06	0.52	0.49
Feb	18.7	20.2	30	7.6	6.8	3.3	310	190	24.9	18.2	37.04	0.56	0.51
Mar	24.6	23.5	31	7.9	5.9	4.1	325	192	27.0	19.5	36.09	0.59	0.53
Apr	28.6	27.2	32	8.1	5.7	4.3	336	195	28.5	18.7	33.04	0.63	0.54
May	34.5	30.2	38	8.4	5.2	4.5	345	202	32.3	18.9	31.03	0.67	0.56
Jun	28.4	27.1	29	7.2	6.6	4.6	355	212	28.0	19.5	48.07	0.71	0.58
July	27.3	27.7	23	6.7	6.9	4.8	370	198	27.2	19.9	56.09	0.74	0.61
Aug	25.8	26.2	24	6.2	7.2	3.9	378	185	26.0	20.7	64.57	0.76	0.62
Sep	25.3	25.8	22	6.4	7.4	3.7	365	174	25.5	22.1	68.03	0.70	0.65
Oct	23.1	23.5	23	6.6	7.6	3.8	340	168	24.8	21.8	54.02	0.64	0.59
Nov	21.8	20.4	26	6.9	7.7	3.6	320	164	23.9	20.3	51.02	0.58	0.56
Dec	20.1	19.3	27	7.1	7.9	3.4	310	160	23.0	18.5	47.04	0.54	0.53
RANGE VALUE	19.6°-34.5°	18.5°-30.2°	22-38	6.2-8.4	5.2-8.1	3.1-4.3	290-378	160-212	21.5-32.3	17.4-22..1	31.03-68.03	0.52-0.76	0.49-0.65

Notation: AT°- Atmospheric temperature, WT°- Water temperature, Do_2- Dissolved Oxygen, Fco_2- Free Carbon dioxide, TH- Total hardness, Cl- Chloride, TDS- Total dissolved Solid, Po_4- Phosphate, No_3- Nitrate, Sio_2-Silicate

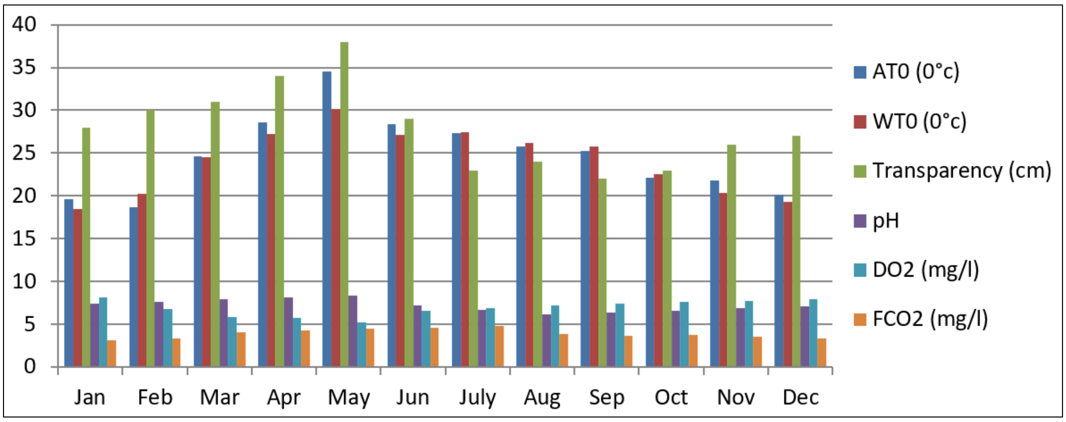

Fig 3: Monthly variation of AT°- Atmospheric temperature, WT°- Water temperature, Do_2- Dissolved Oxygen, Fco_2- Free Carbon dioxide

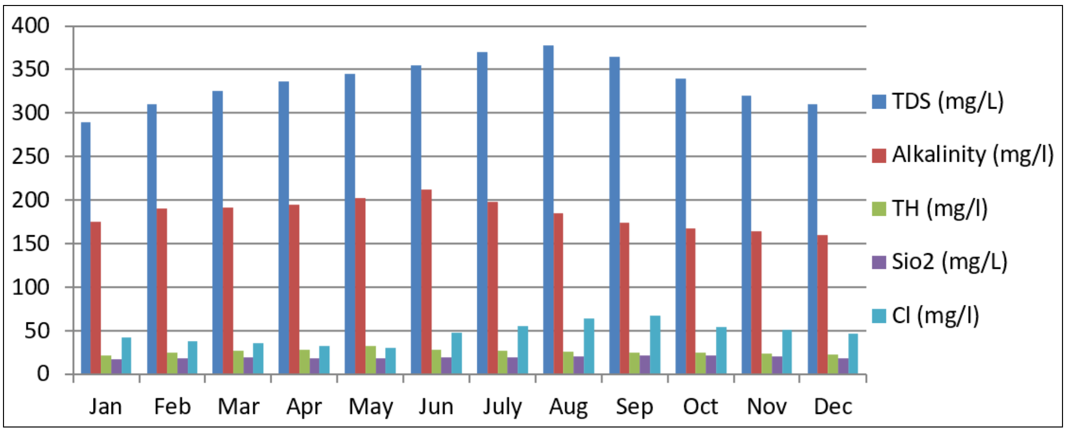

Fig 4: Monthly variation of TDS - Total dissolved solid, Alkalinity, TH- Total Hardness, Sio_2- Silicate, Cl- Chloride

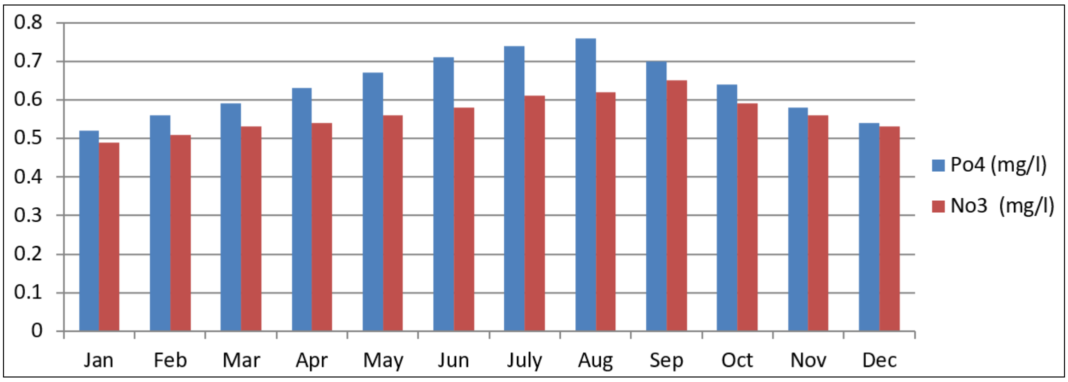

Fig 5: Monthly variation of Po4- Phosphate, No3- Nitrate

Results and discussion

The atmospheric temperature varied from 19.6 to 34.5^{0}c showing lowest range in winter (January) and highest in summer (May). The water temperature varied from 18.5^{0}c (January) and 30.2^{0}c (May). Water temperature ranging between 20^{0}c-30^{0}c in subtropical region is found conductive for the growth and survival of fish (Ranjan *et al* 2006) [13]. The minimum value of transparency was 22 cm (September) while its maximum value was 38cm (January). The pH of the water ranged from 6.2 to 8.4 showing lowest range in winter (December) and maximum in summer (May). The pH value ranging between 6.5 to 9.0 are the characteristics marked peculiarity of most of the managed fish ponds (Manjare *et al* 2010) [10]. The minimum value of Dissolved Oxygen was recorded in summer season 5.2(May) and maximum value recorded winter season 8.1(January). The dissolved oxygen regulate the metabolic process of aquatic organisms and is often consider as an indicator of environmental condition affecting survival and growth of organism. Low concentration of dissolved oxygen in water causes hypoxia condition while its super saturation may result in the gas bubble leading to the mass mortality of fish in both the cases (Kumar *et al* 2006) [13]. The maximum value of free carbon dioxide was recorded in monsoon season July (4.8mg/l) and minimum value recorded in winter season January (3.1mg/l). The highest value of free co_2 during monsoon season may be due to active decomposition of organic matter. According to Alam (2001) [1] the decomposition of organic sediments in water bodies is always associated with accumulation of carbon dioxide, decrease in pH and increase in bicarbonates. The maximum value of Total dissolved solids were recorded in monsoon season August (378mg/l) and the minimum value was recorded in winter season January (290mg/l) respectively. The main source for Total dissolved solid in a pond ecosystem are agriculture runoff and residential runoff (Adoni *et al* 1985) [3]. The maximum value of Total alkalinity were recorded in monsoon season June (212mg/l) and minimum value recorded in winter month December (160mg/l) respectively. The optimum value of total alkalinity for obtaining higher fish production have been reported as (80-120 mg/l) in fish pond (Krishnamurthy 1996) [9]. Higher value of alkalinity (>280ppm) have been reported to cause eutrophication. The lowest values of total hardness were recorded in winter month January (21.5mg/l) and highest values of total hardness were recorded in summer month May (32.3 mg/l). According to Kashyap (2016) [12] total hardness is the measure of dissolved ions in water. Soft water contain ion than 60mg/l and hard water contain more than 130 mg/l $caco_3$ equivalent. The minimum value of Silicate was recorded in winter month January (17.4mg/l) and the maximum value recorded in monsoon month September (22.1mg/l). Silica concentration is an important in regulation of growth of diatoms if fresh water ecosystem (Tahir and Toktali 2017) [17]. Maximum and minimum value of chloride ion were recorded in monsoon September (68.03mg/l) and summer May (31.03mg/l). The higher value of phosphate recorded in monsoon month August (0.76mg/l) and lowest value recorded in winter month January (0.52mg/l). In the present study the major source of phosphate are domestic sewage, detergent, agriculture effluents with fertilizers. The maximum value of nitrate was recorded in monsoon month September (0.65mg/l) and lowest value of nitrate was recorded in winter month January (0.49mg/l) respectively. The higher concentration of phosphate and nitrate is an indicator of pollution in water.

Conclusion

The analytical evaluation of physico-chemical factors will be significant for suitable planning and management of sustainable fisheries and conservation of pond ecosystem. Hence the physic-chemical characteristics of the pond water assess the status of structural and functional aspects of the pond for its suitable management and conservation. Water quality in the pond is slowly reaching to alarming stage and therefore, proper planning is essential to conserve its fragile ecosystem.

Recommendations

Certain effective remedial measures should be taken into consideration for raising the productive potentiality and proper conservation of the pond.

1. Attention must be paid to restrict discharge of domestic sewage cattle dumping and washing of clothes with detergents, utensils etc. in the pond, in order to check to organic load.
2. Immersion of idol in the pond during festive occasion should be avoided and discouraged to minimize the accumulation of organic/ inorganic wastes.
3. Influx of agricultural runoff through catchment areas carrying non degradable pollutants should be properly checked to prevent its hazardous impact on food chain and survival of fish.
4. Indiscriminate fishing should be prohibited.

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