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Physico-chemical assessment of wetland ecosystems of Madhepura, Bihar

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ABSTRACT

Wetlands are areas of land that are either covered by water or drenched with water. This study assesses the physico-chemical studies of ecosystem of Madhepura through field investigations. Wetlands are amongst the most productive ecosystems on the Earth and provide many important services to human society. However, they are also ecologically sensitive and adaptive systems. Wetlands exhibit enormous diversity according to their genesis, geographical location, water regime and chemistry, dominant species, and soil and sediment characteristics. This study reveals the parameters of water quality such as pH, transparency, electrical conductivity, total dissolved solids, total hardness, magnesium, calcium, potassium, nitrate and water discharge. pH value was between 6.6-8.5, TDS ranges from 101.57 - 18.7 mg/l whereas EC ranges from 192.13 - 38.4 µS, water discharge very high during monsoon (347.4 mm/day). These parameters play an important role in the streams across seasons. Regular monitoring of streams is necessary to maintain and protect these wetland ecosystems.

Key words: Physico-chemical parameters, total dissolved solids, total hardness, magnesium, calcium, potassium, nitrate and water discharge

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INTRODUCTION

Wetlands in India occupy 58.2 million hectares, including areas under wet paddy cultivation (Directory of Indian Wetlands). Majority of Inland wetlands are directly or indirectly dependent on major rivers like Ganga, Brahmaputra, Narmada, Godavari, Krishna, Kaveri, Tapti. They found in hot dry regions of Gujarat and Rajasthan, east and west deltaic regions Coast, Highlands of Central India, Humid Regions of South Peninsular India and Andaman and Nicobar and Lakshadweep Islands.

Globally, the areal extent of wetland ecosystems ranges from 917 million hectares (m ha) to more than 1275 m ha. Water discharge varies temporally as well as spatially, and increases along a stream network due to inputs from rainfall, tributaries and groundwater. Wetlands form an important and dynamic ecosystem, and therefore, need continuous monitoring. Very few wetlands are perennial and remain functional all through the year. Wetlands are not delineated under any specific administrative jurisdiction. The primary responsibility for the management of these ecosystems is in the hands of the Ministry of Environment and Forests.

Although some wetlands are protected after the formulation of the Wildlife Protection Act, the others are in grave danger of extinction. Effective coordination between the different ministries, energy, industry, fisheries revenue, agriculture, transport and water resources, is essential for the protection of these ecosystems. For achieving any sustainable success in the protection of wetlands, awareness among the general public, educational and corporate institutions must be created. The policy makers, at various levels along with site managers need to be educated. As the country's wetlands are shared, the bi-lateral cooperation in

the resource management needs to be enhanced. Water quality of riverine systems depends on topography, climate, soil properties, geology, atmospheric deposition and catchment area of a region. Anthropogenic activities in the catchment can also lead to higher concentrations of suspended solids, salts and nutrients (Lintern *et al.* 2018).

Wetlands are always associated with land. They are the barrier between water and land. Many wetlands serve as a reservoir for excessive rainfall to prevent flooding. Wetlands can be made of freshwater, saltwater, or a combination of the two. Wetland typically remains humid and moist at all times making it the perfect home for many animals.

Often times people mistake wetlands for something harmful or nonessential. There are many different animals that live in wetland, but one can generally expect to see amphibians, birds and many different insects there. Some birds remain at a particular wetland all over year while other bird migrates. Wetlands serve as a filter that purifies or cleans surface water. Some wetlands are referred to as seasonal, meaning they typically form in the fall and winter but are totally dried out during the summer. Wetland biomes are responsible for keeping rivers at a normal level. They hold water and then release it to the river as needed. Water bodies loose the capability of self-purification due to the influence of anthropogenic activities near the catchment (Aishvarya *et al.* 2018).

The main objective of the current research is to investigate the changes in the physical, chemical and nutrient parameters in areas of wetlands of Madhepura.

MATERIALS AND METHOD

Area of study:

To analyse the different parameters, three sampling sites were selected that stretches to a distance of 5 km covering the entire length of the wetland passing through district Madhepura upto the confluence with River Kosi. Site I was Tarawe chaur and Site II was Gamharia chaur. Both the sites are low laying floodplain of river Kosi basin, located between 25°34'N to 26°07'N latitude and 86°19'E to 87°07'E longitude. At these sites, the chaur carries household, washing, bathing, cattle wallowing and agricultural effluents. Site I is 3 km downstream from site II. Site II is situated near the village Gamharia and is a shallow small water body which receive sewage effluents from village whereas site I i.e., Tarawe chaur is fairly deep large water body. Both the above sites showed a varied ecological conditions and hence helpful to analyse the seasonal variation in physico-chemical parameters.

Collection and preservation:

The samples were collected in different season i.e. summer (March 2019 to June 2019), monsoon (July 2019 to September 2019) and winter (October 2019 to February 2020) by using plastic bottles of size 1 litre. Electrical conductivity, total dissolved solids, total hardness and water discharge were measured at the collection site and samples were brought to the laboratory for further analysis. The collected samples were transferred to laboratory with taking precautions. The water samples were preserved at 4^{o}C temperature and different physico-chemical parameters were tested in the same day of collection. The parameters were analysed by standard method of APHA (2005). Temperature was calculated by laboratory thermometer. pH metre was used to find the pH of water. Transparency was noticed by using Secchi-disc method. Water discharge was measured by current meter, total hardness and calcium by Titrimetric method, nitrate and magnesium by Phenol disulphonic acid method, and potassium by Flame emission photometric method.

RESULTS AND DISCUSSION

Wetlands water is being used for domestic purposes, irrigation, recreation, etc. Mapping and monitoring of water quality would help in maintaining the quality and sustainable management of the ecosystem. Water sampling was done at stations depending on the water availability in streams. Data of Physico-chemical parameters are presented in table 1.

Table 1: Physico-chemical parameters of wetlands of Madhepura during March 2019 – February 2020

Parameters	Season	Site I	Site II
Water Temperature(^{o}C)	Summer	30.7±4.5	31.5±4.6
	Monsoon	29.6±4.3	28.8±4.3
	Winter	21.0±2.3	21.2±3.1
Transparency(cm)	Summer	37.84±17.85	29.72±13.02
	Monsoon	32.14±16.15	26.68±17.85
	Winter	35.08±17.26	29.48±16.29
pH	Summer	8.1±0.42	7.7±0.41
	Monsoon	7.6±0.21	7.1±0.25
	Winter	8.3±0.39	7.8±0.38
Total Dissolved Solid (mg/l)	Summer	101.57	100.65
	Monsoon	20.3	18.7
	Winter	85.3	88.5
Electrical Conductivity (μ)	Summer	191.03	192.13
	Monsoon	97.08	95.50
	Winter	36.81	38.4
Nitrate(mg/l)	Summer	0.3	0.3
	Monsoon	0.4	0.6
	Winter	0.1	0.3
Potassium(mg/l)	Summer	0.8	2.3
	Monsoon	0.8	4.7
	Winter	0.4	3.3
Calcium(mg/l)	Summer	4.1	4.4
	Monsoon	5.8	6.2
	Winter	3.5	3.2
Magnesium(mg/l)	Summer	9.3	9.4
	Monsoon	10.3	10.9
	Winter	7.1	7.2

pH in the sampled streams ranges from 6.6 - 8.5 and values are higher in winter and low during monsoon due to the presence of organic matter. pH which measures the alkalinity and acidity of water and influences chemical reactions in water bodies. Dissolved solids in streams fluctuate due to movement/mixing of water, organic pollutants. TDS and EC are very high in summer season, but very low in monsoon. TDS ranges from 101.57 - 18.7 mg/l whereas EC ranges from 192.13 - 38.4 μS. Variations in electrical conductivity are brought about by the inorganic dissolved solids such as calcium, nitrate, magnesium and potassium. The water discharge is very high at Site I during monsoon (347.4 mm/day). In summer season, water temperature, total alkalinity, total hardness, calcium and magnesium were very high because of very less water level and high evaporation rate. But, ion contents like total hardness, calcium and magnesium and nitrate were very low in monsoon season because of dilution effect. The ion contents (TDS, EC, chloride, total hardness, calcium, magnesium and sodium), pH, total alkalinity were less due to the dilution with precipitation. Rani *et al.* (2011) reported similar findings of increased suspended solids, turbidity and COD during

monsoon as the rivers received silt and debris, which lowered the ionic contents due to the dilution. The turbidity had decreased due to low discharge while organic matter and nutrient levels decreased due to enhanced algal uptake and microbial activity. The water temperature in post-monsoon appeared to be suitable for the phytoplankton growth and reproduction (Nassar *et al.* 2014). Water discharge played an important role in the present study. The marked difference in seasonal variations in wetlands discharge and concentration of pollutants is due to variations in precipitation, surface run-off, interflow, groundwater flow etc. (Singh *et al.* 2004).

CONCLUSION

Monitoring of wetlands ecosystem through the analyses of physico-chemical parameters in Madhepura revealed that water discharge played an important role evident from TDS, EC, total hardness, calcium, magnesium, nitrate, potassium, etc. Water discharge is highest in Site I compared to Site II due to suspended matter (turbidity), nutrients (orthophosphate and nitrate) and organic contents. Climate, season, types of forest, rocks, soil, land use like agriculture and horticulture fields have influenced the quality of water in wetland. It was observed that site I has clean-water environments i.e., Tarawe chaur whereas poor-water conditions at site II i.e., Gamharia chaur. It was protected by avoiding littering of wastes near water bodies, restrictions on letting untreated sewage and industrial effluents, adoption of constructed wetlands to prevent agricultural runoff with high nutrient loads, restriction on the use of fertilizers in agriculture and horticulture fields, planting native species to enhance water infiltrations.

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