

RESEARCH ARTICLE

Assessment of water quality of Libri River, Purnia (Bihar)**Mishra AK and Hasan S**

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*Corresponding author Email – anjani.mishra.asso.prof@gmail.com**ABSTRACT**

Physico-chemical parameters of river Libri of Koshi zone, Purnia were investigated during March 2009 to February 2010. The result revealed well defined seasonal variation. Relatively high temperature, high value of dissolved oxygen and highest production range of alkalinity were observed which are favorable factors for the production of air breathing fishes. On the basis of studied parameters the river water appears to be of moderate trophic level and hard types.

On the whole river is getting pollute due to intense human activities and influence infusion of foreign materials from the surroundings. These materials mainly comprise of decomposable organic matters of plants and animals, terrestrial washing and effluents.

A large number of dead bodies are burnt on the bank of the river areas using fire wood and thus formed ashes containing huge quantity of minerals and half burnt flesh content are scattered into the river. This causes nuisance in the river water environment and raises a number of water pollution problems. Thus this water neither can be used for irrigation for crop fields nor for bathing can cattle drinking purposes.

KEYWORDS

Physico-chemical parameters, Moderate trophic level, Hard type, Libri river, Purnia

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INTRODUCTION

Water is the most precious gift of nature which is essential for sustaining all forms of life, food production and economic development. (Mane *et al.*, 2005). Fresh water is essential for sustenance of life human, animal and plant. About 65% of human body is water; 5% of it is to be replaced every day. Water serves as a medium in which the plants and animal of lakes and characteristics are greatly affected due to discharge of domestic, municipal, industrial and other several factors (Pandey and Jha, 1998) during the day and night which may be fatal for aquatic life.

Rivers are life line of human settlement but there are natural and anthropogenic factors which influence the water quality of river (Gupta and Chakarpani, 2007). Rivers, Ponds and lakes are the major sources of water. Discharge of urban, industrial and agricultural wastes have increased the quantum of various chemicals that enter the receiving water which alter considerably their physico-chemical characteristics. The river ecosystem receives water primarily from their water sheds, marginal run off and domestic sources. These waters contain excess of organic matter, excess of nitrogen and phosphorous, suspended solids, chloride and pathogenic organisms. They also get a lot of garbage, effluent

and sewage. These control the nature of vegetation and fauna of the aquatic body. (Smart *et al.*, 1985). Phosphorous and nitrogen inputs from the domestic wastes, fertilizers accelerate the process of eutrophication of water (Pickett and Harvey 1988; Vass *et al.*, 1989). Though beneficial in terms of secondary production, eutrophication sometimes promote blooms of blue green algae which alter food chain sequences leading to production of commercially less valuable higher tropic organisms.

The maintenance of a healthy aquatic ecosystem is dependent on the physico-chemical properties of water and biological activity. Further water condition play a very important role in the production of air breathing fishes. The polluted state of water resources has led to steady decline in aquatic productivity. Therefore, limnological investigation is needed. The maintenance of healthy aquatic ecosystem is dependent on the physico-chemical properties of water. So, the monitoring of the river water is necessary step to mark the trend pattern of pollutants and their effect on living organisms.

MATERIALS AND METHODS

The present investigation was carried out in the Libri river. The water samples were collected at the monthly intervals from March 2009 to February 2010. Most of the parameters were analysed at the

sampling sites. Atmospheric and water temperature were recorded with a mercury thermometer and pH of water was measured by a portable pH meter. The transparency of the river water was found out by the help of secchi disc. The analysis of dissolved oxygen, free carbon dioxide, carbonate, bicarbonate, nitrate, phosphorous and chloride were done according to methods of APHA(1975) and Trivedi & Goel (1984).

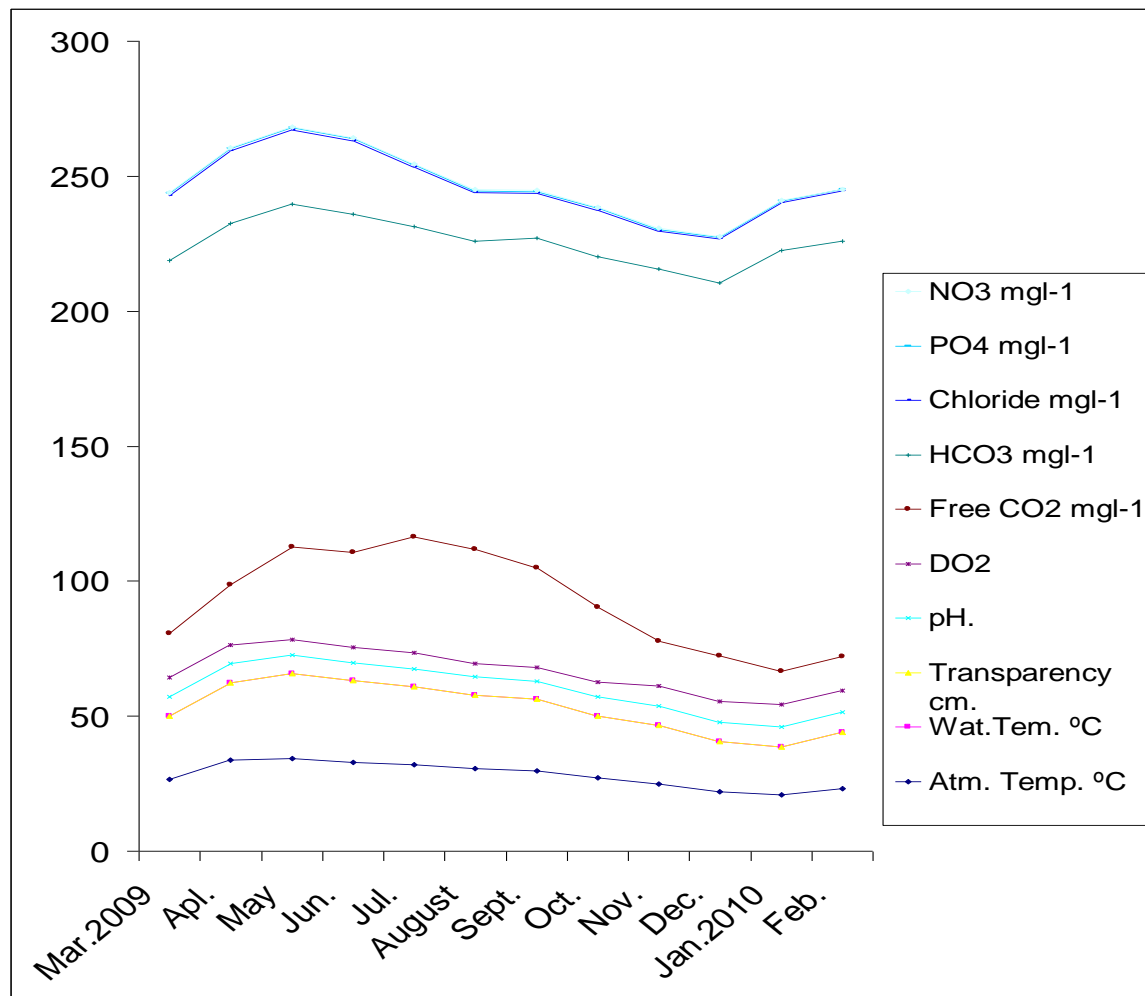
RESULTS

The monthly fluctuations in the physico-chemical properties of the swamps water are shown in Table – 1 and Fig. – 1.

The water and air temperature were found to go more or less hand in hand, Air temperature varied from 21°C to 34.3°C whereas, water temperature ranged from 17.6°C to 31.5°C. The pH values varied from 6.7 to 7.5. The water was slightly acidic in the rainy season. The values of dissolved oxygen were found minimum in rainy season and maximum in winter season. The value of oxygen ranged from 4.8 to 8.1 mg/l. The free CO₂ concentration ranged from 12.4 to 42.8 mg/l. Carbonate alkalinity were absent throughout the year. Bicarbonate alkalinity ranged from 114 to 156 mg/l. The chloride content ranged from 14 to 27.4.mg/l. while the phosphate and nitrate content were found to be ranged from 0.57 to 0.93 mg/l and 0.144 to 0.502 respectively.

Table 1: Physico-chemical characteristics of Libri River.

| Parameters⇒ Months ↓ | Atm. Temp. °C | Water Temp. °C | Transparency (cm,) | pH. | DO ₂ | Free CO ₂ mg· l ⁻¹ | HCO ₃ mg· l ⁻¹ | Chloride mg· l ⁻¹ | PO ₄ mg· l ⁻¹ | NO ₃ mg· l ⁻¹ |
|----------------------------|---------------------|----------------------|-----------------------|-----|-----------------|---|--|------------------------------------|---|---|
| Mar.2009 | 26.7 | 23.3 | - | 7.1 | 7.2 | 16.4 | 138 | 24.2 | 0.80 | 0.144 |
| Apl. | 33.8 | 28.5 | - | 7.2 | 6.9 | 22.2 | 134 | 26.8 | 0.93 | 0.135 |
| May | 34.3 | 31.5 | - | 6.9 | 5.7 | 34.2 | 127 | 27.4 | 0.92 | 0.198 |
| Jun. | 32.8 | 30.3 | 8.4 | 6.8 | 5.5 | 35.4 | 125 | 27.4 | 0.80 | 0.247 |
| Jul. | 32.0 | 28.8 | 9.5 | 6.8 | 5.9 | 42.8 | 115 | 22.2 | 0.67 | 0.433 |
| August | 30.7 | 27.2 | 8.7 | 6.7 | 4.8 | 42.4 | 114 | 18.2 | 0.65 | 0.495 |
| Sept. | 29.7 | 26.5 | 8.1 | 6.7 | 5.2 | 37.0 | 122 | 16.6 | 0.62 | 0.497 |
| Oct. | 27.3 | 22.8 | 7.6 | 7.0 | 5.6 | 27.6 | 130 | 17.2 | 0.63 | 0.502 |
| Nov. | 24.8 | 21.7 | 5.1 | 7.3 | 7.5 | 16.4 | 138 | 14.0 | 0.62 | 0.387 |
| Dec. | 22.1 | 18.6 | 4.2 | 7.2 | 7.7 | 16.8 | 138 | 16.4 | 0.60 | 0.310 |
| Jan.2010 | 21.0 | 17.6 | - | 7.5 | 8.1 | 12.4 | 156 | 17.6 | 0.57 | 0.235 |
| Feb. | 23.3 | 20.6 | - | 7.6 | 8.1 | 12.4 | 154 | 18.4 | 0.60 | 0.193 |

Fig.1 :: Seasonal variation in Physico-chemical characteristics of Libri river, Purnia (Bihar).

DISCUSSIONS

Temperature:

Air temperature is one of the most important ecological factors which controls the physiological behaviour of the aquatic system and distribution of the organisms. In general, the variation in air temperature is brought about by seasonal change in climate grossly determines the heat budget of water body. The water and air temperature correlated to each other because the water temperature varies with rise and fall of atmospheric temperature. It is probably brought about due to the fact that smaller the mass of water, greater and air temperatures were found to go more or less hand in hand. Seasonal temperature changes have profound effects on the physiology of ectotherms, resulting in altered toxicity of chemicals (Garnacho *et al.* 2000). The air temperature varied from 21°C to 34.3°C whereas,

water temperature ranged from 17.6°C to 31.5°C. The fluctuations of surface water temperature followed almost similar trend of air temperature. Indian major carps thrive well in temperature range 18.3°C-37.8°C. Temperature below 16.7°C and above 37.5°C prove fatal to them (Jhingran, 1983). In the present investigation the water temperature ranged from 17.6°C to 31.5°C, which is found suitable for both carps and air breathing fishes.

pH:

pH is the measure of intensity of acidity or alkalinity and measures the concentration of hydrogen ions in water. pH of water gets drastically changed with time due to the exposure to air, biological activities and temperature changes. It is one of the important environmental factors of natural water.

In the present investigation pH values varied from 6.7 to 7.5 (Table -1). The highest pH value during winter appeared to be influenced by water level; large number of phytoplanktons and highest value of dissolved oxygen (Shyam Sunder, 1988; Pandey *et al.*, 1992). According to Banerjee and Ghosh (1967) 6.5 – 7.8 pH water range is most favorable for fish production and 7.5 to 8.5 for average fish production. Thus the present value of pH of water may be considered suitable for fish production.

Turbidity:

Turbidity in water is caused by the substances not present in the form of true solution. Turbidity makes the water unfit for domestic purposes. Maximum turbidity (9.5 cm) was observed in July which was due to monsoon rain which brought additional water from catchments areas, transforming the water muddy and turbid. The colloidal matter present in swamps water impart turbidity to water due to pollution from organic matter, through sewage discharge, industrial discharge and presence of large number of micro-organisms.

Dissolved Oxygen:

The solubility of dissolved oxygen in winter is increased with decreased in water temperature. High dissolved oxygen during winter months was observed by Mathew (1978). A considerable variation in the dissolved oxygen contents was observed in the river water. According to the law of solubility of gases, periods of high temperature should be the time of low oxygen content and vice-versa. As such dissolved oxygen varied inversely with temperature. But it is apparent from the present investigation that photosynthesis activity of phytoplankton and growth of macrophytes also matter much. Water and air temperature collectively affect the solubility of atmospheric oxygen into the water. Nasar and Dutta Munshi (1974) have recognized the air and water temperature the factors controlling the concentration of dissolved oxygen into water but these are not the only factors. The present study does not support this view, as there were several occasions when levels of dissolved oxygen content have not strictly followed the fluctuations of soil and water temperature. The other factors

responsible for reduction of dissolved oxygen contents are decomposition of the organic matters of the bottom; agitation of water during fishing activities and also due to excessive human interferences. Thus, the oxygen content of fresh water depends upon several other factors viz. temperature, intensity of light penetration, photosynthetic activities of aquatic flora, respiration by plants and animal communities, wind action and anthropogenic activities.

Free CO₂ :

Free CO₂ comes in water due to activity of aquatic organisms. Free carbon dioxide helps in buffering the aquatic environment against rapid fluctuations in the acidity or alkalinity and also regulates biological process of aquatic communities (Prassanakumari *et al.*, 2003).

The free CO₂ value ranged from 12.4 to 42.8 mg/l. (Table-1). The high value of free CO₂ during rainy season might be due to high rate of decomposition of organic matters by microbes resulting in rapid production of CO₂. High CO₂ content is the indicative of high pollution (Cole, 1979). The lower value of free CO₂ and higher value of DO₂ in winter were observed due to comparatively clear water and cloudless sky facilitating more and more photosynthesis (Siddhartha *et al.*, 2013)..

Alkalinity:

Alkalinity of water is a measure of weak acid present in it and of the cation balanced against them. Alkalinity in fresh water is due to the presence of three types of substances bicarbonates, carbonates and hydroxides. In the natural and polluted waters, there are many other salts of weak acids such as silicates, phosphates and borate etc., which cause alkalinity in addition to that of carbonates and bicarbonates.

In the present investigation carbonate alkalinity was absent throughout the year. Bicarbonate alkalinity ranged from 98.5 to 140 mg/l. On the basis of average value of bicarbonate the swamps water can be classified under high category of nutrient types after the classification of Philipose (1959) as the alkalinity values were > 100 mg/l. On the basis of Moyle's classification (1946) it can be safely termed as hard water type.

Thus river water can be regarded to be of high productive value. Rai (1980) has reported that water rich in free CO₂, is comparatively less alkaline where as water deficient in this, is more alkaline. Similar observations have been made by Munawar (1970).

Chloride:

Chloride occurs naturally in all types of water. In natural fresh water, however, its concentration remains quite low. The most important source of chloride in the water is the discharge of domestic sewage. In the present investigation chloride content varied between 14 to 27.4 mg/l (Table-1). Chloride content was found highest during summer months which may be due to gradual decrease in the amount of water and increased amount of excreta laid by the various aquatic fauna (Mishra and Yadav, 1978; Cole, 1979; Pandey and Mishra, 1991; Pandey *et al.*, 2007). The minimum value of chloride during rainy season was due to the addition of rain water. As the chloride content is indicator of the index of pollution of animal origin (Thresh *et al.*, 1994). The chloride content was found high and more or less constant. High chloride content indicates deterioration of water quality usually linked with sewage load (Mini *et al.*, 2003)

Phosphate:

Phosphorous in natural water is present in very small quantities, but it is the most single critical factor in maintaining the fertility. In natural water phosphorous is present mostly in organic forms such as H₂PO₄⁻, HPO₄⁻² and PO₄⁻³. Lee (1977) has concluded that 0.01 mg/l phosphate is the critical level for several ponds. In the present investigation phosphate content ranged from 0.48 – 0.94 mg/l. Decreasing trends from monsoon to summer were found in phosphate. The high value recorded during summer months may be due to decomposing plant materials and its subsequent. The low value of phosphate during winter may be due to abundance of phytoplankton which utilizes it. Such findings have also been reported by Kataria *et al.*, (1996). The major supply of phosphorus in the river comes from agricultural areas.

Nitrate:

Nitrate parameter is an excellent parameter to judge organic pollution. Thresh *et al.*, (1994) have

attributed the nitrogen richness of fresh water body to the pollution of animal origin. The level of the total nitrogen concentration is an index of carbon budget of a fresh water body (Munawar, 1970; Pillai and Sreenivasan, 1975).

In the present study the nitrate value ranged from 0.144 to 0.502 mg/l. The relatively low content of nitrate in the investigated water body during active periods of growth of macrophytes might be due to utilization of nitrates during photosynthesis or due to action of denitrifying bacteria which are quite active at high temperature. This is in agreement with the findings of Ganapati, (1943); Pandey *et al.*, (1993). Lee *et al.*, (1975) have indicated that during growing season of aquatic plants, the decrease in nitrogen is probably associated with active uptake of this element by these plant communities. The highest value of nitrate during rainy season might be attributed to rain showers, decomposition of organic matters which get transferred by aerobic and anaerobic bacteria at high temperature into nitrogenous organic matters and influx of flood water (Rao and Govind, 1966).

Pandey and Patel (1996) have reported higher value of phosphate and nitrate in the Saryu river of Ayodhya and have suggested that this high value is due to cremation of dead bodies. On the basis of P and N the investigated water body may be categorized as of moderate trophic level.

Thus it can be calculated that in addition to muddy soil, relatively high temperature, high value of oxygen and highest productive range of alkalinity are favorable factors and affecting production of air breathing fishes. In the present study, seasonal variation in data clearly indicates that the river is of moderate trophic level.

CONCLUSIONS

- The water temperature follows the trend of air temperature and is always found to be less than air temperature.
- pH was almost alkaline
- Carbonate alkalinity was never found during the study period.
- Higher value of oxygen during some months might be due to increased photosynthetic activity while lower values may be because of its utilization during decomposition of organic

matter and respiration by micro and macro organisms.

- Higher value of nitrate and phosphate during the study were due to incoming sewage as well as agricultural runoff.
- On the basis of studied parameters the river water appears to be of moderate trophic level and hard types.
- Burning of dead bodies on the bank of river causes nuisance in the river water environment and raises a number of water pollution problems.

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