

Chemical Parameters of Soil of Turkaulia Lake of North Bihar (India) in Relation to its Productivity

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Abstract

Soil and water are the most precious natural resources and an important ecological factor responsible for the productivity of any water body. For the biological productivity and maintenance of an aquaculture, chemical components and nature of soil are most important abiotic factors. The present study deals with the analysis of some chemical parameters of soil of Turkaulia lake, an ox-bow lake of East-Champaran district of North Bihar, India. pH, phosphate, organic matter, calcium, magnesium, bicarbonate and carbonate were studied because these parameters are the main factor which determines the productivity of the soil. During the study period (i.e., January-December 2010) the hydrogen ion concentration (pH) was higher in most of the months of the year and provides ideal alkaline medium for fish culture. Phosphate concentration was also moderate. Calcium and magnesium were also in good amount. In the soil of Turkaulia lake, carbonate was untraceable while bicarbonate was found in soil in good concentration.

Keywords: Soil, pedogenic, Turkaulia lake, aquaculture, pisciculture, productivity.

Introduction

As early as 500 BC, the Vedas and the Upanishads as well as other ancient Indian documents described soil as synonymous with land- the mother- supporting and nourishing all life forms on the earth¹. Soil is a dynamic and very complex natural resources developed as a result of pedogenic processes. It is made up of partly weathered, unweathered and transformed products of rocks and rock minerals along with organic matters. Soil provides anchorage to roots enabling plants to stand erect which prevents soil from erosion. Soil acts as a reservoir of water and nutrients for plant growth. It acts as an abode of flora and fauna and provides space for air and aeration which create healthy surroundings for the biological activity of soil organisms¹. The soil surface of any water body remains in contact with the water. Chemical components of water and soil might get interchanged and thus altering the growth of the biota and determining the kind of organisms that could survive. Abiotic factors such as the chemical factors of soil play an important role in the aquatic ecosystem and influence the ecology of aquatic organisms. Actually the chemical factors of soil and aquatic flora and fauna are closely interrelated and interdependent. Thus, soil constituents are responsible for the production of phytoplankton and zooplankton which in turn provides food for fishes.

The East-Champaran district is located between 26°15' to 27°01' N latitudes and 84°28' to 85°18' E longitudes and is an important district of North Bihar at Indo-Nepal border. The district is very rich in natural water resources having several rivers, tributaries, ox-bow lakes, wetlands, ponds, tanks and canals^{2, 3}. There are lots of ox-bow lakes and cut-off meanders in this district. The

whole Champaran (East and West) has 41 perennial ox-bow lakes⁴. The total wetland area of the district is 12477 ha⁵. These water bodies are mainly used for pisciculture and irrigation. Among these water bodies of East-Champaran and the present site of investigation, Turkaulia lake (26° 36' 55" N to 84° 51' 02" E) is situated at about 6.5 km west of Motihari town (District HQ of East Champaran) on State Highway 54 (Motihari-Turkaulia-Govindganj) main road in Turkaulia Block (figure-1). This lake is a natural and perennial ox-bow lake of about 5 km radius, almost a circular one and is connected with river Dhanauti by a sluice gate (figure-2)^{2, 3}.

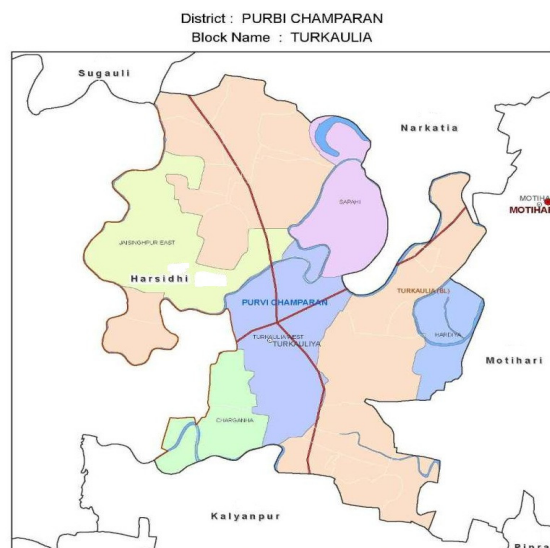


Figure-1
Turkaulia Block of East Champaran District

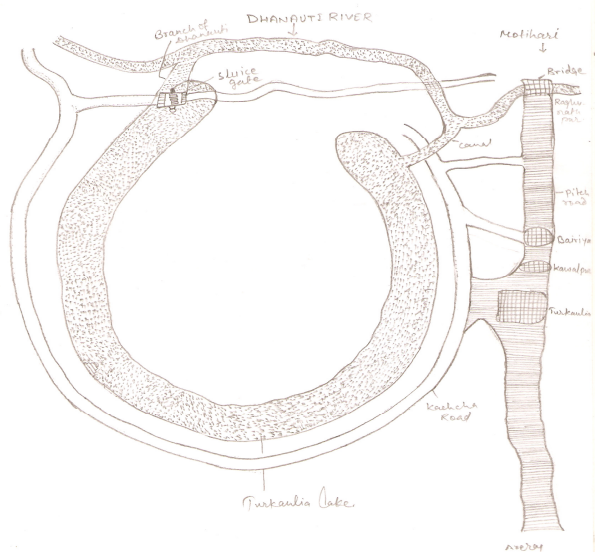


Figure-2
Turkaulia Lake (Diagrammatic)

Pond productivity was classified into three categories- low, medium and high- based on the status of available nitrogen, phosphorus and organic carbon⁶. Soil condition of Basman Lake (Bihar) was studied and found alkaline, phosphate concentration was high, Ca and Mg contents were in good amount while

carbonate was absent⁷. Role of soil in the production of various plankton and fishes were observed while working on a sewage affected water body of North Bihar⁸. Several other workers have also worked on different aspects of edaphic factors of freshwater bodies in India in recent years^{9,10}.

Material and Methods

The nature of soil is major factor for the productivity of any water body. Therefore, soil were analysed during January to December 2010. Soil samples were taken from Turkaulia lake (figure-3), once in every month. For estimation of various chemical parameters the suitable and standard methods were applied. pH was estimated by digital pH meter. For the analysis of carbonate and bicarbonate, titration method was applied. Available phosphate (P_2O_5) was estimated by Olsen's method. Organic carbon was estimated by Walkley's and Black method¹¹ while Ethylene Diamine Tetra Acetate (EDTA) was applied to estimate calcium and magnesium¹².

Results and Discussion

The obtained data of the study of chemical parameters of soil of Turkaulia lake has been shown in table-1.



Figure-3
Actual view of Turkaulia Lake

Table-1
Showing Soil Parameters of Turkaulia Lake During 2010

Soil Constituents	pH	Phosphate (P ₂ O ₅) (ppm)	Calcium and Magnesium (m.e./100gm)	Carbonate (m.e./100gm)	Bicarbonate (m.e./100gm)	Organic Compounds (%)
JAN	8.5	51.5	9.6215	NIL	1.6825	1.59
FEB	8.0	44.5	12.2512	NIL	3.2526	1.42
MAR	7.7	44.6	14.2572	NIL	3.2651	1.40
APR	8.0	39.9	0.6315	NIL	4.2942	1.65
MAY	8.3	38.3	4.1251	NIL	5.2914	1.63
JUN	8.2	39.1	5.2927	NIL	5.9825	1.62
JUL	8.4	40.1	9.2515	NIL	6.2582	1.59
AUG	7.6	53.8	2.7281	NIL	2.7682	1.84
SEP	7.6	54.6	0.7354	NIL	2.3955	1.92
OCT	7.3	62.0	3.2158	NIL	1.2529	1.91
NOV	7.5	60.6	4.1291	NIL	1.1156	1.89
DEC	8.3	60.2	8.3621	NIL	1.2159	1.95

The ranges of variation of pH of soil are from 7.3 to 8.5 in the year of investigation. The maximum value (8.5) of pH was found to be during winter season particularly in the month of January 2010. There was mixed trend of increasing and decreasing tendency. The lowest value was found to be in the month of October (7.3) but rainy season showed its maximum value i.e., 7.6 (table-1). The pH in most of the months was slightly alkaline which is ideal for fish culture. Alkaline soil absorbs more phosphorus than acidic soil. However, phytoplankton helps in uptake of available phosphorus, which is stored for use in their cells and as a result; it helps in production of their population, which may directly or indirectly affect lake productivity.

The value of phosphate in the soil of Turkaulia lake ranged from 38.3 ppm to 62.0 ppm in the investigating year. Its maximum value was observed in the month of October (62 ppm) while the minimum value was found to be in the month of May (38.3 ppm). The winter and summer seasons recorded maximum and minimum values. Total alkalinity with total available phosphate formed the most valuable indices of productivity¹³. There is a direct relationship between total alkalinity and phytoplankton¹⁴. Others observed inverse relationship between phosphate and phytoplankton.

Calcium and magnesium contents of the lake ranged from 0.6315 m.e. % to 14.2572 m.e. % during the research year. Its maximum value was recorded to be in the month of March (14.2572 m.e. %) while the minimum value was noticed in the month of April (0.6315 m.e. %). Ca and Mg contents were closely related with the production of zooplankton population.

The carbonate contents in the soil of Turkaulia lake could not be traced during the year of research depicting its absence.

The bicarbonate values were in the range of 1.1156 (November) to 6.2582 m.e./100 gm. (July). The maximum and minimum

values were observed to be in summer (6.2582 m.e./100 gm.) and winter seasons (1.1156 m.e./100gm.) during the entire period of investigation. The bicarbonate was found in sufficient amount.

Organic matter contents varied from 1.40 to 1.95 % in the year 2010. Its maximum value was found in the month of December (1.95%) in the year of investigation while minimum value was observed in the month of March (1.40 %). Spring season was recorded with minimum value. Organic matter of the soil is usually broken up by bacteria into inorganic compounds which are consumed by phytoplankton and ultimately passed on to the fish crop.

Conclusion

Thus it is clear that soil is the most reliable index for the test of productivity of a water body. Therefore, soil of the Turkaulia Lake was studied thoroughly and observed that the conditions were favourable for the pisciculture. pH, phosphate, organic carbon, calcium, magnesium, carbonate and bicarbonate values were found to be within normal range for suitable productivity. The lake soil is fertile and well aerated for the purpose of pisciculture.

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