ANALYSIS OF SOIL, AN EDAPHIC FACTOR, OF DHANAUTI RIVER OF MOTIHARI, BIHAR (INDIA) IN RELATION TO FISH PRODUCTIVITY

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Abstract: Soil is one of the most important living, dynamic and crucial ecological factor which determines the fertility and productivity of any type of aquatic ecosystem due to its rich inorganic & organic components. Thus, 'healthy soil' is an essential prerequisite for successful fishery or pisciculture practices in lentic or lotic water bodies. The present paper deals with the analysis of some important chemical parameters of soil of Dhanauti river of East Champaran district of North Bihar near Motihari town. For the analysis of soil, pH, conductivity, bicarbonate, carbonate, phosphate (P_2O_5), organic carbon (matter), calcium, magnesium, silica, iron oxides (Fe_2O_3), aluminium contents (Al_2O_3) were examined during the entire study period i.e., January – December, 2010. All examined parameters were found to be in good concentrations which is ideal for successful pisciculture. pH was observed between 7.2 to 7.7 during the study period, providing ideal alkaline medium for pisciculture. Organic carbon (matter) was also found in good percentage, maximum in the months of January to March (3.3%) and minimum during the months of July to September (2.7%) while phosphate was recorded highest in the months of October to December (3.7 ppm) and lowest in the months of January to March (2.3 ppm).

Key Words: **Soil, edaphic factor, dhanauti, fish productivity, motihari, east champaran**.

I. INTRODUCTION

The edaphic factor includes the physical, chemical and biological properties of soil that results from biologic and geologic phenomena or anthropogenic activities (Rajakaruna, N. and Boyd, R. S., 2008). Chemical and physical features of soil greatly influence the ecology and evolution of plants and their associated biota (Rajakaruna, N. and Boyd, R. S., 2008). Edaphic factors affect the ability of soil to sustain biological production and diversity regulate and partition water, filter and buffer contaminants, store and cycle nutrients and provide plant and other organisms to thrive (Reference Module in Earth Systems and Environmental Sciences, 2013). Thus soil productivity is the soil's capacity to produce a certain yield of crops or other plants with optimum management (Foth, H. D., 1990). Structurally, the soil is very complex system and one of the most important dynamic ecological factor. Soil is the unconsolidated outer layer of the earth's crust and it appears in a variety of forms such as different textures, colour, structure and nutrient content depending on a number of factors (Baxter, N. M. and Williamson, J. R., 1963). **A** given volume of soil is made up of solid, liquid and gaseous material. The solid phase may be mineral or organic. The mineral portion consists of particles of varying sizes, shapes and chemical compositions. The organic fraction includes residues in different stages of decomposition as well as live active organisms. The liquid phase is the soil

water (Banerjee & Ghosh, 1967). Soil plays an important role in determining the fertility of water bodies (Banerjee & Ghosh, 1967). Soil fertility is defined as the ability of a soil to supply essential elements for plant growth without a toxic concentration of any elements (Foth, H. D., 1990). Actually, soil is the result of the actions and reciprocal influence of parent rocks, climate, topography, plants, animals and age of the land. Soil provides storage medium for all nutrients and is also responsible for the germination and luxuriant growth of aquatic vegetation or flora as well as the productivity of water bodies. Study of soil of water body is one of the most crucial prerequisite for successful fishery or pisciculture. Soil plays a significant role in determining the productivity of fishes in any natural or manmade water body. Thus, for a successful fish culture and high production, the soil type of water body is highly responsible.

Whole Champaran district (East and West) falls under young alluvium, iron saline and calcareous soil and sandy loam to clay in texture (Kumari, U., Singh, S. K., Singh, S. K. and Singh, U. N., 1990). The East Champaran district is situated in the North Western Corner of the State of Bihar. Motihari is the headquarter city of East Champaran district. Dhanauti River is one of the prime lotic water resource flowing through the districts of East and West Champaran. Dhanauti River, a tributary of River Sikrahana (Burhi Gandak) and was formerly a branch of the Lalbegi and is 113 miles long and ultimately confluences into Sikrahana River near Sitakund, Pipra, East Champaran (Hunter, W. W., 1877). This river is perennial, narrow and highly serpentine in nature which flows through west to east direction in the district of East Champaran.

II. MATERIALS AND METHODS

The soil were collected from two pre-selected sampling sites of the river Dhanauti near Motihari town and were analysed in the laboratory of Post Graduate Department of Zoology, M. S. College (Motihari). Geo-coordinates of both soil sampling sites were recorded by using digital GPS (Table 1). The air dried soil was lightly crushed and foreign materials such as plant residue, plastic pieces, gravel, stones and brick pieces were discarded. Then it was sieved through 2 mm size for further treatment. To get perfect result any possibility of its contact with fertilizers, manures, ashes and other chemicals was avoided.

All parameters were analysed by using suitable, standard and recommended methods as mentioned by APHA (2000). pH of soil was examined on spot (sampling sites) as well as in laboratory by using digital pH meter. The percentage of organic carbon was calculated by Walkley's and Black method (Allison, L. F., Walkley and Black Methods, 1965). The Ca and Mg were analysed by Ethylene Diamine Tetra Acetate (EDTA) method (Tucker, B. B. and Kurtz, L. T. 1961) while available phosphate (P_2O_5) was estimated by Olsen's method (1954). Carbonate and bicarbonate were analysed by using Titration method.

Table 1. Geo-coordinates of Soil sampling sites of river Dhanauti near Motihari town.

SN	Sampling Site	Geo-Coordinates	
		Latitude	Longitude
1	Singhia Hiwan Ghat (Bank) (Near Chati Mai Temple)	26.66611°N	84.89318°E
2	Raghunathpur Ghat (Bank)	26.65148°N	84.88566°E

III. RESULTS AND DISCUSSION

Living organisms, both plants and animals, constitute an important component of soil (Biswas T. D. Mukherjee, S. K., 1967). Healthy soil is crucial for viable fishery or pisciculture in any water body. During the course of investigation (January to December 2010), data were collected from two pre-selected sampling sites in river Dhanauti near motihari town which is given in table 2.

Looking towards the obtained pH (or hydrogen ion concentration) value of soil, it was slightly alkaline in reaction and was found to be in the range of 7.2 to 7.7. The highest value of pH was noted to be in the months of January

to march (7.7) whereas the lowest value (7.2) was found to be in the months of April to June. pH value ranging from 7.0 to 8.5 might not be harmful in the fish productivity as presented by Banerjee & Ghosh (1967). However, Kumari, U., Singh, S. K., Singh, S. K. and Singh, U. N., (1990) reported pH 7.0 to 8.0 in an ox-bow lake (Basman lake of Motihari) of North Bihar where fish production has been recorded maximum even in the heavy flood situation. Thus, the pH concentration was higher in the most of the months of the year which provides an ideal alkaline medium for a successful fish culture.

The highest conductivity was obtained during the months of January to March (1.08) while the lowest (0.28) was recorded in the months of October to December 2010.

The value of bicarbonate in the year 2010 was noted to be in the range of 5.2 to 6.4 showing its highest value (6.4) in the months of July to September while the minimum value was found to be in the months of April to June (5.2).

During the entire period of investigation carbonate was found to be absent on both sampling sites. Carbonate, in the soil of Dhanauti, was untraceable because as soon as carbonate was formed, it was transformed into some kind of carbonate which were found in good number.

The range of phosphate (P_2O_5) during the year 2010 was noted to be in between 2.3 to 3.7 and the highest value (3.7) was recorded in the months of October to December while the minimum value of phosphate was registered to be in the months of January to March (2.3). Total alkalinity with total available phosphate formed the most valuable indices of productivity (Moyle, J. B., 1946).

Soil organic matter is any material produced originally by living organisms (plant or animal) that is returned to the soil and goes through decomposition process (Bot, A. and Benites, J., 2005). In the present investigation, the organic Carbon (matter) was obtained in the range of 2.7 to 3.3 in the year 2010. The maximum value was noted to be in the month of January to March while the minimum value of organic carbon was found in the months of July to September. The organic carbon was found to be ideal for good fish productivity in this river.

The presence of calcium and magnesium components was very little. The value in the year of investigation (2010) was noted to be in the range of 8.1 to 8.4 only. The maximum (i.e., 8.4) was in the months of October to December while the lowest was found to be 8.1 during the months of July to September (table 2). These were also suitable for high yielding fish productivity.

The silica composition ranged from 53 to 59 in the year 2010. The maximum value was noted to be during the months of July to September whereas the minimum value was noted to be during the months of January to March and October to December 2010.

The total iron oxides (Fe_2O_3) were found to be in the range of 10.5 to 12.9 during the year 2010. Its maximum value was noted to be during the months of October to December while the minimum value was observed to be during the months of April to June. αFe_2O_3 is the oldest known iron oxide and is widespread in soils and rocks (Shui-Sheng Fan, Feng-Hsiuang Chang, Hsin-Ta Hsuch and Tzu-Hsing Ko, 2016).

The total aluminium contents (Al_2O_3) at both the selected banks of river Dhanauti during the year 2010 was noted to be in the range of 5.2 to 7.2 (table 2). Although, the highest value was found in the months of July to September (7.2) and the lowest value (i.e., 5.2) was observed in the months of January to March 2010.

The soil surface of any water body remains in contact with the water. Hence, chemical components of water and soil might get interchanged and thus, altering the growth of vegetation and determining the kind of organisms that could thrive there in.

Table 2. Average Mean Value of Soil samples collected at both sites during 2010

SN	Parameters	MONTHS			
		January To March	April To June	July To September	October To December
1	**pH**	7.7	7.2	7.6	7.5
2	**Conductivity (µ mohs)**	1.08	0.61	0.31	0.28
3	**Bicarbonate (m.e. / 100 gm)**	5.6	5.2	6.4	6.0
4	**Carbonate (m.e. / 100 gm)**	NIL	NIL	NIL	NIL
5	**Phosphate (P_2O_5) (ppm)**	2.3	2.7	2.9	3.7
6	**Organic Carbon (%)**	3.3	2.9	2.7	2.8
7	**Ca & Mg (m.e. / 100 gm)**	8.2	8.3	8.1	8.4
8	**Silica (mg/gm)**	53	54	59	53
9	**Fe_2O_3**	12.1	10.5	10.7	12.9
10	**Al_2O_3**	5.2	5.6	7.2	6.4

IV. CONCLUSION

Soil of any water body is very important ecological factor for its fish productivity. Thus, during the present investigation, the soil of Dhanauti River at both the selected sites were undertaken and study of soil was done. It was found that the pH and all other parameters of soil of Dhanauti River was ideal and suitable from fish production or pisciculture point of view. Phosphate concentration was also moderate. Calcium and magnesium were also in good amount. The amount of calcium is perhaps due to degeneration of phytoplankton and deposition of shells and bones brought by the flood and rain water in rainy season. Thus, due to its maintained productivity, it can be concluded that the Dhanauti River has all potentialities for better fish production and is still safe for pisciculture practices.

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