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Nutrient contents of a major water body of Tenughat at Bokaro in relation to fish production

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Abstract : Nutrient contents status of a major water body of Tenughat shows that the conductivity gradually decreases from winter to monsoon, mainly due to decomposition of humus assessed during 2012 to 2013. The reservoir has both thermal and chemical stratification. The analysis of limnological fluctuations suggests the need of eco-friendly nutrient content management of water to augment fish production. The investigation mainly emphasizes morphometric and physico-chemical conditions exhibited gradual decrease in the productivity of the reservoir.

Keywords: Water body, nutrient, content, fish production.

INTRODUCTION

Tenughat is an ancient largest earthen manmade reservoir (dam) in Asia, near Bokaro District of Jharkhand. It is constructed on tributary of river Damodar. The Damoder River valley project on the Damodar River and its tributary river is located in eastern India. The four main multipurpose Dam located at Tilaiya (konar), Maithan, Panchet commissioned during 1953-59. In addition a single purpose reservoir on the main stream the Damodar at Tenughat with storage capacity is 224 million m^3 and constructed later in 1974. The Tenughat Dam is controlled by the Government of Jharkhand.

The 5 kilometer (31 mile) long, 55meters (180ft) high earthfill Dam with composite masonry cum concrete spillway and under sluice structures concrete diaphragm cut off wall rock excavation in foundation, diversion channel coffer dam appurtenant works at Tenughat was built for supply of water to Bokaro Steel City Plant and the Bokaro used by local people for drinking irrigation and other domestic purposes.

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Catchment Area-

Damodar Basin catchment area lies between Hazaribagh plateau on the north and the Ranchi plateau on the ancient land marks. This is very old valley dating back to the lower Gondwana period that is the Upper Carboniferous, when Peninsular India had under gone a series of through faulting on a large scale resulting in the formation of many rift valleys and lakes. The Damodar valley lies above one of such rift valleys and lakes while parts of the Mahanadi and Wardha Godar.

The lower basin of the Konar River somewhat sleepily from the water shed which separates it from Jamunia and in consequence of this part of the district is rough and largely uncultivated. To the east the river later descends from its higher level in a wide east ward curve and so its journey to the Damodar is easy and gentle and its basin forms a gradual slope to the south east. Earlier workers have carried out considerable investigation on the different aspects of limnobiotic components (nutrients) and productivity of freshwater bodies.

After China, India occupies second position in the world in fish production. India contributes 6% in total fish production in the world. 9, 58, 00,000 ton fishes produced in year 2012. Jharkhand state has the resources and suitable climate for increasing the fish production.

More than 10%of total population of Jharkhand state is directly or indirectly dependent on fishery sector for their livelihood.

Recently, cage culture of a Thai fish Pangasius production under NMPM has been setup in Tenughat Dam. It is considered as ATM for fish farmers.

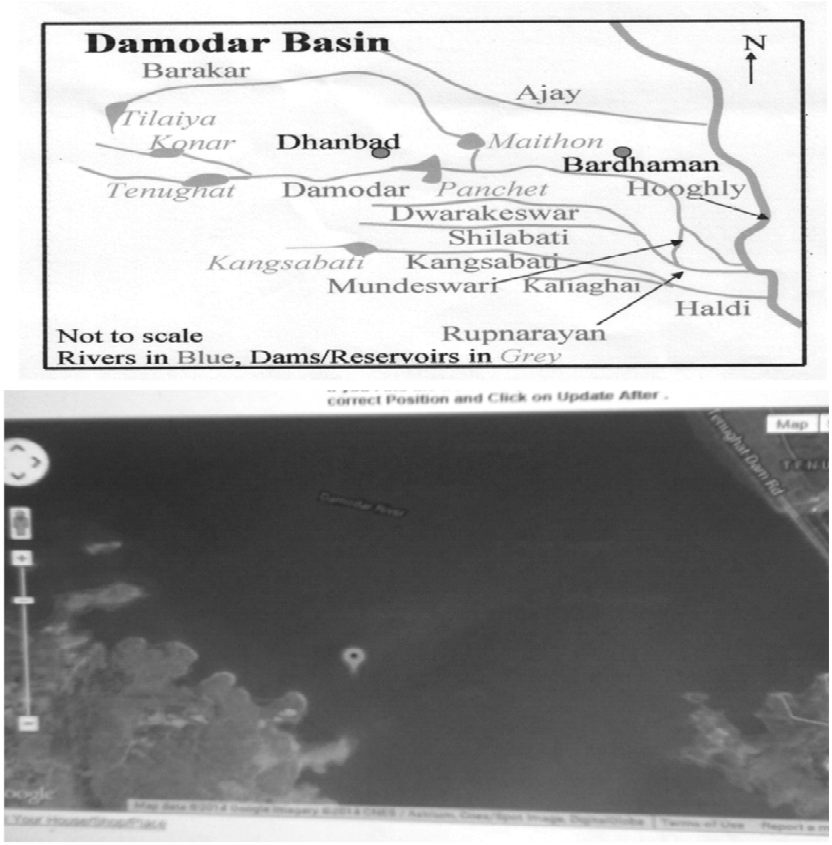

Fig- Showing Geographical view and catchment area of Tenughat (Dam).

Despite the overwhelming importance of reservoirs in inland fisheries of India a reliable estimate of the area under this resource is still elusive causing serious constraints to the Research & Development activities.

Study Area : Tenughat is locally known has a total catchment area of approximately 6,300 m^2. It was divided into five sampling sites covering lentic, intermediate and lotic zones of the dam. Water samples were collected at monthly intervals using standard method, between January 2012 to December 2013 from these sampling sites for the study of physico-chemical and biochemical estimation.

MATERIALS AND METHODS

The temperature of surface water and deep water was measured by thermometer. pH by a portable analyzer kit and DO_2, Free CO_2, HCO_3, alkalinity were determined on the spot immediately after collection of samples. Conductivity, calcium content, magnesium and total hardness of water were estimated in laboratory by following standard methods as mentioned in APHA (1985)[1]. Trivedy and Goel (1984)[3], conductivity, pH, total alkalinity, bicarbonates and were analyzed by preparing soil suspension in distilled water in 1:5 proportions.

Organic matter was analyzed by walkey and Black method (Trivedy and Goel, 1984)[3]. Available phosphorus and nitrate were analyzed with the help of spectrophotometer. Total calcium, chloride and magnesium were analyzed by titrimetic method using EDTA solution.

RESULTS AND DISCUSSION

TEXTURE: The sediment of Tenughat is loamy. The sediment below and near water was found muddy throughout the study period up to the depth of 6 feet.

Colour: The color of sediment is grey in winter and early summer due to low amount of organic matter while it becomes gradually black in late summer and

monsoon due to high organic matter.

Conductivity: The conductivity of sediment varies between 24.8 (Oct) to 25.9 mhos (Dec).The average conductivity was recorded 680, 420, 261.5mhos in winter, summer, and monsoon respectively.

pH: The sediment of Tenughat is acidic. The pH varies between 5.00 to 6.50. Average pH in winter, summer, and monsoon was recorded 6.5, 5.7, and 6.1 respectively.

Total Alkalinity: Total alkalinity was based in the month of Dec (0.32 meq/100gm) and highest. The month of May (1.5 meq/100gm).The average total alkalinity was recorded 0.40,139 and 0.78 meq/100gm in winter, summer and monsoon.

Bicarbonate: Bicarbonate varies between 19.52 mg/gm in December to 91.50mg/100gm in May. The average bicarbonate was recorded 24,36,87,79 and 47.55mg/100gm in winter, summer and monsoon.

Chloride: The chloride varies between 5.20 and 36.00mg/100gm in January and October respectively. The average value of chloride was recorded 5.35, 10.0 and 29.0 mg/100gmin winter, summer and monsoon respectively.

Organic Matter : The organic matter varies between 3.70% in December to 30.94% in January. The average value of organic matter was recorded 3.9%, 22.95 and 27.46%in winter, 14.87%in summer and 15.93% in monsoon.

Available Phosphorus: The available phosphorus between 3.60 mg/100g in December to 7.10mg/100gm in June. The average available phosphorus was recorded 3.8mg/100gm in winter, 6.05mg/100 in summer and 5.30mg/100gmin monsoon.

Nitrate: The nitrate is sediment varies between 0.66mg/100gm in August to 1.51mg/100gm in June. The average value of nitrate was recorded 1.43, 1.51 and 0.73mg/100gm in winter, summer and monsoon respectively.

Calcium: Its value varies between 625.25mg/100 in August to 801.50mg/100gm in October. The average value of calcium was recorded689.38/772.39 and 713.38mg/100gm in winter, summer and monsoon respectively.

Total Magnesium: The lowest total Mg was recorded 36.65mg/100gm in December and highest 233.92mg / 100gm in August. The average Mg was recorded 38.99, 92.46 and 165.69mg/100gm in winter, summer and monsoon respectively.

Table 1:showing change in nutrient contents in water body of Tenughat (dam) in all three seasons.

PARAMETER	UNIT	SEASONS		
		WINTER	SUMMER	ONSOON
Colour		Grey	Grey-Black	Black
Conductivity	Micro mhos	680	420	261
Ph		6.5	5.7	6.1
Total Alkalinity	mg/100gm	0.40	139	0.78
Bicarbonate	mg/100gm	24.36	87.79	47.55
Chloride	mg/100gm	5.35	10.0	0.29
Organic matter	%	3.9	22.95	27.46
Available Phosphorus	mg/100gm	3.8	6.05	5.30
Niitrate	mg/100gm	1.43	1.51	0.73
Total Calcium	mg/100gm	89.38	772.39	713.38
Total Magnesium	mg/100gm	38.99	92.46	165.69

The study of nutrient content of Tenughat Dam for the purpose of fish production revealed that it has less than 35% organic matter and abundance of cations (Mitsch and Gosselnik-1986, B.N Singh-1993)[5,6] the soil is slightly acidic due to the presence of humus which possesses different amino acids and organic compounds. The concentration of CO_2, hydrolysis of acids, salts and production of organic acids aid to the total acidity of the water due to break down of humus.

The dissolved oxygen was favorable ranging from 6.2 to 8.2mg/l at the surface values did not significantly vary in the bottom water. Hence, oxygen distribution as observed in all the months. Free co_2 in bottom layers ranged from 6.0mg/l in September to 8.0mg in May.The rapid decomposition and heterotrophy activity might have contributed to the content of free co_2 of the bottom water showed higher values (50.0mg/l) than that of surface water (40.8 to 94.0mg/l).The conductivity of sediment gradually decreases from winter to monsoon due to rapid

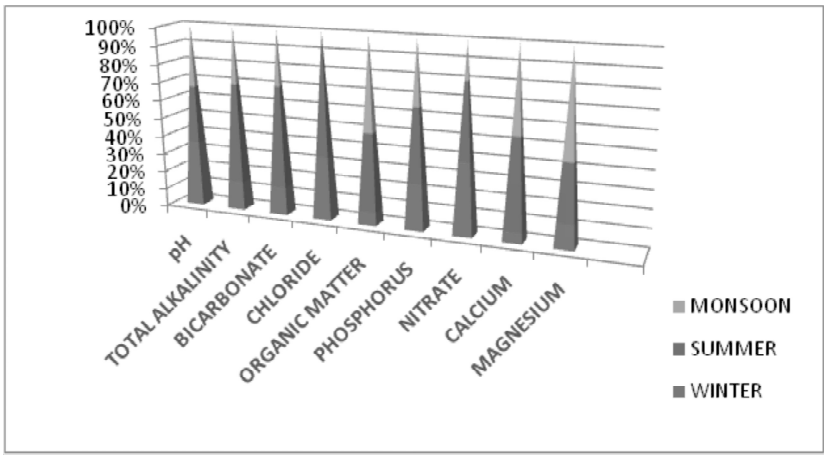

Chart 1. Showing graphical representation of nutrient contents in all three seasons.

decomposition of dead plants and animals.

Total alkalinity, chloride, organic matter, available phosphorus, nitrate, total calcium and magnesium generally increase from winter to summer. Mostly bicarbonate and alkalinity was in the range of 19.52 to 29.20 except in June (78.2mg). Similar results have been also obtained by Bais et al (1992)[2] in the Sagar Lake. Chatrath (1992)[3] has reported reduction in total N, P and Ca in Dal Lake during summer. The increase in these nutrients in the Tenughat Dam is probably due to reduction in the macrophyte biomass and rapid decomposition of humus. The reduction of water table during summer causes setting of water minerals on the sediment bed adding to the nutrient availability of sediment during monsoon period.

There were strong climatic differences between years; particularly in seasonal rainfall (wet season 2012 had little rainfall). As rainfall strongly affected fish yield and primary production, since the differences between these treatments were generally quite large, the input effects likely predominated, and the interpretation of results was probably not largely affected by this problem. Organic and inorganic treatments were run simultaneously, avoiding this annual or seasonal bias.

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