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A Preliminary Study on Basin Soil characteristics in Vanivilas Sagar Reservoir, Karnataka

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ABSTRACT

The scientific understanding of the basin soil of the reservoir is a pre-requisite for utilizing these water bodies for reservoir aquaculture. The sediment represents a mixture of living organisms and dead materials. The mud is a graveyard of past communities, it serves as a library of information. As the bottom sediments contain abundant organic substances, it plays a very important role in fisheries development. The study reveals that the overall percentage of clay was quite high compared to silt and sand. The substratum with more clay and macrophytes leaves little space for spawning by fishes. Therefore, proper management measures are required before the initiation of aquaculture in the reservoir. Obtained data is compared with some Indian reservoirs.

Keywords: Vanivilas Sagar Reservoir, Basin soil characteristics.

INTRODUCTION

The scientific understanding of the basin soil of the reservoir is a pre-requisite for utilizing these water bodies for reservoir aquaculture. The sediment represents a mixture of living organisms and dead materials. The mud is a graveyard of past communities, it serves as a library of information. The knowledge of the texture of the sediment acts as a guide to value the basin soil characteristics of a reservoir. The basin use capability and the method of soil management are largely determined by the texture (Sly, 1989 a, b; Forsberg, 1989). As the bottom sediments contain abundant organic substances, it plays a very important role in fisheries development. The nutrient cycling in reservoirs and lakes is strongly influenced by the type of sediment also (Bostrom et al., 1982; Sly, 1984). Hence, a preliminary investigation of the sediment characteristics in VVSR has been carried out.

MATERIALS AND METHODS

The reservoir was arbitrarily divided into three sectors. Sector I corresponded to the dam area characterized by deeper and stagnant water conditions, and sector III is the confluence point of the reservoir with shallow and flowing waters. The zone in between sectors I and II was marked as sector II At least three random sediment samples were collected using Ekman's dredge sampler in each of the three sectors during pre-monsoon and post-monsoon months during 2000-2001. Analysis for different parameters (Table 1) was done according to Gupta P.K. (1999) and Trivedy et al., (1993) (Table 2)

RESULTS

Data on sediment texture and physico-chemical characteristics recorded at different sectors during pre-monsoon and post-monsoon seasons of the study period are presented in table 8.1. The sediment temperature in the reservoir varied between 29.08 ^{o}C and 29.13 °C and 27.24 °C and 28.00 °C during pre-monsoon and post-monsoon seasons respectively. The high temperature was noticed during the pre-monsoon season only. The pH in the reservoir varied from 8.7 to 9.2 and 8.6 to 9.1 during pre- monsoon and post-monsoon seasons respectively, It

indicates the alkaline nature of the sediment in both seasons. Organic carbon in the reservoir varied between 0.60 to 0.71 % and 0.84 to 1.13 % during pre-monsoon periods: Going by the values it is obvious that organic carbon is medium. Available phosphorus and available nitrogen varied between 1.1 to 2.0 mg / 100gm and 15.6 to 29.8 mg / 100gm respectively indicating a poor distribution of these nutrients. Comparatively higher concentration of these nutrients during post- monsoon months was recorded. The percentage distribution of $CaCo_3$ varied between 2.14% to 3.86%, with higher values during the post-monsoon period.

Data on the percentage composition of sand, silt, and clay are shown in fig1. Sand, silt, and clay fractions in the reservoir ranged between 11.6 % to 34.3%; 17.9 to 29.0%, and 43.7% to 62.6% respectively. There was a decrease in sand content during post-monsoon months, while silt and clay content increased considerably after rains. The overall percentage of clay was quite high in the reservoir. Obtained data on all parameters is compared with some Indian reservoirs.

DISCUSSIONS

The framework of the soil consists principally of mineral and organic particles of various sizes. The variation in size of the particles and the proportionate amount of fine and coarse materials determined to a large extent both the physical and chemical properties of soil (Forsberg, 1989). The relative proportion of different soil particles i.e., sand, silt, and clay is known as soil texture (Gupta P.K, 1999). Based on the relative percentage of sand, silt, and clay various textural names of the soil are used. Erosion of the topsoil in the catchment is the main source of sediment load into the reservoir under investigation. The study did not show marked variation in terms of soil texture at 3 sectors of the reservoir. The basin soil at Sector-I was clayey sand during pre-monsoon that later converted to clayey silt after the monsoon, Sector-I remained clayey sand even after the monsoon, whereas sector-Ill behaved like Sector-I. Therefore the substratum might have helped the colonization by macrophytes, which offer many substrates for invertebrates. Muss (1967) considered substratum as an important abiotic factor for the benthic community. Sahu (1999) found high benthic production in association with the silty sand substratum. His observations conform with David et al., (1969 a, b) and Sly (1989a,b). In the present study, it was inferred that the sediment is not favorable for the construction of nests for spawning which affects fishery development.

The major nutrients like available nitrogen and available phosphorus play a significant role in aquatic food chains. The part of the sediment nitrogen exists as a complex combination in the organic matter fraction. It becomes available to autotrophs after breakdown into simple forms followed by mineralization. Hence early oxidizable organic carbon and mineralizable nitrogen are considered to be quite satisfactory as an index of nitrogen availability. Similarly, phosphorus also occurs in soil ·in many forms and combinations. The total amount of phosphorus present in the soil is not available to autotrophs, only small fractions of it may be available which is of direct relevance in assessing the phosphorus fertility level. The assessment of available nitrogen is based upon the estimation of readily oxidizable organic carbon, the seat of nitrogen in the soil.

The pH value is a measure of the hydrogen activity of the soil water system. It determines the availability of nutrients, microbial activity, and the physical condition of the soil. The reservoir bottom soil during pre-monsoon and post-monsoon seasons is alkaline. The soil is deficient in available nitrogen, organic carbon, and available phosphorus probably due to an intensive situation. The soil exhibits uniformity in different sectors in respect of physical and chemical characteristics.

The bottom soil and surface water temperature and pH did not show any significant variations. The soil and water were uniformly warm with alkaline nature. Devaraj et al., (1987) found acidic basin soil with the production of organic acid in Hemavathy. The lack of organic acid in the present study is confirmed by the high pH of the soil. The values of organic carbon (0.60 to 1.13%) and available phosphorus (1.1 to 2.0mg/100g) indicate poor nutrient distribution in the soil. But available nitrogen (15.6 to 29.8 mg/100g) was quite high in the basin soil. The macrophytic debris might have contributed to this.

CONCLUSIONS

The basin soil is characterized by a high percentage of clay. The low-level fluctuations make the environment ideal for the development of aquatic macrophytes. The sediment remained alkaline. The study reveals that the overall percentage of clay was quite high compared to silt and sand. Organic carbon, available phosphorus, available nitrogen, and calcium carbonate increase in their values from pre-monsoon to post-monsoon months but pH remains alkaline throughout the study period. All the attributes helped aquatic macrophytes to colonize the

basin soil. The substratum with more clay and macrophytes leaves little space for spawning by fishes, hence good fish production cannot be expected. Therefore, proper management measures have to be undertaken before the initiation of the aquaculture program in the reservoir.

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Table 1: Parameters and methodology

Parameter (unit)	Method	Reference
Organic carbon(%)	Walkley and Black rapid titration method	Gupta P.K. (1999), pp. 123-126
pH value	pH meter	Gupta P.K (1999), pp. 83-84
Available phosphorus (mg/100 g)	Olsen's method	Gupta P.K (1999), pp. 143-146
Available nitrogen (mg/100g)	Alkaline permanganate method	Gupta P.K., (1999), pp. 132-134
Calcium carbonate (%)	Rapid titration method	Trivedy et al., (1993), pp. 132-133
Texture	International pipette method	Gupta P.K., (1999) pp.7-18,

Table 2: Physico-chemical characteristics of basin soil

Sector	Temp. (°C)	pH	QC(%)	$CaCo_3$(%)	Available P_20_5 (ma/100a)	Available N (ma/100g)
Pre-monsoon						
I	29.09	8.8-9.90	0.60	2.43	1.2	18.3
II	29.08	8.7-8.9	0.70	2.14	1.1	25.9
Ill	29.13	8.9-9.2	0.71	2.67	1.5	15.6
Average	29.10	-	0.67	2.41	1.2	19.9
Post-Monsoon						
Sector I	28.00	8.7-8.9	1.13	3.86	2.0	25.9
Sector II	27.82	8.6-8.9	0.90	2.48	1.8	29.8
Sector Ill	27.24	8.8-9.1	0.84	2.76	1.7	28.8
Average	27.69	-	0.95	3.03	1.8	28.1

Table 3: Status of Basin soil characteristics in some Indian Reservoirs

Reservoir	Source	pH	OC (%)	Nitrogen (mg/100 g)	Phosphorous (mg/ 100g)	$CaCo_3$ (%)	Sand (%)	Silt (%)	Clay (%)
Hemavathy	Devaraj et al.,	6.3-	0.55	-	-	-	-	-	-

	(1988)	6.9	- 0.63						
Krishnarajasagar	Sugunan,(1995)	6-7.2	1.25 - 1.86	0.6-1.6	-	-	-	-	-
Aliyar	Sugunan, (1995)	6.4	-	-	-	-	24.1	29	46
Bhavanisagar	Natarajan et al., (1981)	5.22-6.4	1.83 - 2.68	31.0-50.8	100-3.58	-	-	-	-
Tungabhadra	Ramakrishniah, (1994)	7-8.5	1.07 - 1.25	25.8-27.8	1.07-1.25	200-300 (mg/1009)	-	-	-
Getaslud	Anon., (1984)	-	0.46 - 0.60	24.38-35.06	2.45-6.08	-	-	-	-
Rihand	Natarajan and Tripati, (1982)	6.0-8.5	-	15.5-30.5	1.1-2.3	0.45-4.8	-	-	-
Govindsagar	Anon., (1989)	8.2-8.8	1.03 - 3.16	13.0-20.5	0.03-0.048	4.22-16.1	24.0-30.2	34.2-48.7	24.2-36.6
Konar	Ramakrishniah and Sakar, (1982)	5.4-6.0	0.3-0.9	-	1.2-8.0	-	-	-	-
Nongmahir	Sugunan and Raghava, (1991b)	4.6-6	1.74 - 2.13	29.9-44.6	0.38-1.12	-	55.10	11.25	33.65
Vanivilas Sagar	(Present Study)	8.6-9.2	0.60 - 1.13	15.6-29.8	1.12-2.0	2.14-3.86	11.6-33.3	17.7-29.8	43.7-62.6

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