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Limno-chemical profile and fisheries potential of Maithon reservoir in Jharkhand, India

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Abstract

The present investigation deals with various Limno- chemical profile of Maithon reservoir in Jharkhand to evaluate the status of fish production potential, stocking quantity of fingerlings, as well as basin sediment characteristics of reservoir. Water temperature, pH, Specific conductivity and TH ranged 12-29 °C, 7.4-8.9, 92-168 $\mu\text{s}/\text{cm}$ and 36-72 respectively. The result indicates that the various parameters are found within the tolerance limit and concluded that reservoir is moderately productive in nature and fit for fish culture.

Keywords: Limno-chemical profile, Fish production potential, Stocking quantity, Maithon Reservoir

1. Introduction

Reservoirs constitute the prime inland fishery resource of India by virtue of their vast area and huge production potential (Sugunan *et al.*, 2000) [10]. India also has vast inland fishery resources (Nath and Das 2004) [7] in the form of rivers and canals, reservoirs, tanks and ponds, estuaries, flood plain lakes and wetlands, etc. Freshwater fishery includes capture, culture-based capture and culture fishery. Open water fisheries being practiced in rivers, rivulets, large and medium reservoirs, lagoons, floodplain wetlands are mostly governed by the principle of capture fishery. The capture fishery is primarily based on auto-stocking and natural recruitment which, in most occasions failed in majority of the larger reservoir of India because of recruitment failure. The total surface area of reservoirs in India has been estimated at 3.51 million ha (Das *et al.*, 2013) [4] and is expected to be doubled by the turn of the century.

2. Maithon Reservoir

2.1. Morphometric and Hydrographic feature

The Maithon reservoir (Lat: 23⁰47' N, Long: 86⁰49'E) was impounded on river Barakar- the main tributary to river Damodar, having water spread 10,716 ha, mean depth: 9.1 m with productive area 6,680 ha sprawling over West Bengal and Jharkhand (Table 1). The catchment (C: 6572 km²) comprises moderately fertile river valley including deciduous forest cover. It is the second largest reservoir after Panchet under Damodar Valley Corporation (DVC), impounded to serve the very purposes of flood control, irrigation, water supply and hydro-electricity.

3. Materials and Methods

As there were no previous records available about the study at Maithon dam, a detailed survey of dam site was conducted. Based on the data obtained during survey, lentic sites were selected for water sampling. The study was carried out through field and laboratory work. Sampling was done from September, 2012 to January, 2013. The field work comprises collection of sediment and water samples, fisheries data along with secondary data related to stocking information were collected from DVC authority. From the predefined location water samples were collected and the analysis of physico-chemical parameters like dissolved oxygen, pH, alkalinity, chloride contents, suspended solids, temperature were carried out as per the APHA, 2005 [1] standard methods.

The growth studies of Indian Major Carps (IMC) revealed the annual average growth of IMC and stocking rate of fish, according to Huet's formula:

$$\text{Stocking of fish} = \frac{\text{Potential fish yield of reservoir (kg)}}{\text{Annual growth of fish (kg)}} + \text{Allowance}$$

4. Results and Discussion

Table 1: Characteristic features of Maithon Reservoir

River system	Barakar
Location	Lat: 23 ⁰ 47' N, Long: 86 ⁰ 49'E
State	Jharkhand & West Bengal
Date of construction	Sept., 1957
Lake type	Reservoir, Fresh water
Area at FRL (ha)	10716
Area at DSL (ha)	2428
Mean depth (m)	9.1
Max depth (m)	24.0
Catchment (C) (Km ²)	6267
C/A	58.48
Productive area (ha)	6572
Stream bed level (ft.)	340
Av. Annual Rainfall (mm.)	11417
Av. Annual Run-off (ac ft.)	21,20,000
Dam type	Composite
Shoreline	Irregular
Shore Development	1.24
Volume Development	1.13
Purpose	Irrigation, water supply, flood control, hydro-electric, navigation.
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4.1. Limno-chemical Characteristics

4.1.1. Water Temperature and pH

Temperature is one of the most important factor for aquaculture. Fish growth is increase with increasing optimum range and then decline rapidly (Sawver 1994) [9]. Water temperature is ranged between 12 °C and 29 °C and pH was in the alkaline range at 7.4-8.9 in research area. These values supposed to be good for aquaculture practices as noticed in most of the tropical water bodies, close to A. P. reservoirs (Das, 2000) [3] having pH range 7.8-9.9.

4.1.2. Specific Conductivity and Total Hardness

Specific conductivity ranged between 92 and 168µs/cm Water containing more than 300 mg/l of TH is not considered desirable for drinking purpose Sanger et a 2015 [8]. In the present study TH is observed in the range of 36-78. Calcium and magnesium contents were moderate.

4.1.3. Water Transparency and Alkalinity

Water transparency was observed to be lowest at 20 cm in September and highest 90 cm in December. Total alkalinity (ppm) was fluctuated to a low of 38 and a high of 84.

4.1.4. Dissolved Oxygen status (DO) and Carbon-dioxide

Dissolved oxygen status (DO) and low CO₂ was ranged from 0-2 ppm cumulatively which is under tolerance limit of reservoir's productivity.

4.1.5. Dissolved nutrients

Dissolved nutrients especially nitrate-N: 10-680 ppb, phosphate-P: trace - 442 ppb and silicate-Si: 1.2-8.5 ppm. The reservoir is mostly pollution free as indicated by its chloride content (Cl: 9.42-24.34 ppm).

4.1.6. Characteristics of Basin Sediment

pH (6.5-8.6) was very nearer to Jhingran 1989 [6] who also recorded the soil pH ranging from 7.80- 8.65, during study of limnochemical features of Chhapparwara reservoir and in Ramgarh reservoir (Jaipur) the soil pH ranged from 7.4-8.6.(Sanger *et al.* 2015) [8].

The organic carbon of the sediment was in the range of (0.65-1.64%), which indicated the poor/ moderately status of productivity in general as (Banerjee 1967) [2].

Total -N: 0.07-0.18%, available - P: 1.08-3.06 mg/100 g soil and available - N: 12.25-24.48 mg/100 g soil.

Table 2: Physico-chemical features of Water in Maithon reservoir

Parameters	Range
Water temperature (°C)	12-29
Water transparency(cm)	20 -60
pH	7.4-8.9
Total alkalinity (ppm)	38-84
CO ₂ (ppm)	0-2
Specific conductivity (µS/cm)	92 – 168
Total hardness (ppm)	36 – 78
Nitrate - N (ppb)	10-680
Phosphate- P (ppb)	Trace – 442
Silicate- Si (ppm)	1.2-8.5
Chloride content (ppm)	9.42-24.34

Table 3: Sediment characteristics of Maithon reservoir

pH	6.5-8.6
Organic carbon (%)	0.65-1.64
Total nitrogen (%)	0.07-0.18
Available-N (mg/100 g)	12.25-24.48
Available-P (mg/100 g)	1.08-3.06

5. Status of fish production potential

The yield from Indian reservoirs has been dwindling around 50, 20 and 8 kg/ha/yr in small, medium and large reservoirs which has gained the modest increment with the intervention of National Fisheries Development Board (NFDB) after 2006 to a height of 85, 53 and 25 kg/ha/y respectively, mainly due to follow up of sound and sustainable stocking program. The limno-chemical profile of Maithon reservoir indicates that it is moderately to good productive in nature with production potential hovering around 250 -300 kg/ha/y. The fish yield was at low up-till 2006 at 4-6 kg/ha/y in this water body, mainly due to recruitment failure, no proper stocking, operation of zero-mesh net in and around the reservoir including unscrupulous fishing, and no observance of closed season, which has gained a substantial increment after 2007 onwards with the modest increase in production at 80-90

kg/ha/y following very sustained and sound stocking program during 2007-2012.

At the present level of management, the average yield from the Indian reservoirs is about 20 kg/ha, whereas a production of 50-100 kg/ha can easily be achieved from large and

medium reservoirs, while the small reservoirs have the potential to yield even 100-300 kg/ha (Sengar et.al.2015) [7]. Rapid fluctuation of reservoir water level, which is common especially in irrigation reservoirs, has been the primary cause of low yields of Indian reservoirs (Jhingran, 1988) [6].

Table 4: Stocking of fingerlings in Maithon reservoir

Year of stocking	fingerling size	Species	Quantity stocked (in lakh)
2007-08	>100 mm	Catla, Rohu, Mrigal, Grass carp, Common carp, Kalbasu	66.86
2008-09	>100 mm	-do-	36.11
2009-10	>100 mm	-do-	4.51
2010-11	>80mm	Catla, Rohu, Mrigal, Grass carp, Common carp, Bata	10.62
2011-12	>80mm	-do-	15.18
2012-13 (upto 31.10.12)	>80mm	-do-	24.5

Table 5: Fish Yield of Maithon reservoir (kg/ha/y)

Year	Yield (kg/ha/y)
2003-04	4-6
2009-10	80-90
2011-12	80-90

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