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# HYDROLOGICAL STUDIES OF MATATILLA RESERVOIR, UTTAR PRADESH

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## ABSTRACT

**Matatilla reservoir, located in semi arid region, (Lat. 25° 15′ N and Long. 78° 23′E) has an area (at FRL) of 13,893 ha, volume and shore development 0.663 and 1.65, shoreline 73.6 km. Volume and shore development indicate that greater part of the reservoir is shallow, which is a favourable point for fish productivity. Temperature and dissolved oxygen gradually decreased with the increase in depth. Carbon dioxide was absent from the surface but invariably present in the bottom (3.6 ppm). pH remained alkaline (7.2-8.4 ppm) throughout the year. Alkalinity, chloride, calcium, magnesium, hardness and productivity was maximum in premonsoon and minimum in monsoon except for calcium and magnesium in postmonsoon. Phosphate, nitrogen and ammonical nitrogen were found in traces. These variations may be due to influx and outflow of water and use of reservoir water for multipurpose activities.**

The assessment of biological productivity of an impoundment is necessary to ascertain whether productivity is adequate enough to sustain standing population of commercially important fishes or if there is any scope for the introduction of additional species of commercial value in order to fully utilise food resources which are presently left unutilised by the existing species. Biological productivity in turn is dependent on several physico- chemical characteristics of the water.

Although some work has been done in the past by Raj (1941), Ganapati (1955), Dorai-Rajah (1950), and Sreenivasan (1976), in small and medium sized irrigation reservoirs in Tamil Nadu, very little information is available on physico-chemical characters and productivity of other large multipurpose reservoirs of the country. These reservoirs may differ from medium reservoirs in their hydrological condition. The present communication gives an account of some aspects of hydrology of multipurpose Matatilla reservoir, largest in the Bundhelkhand region of Uttar Pradesh, studied for a period of one year, from 1983-84.

Matatilla reservoir is situated on the river Betwa (a tributary of Chambal), located at latitude 25° 15′ E and longitude 78° 23′E (Fig.I). The reservoir has an area (at FRL) of 13,893 hectares; gross capacity, 964.72 mcm; maximum depth, 27.5 m; depth at dead storage, 18.18 m; volume development, 0.66; shore development, 1.65; shore line, 73.6 km and average rainfall 76.3 mm per annum.

To minimise the sampling error, Matatilla reservoir was conventionally divided into three sectors. i.e. the lotic, the lentic and intermediate. Water samples for chemical analysis, were collected by Nanson samplers. Primary productivity was measured using light and dark bottles technique (Jhingran *et al.* 1964). Temperature was recorded by a reversible thermometer. The data on surface, column and bottom value were averaged at all the centres and were subsequently pooled to arrive at the average of the entire reservoir. Standard methods (APHA, 1985) were followed for analysis of chemical parameters.

Table I clearly shows highly fluctuating minimum and maximum values of different physico-chemical parameters of water. Temperature showed an everage value of 23.5°C. while pH was 7.8 and dissolved oxygen value 9.4 ppm. Levels of nutrients were very low in the reservoir.

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Fig. 1 : *Location of Matatilla reservoir*

Table I : *Physico-chemical characteristics of Matatilla reservoir.*

| Characteristics | Average value | Minimum | Maximum |
|---|---|---|---|
| Temperature (°C) | 23.500 | 19.40 | 26.300 |
| pH | 7.800 | 7.40 | 8.200 |
| Dissolved Oxygen (ppm) | 9.400 | 7.80 | 11.300 |
| Free Carbon dioxide (ppm) | 1.200 | 0.60 | 3.000 |
| Total Alkalinity (ppm) | 94.200 | 56.00 | 186.600 |
| Phosphate (ppm) | 0.015 | 0.01 | 0.023 |
| Nitrate Nitrogen (ppm) | 0.015 | 0.01 | 0.021 |
| Ammonical Nitrogen (ppm) | 0.016 | 0.01 | 0.026 |
| Chloride (ppm) | 12.800 | 12.00 | 13.500 |
| Calcium (ppm) | 29.100 | 20.60 | 33.300 |
| Magnesium (ppm) | 10.300 | 9.00 | 12.000 |
| Hardness (ppm) | 116.200 | 100.00 | 130.000 |

Surface and bottom water analysis shows that maximum water temperature was 28.3°C, at surface in premonsoon and minimum 19.6°C at bottom in postmonsoon, pH maximum 8.2 in postmonsoon and minimum 7.5 at bottom in premonsoon, maximum dissolved oxygen, 11.3 ppm in postmonsoon and minimum 7 ppm bottom in premonsoon, freecarbon dioxide nil on surface in all the seasons and maximum 3.6 ppm in premonsoon and 7 ppm in bottom in postmonsoon, maximum alkalinity 175 ppm in surface in premonsoon and minimum 54 ppm in bottom in postmonsoon season (Table II). The maximum values of gross primary production (187.5 mg C/$m^3$/h), net production (41.66 mg C/$m^3$/h) and respiration (175 mg C/$m^3$/h) were recorded during premonsoon period. The minimum values of gross primary production (125 mg C/$m^3$/h), net production (10.4 mg C/$m^3$/h) were observed in monsoon season while respiration (125 mg C/$m^3$/h) in postmonsoon (Table III).

Production potential of impounded water depends upon various factors like area, nature of substratum and basin, climatic conditions, quality of water etc. Matatilla reservoir which is geographically located in semi-arid region where temperature becomes high (average temperature 34°C) during summer leads to relatively higher production. Volume and shore development indicated that greater part of the reservoir is shallow, a favourable point for productivity. The wind speed of 4 km/h with occassional storm, ensures thorough mixing of its water mass.

Table II : *Physico-chemical features of surface and bottom water of Matatilla reservoir during premonsoon, monsoon and postmonsoon seasons.*

| Characteristics | Premonsoon | | Monsoon | | Postmonsoon | |
|---|---|---|---|---|---|---|
| | Surface | Bottom | Surface | Bottom | Surface | Bottom |
| Water Temp. (°C) | 26.3 | 22.8 | 26.3 | 26.2 | 19.9 | 19.6 |
| pH | 7.8 | 7.5 | 8.0 | 7.6 | 8.2 | 8.1 |
| Dissolved Oxygen (ppm) | 10.1 | 7.0 | 9.6 | 9.2 | 11.3 | 9.2 |
| Free Carbon dioxide (ppm) | Nil | 3.6 | Nil | 3.2 | Nil | 1.0 |
| Alkalinity (ppm) | 175.0 | 156.0 | 60.0 | 60.6 | 60.0 | 54.0 |

Table III : *Photosynthetic Production in Matatilla reservoir.*

| Season | Gross Primary Production ($mgC/m^3/h$) | Net Production ($mgC/m^3/h$) | Respiration ($mgC/m^3/h$) |
|---|---|---|---|
| Premonsoon | 187.5 | 41.66 | 175.0 |
| Monsoon | 125.0 | 10.4 | 170.0 |
| Postmonsoon | 135.4 | 31.25 | 125.0 |

Depth-wise (Table II) study of physico-chemical parameters indicates the presence of thermal and chemical stratification during premonsoon period. This stratification during summer is broken by influx of flood water. Similar thermal and chemical stratification were observed in other North Indian reservoirs like Rihand (Singh, 1978) and Getalsud (Pal, 1978). Many southern reservoirs like Bhavanisagar (Dorai-Rajah, 1950), Amaravathy (Sreenivasan, 1969), have also shown chemical stratification but difference between these reservoirs and Matatilla reservoir is that while the first two show an increase in bicarbonate from surface to bottom, the latter shows a decreasing trend during premonsoon. This decreasing trend may be due to the fact that on account of presence of carbondioxide, carbonate deposit remains absent at the bottom and thus during stratification further increases in carbondioxide in bottom layers, could not increase bicarbonate. Uniform concentration of alkalinity from surface to bottom during monsoon period may be due to proper mixing of water layers owing to flood.

Pahwa and Mehrotra (1966) stated that total alkalinity is directly correlated with pH. However, in the present case while pH varied within a narrow range, alkalinity showed marked seasonal fluctuations. Alkalinity was low in postmonsoon (winter), when water-level was high. But when the water level subsided in summer there was an increase in alkalinty. Again with the onset of monsoon rains, the alkalinity was reduced.

Depth-wise analysis (Table II) shows decrease in dissolved oxygen concentration with increase in depth during premonsoon, showing clinograde oxygen distribution. The high photosynthetic activity at surface and tropholytic activity at bottom lead to clinograde oxygen curve. Thus, the oxygen curve is an important paramenter for explaining the productive nature. This phenomena was not noticed in Matatilla during monsoon, may be due to mixing of water layers during flood. Banerjee (1957), listed 17 elements which are necessary for protoplasmic growth to sustain life. Only five of them viz. nitrogen, phosphorus, potassium, calcium and magnesium play an important role in aquatic productivity. In Matatilla reservoir, the concentration of phosphate was very poor, the maximum obtained being only 0.023 ppm. It was totally absent on many occasions. Similarly, nitrate concentration was also very poor in the reservoir water. The maximum concentration obtained was only 0.021 ppm. Moyle (1949) reported phosphates and nitrates concentration 0.1-0.2 ppm and 0.2-0.5 ppm respectively, as favourable for fish production. Calcium and magnesium concentrations were always high in Matatilla reservoir.

Zone-wise study of chemical parameters (Table II) indicate that the lotic zone is characterised by comparatively cooler temperature, high concentration of dissolved oxygen and alkalinity, therfore, is more productive than the other zones.

Primary productivity study indicates low to moderate production inspite of high value of alkalinity and hardness of reservoir water. Moyle (1949) opined that medium hard water

has high productivity potential. The low value of primary productivity in Matatilla reservoir may be due to low concentration of dissolved nutrients like phosphates and nitrates.

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