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ESTIMATION OF PRIMARY PRODUCTIVITY OF WATER RESERVOIR IN MONSOON SEASON AT UMMED SAGAR DAM SHAHPURA, BHILWARA OF RAJASTHAN

Dr. A.K. SIROYA[#] and Dr. NISHA SIROYA[@]

[#]Department of Zoology, S.P.S.B. Govt. College Shahpura, Bhilwara (Raj.)
[@]Department of Zoology, S. D. Govt. College Beawar (Rajasthan)
(Affiliated with- M.D.S. University Ajmer, Rajasthan, India 305001)

ABSTRACT

Primary production is the synthesis of organic materials like carbohydrates from inorganic compounds, such as Carbon dioxide and water. Primary productivity is a desirable attribute for environmental health of surface water, study of primary production is of great importance for all aspects viz. environmental domestic as well as fishery industry. In the present investigation, we explored the Gross primary production (GPP) of a water reservoir known as Ummedsagar dam situated at Shahpura, Bhilwara district of Rajasthan to evaluate the health of this water reservoir.

Key Words: *Primary production, environmental health and Water reservoir*

1.0 INTRODUCTION

Primary production is the synthesis of organic material like carbohydrates from inorganic compounds, such as Carbon dioxide and water. This is also known as carbon fixation: Carbon dioxide is fixed by photosynthesis and as well by chemosynthesis. Photosynthesis by phytoplankton accounts for the most primary production. The locally grown macroalgae, microphyto benthos, chemosynthetic microbes, and symbiotic associations also equally important in Carbon fixation. Primary productivity is a desirable attribute for the environmental health of surface waters (dams, rivers, lakes, estuaries and oceans) [Mir, A.Q. *et al* 2005] It is

nonetheless useful to define three components of primary production that can be estimated from measurements in closed systems: (Cullen, J. J. 2001)

- **Gross primary production** (GPP) is the rate of photosynthesis, not reduced for losses to excretion or to respiration in its various forms
- **Net primary production** (NPP) is gross primary production less losses to respiration by phytoplankton
- **Net community production** (NCP) is net primary production less losses to respiration by heterotrophic microorganisms and metazoans.

Hence the study of primary production is of great importance for all aspects like environmental, domestic supply as well as fishery industry. Shahpura is the sub-divisional headquarter of Bhilwara district of the Rajasthan state. Water is a prime natural resource, a basic human need like drinking and irrigation hence its use needs appropriate planning, development and management. In freshwater bodies, nutrients play a major role as their excesses lead the water body's ultraoligotropication to eutrophication.

2.0 STUDY AREA

The study area Ummed sagar dam is situated in Shahpura town, 55 km from Bhilwara. The Shahpura town is surrounded by a wall with four gates, it's a place of pilgrimage for the followers of *Ram Sanehi* sect founded amongst the Hindu in 1804. The sect has a holy shrine known as *Ram Dwara*. Pilgrims from all over the country visit this shrine throughout the year. In *Phalgun Shukla* (March-April) an annual fair known as *Phool Dol ka Mela* is held here for five days. There is a large palace complex in the northern part of Shahpura, which is surmounted by balconies, towers and cupolas. It offers beautiful views of the lake and the town from its upper terraces. Kesari Singh, Jorawar Singh and Pratap Singh Barahat were famous freedom fighters who belonged to Shahpura. Trimurti Smarak, *Barahat Ji Ki Haveli* and *Pivaniya Talab* are other important attractions here. Shahpura is also famous for the traditional art form of *Phad* painting.

Ummedsagar dam is a medium irrigation project constructed across the local nallah of the Banas catchment in the year 1917 by Raja Ummed Singh. Geographically, the dam is located 7.5 km from Shahpura towards the South of Tehsil Shahpura of Bhilwara district at 25°34'15.84" North latitude and 74°54'26.57" East longitude. The project has been designed for irrigation water supply for the Rabi season and in some cases for Kharif protection under the failure of the last rainfall spell of the Monsoon. The water reservoir benefits approximately 23 villages in the command area.

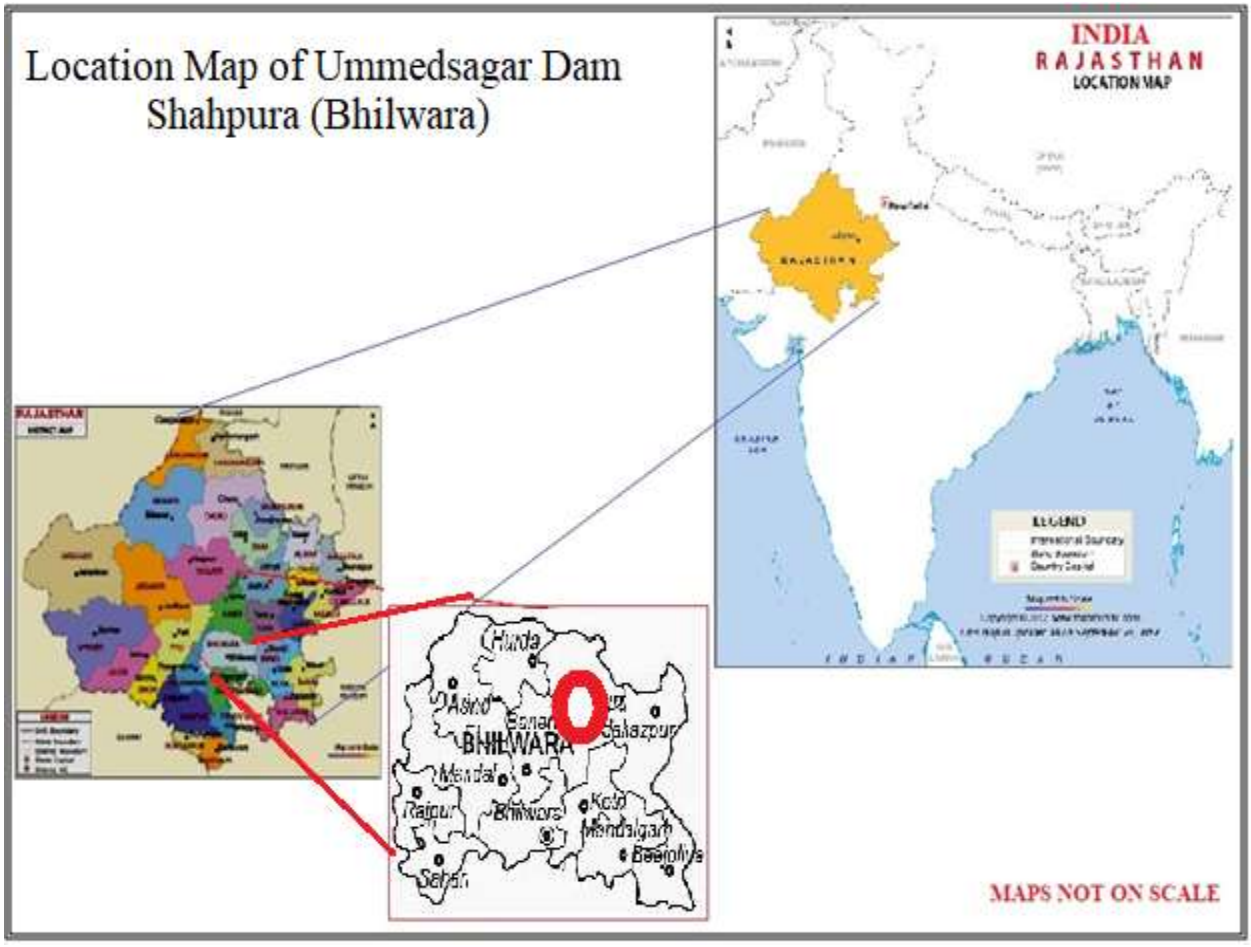

Figure: 01 Location map of Ummedsagar dam Shahpura (Bhilwara)

Figure: 01 Photograph of Ummedsagar dam Shahpura (Bhilwara) during monsoon

3.0 MATERIALS AND METHODS

Water samples were collected from 04 sites in the reservoir from July 2016 to September 2016. Gross primary productivity (GPP) was measured with the light-and-dark bottle method [Gupta B. P. (1982)]. In this method, a sample of water is placed into two bottles. One bottle is stored in the dark and the other in a lighted area. Without photosynthesis, only respiration can occur in the bottle stored in the dark. The dissolved oxygen (DO_2) sensor was used to measure the amount of dissolved oxygen in samples.

4.0 RESULTS AND DISCUSSION

In the course of the investigation, we filled two bottles with pond water containing only photosynthesizing organisms. This practice was repeated at four different locations of the reservoir to take different site samples then, we used a dissolved oxygen (DO_2) sensor to measure the amount of dissolved oxygen in each bottle. One bottle was put under a light and the second bottle was wrapped with aluminium foil to block all light and was put under the same

light. After 24 hours, pond water DO_2 in the two bottles was again measured. Average values for DO_2 are provided in the following table.

Table: 01 Average values for DO_2 of a water reservoir at Raipur

DO Measurements 24 hours	DO (mg/L = ppm)				
	Sample- 1	Sample- 2	Sample- 3	Sample- 4	AVERAGE
Light bottle initial (IL)	6.22	6.24	6.26	6.23	6.2375
Dark bottle initial (ID)	6.23	6.22	6.25	6.25	6.2475
Light bottle final (FL)	6.38	6.41	6.38	6.37	6.3850
Dark Bottle final (FD)	6.21	6.19	6.13	6.16	6.1725

So the Average values for DO_2 of this water reservoir are 6.2375 mg/L for Light bottle initial (IL) & 6.2475 mg/L for Dark bottle initial (ID), 6.3850mg/L for Light bottle final (FL) and 6.1725 mg/L for Dark Bottle final (FD) measured.

The phytoplankton and other elements in the water produce oxygen in the water bottle, but some oxygen disappears due to respiration. The latter is measured from the readings of the dark bottle, where only respiration takes place. Thus the oxygen produced by photosynthesis of enclosed organisms (representing a sample of the water body) can be known. However this oxygen production indicates net primary productivity only. From the DO difference in dark bottle oxygen consumed by the enclosed organisms can be obtained and when this respiration value is added to the oxygen production in the white bottle, a value for gross primary productivity is obtained.

Calculation of NPP (Final – Initial DO) Average

NPP = Light bottle final (FL) -Light bottle initial (IL)

Then NPP of the reservoir is 6.3850-6.2375 = **.1475 mg/L**

Calculation of GPP (Final DO – Final DB)

The light bottle is measuring NPP, because it allows for both photosynthesis and cellular respiration. The dark bottle measures Ra (Autotrophic respiration) because it only allows for respiration. Therefore, GPP can be calculated by rearranging the formula:

GPP = NPP + Ra (Autotrophic respiration)

Ra = Dark bottle initial (ID) - Dark bottle Final (FD)

Then Ra is 6.2475-6.1725 = .075 mg/L

Thus the GPP of reservoir is .1475 + .075 = .2225 mg/L for 24 hours

Means the Gross productivity of this water reservoir is good, not affected by anthropogenic and agricultural activities, showing less pollution as compared with the Gross productivity of some of the water bodies, adapted from Odum (1959), which are indicated as in given table-02:

Table: 02 The Gross productivity of some of the water bodies

	Water Source	**Gross productivity**
1	Open ocean (long term)	.005 mg/L/day
2	Shallow inshore water	.032 mg/L/day
3	Tidal estuaries	.044 mg/L/day
4	Coral reefs	.182 mg/L/day
5	Pond-with untreated sewage	.270 mg/L/day
6	Mass algal culture	.430 mg/L/day
7	Polluted stream	.570 mg/L/day

The amount of O_2 used in respiration is 0.075 mg O_2 / L, not -0.075 mg O_2 / L. Primary production is the rate of carbon fixation by photosynthesis. Based on the results, the dam is classified as oligotrophic from the eutrophic, oligotrophic and ultraoligotrophic categories.

The primary forcing variable is therefore light and availability of essential nutrients such as nitrogen. Temperature is another key factor that influences primary production. The physico-

chemical variables, transparency, pH, electrical conductivity, concentration of soluble nutrients and other anions and cations influence the productivity of water bodies.

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