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Seasonal variation in primary productivity of Som Kamla Amba reservoir of Dungarpur district, Rajasthan, India

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Abstract
Primary productivity provides information regarding to the amount of energy available to support biological component of aquatic ecosystem. The present investigation were aimed to understand the status of primary productivity of Som Kamla Amba Reservoirs of Dungarpur District, Rajasthan, India. The primary productivity has been determined by using standard 'Light and Dark bottle' method at every month in a period of one year i.e., 2015-16. The study results reveal that Primary productivity of Som Kamla Amba reservoir high and it support better growth biotic components like zooplanktons etc.

Keywords: Primary productivity, Seasonal variation, Som Kamla Amba reservoir, Dungarpur

1. Introduction
The flow of energy through any ecosystem starts with the fixation of sunlight by plants and other autotrophic organisms. In this way the plants accumulate which is called primary production. The rate at which this energy accumulates is called primary productivity. The total energy accumulated is gross primary production; however, since plants use some of this energy themselves, it is not available for the food web (Mitsch and Gosselink, 1993) [7]. Estimation of primary productivity is essential to understand food chain and food web (Chinnaiah and Madhu, 2010) [4], water quality (Wetzel, 2000) [15] and pollution study (Prabhakar *et al.*, 2009) [10]. The primary productivity of the aquatic ecosystem is adversely affected by anthropogenic activity. Odum and Barrett, 2008 [8] explained that the primary productivity is rate of conversion of solar energy into the organic matter by the process of photosynthetic activity and chemosynthetic activity by the biological component of the ecosystem. Several environmental biologist and ecologists from across the globe have laid emphasis on the role and significance of the primary productivity as a vital functional attribute of the biosphere (Westlake, 1963) [14]. Studies on Primary productivity of many aquatic ecosystems have been reported by earlier workers from world (Joseph and Shanthi, 2010; Patil and Chavan, 2010; Vasanthkumar and Kumar, 2011) [6, 9, 12]. The present study has been undertaken to analyze the seasonal variations of Primary productivity in Som Kamla Amba Reservoir of Dungarpur district of Rajasthan, India.

2. Materials and Methods
2.1 Study area
Som Kamla Amba Reservoir is situated in Aspur tehsil of Dungarpur, Rajasthan at 23^0-56'N Latitude and 74^0-02'E Longitude. The reservoir is extensively used for irrigation and fishery purposes.

Primary productivity
The primary productivity is determined by using standard "light and dark bottle" method in every month for a period of one year from February 2015 to January 2016. Primary productivity was measured at all the stations of the reservoir. For this purpose, glass stoppered black and white BOD bottles of 250 ml were used. In case of surface water samples, the bottles were suspended about 15 cm below the water line and in case of bottom, the bottles were suspended near the bottom, using thread and float, at the same depth from where the bottom water sample was collected. The incubation period was kept three hours. Oxygen (O_2) estimation in the BOD bottles were made following usual Winkler's method. The calculation was done as under:

(i) Gross Oxygen Production (GOP) mg l^{-1} = LB-DB
(ii) Net Oxygen Production (NOP) mg l^{-1} = LB – IB
(iii) Community Respiration (CR) mg l^{-1} = IB – DB
The values of gross and net primary productivity were calculated as follows:

(i)	Gross Primary Productivity (g C m^{-3} h^{-1}) =	GOP / 1.2 x h	x 0.375

(ii)	Net Primary productivity (g C m^{-3} h^{-1}) =	NOP / 1.2 x h	x 0.375

Where,
LB = Dissolved oxygen in light bottle
DB = Dissolved oxygen in dark bottle
IB = Dissolved oxygen in initial bottle
h = Duration of incubation or exposure
1.2 = A constant
0.375 = A factor value (1 g of oxygen is equal to 0.375 g carbon)

The observed Gross Primary Productivity (GPP), Net Primary Productivity (NPP) and Community Respiration (CR) in mg/l/hr were converted into gC/m3 /hr by multiplying these values with a factor of 0.375 as suggested by Benton and Werner 1972 [2].

3. Results

In the present study primary productivity of Som Kamla Amba reservoir has been determined. Seasonal record of Primary productivity recorded as Gross primary productivity, Net primary productivity and Community respiration during February 2015 to January 2016 is depicted in Table1 and 2.

Table 1: Seasonal record of Primary Productivity of surface water of Som Kamla Amba reservoir during February 2015 to January 2016

	Winter	Summer	Monsoon
GPP	0.22±0.03	0.24±0.01	0.22±0.02
NPP	0.17±0.02	0.17±0.03	0.14±0.01
CR	0.23±0.03	0.28±0.09	0.17±0.03

Table 2: Seasonal record of Primary Productivity of sub surface water of Som Kamla Amba reservoir during February 2015 to January 2016

	Winter	Summer	Monsoon
GPP	0.22±0.03	0.24±0.02	0.24±0.02
NPP	0.11±0.02	0.22±0.19	0.13±0.03
CR	0.34±0.10	0.38±0.01	0.34±0.12

GPP= Gross Primary Productivity, NPP= Net Primary Productivity, CR= Community Respiration,

Gross Primary Productivity (gC/m3/hr): Seasonal variation of Gross primary productivity in Som Kamla Amba reservoir showed lower in monsoon (0.22±0.02) and winter (0.22±0.03) in surface and subsurface water respectively. GPP is higher in summer season (0.24±0.01) in surface water and at sub surface water GPP is higher in summer and monsoon.
Net Primary Productivity (gC/m3/hr): Seasonal fluctuation at Som Kamla Amba reservoir showed low rate of production in monsoon season (0.14±0.01) and winter (0.11±0.02) at the surface and sub surface water respectively. NPP is higher in summer season (as 0.17±0.03 and 0.22±0.19) at both the surfaces of water.
Community Respiration (gC/m3/hr): Seasonal variation at Som Kamla Amba reservoir showed lower values were in monsoon (0.17±0.03) and winter (0.34±0.10) at surface and subsurface water respectively while higher values are observed in summer season as (0.28±0.09) and (0.38±0.01) at surface and subsurface water respectively.

4. Discussion

(A) Gross and Net primary productivity

Gross primary productivity is considered to be total photosynthetic activity any ecosystem. Net primary productivity is measurement of the rate of storage of organic material in the tissues of primary producers of the ecosystem after utilization of respiratory activity of the primary producers. Seasonal variations of GPP and NPP is minimized during monsoon in the reservoir and increased during the summer season of the study period. Mitsch and Gosselink (1993) [7] were reported that, the increased trend in the GPP of the aquatic ecosystem from northeast monsoon season to summer seasons and the GPP rate will be decreased during monsoon season. The higher values of GPP during the summer season may be availability and utilization of solar radiation leads to the high biomass of phytoplankton and algal blooms. The lower values of GPP and NPP is in monsoon season may be due to the minimum photoperiod of the seasons with low solar radiation, temperature coupled with less abundance of number phytoplankton. Mitsch and Gosselink (1993) [7] were studied on different aquatic ecosystems and reported that, high values of GPPP during summer season may be due to high assimilation of solar energy, while minimum production of GPP during monsoon season because of the inflow of more rainwater with high amount of turbidity in to the reservoir. Prabhakar *et al.*, (2009) [10] worked on reservoir at Pune and reported that, the GPP higher in northeast monsoon season and lower in southwest monsoon season. Clean water may permit more light to penetrate which in turn promote the higher values of GPP during northeast monsoon season. On other hand adding of more amounts of nutrients along with runoff water during monsoon season and later phase of northeast monsoon the water will be more clear water responsible for high production of GPP. The minimum rates of GPP production during the southwest monsoon season may be due to high amount of suspended particles present in the water. Radwan (2005) [11], also reported similar results while working with lakes of Uttarakhand state that, more abundance of phytoplankton are responsible for more production of GPP and lower density of phytoplankton showed less GPP production. Similar findings viz., low phytoplankton density and nutrient status and are responsible for low primary productivity in monsoon season and high GPP production during summer season could be coupled with high population of phytoplankton, maximum nutrient budget due to inflow of surface runoff from the surrounding area resulting in high GPP productivity. Similar results were also observed by Das (2002) [5] and Anjinappa (2002) [1]

(B) Community respiration (CR)

Community respiration is defined as reduction of NPP from GPP and later converted into releasing of CO2. The study results indicate that, Community respiration of the reservoir is low during the monsoon, while high values were obtained during summer season. The high community respiration of all biotic and abiotic compements organic matter reduces the content of dissolved oxygen (Vollenweider, 1974) [13]. This

examination supports the present investigation as dissolved oxygen was found low in concentration during the summer season. According to Prabhakar et al. 2009 [10], the rate of community respiration was high in summer season due to the effect of sewage water discharged from the diverse drains of surrounding area and this activity enhance the activities of various biological components particularly during the summer season by the utilization of decomposition of organic matter. Similar results are also found in the present reservoir.

5. Conclusion

The above study indicates that, the Som Kamla Amba reservoir exhibited high productivity during the study period and established a good food chain and food web. The high productivity of the reservoir supports the high abundance of zooplanktons and higher organisms of the reservoir.

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