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Seasonal variation in primary productivity of Nandeshwar Dam of Udaipur district, Rajasthan, India

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Abstract

Primary productivity gives information related to the amount of energy available to support bioactivities of the system. The present study is aimed to know the status of primary productivity of the Nandeshwar Dam of Udaipur, Rajasthan. It is determined by using standard 'Light and Dark bottle' method at an interval of 15 days in every month a period of two years (July 2015 to July 2016). Results indicate that Primary productivity of High productivity of Nandeshwar Dam favors better growth of zooplanktons.

Keywords: Primary productivity, nandeshwar dam, rajasthan

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^[4]. Estimation of primary productivity is essential to understand food chain and food web^[3], water quality^[8] and pollution study^[5]. The primary productivity of the aquatic ecosystem is adversely affected by anthropogenic activity. The overall productivity of a water body can easily be deduced from its primary productivity, which forms the backbone of the aquatic food chain Ahmed SH^[1] *et al.* It gives information related to support bioactivities of the system. According to Odum and Barrett^[6] the primary productivity of an ecosystem is the rate at which radiant energy is converted to organic substances by the photosynthetic and chemosynthetic activity of the producer organisms. The aquatic resources have been till date the potential source of organic production for the entire living organisms. Many ecologists of the world have laid emphasis on the importance of the primary productivity as an important functional attribute of the biosphere because of its controlling effects on the rate of multiplication and growth of the living organisms of the ecosystem^[7]. The present study has been undertaken to analyze the seasonal variations of Primary productivity in Nandeshwar dam of Udaipur district, Rajasthan.

Materials and Methods

Study area

Nandeshwar dam is situated in the Udaipur district of Rajasthan. It is 13 km away from the Udaipur city. Nandeshwar dam is located at latitudes 24°31'30"N and 73°38'00"E longitude. Water of dam is extensively used by people living in the vicinity of dam. The overflow of this dam goes to the Pichhola lake of Udaipur especially during monsoon. Water of the dam is used for irrigation and fisheries purposes.

Primary productivity

The primary productivity is determined by using standard "light and dark bottle" method of at an interval of 15 days in every month for a period of two years from July 2015 to July 2015. Primary productivity was measured at all the stations following light and dark bottles method. 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

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three hours. Oxygen (O₂) estimation in the BOD bottles was made following usual Winkler's method. The calculation was done as under:

1. Gross Oxygen Production (GOP) mg l⁻¹ = LB-DB
2. Net Oxygen Production (NOP) mg l⁻¹ = LB – IB
3. Community Respiration (CR) mg l⁻¹ = IB – DB

The values of gross and net primary productivity were calculated as follows:

$$(1) \text{ Gross Primary Productivity (g C m}^{-3} \text{ h}^{-1}) = \frac{\text{GOP}}{1.2 \times \text{h}} \times 0.375$$

$$(2) \text{ Net Primary productivity (g C m}^{-3} \text{ h}^{-1}) = \frac{\text{NOP}}{1.2 \times \text{h}} \times 0.375$$

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 g C m⁻³ h⁻¹ by multiplying these values by a factor of 0.375 as suggested by Benton AH [3] *et al.*

Results and Discussion

The seasonal variations of gross primary productivity (GPP), net primary productivity (NPP) and community respiration (CR) of Nandeshwer dam are given in the Tables 1 and 2. The mean, maximum, minimum, standard deviation and coefficient of variation percentage, in GPP, NPP and CR of different seasons are also presented.

Table 1: Annual record of different station in surface water of Nandeshwer dam during 2015-2016.

Season parameter	Mean	Min	Max	SD	CV (%)
GPP (gC/m ³ /hr)	0.22	0.17	0.27	0.04	16.06
NPP (gC/m ³ /hr)	0.13	0.08	0.20	0.03	21.05
CR (gC/m ³ /hr)	0.30	0.17	0.42	0.06	31.74

Table 2: Annual record of different station in Sub-surface water of Nandeshwer dam during 2015-2016.

Season parameter	Mean	Min	Max	SD	CV (%)
GPP (gC/m ³ /hr)	0.18	0.12	0.23	0.03	15.20
NPP (gC/m ³ /hr)	0.10	0.07	0.15	0.03	32.10
CR (gC/m ³ /hr)	0.27	0.10	0.42	0.10	39.10

GPP

In the present study, the mean value of gross primary productivity in the surface water of the Nandeshwer dam ranged between 0.173 to 0.268 g C m⁻³ h⁻¹ during the study period. While in the sub-surface water gross primary productivity variations were between 0.117 to 0.229 g C m⁻³ h⁻¹ during the study period. The overall average value of gross primary productivity in the dam at station A was highest followed by B and C. However, (Gupta 1991) found only (0.19 gC/m³/hr) GPP in the Daya reservoir. (Rajkumar 2005) also reported higher average GPP (0.45 g C m⁻³ h⁻¹) in Daya reservoir. (Mishra, *et al.*, 2012) have also reported higher

average GPP (0.64 g C/m³/h) in Goverdhan sagar.

NPP

In the present investigation the value of net primary productivity in the surface water of the Nandeshwer dam varied between 0.083 to 0.202 g C m⁻³ h⁻¹ during the study period. While in the sub-surface water net primary productivity variations were between 0.071 to 0.148 g C m⁻³ h⁻¹. Station B showed the highest overall average value of net primary productivity followed by A and C. (Rajkumar 2005) has reported an NPP value of 0.31 gC/m³/hr in the surface water of Daya reservoir. (Mishra, *et al.*, 2012) have recorded also (0.64 gC/m³/hr) NPP from Goverdhan sagar, Udaipur.

CR

Community respiration in the surface water of the Nandeshwer dam fluctuated 0.167 to 0.423 g C m⁻³ h⁻¹ during the study period. While in the sub-surface water community respiration variations were between 0.097 to 0.417 g C m⁻³ h⁻¹. The overall average value of community respiration in the dam at station A was highest followed by B and C. (Rajkumar 2005) has reported an NPP value of 0.31 gC/m³/hr in the surface water of Daya reservoir. Mishra *et al.*, (2012) have recorded also (0.64 gC/m³/hr) NPP from Goverdhan sagar, Udaipur.

Conclusion

It is observed from above results that most of the seasonal values of primary productivity of Nandeshwar lake, Udaipur. Hence it is concluded that the productivity of Nandeshwar dam is moderately productive. This productivity of Nandeshwar dam showed their food chain and food web is in good condition and it favors better growth of zooplanktons and fishes. It also indicates the water body is polluted and leads towards eutrophication. Moderate productivity of Nandeshwar dam may be due to shallowness of area which is more productive than deep water bodies in part due to nutrients regulating from sediments and extent of attached macrophyte growth.

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