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Seasonal variation in primary productivity of Manjalar Reservoir on WesternGhats, Tamil Nadu, India

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Abstract

The present study was carried out to study seasonal variation in primary productivity of Manjalar Reservoir in Western Ghats, Tamil Nadu. Water samples were collected at four sampling stations at the dam twice a month from January to December 2021. The primary productivity is in relation to physical and chemical parameters and gives information related to the amount of energy available to support the bioactivities of the ecosystem. It is determined by using the standard 'Light and Dark Bottle' method at an interval of 15 days in every month for a period of one year (Jan.–Dec. 2021). Results indicate the primary productivity of the high productivity of the Manjalar reservoir favours the growth of Plankton.

*Keywords**:** Primary productivity, Manjalar Dam, Seasons, Western Ghats*

Introduction

Water is the most important factor for all kinds of life. It is forms a medium of physical, chemical, transformations especially those of biological significance takes place. Water is an elixir of the body and it is a primary need of all living organisms. The increasing pace of developmental activities and extensive use of water resources are subjected to the quality and hydrobiology of freshwater resources (Gowri, P 2009).

Water resources have a have a special need for conservation, development, and management for suitable and sustainable utilization. Water quality is important for drinking, agriculture, industrial use, man-made activities, etc. The quality of surface water depends on the equilibrium between the physical, chemical, and biological characteristics of the surroundings, which change with seasonal and climatic conditions. The productivity of an aquatic regime is its capacity to support aquatic living organisms. Primary production refers to the amount of organic matter made from inorganic materials through the process of photosynthesis (Babar *et al.,* 2015).

Primary productivity is the process by which organisms make their own food, and their different water bodies has been investigated to assess the fish production potentialities of a water body and to formulate fishery management policies. Primary production of reservoirs helps to understand the tropic status and assess the fish production potential of aquatic ecosystems. Melack (1976). The flow of energy in any ecosystem starts with the fixation of sunlight by plants and other autotrophic organisms. In this way, the plants accumulate, which is called primary productivity. Chinnaiah B., Madhu V. (2010). Estimation of primary productivity is essential to understanding the food chain and food web. Gupta MC *et al.,* (1991).

Primary productivity is the process where organisms utilise inorganic substances to produce simple organic materials. It typically occurs through photosynthesis, and phytoplankton has a big role in removing carbon dioxide from an aquatic ecosystem (Hamdan *et al.,* 2018). The total energy for this gathering the gross primary production. Primary productivity is used to related the rate at which plants and their photosynthetic organisms is an ecosystem. Ahmed SH *et al.,* (1989). There are two aspects of primary productivity. **Gross productivity:** The entire photosynthetic production of organic compounds is an ecosystem. **Net productivity**: The organic materials that related to photosynthetic organisms in the ecosystem have used some of these compounds for their **Cellular energy** needs (cellular respiration). And their, effect of primary production is the principle for ecosystem food chains. The food chains in aquatic environments will be aided by increased phytoplankton productivity (Tailb *et al.,* 2022). Monitoring different freshwater systems is important for environmental sustainability (Lie *et al.,* 2018; Bakaeva *et al.,* 2021; and Talib, 2017). studied the phytoplankton primary production.

Many ecologists around the world have laid emphasis on the importance of primary productivity as an important factor in the growth of living organisms in the ecosystem. (Odum EP, 2008), Westlake *et al.*,(2014). There could be several reasons for the higher productivity in reservoirs. Some possible reasons could include a high nutrient concentration in the water due to agricultural runoff, a high level of sunlight exposure due to lake shading, and a large population of aquatic plants and algae that photosynthesize rapidly (Wyatt *et al.,* 2012). Additionally, the reservoir may have a diverse ecosystem with a high abundance of productivity and invertebrates that support the food chain and contribute to high GPP (Jeffres *et al.,* 2020). The primary productivity is in relation to the physical and chemical parameters of the aquatic ecosystem. It has been measured by several workers in various aquatic ecosystems around the world.

The present study has been undertaken to analyse the seasonal variations of primary productivity in Manjalar Reservoir on Western Ghats, in Tamil Nadu.

Study area

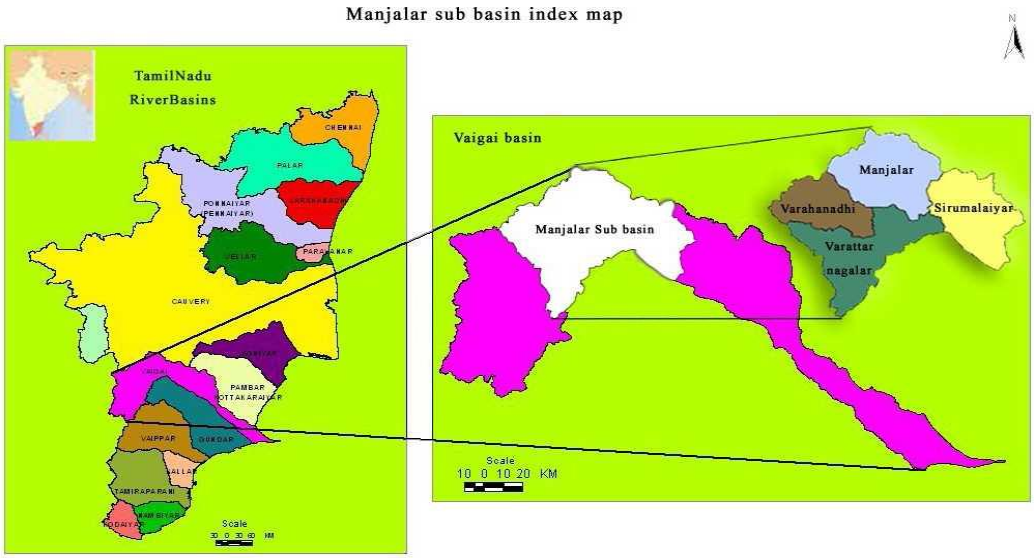


Fig: 1 Location map of Manjalar Reservoir

Methodology

The primary productivity is determined by using the standard "light and dark bottle'' method at an interval of 15 days in every month for a period of one year (January–December 2021). Primary productivity was measured at all stations following the light and dark bottle method. In this method, changes in dissolved oxygen content were measured using Winkler's method of light and dark bottle-incubated water samples. The BOD bottles were made following usual as an index of estimating the rate of photosynthesis by the phytoplankton and the respiration by microbial organisms present in the water. The rates of gross primary production, net primary production, and community respiration were calculated by the light and dark bottle method (Trivedy and Goel, 1986), APHA (2005), Production in terms of oxygen equivalent expressed in mg/l was converted to gramme carbon value by multiplying it by the factor 0.375. Productivity values were expressed as gC.m3.d-1. The calculation was done under:

Calculation

- Net Primary Productivity

$$O_2 \text{ mg L, 1 hr}^{-1} = \frac{DI-Di}{h}$$

- Gross Primary Productivity

$$O_2 \text{ mg L, 1 hr}^{-1} = \frac{DI-Dd}{h}$$

- Community Respiration

$$O_2 \text{ mg L, 1 hr}^{-1} = \frac{Di-Dd}{h}$$

Where

Di = Dissolved oxygen (DO) in the initial bottle in mg L^{-1}

DI = DO in the light bottle in mg L^{-1}

Dd= DO in the dark bottle in mg L^{-1}

H = Duration of exposure in hours.

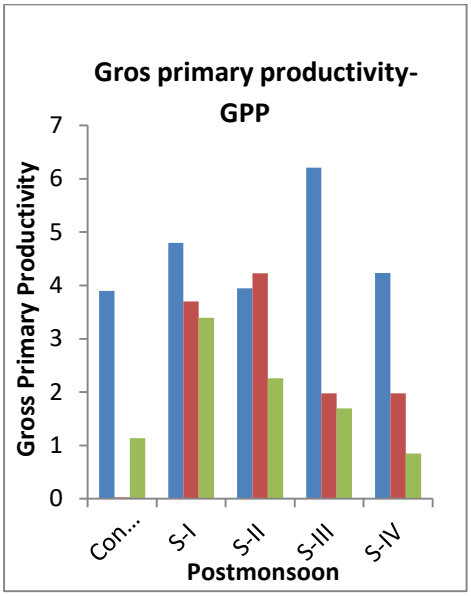
The observed Gross primary productivity (GPP), Net primary productivity (NPP) and Community Respiration rate (CR) in mg/l /hr were converted into g C $m^{-3}h^{-1}$ by multiplying these values by factor of 0.375 as suggested by Benton A.H *et al.,* (1972).

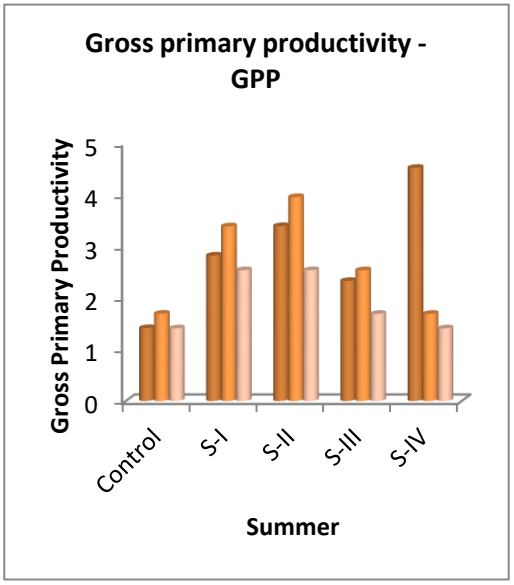
Result and Discussion

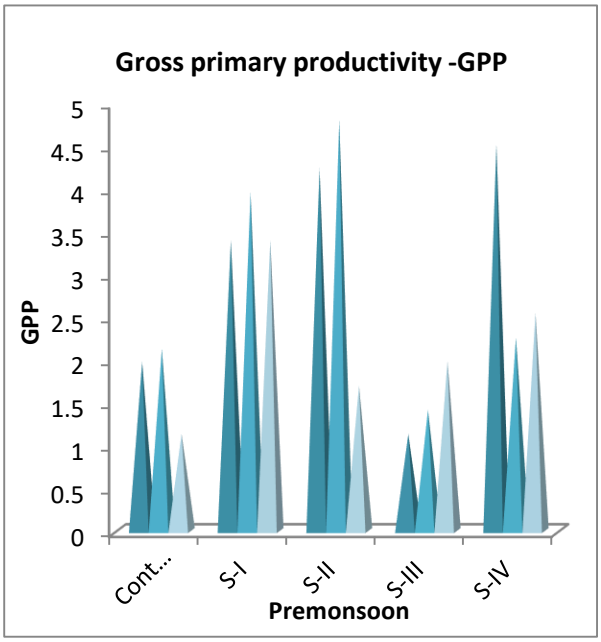
The seasonal variations of gross primary productivity (GPP), net primary productivity (NPP), and community respiration rate (CR) of Manjalar dam are given as maximum and minimum primary productivity for different seasons. The graph below is also presented. There are three types of productivity determinations. The higher value of gross primary productivity in early rainy and winter conditions was an indication of the presence of diverse

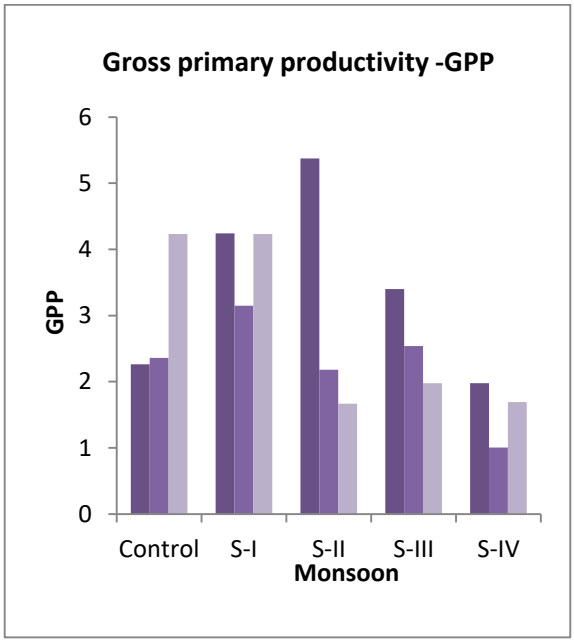
phytoplankton and a higher photosynthesis rate. A similar trend in gross primary productivity (GPP) has also been reported by Mandal *et al.*, (1999). Naz *et al.*, (2006).

Primary productivity- Gross primary productivity- 2021







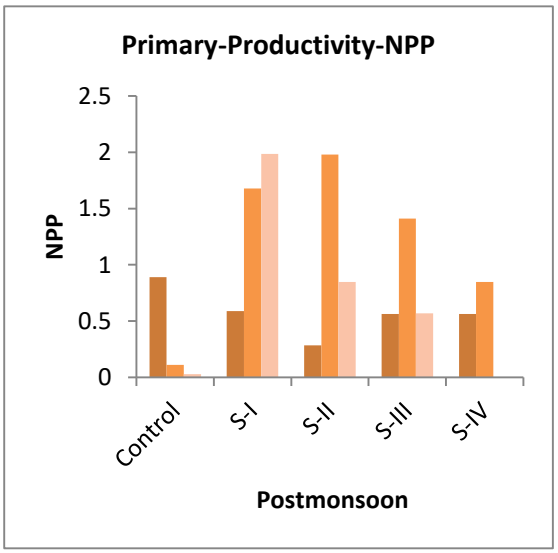


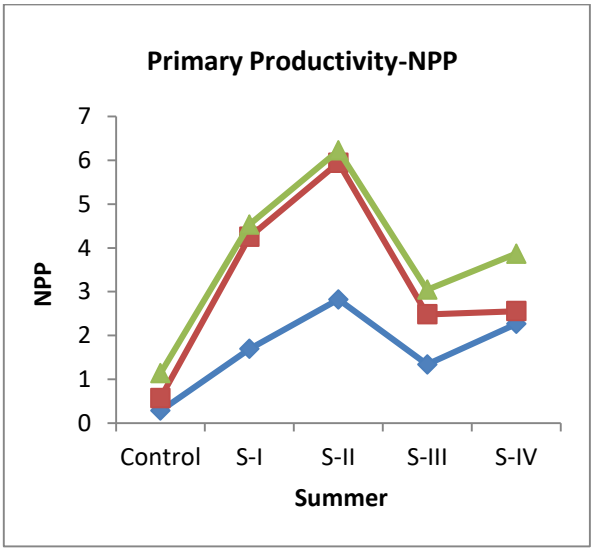
GPP

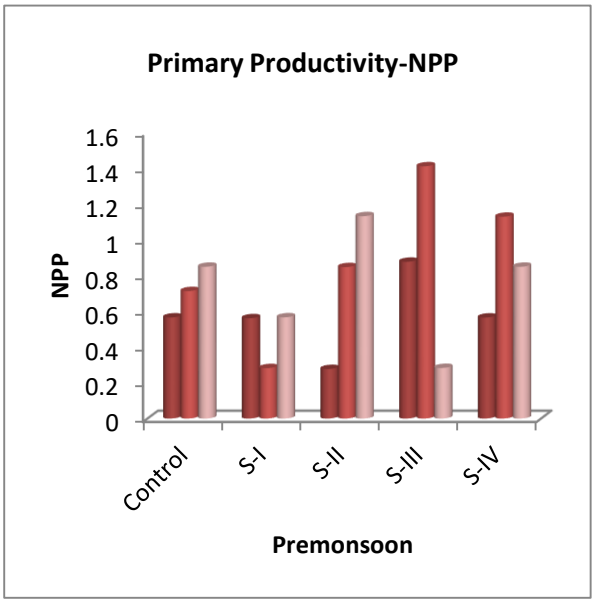
In the present study Was observed the primary productivity in the surface water of the Manjalar dam during the study period one year Gross Primary productivity the maximum GPP was observed during the months of the maximum Gross primary productivity was observed during the months of January 6.21 (S-III) and 4.8 5.6 (g cm^{-3} h^{-1}) (S-I) and the

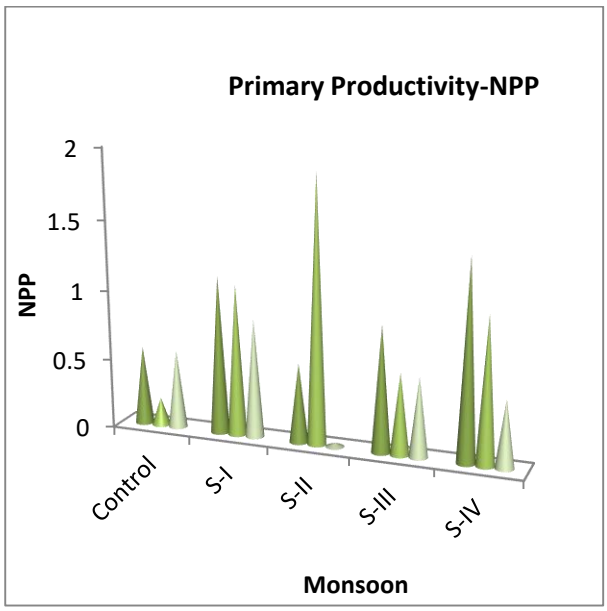
minimum during November 1.007 (g cm^{-3} h^{-1}) (S-IV) was recorded during 2021.(Mishra *et al.*, 2012) have also reported higher average GPP (5.6 g cm^{-3} h^{-1}) (Post monsoon) in Goverdhan sagar.

Net primary productivity







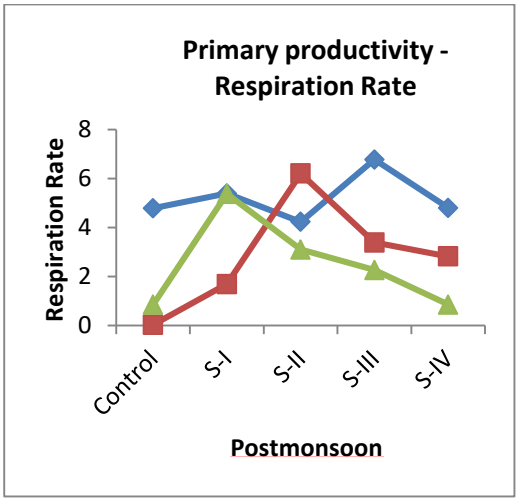


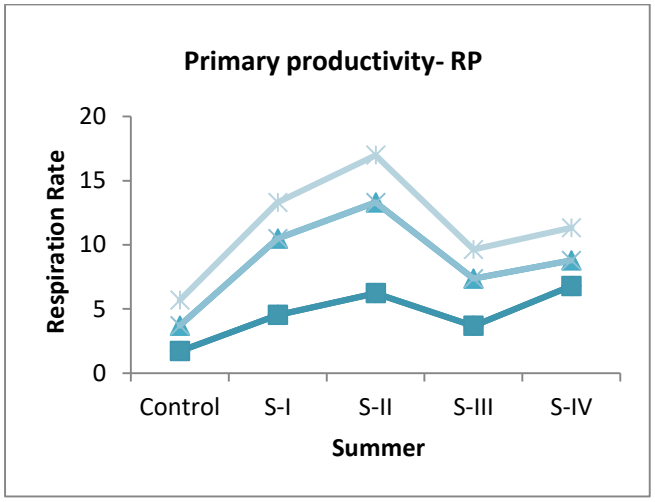
NPP

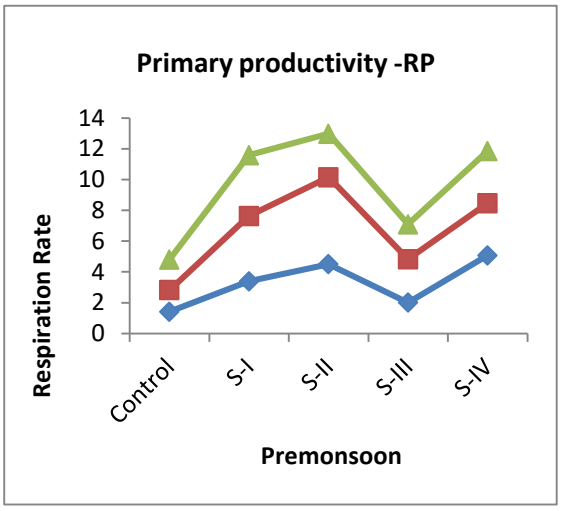
In the present study Was observed the primary productivity in the surface water of the Manjalar dam during the study period one year Net primary productivity the maximum Net primary productivity was observed during the months of May 3.12 (S-II) and (S-I) 2.55 (g

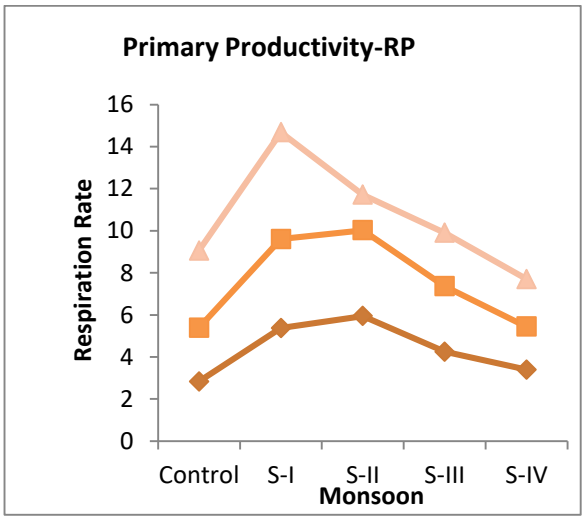
cm^{-3} h^{-1}) and minimum during March 0.004 (g cm^{-3} h^{-1}) (S-IV) was recorded during 2021, also reported an NPP value of 0.31 (g cm^{-3} h^{-1}) in the surface water of Daya reservoir.(Mishra *et al.*, 2012) have reported also 0.64 (g cm^{-3} h^{-1}) NPP from Goverdhan sagar, Udaipur.

Community Respiration Rate









CR

In the present study, it was observed the primary productivity in the surface water of the Manjalar dam during the study period one year Community Respiration rate (Rajkumar 2005**).** The maximum Respiration rate was observed during the months of May (7.08 and 5.949 g cm^{-3} h^{-1}) and (S-II and I) the minimum was recorded during February (1.689) (S-I) and September 2.263 (g cm^{-3} h^{-1}) (S-III) during the year 2021. Mishra *et al.*, (2012) have also recorded 0.31 (g cm^{-3} h^{-1}) CR From Goverdhan sagar, Udaipur.

Conclusion

This research work on the seasonal variation of reservoir water productivity is helpful for water management, enhances agricultural practices, increases the yield of the fishery industry, and will be helpful for the construction of better policies to ensure environmental sustainability. This information can be used to optimise water usage for agriculture, fishing, and other activities, leading to a more sustainable use of water resources. It is observed from the above results that most of the seasonal values of the primary productivity of Manjalar Dam. Hence, it was concluded that the productivity of Manjalar Dam showed their food chain and food web are in good condition and that it favours the growth of phytoplankton, zooplankton, and fish. It also indicates the water body is not polluted. The productivity of Manjalar dam means that the water is suitable for fish culture, irrigation, agriculture, and domestic purposes. Hence, it is recommended that regular monitoring be done to maintain water quality.

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