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Assessment of seasonal variation in primary productivity of Arjunsagar Reservoir, Uttar Pradesh, India

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Abstract
The Study was conducted in the Arjunsagar Reservoir of Dist. Mahoba U.P. in April 2017 to Jan 2018.Two sites and three seasons were selected for research i.e. Pre-monsoon, Post -monsoon and winter, Primary Productivity was calculated by light and dark bottle method and GPP, NPP & CR were calculated. The GPP was found Max in the month of Oct from S-1 is 1.187 and from S-2 1.156 mgC/l/d (1.1715±0.0155) and min in month of May 0.025 mgC/l/d from S-1 and June from S-2 0.025 mgC/l/d (0.3435±0.0625). NPP was max in the month of Oct from S-11.0931 & in Sep from S-2 1.062 (1.062±.031) and min in month of June from site S-1 0.062& S-2 is.184 (0.123±.061) respectively, where as CR was found max in May from site S-1 is .937 & in Jan S-2 is 0.312 mgC/l/d (0.4995±.4375) and found min in Sep from S-1 0.031 and were S-2 is 0.062 (0.062±0.031) in month of May and June.

Keywords: GPP, NPP, CR, Reservoir

Introduction
Primary Productivity of a reservoir indicates the health of water body. A healthy aquatic ecosystem reflects the fish production which connected with the primary productivity. Primary Productivity is an important biological phenomenon in aquatic environment upon which entire diverse array of life depends directly or indirectly. Primary Productivity is the major component for the fish production and the potential of fish production can be estimated by primary production which is influenced by biotic as well as abiotic interaction. In aquatic body primary production gives information relating the amount of energy available to support bioactivity of the system (Vollenweider 1969) [2].

Primary Productivity is a biological phenomenon in freshwater ecosystem. The flow of energy in any kind of ecosystem must begin by the complex biological process of trapping of solar energy by primary producers and other creatures so called autotrophic organisms. Through photosynthetic process the primary producers are able to store the food material which is known as primary production and the rate of this energy accumulates is known to be primary productivity. Among the accumulate energy, the producers are utilize the some part of energy therefore the total energy is not available for the food web (Mitsch and Gosselink, 1993) [3]. Nutrient enrichment affects in the population of phytoplankton and also it will become the vast changes directly in the food web of aquatic ecosystem.

Each and every Species community has an important role in primary production processes and ecosystem functioning. Measurement of primary production or photosynthesis is helpful to understand the trophic status and to assess the fish production potential of aquatic ecosystem. McConnell *et al*., (1988) [4], Oglesby, R. T. (1977) [5]. To estimate the total bio-activity of a reservoir it is necessary to determine the magnitude of primary production Prasad, D. Y. (1990) [6]. The study of primary production in lakes is fundamental to understand both water quality and fisheries Wondie, A *et al*., (2007) [7].

Uttar Pradesh is India's most populous state, as well as the world's most populous sub-national entity state. It is located in the northern part of India between 24"to 31°N and77°Eto 84"E.The state has an area of 243,286 km^2. Uttar Pradesh covers a large part of the highly fertile and densely populated upper Gangetic plain.

The larger Gangetic plain in the north includes the Ganga-Yamuna Doads; the Ghaghra plains; the Ganga plains and the Terai. Main revers of Uttar Pradesh are the Ganga and its tributaries *viz*., the Yamuna, Ramganga, Gomti and Ghagra. In recent years, some of the northern and southern tributaries of Ganga and their minor feeder streams have been tamed, creating a few reservoirs. Approximately 79% of reservoirs belonged to small category, followed by medium reservoirs (19%) and four large reservoirs. According to the water expanse under each category, about half of the area is under large reservoirs followed by over 35% under medium and only 15%under small reservoirs.

2. Material Methods

2.1 Study Area

The Study was conducted in the Arjunsagar Reservoir District Mahoba Uttar Pradesh in April 2017 to January 2018.Two site of Arjunsagar reservoir (basin-Ganga) were selected during the tenure of experiment Site-1 latitude 28.382N and longitude 79.668E and Site -2 latitude 28.391N and longitude 79.696E and Maximum Height of reservoir is 88 m, Length is 5200m and the total catchment area was 285 km^2 respectively.

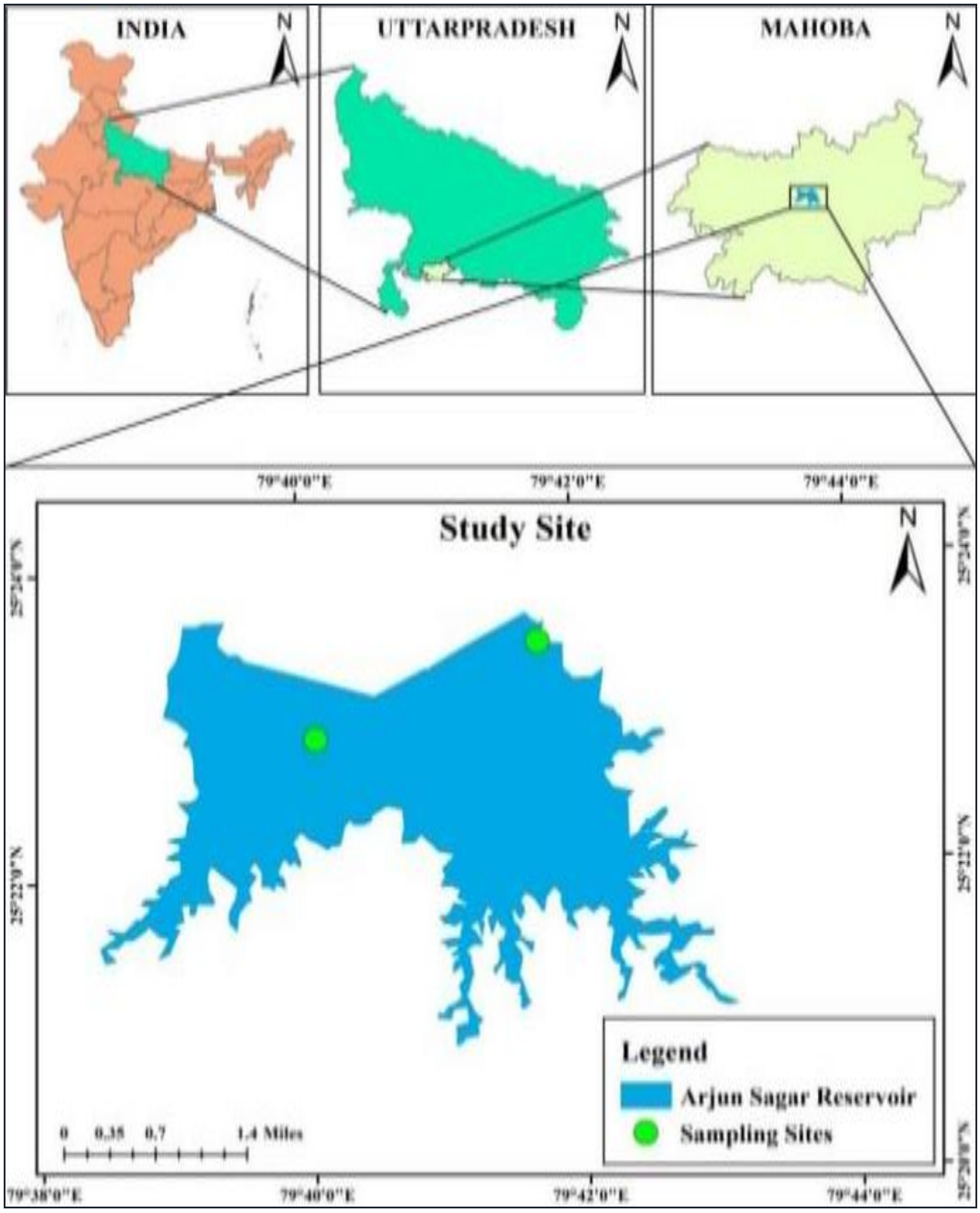

Fig 1: Picture Showing Map of Arjunsagar Reservoir along with latitude and longitude

2.2 Estimation of Primary Productivity

The present study investigates the monthly variation in primary productivity of Arjun Reservoir at two sites during April 2017 to January 2018. Primary productivity was estimated by 'Light and Dark Bottle' method.

The primary productivity has been expressed as gross primary productivity (GPP) and net primary productivity (NPP), and community respiration (CR).

Calculations for Primary Productivity

Initial DO = IB mg/L

Light bottle DO after incubation period (1 day) =LB mg /L

Dark bottle DO after incubation period = DB mg/L

t = time

1. Gross photosynthesis = LB-DB mg/L.
2. Net photosynthesis = LB – IB mg/L
3. Respiration = IB – DB mg/L

Therefore Primary Productivity can be calculated by the formula and expressed as mgC/l/day
Gross Primary Productivity = LB-DB × 0.375 / t
Net Primary Productivity = LB-IB × 0.375/ t
Community respiration rate = IB-DB × 0.375 / t

Result and Discussion
The productivity of Arjunsagar reservoir from site-1 and site-2 (S-1, S-2) calculated in term of Gross primary productivity (GPP), Net primary productivity (NPP) and Community respiration (CRR). Monthly and seasonal variation records site wise were calculated and depicted in table number 1, 2, 3 and 4 respectively.

Gross Primary Productivity
The result contemplated that the site wise GPP mean value was found in between0.3435±0.0625 to1.1715±0.0155 mgC/l/d (minimum to maximum) in Pre-monsoo, post-monsoon and winter season. Maximum GPP was found during October from S-1 and S-2 is 1.187 mgC/l/d and 1.156 mgC/l/d and minimum in month of May 0.025 mgC/l/d from S-1 and June from S-2 0.025mgC/l/d.In this investigation there is gradually decrease in GPP from winter season and gradually increase from the Pre-Monsoon season.

Net Primary Productivity
Whereas site wise NPP mean values varies 0.123±.0612 and 1.062±.031 (minimum to maximum) NPP was maximum in the month of October from S-11.0931 & in September from S-2 1.062and minimum in month of June from site S-1 0.062& S-2 is0.184 respectively.

CR
Respiration rate was found minimum in month of September from S-10.031 and were S-2 is 0.062 in month of May and June and CR was found maximum in May from site S-1 is .937 & in Jan S-2 is 0.312 mgC/l/d. Site wise mean value was found0.062±0.031 to 0.4995±.4375 in month of May September and December.

Table 1: Season Variation in Gross Primary Productivity (mgC/l/d)

S. No	Month	From Site S1	FromSite S2	Mean ±SD
1.	April	0.406	0.281	0.3435±0.0625
2.	May	0.25	0.437	0.3435±0.0935
3.	June	0.312	0.25	0.281±0.031
4.	September	1.031	1.156	1.0935±0.0625
5.	October	1.187	1.156	1.1715±0.0155
6.	November	1.093	1.125	1.109±0.016
7.	December	0.968	0.937	0.9525±0.0155
8.	January	0.968	0.687	0.8275±0.1405

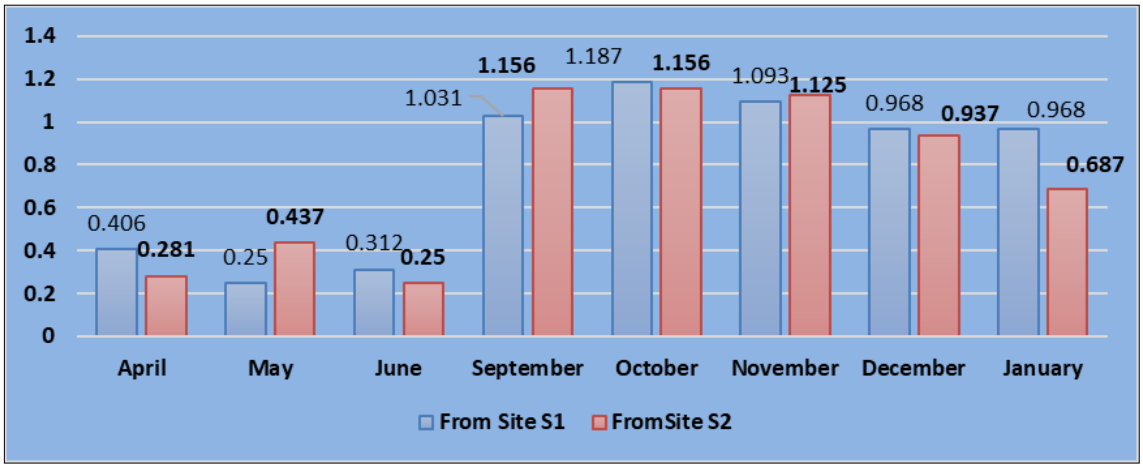

Fig 1: Gross Primary Productivity (mgC/l/d)

Table 2: Season Variation in Net Primary Productivity (mgC/l/d)

S. No	Month	From Site S1	From SiteS2	Mean ±SD
1.	April	0.281	0.218	0.2495±0.0315
2.	May	0.187	0.375	0.281±0.094
3.	June	0.062	0.184	0.123±0.061
4.	September	1	1.062	1.031±0.031
5.	October	1.093	1.031	1.062±0.031
6.	November	1.031	0.968	0.9995±0.0315
7.	December	0.843	0.687	0.765±0.078
8.	January	0.593	0.375	0.484±0.109

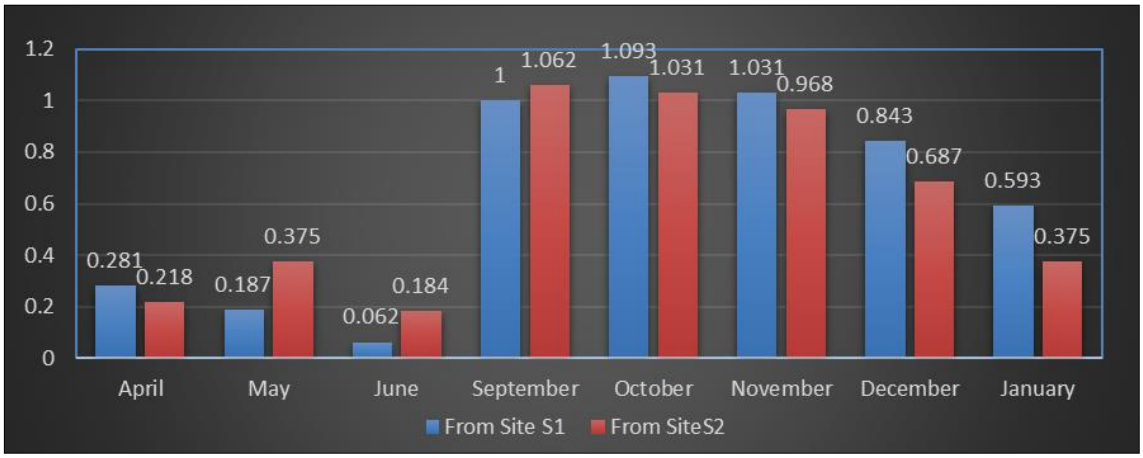

Fig 2: Net Primary Productivity

Table 3: Season Variation in RR (mgC/l/d)

S. No	Month	From Site S1	From SiteS2	Mean ±SD
1.	April	0.125	0.065	0.095±0.03
2.	May	0.937	0.062	0.4995±0.4375
3.	June	0.093	0.062	0.0775±0.0155
4.	September	0.031	0.093	0.062±0.031
5.	October	0.093	0.125	0.109±0.016
6.	November	0.062	0.156	0.109±0.047
7.	December	0.125	0.25	0.1875±0.0625
8.	January	0.375	0.312	0.3435±0.0315

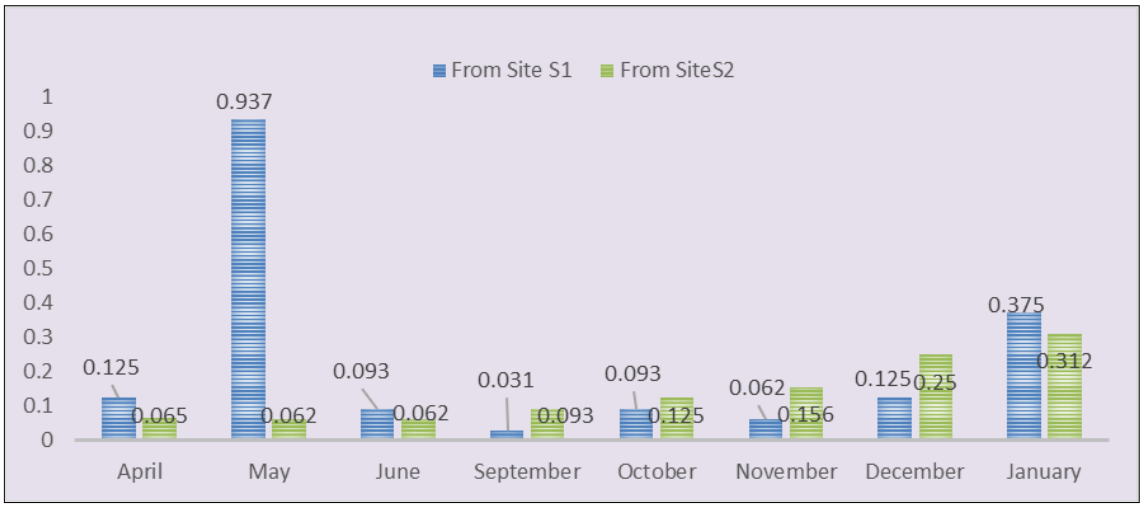

Fig 3: CR

Table 4: Showing the seasonal variation in productivity of Arjunsagar Reservoir on site S1 and S2

Season	Month	GPP				NPP				CRR			
		S1	S2	Mean	SD	S1	S2	Mean	SD	S1	S2	Mean	SD
Pre Monsoon	Apr	0.406	0.281	0.3435	0.0625	0.281	0.218	0.2495	0.0315	0.125	0.065	0.095	0.03
	May	0.25	0.437	0.3435	0.0935	0.187	0.375	0.281	0.094	0.937	0.062	0.4995	0.4375
	June	0.312	0.25	0.281	0.031	0.062	0.184	0.123	0.061	0.093	0.062	0.0775	0.0155
Post Monsoon	Sep	1.031	1.156	1.0935	0.0625	1	1.062	1.031	0.031	0.031	0.093	0.062	0.031
	Oct	1.187	1.156	1.1715	0.0155	1.093	1.031	1.062	0.031	0.093	0.125	0.109	0.016
Winter	Nov	1.093	1.125	1.109	0.016	1.031	0.968	0.9995	0.0315	0.062	0.156	0.109	0.047
	Dec	0.968	0.937	0.9525	0.0155	0.843	0.687	0.765	0.078	0.125	0.25	0.1875	0.0625
	Jan	0.968	0.687	0.8275	0.1405	0.593	0.375	0.484	0.109	0.375	0.312	0.3435	0.0315

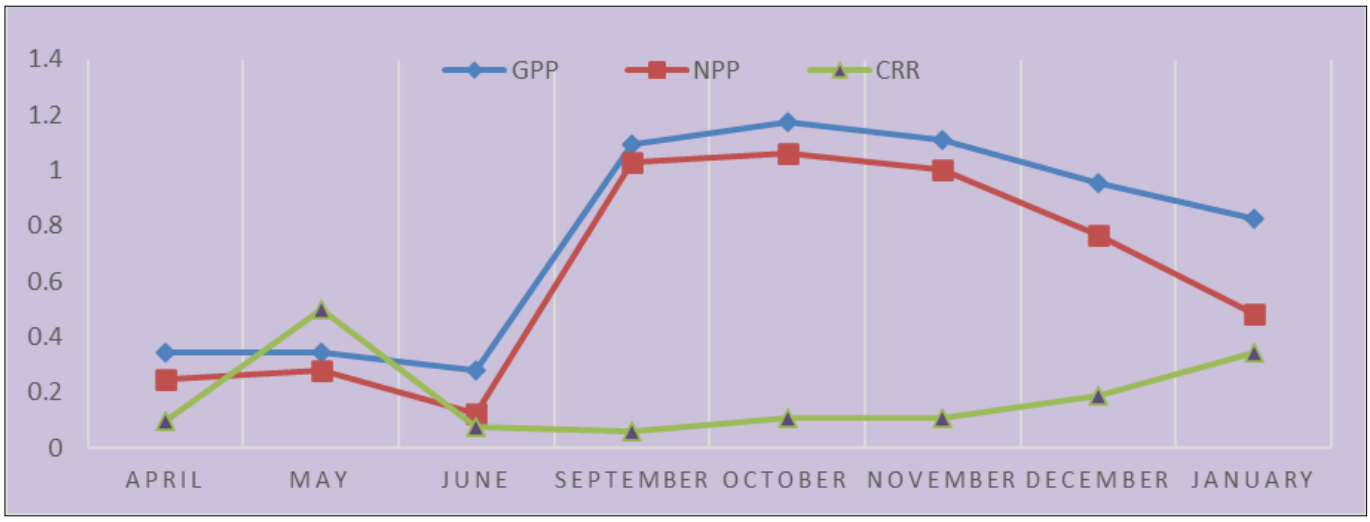

Fig 4: GPP, NPP CR

Investigation show that the seasonal-wise variation in GPP was maximum in the post monsoon season and minimum pre monsoon season or gradually decreasing during winter season, whereas NPP was maximum in rainy season and post monsoon season and minimum in June and the community respiration was maximum in month of January season and minimum in post and pre monsoon season from the reservoir sites S-1 and S-2.And there is no such a vast difference between occur in sites S-1 & S-2.

Several researcher shows a similar investigations Barbar *et al*. (2015) [8], shows highest GPP and NPP in January to may and decline from June to December. It further showed gradual increase from February to June. Meera and Nadan (2010) [9] reported maximum GPP &NPP in month of November and Nil in September. Similar trends of GPP has been also reported from Bhouyian and Das (1985) [11] and Mandal *et al*., (1999) [10] shows high value in month of early rainy and winter season was the indication of presence of diverse phytoplankton and higher photosynthesis rate. Namrata Pawaiya *et al*., (2018) [12]. The result indicates that productivity is greater than respiration it shows positive relationship. This studied have similar and different results from the other investigators it is due to the climate changes, but GPP, NPP and CR values record indicated that the reservoir water is clean and light penetration might have favored growth of aquatic flora that ultimately favored the primary productivity.

4. Conclusion

This study concluded that the productivity of Arjunsagar reservoir is moderately productive it showed the food chain and food web are in good state and it also indicates higher productivity nature of the ecosystem and therefore is likely to be a potential source of fish production for commercial purpose.

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