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ESTIMATION OF PRIMARY PRODUCTIVITY OF WATER RESERVOIR IN MONSOON SEASON AT LAMANA DISTRICT AJMER (RAJASTHAN)

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ABSTRACT

Earth's aquatic systems have been conceptualized as the cradle of life, stretching far back in history. These vital aquatic systems generally fall into two main realms: aquatic and marine. Now, if you want to really get into the fascinating world of water's miraculous systems, visualizing them through the disciplines of limnology (which is the study of inland waters) is surprisingly insightful. In these soluble water environments, water is constantly influenced by many physical and chemical factors. As these factors emerge-and subside, they directly affect the records and positions that live there, influencing their number and diversity.

A very important principle has been formulated as primary. It is essentially made up of organic matter, substances such as carbohydrates, carbon dioxide, and water. The rate at which this happens, called primary primordial, is a great indication of the spiritual health of the water body. This is because studying primary production is not only important for understanding the environment, but also for fisheries such as fishing. In our current work, we are taking a closer look at the Gross Primary Production (GPP) of a water reservoir of Lamana located in the Ajmer districts of Rajasthan. Our goal is to use this information to determine if this particular habitat is healthy.

Key Words: Carbon dioxide, Primary production and Water reservoir

1.0 INTRODUCTION

Primary production is essentially the creation of organic stuff, like carbohydrates, from inorganic ingredients such as carbon dioxide and water. Think of it as nature's way of cooking up basic sustenance. This remarkable feat is also referred to as carbon fixation, because it's all about taking that carbon dioxide and integrating it into new forms. The primary methods for this are photosynthesis (using light energy) and chemosynthesis (using chemical energy). Most of this primary production, especially in aquatic environments, is accomplished by tiny, light-harvesting organisms called phytoplankton. However, other players are equally vital in fixing carbon, including: Macroalgae (larger seaweeds), Microphyto benthos (microscopic plants living on the bottom), Chemosynthetic microbes (microbes that use chemical reactions for energy) and Symbiotic associations (organisms working together for mutual benefit)

As documented by Mir, A.Q. *et al* in 2005, a high rate of primary productivity is a positive indicator for the health of surface waters, whether they are dams, rivers, lakes, estuaries, or oceans. To better understand this process, it's useful to break primary production down into three measurable components, as defined by Cullen, J. J. in 2001:

Gross Primary Production (GPP): This is the total rate of photosynthesis, without subtracting any losses from the organisms themselves, such as excretion or respiration. It's the full output.

Net Primary Production (NPP): This is the GPP minus any organic material lost due to respiration by the phytoplankton themselves. It's what's left over after the primary producers use some for their own life processes.

Net Community Production (NCP): This is the NPP minus the organic material consumed through respiration by other organisms in the ecosystem, such as heterotrophic microorganisms and multi-celled animals. It represents the net gain of organic matter for the entire community. Therefore, the study of primary production holds immense significance for all aspects of our shared environment, including agricultural endeavors.

On a related note, in the region of Lamana, which is a Gram Panchayat headquarter in the Ajmer district of Rajasthan, water is recognized as a critical natural resource. It is a fundamental requirement for all biological life forms and a valuable asset for any region. Thus, the effective planning, development, and management of water resources are paramount. Within freshwater systems, nutrients play a crucial role. However, an excess of these nutrients can lead to the undesirable process of eutrophication, which can severely impact the health of a water reservoir.

2.0 MATERIALS AND METHODS

Water samples were collected from July to September 2023, the samples were collected from four designated sites within the reservoir. Our objective was to quantify the gross primary productivity (GPP) on a monthly basis. To achieve this, we employed a well-established technique known as the light and dark bottle method, a protocol outlined by Gupta, B. P. in 1982. This method is elegantly simple: A water sample is divided and placed into two identical containers, or "bottles." One bottle is then sealed and stored in total darkness, preventing any light from reaching it. In this environment, only respiration—the consumption of organic matter—can occur. The other bottle is placed in an area exposed to light, allowing both photosynthesis (the production of organic matter) and respiration to take place.

To precisely measure the changes occurring within these bottles, we utilized a dissolved oxygen (DO_2) sensor. This sensor allowed us to accurately determine the amount of oxygen present in each sample, providing the crucial data needed to calculate GPP.

3.0 STUDY AREA

Lamana is a village located in the Ajmer district of the Rajasthan state in India. If you're traveling along National Highway No. 8, you'll find it right there. It's also nestled quite close to the impressive Aravalli mountain range. To be precise, Lamana is situated at a latitude of 26.2399 degrees North and a longitude of 74.4784 degrees East. Its elevation is 479.48 meters above mean sea level, placing it in the northeast region of this planet. The satellite view of the water reservoir is shown in the figure- 01 and location map in figure-02.

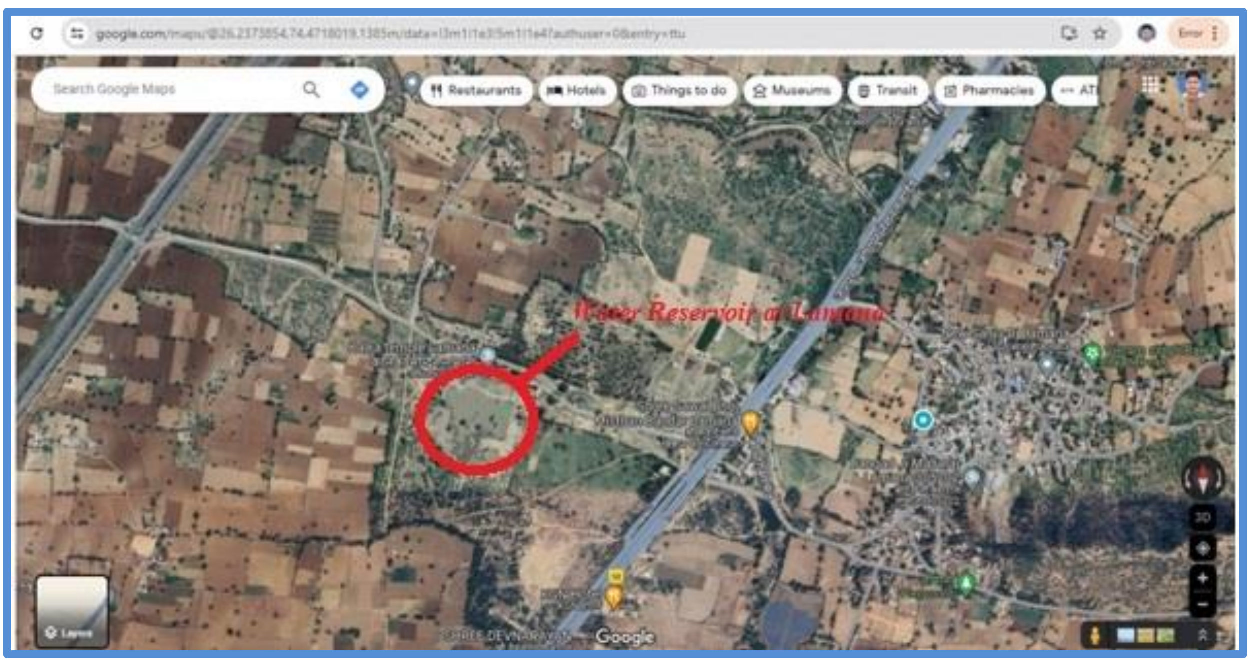

Figure- 01 Satellite View of water reservoir at Lamana, District Ajmer

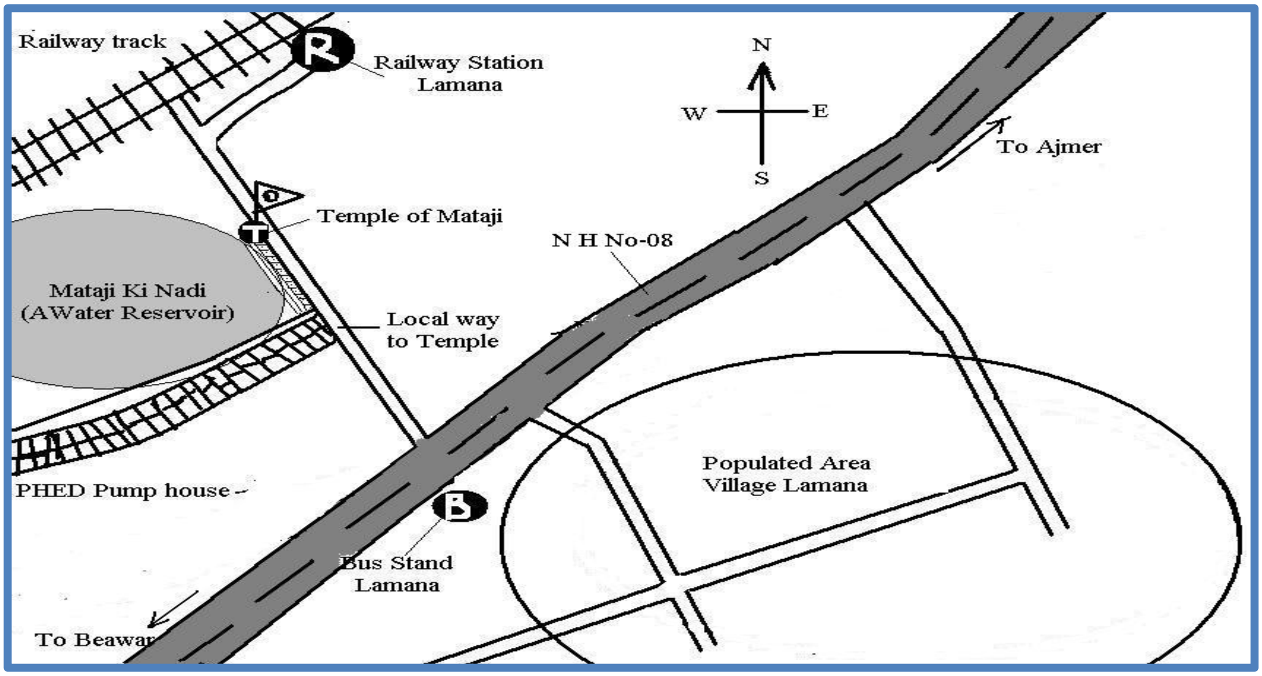

Fig.2 Location map of water reservoir at Lamana, District Ajmer

4.0 RESULTS AND DISCUSSION

In the course of investigation, we executed a precise procedure involving two specialized containers, which we refer to as "bottles." Each bottle was filled with water directly from the reservoir, containing the essential photosynthesizing organisms. To ensure a comprehensive understanding of the reservoir's variations, this procedure was meticulously replicated at three distinct locations within the reservoir, allowing us to acquire diverse site samples. Following the initial filling, we deployed a highly sensitive dissolved oxygen (DO_2) sensor. This instrument allowed us to precisely measure the initial quantity of dissolved oxygen present within each bottle. The bottles were then subjected to specific light conditions for a 24-hour cycle:

Light Bottle: One bottle was placed directly under a light source, permitting the process of photosynthesis to occur.

Dark Bottle: The second bottle was completely enveloped in aluminum foil to meticulously block all incoming light. Crucially, this "dark bottle" was placed under the same light source as the first, ensuring that temperature and other ambient factors were consistent, isolating the effect of light.

After the 24-hour period had elapsed, the dissolved oxygen levels within both the light and dark bottles were measured again using the DO2 sensor. The average values of this measured data, compiled on a monthly basis for dissolved oxygen, NPP and GPP are provided in the subsequent data tables-01.

Table-01 Productivity data of water reservoir at Lamana, District Ajmer

DO Measurements (24 hours)	Dissolves Oxygen (mg/L = ppm)			
	Jul-23	Aug-23	Sep-23	AVERAGE
Light bottle initial (IL)	6.20	6.30	6.40	6.30
Dark bottle initial (ID)	6.20	6.30	6.40	6.30
Light bottle final (FL)	6.35	6.51	6.64	6.50
Dark Bottle final (FD)	6.12	6.23	6.35	6.23
NPP = FL - IL	**0.15**	**0.21**	**0.24**	**0.20**
Ra (Autotrophic respiration)= ID - FD	0.08	0.07	0.05	0.07
GPP = NPP + Ra	**0.23**	**0.28**	**0.29**	**0.27**

So the Average values for DO_2 of this water reservoir are 6.30 mg/L for Light bottle initial (IL) & Dark bottle initial (ID), 6.50 mg/L for Light bottle final (FL) and 6.23 mg/L for Dark Bottle final (FD) measured.

The phytoplankton and other organisms in the water create oxygen. But they also use some of it up through respiration. We can measure this 'used up' oxygen by looking at a dark bottle, where only respiration occurs. This helps us understand how much oxygen is truly produced through photosynthesis in the water. What we initially measure is just the net primary productivity. To get the full gross primary productivity, we take the oxygen consumed in the dark bottle (from respiration) and add it to the oxygen produced in the 'white' bottle. This gives us the total amount of oxygen made.

Calculation of Average NPP (Final – Initial DO)

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

Then NPP of reservoir is 6.50-6.30 = **.20 mg/L**

Calculation of Average 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 6.30-6.23 = .07 mg/L

Thus the GPP of reservoir is .20 + .07 = .27 mg/L for 24 hours

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

Open ocean (long term)	:	.005 mg/L/day
Shallow inshore water	:	.032 mg/L/day
Tidal estuaries	:	.044 mg/L/day
Coral reefs	:	.182 mg/L/day
Pond-with untreated sewage	:	.270 mg/L/day
Mass algal culture	:	.430 mg/L/day
Polluted stream	:	.570 mg/L/day

Primary production is the rate of carbon fixation by photosynthesis. 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.

5.0 CONCLUSION

The above study results indicate that, the water reservoir at Lamana is exhibited high productivity during the study period and established a good food chain and food web. Between July and September, there was a noticeable increase in all sorts of plant life: soft, leafy greens, sparser vegetation, bushy shrubs, and even the broadleaf trees that shed their leaves. This surge in greenery directly caused the water body's primary production to rise. The high productivity of the reservoir supports the high abundance of zooplanktons and higher organisms of the reservoirs. Based on these positive findings, it's recommended to continue monitoring the Lamana reservoir to maintain its current healthy and productive state. Focus should be on-Sustaining the surrounding terrestrial vegetation and Regular water quality assessments. This will help detect any potential imbalances early on and ensure the ecosystem remains stable and thriving.

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