Biological Productivity of Wetlands of Mithila Plain

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Abstract:

The river basins in north Bihar are replete with a series of shallow water bodies, locally called *wetland* spread over 46000 hac. These biologically sensitive and fragile areas are repository of a variety of freshwater and ornamental fishes. These *wetlands* provide a basis to the capture fisheries with a production rate of 40-50 kg/ha/yr. Greater colonization of macrophytes and habitat destruction hinders the fisheries. Despite having a vast potential of fish production the state lags behind in meeting the total fish demand. As against an annual requirement of 5.80 lac metric tonnes the state produces only 4 lac metric tonnes. Similarly the state produces only 350 million fish seeds as against the demand of 800 million fish seeds.

However certain managed pockets have shown high fish production to the tune of over 1000kg/ha/yr. The State Fisheries Policy envisages recognizing this unique property regime for cooperative management wherein crop cultivation is to be integrated with fisheries. Fisheries sector plays a key role in food security and employment generation as significant proportion of population depends upon it for livelihood sustenance. It also generates precious revenue for the state. The research paper mainly focus on biological productivity basis on primary and secondary level at Mithila wetland plain.

Keywords: Basins, Shallow Water, Fresh Water, Microphytes, Habitat, Cultivation, Population.

Introduction:

All efforts are being made to make the state self sufficient in fish production. Farmers are being sent to other states for training in fish production under scientific aquaculture. Incentives in the form of loan/subsidies and insurance facilities are being extended all with an intention to motivate them to augment aquatic productivity. With a view to augment the productivity of nutritionally more significant cat fishes, the State Government has recently declared Mangur (*Clarias batrachus*) as the state fish. Steps are on for farming *Pungasius* as well. The State Government has extended the facility of insurance of fish to the farmers.

Wetlands in the region could be harnessed for wild collection of ornamental fish also. A large section of local population, specially those belonging to the economically weaker sections, feed upon the shell fishes to supplement their requirement of low cost animal proteins. Prabhakar and Roy (2009) have provided a detailed account of the use of flesh of molluscs like *Pila*, *Bellamya*, *Lamellidens* and *Parreysia* by the aboriginals in the Kosi region for the cure of a number of ailments. They have also provided the details of the local use of *Paratelphusa* sp. And *Macrobrachium* sp.

In an ecosystem, the flow of energy starts with the fixation of sunlight by plants and other autotrophic organisms. Productivity in a broad sense refers to potential of orgaic matter synthesis which means ability of an area to support a biological population and sustain a level of growth and respiration. The plant accumulates energy through fixation and this energy is called primary production. The rate at which this energy accumulates is called primary productivity. The total energy accumulated is gross primary production. However, it is not all available for the food web since plants use some energy themselves. The difference between what is accumulated and what is available for food web is called net primary production (NPP). It represents the total amount of organic matter synthesized by photosynthesis less the amount the organic matter used for respiration by the producers. In general, wetland has the highest primary production of all the world's ecosystems.

Wetland ecosystems sustain diverse taxonomic groups are rated highly productive than the adjacent terrestrial and aquatic ecosystem. The openness of a wetland to hydrological fluctuations is possibly one of the most important determinants of primary productivity. So wetlands that are stagnant are less productive than those that flow or are open to flooding rivers. Primary productions by aquatic macrophytes play important role in energy transformation at different trophic levels of ecosystem compartments. Primary production of the phytoplankton is one of the indices of the trophic level in water ecosystems.

There is gross catchment area of Mithila Plain. Catchment of the Mithila Plain is used for various anthropogenic activities such as agriculture, grazing the animals, water abstraction for irrigation, cattle bathing which contributed to deterioration of water quality and accelerated eutrophication. Eutrophication affects ecological status of freshwater lakes and physic-chemical parameters in fresh water bodies. There are only the few studies on primary productivity of Mithila Plain of Bihar. The objective of present study is to evaluate the primary productivity in order to discover better potential of fish, food, fodder, fuel in the Mithila Plain. The immense and ever increasing importance of this plain makes the present study extremely relevant.

The oxygen method was used for measuring primary production exposing the sample of phytoplanktons in light and dark bottles. All the samples were suspended at 0.5 m depth for incubation period of 3 hours. Oxygen was estimated by the modified Winkler's method. Calculations were performed as given below:

GPP = Gross Primary Production ($gC/m^3/hr$) = $\frac{LB-DB}{T}$ X 0.3125

NPP = Net Primary Production ($gC/m^3/hr$) = $\frac{LB-IB}{T}$ X 0.3125

CR = Community Respiration ($gC/m^3/day$) = $\frac{IB-DB}{T}$ X 0.375

Where IB, LB and DB is dissolved oxygen present in the initial bottle, light bottle and dark bottle respectively. The productivity values were expressed s $gC/m^3/day$, taking 12 hours photoperiod in the course of a day.

The macrophytes were collected by using a 1x1 m^2 wooden quadrate. Samples were taken to the laboratories in the polyethylene bags and were washed with tap water. Samples were then oven bried 65^0 C for 2 days in order to determine their dry biomass. Annual production was taken as summing up of positive differences of monthly biomass changes of macrophytic community while the net annual production has been calculated by difference method as given.

Table 1 : GPP, NPP and Respiration (2021-2023)

Month	GPP/Day	NPP /Day	Res/Day	NPP:GPP	Res. % of Gross Production
Jan. 21	4.1	2.5	1.92	0.61	46.83
Feb. 21	3.8	2.35	1.74	0.62	45.79
Mar. 21	3.1	2.0	1.32	0.65	42.58
Apr. 21	2.9	1.95	1.14	0.67	39.31
May 21	2.4	1.65	0.90	0.69	37.50
June 21	2.1	1.45	0.78	0.69	37.14
July 21	1.7	1.20	0.60	0.71	35.29
Aug 21	2.0	1.40	0.72	0.70	36.00
Sept. 21	1.8	1.25	0.66	0.69	36.67
Oct. 21	2.35	1.55	0.96	0.66	40.85
Nov. 21	2.2	1.50	0.84	0.68	38.18
Dec. 21	2.75	1.75	1.20	0.64	43.64
Jan. 22	3.25	2.05	1.44	0.63	44.31
Feb. 22	2.5	1.60	1.08	0.64	43.20
Mar. 22	2.9	2.0	1.32	0.65	41.58
Apr. 22	2.9	1.65	1.14	0.67	39.11
May 22	2.2	1.65	0.91	0.69	36.50
June 22	2.4	1.55	0.72	0.63	36.14
July 22	1.65	1.30	0.60	0.71	34.29
Aug 22	1.3	1.10	0.32	0.75	25.00
Sept. 22	1.7	1.25	0.54	0.74	31.76
Oct. 22	1.9	1.35	0.66	0.71	34.74
Nov. 22	2.6	1.85	0.90	0.71	34.62
Dec. 22	3.4	2.35	1.26	0.69	37.06
Jan. 23	3.2	2.20	1.20	0.69	37.06
Feb. 23	3.3	2.25	1.26	0.68	38.18
Mar. 23	2.9	1.95	1.14	0.67	39.31
Apr. 23	2.2	1.55	0.78	0.70	35.45
May 23	2.35	1.60	0.90	0.68	38.30
June 23	1.5	1.15	0.42	0.77	28.00
July 23	1.3	1.05	0.30	0.81	23.08
Aug 23	1.4	1.05	0.42	0.75	30.00
Sept. 23	1.6	1.15	0.54	0.72	33.75
Oct. 23	2.1	1.45	0.78	0.69	37.14
Nov. 23	2.9	1.95	1.14	0.67	39.31
Dec. 23	3.6	2.35	1.50	0.65	41.67
Average	**2.46**	**1.67**	**0.96**	**0.68**	**37.10**

Source: Calculated by Scholar

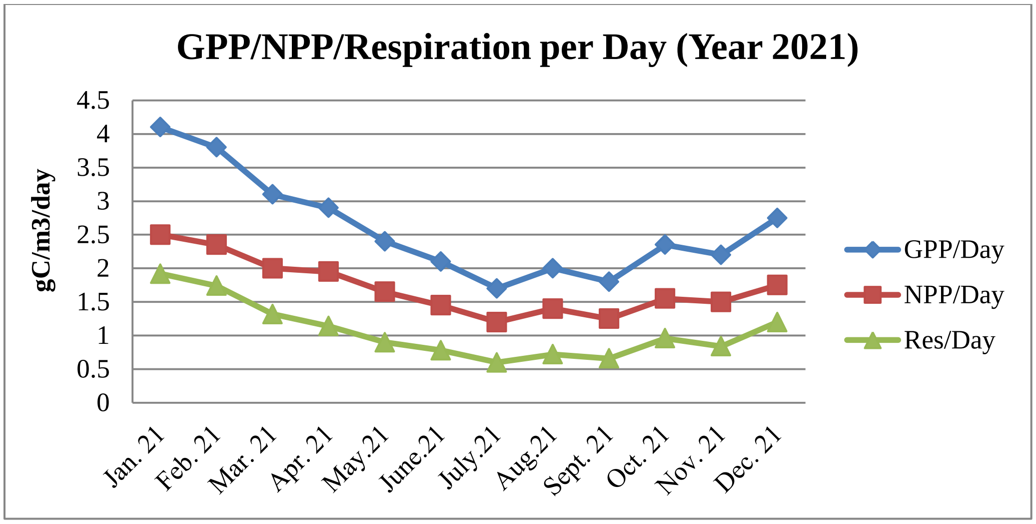
GPP/NPP/Respiration per Day (Year 2021)
gC/m3/day
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan. 21
Feb. 21
Mar. 21
Apr. 21
May.21
June.21
July.21
Aug.21
Sept. 21
Oct. 21
Nov. 21
Dec. 21
GPP/Day
NPP/Day
Res/Day

Fig. 1

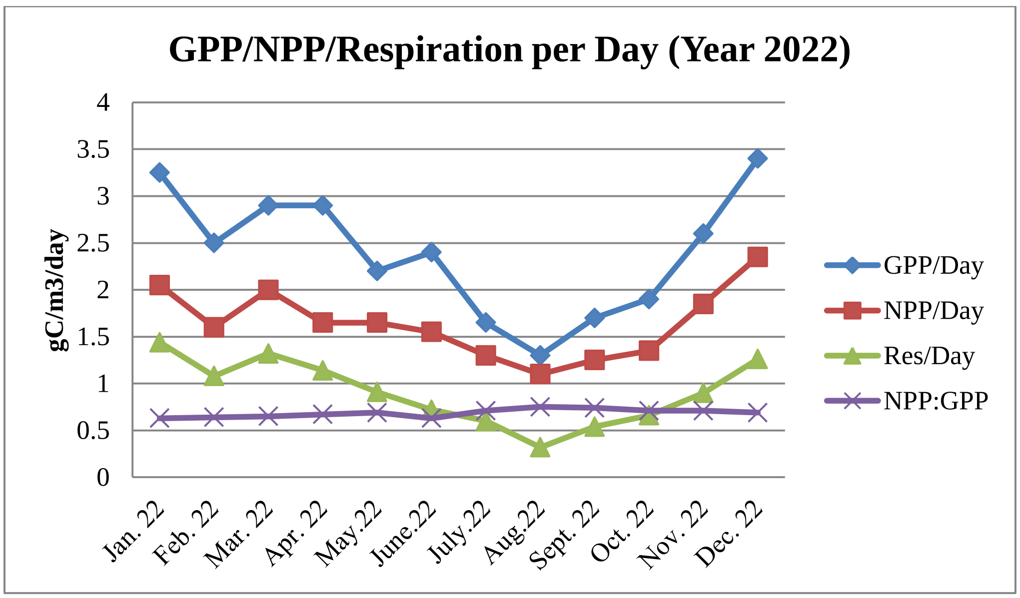
GPP/NPP/Respiration per Day (Year 2022)
gC/m3/day
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan. 22
Feb. 22
Mar. 22
Apr. 22
May.22
June.22
July.22
Aug.22
Sept. 22
Oct. 22
Nov. 22
Dec. 22
GPP/Day
NPP/Day
Res/Day
NPP:GPP

Fig. 2

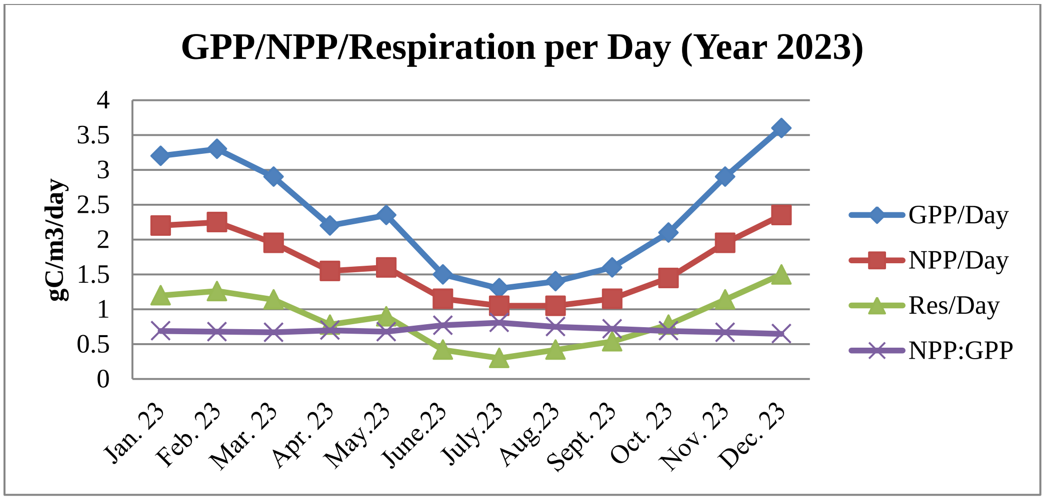
GPP/NPP/Respiration per Day (Year 2023)
gC/m3/day
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan. 23
Feb. 23
Mar. 23
Apr. 23
May.23
June.23
July.23
Aug.23
Sept. 23
Oct. 23
Nov. 23
Dec. 23
GPP/Day
NPP/Day
Res/Day
NPP:GPP

Fig. 3

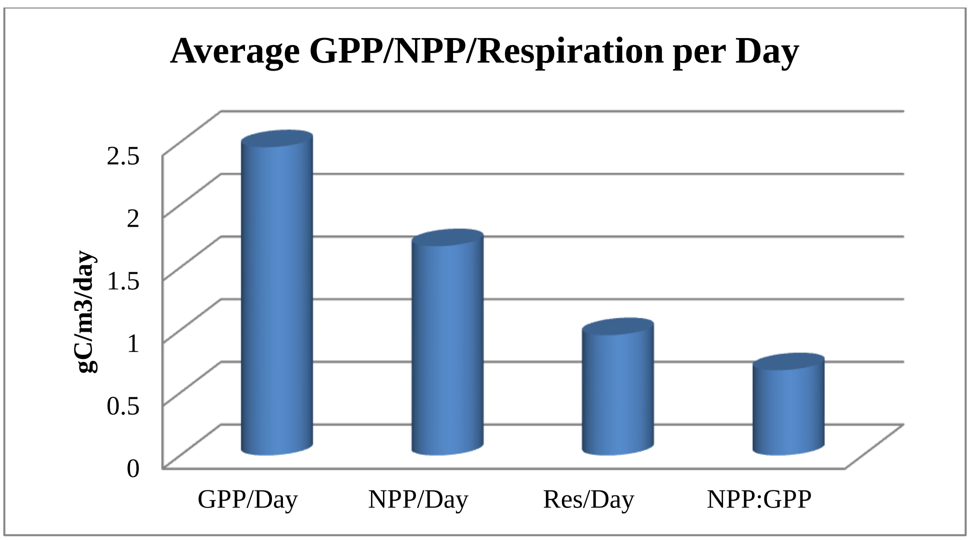
Average GPP/NPP/Respiration per Day
gC/m3/day
2.5
2
1.5
1
0.5
0
GPP/Day
NPP/Day
Res/Day
NPP:GPP

Fig. 4

Table 2 : Monthly variations in macrophytic biomass and net production (2023)

Month	Wet Weight	Mois %	Dry Matter %	Dry Matter (g/m²)
Jan. 23	1090	88.04	11.96	130.364
Feb. 23	1020	88.87	11.13	113.526
Mar. 23	850	89.66	10.34	87.89
Apr. 23	690	88.6	11.4	78.66
May 23	570	92.4	7.6	43.32
June 23	725	91.6	8.4	60.9
July 23	840	91.83	8.17	68.628
Aug 23	970	87.6	12.4	120.28
Sept. 23	1114	84.15	15.85	176.569
Oct. 23	1330	78.53	21.47	285.551
Nov. 23	1290	83.5	16.5	212.85
Dec. 23	1115	86.12	13.88	154.762
Average Standing Crop = 127.78 g dry weight/m²/yr				

Source: Calculated by Scholar

The gross and net primary productivity of the phytoplankton of Mithila Plain were observed and found that they showed monthly variations (Table 1). Maximum GPP (4.10 gC/m^3/day) was recorded during January and minimum during July and August (1.3 gC/m^3/day). Similarly, NPP was maximum during December (2.50 gC/m^3/day) and minimum (1.05 gC/m^3/day) during July and August. The CR was also recorded maximum (1.92 gC/m^3/day) in December and minimum (0.30 gC/m^3/day) during the month of July nd August. The value of NPP:GPP ration was maximum during the month of July and minimum in December.

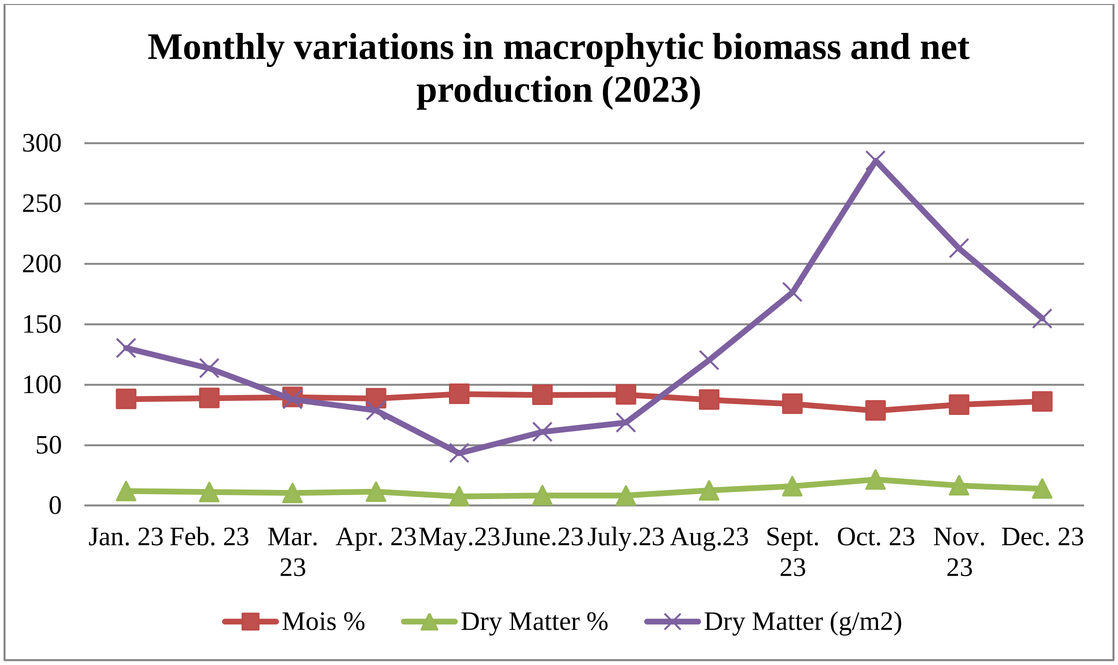

Fig. 5

Respiration percentage of gross production was maximum during December and minimum during the month of July. Values of GPP, NPP and RES were also found to vary across the seasons.

Conclusion:

The living components of an ecosystem consist of producers and consumers. The producers are chlorophyll bearing phytoplankton, green plants and photosynthetic bacteria which synthesize energy containing organic substance through utilization of solar radiation and inorganic materials. Primary productivity studies from a part of biological productivities of wetland sites. Estimation of macrophytic biomass is essential in determining the distribution of flow of material in an ecosystem. The measurement of phytoplankton productivity helps to understand conversation ratio at various trophic level and resources as an essential input for proper management of water resource. The estimation of primary productivity of an ecosystem is essential to understand its food chain and food web. The daily and seasonal carbon flow in the system forms the base of annual food pyramid and can be used to estimate production at higher tropic levels. Physical, chemical and biological aspects of wetland influence primary productivity directly and the fish production indirectly. High rates of production both in natural and cultured ecosystems occur when physic- chemical factors are favorable. Pollution of water on the long run leads to reduction in primary productivity.

Aquatic macrophytes were represented by ceratophyllum demersum, hydrilla verticilata, ottelia alismoids, vallisnaria spirllis, jpomoea aquatic,nelumbo nucifera, nymphoides indica, potamogeton nodosus ad azolla pinnata in different month of the year. Maximum biomass of macrophyte was recorded in October (285.551g/m^2) and minimum in May (43.32 g/m^2).

The primary productivity of the macrophyte and phytoplankton is the sources of energy input in the aquatic ecosystem. The photosynthesis fixation of carbon dioxide and its quantitative measurement is considered a vital index of the productive potential of any aquatic ecosystem. High rates of production in natural and cultural ecosystems occur when physic-chemical factors are favorable. Primary production of the phytoplankton is one of the indices of the trophic level in water ecosystems.

From the net productivity and respiration percentage of gross primry productivity in the present study, it may be suggested that Mithila Plain may progress towards eutrophication in near future. Present condition indicates better possibilities of pisciculture in this plain. The plain has immense importance as a source of rich floral and faunal diversity and it also provides livelihood to poor villagers of the area. So it needs immediate remedial measures for better management and restoration.

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References:

1. Prabhakar, A.K. and Roy, S.P. 2009. Ethnomedicinal uses of some shell fishes bypeople of Kosi river basin of north Bihar, India. *Ethno. Med.,* 3(1): 1-4.
2. Kumari, Smita 2012. Fish farmer braves odds, makes big success. The Telegraph, Patna 10th Aug. 2012.
3. Jha, V., Verma, A.B. and Mishra, A. 2013. Plants in relation to f isheries practices – a survey on biodiversity utilization in north Bihar, India. In: Asha Gupta (ed.) Biodiversity Conservation and Utilization, D.K. Agencies Pvt. Ltd., pp. 155– 160, (Chapter – 14).