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Short Communication

Net primary production of the river Buriganga, Bangladesh

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Abstract

Incubation experiments were carried out on-board under natural illumination condition to the assessment of net primary production of the river Buriganga. The net primary production (NPP) of the river Buriganga were found 147.73±1.8 $\mu gCm^{-2}d^{-1}$ and 66.48±1.9 $\mu gCm^{-2}d^{-1}$ in day-1 of wet and dry season respectively. The productivity was gradually decreased by time during the incubation period. The net primary productivity of the river were very small unit due to heavy pollution by the chemical and organic wastes. The concentration of dissolved oxygen (DO) in this water body were very low which is so difficult to survival of aquatic life in water of Buriganga.

Keywords: Net primary production, gross primary production, respiration, Buriganga River.

Introduction

The productivity of phytoplankton is the single most important degree of 'global change' and characterizes a universally significant flux of carbon between the atmosphere and the biosphere. Primary productivity is the measure of carbon intake by plants during photosynthesis and this measure is a vital pointer for studying the health for plant communities.

Primary production delivers links between the biosphere and the climate system through the global cycling of C, water and nutrients[1]. Gross primary production (GPP) is the total amount of C assimilated by plants within a given area over a specified timeframe. Net primary production (NPP) is GPP less the flux of autotrophic respiration of assimilate used for the plant's own metabolism (R), therefore:

NPP = GPP – R

The productivity of the river Buriganga related to plankton abundant, seasonal variation, and physicochemical parameters of water body. The Buriganga is the great economic importance river in respect of multipurpose uses which is now one of the most polluted rivers in Bangladesh because of rampant dumping of industrial and human waste. Water pollution have established to be actual thoughtful and observable form of environmental contamination as per water bodies are used comprehensively by means of dumps[2]. Millions of industrial units and sewerage outlines discarding enormous bulks of lethal wastes into Buriganga River gradually contaminating water[3].

The primary production of this river is almost zero. The present study thus deals with a short term assessment of net primary production and some physico-chemical factors related to it.

Materials and methods

Study site and sample collection: The river Buriganga flows the southwest outskirts of the capital Dhaka city of Bangladesh. Its average length, width and depth are 27 km, 400 m and 10 m respectively. Buriganga is the most polluted river of the world due to various types of waste settled from commercial sectors, tannery industry and households. Water samples were collected in two different seasons eg. wet season (July 2017) and dry season (December 2017) using 1 Lpolypropylene bottles from five different points of the river Buriganga such as Showari Ghat, Mitford Ghat, Babu Bazar Boat Ghat, Badamtoli Ghat, and Shyampur Ghat through engine-boat (Figure-1). Before collecting the samples, all bottles were washed with distilled water then dried.

Preparation of incubation experiment: Four days (4D) long incubation experiments were carried out on-board under natural illumination condition.1L polypropylene bottle which was filled with sample water collected instantaneously at the same sampling point. For each incubation experiment, three replicates were used. All incubation experiments were conducted in a water bath with natural condition.

Laboratory measurement: Measurement of incubation experiments were done 4 times per day (6h interval). Dissolved Oxygen and Temperature were measured using EZDO 7031 (Taiwan) DO/Oxygen/Temp waterproof Multi-function meter. pH were measured using a hand held pH-meter (HI 7007, Hanna, US).

Calculation and analysis: We calculated net primary production and respiration of the sample water of Buriganga. NPP (12h) and dark respiration (Rd) (12h) were calculated from

the variations of dissolve oxygen concentration. According these data set, total respiration over 24h and gross primary production were calculated as follows: [GPP=NPP+R]. All calculations of metabolic parameters were converted to carbon (C) using "Redfield Richards Ratio" experiential formula[4]. The mean values, standard deviation (SD) were analyzed using statistical software. Difference between wet season and dry season productivity were compared using Student's paired t-test (two sample assuming equal variances), to analyze the variances with 0.05 level of significance.

Results and discussion

Water temperature range and pH values of the river Buriganga were found from 24.6~ 31.5°C and 6.1 ~ 7.3 in wet season; and from 15.6 ~ 21.5°C and 7.1 ~ 7.9 in dry season respectively. The highest value of temperature 30°C throughout rainy season and lowest value of temperature18°C throughout winter season were observed and also found higher value of pH 7.16 in during winter and 6.25 in rainy season[5]. The highest temperature of 31.5°C in wet season and the lowest temperature of 16.2°C in dry season were mentioned and observed pH of whole samples were greater in dry season than wet season[6].

For the period of natural illumination incubation experiment, the values of dissolved oxygen (DO) were found 5.60 ~ 1.45 mg^{-1}in wet season and 1.06 ~ 0.03mg^{-1} in dry season. DO range 4.6 ~ 5.4mg^{-1} in wet season and 2.0 ~ 5.5.13mg^{-1} in dry season were mentioned[6]. DO of the river Buriganga were as low as 2 mg^{-1} in dry season[7]. The gross primary production (GPP), net primary production (NPP) and respiration rates (R) of the river Buriganga were546.59± 1.4µgC$m^{-2}d^{-1}$, 147.73±1.8 µgC$m^{-2}d^{-1}$ and 398.86±1.3 µgC$m^{-2}d^{-1}$ in day-1 of wet season respectively. The productivity was gradually decreased by time during the incubation period (Table-1).

The values of dissolved oxygen were observed maximum in wet season with compare to dry season due to river flow, rain, flood, mixing of water, etc. The water stream of the river in monsoon is reflected sufficient to dilute the waste settled however in dry seasons the dilution is enormously reduced[8-9]. In case of dry season under natural illumination incubation experiment, the gross primary production (GPP), net primary production (NPP) and respiration rates (R) of the river Buriganga were 273.30± 2.3µgC$m^{-2}d^{-1}$, 66.48±1.9µgC$m^{-2}d^{-1}$ and 206.82± 2.1µgC$m^{-2}d^{-1}$ in day-1 respectively (Table-2). All of this productivity was gradually decreased by time during the incubation period (Table 2).

The net primary production were observed maximum in wet season with compared to dry season. NPP gradually decreased by time during the incubation period (Figure-2). The rates of GPP, R and Rd of wet season were also maximum than the dry season. There was no significance difference of net primary production rates between wet and dry season (t-test; $p < 0.005$).

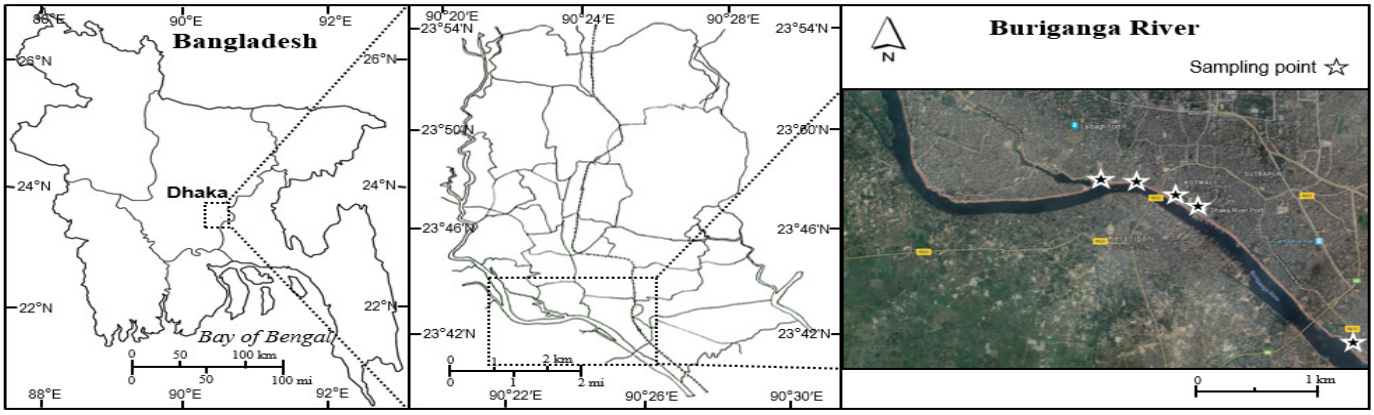

Figure-1: The maps presenting the location of study site of the river Buriganga, Bangladesh.

Table-1: Summary result of 4 days natural illumination incubation experiment in wet season.

Parameter	Day-1	Day-2	Day-3	Day-4
GPP[µgC$m^{-2}d^{-1}$]	546.59 ± 1.4	443.18 ± 1.6	217.90 ± 1.5	81.25 ± 2.1
NPP[µgC$m^{-2}d^{-1}$]	147.73 ± 1.8	73.86 ± 1.9	11.08 ± 1.1	7.39 ± 1.7
Rd[µgC$m^{-2}d^{-1}$]	16.62 ± 1.5	15.39 ± 2.2	8.62 ± 1.2	3.08 ± 1.9
R[µgC$m^{-2}d^{-1}$]	398.86 ± 1.3	369.32 ± 1.6	206.82 ± 1.7	73.86 ± 1.5
P/R	1.37	1.20	1.05	1.10

GPP: Gross primary production rates; NPP: Net primary production rates; Rd: Dark respiration rates; R: Total respiration; P/R: ratio of gross primary production and respiration; and ±SD: Standard deviations.

Table-2: Summary result of 4 days natural illumination incubation experiment in dry season.

Parameter	Day-1	Day-2	Day-3	Day-4
GPP[µgCm^{-2}d^{-1}]	273.30 ± 2.3	51.70 ± 2.4	22.90 ± 1.4	18.47 ± 1.6
NPP[µgCm^{-2}d^{-1}]	66.48 ± 1.9	22.16 ± 1.4	5.17 ± 1.7	3.69 ± 1.2
Rd[µgCm^{-2}d^{-1}]	8.62 ± 1.6	1.23 ± 1.9	0.74 ± 1.3	0.62 ± 1.7
R[µgCm^{-2}d^{-1}]	206.82 ± 2.1	29.55 ± 2.1	17.73 ± 1.1	14.77 ± 1.4
P/R	1.32	1.75	1.29	1.25

GPP: Gross primary production rates; NPP: Net primary production rates; Rd: Dark respiration rates; R: Total respiration; P/R: ratio of gross primary production and respiration; and ±SD: Standard deviations.

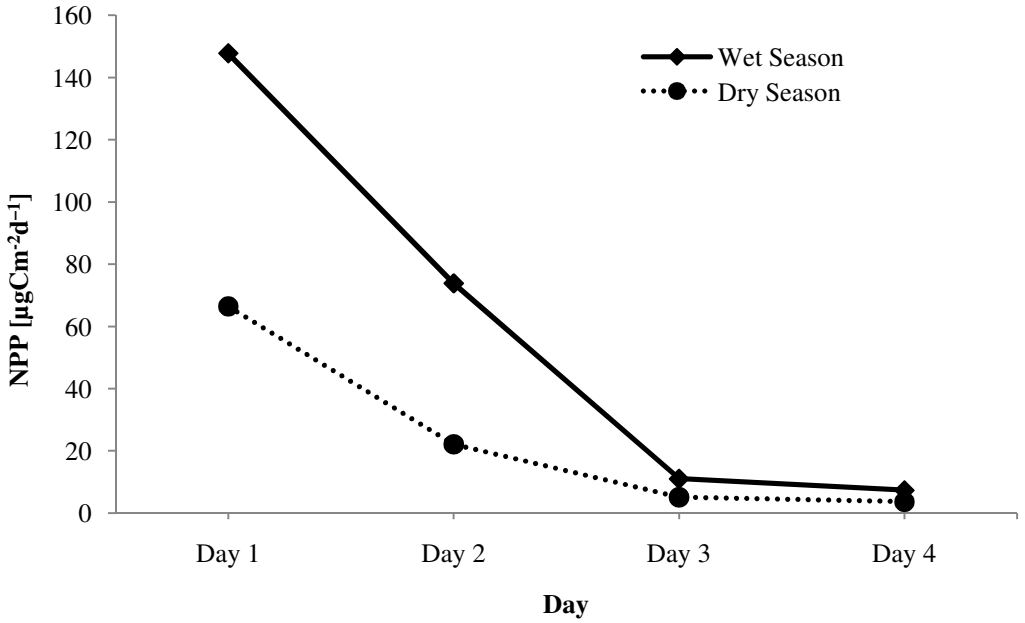

Figure-2: Comparison of net primary production (NPP) rates between wet and dry season.

The net primary productivity of the river Buriganga is very small unit (micro level). The results strongly believed that due to heavy pollution through the bio-chemical wastes, the oxygen concentration of the water body come to be very little which is so difficult to survival of life in water of Buriganga.

Conclusion

The Buriganga is the lifeline of Bangladeshi capital and the most economic important river of the country but unfortunately the biological productivity of the river is almost zero due to heavy toxic wastes from Industry and rampant disposal of Municipal wastes.

The contamination of this river water leads to either death or relocation of aquatic organism to some other habitats. Consequently, it desires to endless efforts to control the pollution crisis by the public awareness and Government initiative.

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