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Evaluation the potentiality of ancient ponds by palmer's Algal pollution index, Noakhali, Bangladesh

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Abstract
Ponds play an important role from very beginning in the society. Ponds are recognized as an obvious part of our life. Especially aged and historical ponds contributes to the society in many ways as source of drinking water, fish culture and other daily purposes. The present study was aimed to evaluate the organic pollution status in three contiguous ancient ponds of Islamia Kamil M.A. Madrasa, Karamatia Kamil Madrasa and District Central Mosque in Noakhali, Bangladesh. A well-established Palmer's algal pollution index was employed to evaluate pond water quality. This study reported all sampling ponds had organic pollution due to algal distribution. A total four groups of phytoplankton as Chlorophyceae (14 genera), Bacillariophyceae (8 genera), Cyanophyceae (5 genera) and Euglenophyceae (2 genera) were identified in conducting study. A total phytoplankton was recorded from $2.32\times10^6 \pm 3.5\times10^5$ to $8.75\times10^5 \pm 8.64\times10^4$ ind/l in all samling ponds. The evaluation of physico-chemical parameters (Water temperature, transparency, dissolved oxygen, total alkalinity, ammonia and p^H) was also performed to understand the water quality more specifically.

Keywords: Ancient ponds, phytoplankton, organic pollution

1. Introduction
Noakhali is one of the most historical region in Bangladesh. A lot of ponds are standing as the symbol of early civilization in this district. In Noakhali all most every Muslim prayer halls as mosques have pond as a part of social activities. In present days these historical ponds are also used for fish culture. It's time to evaluate the fertility of this types of long-standing ponds through determining the organic pollution level. Now a days ponds are very accessible to urban pollution. Especially large ponds are comparatively most useable for depositing daily urban chemical and biological pollute loads through surface runoff or direct sewage landing. Phytoplankton is the basic identity of water bodies. Phytoplankton introduces the stability pond ecosystem by their abundance and diversity [1, 2]. Phytoplankton responses to the fluctuation of environmental qualities as physical and chemical properties [3, 4, 5]. Seasonal phytoplankton distribution is controlled by different nitrogenous and phosphorus nutrients which triggered by temperature, turbidity and organic pollution in aquatic body [6, 7, 8].

Therefore, the algal community is the consequence of incorporation and collaboration of prime physical, chemical and earthen morphological characteristics of water bodies. Thus, the different algae response according to their tolerance level to the water quality [9, 10, 11]. Algae are well accepted bio indicator by the Palmer's classic algal index [12]. The present study aimed to assess the organic pollution intensity in ancient ponds by using Palmer's pollution scale.

2. Materials and methods
The conducting study was aimed to evaluate the organic pollution level in three historical ponds, Noakhali, Bangladesh. The pond preparation is one of the most ancient ethos for drinking water and fish culture in Bangladesh.

Table 1: Characteristics of Sampling Ponds

Criteria	Pond A	Pond B	Pond C
Name of Authority	Islamia Kamil M.A. Madrasa, Sonapur, Noakhali	Karamotia Kamil Madrasa, Sonapur, Noakhali	District Jame Mosque, Maijdee, Noakhali
Location	22.826N	22.8398N	22.8648N
	91.099E	91.10007E	91.0984E
Pond area (approximate)	30 decimal	280 decimal	90 decimal
Pond depth (approximate)	18 Ft.	60 Ft.	30 Ft.
Pond Establishment	1940	1850	1950
Fish culture: Name of fishes	Tilapia and pangas.	Rohu, Catla, Mrigal carp,Black rohu, pangas, tilapia.	Tilapia,Rohu, Catla, silver carp
Types of fish feeds	Fish feed and ill-spent potluck of student dormitory.	Only fish feed.	Pestle of rice,chaff, Roughage, glume.
Fish feeding strategy	Weekly	Twice in a month	Weekly
Fishing strategy	Fish netting quarterly in every year.	Fish netting twice in a year and game fishing once in a year	Fish netting quarterly in every year.
Fish mortality	Monthly 10 – 15 pieces.	No record	Mostly summer season is very

			high mortality.
Aeration system	Absence	Absence	Absence
Local dependency	A day 1000/1200 peoples are depended for bathing and cloth washing.	A day 700/800 peoples are depended for bathing and cloth washing.	A day 1800/2000 peoples are depended for bathing and cloth washing.
Pond maintenance	Yearly	Yearly	Yearly
Waste discharges from Industry/ office/ House	No	No	No

Phytoplankton were collected from surface layer of water body through phytoplankton net (mesh size: 30 µm) and preserved in 150 ml plastic container with 5 % formaldehyde. Therefore, phytoplankton were identified at 16×10 and 16×40 magnification using a light microscope in sedge wick-Rafter plankton counting cell. The abundance and genus diversity of phytoplankton were determined by following [13, 14, 15]. For determining water organic pollution level by following Palmer's algal pollution index [12]. This study also conducted to determine physico-chemical water parameters as water temperature, water transparency, water pH through thermometer, secchi disc and pH meter (HANNA-HI96107) respectively in three sampling ponds. In conducting study total alkalinity (mg/l), dissolved oxygen (mg/l), ammonia (mg/l) were determined according to guiding principles from the American Public Health Association [16].

3. Results & Discussion

The conducting study was aimed to identify and estimate phytoplankton in three historical ponds, Noakhali. There are four groups of phytoplankton as Chlorophyceae (14 genera), Bacillariophyceae (8 genera), Cyanophyceae (5 genera) and Euglenophyceae (2 genera) were identified in present study (Table 1). The organic pollution level in all sampling ponds was determined by following Palmer [12]. The Pond A and Pond B were conducted probable high organic pollution (Table 2). Furthermore, the Pond C was accompanied as high organic pollution (Table 2). *Scenedesmus*, genera of Chlorophyceae was found in all sampling ponds (Table 2). *Scenedesmus* is caused to organic pollution and eutrophication according to [12, 17, 18]. Navicula with highest index value from Bacillariophyceae was only found in Pond C (Table 2). Another genera of Bacillariphyceae, *Synedra* was observed in Pond B and Pond C (Table 2). *Navicula* and *Synedra* were also observed in fish culture and rain fed ponds [19, 20, 21, 22]. The most prominent Cyanophyta, *Oscillatoria* was found in Pond B and Pond C (Table 2). After that, *Microcystis* was found in two of sampling ponds (A & B) in Table 2. *Microcystis* was proven as the most known single indicator of water pollution by [23]. Moreover, The *Euglena* was recorded in Pond A and Pond C (T able 2) in the present study. *Euglena* is one of the highest scorer and contributor in aquatic organic pollution [12]. The organic pollution index also observed in ponds, rivers and other freshwater aquatic bodies by [17, 24, 25, 26, 27, 28, 29, 30].

Table 2: Evaluation of historical ponds according to palmer's Algal Pollution Index

Phytoplankton	Index Value	Pond A	Pond B	Pond C
Chlorophyceae				
Actinastrum Hanzschi	-	P	P	P
Ankistrodesmus	2	2	2	2
Botryococcus	-	P	P	P
Chlorogonium	-	P	P	P
Chlorella	3	3	3	3
Characium	-	P	P	A
Cosmarium	-	P	P	P
Gomphosphaeria	-	1	1	1
Oocystis	-	P	P	P
Pediastrum	-	P	P	P
Scenedesmus	4	4	4	4
Sphaerocytis	-	P	P	P
Tetraedron	-	P	A	A
Volvox	-	P	P	P
Bacillariophyceae				
Cocconeis	-	P	A	P
Cyclotella	1	1	A	1
Cymatopleura	-	P	A	A
Fragilaria	-	P	A	P
Navicula	3	A	A	3
Synedra	2	A	2	2
Melosira	1	A	1	1
Amphora	-	P	A	P
Cyanophyceae				
Anabena	-	P	P	P
Aphanothece	-	P	P	P
Merisinopedia	-	P	P	P
Microcystis	-	A	P	P
Oscillatoria	5	A	5	5
Euglenophyceae				

Euglena	5	5	A	5
Trachelomonas	-	P	P	A
Palmer's Algal Index	-	16	18	27
Water Organic Pollution		Probable High Organic Pollution	Probable High Organic Pollution	High Organic Pollution

The total and group wise algal distributions in all sampling ponds were significantly different (P<0.05) in Table 3. The abundances of Chlorophyceae in Pond A, Pond B and Pond C were recorded $1.21\times10^6 \pm 1.94\times10^5$, $2.06\times10^5 \pm 2.19\times104$ and $3.12\times10^5 \pm 5.46\times10^4$ respectively (Table 3). The Bacillariophyceae loads in Pond A, Pond B and Pond C were recorded $2.28\times10^4 \pm 3.91\times10^3$, $1.19\times10^4 \pm 1.36\times10^3$ and $1.18\times10^4 \pm 1.54\times10^3$ respectively (Table 3). The individuals of Cyanophyceae in Pond A, Pond B and Pond C were recorded $1.04\times10^6 \pm 1.68\times10^5$ ind/l, $1.13\times10^5 \pm 9.4\times10^3$ ind/l and $5.47\times10^5 \pm 4.52\times10^4$ ind/l respectively (Table 3) Furthermore, Euglenophyceae individuals in Pond A, Pond B and Pond C were recorded $3.45\times10^4 \pm 4.86\times10^3$, $3.33\times10^3 \pm 5.89\times10^2$ and $2.18\times10^3 \pm 3.83\times10^2$ respectively (Table 3).A total phytoplankton of Pond A, Pond B and Pond C was $2.32\times10^6 \pm 3.5\times10^5$ ind/l, $3.34\times10^5 \pm 3.15\times10^4$ ind/l and $8.75\times10^5 \pm 8.64\times10^4$ ind/l, respectively. The findings from this study are in agreement with [20, 21, 22, 31, 32].

Table 3: Physico-chemical Parameters in Sampling Ponds

Phytoplankton	Pond A (ind/l)	Pond B (ind/l)	Pond C (ind/l)
Chlorophyceae (P<0.05)	$1.21\times10^6 \pm 1.94\times10^{5\,a}$	$2.06\times10^5 \pm 2.19\times10^{4\,b}$	$3.12\times10^5 \pm 5.46\times10^{4\,b}$
Bacillariophyceae (P<0.05)	$2.28\times10^4 \pm 3.91\times10^{3\,a}$	$1.19\times10^4 \pm 1.36\times10^{3\,b}$	$1.18\times10^4 \pm 1.54\times10^{3\,b}$
Cyanophyceae (P<0.05)	$1.04\times10^6 \pm 1.68\times10^{5\,a}$	$1.13\times10^5 \pm 9.4\times10^{3\,c}$	$5.47\times10^5 \pm 4.52\times10^{4\,a}$
Euglenophyceae (P<0.05)	$3.45\times10^4 \pm 4.86\times10^{3\,a}$	$3.33\times10^3 \pm 5.89\times10^{2\,b}$	$2.18\times10^3 \pm 3.83\times10^{2\,b}$
Total Phytoplankton (P<0.05)	$2.32\times10^6 \pm 3.5\times10^{5\,a}$	$3.34\times10^5 \pm 3.15\times10^{4\,b}$	$8.75\times10^5 \pm 8.64\times10^{4\,b}$

Water temperature in all sampling ponds was recorded from 29.75±0.78 ^{0}C to 30.59±0.78 ^{0}C (Table 4). The prime factor temperature enhance the phytoplankton distribution through photosynthesis [33, 34]. Total alkalinity (7.63±0.82 to 22.50±2.42 mg/l) was recorded in sampling ponds and indicated buffering characters (Table 4). The photosynthesis limit is projected by total alkalinity in water body [35]. In present study dissolved oxygen (3.63±0.29 to 5.19±0.16 mg/l) was observed in sampling ponds (Table 4). Dissolved oxygen as the byproduct of photosynthesis specifies the pond secondary zooplankton productivity [33, 34, 36]. The highest water transparency in Pond B (11.23±0.42 cm) followed by Pond C (7.09±0.11 cm) and Pond A (2.73±1.64 cm) in Table 4. Water transparency showed negative relation with phytoplankton assemblages [20, 37]. The lowest dissolved ammonia in Pond B ($1.5\times10^{-1}\pm1.3\times10^{-1}$) was followed by Pond C ($1.9\times10^{-1}\pm2\times10^{-2}$) and Pond A ($2.9\times10^{-1}\pm4\times10^{-2}$) in Table 4. The biological by product dissolved ammonia of microorganisms and fishes enhance the algal growth in aquatic bodies [38]. The pH range (7.3-8.7) was observed in all sampling ponds (Table 4). Water pH level is recognized as indicator of fruitfulness of water bodies [39]. The water transparency, total alkalinity, dissolved oxygen, total suspended solids were significantly (P<0.05) varied in sampling ponds: A, B and C.

Table 4: Physico-chemical Parameters in Sampling Ponds

Physico-chemical Parameters	Pond-A	Pond -B	Pond-C
Temperature (NS) ^{0}C	29.75±0.78^a	30.58±0.94^a	30.59±0.78^a
Alkalinity (P<0.05) mg/l	22.50±2.42^a	10.50±0.76^b	7.63±0.82^b
Dissolved Oxygen (P<0.05) mg/l	5.19±0.16^a	3.63±0.29^b	3.76±0.23^b
Transparency (P<0.05) cm	2.73±1.64^c	11.23±0.42^a	7.09±0.11^b
NH_3 (P<0.05) mg/l	$2.9\times10^{-1}\pm4\times10^{-2\,a}$	$1.5\times10^{-1}\pm1.3\times10^{-1\,b}$	$1.9\times10^{-1}\pm2\times10^{-2\,b}$
pH	7.5-8.7	7.5-8.3	7.3-8.2

4. Conclusions

The study was attempted to reveal the organic pollution status of three ancient ponds in Noakhali, Bangladesh. These ponds are become vulnerable of being organic polluted by anthropogenic activities. The aged ponds are considered as blessing with organic and inorganic nutrients which enhance the natural primary productivity.

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