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Characteristics and Dynamic of Algal Communities in a New Impounded Hydro-Agricultural Dam Lake (Samendeni Reservoir) in Burkina Faso (Western Africa)

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Abstract

Proliferation of microalgae is the result of a complex interaction between hydrological and physico-chemical variables influenced by climatic and anthropogenic factors. This study assessed algal communities in the Samendeni Dam Lake to serve as indicators of water quality for sustainable management of hydro-agricultural water resources. Therefore, physico-chemical parameters and microalgae were monitored in three sampling zones from November 2021 to October 2022. A comparison of physico-chemical parameters was realized between sampling zones and between seasons. CCA and RDA were used to establish the relationship between parameters and microalgae. The results show 96 species belonging to 46 genera, 30 families, 19 orders, 9 classes, and 7 phyla. Charophyta dominated microalgal communities in both dry and rainy seasons. Phytoplankton species reached 34 in the dry season and 41 in the rainy season, whereas periphyton revealed 41 species in both seasons. Phytoplankton abundances ranged from 213 to 5440 cells·mL^{-1} and 3 to 110 cells·cm^{-2} for periphyton. At $p < 0.05$, significant correlation of Charophyta with pH ($r = 0.39$, p-value = 0.04), EC ($r = -0.41$ - 0.91, p-value = 0.00 - 0.03), Transp ($r = 0.73$, p-value = 0.03), Ammo ($r = 0.48$, p-value = 0.01), Nitra ($r = 0.81$, p-value = 0.01), Nitri ($r = 0.91$, p-value = 0.00) was observed. Bacillariophyta significantly correlated to pH ($r = 0.70$, p-value = 0.04), EC ($r = -0.51$ - 0.94, p-value = 0.00 - 0.04), DO ($r = -0.70$ - 0.81, p-value = 0.01 - 0.04), Transp ($r = -0.71$ - 0.73, p-value = 0.02 - 0.03), Nitra ($r = 0.84$, p-value = 0.00) and OrthoP ($r = 0.44$ - 0.73, p-value = 0.02 - 0.03). Chlorophyta was significantly correlated to EC ($r = -0.41$ - 0.95, p-value = 0.00 - 0.03), Transp ($r = -0.52$, p-value = 0.01), Nitra ($r = 0.71$, p-value = 0.03), Ammo ($r = 0.42$, p-value = 0.03). Cyanophyta showed significant correlation with pH (r = 0.43, p-value = 0.02); EC (r = 0.68, p-value = 0.04), Transp (r = −0.44, p-value = 0.02), OrthoP (r = 0.44 - 0.54, p-value = 0.00 - 0.02) and Ammo (r = 0.43, p-value = 0.02). Ochrophyta significantly correlated to Nitra (r = 0.42, p-value = 0.03). While Charophyta and Chlorophyta species in the dam lake indicate relatively good water quality, recorded harmful Cyanophyta species show a possible deterioration of the habitat. Therefore, continuous water quality monitoring since the construction of dam lakes should be performed for careful water management.

Keywords

Phytoplankton, Periphyton, Physico-Chemical Parameters, Water Quality, Samendeni Dam Lake

1. Introduction

New impounded lakes are often known to be sustainable productive systems [1] [2]. As primary producers of water bodies, the proliferation of microalgae is the result of a complex interaction between hydrological and physico-chemical variables [3]. These variables are strongly influenced and disturbed by anthropogenic activities [4]. As a result, important amounts of nutrients composed of phosphorus and nitrogen are loaded in water environments [5], leading to eutrophication of aquatic ecosystems, algal proliferation and degradation of water quality [6] [7].

Burkina Faso faces significant water resource challenges due to its semi-arid climate and increasing population demands [8]. The country has implemented hydro-agricultural water bodies to develop and improve agricultural production. The largest are the dam lakes of Kompienga in the Eastern region, Bagre in the South-East region and Samendeni in the western part of the country [9]. The Samendeni Dam Lake impounded on the Mouhoun River in 2017 is the most recent hydro-agricultural water body of the country. This water body is mostly used for agricultural practices, animal watering and fishing. Fertilizers and nutrients drained into water bodies stimulate the production of chlorophyllous organisms, particularly microalgae [10]. However, many authors reported that several types of microalgae from Cyanophyta and Miozoa are known to be harmful to human and animal health and may negatively compromise the development of the food chain [11]. According to Renuka *et al.* [12], microalgal communities composed of phytoplankton and periphyton are sustainable alternative for assessing the pollution levels of water ecosystems. In a hydro-agricultural freshwater system, this can contribute to environmental preservation and the enhancement of agricultural irrigation practices [13]. Thus, this study seeks to use microalgae as a baseline tool for monitoring water pollution in hydro-agricultural systems. The specific objectives are:

- To measure physico-chemical parameters of the water, likely to foster algal development;

- To assess diversity and abundance of microalgae communities;
- To determine spatial and temporal variations of algal communities in relation with water quality.

2. Materials and Methods

2.1. Characteristics of the Study Area

The Samendeni Dam Lake is located between the geographical coordinates of 11˚23' north latitude and 4˚42' west longitude. It has been listed since 2020 as a wetland of international importance [14]. Considered as the third largest dam in Burkina Faso after Kompienga (16,000 to 20,000 ha) and Bagré (21,000 to 25,000 ha), the area of the dam is estimated between 10,500 and 15,300 ha [9]. Its watershed drains a volume of water estimated at 1,050,000,000 m^3 [15]. The study area is covered by the Sudanese and Sudano-Sahelian zones and the inter-annual mean precipitation was 1288.27 mm over the period 2012-2022. The rainy season is generally from May to October and daily temperatures vary between 23.50˚C (December) to 31.30˚C (April). The study was carried out on 2 horizontal transects going from one bank (coastline) to the other, each consisting of 5 sampling stations. The length of transect 1 is 4613 m and that of transect 2 is 4984 m. An average distance of 4850 m was observed between transects, while a distance of 1200 m was between 2 sampling stations on a transect (**Figure 1**).

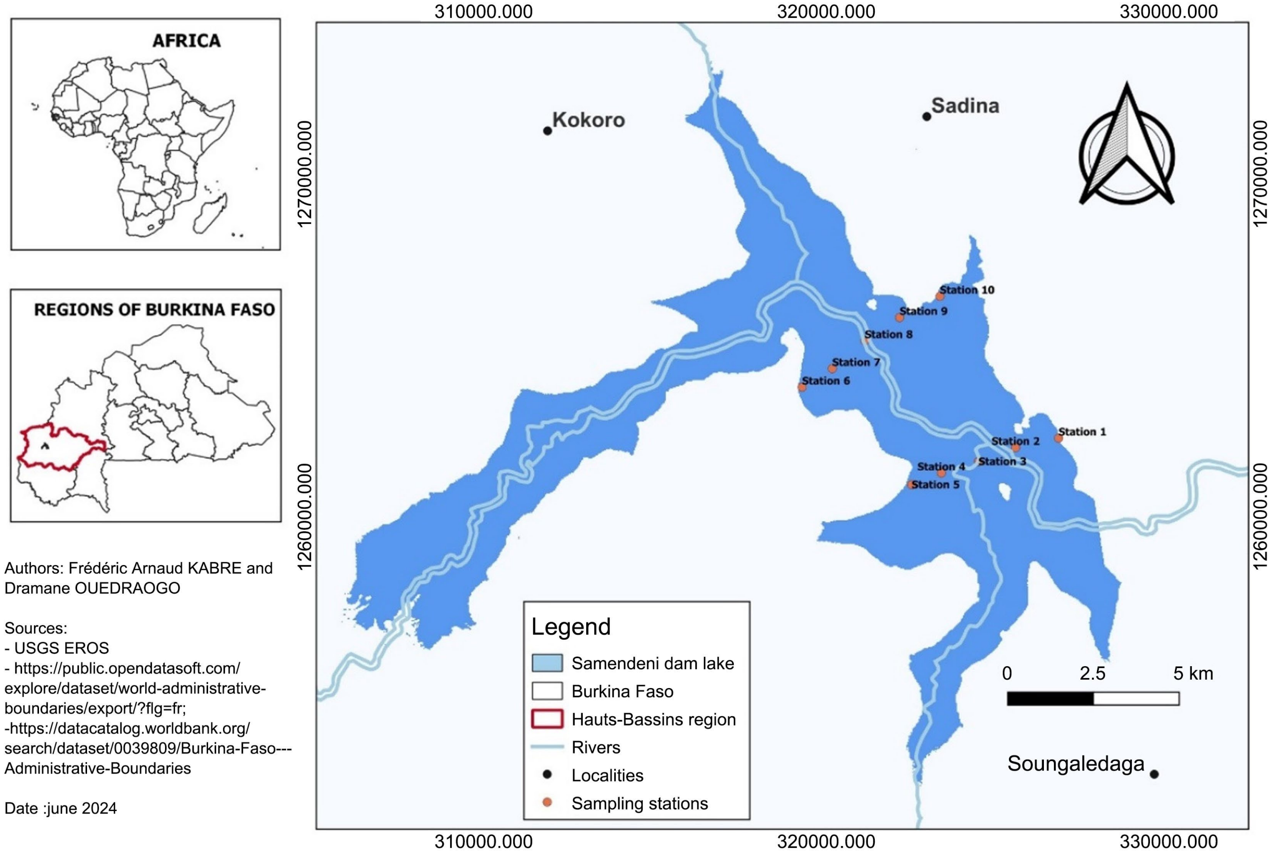


Figure 1. Location map of the Samendeni Dam Lake.

2.2. Sampling Method and Species Identification

The 10 sampling stations from transects 1 and 2 (**Figure 1**) were grouped into 3 main sampling zones for the study according to the similar characteristics they have. The open water zone 1 (OWZ1) that includes stations 1, 5, 6, and 10 is strongly influenced by human activities and characterized by the presence of macrophytes, with an average depth of 1.50 ± 0.30 meters. The open-water zone 2 (OWZ2) that includes stations 2, 4, 7, and 9 is the open and well-lit zone of the body of freshwater, with an average depth of 12.00 ± 3.00 meters. The open-water zone 3 (OWZ3) includes stations 3 and 8, located below the range of effective light penetration in the body of freshwater, with an average depth of 21.25 ± 2.60 meters. Measurements of physico-chemical parameters and sampling of microalgae were done on the 15th of every month, from November 2021 to October 2022 at the station of the 3 sampling zones. As the site is located at the Hauts-Bassins Region of Burkina Faso, the study was conducted on-site with the authorization of the Regional Department of Agriculture, Animal and Fisheries Resources of this region.

Water pH, electrical conductivity ($\mu s \cdot cm^{-1}$), dissolved oxygen ($mg \cdot L^{-1}$) and temperature (˚C) were measured at a depth of 40 cm using a multiparameter probe Bante900P. Water transparency (m) was estimated using a Secchi disc. Concentrations of Ammonium nitrogen (NH_4^+), nitrites (NO_2^-), nitrates (NO_3^-) and orthophosphates (PO_4^{3-}) were determined using standard methods [16]. Therefore, they were determined using a spectrophotometer HACH DR3900 at 640 nm, 540 nm, 410 nm and 880 nm, respectively.

Phytoplankton were sampled at a depth of 40 cm in each station of the 3 sampling zones. They were sampled according to the sampling period as described above. A volume of 40 mL of freshwater was collected and preserved with 5% formalin at ambient temperature [9]. At the laboratory, samples were left undisturbed in a dark place for 24 hours to allow algal cells to settle [9]. After settling, the top water was removed, and 20 mL of subsamples were used for qualitative and quantitative analysis [7].

A periphyton trapping device (**Figure 2**) was an artificial support made up of square wood, suspended between two wires stretched parallel and spaced 25 cm apart. It was held at the bottom of OWZ1 by a stone and at the surface of the water by a float. There were 3 rows of 5 square woods. A square wood measured 10 cm on a side. The trapping device was settled only at the four stations of the OWZ1 for sampling. Periphyton was sampled by brushing both sides of wooden plates and collected in vials. The samples were immediately preserved in 20 mL of 5% formalin at ambient temperature for qualitative and quantitative analysis.

Microalgae species were examined and photographed using an optical binocular microscope BELONA, manufactured by OPTO-EDU (Beijing) Co. LTD., China. They were identified on the basis of realized images using standard works such as Niamien-Ebrottié [17], Seu-Anoï [18], Adon [19], Kouassi [20], Wehr [21] and Koffi [22]. Identified species were verified and classified using the taxonomical criteria of AlgaeBase [23].

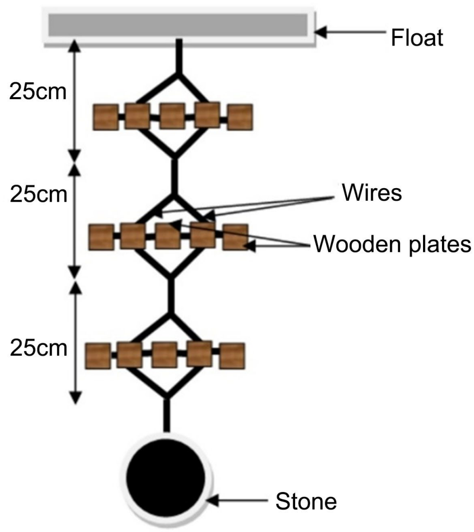


Figure 2. Periphyton trapping device.

2.3. Quantitative Analysis of Microalgae

Phytoplankton abundance and periphyton density were determined using a Malassez chamber that was filled with a homogeneous solution and kept undisturbed for 5 min to allow particles to settle [24]. After settling, all individuals in the chamber were counted four times for each sample of periphyton or sub-sample of phytoplankton, and the relative abundance (RA) was determined using the following formula [25]:

$$\mathrm{RA} = \frac{N * 10^6 * Vs}{q * (Vs + v)} \tag{1}$$

N: Number of individuals per room; *Vs*: Volume of sub-sample for phytoplankton or sample for periphyton; *q*: Volume of the counting room; *v*: Volume of formaldehyde solution used for preservation.

The relative abundance of phytoplankton in the samples (RAs) was determined by the following formula:

$$\mathrm{RAs} = \mathrm{RA} * k^{-1} \tag{2}$$

k: Dilution factor (0.50).

The density of periphyton was obtained from the formula:

$$D = \frac{\mathrm{RA} * (Vs + v)}{S} \tag{3}$$

Vs: Volume of sample; *S*: Total area of periphyton trapping device (3000 cm^2).

2.4. Quantitative Analysis of Microalgae

The frequency of occurrence (*F*) of a taxon is the ratio between the number of samples (Pa) from a station where the taxon is present and the total number (*P*) of samples [26]. It is calculated according to the formula:

$$F(\%) = \frac{Pa}{P} * 100$$

Pa: Number of samples; *P*: Total number of samples.

Depending on the value of F, three groups of species can be distinguished: the constant species (F>50%), the accessory species (25 < F< 50%) and the accidental species (F< 25%).

Shannon-Wiener diversity index (H'), Pielou's evenness index (J) and Similarity Sørensen index (S) were performed using the package vegan from the R software version 4.4.1.

Hutcheson's t-test (Diversity t-test) was performed with the software R-4.4.1 to compare Shannon-Wiener diversity indices between the sampling zones using the package ecolTest.

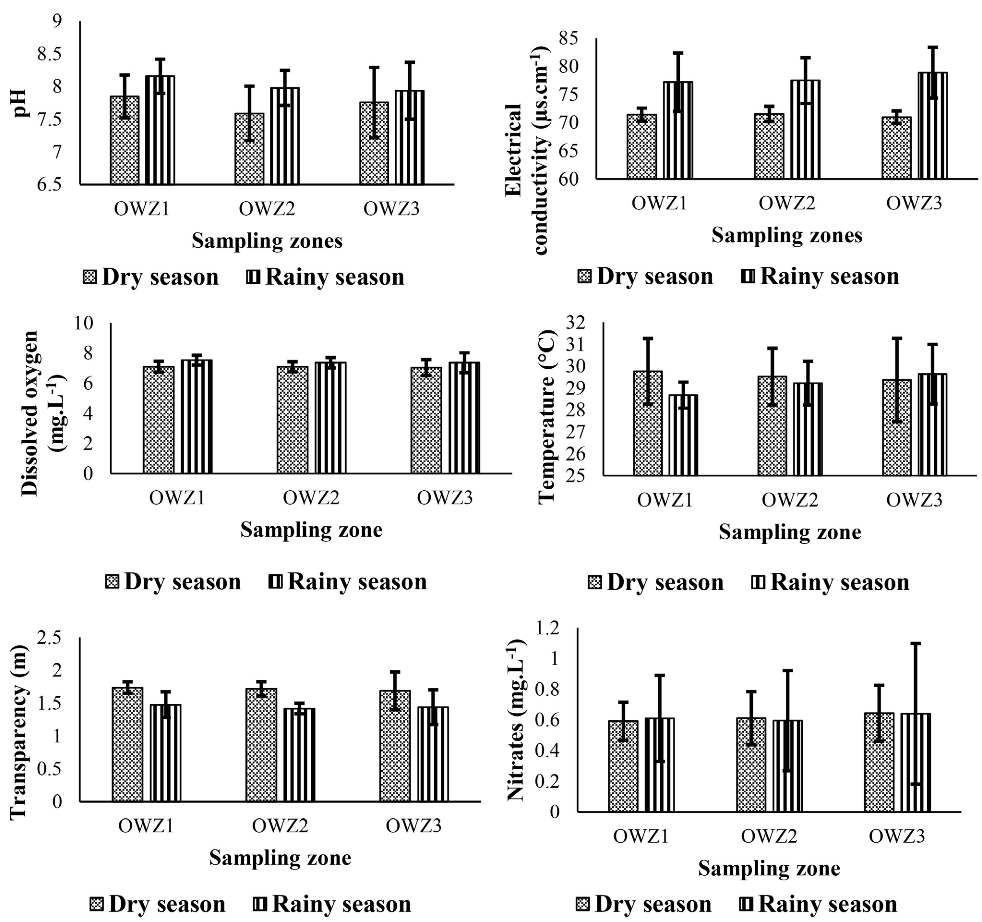
Comparison of physico-chemical parameters between the sampling zones and seasons was performed using the software R-4.4.1. After determining the normality of the data with the Shapiro-Wilk test, an ANOVA test was applied to the physico-chemical parameters that followed a normal distribution, and the Kruskal-Walli's test was used for the other parameters.

Water pH, electrical conductivity (EC), dissolved oxygen (DO), temperature (Temp), transparency (Transp), Nitrates (Nitra), Nitrites (Nitri), Orthophosphates (OrthoP), Ammonium nitrogen (Ammo) and abundance of microalgal species were used for this analysis. To study the distribution of phytoplankton and periphyton species in relation to environmental parameters, Detrended Correspondence Analysis (DCA) was employed to assess variations in microalgal composition and determine the length of the different environmental gradients. For gradient lengths shorter than 4 standard deviations (SD), as observed for periphyton, linear analysis methods such as Redundancy Analysis (RDA) were deemed more appropriate than unimodal methods. In contrast, Canonical Correspondence Analysis (CCA) was used for phytoplankton, where gradient lengths exceeded 4 SD, indicating a preference for unimodal response models. It allowed analyzing the links between environmental and biotic variables [27] and cross-referencing monthly microalgae density data with monthly environmental data. Monte Carlos permutation test (permutation 1000) was performed to highlight the environmental variables that best influence the species' abundance. Correlation coefficient was used to determine and measure the intensity of the relationship between the different parameters and the abundance of algal species. Correlation test was performed to highlight the environmental variables that best influence the species abundance. The Correlations between environmental variables and the abundance of microalgal communities, CCA and RDA were performed using XLSTAT 2023.2.0 software.

3. Results

3.1. Physico-Chemical Variables of Freshwater

The average value of pH in Samendeni Dam Lake was 7.88 ± 0.43. Those of electrical conductivity, dissolved oxygen, temperature, transparency, nitrates, nitrites, orthophosphates and ammonium nitrogen was 74.59 ± 4.76 µs·cm^{-1}, 7.25 ± 0.49 mg·L^{-1}, 29.37˚C ± 1.40˚C, 1.58 ± 0.24 m, 0.62 ± 0.28 mg·L^{-1}, 0.01 ± 0.02 mg·L^{-1}, 0.06 ± 0.14 mg·L^{-1} and 0.39 ± 0.29 mg·L^{-1}, respectively. Comparison of the physico-chemical parameters between dry season and rainy season (**Figure 3**) using ANOVA test showed significant differences for pH (F = 7.77, p-value = 0.01), electrical conductivity (F = 52.81, p-value = 0.00) and dissolved oxygen (F = 8.40, p-value = 0.01). Non-parametric test showed significant differences between dry and rainy seasons for transparency (X^2 = 24.83, p-value = 0.00), nitrites (X^2 = 18.50, p-value = 0.00), orthophosphates (X^2 = 35.93, p-value = 0.00) and ammonium nitrogen (X^2 = 20.21, p-value = 0.00). Temperature (X^2 = 0.27, p-value = 0.61) and nitrates (X^2 = 2.96, p-value = 0.09) did not show significant differences. Comparison of physico-chemical parameters between sampling zones using ANOVA did not show significant differences between sampling zones for pH (F = 1.39, p-value = 0.26) and dissolved oxygen (F = 0.32, p-value = 0.73). Non-parametric test did not show significant differences for electrical conductivity (X^2 = 0.08, p-value = 0.96), temperature (X^2 = 0.18, p-value = 0.91), transparency (X^2 = 0.58, p-value = 0.75), nitrates (X^2 = 0.023, p-value = 0.99), nitrites (X^2 = 0.16, p-value = 0.93), orthophosphates (X^2 = 0.04, p-value = 0.98) and ammonium nitrogen (X^2 = 0.19, p-value = 0.91).



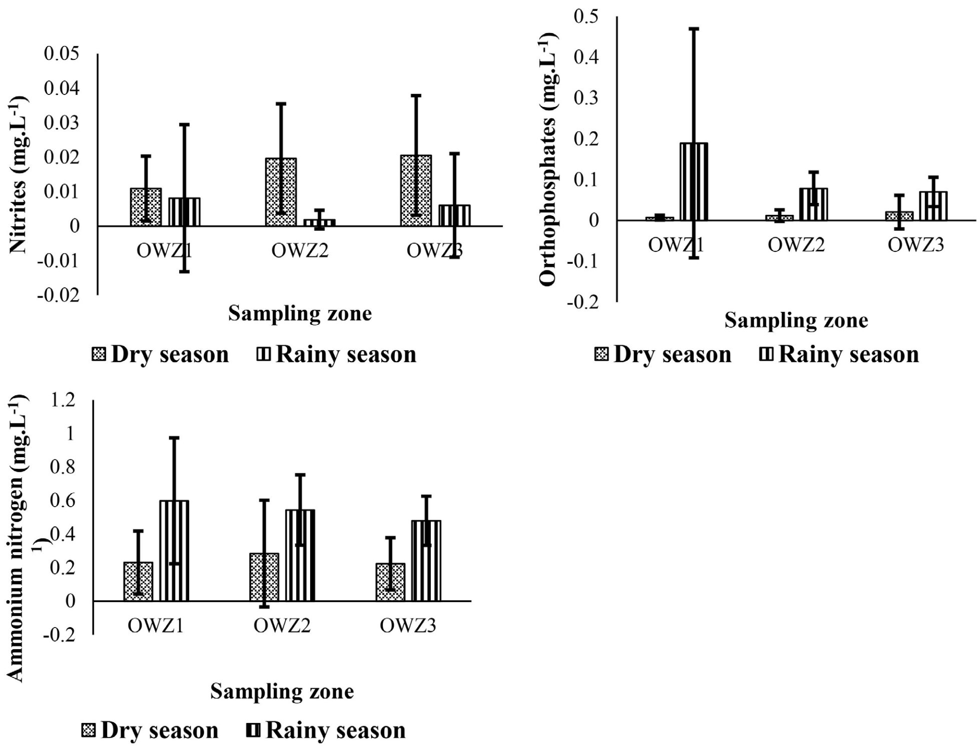


Figure 3. Spatial and seasonal variation of physico-chemical parameters of Samendeni Dam Lake.

3.2. Diversity and Relative Abundance of Algal Microflora

In the Samendeni Dam Lake, a total of 96 species belonging to 46 genera, 30 families, 19 orders, 9 classes and 7 phyla were recorded. From phytoplankton communities, Charophyta was the most represented phylum during the study period, with 14 species corresponding to 41.18% of total recorded species at dry season and 17 species corresponding to 41.46% of total recorded species at rainy season. Miozoa was the least represented phylum during the dry season, with 2 species corresponding to 5.88% of total recorded species, while Ochrophyta was the least represented phylum during the rainy season, with only 1 species corresponding to 2.44% of total recorded species. From periphyton communities, Charophyta was also the most represented phylum during the study period, with 16 species corresponding to 39.02% of total recorded species at the dry season and 14 species corresponding to 34.15% of total recorded species during the rainy season. Miozoa was the least represented phylum during the study period, with 2 species corresponding to 4.88% of total recorded species during the dry season and only 1 species corresponding to 2.44% of total recorded species during the rainy season.

Shannon-Wiener diversity index (H') of phytoplankton at dry season shows that OWZ1 and OWZ3 were the most diversified with species. At rainy season, OWZ1 was the most diversified (Table 1). Significant differences of H' values were observed between dry and rainy seasons at OWZ1 ($t = -5.73$, p-value = 0.00), OWZ2 ($t = 20.14$, p-value = 0.00) and OWZ3 ($t = 24.40$, p-value = 0.00) (Table 1). Regarding periphyton, a significant difference of H' values was observed between dry and rainy seasons (t = 3.47, p-value = 0.00), indicating that dry season was most diversified in species (Table 2). The high evenness (J) values of both phytoplankton and periphyton (Table 1, Table 2) indicate a co-dominance of the species abundance in time and space.

Table 1. Shannon-Wiener diversity and Pielou's evenness indices of phytoplankton species at the sampling zones of Samendeni Dam Lake at dry season and rainy season. Diversity values with the different letters indicate that these values were significantly different between seasons (Hutcheson t-test used for comparison).

	Dry season		Rainy season	
	H'	**J**	**H'**	**J**
Open-water zone (OWZ1)	2.86[a]	0.89	2.90[c]	0.88
Open-water zone (OWZ2)	2.77[b]	0.90	2.59[d]	0.83
Open-water zone (OWZ3)	2.86[a]	0.94	2.62[e]	0.89

Table 2. Shannon-Wiener diversity and Pielou's evenness indices of periphyton species of Samendeni Dam Lake at dry season and rainy season. Diversity values with the different letters indicate that these values were significantly different between seasons (Hutcheson t-test used for comparison).

	Dry season	Rainy season
H'	3.23[a]	3.01[b]
J	0.87	0.81

Kruskal-Wallis test revealed that at dry season, there were significant differences concerning the abundance of phytoplankton species between OWZ1 and OWZ2 (df = 11, p-value = 0.00), OWZ1 and OWZ3 (df = 9, p-value = 0.01) and OWZ2 and OWZ3 (df = 9, p-value = 0.00) (Figure 4). At rainy season, significant differences were observed between OWZ1 and OWZ2 (df = 7, p-value = 0.01) and OWZ2 and OWZ3 (df = 5, p-value = 0.01). However, there was no significant difference in phytoplankton abundance between OWZ1 and OWZ2 (df = 5, p-value = 0.07). For periphyton density, a significant difference was observed between dry and rainy seasons (df = 11, p-value = 0.00) (Figure 4).

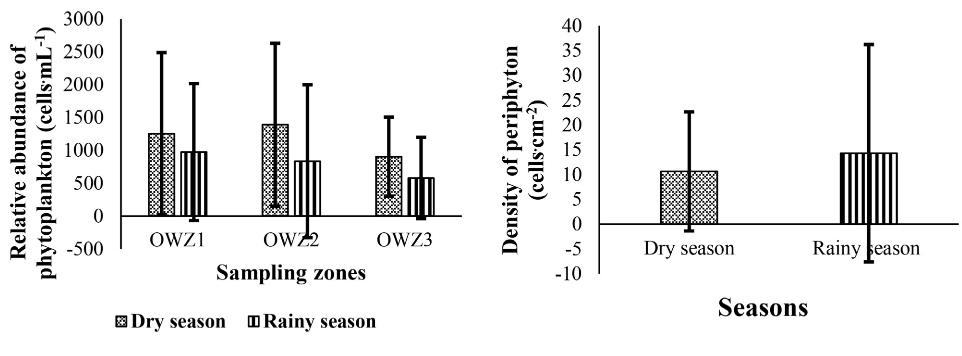


Figure 4. Microalgae proliferation in the sampling site of Samendeni Dam Lake.

At dry season, phytoplankton species *Closterium acutum* Brébisson had the highest abundance at the three sampling zones with 5440 cells·mL^{-1} at OWZ1, 4760 cells·mL^{-1} at OWZ2 and 2465 cells·mL^{-1} at OWZ3. At rainy season, *Oscillatoria geminatum* Schwabe ex Gomont had the highest abundance with 4781 cells·mL^{-1} at OWZ1, 5631 cells·mL^{-1} at OWZ2 and 3081 cells·mL^{-1} at OWZ3 (Table 3). Regarding periphyton at dry season (Table 3), the species *Peridinium* sp.2 (57 cells·cm^{-2}) had the highest density and *Stauroneis anceps* Ehrenberg (110 cells·cm^{-2}) at rainy season.

Table 3. Seasonal abundance of phytoplankton and periphyton density in the Samendeni Dam Lake in dry season (DS) and rainy season (RS).

Taxonomy						Phytoplankton abundance (cells·mL^{-1})		Periphyton density (cells·cm^{-2})	
Phylum	**Classe**	**Order**	**Family**	**Genera**	**Species**	**DS**	**RS**	**DS**	**RS**
Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseiraceae	*Aulacoseira*	*Aulacoseira granulata* (Ehrenberg) Simonsen 1979	482	177	3	27
Bacillariophyta	Bacillariophyceae	Cymbellales	Cymbellaceae	*Cymbella*	*Cymbella cymbiformis* C. Agardh 1830	0	71	0	0
Bacillariophyta	Bacillariophyceae	Cymbellales	Gomphonemataceae	*Encyonema*	*Encyonema elginense* (Krammer) D.G.Mann 1990	0	0	3	13
Bacillariophyta	Bacillariophyceae	Cymbellales	Gomphonemataceae	*Encyonema*	*Encyonema silesiacum* (Bleisch) D. G. Mann 1990	0	0	23	10
Bacillariophyta	Bacillariophyceae	Fragilariales	Fragilariaceae	*Fragilaria*	*Fragilaria subconstricta* Østrup 1910	0	142	0	0
Bacillariophyta	Bacillariophyceae	Cymbellales	Gomphonemataceae	*Gomphonema*	*Gomphonema gracile* Ehrenberg 1838	0	0	0	3
Bacillariophyta	Bacillariophyceae	Naviculales	Naviculaceae	*Navicula*	*Navicula* sp.	142	0	0	0
Bacillariophyta	Bacillariophyceae	Naviculales	Naviculaceae	*Navicula*	*Navicula tripunctata* (O.F. Müller) Bory 1822	0	0	7	30
Bacillariophyta	Bacillariophyceae	Naviculales	Neidiaceae	*Neidium*	*Neidium affine* (Ehrenberg) Pfitzer 1871	0	0	13	10
Bacillariophyta	Bacillariophyceae	Naviculales	pinulariaceae	*Pinnularia*	*Pinnularia brebissonii* (Kützing) Rabenhorst 1864	0	0	13	0
Bacillariophyta	Bacillariophyceae	Naviculales	Pinulariaceae	*Pinnularia*	*Pinnularia viridis* (Nitzsch) Ehrenberg 1843	0	0	7	17
Bacillariophyta	Bacillariophyceae	Naviculales	Sellaphoraceae	*Sellaphora*	*Sellaphora pupula* (Kützing) Mereschkovsky 1902	113	0	3	0
Bacillariophyta	Bacillariophyceae	Naviculales	Stauroneidaceae	*Stauroneis*	*Stauroneis anceps* Ehrenberg 1843	0	0	0	110
Bacillariophyta	Bacillariophyceae	Surirellales	Surirellaceae	*Surirella*	*Surirella* sp.	0	0	0	3
Bacillariophyta	Bacillariophyceae	Bacillariales	Bacillariaceae	*Tryblionella*	*Tryblionella scalaris* (Ehrenberg) Siver & P.B.Hamilton 2005	0	0	0	3
Bacillariophyta	Bacillariophyceae	Licmophorales	Ulnariaceae	*Ulnaria*	*Ulnaria ulna* (Nitzsch) Compère 2001	0	0	7	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Actinotaenium*	*Actinotaenium australe* (Raciborski) Croasdale 1981	0	142	0	0
Charophyta	Zygnematophyceae	Desmidiales	Closteriaceae	*Closterium*	*Closterium acutum* Brébisson 1848	4222	2302	0	77
Charophyta	Zygnematophyceae	Desmidiales	Closteriaceae	*Closterium*	*Closterium gracile* Brébisson ex Ralfs 1848	3683	1487	0	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Cosmarium*	*Cosmarium binum* Nordstedt 1880	0	0	3	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Cosmarium*	*Cosmarium ceratophoroides* Bourrelly 1961	0	0	3	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Cosmarium*	*Cosmarium connatum* Brébisson ex Ralfs 1848	0	0	3	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Cosmarium*	*Cosmarium contractum* 0. Kirchner 1878	2068	354	0	10
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Cosmarium*	*Cosmarium decoratum* West & G.S. West 1895	198	0	0	0

Continued

Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Cosmarium*	*Cosmarium laeve* Rabenhorst 1868	0	0	0	3
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Cosmarium*	*Cosmarium margaritatum* (P.Lundell) J.Roy & Bisset 1886	0	0	3	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Cosmarium*	*Cosmarium punctulatum* Brébisson 1856	0	0	3	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Cosmarium*	*Cosmarium reniforme* (Ralfs) W. Archer 1874	0	106	0	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Cosmarium*	*Cosmarium regulare* Schmidle 1894	0	0	3	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Cosmarium*	*Cosmarium spinuliferum* West & G.S.West 1902	0	0	3	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Cosmarium*	*Cosmarium undulatum* var. *minutum* Wittrock 1869	142	0	0	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Euastrum*	*Euastrum denticulatum* F. Gay 1884	0	106	40	10
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Euastrum*	*Euastrum trigibberum* West & G.S.West 1895	0	0	3	7
Charophyta	Zygnematophyceae	Desmidiales	Gonatozygaceae	*Gonatozygon*	*Gonatozygon aculeatum* W. N. Hastings 1892	822	248	0	0
Charophyta	Zygnematophyceae	Desmidiales	Gonatozygaceae	*Gonatozygon*	*Gonatozygon kinahanii* (W. Archer) Rabenhorst 1868	0	496	3	7
Charophyta	Zygnematophyceae	Desmidiales	Gonatozygaceae	*Gonatozygon*	*Gonatozygon pilosum* Wolle 1882	878	496	3	0
Charophyta	Zygnematophyceae	Zygnematales	Zygnemataceae	*Mougeotia*	*Mougeotia sp.*	0	0	0	7
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Spondylosium*	*Spondylosium tetragonum* West & G. S. West 1892	595	142	7	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Staurastrum*	*Staurastrum brevispina* Brébisson 1848	0	0	3	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Staurastrum*	*Staurastrum cingulum* (West & G.S.West) G.M.Smith 1922	0	0	3	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Staurastrum*	*Staurastrum gracile var. elongatum* A.M.Scott & Prescott 1958	0	0	0	3
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Staurastrum*	*Staurastrum hystrix* Ralfs 1848	963	142	0	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Staurastrum*	*Staurastrum laeve* Ralfs 1848	368	496	17	13
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Staurastrum*	*Staurastrum leptocladum* Nordstedt 1870	0	0	0	3
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Staurastrum*	*Staurastrum manfeldtii* Delponte 1878	0	0	0	7
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Staurastrum*	*Staurastrum muticum* Brébisson ex Ralfs 1848	340	425	0	3
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Staurastrum*	*Staurastrum quadrangulare* Brébisson 1848	0	0	7	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Staurastrum*	*Staurastrum quadricornutum* J. Roy & J. Bisset 1886	142	0	0	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Staurastrum*	*Staurastrum sp.*	0	142	0	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Staurastrum*	*Staurastrum teliferum* Ralfs 1848	0	142	0	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Staurastrum*	*Staurastrum tohopekaligense* Wolle 1885	1218	956	0	0
Charophyta	Zygnematophyceae	Desmidiales	Desmidiaceae	*Staurastrum*	*Staurastrum volans* West & G.S.West 1895	567	319	0	3
Charophyta	Zygnematophyceae	Zygnematales	Zygnemataceae	*Zygnema*	*Zygnema sp.*	0	0	0	3
Chlorophyta	Chlorophyceae	Sphaeropleales	Scenedesmaceae	*Coelastrum*	*Coelastrum microporum* Nägeli 1855	0	0	0	3
Chlorophyta	Chlorophyceae	Sphaeropleales	Scenedesmaceae	*Desmodesmus*	*Desmodesmus armatus* (Chodat) E. H. Hegewald 2000	170	177	0	0
Chlorophyta	Chlorophyceae	Sphaeropleales	Scenedesmaceae	*Desmodesmus*	*Desmodesmus communis* (E. Hegewald) E. Hegewald 2000	680	425	7	73
Chlorophyta	Chlorophyceae	Sphaeropleales	Scenedesmaceae	*Desmodesmus*	*Desmodesmus magnus* (Meyen) P. M. Tsarenko 2000	0	0	27	0

Continued

Chlorophyta	Chlorophyceae	Sphaeropleales	Scenedesmaceae	*Desmodesmus*	*Desmodesmus opoliensis* (P.G.Richter) E.Hegewald 2000	142	106	7	0
Chlorophyta	Chlorophyceae	Sphaeropleales	Scenedesmaceae	*Desmodesmus*	*Desmodesmus perforatus* (Lemmermann) E.Hegewald 2000	0	0	17	0
Chlorophyta	Chlorophyceae	Chlamydomonadales	Volvocaceae	*Eudorina*	*Eudorina elegans* Ehrenberg 1832	0	248	0	3
Chlorophyta	Chlorophyceae	Sphaeropleales	Selenastraceae	*Messastrum*	*Messastrum gracile* (Reinsch) T.S.Garcia 2021	170	106	3	3
Chlorophyta	Chlorophyceae	Sphaeropleales	Hydrodictyaceae	*Monactinus*	*Monactinus simplex* (Meyen) Corda 1839	170	0	0	0
Chlorophyta	Trebouxiophyceae	Chlorellales	Oocystaceae	*Oocystis*	*Oocystis borgei* J. W. Snow 1903	0	142	0	0
Chlorophyta	Chlorophyceae	Sphaeropleales	Hydrodictyaceae	*Pediastrum*	*Pediastrum duplex* Meyen 1829	0	0	10	0
Chlorophyta	Chlorophyceae	Chlamydomonadales	Volvocaceae	*Pleodorina*	*Pleodorina californica* W. R. Shaw 1894	0	177	0	0
Chlorophyta	Chlorophyceae	Sphaeropleales	Scenedesmaceae	*Scenedesmus*	*Scenedesmus naegelii* Brébisson 1856	0	0	0	3
Chlorophyta	Chlorophyceae	Sphaeropleales	Scenedesmaceae	*Scenedesmus*	*Scenedesmus sp.*	170	0	0	0
Chlorophyta	Chlorophyceae	Sphaeropleales	Scenedesmaceae	*Tetradesmus*	*Tetradesmus dimorphus* (Turpin) M.J.Wynne 2016	0	0	0	13
Chlorophyta	Chlorophyceae	Sphaeropleales	Scenedesmaceae	*Tetradesmus*	*Tetradesmus lagerheimii* M.J.Wynne & Guiry 2016	0	0	0	3
Chlorophyta	Chlorophyceae	Sphaeropleales	Hydrodictyaceae	*Tetraëdron*	*Tetraëdron caudatum* (Corda) Hansgirg 1888	0	0	0	3
Chlorophyta	Chlorophyceae	Sphaeropleales	Hydrodictyaceae	*Tetraëdron*	*Tetraëdron minimum* (A. Braun) Hansgirg 1889	425	283	0	0
Chlorophyta	Chlorophyceae	Sphaeropleales	Scenedesmaceae	*Tetrastrum*	*Tetrastrum elegans* Playfair 1917	0	106	0	0
Chlorophyta	Chlorophyceae	Sphaeropleales	Scenedesmaceae	*Tetrastrum*	*Tetrastrum staurogeniiforme* (Schröder) Lemmermann 1900	170	0	0	0
Cyanophyta	Cyanophyceae	Chroococcales	Microcystaceae	*Aphanothece*	*Aphanothece microscopica* Nägeli 1849	0	0	3	0
Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	*Chroococus*	*Chroococus sp.*	198	0	0	0
Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	*Johanseninema*	*Johanseninema constrictum* (Szafer) Hasler, Dvorák & Poulícková 2014	1558	142	0	3
Cyanophyta	Cyanophyceae	Chroococcales	Microcystaceae	*Merismopedia*	*Merismopedia elegans* A. Braun ex Kützing 1849	822	283	0	0
Cyanophyta	Cyanophyceae	Chroococcales	Microcystaceae	*Merismopedia*	*Merismopedia glauca* (Ehrenberg) Kützing 1845	0	177	3	13
Cyanophyta	Cyanophyceae	Chroococcales	Microcystaceae	*Merismopedia*	*Merismopedia tenuissima* Lem-mermann 1898	0	283	0	0
Cyanophyta	Cyanophyceae	Chroococcales	Microcystaceae	*Merismopedia*	*Merismopedia tranquilla* (Ehrenberg) Trevisan 1845	283	283	7	0
Cyanophyta	Cyanophyceae	Oscillatoriales	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria corallinae* Gomont 1890	397	177	0	0
Cyanophyta	Cyanophyceae	Oscillatoriales	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria geminatum* Schwabe ex Gomont 1892	2125	4498	0	0
Cyanophyta	Cyanophyceae	Oscillatoriales	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria limosa* C. Agardh ex Gomont 1892	0	71	0	0
Cyanophyta	Cyanophyceae	Oscillatoriales	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria tenuis* C. Agardh ex Gomont 1892	0	142	0	0
Cyanophyta	Cyanophyceae	Oscillatoriales	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria tenuis* f. *natans* (Gomont) Elenkin 1949	0	0	0	7
Cyanophyta	Cyanophyceae	Oscillatoriales	Oscillatoriaceae	*Phormidium*	*Phormidium hamelii* (Frémy) Anagnostidis & Komárek 1988	595	0	0	0
Cyanophyta	Cyanophyceae	Leptolyngbyales	Leptolyngbyaceae	*Planktolyngbya*	*Planktolyngbya limnetica (Lemmermann) Komárková Legnerová & Cronberg 1992*	0	0	3	7
Cyanophyta	Cyanophyceae	Pseudanabaenales	Pseudanabaenaceae	*Pseudanabaena*	*Pseudanabaena catenata* Lauterborn 1915	0	0	37	23
Euglenozoa	Euglenophyceae	Euglenales	Phacaceae	*Phacus*	*Phacus* sp.	0	0	0	3
Euglenozoa	Euglenophyceae	Euglenales	Euglenaceae	*Trachelomonas*	*Trachelomonas abrupta* Svirenko 1914	0	0	30	0

Continued

Euglenozoa	Euglenophyceae	Euglenales	Euglenaceae	*Trachelomonas*	*Trachelomonas lefevrei* Deflandre 1926	0	0	10	0
Euglenozoa	Euglenophyceae	Euglenales	Euglenaceae	*Trachelomonas*	*Trachelomonas sp.*	0	0	0	3
Euglenozoa	Euglenophyceae	Euglenales	Euglenaceae	*Trachelomonas*	*Trachelomonas volvocinopsis* Svirenko 1914	0	0	23	23
Miozoa	Dinophyceae	Peridiniales	Peridiniaceae	*Peridinium*	*Peridinium sp.* 1	1303	1239	3	0
Miozoa	Dinophyceae	Peridiniales	Peridiniaceae	*Peridinium*	*Peridinium sp.* 2	680	850	57	13
Ochrophyta	Chrysophyceae	Chromulinales	Dinobryaceae	*Dinobryon*	*Dinobryon sertularia* Ehrengerg 1834	0	71	0	0

3.3. Occurrence of Microalgae in the Sampling Zones

Considering the two categories of species, constant species were the most abundant at dry season (62%), whilst at rainy season, accessories species were the most abundant (56%). At dry season, among the 34 recorded phytoplankton species, 3 species (*Cosmarium decoratum* West & G.S.West, *Sellaphora pupula* (Kützing) Mereschkovsky and *Staurastrum quadricornutum* J. Roy & J. Bisset) were identified exclusively at OWZ1; 2 species (*Chroococcus* sp. and *Navicula* sp.) were found only at OWZ2 and 4 species (*Cosmarium undulatum* var. *minutum* Wittrock, *Monactinus simplex* (Meyen) Corda, *Scenedesmus* sp., *Tetrastrum staurogeniiforme* (Schröder) Lemmermann) were restricted at OWZ3 (**Figure 5**). At rainy season, among 41 recorded phytoplankton species, 6 species (*Cosmarium reniforme* (Ralfs) W. Archer, *Euastrum denticulatum* F. Gay, *Fragilaria subconstricta* Østrup, *Merismopedia glauca* (Ehrenberg) Kützing, *Staurastrum* sp. and *Staurastrum teliferum* Ralfs) were exclusively found at OWZ1; 6 species (*Cymbella cymbiformis* C. Agardh, *Oocystis borgei* J. W. Snow, *Oscillatoria limosa* C. Agardh ex Gomont, *Oscillatoria tenuis* C. Agardh ex Gomont, *Pleodorina californica* W. R. Shaw and *Tetrastrum elegans* Playfair) were identified solely at OWZ2 and 2 species (*Actinotaenium australe* (Raciborski) Croasdale and *Dinobryon sertularia* Ehrengerg) were found only at OWZ3 (**Figure 5**).

When comparing algal species composition between sampling zones by using Sørensen similarity index (S), similarities were found at dry season between sampling zones (S = 0.50 - 0.57). No similarities were found between sampling zones at rainy season (S < 0.50).

3.4. Impact of Water Quality on Phytoplankton and Periphyton Communities

Canonical correspondence analysis (CCA) and the Pearson correlation test show that phytoplankton species were diversely influenced by physico-chemical parameters (**Figure 6**). At $p < 0.05$, pH was positively correlated to *C. acutum* (r = 0.39, p-value = 0.04), *C. gracile* Brébisson ex Ralfs (r = 0.39, p-value = 0.04), and *J. constrictum* (Szafer) Hasler, Dvorák & Poulícková (r = 0.43, p-value = 0.02). Electrical conductivity was negatively correlated to *A. granulata* (r = −0.51, p-value = 0.01), *Cosmarium decoratum* West & G.S. West (r = −0.41, p-value = 0.03) and *M. gracile* (Reinsch) T.S. Garcia (r = −0.41, p-value = 0.03). Transparency was negatively correlated to *Cymbella cymbiformis* C. Agardh (r = −0.44, p-value =

0.02), *Oscillatoria limosa* C. Agardh ex Gomont (r = −0.44, p-value = 0.02) and *Tetrastrum elegans* Playfair (r = −0.52, p-value = 0.01). Nitrates showed positive correlation with *Dinobryon sertularia* Ehrengerg (r = 0.42, p-value = 0.03). Orthophosphates showed a positive correlation with *J. constrictum* (r = 0.44, p-value = 0.02), *Merismopedia elegans* A. Braun ex Kützing (r = 0.54, p-value = 0.00), *Navicula* sp. (r = 0.45, p-value = 0.02) and *Oscillatoria corallinae* Gomont (r = 0.50, p-value = 0.01). Ammonium nitrogen showed a positive correlation with *Merismopedia elegans* (r = 0.43, p-value = 0.02), *Scenedesmus* sp. (r = 0.42, p-value = 0.03) and *Staurastrum hystrix* Ralfs (r = 0.48, p-value = 0.01).

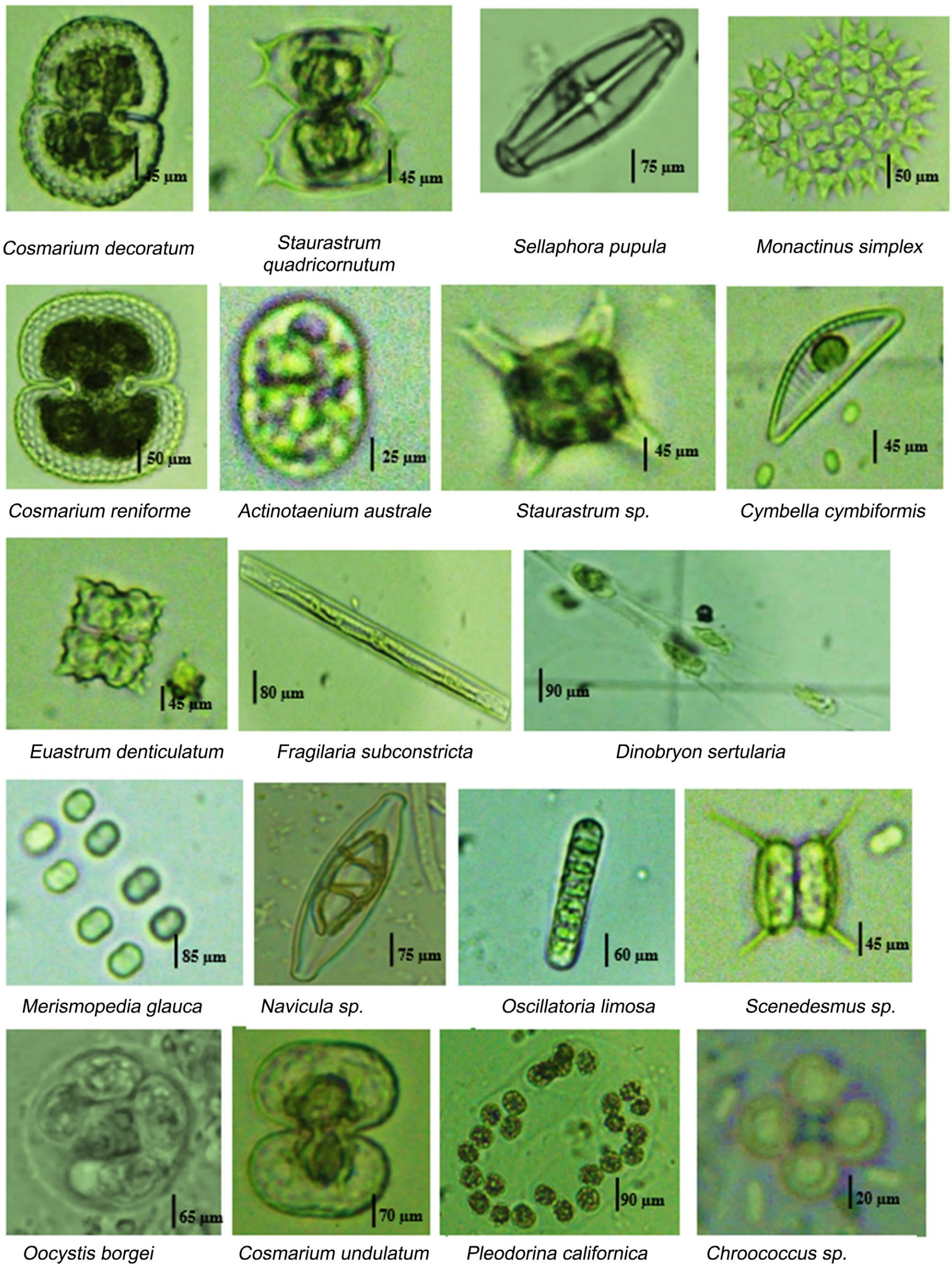


Figure 5. Few most characteristic microalgae identified in sampling zones of the Samendeni Dam Lake.

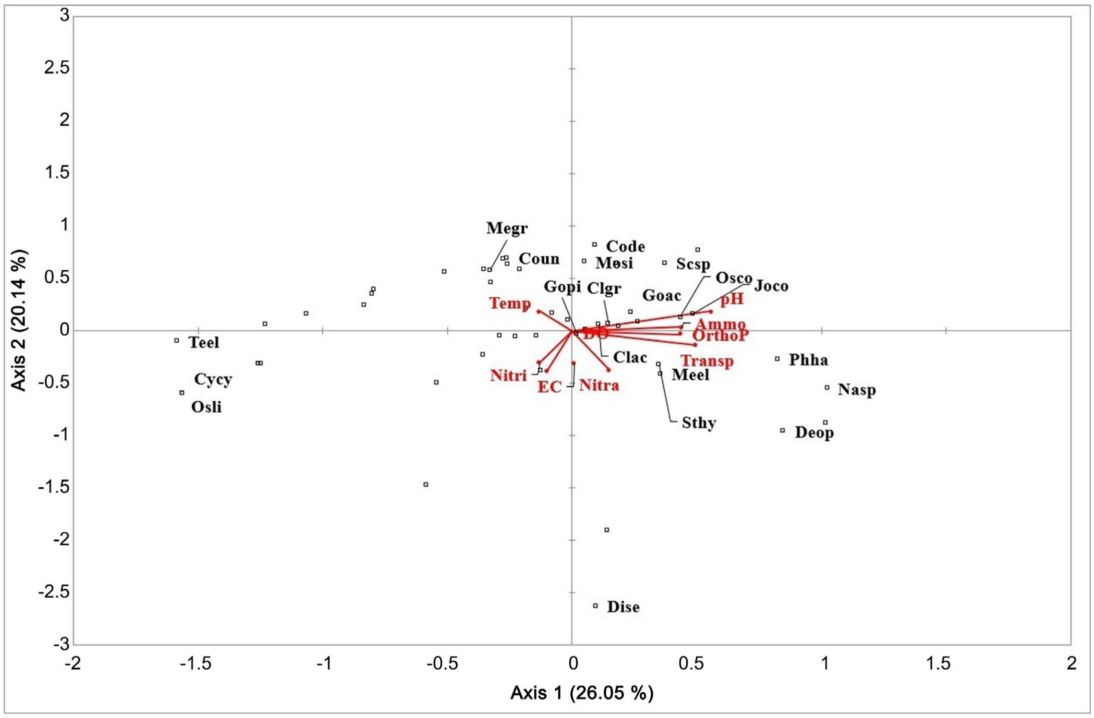


Figure 6. Canonical correspondence analysis (CCA) of phytoplankton communities and physico-chemical variables. Augr: *A. granulata*, Clac: *C. acutum*, Clgr: *C. gracile*, Code: *C. decoratum*, Coun: *C. undulatum*, Cycy: *C. cymbiformis*, Deop: *D. opoliensis*, Dise: *D. sertularia*, Goac: *G. aculeatum*, Gopi: *G. pilosum*, Joco: *J. constrictum*, Meel: *M. elegans*, Megr: *M. gracile*, Mosi: *M. simplex*, Nasp: *Navicula sp.*, Osco: *O. corallinae*, Osli: *O. limosa*, Phha: *P. hamelii*, Scsp: *Scenedesmus sp.*, Sthy: *S. hystrix*, Teel: *T. elegans*.

Redundancy analysis (**Figure 7**) and Pearson correlation test show that periphyton species were diversely influenced by physico-chemical parameters. At $p < 0.05$, pH was positively correlated to *Neidium affine* (Ehrenberg) Pfitzer (r = 0.70, p-value = 0.04). Electrical conductivity was positively correlated to *Aulacoseira granulata* (Ehrenberg) Simonsen (r = 0.71, p-value = 0.03), *C. acutum* (r = 0.84, p-value = 0.01), *Desmodesmus communis* (E. Hegewald) E. Hegewald (r = 0.73, p-value = 0.03), *Encyonema elginense* (Krammer) D.G.Mann (r = 0.94, p-value = 0.00), *Eudorina elegans* Ehrenberg (r = 0.80, p-value = 0.01), *M. glauca* (r = 0.68, p-value = 0.04), *Pinnularia viridis* (Nitzsch) Ehrenberg (r = 0.68, p-value = 0.04), *Staurastrum volans* West & G.S.West (r = 0.91, p-value = 0.00), *S. anceps* (r = 0.83, p-value = 0.01), *Surirella* sp. (r = 0.81, p-value = 0.01) and *Tetradesmus dimorphus* (Turpin) M.J.Wynne (r = 0.95, p-value = 0.00). Dissolved oxygen was positively correlated to *N. affine* (r = 0.81, p-value = 0.01) and negatively with *Pinnularia brebissonii* (Kützing) Rabenhorst (r = −0.70, p-value = 0.04). Transparency was positively correlated to *Gonatozygon pilosum* Wolle, *S. pupula*, *Spondylosium tetragonum* West & G. S. West, *Staurastrum brevispina* Brébisson and *Staurastrum cingulum* (West & G.S.West) G.M.Smith (r = 0.73, p-value = 0.03) and negatively with *Gomphonema gracile* Ehrenberg (r = −0.71, p-value = 0.03). Nitrates were positively correlated to *Pinnularia viridis* (r = 0.84, p-value = 0.00), *S. volans* (r = 0.81, p-value = 0.01) and *T. dimorphus* (r = 0.71, p-value =

0.03). Nitrites showed a positive correlation to *Euastrum trigibberum* West & G.S.West (r = 0.91, p-value = 0.00). Orthophosphates were positively correlated to *Gomphonema gracile* (r = 0.73, p-value = 0.03).

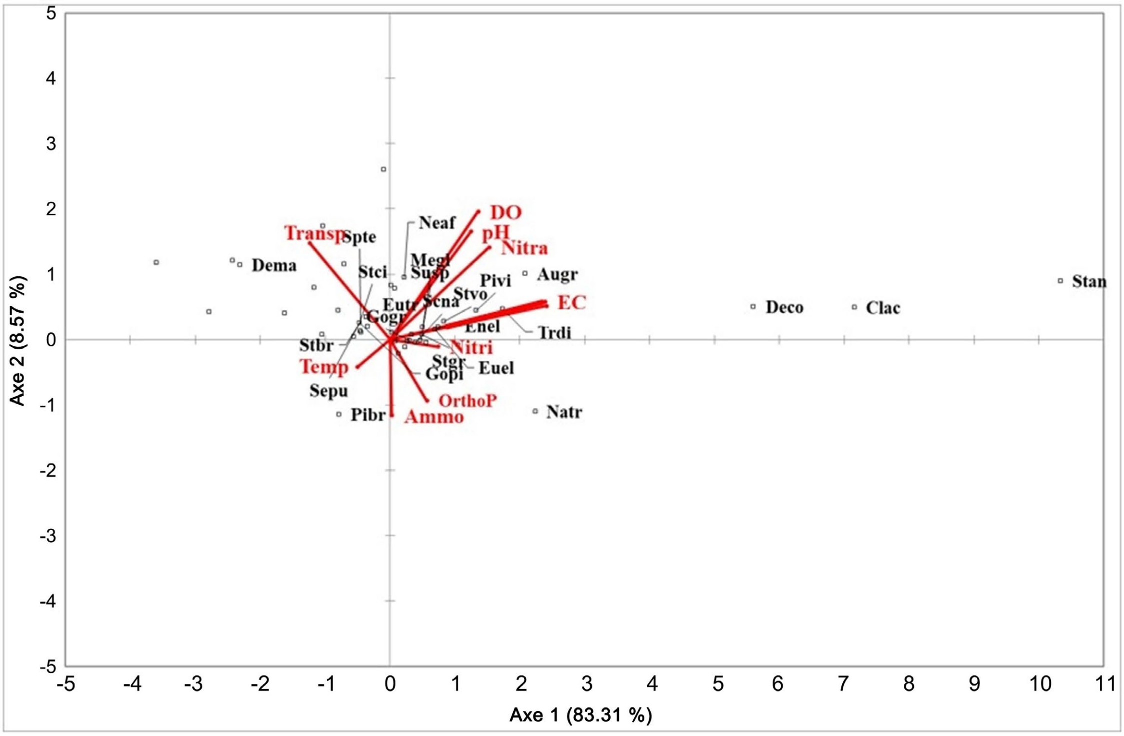


Figure 7. Redundancy analysis (RDA) of periphyton communities and physico-chemical variables. Augr: *A. granulata*, Clac: *C. acutum*, Deco: *D. communis*, Dema: *Desmodesmus magnus*, Enel: *E. elginense*, Eutr: *E. trigibberum*, Euel: *E. elegans*, Gogr: *G. gracile*, Gopi: *G. pilosum*, Megl: *M. glauca*, Natr: *N. tripunctata*, Neaf: *N. affine*, Pibr: *P. brebissonii*, Pivi: *P. viridis*, Scna: *S. naegelii*, Sepu: *S. pupula*, Spte: *S. tetragonum*, Stbr: *S. brevispina*, Stci: *S. cingulum*, Stgr: *S. gracile*, Stan: *S. anceps*, Stvo: *S. volans*, Susp: *Surirella sp.*, Trdi: T. *dimorphus*.

4. Discussion

4.1. Physico-Chemical Variables of Freshwater

Understanding the ecological processes of a freshwater habitat using physico-chemical parameters is crucial for assessing its ecological health and long-term stability [28]. In this study, some major water parameters were used in this way. These parameters play a very important role in the survival of both micro and macro-organisms in an aquatic ecosystem [29]. Thus, measured pH was found to be within the standard of natural waters that is between 6.00 and 8.50 [30]. Standard values of pH were previously noted by different works in Burkina Faso such as those of Ouattara *et al.* [31] on the Loumbila reservoir (pH = 7.92) 68 years after impoundment and Zongo *et al.* [7] on the Bagré reservoir (pH = 8.31) 6 years after impoundment. The values of pH between 7.50 and 8.50 are favorable for good production of microalgae [7]. Electrical conductivity of 74.59 ± 4.76 µS/cm is characteristic of a system with limited mineralization and relatively low anthropogenic influence, reflecting a water body in its early stages of nutrient and mineral cycling [32]. However, high values can prevent light penetration and medium oxygenation [33]. The temperature stability of 29.37˚C ± 1.40˚C is ecologically significant for tropical freshwater systems, as it supports year-round biological activity and ensures a relatively consistent metabolic rate for aquatic organisms [34]. The water temperature was practically the same throughout water body [31] [35]. It is influenced by climatic variables such as air temperature, solar radiation, wind speed, flow rate, groundwater [36]. In Samendeni freshwater, temperatures were in the range of 18˚C - 30˚C, facilitating the development of phytoplankton [7]. Water transparency of 1.58 ± 0.24 m in Samendeni Dam Lake was higher than that measured by Zongo *et al.* [7] (Transp = 0.49 m) and Ouattara *et al.* [31] (Transp = 0.57 m) in Bagré and Loumbila reservoirs, respectively. The high transparency of the Samendeni dam lake proves that this newly impounded reservoir is less disturbed compared to the others. However, the high transparency of water at dry season compared to rainy season could be explained by water flows from the blackish-colored forest litter, located at the dam lake shore drained into the water body during rainy season [37]. Dissolved oxygen of 7.25 ± 0.49 $mg \cdot L^{-1}$ ranges within the standard of the required values [3 to 8 $mg \cdot L^{-1}$) for natural waters [38]. This is essential in supporting aquatic organisms and indicating good water quality. Higher oxygen levels enhance the metabolic activity, stimulate primary production and alter nutrient cycling, potentially leading to nutrient depletion in the water column [39]. The best water quality should correspond to total nitrogen and total phosphorus concentrations close to zero [40]. Therefore, nutrient profile of Samendeni Reservoir, characterised by low concentrations of nitrates, nitrites, ammonium nitrogen and orthophosphates, reflects a system with limited nutrient loading and low eutrophication risk [41]. However, the significant increase in the water contents of nitrites, ammonium nitrogen, and orthophosphates at rainy season suggests that external inputs from runoff are an important driver of nutrient dynamics [42]. Seasonal variations likely enhance nutrient availability for phytoplanktonic and periphytic microalgal communities, promoting growth during the rainy season. According to Cook *et al.* [43], this episodic nutrient enrichment of the water body could lead to temporary algal blooms, altering production rates, and potentially influencing competition among algal species.

4.2. Algal Microflora in the Lake

Anthropogenic factors (e.g., agriculture, animal watering, fishing) and climatic variables (e.g., precipitation, solar radiation, wind) influencing physico-chemical parameters of water contribute to the variation in species' richness, composition, abundance and assemblage of microalgae in water bodies [44]. The dominance of Charophyta in the Samendeni Dam Lake during dry and rainy seasons indicates the adaptability and resilience of this taxonomical group to changing environmental conditions. Charophyta can grow well in neutral pH (7.5 to 8.5) and optimum temperature (18˚C to 30˚C) [45] as observed in the study habitat. Desmidiaceae that numerically dominate the algal flora in waters from the sudanian and sahelian zones of Africa is similarly mentioned by authors such as Ouattara *et al.* [46] and Santi *et al.* [47]. Miozoa and Ochrophyta were less represented in the water body, reflecting their limited ecological adaptability. Their low abundance could suggest specific environmental sensitivities or a preference for niche habitats in the water body. The Shannon-Wiener diversity index highlighted significant differences between seasons and zones, suggesting complex interactions between microalgae and environmental factors [48]. High evenness values indicate that several microalgae species coexist in sampling zones. The specific richness of phytoplankton recorded in Samendeni Dam Lake was lower than that of Bagré Reservoir with 203 species, including 114 new species [49] and Loumbila Reservoir with 205 species [31]. That may be due to the characteristics of the Samendeni reservoir which is younger than the Bagré and the Loumbila reservoirs and less influenced by anthropogenic activities. Consequently, high water clarity and low nutrient content observed in the Samendeni Dam Lake conduct to lower species richness. According to Ravindra and Kaushik [50], nitrates and orthophosphates stimulate the proliferation of microalgae. Species abundance indicates a dominance of *C. acutum* in the dry season and *O. geminatum* in the rainy season. Additionally, some species of phytoplankton are exclusively present in different zones and adapted to specific ecological niches [51]. The shift from constant species dominance in the dry season to accessory species dominance highlights the strong influence of water quality on microalgae abundance [52]. The abundance and diversity of phytoplankton species were higher during the dry season, likely due to the seasonal shrinkage of the water body [53] [54]. Furthermore, while periphyton density peaks during the rainy season, it exhibits lower diversity. Periphyton communities tend to dominate in oligotrophic lakes due to their ability to access nutrients from their substrates [55]. In such nutrient-poor environments, the low density of phytoplankton allows ample light to reach the substrates, facilitating the growth of periphyton [56]. The abundance and diversity of microalgae in a hydro-agricultural dam lake have favorable characteristics for sustainable agricultural practices, such as promoting plant growth and enhancing soil quality [13] [57]. As listed in **Table 3**, Desmidiaceae, Euglenaceae and Cyanophyceae were recorded in the Samendeni Dam Lake. Indeed, the presence of Desmidiaceae species indicates oligotrophic habitats, whereas Euglenaceae species are particularly abundant in eutrophic habitats [24] [58]. Cyanophyta species can include potentially toxic species that can negatively impact animal health and aquatic life [59] [60]. The presence of some species from Euglenaceae such as *Trachelomonas abrupta* Svirenko, *Trachelomonas lefevrei* Deflandre, *Trachelomonas volvocinopsis* Svirenko and *Cyanophyceae* such as *Oscillatoria geminatum* Schwabe ex Gomont, *Pseudanabaena catenata* Lauterborn and *Merismopedia elegans* A. Braun ex Kützing, in the Dam Lake would indicate the beginning of degradation of the new impounded water body and the need to control its water quality.

4.3. Relationship between Microalgae and Water Parameters

Canonical correspondence analysis and redundancy analysis have revealed that the physico-chemical parameters strongly impact phytoplankton and periphyton communities in Samendeni Dam Lake. **Figure 5** and **Figure 6** show that a strong correlation of Chlorophyta species as well as Bacillariophyta species, Charophyta species, Cyanophyta species and Ochrophyta species were observed with pH, dissolved oxygen, electrical conductivity, transparency, nitrates, nitrites, ammonium nitrogen, orthophosphates. The strong correlation shows the ability of the species to adapt and grow under various physico-chemical conditions [7] [61]. Changes in water parameters inevitably impact the availability of species in freshwater ecosystems, serving as indicators of water quality [62]. According to Olele and Ekelemu [63], the sensitivity of species to electrical conductivity as observed with some Charophyta species in this study underscores their potential suitability as indicators of a good water quality and habitat conditions. Reynolds [64] reported that Charophyta and Bacillariophyta are oligotrophic indicators, while Cyanophyta and Euglenozoa are eutrophic indicators. In contrast, the presence of some Cyanophyta species (e.g., *O. limosa*, *O. corallinae*, *M. elegans*, *M. glauca*) and some Ochrophyta species (e.g., *D. sertularia*) indicate a nutrient-rich environments [31]. However, an increase in Cyanophyta abundance can have adverse effects, as some species can generate algal blooms and be harmful. This situation may be toxic to aquatic life and be unhealthy for human population [31]. An increase in the abundance of Cyanophyta is suggesting alterations in physico-chemical parameters, leading to a shift in microalgae populations, thereby influencing the overall ecological health and dynamics of water systems [65].

5. Conclusion

The presence of diversified species (96 species) related to the physico-chemical parameters of the Samendeni Dam Lake indicates the current situation of this new impounded system. It underscores the importance of continuous water quality monitoring, serving as a fundamental tool for habitat assessment. Charophyta is emerging as the dominant group, showcasing their remarkable adaptability to less polluted water. While pH, electrical conductivity, dissolved oxygen, temperature, transparency, nitrates, nitrites, ammonium nitrogen and orthophosphates met acceptable thresholds, their variations across seasons highlight the nuanced nature of this recently established ecosystem. However, some Cyanophyta species can be potentially harmful species, indicating pollution of the water system. The presence of such species in a water body can serve as a cautionary reminder of the necessity for prudent management of the ecosystem and controlling algal proliferation. Therefore, efforts are essential for maintaining water quality, safeguarding biodiversity, and promoting sustainable agricultural practices, thereby preserving the delicate ecological balance of emerging freshwater environments.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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