Water Quality of The Tirtoagung Reservoir Based on The Phytoplankton Diversity Index And The Saprobic Index in Sleman Yogyakarta

Rahmayanti [a], and Sudarsono [a]

[a]Department of Biology Education, FMIPA, Universitas Negeri Yogyakarta

Article Info	ABSTRACT (10 PT)
	Embung Tirtoagung is an artificial aquatic ecosystem as a supplier of agricultural land during the dry season and as a fishery facility in Sleman Regency. This study aims to determine the water quality in Tirtoagung Embung based on the diversity index and saprobic index. This research is an exploratory descriptive research by way of observation. The research was conducted in February – April 2021 during the rainy season. The sampling locations were at 5 stations selected by random sampling. The results of the study showed that the water quality in Tirtoagung Embung is included in the lightly polluted category. It is known from the calculation of the diversity index that is 2,391 so that the situation is in the moderate category and the Tirtoagung reservoir is in a lightly polluted condition. Then seen from the calculation of the saprobic index, which is 0.71 - 1.00 so that the condition of the waters of the Tirtoagung reservoir is in the - mesosaprobic phase with light pollution levels and few organic and inorganic compounds. In addition, the water quality of the Tirtoagung reservoir based on physical and chemical parameters is still feasible for the survival of phytoplankton.
Corresponding Author: Rahmayanti Departement of Biology Education Universitas Negeri Yogyakarta Indonesia Email: rahmayanti.2017@uny.ac.id	

1. INTRODUCTION

Aquatic ecosystems are divided into two, namely freshwater ecosystems and seawater ecosystems. Freshwater aquatic ecosystems originate from surface water and groundwater. Based on the surface water, the waters are grouped into 2, namely flowing water (lotic water) and pooling water (lentic water). Lotic waters are waters with the characteristics of continuous currents with varying speeds so that the transfer of water masses is continuous. Examples are rivers, canals, and ditches. Meanwhile, lentic waters are waters with characteristics of slow or even non-existent water flow so that mass transfer takes a long time. For example ponds, reservoirs, lakes, swamps, ponds and ponds.

Embung Tirtoagung which is located in Krapyak Hamlet, Margoagung Village, Seyegan Sleman District. According to the records of the Water Resources, Energy and Minerals Service (SDAEM), this reservoir is one of 24 other reservoirs built across Sleman Regency to supply 30 hectares of agricultural land in the Sleman Regency area. The Tirtoagung Reservoir was built in 2014 which was inaugurated by the Regent of Sleman Sri Purnomo on April 12, 2015. The Tirtoagung Reservoir has a depth of 3-5 meters and can hold as much as 30,000 m of water to meet water resources, especially the agricultural sector in Seyegan District, Sleman Regency. Irrigation canals located next to the reservoir irrigate the rice fields and fishponds around the reservoir. Therefore, apart from being used as irrigation for agricultural land, the Tirtoa-Gung Reservoir is also used for fishing activities.

Water quality can be seen from physical and chemical parameters such as temperature, acidity, turbidity, nitrate, ammonia, and oxygen levels. Besides using chemical physical parameters, biological parameters are also used in testing water quality. The biological parameters that are usually used are the calculation of the phyto-plankton found in these waters.

The importance of knowing the diversity of an aquatic organism is to see the quality of the water. The higher the diversity of phytoplankton, the better the quality of the water. It is important to know the condition of the sap-robitas level of waters, which is the state of water quality caused by the addition of organic matter in a water, the indicator of which is usually the number and composition of the species of organisms in the

waters (Anggoro, 1988). According to Parsoone and Depauw (1983) in Utomo (2013), that the saprobic level will indicate the degree of pollution that occurs in the waters and will be manifested by the many microorganism indicators of pollution. The saprocity of the waters can be seen from the number of tons of phytoplankton or zooplankton also macrobenthos. In this study using phytoplankton because phytoplankton is an organism that produces organic compounds.

Phytoplankton is an important organism in the sea because it is the basic organism in composing a food chain in an ecosystem. Phytoplankton are also known as producers which produce food sources from inorganic materials (Webber and Thurman, 1991). Phytoplankton will be utilized by trophic level consumers in the waters, such as invertebrates, fish and marine mammals (Asriyana and Yuliana, 2012).

2. RESEARCH METHOD

Contains the type of research, time and place of research, targets/objectives, research subjects, procedures, instruments and data analysis techniques as well as other matters related to the method of research. targets/objectives, research subjects, procedures, data and instruments, and data collection techniques, as well as data analysis techniques and other matters related to the method of research can be written in sub-chapters, with sub-headings. Sub-subheadings do not need to be notated, but are written in lowercase with a capital letter, TNR-12 bold, left aligned. As an example can be seen below.

2.1 Types of Research

This study uses a quantitative descriptive explorative approach by means of observation.

2.2 Time and Place of Research

This study was conducted in February 2021. The sampling location was in Embung Tirto Agung, Sleman. The observation of phytoplnakton samples were carried out by the Microscopy Laboratory FMIPA UNY. The process of identifying and calculating the number of phytoplankton is carried out in the Biology library of FMIPA UNY

2.3 Subject of Research

The population's study was all phytoplankton living in Embung Tirtoagung, Sleman and the sample was phytoplankton netted in plankton net no. 25 in each samel collection zone at 5 stations.

2.4 Procedure
Preparation and determination of sampling points

The preparation carried out is a survey of the place or location of research and preparation of the necessary tools and materials. Determination of the location of the study was also carried out by purposive sampling method. There are 5 station locations for water sampling, namely:

a) Station I is part of the outlet or outlet channel of Embung Tirtoagung water. The condition of the waters at this location is water that tends to be more turbid than other stations. There are no community activities that affect the condition of the waters in Embung Tirtoagung Sleman Yogyakarta.

b) Station II is part of the inlet or water entrance channel of Embung Tirtoagung. The condition of the waters at this location is close to residential areas and there is community intervention as a tilapia farming fishery.

c) Station III is the western part of Tirtoagung reservoir. The condition of the waters at this location is used by the surrounding community as agriculture and irrigation in the Rice Field area of Krapyak Hamlet, Sleman, Yogyakarta.

d) Station IV is the eastern part of Tirtoagung reservoir. The condition of the waters at this location is that there are agricultural irrigation canals but are no longer used for agricultural irrigation facilities and are more widely used as fish fishing points.

e) Station V is the central part of Embung Tirtoagung. The condition of the waters at this location is known to have no influence from the activities of the surrounding community.

Sampling

Phytoplankton sampling is carried out in the morning at 10 am. Sampling was carried out 2 repetitions 10 days apart. In each sampling at 5 stations starting from the outlet, inlet, then to the west point then to the east point and finally to the middle section. Sampling was carried out in February, namely in the rainy season. The weather on the day of sampling in the first test was sunny while on the second test it tended to be cloudy.

Sampling steps:

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a) Prepare tools and materials in the form of *plankton net* and 20 ml flakon bottles containing glycerin and alcohol.
b) Lower the *plankton net into the designated convex point, then pull* the plankton net *to the surface*.
c) Put filtered water samples from plankton net storage bottles into ±20 ml flakon bottles containing 70% alcohol and glycerin.
d) Placing a flakon bottle on an ice flask filled with ice.
e) Do the same at all specified convex points sequentially

Measurement of physical-chemical factors of reservoir waters
a) Temperature measurement
The water temperature at each station is measured by inserting a thermometer into a bucket filled with sample water for ± 5 minutes then recording the results.
b) pH measurement
The pH of the water at each station is measured by inserting the pH meter into a bucket containing the sample water for ± 5 minutes then recording the resultsa.
c) Light intensity measurement
The brightness or intensity of light at each station is measured by lifting the lux meter towards sunlight for ± 5 minutes then record the results.
d) Measurement of turbidity, DO, phosphate and nitrate
Conducted at the Center for Environmental Health Engineering and Disease Control Yogyakarta (BBTKLPP) by providing test samples as much as 1 liter per station carried using a 1-liter sample test bottle.

Observation activities in the Laboratory
a) Prepare tools and materials in the form of microscopes, object glasses, cover glasses, tissue, droppers, and flacon bottles containing water samples to be observed
b) Take a sample of 1 drop using a drip dropper on the object glass then covered with a cover glass.
c) Observe using a microscope with a magnification of 10X10.
d) Photograph the phytoplankton obtained and write the results in the book along with the amount.
e) For those whose species names are unknown, sample A is written, sample B, etc. until identified using an identification book
f) After each observation, clean the glass cover and object glass using a tissue for the next sample droplet.
g) Observations were made as much as 1 ml (20 drops) on each sample bottle.

Observation and identification of Phytoplankton
Phytoplankton sample observations were carried out in the microscopy room of the UNY biological laboratory using a microscope. Observation is carried out by taking 1 drop of water sample sample on a glass object then closed using *a glass cover* and observed under a microscope. After that, identification was carried out by matching organisms obtained using identification books entitled "Illustration of The Freshwater Plankton Of Japan" and "Microalgae Identification".

2.5 Data, Instruments, and Data Collection Techniques
Data
The sampling zone is in the form of :
a) Station 1 : outlet
b) Station 2 : inlet
c) Station 3 : west
d) Station 4 : east
e) 5th Station : Central
Physical and chemical parameters
a) Physics: temperature, pH, light intensity
b) Chemical : DO, Nitrate, Phosphate
Biological parameters
Phytoplankton diversity

Instruments
   This instruments used in this study were pH meter, microscope, label paper, plankton net no. 25, turbidimeter, glass objects, *cover* glass, thermometer, pipet, identification book, camera, luxmeter do meter. the materials used were glycerine, aquadest, water samples from embung and alcohol 70 %

Data Collection Techniques
   Sampling is carried out using plankton net by sinking into reservoir water and then withdrawn, so that the water is filtered in plankton net. The filtered water is put into a bottle that has been given glycerin and 70% alcohol. Sampling was carried out 2 times at each station.

Data Analysis Techniques
   a) Phytoplankton type data
   b) Phytoplankton diversity index is calculated by the formula:

$$H' = -\sum (P_i \ln P_i) \qquad ; P_i = N_i/N$$

   Information:
   H'   : Species Diversity Index
   N   : The number of individuals of all types
   Ni   : Number of individuals of a breed

No	H'	Quality
1	>3	Unpolluted
2	2>H'>3	Very lightly polluted
3	1,6>H'>2	Lightly polluted
4	1>H'>1,6	Moderately polluted
5	<1	Heavily polluted

   c) Phytoplankton Density (individual/L)

$$\frac{A \times V}{V_S}$$

   Information :
   A   : amount of phytoplankton
   V   : Total amount of volume
   Vs   : Water sample volume

   d) Dominance Index

$$D = \sum_{i=0}^{i} \left(\frac{ni}{N}\right)\square^2$$

   Information :
   D   = Dominance Index
   Ni = Number of individuals from each spesies
   N   = Total number of individuals

   The criteria used to determine the Dominance Index are: :
   <0,5   : Low breed dominance
   0,5<0<1   : Medium breed dominance
   0>1   : High breed dominance

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e)   Saprobic Index
     To calculate the saprobitas of waters, trosap analysis is used, the value of which is determined from the Saprobik Index (SI). The formula used is the result of the formulation (Maresi, et al. 2015 in Rikardo 2016) :

$$X = \frac{(C + 3D - B - 3A}{A + B + C + D}$$

Information :
X : Saprobic Index
A : number of genera/species of polysaporobic organisms (Cyanophyceae)
B : number of genera/species of α organisms – Mesosaprobic (Euglenaphyta)
C : number of generus/species of β – Mesosaprobic organisms (Chloroccales and diatoms)
D : number of genus/species of Oligosaprobic organisms (Chrysophyceae/Conjugates)

f)   Physical-Chemical Data analysis techniques The data analysis technique used in this study is descriptive analysis describing the results of the research and presented in the form of tables and figures

3.   RESULTS AND ANALYSIS

In the results of research conducted in Embung Tirto Agung Krapyak Hamlet, Margoagung Village, Seegan District, Sleman Regency found 5 classes of phytoplankton consisting of 12 types. The class of phytoplankton found consists of Bacillariophyceae, Chlorophyceae, Cyanophyceae, Rhodophyceae and Euglenaphyceae

Table 1. Types of Phytoplankton found in Embung Tirtoagung

Class	Species	Sampling Station 1	2	3	4	5	Sum
A	*Coscinodiscus radiates*	8	3	5	5	8	29
	Surriella robusta	3	5	6	3	3	20
	Asterococcus sp.	3	4	4	6	10	27
	Sphaeroplea sp.	4	3	6	4	9	26
	Pediastrum simplex	-	1	6	5	5	17
B	*Spirogyra* sp.	4	4	3	5	5	21
	Stigocloneum sp	-	3	4	5	-	12
	Zygnema sp.	2	6	4	2	1	15
	Spirullina sp.	-	5	5	2	3	15
D	*Oscilatoria* sp.	2	2	2	4	8	18
E	*Bangia* sp.	2	5	2	2	2	13
F	*Euglena caudate*	-	1	1	1	8	11
	Jumlah	28	42	48	44	62	224

Information :
     A = class Bacillariophyceae
     B = class Chlorophyceae
     C = class Cyanophyceae
     D = class Rhodophyceae
     E = class Euglenaphyceae

It is known that phytoplankton diversity indices have varying results. The highest phytoplankton diversity index was at station 3 or the western part of the reservoir at 2.391. The high value of the diversity index at the station is due to the presence of chemical physics factors measured during the study.

Table 2. Diversity Index value in Embung Tirto Agung

Diversity index (H') at each station

Station 1	Station 2	Station 3	Station 4	Station 5
1.9580	2.3744	2.3910	2.3868	2.2436

Judging from the physical parameters, station 3 has an optimum temperature for phytoplankton growth, which is 30.5 ° C, then from the turbidity value of 3.35 NTU and for light intensity at station 3 has a value of 3169 Lux. The turbidity value at station 1 has the highest turbidity value of other stations. This makes it difficult for light to enter or penetrate in the water for phytoplankton survival and photosynthesis, causing phytoplankton diversity at station 3 to be higher than other stations.

Then seen from the chemical parameters include a fairly high nitrate content and support the growth of phytoplankton which is 5.09 mg / L. This is in accordance with the opinion of Yazwar (2008) who states that the high concentration of nitrates that is optimal for phytoplankton life is 3.9 mg / L - 15.5 mg / L. While the lowest phytoplankton diversity value is at the first station of 1.958. This happens because the nitrate content at the station is relatively low, which is 1.09 mg / L (table). According to Basmi (1995), if the content of nitrates and phosphates in a water is minimum, the growth of phytoplankton or its population will decrease.
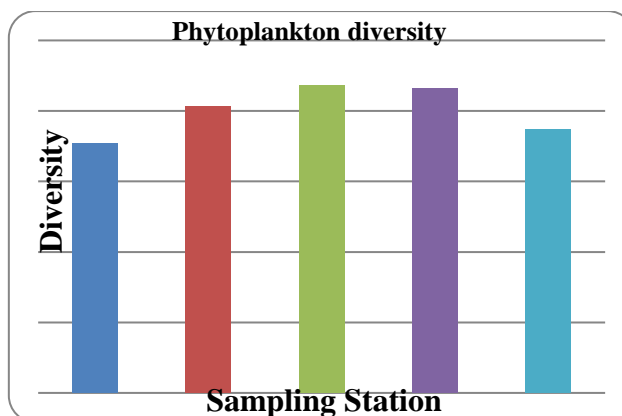

Figure 1. Phytoplankton Diversity in Embung Tirtoagung

Based on the phytoplankton diversity index in Embung Tirtoagung, it shows that the reservoir is very lightly polluted. Of the five study sites, station 1, the outlet section, was seen to be at a level of light pollution. This is due to physico-chemical factors, namely the lowest nitrate and phosphate content of other stations. When viewed from other environmental factors such as turbidity, station 1 is the most turbid than other stations because of the possibility of silt and soil deposits as station 1 is the outlet section which is used as an outlet so that the water of this outlet tends to be more polluted even though it is still in the mild category.

Based on the calculation of the saprobic index in the table above, the saprobic index at the five research stations ranged from the lowest +0.71 to the highest of +1.00. The highest saprobic index of 1.00 is found at station 1 which is the outlet and the lowest saprobic index value of 1.00 is at station 5 which is the middle of the reservoir.

Table 3. Saprobic index values at each station

Station	Saprobic Index value	Pollution Level	Saprobik phase
1	1.00	Light	β - mesosaprobik
2	0.92	Light	β - mesosaprobik
3	0.95	Light	β - mesosaprobik
4	0.95	Light	β - mesosaprobik
5	0.71	Light	β - mesosaprobik

According to Suwondo (2004) based on the calculation of the saprobic index in Embung Tirtoagung that the waters are classified at the level of saprobite β mesosaprobic / oligosaprobic, where the relationship

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between pollutants and the saprobic index obtained shows that the waters are classified as light pollution with few organic and inorganic compounds. Organic pollution in a water is related to the content of nitrates and phosphates, this is because nitrates and phosphates act as nutrients for phytoplankton to grow and multiply.

The results show that the quality of Embung Tirtoagung is in the Beta Mesosaprobik phase, in accordance with the theory of Pantle and Buck (1955) in Anggoro (1983) that Beta Mesosaprobik is a saprobitas of waters with moderate to mild pollution levels, fertility can be used for the cultivation of shellfish, oysters, snapper, milkfish and seaweed. Because the reservoir is also used as a place for fish farming.

The quality of waters can be determined from physical and chemical parameters. The physical parameters measured are temperature, light intensity and turbidity. The chemical parameters measured are pH, DO, nitrate and phosphate content.

Table 4. Measurement of Physical-Chemical Conditions of Embung Tirtoagung Waters

No	Parameter	Observation Station					Average
		1	2	3	4	5	
A. Physics							
1	Temperature	31	30.5	30.5	30	30	30,4
2	Light intensity	1324	2209	3169	1151	4730	2516
3	Turbidity	6.75	3.35	3.35	3.25	3.2	3.98
B. Chemistry							
4	Ph	8.5	8.53	8.6	8.55	8.75	8,6
5	DO	7.5	7.95	7.25	7.8	8	7.7
6	Phosphate	0.11	0.15	0.16	0.32	0.30	0.21
7	Nitrate	1.91	4.36	5.09	2.64	5.30	3.86

Based on the measurement of physical-chemical parameters carried out, it was found that the temperature was 30 ° C, light intensity 2516 lux, turbidity 3.98 NTU, pH 8.6, DO 7.7 mg / L, nitrate 3.86 mg / L, phosphate 0.21 mg / L. with these results showed that the Tirtoagung reservoir was still suitable for phytoplankton survival even though the nitrate content was higher and caused eutrophication.

4. CONCLUSION

The quality of Embung Tirtoagung waters based on its phytoplankton diversity index is included in the medium category so that the quality of waters in Embung Tirtoagung is classified as very lightly polluted. The quality of Embung Tirtoagung waters based on the calculation of the saprobic index is at the level of saprobitas β mesosaprobic / oligosaprobic, namely the relationship between pollutants and the saprobic index obtained shows that these waters are classified as light pollution with few organic and inorganic compounds. Water quality based on the measurement of physical-chemical parameters carried out found that the Tirtoagung reservoir is still suitable for phytoplankton survival even though the nitrate content is higher and causes eutrophication.

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