JURNAL PENDIDIKAN MATEMATIKA DAN IPA

Vol. 13, No. 1 (2022) h. 141-155

http://jurnal.untan.ac.id/index.php/PMP

TROPHIC STATUS OF PHYTOPLANKTON AS BIOINDICATOR OF EUTROPHICATION LEVEL OF FLOOD RETENTION PONDS IN SAMARINDA CITY

Ndaruning Tri Rahayu[1], Sudrajat[2], Medi Hendra[3]

[1,2,3] Department Of Biology Faculty Of Mathematics And natural Sciences, University Of Mulawarman Samarinda, East Kalimantan, Indonesia

Email: rahayu.smd07@gmail.com

DOI: http://dx.doi.org/10.26418/jpmipa.v13i1.51663

Abstract

The flood retention pond in the city of Samarinda, is a body of stagnant water (lentik), the flow of water is not so large that it affects the life of the organisms in it. The research was carried out in December 2020 - March 2021 at three stations using the method Purposive sampling. The composition of phytoplankton species consisted of Chlorophyceae, Dictyochophyceae, Cyanophyceae, Bacillariophyceae (Diatom), Euglenophyceae, Dinophyceae, Trebouxiophyceae. There are three classes of phytoplankton with relatively high abundance, namely Chlorophyceae, Cyanophyceae and Bacillariophyceae (Diatoms). At the moment of condition rain the highest species abundance at station 1 was Eutonia sp. from the Bacillariophyceae (Diatom) class, at station 2 the species of Merismopedia punctata from the Cyanophyceae class and at station 3 Merismopedia punctata from class Cyanophyceae. When conditions are not raining, the highest species abundance at station 1 is Eutonia sp. from the Bacillariophyceae (Diatom) class, at station 2 the species of Merismopedia punctata is from the Cyanophyceae class and at station 3 is the Merismopedia punctata species from the Cyanophyceae class. TSI analysis when it rains and does not rain have an average index value ranged from 10,46 – 17,79, the eutrophication status is in the Oligotrophic category. The water quality factor that forces the eutrophication status in this pond is related to the relatively high nitrogen (N) and phosphorus (P) nutrients.

Keywords: Phytoplankton composition, retention pond, trophic status.

INTRODUCTION

Retention ponds are one way to prevent regular flooding in Samarinda City. This retention pond is one of the drainage systems in the north Samarinda sub - district, Samarinda

Received : 01/01/2022
Revised : 05/01/2022
Accepted : 09/01/2022

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 1 (2022) h. 141-155

Ulu. According to Pramaningsih (2017) The river drainage system and retention pond serve to withstand surface water flow coming from trenches - small trenches and serves as a flood control system within the city.

In densely populated urban areas, there is a wide variety of socioeconomic activities such as markets, shopping centers, hospitals and hotels that produce domestic waste. In such conditions, in case of heavy rain the trench will carry its domestic waste and be directed into a flood retention pond. Household waste contains a lot of organic material N, P, K from ditergen and others and if it enters a body of water will cause environmental pollution. One indicator of environmental pollution of water by organic matter is eutrophication (fertility of water). Eutrophication is a process of water enrichment, mainly by nitrogen and phosphorus, as well as several other factors such as silicon, potassium, calcium that cause uncontrolled growth of aquatic plants known as blooming algae. Eutrophication is caused by an increase in nutrients entering the waters caused by household and industrial waste (Soeprobowati, 2010). According to Suryono (2010) the natural eutrophication process will occur in stagnant waters for a long time. Along with the increasing activity of the community, there will be an increase in the entry of nutrients into the body of water and if the process of self purification is exceeded then there will be a process of eutrophication.

Phytoplankton act as a producer in water ecosystems that act as an important role in maintaining a dynamic balance in water (Zhao, 2019) and phytoplankton act as a role in determining ecosystem productivity in water. Phytoplankton highly sensitive to changes such as physical, chemical and biological aquatic environments (Dong, 2014). In increasing nutrient availability is often the occurrence of blooming algae that will cause ecosystem conditions to be disrupted (Michalak, 2016). The blooming process of algae has a damaging effect on the structure of the phytoplankton community, due to the dominance of certain phytoplankton species (Kozak, 2020).

Changes in composition, the community structure of diversity index and distribution can be used to evaluate eutrophication status (Liu, 2017). Analysis that can be used to evaluate the fertility rate of the waters is a condition of trophic state index by analyzing several parameters that affect the eutrophic process. This index value can facilitate the assessment of the condition of a water (Khasani, 2017). Trophic status is a condition of the availability of energy in the nets - food webs and is the main thing in supporting the integrity of the community and the function of the ecosystem. This means that describing the state of trophic status in the ecosystem requires analysis of the ratio of available nutrients, because in an ecosystem the rate of carbon input is related to the rate of supply of nitrogen and phosphorus. According to Carlson (1977) grouping fertility status rates in waters into Ultraoligotrophic, Oligotrophic, Mesotrophic, Eutrophic and Hypereutrophic.

Based on the background above, the author is interested in researching one of the flood retention ponds in Samarinda City to be able to know how the composition of phytoplankton

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 1 (2022) h. 141-155

species, the trophic status of their ecosystems based on phytoplankton, and the parameters of water quality that drive the occurrence of eutrophication.

METHODS

This study was conducted from November 2020 to March 2021. The sampling was conducted at the flood retention pond Jl.Wahab Syahrani Samarinda City. Observation and analysis of phytoplankton samples were conducted in the Laboratory of Animal Anatomy and Microtechnical, Building G, 3rd Floor. Chlorophyll-a measurement was conducted in the Laboratory of Plant Physiology and Development and Analysis of water quality chemical factors (Nitrates and Phosphates) conducted in the Environmental Laboratory of the Faculty of Mathematics and Natural Sciences, Mulawarman University, Samarinda, East Kalimantan.

Determination of location and sampling point is using the purposive sampling method of location determination based on the existence of certain objectives by researchers and following technical considerations.

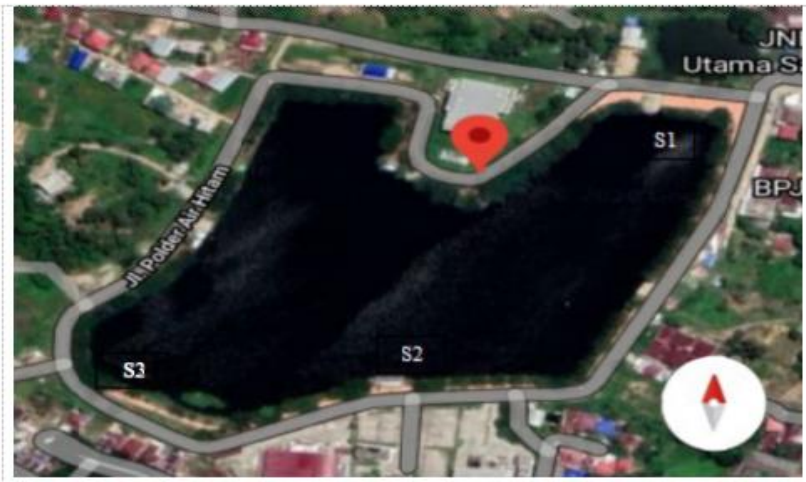

Figure 1. Sampling location in flood retention pond jl.wahab syahrani samarinda city.

Station 1

The sampling location at station 1 is located on the mainline of water ingress coming from one of the small ponds as a water reservoir containing floodwater overflows that will be full when there is heavy rain.

Station 2

The sampling location at station 2 is located on the mainline of the water.

Station 3

The sampling location at station 3 is located at the ingress of water coming from the land that is made to accommodate or where the water passes from the mainland

Station Determination

This study is using the purposive sampling method, namely sampling at every point in the flood retention pond. Where 3 sampling stations are set for observation, namely station 1 in the water entrance section, station 2 in the water exit section, and station 3 in the water entry section coming from the mainland. Determination of the

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 1 (2022) h. 141-155

location of sampling points taking into account the ecological impact of the waters due to surrounding activities such as indiscriminate garbage disposal and settlements around the pond

Water Sampling

Water quality data is used to determine the condition of water quality and fertility of water in the form of physical parameters - chemistry and biology. Each sampling point for analysis of the quality of physics - chemistry was taken as much as 1.5 liters of water samples. The sampling method is done by means of retention ponds divided into 3 station points. Each station is sampled with 1.5 liters of water and then put it in a sample bottle. After that the sample will be taken to the environmental laboratory to be analyzed water quality.

Plankton Sampling

Sampling water at the sample point using a sampling tool with a water volume of 50 liters, then water samples filtered using plankton net no.25 and inserted into the sample bottle. Water samples that have been filtered and inserted into the sample bottle are sprayed with a sprayer containing aquadest and given formaldehyde 4% as much as 2 -3 drops. Sampling is done at 3 stations that have been divided. Then brought for further analysis in the Laboratory of Animal Anatomy and Microtechnical, Building G, 3rd Floor, Faculty of Mathematics and Natural Sciences Mulawarman University, Samarinda.

Chlorophyll Sampling-a

Chlorophyll sampling-a was preceded by phytoplankton sampling. Phytoplankton samples are taken horizontally at each station by filtering 5 liters of water using net plankton no. 25for then filtered and inserted into the sample bottle. After the sample is obtained put it in a dark bottle and put it in a tool box to keep the chlorophyll-a awake.

Phytoplankton Observation

Taken one drop of water from the sample bottle and drip on the glass object using a dropping pipette and then covered with a glass cover. It is then observed using a microscope with magnifications of 10X, 100X and 400X in order to provide clarity on the type of phytoplankton. His observations were made to be identified and then calculated abundance index, diversity index, alignment index and dominance index. Phytoplankton that have been in can be analyzed and identified by referring to the book Plankton Practical Guide to Indetifying Plankton, Book Phytoplankton and Book Field Guide to Phytoplankton

Data Analysis

The phytoplankton community analyzed using the Plankton Abundance Index (APHA, 1989), Shannon Whienner Diversity Index (H') and Shannon-Evenness Index (E) with the following formula:

A. Plankton Abundance Index (APHA,1989)

$$N = \frac{T}{L} x \frac{p}{p} x \frac{V}{v} x \frac{1}{W}$$

Information:

N = Amount of Phytoplankton per liter

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 1 (2022) h. 141-155

T = Area of glass cover (mm2)
L = Field of view (mm2)
P = Number of phytos
P = Number of observed field of view
V= Filtered phytoplankton sample volume (ml)
v = Volume of phytoplankton samples under the glass cover (ml)
W = Volume of filtered phytoplankton samples (liters)

B. Shannon Whienner Diversity Index (H')

$$H' = \sum pi \ \log \ pi \ (pi = \frac{n}{N})$$

Information:
H' = Shannon-Winner Diversity
Pi = Abundance Index
n = Number of individuals per species
N = Total number of all types

C. Shannon-Evenness E. Index (E)

$$E = \frac{H'}{Hmaks}$$

Information:
E = Shannon-Evennes e-grading index
H' = Shannon-Winner diversity index
H max = ln S
S = Number of species

D. Samppson Dominance Index

$$C = \sum[ni/N]^2$$

Information:
C = Dominance index
Ni = Number of Individuals
N = Total Number of Individuals

E. Chlorophyll-a concentration is calculated by using equation formulas namely

$$Klorofil - a = \frac{\text{Ca x Va}}{\text{V x d}}$$

Information:
Ca = (11.6 x E665) - (1.31 x E645) - (0.14 x E630)
Va = Acetone volume (10 ml)
V = Volume of filtered water sample (ml)
D = Cuvet diameter (1 mm)
E = Absrobansi at different wavelengths (which are predicted with a wavelength of 750 nm)

F. Phytoplankton Trophic Status Index Analysis

The analysis used to determine the fertility status of the waters is the Trophic State Index (TSI) Carlson (1977). Calculation of water fertility with TSI using variable brightness secchi disk (SD), chlorophyll-a (Klr-a) and total phosphate (TP) which is then entered using the following formula:$TSI\ chl = 10\ x \left(6 - \frac{2.04 - 0.68 \ln chl}{\ln 2}\right)$

$$TSI\ SD = 10\ x \left(6 - \frac{\ln SD}{\ln 2}\right)$$

$$TSI\ P = 10\ x \left(6 - \frac{\ln \frac{48}{P}}{\ln 2}\right)$$

$$TSI = \frac{(TSI\ chl + TSI\ SD + TSI\ P)}{3}$$

Information**:**
TSI chl = Fertility index value for total chlorophyll-a
TSI SD = Fertility index value for secci disk depth
TSI P = Fertility index value for total phosphate

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 1 (2022) h. 141-155

Table 1. Water fertility status is carlson trophic state index (TSI) (1977).

TSI	Chl	P	SD	Trophic Class
< 30 – 40	0 - 2.6	0 - 12	> 8 - 4	Oligotrophic
40 – 50	2.6 - 20	12 - 24	4 - 2	Mesotrophic
50 - 70	20 - 56	24 - 96	2 – 0.5	Eutrophic
70 – 100+	56 – 155+	96 – 384+	0.5 - 0.25	Hipereutrophic

RESULTS AND DISCUSSION

The presence of phytoplankton in flood retention ponds consists of the classes Chlorophyceae, Dictyochophyceae, Cyanophyceae, Bacillariophyceae (Diatom), Euglenophyceae, Dinophyceae, and Trebouxiophyceae. The abundance and quantity of phytoplankton types is presented on (Table 2). In general there are 3 classes of phytoplankton with a relatively high abundance namely Chlorophyceae, Cyanophyceae, and Bacillariophyceae (Diatom).

Based on (Table 1) When rainy conditions can be identified as many as 7 classes namely Chlorophyceae, Dictyochophyceae, Cyanophyceae, Bacillariophyceae (Diatom), Euglenophyceae, Dinophyceae, Trebouxiophyceae and 16 species namely *Monoraphidium contortum, Carteria* sp, *Scenedesmus acutus, Gonium* sp, *Closterium* sp, *Ankistrodesmus* sp., *Dictyocha fibula ,Merismopedia punctata, Oscillatoria tenuis, Dolichospermum planctonicum, Eunotia* sp, *Pinnularia* sp, *Lioloma* sp, *Euglena* sp, *Scrippsiella* sp, *Botroyococcus acutus*. The highest abundance of species at station 1 is the *Eutonia* sp type. from the Bacillariophyceae (Diatom) class, at station 2 of the *Merismopedia punctata* class of Cyanophyceae class and at station 3 of the *Merismopedia punctata t*ype of Cyanophyceae class. The highest abundance is found at station 2 with a score of 671 ind/L and the lowest abundance is found at station 3 with a value of 471 ind/L.

While when dry conditions are not raining (Table 2) consists of 7 classes namely Chlorophyceae, Dictyochophyceae, Cyanophyceae, Bacillariophyceae (Diatom), Euglenophyceae, Dinophyceae, Trebouxiophyceae and 14 species namely *Monoraphidium contortum, Carteria* sp, *Scenedesmus acutus, Closterium* sp, *Ankistrodesmus* sp., *Dictyocha fibula , Merismopedia punctata, Oscillatoria tenuis, Dolichospermum planctonicum, Eunotia* sp, *Pinnularia* sp., *Euglena* sp, *Scrippsiella* sp, *Botroyococcus acutus*. The highest abundance of species at station 1 is the *Eutonia* sp type. From bacillariophyceae (Diatom) class of 234 ind/L, at station 2 of *Merismopedia punctata* of Cyanophyceae class, and station 3 is *Merismopedia punctata* of Cyanophyceae class. The highest abundance is found at station 1 of 666 ind/L and the lowest abundance is found at station 3 with a value of 532 ind/L.

Based on the observations and calculations of phytoplankton as a whole, the composition of phytoplankton class in the waters of flood retention ponds in samarinda city consists of Chlorophyceae, Dictyochophyceae, Cyanophyceae, Bacillariophyceae (Diatom), Euglenophyceae, Dinophyceae, Trebouxiophyceae with a total of 16

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 1 (2022) h. 141-155

species during rainy conditions and 14 species when conditions are not raining. The highest phytoplankton abundance value of the two conditions is found in station 2 which is 671 Ind/L during rainy conditions and station 1 at 666 Ind/L when conditions are not raining. This causes both stations to have a higher primary productivity value compared to station 3 which has a relatively lower phytoplankton abundance value among other stations of 471 ind/L when it rains and 532 ind/L when it is not raining. The low level of phytoplankton abundance in station 3 causes the primary productivity rate of phytoplankton in this station to be lower when compared to station 1 and station 2. Therefore, the abundance of phytoplankton in a water has to do with the primary productivity of the waters. According to Rashidy (2013), the main organism that plays a role in primary productivity is phytoplankton. The value of phytoplankton abundance at the time of research throughout the research station did not fall into the blooming category. According to Thoha (2013), phytoplankton are said to be blooming when their abundance > 5000 Ind/L.

Table 2. Composition of phytoplankton species in flood retention pond waters when it rains and does not rain

No	Class	Species Name	Amount		S1		S2		S3	
			Rain	Dry	Rain	Dry	Rain	Dry	Rain	Dry
1		*Monoraphidium contortum*	20	31	10	15	5	10	5	6
2		*Carteria* sp	73	107	20	30	33	45	20	32
3	Chlorophyceae	*Scenedesmus acutus*	62	85	20	36	22	29	20	20
4		*Gonium* sp.	368	-	112	-	146	-	110	-
5		*Closterium* sp	33	31	11	10	10	11	12	10
6		*Ankistrodesmus* sp.	29	34	12	10	10	12	7	12
7	Dictyochophyceae	*Dictyocha fibula*	35	34	10	9	15	15	10	10
8		*Merismopedia punctata*	403	493	115	142	149	172	139	179
9	Cyanophyceae	*Oscillatoria tenuis*	24	200	7	50	11	70	6	80
10		*Dolichospermum planctonicum*	80	100	37	40	28	28	15	32
11	Bacillariophyceae (Diatom)	*Eunotia* sp.	411	448	211	234	147	149	53	65
12		*Pinnularia* sp	94	94	35	35	30	30	29	29
13		*Lioloma* sp	10	-	4	-	3	-	3	-
14	Euglenophyceae	*Euglena* sp	42	37	15	10	17	17	10	10
15	Dinophyceae	*Scrippsiella* sp.	100	105	34	35	42	43	24	27
16	Trebouxiophyceae	*Botroyococcus acutus*	13	49	2	10	3	19	8	20
	Abundance		**1797**	**1848**	**655**	**666**	**671**	**650**	**471**	**532**
	Number of Species		**16**	**14**	**16**	**14**	**16**	**14**	**16**	**14**

In (Table 2) there are two species that dominate the waters, namely *Merismopedia punctata* from cyanophyceaedan class and *Eutonia* sp. from the Class Bacillariophyceae (Diatom). This is because *Merismopedia punctata* species can live in fresh water and salt water. *Merismopedia punctata* is one of the species of cyanophyceae class which in that class is able to bind water quality (N) from free air processes so as to accelerate growth compared to other species. According to Subarijanti (2010) cyanophyceae groups can survive in waters that have low nitrogen concentrations while others do not survive.

In species *Eutonia* sp. is a species of bacillariophyceae (Diatom) class in which it can live in freshwater and seawater. These classes are usually able to live in a high salinity range and are able to adapt to the surrounding

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 1 (2022) h. 141-155

environment. According to Fathur (2012), it states that the Bacillariophyceae class is cosmopolitan and rapidly multiplying and widespread. While Bismark (2009) suggests that the class is a type commonly found in freshwater waters.

Based on these two conditions when the conditions are not raining there are sepesies that are not found in the rainy conditions, namely the species *Gonium* sp. and *Lioloma* sp. This is likely due to the existence of ligkungan factors that are not suitable for the growth of both species. Which in both species can grow well in relatively high waters and high light intensity.

Diversity Index (H')

Diversity Index (H') when rain conditions average 2,143 and when not raining around 2.14 which indicates the value of the index of uniformity (H') is included in the criteria (Table 3). Both conditions show that when it rains and does not rain these waters have a moderate level of diversity index. According to Odum (1994) diversity index value with H' ≤ 1 value including low diversity level, H' value of 1<< 3rd moderate diversity level and if H' value ≥ 3rd high diversity level.

Tabel 3. Diversity index (H')

No	Station	Diversity Index (H')	
		Rain	Not Raining
1	1	2,11	2,06
2	2	2,15	2,20
3	3	2,17	2,16
Average		**2,143**	**2,14**

Dominance Index (D)

The dominance of phytoplankton species at the time of rain has a value range of 0,16 – 0,17 which means that no species is dominant and its community structure is stable. At the time of not raining the value range is 0.16 - 0.19 which means the structure of the phytoplankton community is stable. Both conditions show that when it rains and does not rain, these waters have a stable community structure and no phytoplankton dominate (Table 4). According to Rosanti (2006), if the value of D < 0.5 means the structure > of the phytoplankton community in a stable state.

Tabel 4. Dominance index (D)

No	Station	Dominance Index (D)	
		Rain	Not Raining
1	1	0,17	0,19
2	2	0,15	0,15
3	3	0,16	0,16

Type Alignment Index (E)

The Type E grade in the water when the rain ranges from 0.76 - 0.78 and at the time of non-rain ranges from

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 1 (2022) h. 141-155

0.8-0.90 (Table 5). From both conditions shows that in these waters has a relatively even type of equitable index and almost the same in rainy conditions or not rain. According to Basmi (2000), stating that if the value of E approaches 0 means the equitableness between species is low means the wealth of individuals owned by each species is very much different (uneven). But on the contrary if the value of E is close to 1, the equitableness between species is relatively even or the number of individuals – each species is relatively the same.

Tabel 5. Type alignment index (E)

No	Stasiun	Type Alignment Index (E)	
		Rain	Not Raining
1	1	0,76	0,83
2	2	0,77	0,90
3	3	0,78	0,87

Water Quality Analysis

Temperature (^{O}C)

Based on (Table 6) the measurement of temperature parameters when raining ranges between 31.23 - 33.92^{O}C. At no time of rain temperatures range from 29.23 - 32.21^{O}C, meaning it still supports the growth of phytoplankton. This indicates that the temperature tends to be higher because it belongs to the retention pool and is influenced by the surrounding environment. Irawati (2014) states that the temperature range corresponding to growth and development for phytoplankton is around 20 - 30^{O}C.

Table 6. Measurement of physical and chemical parameters in flood retention ponds

No	Parameter	Unit	Station Results					
			1		2		3	
			Rain	Dry	Rain	Dry	Rain	Dry
A. Physics								
1	Temperature	^{O}C	33,92	32,21	31,23	31,55	31,89	29,23
2	Brightness	cm	33	30	23	29	23	34
3	Turbidity	NTU	33,6	20,0	32,3	15,1	37,1	19,8
B. Chemistry								
4	pH	-	7,93	6,88	7,90	8,48	7,94	8,61
5	DO	Mg/L	5,33	6,56	5,18	6,23	4,46	5,93
6	Nitrate	Mg/L	0,6394	0,111	0,7714	ttd	0,780	0,199
7	Phosphate	Mg/L	0,005	0,0045	ttd	ttd	ttd	ttd

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 1 (2022) h. 141-155

Brightness (cm)

The brightness level of the water when the rain is between 23 - 33cm and when not raining ranges from 29 - 34cm (Table 6). Both conditions show very low retention night brightness. Brightness values can be affected by weather conditions, measurement times, and suspended solids from the retention pond environment that originates from the land around the retention pond when rain will flow and bring other compounds to the retention pool. According to Suardiani (2018) states that the value of water brightness is good for the survival of aquatic organisms is > 45 cm.

Turbidity

The value of water turbidity obtained at the time of not rain ranges between 15.1 - 20 NTU and at the time of rain ranges from 32.3 - 37.1 NTU (Table 6). From both conditions the value of turbidity increases very high during the rain. The condition is caused by the suspended solids coming from the mainland which then when the rain will flow into the retention pond. According to Salwiyah (2010), the optimum turbidity of a water ranges from 5 - 30 NTU so it can be said that the turbidity in the waters of the retention pond when the conditions are not raining is still within the optimum limit and when the rain conditions are above the optimum limit.

Power of Hydrogen (pH)

Power of Hydrogen (pH) values at the time of rain range from 7.90 - 7.93 and when not raining ranges from 6.88 - 8.61 (Table 6). Based on both conditions, pH values indicate that aquatic fertility is still productive for phytoplankton growth. According to Yuliana (2007) states that the optimum pH for phytoplankton life ranges from 6.5 – 8.0.

Disosolve Oxygen (DO)

The dissolved oxygen values that are applied during rain range from 4.46 -5.33 mg/L and at the time of not raining range from 5.93-6.56mg/L (Table 6). Both conditions show the waters of the flood retention pond are still in good condition for the survival of aquatic organisms. This is in the opinion of Wijaya (2009), phytoplankton can live at oxygen concentrations of more than 3 mg /L.

Nitrate

The result of nitrate concentration value at the time of rain ranges from 0.639-0.780 Mg/L and when not raining ranges from 0.111 - 0.199 Mg/L (Table 6). Of these two conditions the highest concentration value in the rain. Based on Perda Kaltim N0.2 Year 2011 on Water Quality Management and Water Pollution Control Attachment V Class I, nitrate value (NO_3) optimal nitrate content value is worth 10 mg / L for water pollution level.

Phosphates (P)

The value of phosat concentration at the time of rain is 0.005 Mg /L and at the time of not raining is 0.045 Mg / L (Table 6). The phosphate value obtained from the two conditions is still in accordance with the Quality Standard of PERDA Kaltim N0.2 Year 2011 on Water Quality Management and Water Pollution Control Annex V Class I. Optimal phosphorus levels for phytoplankton growth range from 0.27- 5.51 mg/l (Effendi, 2003).

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 1 (2022) h. 141-155

Analysis Chlorophyll-a Content

The results of the analysis of chlorophyll-a content presented in (Table 7) the concentration value of chlorophyll-a when it rains has a range value of 0.091mg/L - 0.136mg/L with an average of 0.108 mg/L classified as oligotrophic. While not raining ranges from 1,224mg/L-1,766mg/L with an average of 1,533mg/L classified as oligotrophic. Based on the average of the two conditions, the value of chlorophyll-a concentration ranged from 0.108mg/L - 1.533mg/L. The value obtained had a difference of 1.425mg/L caused by differences in weather conditions at the time of sampling. From the average of the two conditions, the result is chlorophyll-a content in flood retention ponds in Samarinda city is classified into oligotrophic water criteria. The classification is based on the trophic status of the waters based on chlorophyll according to the Carlson Trophic State Index (TSI) (1977).

Table 7. Chlorophyll Concentration Value-a

Station	**Sampling Time**		**Chlorophyll - a**	
	Rain	**Not Raining**	**Rain**	**Not Raining**
1	09-Jan-21	22-Feb-21	0,136	1,609
2	09-Jan-21	22-Feb-21	0,097	1,224
3	09-Jan-21	22-Feb-21	0,091	1,766
Average			**0,108**	**1,533**

Water Fertility Status

Trophic State Index (TSI) Analysis of Flood Retention Pond water in Samarinda is presented in (Table 4.7) When rainy conditions the average TSI value is 10.46 which means the fertility rate is oligotrophic. When conditions are not raining the average TSI value of 17.79 belongs to the oligotrophic waters category. Based on both conditions with average values ranging from 10.46 - 17.79 water rushes are in the same category that is Oligotrophic. Based on these two conditions when the conditions are not raining there is a very high increase in the average TSI value compared to the conditions when it rains with a difference in value of 1,425. This happens because when the conditions are not raining the combination of TSI P, TSI SD and TSI chl-a values provide a more representative and better yield value than the result value in rainy conditions. Carlson Trophic State Index (TSI) results with Kepmen LH No.115 year 2003 on Guidelines For The Establishment of Water Quality Status has the appropriate result that the condition of flood retention ponds is in the category of Oligotrophic status that indicates the quality of water is still natural and has not been polluted from the source of nitrogen and phosphorus nutrients. According to Zulfia (2013) chlorophyll-a content in a water depends on nitrogen and phosphorus content. TSI Carlson can describe the fertility status of tropical waters in both the fresh and the sea. Eutrophication is the process of enrichment of nutrients and organic matter in water or water pollution due to the emergence of excess nutrients in the water ecosystem. Some factors that affect the occurrence of eutrophication

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 1 (2022) h. 141-155

in phytoplankton are organic waste dalarn water, sediment that decomposes and increases the concentration of nitrogen (N) and phosphorus (P) elements that can encourage the growth of phytoplankton (Rustadi, 2009).

At the optirnum concentration, N and P nutrients are beneficial for phytoplankton growth. But when the concentration of these elements has a high value, there will be excessive phytoplankton growth (blooming) or eutrophication and water pollution can occur. If it is severe, the water quality will decrease, the water will turn murky, oxygen dissolved low, tirnbul toxic gases and toxic materials (Sugiura, 2004).

The content of organic compounds with growth that indicates the higher the organic content in the waters, the greater the impact given. This is possible because most organic compounds also get support from several factors, namely influenced by temperature, pH, DO, organic matter, carbon and nitrogen ratios and supported factors - other factors will be able to oxidize organic material compounds. As long as there is organic matter, during that time the decomposition process takes place (Purnomo, 2013).

The content of NO3 is also inseparable from the presence of phytoplankton in the waters. Phytoplankton need NO3 for their optimum growth process. Nitrate (NO3) is an element used by phytoplankton. The need for nitrates (NO3) is higher compared to the need for nitrogen in the form of other compounds (Wetzel, 2001).

Table 8. Results of water fertility status analysis / trophic state index (TSI)

Station	Total P (mg/L)		Secchi Disk (cm)		Klorofil-a		TSI P		TSI SD		TSI chl-a		TSI Total	
	Rain	Dry	Rain	Dry	Rain	Dry	Rain	Dry	Rain	Dry	Rain	Dry	Rain	Dry
1	0,005	0,004 5	33	30	0,136	1,609	27,3	25,8	9,5	10,8	10,9	35	15,9	23,86
2	0	0	23	29	0,097	1,224	0	0	1,47	11,4	23,8	32,2	8,4	14,53
3	0	0	23	34	0,091	1,766	0	0	14,1	9	7	36	7,0	15
Average TSI Total													**10,46**	**17,79**

CONCLUSION

The composition of phytoplankton species in the flood retention room consists of the classes Chlorophyceae, Dictyochophyceae, Cyanophyceae, Bacillariophyceae (Diatom), Euglenophyceae, Dinophyceae, and Trebouxiophyceae. In general there are three classes of phytoplankton with a relatively high abundance namely Chlorophyceae, Cyanophyceae, Bacillariophyceae (Diatom). At the time of rainy conditions, the highest abundance of species at station 1 was the *Eutonia* sp type. from the Bacillariophyceae (Diatom) class, at station 2 of the *Merismopedia punctata* class of Cyanophyceae class and at station 3 of the *Merismopedia punctata* type of

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 1 (2022) h. 141-155

Cyanophyceae class. At a time when conditions do not rain the highest abundance of species at station 1 is the *Eutonia* sp. type From Bacillariophyceae class (Diatom), at station 2 type *Merismopedia punctata* from Cyanophyceae class and station 3 is *Merismopedia punctata* type of Cyanophyceae class. Trophic State Index (TSI) Carlson analysis of flood retention pond waters in Samarinda during rainy conditions TSI average value of 10.46 which means its fertility rate is oligotrophic. When conditions are not raining the average TSI value of 17.79 belongs to the oligotrophic waters category. Based on both conditions with average values ranging from 10.46-17.79 water rushes are in the Oligotrophic category. Factors of water quality parameters related to trophic status in flood retention pond waters are nitrogen (N) and phosphorus (P) compounds.

REFERENCES

Basmi, H.J. (2000). *Planktonology: Plankton as an Indicator of Water Quality*. Bogor: Faculty of Fisheries and Marine Sciences IPB

Bismark, M. (2009). *Water Quality, Abundance and Diversity of Plankton in Mangrove Ecosystems in Siberut Island, Sumatra*. R&D and Nature Conservation Center, Bogor

Carlson, R.E. (1977). A Trophic State Index for Lakes 1. *Journal Nature, 22*(2)

Dong, X. (2014). Flow Directionality, Mountain Barriers and Functional Traits Determine Diatom Metacommunity Structuring of High Mountain Streams. *Journal Sci. Rep, 6*(2)

Effendi, P. (2003). *Water Quality Study: For Resource Management and Aquatic Environment*. Yogyakarta: Kanisius

Fathur, M.M. (2012). Dynamics of Water Quality and Relationship of Plankton Abundance with Water Quality in Bontoa Subdistrict Pond, Maros Regency. *Journal of Aquaculture Technology Innovation, 1*(1) : 1 – 14.

Irawati, N. 2014. Water Fertility Estimation Based on Nutrient Distribution and Chlorophyll-a in Kendari BaySulawesi Tenggara. FPIK. Halu Oleo University. Kendari. Southeast Sulawesi. *Journal Aquascience, 3*(1), 193-199.

Khasani, A. (2017). Analisis Trophic State Index Carlson Air Muara Sungai Banjir Kanal Timur, Semarang. *Jurnal of Maquares. 6* (1), 17-25.

Kozak, A. (2020). Functional Groups of Phytoplankton and Their Relationship with Environmental Factors in the Restored Uzarzewskie Lake. *Journal Aquascience, 1* (12), 313 - 322.

Liu, X. (2017). Acomparison of Factors Influencing the Summer Phytoplankton

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 1 (2022) h. 141-155

Biomass in China's Three Largest Freshwater Lakes: Poyang, Dongting, and Taihu. *Journal Hydrobiologia, 1*(1), 283–302.

Michalak, A.M. (2016). Study Role of Climate Change in Extreme Threats to Water Quality. *Journal Nature* , *4*(2), 349–350.

Odum, E.P. (1994). *Basics - Ecology Basics Third Edition.* Yogyakarta: Gajah Mada University Press.

Pramaningsih. (2017). Spatial Distribution Study of Water Quality of Karangmumus River, Samarinda, East Kalimantan. *Journal of Natural Resources and Environmental Management, 7*(3), 211-218

Purnomo, P. W. (2013). The Relationship Between Total Bacteria with Organic Matter NO3 and H2S at Locations Around Water Hyacinth and Open Water in Rawa Pening. *Journal Of Management Of Aquatic Resources, 2*(3), 85-92.

Rashidy, E. A. (2013). Composition and Abundance of Phytoplankton in the Coastal Waters of Tekolabbua Village, Pangkajene District, Pangkep Regency, South Sulawesi Province. *Journal of Nature and the Environment, 4*(7), 12 – 16.

Rosanti, D. (2006). Plankton Abundance in The Mangrove Area of Sembilang National Park Banyuasin Regency. Journal of Sainmatika. Faculty of Science, Pgri University palembang. *Journal Science, 3*(1), 11 – 20

Rustadi. (2009). Eutrophication of Nitrogen and Phosphorus and Its Control with Fisheries In Sermo Reservoirs. *Journal of People And The Environment, 16*(3), 176-186.

Salwiyah. (2010). Water Quality Conditions Related to the Fertility of the Waters Around The Tanasa Power Plant Konawi Regency, Southeast Sulawesi Province. *Thesis*. Kendari, Indonesia: Haluoleo University.

Soeprobowati, T. R. (2010). Trophic Status of Rawapening Lake and Its Management Solutions. Semarang: Department of Biology FMIPA Diponegoro University. *Journal of Science & Mathematics, 18*(1), 1-10.

Suardiani, N. K. (2018). Primary Productivity of Phytoplankton in Fishing Area in Lake Buyan Nature Park, Buleleng, Bali. *Journal Aquatic Sience I, 1*(1), 8 – 15

Subarijanti, H. U. (2010). Environmental Factors Influencing Phytoplankton Growth. *Journal of Nature and the Environment, 1*(1), 1 – 8

Jurnal Pendidikan Matematika dan IPA
Vol. 13, No. 1 (2022) h. 141-155

Sugiura, N. M. (2004). Assessment for the Complicated Occurrence of Nuisance Odours from Phytoplankton and Environmental Factors in a Eutrophic. *Lake. Lake &Resenoirs: Res and Mqn, 9*(1), l95-201.

Suryono, T. (2010). Fertility and Pollution Rate of Limboto Lake, Gorontalo. Oceanology and Limnology in Indonesia (2010). *Journal of Science, 36*(1), 49-61.

Thoha, H. (2013). Abundance and spatial distribution of plankton communities in the waters of the Banggai Islands. A. *Journal Tropical Marine Science and Technology, 5* (1), 145-161.

Wetzel, R. G. (2001). *Limnology Lake and River Ecosystems. Three edition.* Academic Press, California.

Wijaya. (2009). Phytoplankton Community Structure as Bioindicator of Water Quality of Rawapening Lake, Semarang, Central Java. Bandung: Laboratory of Ecology and Biosystematics FMIPA Undip. *Journal Science, 1*(1), 55 - 61.

Yuliana. (2007). Community Structure and Abundance of Phytoplankton in Relation to The Physical - Chemical Parameters of The Waters in Laguna Lake Ternate, North Maluku. *Journal Protein, 14* (1), 85 - 92.

Zhao, X. (2019). Use of taxon-specifific models of phytoplankton assemblage composition and biomass for detecting impact. Ecol. *Indic, 97* (1), 447 – 456.

Zulfia, N. (2013). The status of Rawa Pening Trophic is reviewed from Nutrient Content (NO3 and PO4) and Chlorophyll-a. *Journal of Aquatic Resources, 5*(3), 189-199.