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Determination of trouble status in Banyuajuh flows reviewed by klorofil-a using the TSI approach

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ABSTRACT

Trophic status is an important indicator for a water body. Indicators that can be used include chlorophyll-a as a determinant of whether or not many biota can survive in a body of water. The trophic status of waters can be indicated as water fertility which is closely related to chlorophyll content in phytoplankton. This study aims to determine the trophic status of Banyuajuh waters through the TSI method. This research was conducted from October to November 2022. Water and plankton sampling was carried out using purposive sampling method, with 3 stations and morning and evening time exploration in each week. Water quality parameters include temperature, brightness, pH, DO, light intensity, nitrate and phosphate. Plankton data were identified to determine the species at each station. The results of trophic status research in Banyuajuh waters using the TSI method at station 1 is classified as moderate to severe eutrophic, station 2 is classified as mesotrophic and oligotrophic and at station 3 is classified as moderate eutrophication. Based on the pedeketan used, it indicates that Banyuajuh waters are classified as Oligtrophic to Severe Eutrophication.

Introduction

According to PP number 27 of 2021, Indonesia has fisheries potential sourced from capture fisheries and aquaculture. Aquaculture is an economic activity in the field of fish or aquatic animals or aquatic plants. Aquaculture is grouped into three types, namely seawater aquaculture, brackish water aquaculture (ponds), and freshwater aquaculture[1]. Banyuajuh Village is one of the villages located in Kamal Sub-district, Bangkalan Regency, which is located near the sea coast. One of the lands in Banyuajuh village has not been optimally utilized in terms of aquaculture. Ponds in banyuajuh waters in management look very not optimal and have not been running well, determining trophic status needs to be done in order to determine the level of fertility of ponds in banyuajuh village so that they can be utilized and managed according to their fertility level. Biological factors that can affect the productivity of waters one

of which is colorophyll-a. Chlorophyll-a is a pigment capable of photosynthesis and is present in all phytoplankton biota. The concentration of chlorophyll-a in a water body is highly dependent on several physico-chemical parameters such as temperature, pH, brightness, DO, light intensity and the most important are chlorophyll-a and phosphate. Tropic status is an indicator of the fertility level of a water body that can be measured from nutrients and brightness levels and other biological activities that occur in a water body. The TSI method was used because it has fairly simple parameters, namely phosphate, chlorophyll-a and brightness. This research was studied using the TSI approach to obtain the fertility status of Banyuajuh waters.

Method

This study was conducted in Banyuajuh waters in September-October 2022 at three sampling stations in the aquaculture area in Banyuajuh, Kamal, Bangkalan. Samples were collected every week for one month from three different stations using purposie sampling method. Station 1 is a pond containing fish, station 2 is a small river whose waters are quite shallow and station 3 is a fish pond containing catfish.

Sampling

Water sampling is done by putting water into a 600 ML sample bottle. Water samples were used to determine phosphate and chlorophyll-a levels. Measurement of brightness was carried out in situ using a secchi disk.

Water Quality Parameters

Water quality parameters including physical and chemical parameters were measured as a form of support to strengthen the fertility status of Banyuajuh waters, consisting of water temperature, light intensity, DO (Dissolved Oxygen), phosphate (SNI 06-6989.31-2005), chlorophyll-a (SNI 06-4157-1996).

Data Analysis

The research was conducted descriptively, the observation data were processed using Excel 2016 to calculate the mean and standard error of phosphate, chlorophyll-a, brightness, water temperature, light intensity and DO (Dissolved Oxygen). Phosphate, chlorophyll-a and brightness data that have been averaged are entered into the TSI calculation as follows:

$$\frac{TSI\ TP + TSI\ Chl\ a + TSI\ SD}{3}$$

Description:
TSI TP = Trophic status index value for total phosphate
TSI Chl-a = Trophic status index value for chlorophyll-a
TSI SD = Trophic status index value for secchi disc depth

Results and Discussion

Water Quality Parameters

Water quality parameter data measured as supporting data include physical parameters in the form of temperature, brightness and chemical parameters in the form of pH, temperature, light intensity and DO shown in table 1 water quality parameters.

Table 1. Water Quality Parameters

Parameter	Week 1	Week 2	Week 3	Week 4	Std Error
Station 1 Morning					
Temperature (ºC)	27.967	29.133	27.933	26.333	± 0.188
Brightness (cm)	19.033	19.833	18.066	19.6	± 03533
pH	8.833	7.832	7.5267	7.426	± 0.563
DO (mg/L)	5.44	5476	4.603	6.506	± 0.539
Light intensity	1117.7	1250.3	1113	1116.7	± 3.353
Phosphate	1.203	0.629	1.38	1.575	± 0.698
Chlorophyll-a (mg/m3)	5.249	4.466	4.264	3.914	± 1.957
Station 2 Morning					
Temperature (ºC)	28.467	27.6	27.933	26.367	± 1.179
Brightness (cm)	7.966	4.756	4.733	4.466	± 0.122
pH	8.466	7.5	7.706	7.31	± 0.158
DO (mg/L)	6.356	7.033	6.666	8.293	± 0.665
Light intensity	1279.3	1294.3	971.3	1043.7	± 24.373
Phosphate	0.775	1.293	1.426	1.58	± 0.292
Chlorophyll-a (mg/m3)	1.998	2.006	1.971	1.544	± 0.072
Station 3 Morning					
Temperature (ºC)	28.633	28.867	28.333	27.267	± 0.165
Brightness (cm)	11.266	12.366	12.8	14.66	± 0.293
pH	8.693	7.586	7.703	7.463	± 0.871
DO (mg/L)	6.023	6.563	5.796	9.386	± 1.047
Light intensity	1571.3	1448	992	1372.2	± 34.211
Phosphate	0.89	0.344	0.948	0.603	± 0.344
Chlorophyll-a (mg/m3)	3.068	2.866	2.721	3.047	± 0.35
Station 1 Afternoon					
Parameter	**Week 1**	**Week 2**	**Week 3**	**Week 4**	**Std Error**
Temperature (ºC)	32.567	30.233	27.5	26.433	± 0897
Brightness (cm)	19.666	19.66	18.33	21.233	± 0.235
pH	8	6.69	6.696	6.33	± 0.159
DO (mg/L)	5.536	5.406	4.566	10.05	± 0.258
Light intensity	1023.3	969.33	782.33	471.67	± 25.681
Phosphate	0.948	0.373	0.618	0.632	± 0.430
Chlorophyll-a (mg/m3)	5.341	4.751	4.147	5.413	± 1.648
Station 2 Afternoon					
Temperature (ºC)	30.533	29.433	27.567	27.433	± 0244
Brightness (cm)	7.933	3.86	5.106	5.156	± 0.064
pH	8.813	7.17	7.606	7.026	± 0.201
DO (mg/L)	6.336	7.59	7.636	8.92	± 0.324
Light intensity	1093.3	881.33	1076.7	671	± 42.644
Phosphate	1.403	0.632	1.752	1.868	± 0751
Chlorophyll-a (mg/m3)	2.181	1.923	1.992	2.196	± 0353
Station 3 Afternoon					
Temperature (ºC)	32.633	30.067	30.133	26.633	± 0.235
Brightness (cm)	12.233	11.386	12.156	15.133	± 0.306
pH	8.813	7.406	7.21	7.03	± 0.168
DO (mg/L)	7.663	7.166	5.23	11.603	± 0.427
Light intensity	1595.7	1006.3	1175.3	767.67	± 26.494
Phosphate	1.235	1.436	1.12	0.833	± 1.034
Chlorophyll-a (mg/m3)	2.794	2.794	2.677	3.404	± 1.374

Water Temperature

The temperature value in Banyuajuh waters ranged from 26.3-32.5^{0}C. The highest temperature was at station 3 week 1 at the time of sampling in the afternoon, this happened because in the afternoon the weather was still very sunny so that the temperature entered the water at an optimal condition. The states that changes in temperature in a body of water are influenced by several factors, namely atmospheric conditions and the intensity of sunlight entering the water body[2]. Temperature can affect the activity and metabolic development of aquatic organisms both directly and indirectly[3]. Temperature affects phytoplankton because temperature can increase enzymatic chemical reactions in the photosynthesis process so that the rate of photosynthesis will increase with increasing temperature. In a cultivation, if the temperature in the water is not normal, it will cause the cultured biota to experience stress.

Light Intensity

The value of light intensity in Banyuajuh waters ranged from 471-1595 lux. The highest value of sunlight intensity was obtained at station 3 when sampling in the afternoon, this is because sunlight in the afternoon is in optimal conditions and at station 3 there is no cover around it, therefore sunlight can directly penetrate into the water. The same thing is also said that there are several factors that affect the intensity of light, namely depth, location on earth, cloud conditions, weather and angle of incidence of sunlight, waters around which there is no cover will get more optimal sunlight than waters around which there is cover[4]. Optimal light intensity will make photosynthesis activities take place well because it has optimum light. This is also proven by research Sudrjriana, et al., that low and moderate sunlight intensity will be a limitation during photosynthesis[5]. The intensity of sunlight entering the water is getting deeper, the intensity of the light will decrease, so that phytoplankton have tolerance in utilizing light, some are biased and some are strong.

Brightness

The brightness of the waters is an important parameter to determine the cleanliness of a body of water, the higher the brightness, the deeper the sunlight can penetrate into the waters[6]. Banyuajuh waters have a brightness ranging from 4.4 - 21.2 cm2. The highest brightness value was obtained in week 4 at station 1 during afternoon sampling, this is because at the time of sampling it was raining so suspended solids such as mud and particulate matter were carried by water so that they entered the water body. The brightness of a body of water is highly dependent on color, turbidity, weather conditions, the amount of dissolved solids, the amount of suspended solids, plankton and other microscopic organisms[7].

pH

pH or hydrogen potential is a degree that determines the acidity or basicity of a solution or liquid. pH is very important as a water quality parameter because it controls the type and rate of chemical reactions in the water. The pH value in Banyuajuh waters ranges from 7 - 8.8. The pH value in Banyuajuh waters is still relatively stable because there is no drastic increase or decrease. Briggs & Smith said that the pH value of water is influenced by CO_2 concentration because during the day photosynthesis occurs, the CO_2 concentration decreases so that the pH of the water will increase[8]. The process of decomposing organic matter into minerals such as nitrates, phosphates, the sampling rate is raining so suspended solids such as mud and particle particles are carried by water so that they enter water bodies[7].

DO (Dissolved Oxygen)

DO is an important water quality parameter in the environment that is used to determine the level of fertility of a body of water[9]. The results of DO measurements in Banyuajuh waters ranged from 4.5 - 11.6 mg/L. The highest value of DO was shown by station

3 in the afternoon, this happened because it was raining at the time of sampling. Huet says that oxygen levels in water will increase the higher the temperature in the environment is low[10]. The dissolved oxygen content of the waters is at least 2 ppm in normal conditions and is not polluted by other contaminated compounds, the oxygen content of drinking can be said to have been able to support the life of organisms in it[11].

Phosphate

Phosphate is a form of phosphorus that can be utilized by plants. Phosphate is also an essential element for higher plants and algae so that it can affect the primary productivity process. The results of phosphate measurements in Banyuajuh waters can be seen in the graph of phosphate values ranging from 0.3 -1.8 mg/L. The highest phosphate value was obtained at station 2 in week 4 during afternoon sampling, this happened because at the time of sampling it was raining when phosphate nutrients from land entered the water body. The same thing was also said by Lulu, et al., that in rainy conditions the value of phosphate will increase due to the entry of pollutants from land that enter the water because it is carried by rainwater[12]. The excessive phosphate content in water can cause detonation of algae growth and can have an impact on the decrease in dissolved oxygen in water bodies so that it can cause the death of aquatic biota[13]. Phosphate is needed by waters to support organisms in the growth and development of phytoplankton life.

Chlorophyte

Chlorophia is a blue-green pigment that plays an important role in the photosynthesis process and is owned by some phytoplankton that live in waters[14]. Chlorophyll-a in Banyuajuh waters ranged from 1.5 - 5.3 mg/l. The highest chlorophyll-a value was at station 1 when sampling in week 4 in the afternoon, this happened because it was raining at the time of sampling. Arya & Jarot al said that high rainfall can bring high nutrients from land into water bodies, this is the cause of increased aquatic fertility which triggers the high development of aquatic primary productivity[15]. High rainfall causes an increase in the volume of water containing high nutrients that can be utilized for phytoplankton growth, where phytoplankton is part of chlorophyll-a.

TSI (Trophic State Index) Approach

The status of fertility with the TSI approach in the waters of Banyuajuh, Bangkalan in September-October is presented in Figure 1.

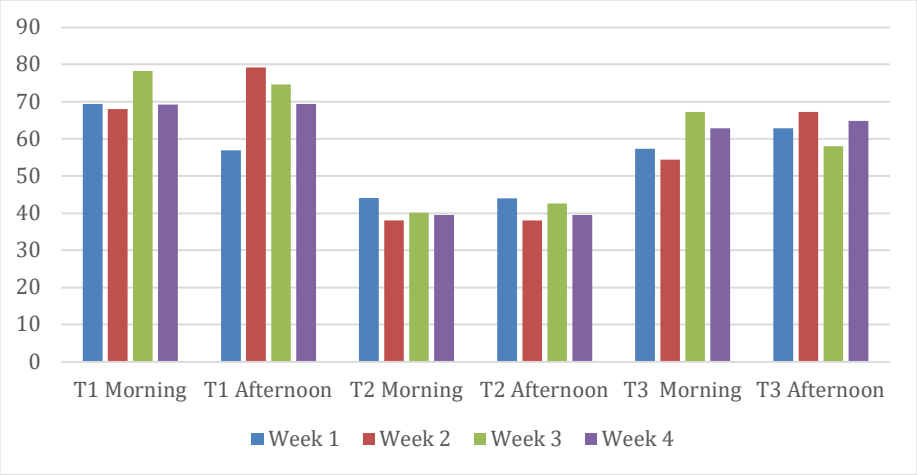

Fig 1. TSI (Trophic State Index) value

Based on graph 4.13, it can be seen that the highest Trophic State Index (TSI) value in Banyuajuh waters was in station 1 during the second week, which amounted to 79.228. The Trophic State Index (TSI) value at station 1 ranged from 56.866 - 79.228. Trophic State Index (TSI) values at station 2 ranged from 38.006 - 44.098. Trophic State Index (TSI) values at station 3 ranged from 54.396 to 67.227. According to Carlson, the level of water pollution based on the TSI approach is categorized into 7 namely ultraoligotrophic (<30), oligtrophic (30-40), mesotrophic (40-50), mild eutrophication (50-60), moderate eutrophication (60-70), severe eutrophication (70-80), and hypertrophic (>80). Based on this statement, the trophic status of Banyuajuh waters at station 1 is included in moderate to severe eutrophication waters. Station 2 belongs to oligtrophic and mesotrophic waters. Station 3 is included in moderate to mild eutrophication waters. Eutrophication conditions are conditions where waters are rich in nutrients and organic matter eutrophication waters are said to be waters that have high fertility because they have high nutrient content waters in this condition show in polluted conditions[16]. Mesotrophic waters are waters that have low nutrient content, waters in this condition show that water quality is still natural and has not been polluted by nutrients[17]. Mesotrophic waters in this condition are waters that contain moderate nutrients and show an increase in nutrients but are still within tolerance limits because they have not shown any indication of pollution[18]. Based on the trophic status obtained, Banyuajuh waters, which are used as a place for aquaculture, are still classified as good for providing natural food for the organisms in them. The same thing was also said by Setya, et al., that the level of water fertility can also be determined by the nutrients available for natural food, namely nitrate and phosphate[19].

Conclusion

Based on the research conducted in Banyuajuh waters, it can be concluded that the level of fertility in Banyuajuh waters is influenced by physical, chemical and biological parameters. Determination of trophic status using TSI method, station 1 has moderate to severe eutrophication status, station 2 has oligotrophic and mesotrophic status, station 3 has moderate eutrophication status.

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