JOURNAL OF SOILSCAPE AND AGRICULTURE
Volume 2, Issue 1 : (44 – 64), 2023
E-ISSN: 2963-7961
Journal Homepage: http://journal.unej.ac.id/JSA

Identification of River Water Pollution Based on Saprobic Index of Macrozoobenthos in Anggokoine River, Oheo Sub-District North Konawe District

La Baco Sudia[a]*, La Ode Ahmad Nur Ramadan[b], Kahirun[a], La Ode Muhammad Erif[a], Surya Cipta Ramadhan Kete[a] , Lalu Darwite[a]

[a] Department of Environmental Science, Halu Oleo University, Indonesia
[,b] Department of Chemistry, Halu Oleo University, Indonesia

ARTICLE INFO

Article History:
Received: 14 - 08 - 2023
Accepted: 29 - 09 - 2023
Published: 30 - 09 - 2023

Keyword:
Pollution;
Macrozoobenthos;
Saprobic Index;
Anggokoine River;

Corresponding Author:
La Baco Sudia
[a]Department of Environmental Science, Halu Oleo University, Indonesia.
*email:labaco.sudia@uho.ac.id

ABSTRACT

Macrozobenthos is a bioindicator in assessing the quality of river waters, because each species has a different tolerance to pollutant disturbances. This research aims to identify water pollution in the Anggokoine River, Oheo District, North Konawe Regency using the Macrozoobenthos Saprobic Index Method. Sampling was carried out in November 2018 and February 2019 at three stations. Sample analysis was conducted at the Southeast Sulawesi Provincial Health Laboratory. The results of the analysis showed that 14 types of benthos were found from 6 families, namely the Bivalvia class, Plecypoda class and Gastropoda class. Analysis of the macrozoobenthos saprobic index at Stations I, II and III is 2.6, 2.7 and 2.3. This shows that stations I and II are classified as heavily polluted (2.5-3.5 α-Mesosaprobic), while Station III is classified as moderately polluted (1.5-2.5 α-Mesosaprobic). Thus it can be concluded that macrozobenthos can identify river pollution well and the Anggokoine river has been polluted moderately to heavily.

INTRODUCTION

Anggokoine River is a river located in the Oheo sub-district, North Konawe Regency, included in the Lasolo-Konaweha River and Lasolo watershed, this river plays an important role in the life of freshwater biota and also the needs of human life for various activities such as agriculture and as a place for people to look for freshwater fish. Community activities in the form of clearing agricultural land for the expansion of agricultural areas on the edge of the Anggokoine River area have caused disturbances to the ecosystem and agricultural activities that use pesticide fertilizers where the results of farmers' fertilizers enter the river through irrigation channels for community rice fields, resulting in the potential loss of ecosystem

balance with high sedimentation in the waters as seen from the turbidity of the waters, causing a decrease in river water quality and suspected pollution.

According to Government Regulation No. 82 of 2001, water pollution is the entry or inclusion of living beings, substances, energy, and or other components into water by human activities, so that water quality drops to a certain level that causes water to be unable to function by its designation. The quality of water in the river determines the survival of river biota and humans who directly utilize the river water. The number of activities carried out by the community on the banks of the river such as fishing activities, livestock waste, and agricultural waste can cause water pollution which affects the quality of river water. The quality or index criteria for river water pollution can be identified in three ways, namely water identification using physical, chemical, and biological indicators. Physical parameters include; temperature, total suspended solids (TSS), total dissolved solids (TDS), and turbidity, chemical parameters include; acidity (pH), dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), Ammonia (NH_3), Nitrite (NO_2), Phosphate (PO_4) and biological parameters include; macrozoobenthos animals. Macrozoobenthos have been widely used in various countries as biological indicators to monitor water pollution and determine the health of river ecosystems, in addition to physical and chemical parameters of water quality. This biological approach is based on groups of taxa that have a certain level of sensitivity to water quality due to contamination by organic matter. The aim of this study is to use Macrozoobenthos as a bioindicator of water quality to identify water pollution in the Anggokoine River, Oheo District, North Konawe Regency.

METHODS

Location and Time

This research was conducted in Anggokoine River, Oheo Sub-district, North Konawe Regency and Macrozoobenthos samples were taken to the Biology Laboratory of the Faculty of Mathematics and Natural Sciences for analysis, from November 2018 to February 2019. Then the water samples were taken at the Southeast Sulawesi Provincial Health Laboratory Center to be analyzed for the physical quality of river water clams. The research location as shown in Figure 1.

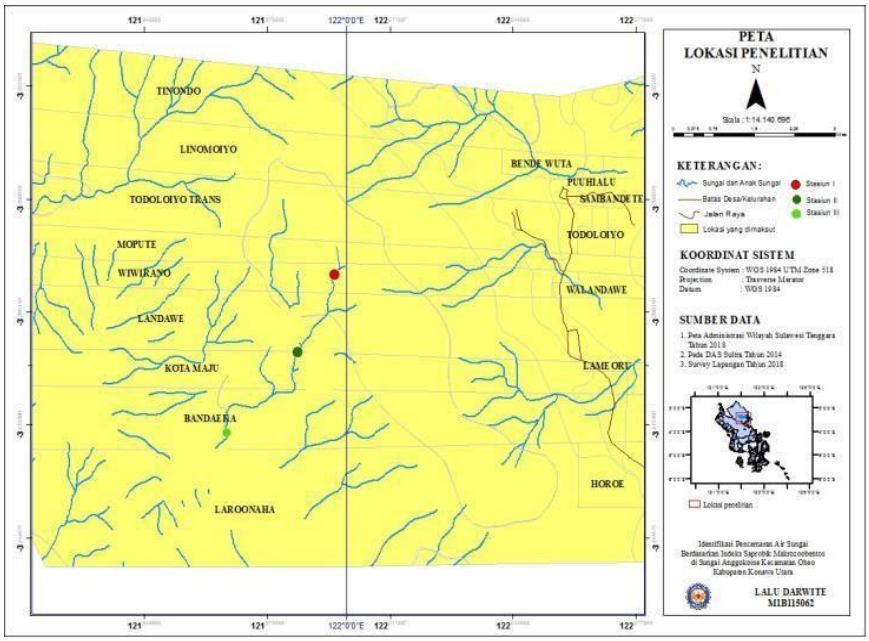

Figure 1. Research location map

Method of Colloecting Data

The data collection technique used in this study is direct exploration at the research site, then field data collection regarding water quality including temperature parameters, Turbidity, TSS, TDS, pH, Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Ammonia (NH_3), Nitrite (NO_2) and Phosphate (PO_4) then analyzed in the laboratory. In addition, observations will be made on the environmental conditions around the Anggokoine river basin.

Physical Chemical Water Quality Condition

Parameters directly associated with macrozoobenthos life, such as water temperature, turbidity, TSS, TDS, DO, BOD, NH_3, NO_2, PO_4 and pH of the water were then compared with class II water quality standards (Peraturan Pemerintah Republik Indonesia Nomor 82 Tahun 2001).

River Water Quality Based on Macrozoobenthos (Biology)

Water quality status is determined based on the results of macrozoobenthos identification using the saprobic index (S) scoring system developed by Makino (2001) this method is known as the sabrobiem system by classifying four conditions or degrees of river pollution, namely; Class I. Oligosaprobic unpolluted conditions, Class II. β-Mesosaprobic lightly polluted condition, Class

III.

α-Mesosaprobic moderately polluted conditions and Class IV. Polygosaprobic heavily polluted conditions.

Furthermore, Ravera (1979) saprobic index with the formula used is $s = \frac{\sum sxh}{\sum h}$

Description:
s= level of saprobity or the magnitude of the value of pollution instructions of each type based on Ravera Table (1979)
s= 1 to 4 where:
s = 1, for groups of individuals classified as Oligosaprobic,
s = 2, for groups of individuals classified as (β-Mesosaprobic)
s= 3, for a group of individuals classified as (α-Mesosaprobic)
s= 4, for the group of individuals classified as Polysaprobic
h= Frequency of occurrence of each individual species encountered, this frequency is not calculated, but estimated.
h= 1, for species that occur only by chance/very rarely
h= 3, for species that are frequently encountered
h= 5, for very abundant species

Saprobic index (S) values correlate with pollution levels as presented in Table 1.

Table 1. Relationship between saprobic index (S) and water pollution level

Saprobic Index (S) Range Value	Pollution Level
1,0-1,5	Slightly or not polluted (Oligosaprobic)
1,5-2,5	Moderately polluted (β-Mesosaprobic)
2,5-3,5	Heavy pollution (α-Mesosaprobic)
3,5-4,0	Very heavy pollution (Polysaprobic)

Source : Revera (1979)

RESULT AND DISCUSSION

Water Quality Based on Biological Approach

Types of Macrozoobenthos

Macrozobenthos is employed as a bioindicator to measure the quality of river water. The Gerris remigis species is from the Gerridae family, Bivalvia class, the Melanoides tuberculata species is from the Thiaridae family, Gastropoda class, the Melanoides requentii species is from the Thiaridae family, Gastropoda class, the Melonoides torulosa species is from the Thiaridae family, Gastropoda class, the

Melonoides torulos This demonstrates that this species is very resistant to contaminants.

Table 2. Classification and frequency based on individuals of each observation point at Station I

No	Class	Family	Species	Total		
				II.a	II.b	II.c
1	*Pelecypoda*	*Umionidae*	*Anadonta sp*	3		
2	*Gastropoda*	*Thiaridae*	*Thira sp*	18		2
3	-	*Pleuroceridae*	*Viviparus sp*	2	5	6
4	-	*Thiaridae*	*Melanoides granifera*	15	4	10
5	-	*Ampullariidae*	*Pila polita*	2		1
6	-	*Thiaridae*	*Melonoides torulosa*	16	4	4
7	-	*Pleuroceridae*	*Maurea cunninghami*	2		

Based on Table 2, the composition or frequency of the presence of benthic species that are very abundant at Station I is found at point I.c with coordinates 3º22'59.4048 "South latitude and 122º4'5.9808" East longitude, namely; the species of *Melonoides torulosa* and the species of *Melanoides tuberculata*, then the composition or frequency of benthic species that are often encountered are the species of *Gerris remigi*, *Melanoides tuberculata*, and *Melonoides torulosa* while the composition or frequency of benthic species whose presence is only coincidental/ rare, namely the type of Bulimidae and the species of *Melanoides requentii*. All individuals found at Station I belong to the class Gatropoda and class Bivalvia with the type of macrozoobenthos categorized Oligosaprobic namely *Gerris remigis* species, *Melanoides requentii* species and Bulimida species, for the type of macrozoobenthos categorized as α-Mesosaprobic, namely *Melanoides torulosa*, while the species of macrozoobenthos categorized as Polysaprobic is the type of *Melanoides tuberculata* and there is no species of macrozoobenthos categorized as β- Mesosaprobic. The lack of macrozoobenthos species found at Station I is because this location is less favorable for the development of benthic species due to the condition of the river substrate base which contains more sand and slightly muddy, lack of dead plant debris, relatively high water temperature of 25.3 ºC, pH value of 6.58, low PO_4 value is low at 0.07 mg/L, DO value that does not meet the 3.47 mg/L it can not support for macrozoobenthos animals in the process of respiration and decomposition of organic matter in water and the state of high COD value of 26.7 mg/L. According to Andriani (2017), the basic substrate conditions in the form of muddy sand, high organic substrate content, high temperature, inappropriate pH conditions, high COD values and low dissolved oxygen in the water so that it causes low abundance of macrozoobenthos species.

Based on Table 3, the composition or frequency of the presence of benthic species that are very abundant at Station II is found at point II.a with coordinates 3º23'48.1164" South latitude and 122º4'55.8356 "East longitude, namely; the species of *Thira sp*, *Melanoides granifera* and *Melonoides torulosa*, then the composition or frequency of benthic species that are often encountered are the species of *Viviparus sp*, *Thira sp*, Pleuroceridae and *Melonoides torulosa* while the composition or frequency

of benthic species whose presence is only coincidental / rare, namely the type of *Anadonta sp*, the species of *Maurea cunninghami* and the species of *Pila polita*. All individuals found at Station II belong to the Gatropoda class and Pelecypoda class, the type of macrozoobenthos categorized as Oligosaprobic, namely the species of *Pila polita* and the species of *Maurea cunninghami*, for the species of macrozoobenthos categorized as β-Mesosaprobic, namely the type of *Anadonta sp* and the species of *Viviparus sp*, then for the species of macrozoobenthos categorized as α-Mesosaprobic, namely the species of *Thira sp* and the species of *Melanoides torulosa*, while the type of macrozoobenthos categorized as Polysaprobic is the species of *Melanoides granifera*.

Table 3. Classification and frequency based on individuals of each observation point at Station II

No	Class	Family	Species	Total		
				II.a	II.b	II.c
1	*Pelecypoda*	*Umionidae*	*Anadonta sp*	3		
2	*Gastropoda*	*Thiaridae*	*Thira sp*	18		2
3	-	*Pleuroceridae*	*Viviparus sp*	2	5	6
4	-	*Thiaridae*	*Melanoides granifera*	15	4	10
5	-	*Ampullariidae*	*Pila polita*	2		1
6	-	*Thiaridae*	*Melonoides torulosa*	16	4	4
7	-	*Pleuroceridae*	*Maurea cunninghami*	2		

The location at Station II began to support the development of benthic species compared to Station I, which found 7 benthic species from 5 families, this is due to the condition of the bottom of the river substrate which began to contain a lot of mud, the large number of remnants of sediment particles needed to feed macrozoobenthos such as the remains of dead plants that float in the waters are food for benthos of the Gastropoda class, relatively low water temperature conditions compared to Station I which is 23.3 ºC, lower pH value compared to Station I which is 6.25 and higher Ammonia (NH3) which is higher at 0.10 mg/L, a low BOD value of 2.4 ml/L and a low COD value of 21.8 ml/L, this condition is quite good for the growth and development of benthic animals and plays a role in the formation of protein in the body of living bodies, especially benthic animals. The state of dissolved oxygen values at this station is relatively low with a DO value of 3.34 mg/L and a high TSS value, where this situation affects the development of macrozoobenthos species that are intolerant of environmental factors, especially low dissolved oxygen conditions, benthic species of the Gastropoda class that have a high abundance due to their sensitivity that is tolerant of inappropriate dissolved oxygen conditions. According to Merliyana (2017), benthic animals of the Gastropoda class are found in waters that are lightly polluted to heavily polluted, insensitive to environmental pressure because their bodies have an

operculum that can be used to close the shell when water conditions are outside their tolerance range such as in waters that experience high organic pollution and can live in limited oxygen conditions.

Table 4.Classification and frequency based on individuals of each observation point at Station III

No	Class	Famili	Jenis	Jumlah		
				III.a	III.b	III.c
1	*Pelecypoda*	*Umionidae*	*Anadonta sp*	3	2	
2	*Bivalvia*	*Corbiculidae*	*Corbicula moltkiana*		1	
3	*Gastropoda*	*Pleuroceridae*	*Pleurocora sp*	5	2	2
4	-	-	*Viviparus sp*	5	1	
5	-	*Ampullariidae*	*Pila polita*	15	5	8
6	-	*Menetidae*	*Menetus sp*		1	
7	-	*Thiaridae*	*Melonoides torulosa*	4	1	5
8	-	-	*Melanoides granifera*			3
9	-	-	*Thira sp*	3		
10	-	-	*Bulimidae*		1	

Based on Table 4, the composition or frequency of the presence of benthic species that are very abundant at Station III is found at point III.a with coordinates 3º24'44.0784" South latitude and 122º5'11274 "East longitude, namely the species of *Pleurocora sp, Viviparus sp, Pila polita* and the species of *Melonoides torulosa* then the composition or frequency of benthic species that are often encountered are the species of *Anadonta sp, Pleurocora sp, Viviparus sp* and *Pila polita* and the species of *Melonoides torulosa* while the composition or frequency of benthic species whose presence is only by chance / rarely, namely the species of *Melanoides granifera* and *Thira sp*, the species of Bulimidae, the species of *Menetus sp* and the species of *Corbicula moltkiana*. All individuals found at Station III belong to the Gatropoda class, Pelecypoda class and Bivalvia class, macrozoobenthos species categorized as Oligosaprobic namely *Corbicula moltkiana* species, *Pila polita species*, Bulimidae species and *Menetus sp* species, for the species of macrozoobenthos categorized as β- Mesosaprobic, namely the species of *Anadonta sp* and the species of *Viviparus sp*, then for the species of macrozoobenthos categorized as α- Mesosaprobic, namely the species of *Pleurocora sp*, the species of *Thira sp* and the species of *Melanoides torulosa*, while for the species of macrozoobenthos categorized as Polysaprobic, namely the species of *Melanoides granifera*.

The location at Station III is very supportive for the development of macrozoobenthos species, due to the condition of the muddy substrate base with a little sand and clay loamy many remnants of sediment particles, many remnants of dead plants that float in the water and are food for benthic animals, low water temperature of 21 ºC, low TSS value of 50 mg/L, low pH of 6.29, BOD value of 3.51 mg/L, COD value of 22.30 mg/L and high Ammonia (NH_3) value of 0.10 mg/L and high Phosphate (PO_4) value of 0.030 mg/L. This is quite good as one of the main nutrients for the growth and development of aquatic

plants and plays a role in the formation of proteins in the body of living bodies, especially benthic animals and the state of dissolved oxygen in water which began to increase at 3.49 mg/L compared to Stations I and II.

Water Quality Based on Macrozoobenthos Saprobic Index

To obtain the results of the water quality status of the Anggokoine River, the macrozoobenthos species data from the identification results were then analyzed using the saprobic index (S) approach then obtained a recapitulation value. The results of the recapitulation of macrozoobenthos species data determined based on the range of saprobic indices from the three stations that have been carried out in the Angokoine River, namely Station I, Station II and Station III can be seen in Table 5.

Table 5. Pollution level values of each research station conducted in Anggokoine River based on saprobic index (S) values

Station	Station Saprobic Level Value (S)	Saprobic Index Range Value	Pollution Level Category
Station I	2,6	2,5-3,5	α- Mesosaprobic (Heavy pollution)
Station II	2,7	2,5-3,5	α- Mesosaprobic (Heavy pollution)
Station III	2,3	1,5-2,5	β- Mesosaprobic (Moderate pollution)

Based on Table 5, Station I has a saprobic index value of 2.6 and Station II is 2.7 which in both stations is in the range of saprobic index 2.5-3.5 which shows the level of water pollution in Anggokoine River with the α-Mesosaprobic category which means the state or condition of Anggokoine River in heavy pollution conditions. This is because Station I is dominated by macrozoobenthos groups that are tolerant or the level of saprobity is Mesosaprobic- Polysaprobic, namely the species of *Melanoides tuberculata* and the species of *Melonoides torulosa* whose composition or frequency of presence is very abundant and often found the species of *Gerris remigis* whose sensitivity is facultative and rarely found intolerant macrozoobenthos or Oligosaprobic saprobic level, namely the species of Bulimidae and the species of *Melanoides requenti* so that it can affect the saprobic index value and is an indicator of heavy pollution conditions. Then at Station II due to the abundance of *Thira sp*, *Viviparus sp*, *Melanoides granifera* and *Melanoides torulosa* which are macrozoobenthos species that have a wide tolerance to pollutants or Mesosaprobic- Polysaprobic saprobic levels so that they can develop to reach high densities in heavily polluted waters. In general, these organisms are not sensitive to various environmental pressures and their abundance can increase in waters polluted by organic matter and low oxygen conditions in water so that they can affect the saprobic index value and are indicators of heavy pollution. Then at Station III has a saprobic index value of 2.3 which is in the range of saprobic index 1.5-2.5

which shows the level of water pollution in the Anggokoine River with the β-Mesosaprobic category which means the condition or condition of the Anggokoine River is in a moderate pollution condition. This is because at Station III the composition of macrozoobenthos species found is more dominated by groups of macrozoobenthos whose saprobity level is Oligosaprobic- Mesosaprobic, namely from the species of *Pila polita*, *Pleucora sp*, *Viviparus sp*, and *Melanoides torulosa* and rarely found macrozoobenthos whose saprobity level is Polysaprobic, namely from the species of *Melanoides granifera* compared to Station I and Station II which are dominated by the Mesosaprobic-Polysaprobic group. Overall, the Anggokoine River is dominated by macrozoobenthos from the Gastropoda class which has a wide tolerance to high organic matter pollution, low dissolved oxygen conditions and is not sensitive to environmental stress, namely the species *Melanoides tuberculata*, *Melanoides torulosa*, *Melanoides garanifera* and *Thira sp* which are abundant and are indicators of pollution in river waters.

River Water Quality Based on Physical-Chemical Water

Temperature

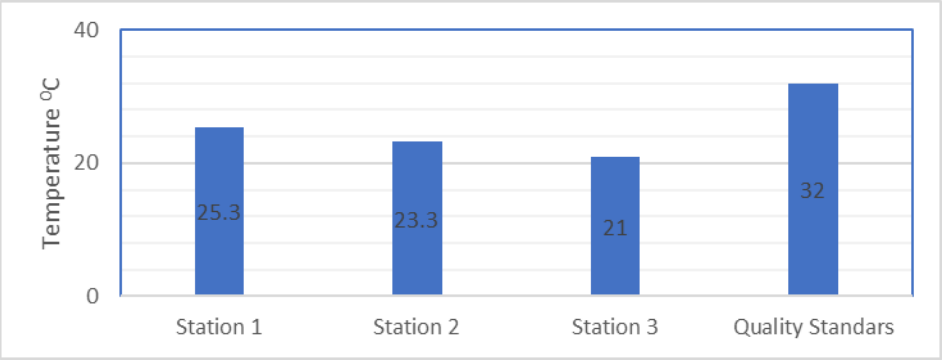

Figure 2. Profile of changes in water temperature values of Anggokoine River

Based on the results in Figure 2, it can be seen that the temperature value of the Anggokoine River water at Station I to Station III with a temperature value range is 21-25.3 ºC, this value can still be tolerated by macrozoobenthos, namely in the range of 20-30 ºC (Sugiarto et al., 2017). The highest temperature is at Station I which is 25.3 ºC, this is because Station I has a low level of depth of the water body and a fairly fast water flow condition compared to Station II and Station III, the lowest temperature value is at Station III which is 21 ºC, this is due to good vegetation cover, slow water flow and a high level of depth of the water body. According to Effendi (2000), the temperature of a water body is influenced by several factors including; vegetation, water flow and depth of the water body. Thus, the temperature value of Anggokoine River water at each station has not exceeded the class II water quality standard according to Government Regulation No. 82 of 2001, which is 32 ˚C.

Total Suspended Solid (TSS)

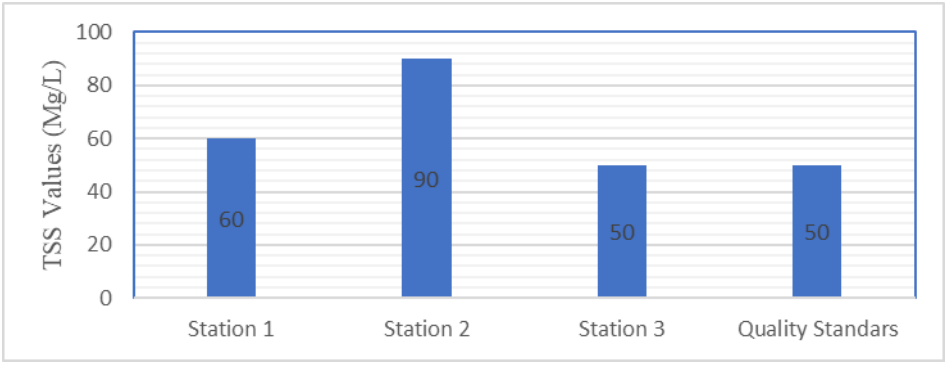

Figure 3. Profile of Changes in Total Suspended Solid (TSS) Values of Anggokoine River Water

Based on the results in Figure 3, the range of TSS values of Anggokoine River water ranged from 50-90 mg/L. Overall, the highest change in the value of total TSS was found at Station II with a TSS value of 90 mg/L, this is thought to be due to agricultural activities at Station II which produce inorganic waste, suspended materials and waste from agricultural activities that enter the river through irrigation channels for community rice fields and the many fishing activities in the Anggokoine River and at Station I which is 60 mg/L, This is thought to be due to the presence of a large number of suspended particles sourced from the Lalindu River which enters through a small river into the Anggokoine River, thus the TSS value at Station I and Station II has exceeded the value of the class II water quality standards of Government Regulation No. 82 of 2001, namely with the value of TSS. 82 of 2001, with a TSS value of 50 mg/L.

Total Dissolved Solid (TDS)

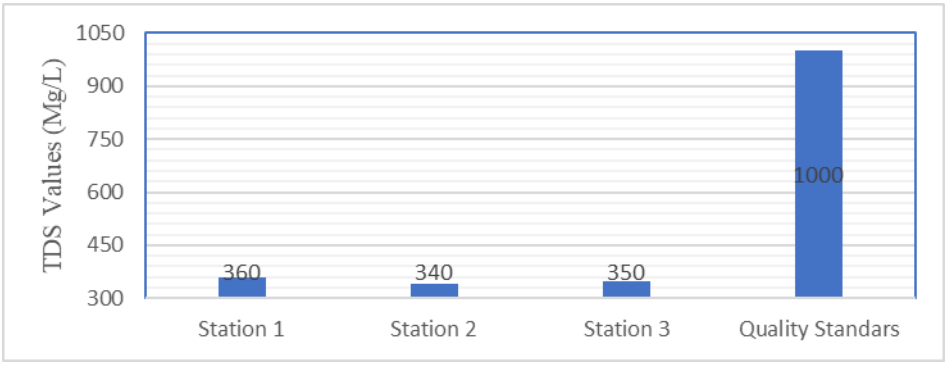

Figure 4. Profile of Changes in Total Dissolved Solid

Based on the results in Figure 4, the range of TDS values from Station I to Station III is 340-360 mg/L. This is not significant due to the condition of the Anggokoine River where the topography is relatively flat and there is no anthropogenic influence from industrial or household activities. Based on Government Regulation No. 82 of 2001, the value of TDS in Anggokoine River does not exceed the

class II water quality standard of 1000 mg/L.

Turbidity

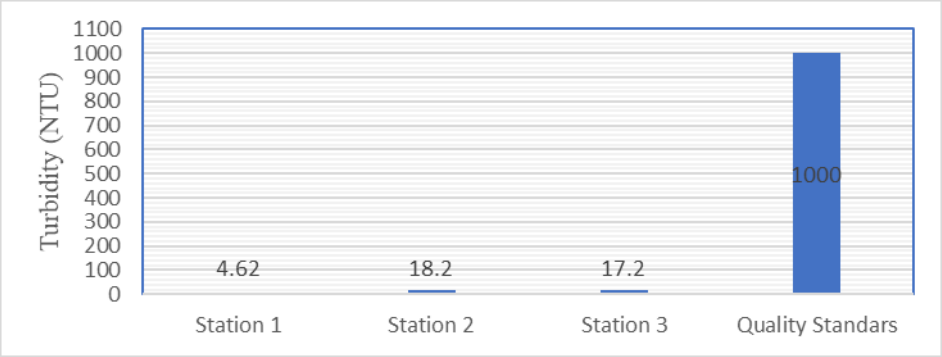

Figure 5. Profile of Changes in Turbidity Value of Anggokoine River Water

Based on the results in Figure 5, the range of turbidity values of the Anggokoine River water ranged from 4.62-18.2 NTU. Overall, the increase in turbidity values from Station I to Station III was very significant, this was because at Station II there were agricultural activities where the results of the discharge in the form of mud particles and organic matter entered the river through the irrigation channels of the community's rice fields and the many fishing activities at Station II and Station III, causing soil erosion along the River.

Degree of Acidity (pH)

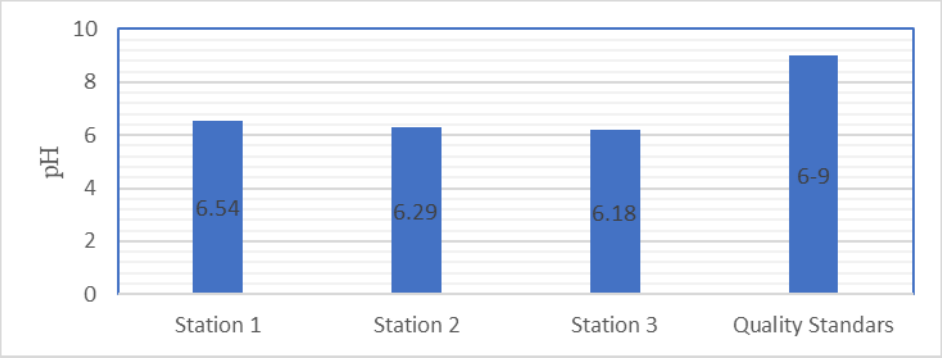

Figure 6. Profile of Changes in the Degree of Acidity (pH) of Anggokoine River Water

Based on Figure 12, the range of pH of Anggokoine River is 6.18-6.58 or around 6-7. This is due to the relatively deep level of river water at each station, which is 1-3 meters from the river body, thus the pH value of Anggokoine River still meets the class II water quality.

Dissolved Oxygen (DO)

Based on Figure 7, the range of dissolved oxygen (DO) values in Anggokoine River is 3.34-3.49 mg/L, thus the DO value in Anggokoine River at each station has not met the Class II water quality standards according to Government Regulation No. 82 of 2001 which is 4 ml/L. This was influenced by the lack of photosynthesis process of aquatic plants, the lack of diffusion mechanism from the atmosphere and the condition of vegetation cover which began to decrease so that it was a factor in the low value of dissolved oxygen in Anggokoine River.

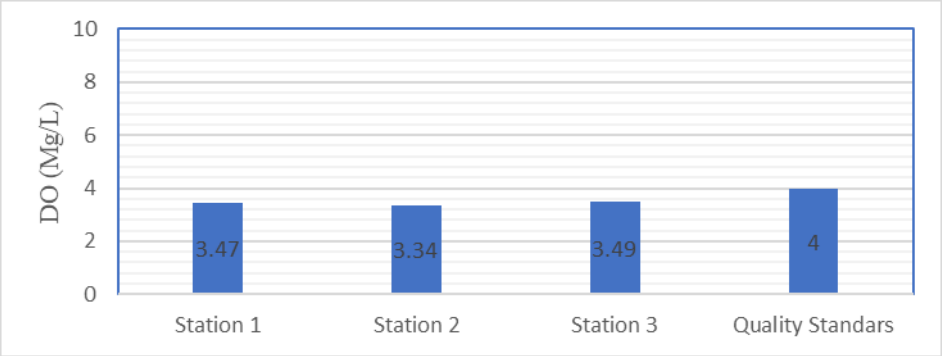

Figure 7. Profile of Changes in Dissolved Oxygen (DO) Values of Anggokoine River Water

Biochemical Oxygen Demand (BOD)

Based on the results in Figure 14, the range of BOD values of Anggokoine River is 2.40-4.10 mg/L, the highest BOD values were obtained at Station I and Station III, namely 3.51-4.10 mg/L, thus based on Government Regulation No. 82 of 2001, the value of biochemical oxygen demand (BOD) of Anggokoine River at Stations I and III has exceeded the class II water quality standards according to Government Regulation No. 82 of 2001 which is a maximum of 3 mg/L, in contrast to the BOD value at Station II which is 2.40 mg/L, the high BOD value at Station I is thought to be due to organic matter entering Anggokoine River through the Ambaikaweha River. 82 of 2001 which is a maximum of 3 mg/L, in contrast to the BOD value at Station II which is 2.40 mg/L, the high BOD value at Station I is suspected of organic matter entering the Anggokoine River through the Ambaikaweha River which is sourced from the Lalindu River, as well as at Station III which is suspected of organic matter entering the Anggokoine River through the Lameoru River connected to residential areas and oil palm plantation areas.

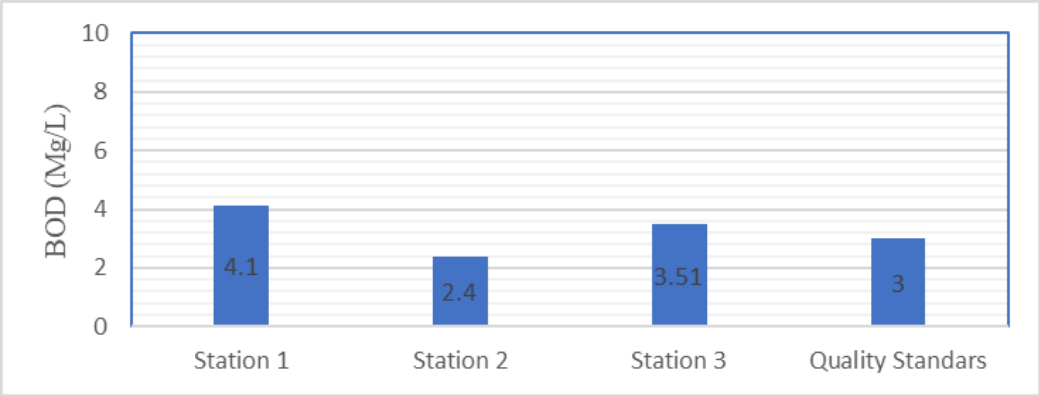

Figure 8. Profile of Changes in Biochemical Oxygen Demand (BOD) Value of Anggokoine River Water

Chemical Oxygen Demand (COD)

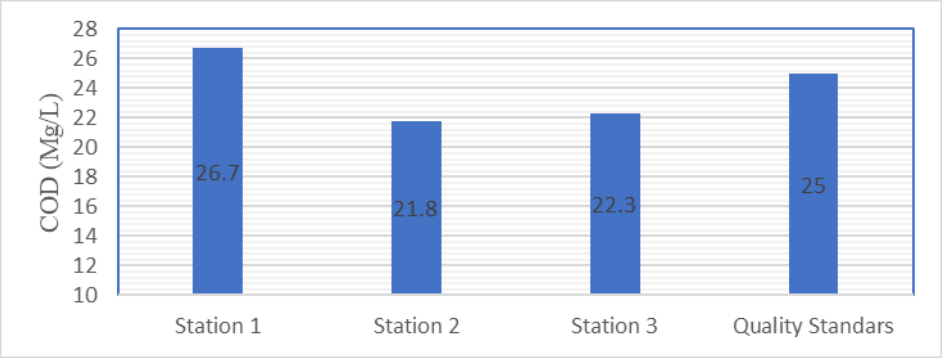

Figure 9. Profile of Changes in Chemical Oxygen Demand (COD) Value of Anggokoine River Water

Based on Figure 9, the range of COD values in Anggokoine River is 21.8-26.7 mg/L. The highest COD value is at Station I which is 26.7 mg/L, this is thought to be due to wood processing activities by the community which produce chemicals in the form of lignin and are thought to be the source of the high COD value at the Station, thus the COD value at Station I has exceeded the class II water quality standard according to Government Regulation No. 82 of 2001 which is 25 mg/L.

Ammonia (NH_3)

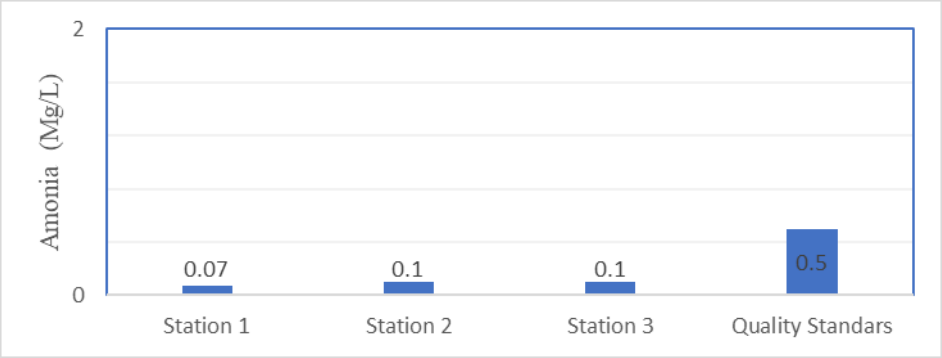

Figure 10. Profile of Changes in Ammonia Value (NH_3) of Anggokoine River Water

Based on Figure 9, the range of NH_3 of Anggokoine River ranged from 0.07-0.10 mg/L. The highest Ammonia value is at Station II and Station III, which is 0.10 mg/L, this is because at these stations there are many plant debris that float on the riverbank sourced from agricultural activities and fish finding activities so that it is thought to be the cause of the increase in NH_3value at that station.

Nitrite (NO_2)

Based on Figure 11, the range of NO_2 value of Anggokoine River is 0.02- 0.03 mg/L, the highest NO_2value is at Station I and Station III. This is because at both stations livestock activities such as community cows were found living wild along the banks of the Anggokoine River and are thought to be the cause of the high NO_2, in contrast to Station II where no livestock activities such as community cows were found so that this can be suspected to be the cause of the low concentration of nitrite at Station II, namely 0.02 mg. NO_2 concentration at Station II, which is 0.02 mg/L.

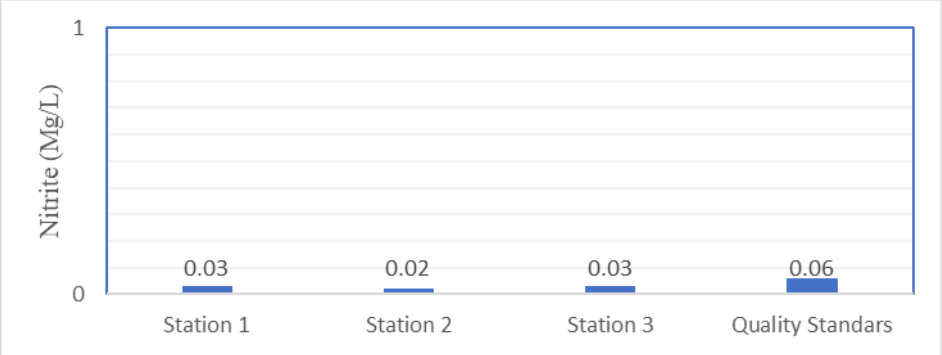

Figure 11. Profile of Changes in Nitrite Value (NO_2) of Anggokoine River Water

Phosphate (PO_4)

Based on Figure 12, the range of Phosphate (PO_4) in Anggokoine River is 0.21-0.030 mg/L. The low value of phosphate at each station in Anggokoine River is thought to be due to the lack of reaction

between aquatic organisms and the absence of remnants of wildlife so that it causes the low value of phosphate at each station, this situation overall the content of phosphate values in Anggokoine River still has not exceeded the class II water quality standards according to Government Regulation No. 82 of 2001 which is 0.2 mg/L.

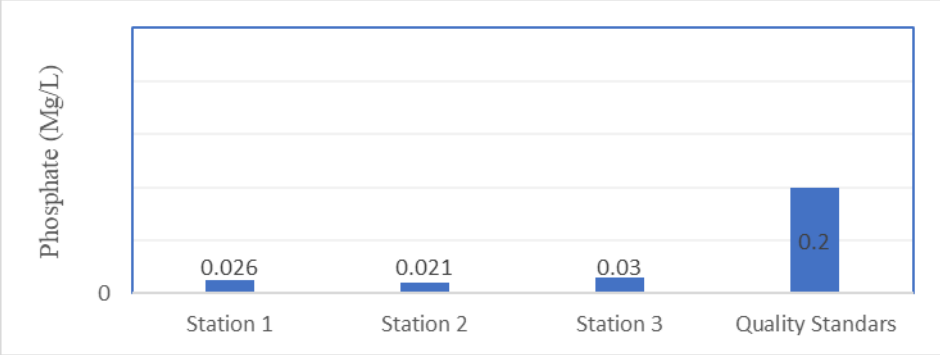

Figure 12. Profile of Changes in Phosphate Value (PO4) of Anggokoine River Water

Relationship between Physical-Chemical River Water Quality and Macrozoobenthos Saprobic Index

The results of the measurement of physico-chemical parameters of river water related to the saprobic index of macrozoobenthos in Anggokoine River include parameters of Temperature, TSS, TDS, pH, DO, BOD, COD, Ammonia, Nitrite and Phosphate. Based on the measurement results at the three stations, the temperature value at the research location has a temperature range of 21-25.3 ˚C. According to *Sastrawijaya (2000),* high or low temperature conditions in waters will have two effects on aquatic organisms, which can reduce species diversity or vice versa can support species abundance, especially benthic animals. This is evidenced by the results of the analysis where the saprobic index value obtained at Station I is 2.6 and Station II is 2.7 which is in the range of saprobic index 2.5-3.5 which shows the level of water pollution in Anggokoine River categorized as α- Mesosaprobic which means the condition or condition of Anggokoine River is in a heavily polluted condition, The species of macrozoobenthos found are dominated by the benthic species *Melanoides tuberculata*, *Melanoides torulosa*, *Melanoides granifera* and *Thira sp* which are types of macrozoobenthos that are tolerant of environmental stress with the temperature of river water, namely at Station I, 25.3 ºC and at Station II, 23.3 ºC. Then at Station III the results of the analysis where the saprobic index value is 2.3 which is in the range of saprobic index 1.5-2.5 which shows the level of water pollution in Anggokoine River categorized as β- Mesosaprobic which means the condition or condition of Anggokoine River in moderate pollution conditions with a river water temperature value of 21 ˚C.

Based on the measurement results from the three stations, the total suspended solids (TSS) value of Anggokoine River water ranged from 50-90 mg/L. According to Prasiwi and Wardhani (2018), the amount of suspended solids in the water will affect the state of the population of benthic species and diversity and affect the animals that can live in a body of water and is an indicator of a decrease in water

quality. This situation is evidenced by the identification results that the macrozoobenthos found at Station I and Station II are more dominated by macrozoobenthos groups that are tolerant, namely the species of *Melanoides tuberculata, Melanoides torulosa, Melanoides granifera* and *Thira sp* which are types of macrozoobenthos that are tolerant of polluted materials, while at Station III they are more dominated by facultative macrozoobenthos groups and the results of saprobic index analysis where at Station I, namely 2.6 and Station II, namely 2.7,6 and Station II is 2.7 which is in the range of saprobic index of 2.5-3.5 which shows the level of water pollution in Anggokoine River categorized as α-Mesosaprobic which means the condition or condition of Anggokoine River in severe pollution conditions with the value of total suspended solids or Total Suspended Solid (TSS) which is 60-90 mg/L. Then at Station III, the results of the analysis where the saprobic index value is 2.3 which is in the range of saprobic index 1.5-2.5 which shows the level of water pollution in Anggokoine River categorized as β- Mesosaprobic which means that the condition or condition of Anggokoine River is in moderate pollution conditions with a total suspended solids value or Total Suspended Solid (TSS) of 50 mg/L.

Based on the measurement results of the three stations the value of total dissolved solids or Total Dissolved Solid (TDS) ranging from Station I to Station III is 340-360 mg/L, this situation greatly affects the diversity of macrozoobenthos. According to Maula (2018), the high or low value of TDS will affect the clarity of water so that it will interfere with the process of photosynthesis carried out by macroorganisms in water due to reduced incoming sunlight, while these macroorganisms are a food source for macrozoobenthos, this situation causes reduced food sources which will affect the number of species in the community and the nature of these organisms. This will have an impact on the diversity of benthic species that are dominant, namely only from the Pelecypoda class, Bivalvia class and Gastropoda class with a high abundance of 14 species of macrozoobenthos with the results of the analysis of the saprobic index of macrozoobenthos at Station I, namely 2.6 and Station II, namely 2.7 which is in the range of saprobic index 2.5-3.5 which shows the level of pollution in the Anggokoine River with the α-Mesosaprobic category, which means the state or condition of the Anggokoine River in a heavily polluted condition. Then at Station III, the results of the analysis where the saprobic index value is 2.3 which is in the range of saprobic index of 1.5-2.5 which shows the level of water pollution in Anggokoine River categorized as β- Mesosaprobic which means the state or condition of Anggokoine River in moderate pollution conditions.

Based on the results of measurements at the three stations, the pH value in Anggokoine River has a range of 6.18-6.58, this situation is still categorized as normal so that it does not affect the development and growth of macrozoobenthos. According to Effendi (2003), benthic organisms like pH values around 5.6-8.3 in their environment. This is evidenced by the results of identification found 14 benthic species from the dominant benthic class consisting of Pelecypoda, Bivalvia and Gastropoda macrozoobenthos class of this class likes normal pH and is a type of class that is tolerant and facultative.

This situation is evidenced by the results of the analysis of the saprobic index of macrozoobenthos at Station I which is 2.6 and Station II which is 2.7 which is in the range of saprobic index 2.5-3.5 which shows the level of pollution in Anggokoine River categorized as α-Mesosaprobic which means the state or condition of Anggokoine River in a heavily polluted condition. Then at Station III, the results of the analysis where the saprobic index value is 2.3 which is in the range of saprobic index 1.5-2.5 which shows the level of water pollution in Anggokoine River categorized as β-Mesosaprobic which means the state or condition of Anggokoine River in moderate pollution conditions.

Based on the results of the analysis at the three stations, the value of dissolved oxygen or Dissolved Oxygen (DO) is 3.34- 3.49 mg/L. This shows the state of dissolved oxygen in water that does not meet the standards so that it can affect the macrozoobenthos population that lives with low dissolved oxygen for respiration and decomposition of organic matter. According to Maula (2018), low dissolved oxygen in a body of water will affect benthic metabolism so as to reduce the diversity of benthic populations and increase the abundance of benthic species that are tolerant or facultative to the state of dissolved oxygen in low water. This is evidenced by the results of the identification of macrozoobenthos obtained in the Anggokoine River, namely from the Gastropoda, Pelecypoda and Bivalve classes, which are types of macrozoobenthos that are facultative and tolerant of environmental stress such as *Melanoides tuberculata*, *Melanoides torulosa*, *Melanoides granifera, Viviparus sp* and *Thira sp* which are types of macrozoobenthos that are tolerant of environmental stress with the results of the analysis of the saprobic index of macrozoobenthos where at Station I it is 2.6 and Station II is 2.7 which is in the range of saprobic index 2.5-3.5 which shows the level of pollution in Anggokoine River categorized as α-Mesosaprobic which means the state or condition of Anggokoine River in a heavily polluted condition. Then at Station III, the results of the analysis where the saprobic index value is 2.3 which is in the range of saprobic index 1.5-2.5 which shows the level of water pollution in Anggokoine River categorized as β- Mesosaprobic which means the state or condition of Anggokoine River in moderate pollution conditions.

Based on the results of the analysis at the three stations, the value of BOD is 2.40-4.10 mg/L, this shows the state of BOD in high water and thus has exceeded the quality standards according to Government Regulation No. 82 of 2001 which is 3 mg/L. However, this situation is a trigger factor for an increase in the population of macrozoobenthos species that are dominant in a body of water, namely macrozoobenthos of the Gastropoda class. According to Prasiwi and Wardhani (2018), if the BOD value of a water body exceeds the quality standard, it can be said that pollution has occurred and will indirectly reduce the benthic population that is not resistant to environmental stress. This situation is evidenced by the results of identification where all types of macrozoobenthos found in the Anggokoine River are tolerant and facultative types of macrozoobenthos to environmental stress, namely macrozoobenthos

from the Gastropoda class which dominate the waters of the Anggokoine River with a high abundance of species with the results of the analysis of the macrozoobenthos saprobic index where at Station I, namely 2.6 and Station II, namely 2.7,6 and Station II is 2.7 which is in the range of saprobic index 2.5-3.5 which shows the level of pollution in Anggokoine River categorized as α-Mesosaprobic which means the condition or condition of Anggokoine River in heavy pollution conditions. Then at Station III, the results of the analysis where the saprobic index value is 2.3 which is in the range of saprobic index 1.5-2.5 which shows the level of water pollution in Anggokoine River categorized as β-Mesosaprobic which means the state or condition of Anggokoine River in moderate pollution conditions.

Based on the analysis of the three stations, the value of chemical oxygen demand (COD) of Anggokoine River water ranged from 21.80-26.70 mg/L. Overall, the COD value in Anggokoine River is not good so that it affects the species of macrozoobenthos that can live in it, namely only macrozoobenthos from the Gastropoda, Pelecypoda and Bivalve classes. Melati (2007) stated that the presence of benthos from the Gastropoda class can indicate that the water conditions are heavily polluted. This is evidenced by the results of the identification of the dominant macrozoobenthos, namely the type of *Melanoides tuberculata*, *Melanoides torulosa, Melanoides granifera* and *Thira sp*, which is a type of macrozoobenthos that is tolerant of pollution by orgaic materials from human activities and other environmental pressures and the results of the analysis of the saprobic index of macrozoobenthos at Station I which is 2.7,6 and Station II is 2.7 which is in the range of saprobic index 2.5-3.5 which shows the level of pollution in Anggokoine River categorized as α-Mesosaprobic which means the condition or condition of Anggokoine River in heavy pollution conditions. Then at Station III, the identification results show the distribution of macrozoobenthos species that are balanced between the types of tolerance to contaminants and environmental pressures that can affect the saprobic index value. This is evidenced by the results of the analysis where the saprobic index value is 2.3 which is in the range of saprobic index 1.5-2.5 which shows the level of water pollution in Anggokoine River categorized as β-Mesosaprobic which means that the condition of Anggokoine River is in moderate pollution conditions.

Based on the analysis of the three stations, the NH_3 value ranged from 0.07-0.10 mg/L. According to Effendi (2003), NH_3 levels in natural waters are usually less than 0.1 mg/L. High NH_3 levels can indicate the presence of organic matter pollution from domestic waste, industrial waste, and agricultural fertilizer runoff, so that a situation where high ammonia values will cause a decrease in the diversity of aquatic organisms. Overall, the NH_3 value of Anggokoine River water has no significant effect on the development of macrozoobenthos from the Gastropoda, Pelecypoda and Bivalve classes with the results of the analysis of the saprobic index of macrozoobenthos at Station I which is 2.6 and Station II which is 2.7 which is in the range of saprobic index 2.5-3.5 which shows the level of pollution

in Anggokoine River categorized as α-Mesosaprobic which means the condition or condition of Anggokoine River in a heavily polluted condition. Then at Station III, the results of the analysis where the saprobic index value is 2.3 which is in the range of saprobic index 1.5-2.5 which shows the level of water pollution in Anggokoine River categorized as β-Mesosaprobic which means the state or condition of Anggokoine River in moderate pollution conditions.

Based on the results of the analysis at the three stations, the NO_2 value of Anggokoine River water ranged from 0.02-0.03 mg/L, this situation has not exceeded the class II water quality standard according to Government Regulation No. 82 of 2001 which is 0.06 mg/L. This is still categorized as stable so that it does not affect the life and development of macrozoobenthos animals from the Gastropoda, Pelecypoda and Bivalvia classes with the results of the analysis of the macrozoobenthos saprobic index at Station I, namely 2.6 and Station II, namely 2.7 which is in the range of saprobic index 2.5-3.5 which shows the level of pollution in the Anggokoine River categorized asα- Mesosaprobic, which means that the condition or condition of the Anggokoine River is in a heavily polluted condition. Then at Station III, the results of the analysis where the saprobic index value is 2.3which is in the range of saprobic index of 1.5-2.5 which shows the level of water pollution in Anggokoine River categorized as β-Mesosaprobic which means the state or condition of Anggokoine River in moderate pollution conditions.

Based on the results of the analysis at the three stations, the value of PO_4 of Anggokoine River water ranged from 0.021-0.030 mg/L. According to Warman (2015), the presence of phosphate in the waters is very important for the growth of aquatic plants, these aquatic plants are then food for macrozoobenthos animals that function in the formation of protein and metabolism in the body. This situation triggers an increase in the abundance of macrozoobenthos species of the Gastropoda class due to the high nutrient P which is a nutrient for phytoplankton and aquatic plants and will indirectly support the growth and development of macrozoobenthos animals because the food sources needed are available and have an impact on the population of species that dominate the waters with the results of the analysis of the saprobic index of macrozoobenthos where at Station I is 2.6 and Station II is 2.7,6 and Station II is 2.7 which is in the range of saprobic index 2.5-3.5 which shows the level of water pollution in the Anggokoine River with the α-Mesosaprobic category which means the condition or condition of the Anggokoine River in heavy pollution conditions. Then at Station III, the results of the analysis where the saprobic index value is 2.3 which is in the range of saprobic index 1.5-2.5 which shows the level of water pollution in Anggokoine River categorized as β-Mesosaprobic which means the state or condition of Anggokoine.

CONCLUSION

Based on the research conducted and the results the types of macrozoobenthos in Anggokoine River are 14 types of macrozoobenthos from 6 families consisting of the Gastropoda class, Plecypoda class and Bivalve class. Based on the analysis that has been carried out, the indicator of water pollution in Anggokoine River based on the saprobic index of macrozoobenthos at Station I is 2.6 and Station II is 2.7 which is in the range of saprobic index of 2.5-3.5 categorized as α- Mesosaprobic which means the state or condition of Anggokoine River is in a heavily polluted condition. Then at Station III, namely 2.3 which is in the range of saprobic index of 1.5-2.5 categorized as β- Mesosaprobic which means that the condition or condition of the Anggokoine River is in a moderately polluted condition.

REFERENCES

Andriani, N. 2017. Penyusunan Modul SMA Kelas X Materi Ekosistem Berbasis Keanekaragaman Dan Kemelimpahan Makrozoobentos di Aliran Sungai Kali Asin Madiun. Universitas PGRI Madiun. Prosiding Seminar Nasional SIMBIOSIS Vol. II No. 3 Hal. 192-206.

Effendi H. 2000. Telaah Kualitas Air Bagi Pengelolaan Sumber Daya dan Lingkungan Perairan Bogor: Jurusan Manajemen Suber Daya Perairan. Fakultas Perikanan dan Ilmu Kelautan. IPB

Effendi H. 2003. Telaah Kualitas Air Bagi Pengelolaan Sumberdaya Perairan dan Lingkungan Perikanan. PT Kasinus Yogyakarta. ISBN 978-979-0613-8.

Makino, K. 2001. Practice of Water Quality Investigation Depending On Macrobenthos (Paper of Environmental Monitoring/Water Quality). Japan International Coortpertion Agency-National Enviromental Training Institute.

Maula H.L. 2018. Keanekaragaman Makrozoobentos Sebagai Bioindikator Kualitas Air Sungai Cokro Malang. [Skripsi]. Jurusan Biologi. Fakultas Sains Dan Teknologi Universitas Islam Negeri Maulana Malik Ibrahim. Malang.

Melati Fernita. 2007. Metode Sampling Bioekologi. Bumi Aksara. Jakarta.

Merliyana. 2017. Analisis Status Pencemaran Sungai Dengan Makrozoobentos Sebagai Bioindikator di Aliran Sungai Sumur Putri Teluk Betung. [Skripsi]. Jurusan Pendidikan Biologi. Fakultas Tarbiyah dan Keguruan. Universitas Islam Negri Raden Intan. Lampung.

Peraturan Pemerintah Republik Indonesia Nomor 82 Tahun. 2001 Tentang Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air.

Prasiwi, I dan Wardhani, E. 2018. Analisis Hubungan Kualitas Air Terhadap Indeks Keanekaragaman Plankton dan Bentos di Waduk Cirata. Fakultas Teknik Sipil dan Perencanaan. Itenas Bandung. Jurnal Rekayasa Hijau. Vol.II No.3 Hal. 221- 235. ISSN: 2550-1070.

Ravera, O. 1979. Biological Aspect of Freshwater Pollution. Pergamon Press. London.

Satrawijaya, A.T. 2000. Pencemaran Lingkungan. Edisi Kedua. Rineka Cipta. Jakarta.

Sugiarto, Ari, Verina, F.O, Aprilia, V. 2017. Identifikasi Jenis-Jenis Makrozoobentos Yang Terdapat di Sungai Gasing. Kecamatan Gasing. Kabupaten Banyuasin. Sumatera Selatan. Fakultas Matematika dan Ilmu Pengetahuan Alam. Universitas Sriwijaya. Palembang