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# DETERMINATION OF WATER QUALITY STATUS OF DOWNSTREAM JENEBERANG RIVER USING THE POLLUTION INDEX METHOD

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**Abstract**

One of South Sulawesi's greatest rivers, the Jeneberang River serves a variety of purposes, including providing water for PDAMs, agriculture, plantations, domestic consumption, and industry. Given the significance of the Jeneberang River's function, it is essential to ascertain the river's water quality in order to ascertain the status of the river's water quality. The goal of this study is to use the pollution index (PI) approach to assess the downstream Jeneberang River's water quality. This study used a vandorn water sampler, five sampling sites, and the SNI recommendations for river water quality sampling. The purposive sampling technique, which calculates the pollution index, was utilized in this investigation. The water quality status determination in accordance with Kepmen LH 115/2003 and the pollution index method. Temperature, pH, DO, BOD, COD, and TSS are the six parameters that are monitored and observed using SNI. The downstream Jeneberang River was classified as lightly polluted according to the results of the water quality status using the pollutant index method at five sites, with an IP value range of 1.63–2.36.

**Keywords**: Water Quality; Pollution Index Method (PI); Jeneberang River.

## 1. INTRODUCTION

One of South Sulawesi's biggest rivers is the Jeneberang River. With a length of around 80 km, the Jeneberang River flows from east to west from Mount Bawakaraeng (2,833 masl) and Mount Lompobattang (2,876 masl) to the Makassar Strait. There are numerous uses for the Jeneberang River, including the support of water resources, agriculture, plantations, domestic use, and industrial use.

According to information gathered from the ONLIMO KLHK's water quality monitoring in July 2022, the downstream Jeneberang River has been mildly to moderately contaminated, with IP values for BOD indicators ranging from 1 to 7. The Jeneberang River had been lightly polluted at a number of locations, according to the results of water quality monitoring done in earlier studies.

One of them used the Polluting Index method to study the Jeneberang River's water quality and came up with a Pollutant Index (PI) value of 6.8, which indicates that the river's water is considered to be only weakly polluted. BOD and COD values on the Jeneberang River rise from upstream to downstream, according to Lestari's research. To ascertain the condition of river water quality, a river's water quality assessment is crucial. The water quality index method can be used to determine the status of the water quality. The government regulation of the Republic of Indonesia No. 22 of 2021 about the implementation of environmental protection and management is the basis for the metrics used to assess the condition of river

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water quality.

To assess the quality of water bodies in comparison to a budget, the pollution index is calculated. The level of contamination in relation to acceptable water quality indicators is assessed using the Pollutant Index (PI) method. This index, which can be created for numerous designations for an entire body of water or a section of a river, deals with contaminants that are significant for a designation. This study uses the contamination index approach to assess the downstream Jeneberang River's water quality state.

## 2. METODOLOGY

### A. Study Area

Sampling sites are selected based on direct observations in areas where there is a suspected source of pollutants that can pollute the River Jeneberang. 5 (five) sampling locations of river water are divided into 5 (five) segments. The location of sampling should be selected to take into account the time and distance of the journey as the samples should be taken within one day so that their composition does not change the next day. This research was carried out on November 10, 17, and 24, 2022. The sampling location is in the Jeneberang Hilir River, with five (five) river water sampling points (Figure 1). and a description of the sampling point in Table 1.

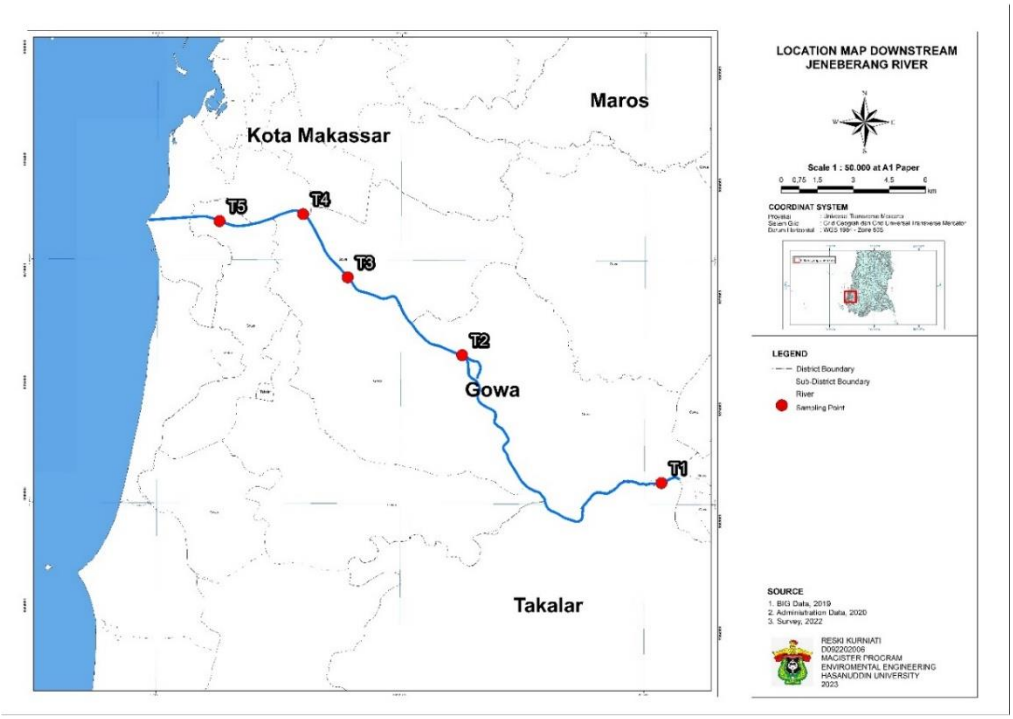


**Figure 1: Sampling Location**

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**Table 1: Description of Sampling Point**

| Sampling point | Coordinates | Description |
|---|---|---|
| T1 | 5° 17' 30.5 S, 119° 34' 22.8 E | Dominated by agricultural activities |
| T2 | 5° 14' 38.4 S, 119° 29' 52.6 E | Dominated by domestic activities |
| T3 | 5° 12' 53.6 S, 119° 27' 17.3 E | There are domestic activities, tofu/tempe industry, and PDAM |
| T4 | 5° 11' 28.1 S, 119° 26' 16.6 E | Dominated by domestic activities, offices |
| T5 | 5° 11' 38 S, 119° 24' 23.6 E | Dominated by domestic activities |

### B. Water quality sampling

Water sampling based on SNI 6989.57:2008 concerning water and wastewater, Part 57: Method of surface water sampling and adjusted to field characteristics The sampling method uses the grab sampling technique. Sampling is done by repeating three times (triplo) and using a Van Dorn water sampler.

### C. Water Quality Sample Testing

The water samples are tested in the laboratory using a testing method that refers to SNI. The parameters tested are (SNI 06-6898.23.2005), pH (SNI 6989.11-2019), DO (SNI 06-6989.14-2004), BOD (SNI 6989.72-2009), COD (SNI 6989.73-2019), TSS (SNI 6989.3-2019).

### D. Polluting Index Method

The determination of the water quality status of the Jeneberang River in this study is determined using the Pollution Index (PI) method, which refers to KepMen LH No. 115 of 2003 concerning Guidelines for Determining Water Quality Status. The value of test parameters from field and laboratory measurements is then compared with water quality standards in Government Regulation of the Republic of Indonesia No. 22 of 2021 concerning the Implementation of Environmental Protection and Management.

The calculation formula for the pollution index (PI) method used in water quality analysis is as follows:

$$Pij = \sqrt{\frac{\left(Ci/Lij\right)^2 M + \left(Ci/Lij\right)^2 R}{2}}$$

In the formula, Li is the concentration of water quality parameters listed in the water designation quality standard (j), Ci is Concentration of water quality parameters measured, Pij is pollution index for designation (j). $(Ci/Lij)^2$ M is maximum Cij/Lij value, $(Ci/Lij)^2$ R is Cij / Lij average value. The criteria for classification of the pollution index are presented in Table 2.

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**Table 2: Pollution Index Classification**

| Pollution Index (PI) | Water Quality Category |
|---|---|
| $0,0 \leq Pij \leq 1,0$ | Good |
| $1,0 \leq Pij \leq 5,0$ | Slightly polluted |
| $5,0 \leq Pij \leq 10$ | Fairly polluted |
| $Pij > 10$ | Heavy polluted |

## 3. RESULT AND DISCUSSION

The results of water quality monitoring carried out in the Jeneberang River reviewed in this study are temperature, pH, DO, BOD, COD, and TSS, which are then compared with PP No. 22 of 2021 concerning the Implementation of Environmental Protection and Management Annex VI of National Water Quality Standards. The sampling activity was carried out in November 2022.

### A. Water quality sample test results

The results of testing water quality samples can be seen in the table. In Table 3, the concentration values for the pH, temperature, and COD parameters have met the quality standards required. As for the DO, BOD, and TSS parameters, they have concentration values that exceed the required quality standard values for all stations.

**Table 3: Water quality sample test results**

| Parameter | Unit | Sample Point | | | | |
|---|---|---|---|---|---|---|
| | | T1 | T2 | T3 | T4 | T5 |
| pH | - | 7.22 | 6.97 | 6.84 | 7.10 | 6.48 |
| Temperature | °C | 26 | 28 | 28 | 29 | 29 |
| DO | mg/L | 8.38 | 8.69 | 8.86 | 8.34 | 8.16 |
| BOD | mg/L | 12.86 | 5.24 | 13.36 | 10.34 | 10.63 |
| COD | mg/L | 9.08 | 14.38 | 14.21 | 14.46 | 17.97 |
| TSS | mg/L | 52.33 | 111.67 | 109.33 | 113.33 | 185.33 |

The temperature value from the test results of water quality samples in the downstream Jeneberang River in the table ranges from 26 °C to 29 °C (Figure 2). Fluctuations in river water temperature can be influenced by season, geographical location, sampling time, and the temperature of wastewater entering the river [5].

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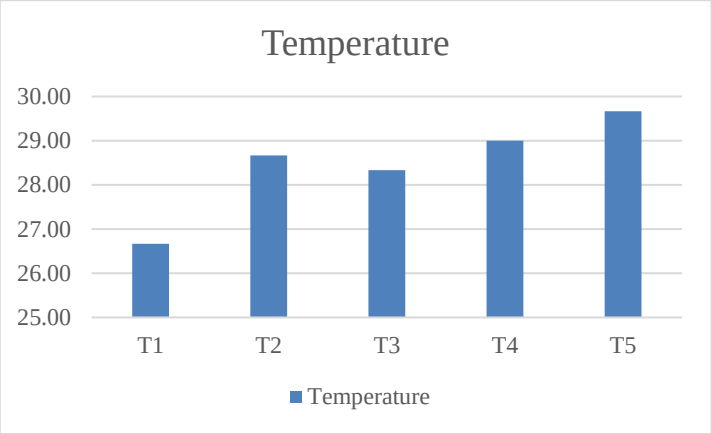


**Figure 2: Temperature at sampling point**

The pH value of the test results of water quality samples is in the range of 6.48 to 7.22 (Figure 3) and meets the required quality standards in accordance with Government Regulation Number 22 of 2021 concerning the Implementation of Environmental Protection and Management Annex VI National Water Quality Standards. pH measurement shows the level of acidity or alkalinity of water because it can affect the level of solubility and presence of nutrients and how nutrients can be used by aquatic organisms [6].

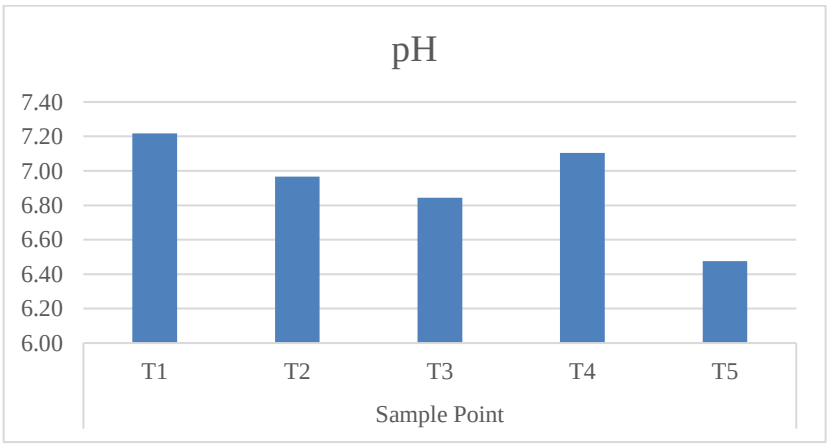


**Figure 3: pH at sampling point**

The DO value of the test results ranged from 8.16 mg/L to 8.86 mg/L (Figure 4). The DO concentration value at each station has exceeded the required class II quality standards, namely the DO value of 4 mg/L. The highest DO value is at the T3 sampling point, with a value of 8.86 mg/L. The DO value of water is dissolved oxygen, which plays a role in the process of food absorption by living things in the water [7].

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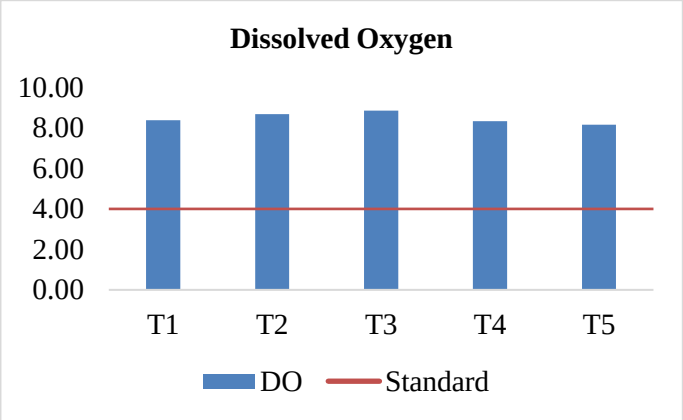


**Figure 4: DO at sampling point**

The BOD value of the test results ranged from 5.24 mg/L to 13.36 mg/L. With the lowest BOD value at the T2 sampling point of 5.24 mg/L and the highest BOD value at the T3 sampling point of 13.36 mg/L (Figure 5). A high BOD value reflects the high activity of microorganisms in the water and indirectly provides a reference to the content of suspended organic materials. The concentration of BOD has decreased downstream as a result of the self-purification process, which is characterized by a discharge that is getting bigger downstream because a large river discharge will accelerate the purification process [7].

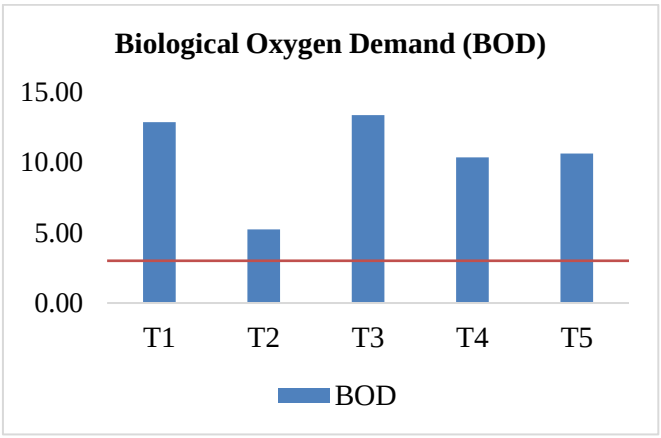


**Figure 5: BOD at sampling point**

The COD concentration value of the test results in Table 7 ranges from 9.08 mg/L to 17.97 mg/L (Figure 6) and meets the required class II quality standards. The value of the COD concentration indicates organic matter that is difficult to decompose. The higher the COD comparison value, the higher the biodegradability level of the liquid waste pollutant [8].

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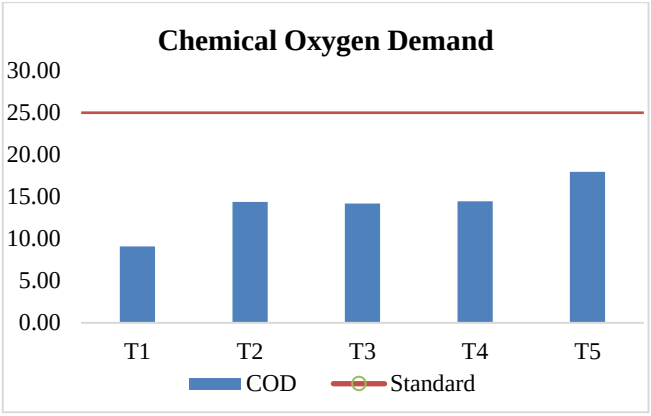


**Figure 6: COD at sampling point**

The TSS concentration value of the test results ranged from 52.33 mg/LL to 185.33 mg/L, with the highest TSS concentration value at the T5 sampling point of 185.33 mg/LL and the lowest TSS concentration at the T1 sampling point (Figure 7). The results of the TSS value at each sampling point have exceeded the required class II quality standards. TSS is a suspended material with a diameter of more than 1 m that is held in a Millipore filter with a pore diameter of 0.5 m. TSS consists of mud, fine sand, and microorganisms. The main source of TSS in waters is soil erosion or soil erosion carried into water bodies [9]. The high concentration of TSS parameters is caused by pollutants entering water bodies originating from domestic activities and landslide material upstream.

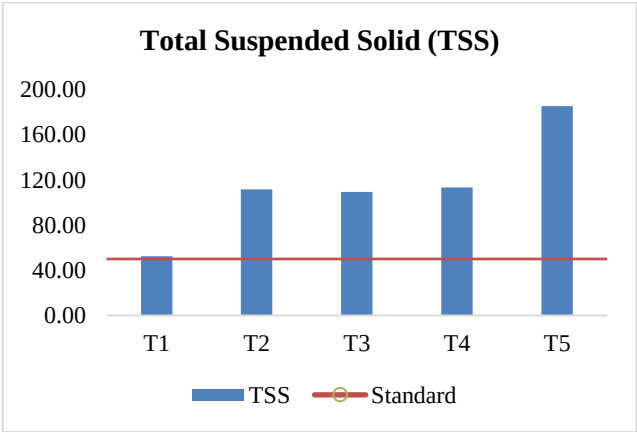


**Figure 7: TSS at sampling point**

### B. Determination of Water Quality Status by Pollution Index Method (PI)

The pollution index is one of the methods used to determine water quality status. Water quality status shows the level of source water quality by comparing predetermined quality standards [4]. The value of the pollution index can be seen in the table. An example of calculation using the pollution index method is represented by calculations at sampling point T1 on Table 4.

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**Table 4: Example calculation of the pollution index method**

| Sampling point | Parameter | Observation (Ci) | Standard (LiX) | Ci/LiX | Ci/LiX New |
|---|---|---|---|---|---|
| T1 | pH | 7.22 | 6 - 9 | 0.96 | 0.96 |
| | Temperature | 26.67 | Deviation 3 | 1.07 | 1.14 |
| | DO | 8.38 | 4 | 2.10 | 2.61 |
| | BOD | 12.86 | 3 | 4.29 | 4.16 |
| | COD | 9.08 | 25 | 0.36 | 0.36 |
| | TSS | 52.33 | 50 | 1.05 | 1.10 |
| | Σ | | | | 10.33 |
| | Ci/LiX Avg | | | | 1.72 |
| | Ci/LiX Maks | | | | 4.16 |
| | **PI** | | | | **2.25** |

From Table 5, based on the Decision of the Minister of Environment No. 15 of 2003 concerning Guidelines for Determining Water Quality Pollution Index, it can be seen in the table that sampling points T1 to T5 fall into the category of slightly polluted with PI values ranging from 1.63 to 2.36.

**Table 5: Pollution Index (PI) of Downstream Jeneberang River**

| *Sampling Point* | Distance (km) | Pollution Index (PI) | |
|---|---|---|---|
| | | Class II | Category |
| **T5** | 0 | 2.25 | Slightly polluted |
| **T4** | 13.8 | 1.63 | Slightly polluted |
| **T3** | 19.99 | 2.36 | Slightly polluted |
| **T2** | 23.24 | 2.09 | Slightly polluted |
| **T1** | 29.51 | 2.21 | Slightly polluted |
| **Average** | | **2.11** | Slightly polluted |

## 4. CONCLUSIONS

Water quality conditions in the downstream Jeneberang River for temperature, pH, and COD parameters still meet the required class II quality standards. Meanwhile, the DO, BOD, and TSS parameters have exceeded class II quality standards based on PP No. 22 of 2021. The water quality status of the downstream Jeneberang river using the pollution index method at sampling points 1–5 is included in the slightly polluted category with PI values ranging from 1.63–2.36 with average 2.11.

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**Declaration of Interest Statement**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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**References**

1) Alpiannur, et al. (2022). Pollutant Load Capacity in the Barito River Basin (Nagara Sub-watershed, Marabahan Sub-watershed and Kuin Sub-Watershed) South Kalimantan Province. Aquatiq Volume 5 Number 1.

2) Anggraeni, Annisa Chika Ayu. (2022). Modeling of Pollutant Load Carrying Capacity and Assimilation Capacity Using WASP Model (Case Study: Downstream Landak River). ITB. Bandung.

3) Dikplhd. (2019). Report of Gowa Regency Regional Environmental Management Performance Information Document 2019. Gowa: BLHD Gowa.

4) Laili, Fanti Nur., & Asep Sofyan. (2017). Identification Of Total Maximum Daily Load (Tmdl) Of Downstream Citarum River In Karawang Using Wasp. Environmental Engineering Journal (Vol. 23, pp. 1–12).

5) Lestari, A. Saidah Pratama Indah. (2021). Analysis of pollution load in Jeneberang River, Gowa Regency, South Sulawesi Province. Journal of Technosciences, Volume 15, Number 2, May-August 2021, pp. 144-150.

6) M Aprilia et al 2022 IOP Conf. Ser.: Earth Environ. Sci. 1109 012051

7) M M Mahbubul Syeed, Md Shakhawat Hossain, Md Rajaul Karim, Mohammad Faisal Uddin, Mahady Hasan, Razib Hayat Khan, Surface water quality profiling using the water quality index, pollution index and statistical methods: A critical review, Environmental and Sustainability Indicators, Volume 18, 2023, 100247, ISSN 2665-9727, https://doi.org/10.1016/j.indic.2023.100247.

8) M. V. Ahipathy and E. T. Puttaiah, "Ecological Characteristics of Vrishabhavathy River in Bangalore (India)," Environmental geology, Vol. 49, No. 8, 2006, pp. 1217-1222.

9) Mar, V., & Firmansyah, I. (2020). Model Dynamic Of Water Quality Index Bod-Based In Indonesia. In Journal of System Dynamics (Vol. 1, pp. 34–41).

10) Munirah, et al. (2020). Water quality characteristics and modeling of Tasik Aman, USM, Penang. The 10th AIC-ELS 2020 IOP Conf. Series: Earth and Environmental Science 711 (2021) 012006. Doi:10.1088/1755-1315/711/1/012006.

11) Naubi, I., Zardari, N. H., Shirazi, S. M., Ibrahim, N. F. B., & Baloo, L. (2016). Effectiveness of water quality index for monitoring Malaysian river water quality. Polish Journal of Environmental Studies, 25(1),231–239. https://doi.org/10.15244/pjoes/60109

12) Nemerow NL. 1974 Scientific Stream Pollution Analysis. Washington: Scripta Book Co.

13) Obin, N.; Tao, H.; Ge, F.; Liu, X. Research on Water Quality Simulation and Water Environmental Capacity in Lushui River Based on WASP Model. Water 2021, 13, 2819. https://doi.org/10.3390/w13202819S.

14) P., I. & A. S. (2011). Study On River Water Quality Status of Bedog River Yogyakarta by Using One-Dimensional Numerical Simulation Bandung. Proceeding the 4th Environmental Technology and Management Conference: "Present and Future Challenges in Environmental Sustainability."

15) Salmin. 2005. Dissolved Oxygen (DO) and Biological Oxygen Demand (BOD) as One of the Indicators to Determine Water Quality.Oceana, 30: 21-26

16) Sari, Enda Kartika &; Wijaya, Oki Endrata. (2019). Determination of Water Quality Status by Pollution Index Method and Ogan River Pollution Control Strategy, Ogan Komering Ulu Regency. Journal Of Environmental Science : Vol 17 Issue (2019) : 486-491

17) Shriram, Pranav and Malladi, Srinivas, A Study and Analysis of Air Quality Index and Related Health Impact on Public Health (January 18, 2021). ICICNIS 2020, Available at SSRN:

ISSN 1533-9211

DOI 10.17605/OSF.IO/S48PJ

https://ssrn.com/abstract=3768477 or http://dx.doi.org/10.2139/ssrn.3768477

18) Srivastava, V., Ismail, S.A., Singh, P. and Singh, R.P. (2015) Urban Solid Waste Management in the Developing World with Emphasis on India: Challenges and Opportunities. Reviews in Environmental Science and Bio/Technology, 14, 317-337. https://doi.org/10.1007/s11157-014-9352-4

19) Su K, Wang Q, Li L, Cao R, Xi Y, Li G. Water quality assessment based on Nemerow pollution index method: A case study of Heilongtan reservoir in central Sichuan province, China. PLoS One. 2022 Aug 18;17(8):e0273305. doi: 10.1371/journal.pone.0273305. PMID: 35980995; PMCID: PMC9387827.

20) Thamrin, Meinarni., Ramli, Muhammad., Sri Widodo, Jayasman Kadir. (2018). Determination of Jeneberang River Water Quality by Pollution Index Method, in Gowa Regency, South Sulawesi Province. National Scientific Conference on Science and Technology : Vol. 4 : November 2018.