IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402, p- ISSN: 2319-2399.Volume 19, Issue 1 Ser. 2 (January 2025), PP 10-16
www.iosrjournals.org

Water Quality Status And River Mitigation Policy In Sebamban River Tanah Bumbu Regency South Kalimantan Indonesia

Aulia Ulhaq[1], Abrani Sulaiman[1,2], Badaruddin[1], Mijani Rahman[1]
Department Of Natural Resources & Environment (Psdal), Faculty Of Post-Graduate, Lambung Mangkurat University, Banjarbaru, Indonesia.

Abstract:
Background*: Sebamban River pollution has been ongoing since 2017, triggered by mining waste and environmentally unfriendly community activities. The research aims to analyze the status of water quality and river mitigation policies in Sebamban River, Tanah Bumbu Regency. This research will be conducted in Sebamban River, Sebamban Village, Sungai Loban Sub-district, Tanah Bumbu Regency, South Kalimantan, Indonesia*.
Materials and Methods*: The storet method is used to determine the parameters that meet or exceed the Water Quality Standards by comparing water quality data with water quality standards. Sampling questionnaires based on the number of families affected by flooding in the Sabamban River area, the number of families affected by flooding is 104 families.*
Results*: Water quality status based on the Storet method at two sample points, namely the upstream and downstream water quality status of the Sebamban River, shows a significant difference in pollution levels, where upstream water has a severe pollution status (total score -32, class D), while downstream water is at a pollution status (total score -23, class C).*
Conclusion *Mitigation policies are needed that focus on reducing pollution from activities, especially the mining industry that causes waste, through strict regulations and supervision to maintain environmental sustainability.*
Key Word: *Mitigation, Sebamban, Storet, River*

Date of Submission: 13-01-2025 Date of Acceptance: 23-01-2025

I. Introduction

Continued population growth and urbanization put pressure on water systems, especially in urban areas and industrial areas such as Tanah Bumbu Regency. Although Indonesia has a large surface water potential, reaching 3,906,476 million m³ per year with Kalimantan contributing 34%, access to clean water and proper sanitation is still a challenge. Data from the Central Bureau of Statistics (BPS) in 2017 noted that only 67.89% of households in Indonesia have access to proper sanitation and 72.04% have proper drinking water sources. Tanah Bumbu District, with a population growth of 346,336 people in 2023, faces the problem of water pollution in the Sebamban River which is influenced by human activities, especially mining, and high rainfall intensity [1].

Sebamban River pollution has been ongoing since 2017, triggered by mining waste and environmentally unfriendly community activities. The Head of the Environmental Agency (DLH) of Tanah Bumbu mentioned that pollution often increases during the rainy season, when water runoff carries sediment particles and pollutants into the river. As a result, water quality deteriorates drastically, impacting not only domestic needs but also the sustainability of the ecosystem. This condition calls for comprehensive pollution management to restore the river to its intended function.

Indonesia has implemented the 1000-0-100 program, which targets universal access to drinking water and proper sanitation and the elimination of slums by 2019. At the local level, regulations such as PP RI No. 22 of 2021 provide the legal basis for the implementation of environmental protection and management. However, the implementation of these policies requires stronger supervisory support, especially in the regulation of industrial waste and sedimentation control. Tanah Bumbu Regency needs to adopt an integrated approach involving regular monitoring, implementation of waste management technology, and community empowerment to maintain the water quality of the Sebamban River.

In order to improve the water quality of the Sebamban River, effective mitigation measures need to be implemented, including strengthening regulations, monitoring industrial effluents, and improving domestic

effluent management capacity. Routine monitoring of water quality upstream and downstream should be conducted periodically to detect changes in water quality status. In addition, the application of environmentally friendly technologies in the mining sector and agricultural land management can reduce pollution. Community empowerment through education and involvement in water resources management is also key to successful mitigation. A comprehensive approach is expected to improve the water quality of Sebamban River, supporting environmental sustainability and the welfare of the people of Tanah Bumbu Regency. The research aimed to analyze the status of water quality and river mitigation policies in Sebamban River, Tanah Bumbu Regency, South Kalimantan, Indonesia.

II. Material And Methods

This research will be conducted in Sebamban River, Sebamban Village, Sungai Loban Sub-district, Tanah Bumbu Regency, South Kalimantan, Indonesia. Samples were taken at three points in the middle and downstream parts of the river, each 1/3 the width of the river at the river surface according to the following map:

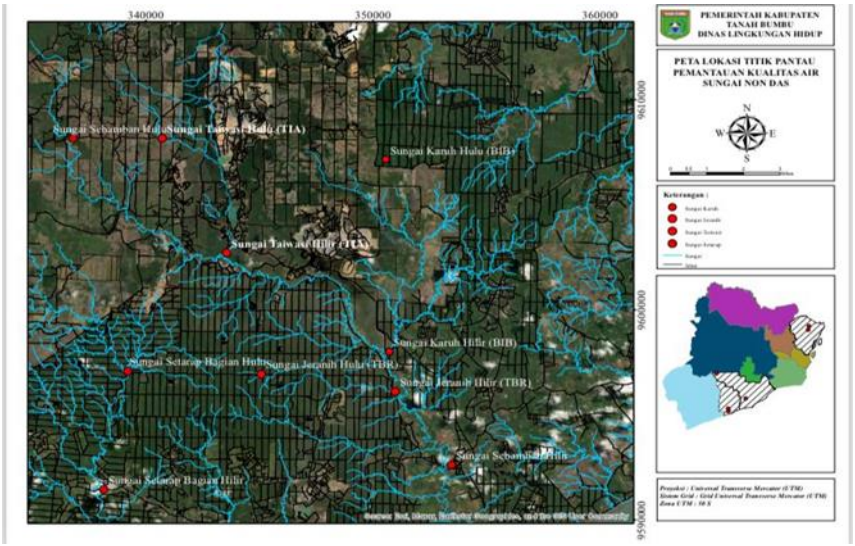

Figure 1: Research location in Sebamban River, Sungai Loban District, Tanah Bumbu Regency, South Kalimantan Province, Indonesia.

Data analysis

The storet method is used to determine the parameters that meet or exceed the Water Quality Standards by comparing water quality data with water quality standards adjusted to the class and designation referring to Environment Number 115 of 2003 concerning water quality management and water pollution control [2].

Sebamban river mitigation analysis was carried out by collecting data through a questionnaire containing a series of questions, or questions to obtain information related to the behavior patterns of the community around the banks of the new Sebamban river. Sampling is based on the number of families affected by flooding in the Sabamban river area, the number of families affected by flooding is 104 families.

III. Results

Sebamban River Water Quality Status

The water quality status of the Sebamban River showed significant variations in chemical and physical parameters between 2022 and 2023, reflecting challenges in water quality management. Chemically, there was an increase in TDS, BOD, COD and total phosphate concentrations indicating increased pollution from activities, agriculture and industry around the river. Although there is a decrease in the TSS value by 2023, it is still high compared to the quality standard, indicating significant sources of contamination, such as erosion and construction activities. Physical parameters such as water temperature show stability, but fluctuations in water color values and a decrease in dissolved oxygen (DO) by 2023 indicate a potential increase in organic pollution that could negatively impact the aquatic ecosystem. The combination of these factors emphasizes the importance of implementing more effective pollution control strategies to maintain the water quality of the Sebamban River. The results of the research analysis are presented in the following Table:

Table 1. Water Quality Status of the Upper Sebamban River

No	Samples	Total Score	Class Status	Water Quality Status
1	Total Dissolved Solids	0	A	Good
2	Total Suspended Solids	-4	B	Mildly Polluted
3	Temperature	0	A	Good
4	Color	0	A	Good
5	Odor	0	A	Good
6	BOD 5 day 20ºC	0	A	Good
7	COD by $K_2Cr_2O_7$**	0	A	Good
8	Dissolved Oxygen (in situ)	-10	B	Mildly Polluted
9	Total Phosphate as P**	0	A	Good
10	Nitrate (NO_3) as N	0	A	Good
11	Ammonia (NH_3-N)	0	A	Good
12	pH	-8	B	Mildly Polluted
13	Iron Dissolved (Fe)**	-10	B	Mildly Polluted
14	Lead Dissolved (Pb)	0	A	Good

Source: Secondary data of the Environmental Agency of Tanah Bumbu Regency (2024)

Based on the calculation results in the Table on the Status of Water Quality of the Upper Sebamban River, each parameter has a significant influence on water quality in the river. The results of the calculation of the Storet method for the water quality of the Upper Sebamban River:
- Total Score: -32
- Class: D
- Upstream Water Quality Status: Severely polluted

The results of Table 1 Water Quality Status of the Upper Sebamban River using the Storet method, the water quality in this area shows a status of severe pollution with a total score of -32 which is included in class D. The parameters Total Dissolved Solid (TDS), temperature, color, odor, BOD, COD, total phosphate, nitrate, ammonia, and heavy metals such as lead (Pb) are in the good category (class A), indicating that the concentration of these substances is still within the tolerance limits of water quality standards. The parameters Total Suspended Solid (TSS), Dissolved Oxygen (DO), pH, and dissolved ferrous metal (Fe) show a decline in quality with a mildly polluted status (class B). DO and Fe, contributing the highest negative scores (-10), indicate low dissolved oxygen problems and iron concentrations that exceed quality standards, potentially endangering aquatic ecosystems. These conditions indicate significant environmental stress, most likely due to anthropogenic activities such as sewage, mining, or industrial activities around the Sebamban River. This emphasizes the need for mitigation measures to reduce sources of pollution and improve water quality in the Upper Sabamban River area.

Table 2. Downstream Water Quality Status of the Sebamban River

No	Samples	Total Score	Class Status	Water Quality Status
1	Total Dissolved Solids	0	A	Good
2	Total Suspended Solids	-5	B	Mildly Polluted
3	Temperature	0	A	Good
4	Color	0	A	Good
5	Odor	0	A	Good
6	BOD 5 day 20ºC	-2	B	Mildly Polluted
7	COD by $K_2Cr_2O_7$**	0	A	Good
8	Dissolved Oxygen (in situ)	-8	B	Mildly Polluted
9	Total Phosphate as P**	0	A	Good
10	Nitrate (NO_3) as N	0	A	Good
11	Ammonia (NH_3-N)	0	A	Good
12	pH	0	A	Good
13	Iron Dissolved (Fe)**	-8	B	Mildly Polluted
14	Lead Dissolved (Pb)	0	A	Good

Source: Secondary data from the Environmental Agency of Tanah Bumbu Regency (2024)

Based on the calculation results in the Table on the Water Quality Status of the Sebamban River Downstream, each parameter has a significant influence on water quality in the river. The calculation results of the Stored method for the water quality of the Sebamban River downstream:
- Total Score: -23
- Class: C
- Downstream Water Quality Status: Moderately Polluted

The results of Table 2 regarding the Downstream Water Quality Status of the Sebamban River using the Storet method, water quality in a polluted status with a total score of -23 which is included in class C. The

parameters Total Dissolved Solid (TDS), temperature, color, odor, COD, total phosphate, nitrate, ammonia, pH, and lead (Pb) are in the good category (class A), indicating that these parameters are still in accordance with water quality standards. Parameters that are lightly polluted (class B), such as Total Suspended Solid (TSS), BOD, Dissolved Oxygen (DO), and dissolved iron (Fe), with negative scores that contribute to a decrease in water quality. DO (-8) and Fe (-8) reflect serious problems, indicating low dissolved oxygen availability and high levels of heavy metals, which can disrupt the lives of aquatic organisms.

Significant environmental pressures come from anthropogenic activities in downstream areas, such as agricultural or industrial waste disposal. Therefore, pollution management and control efforts are needed to improve water quality in the downstream area of the Sebamban River. A comparison of the water quality status of the upstream and downstream Sebamban River based on the Storet method shows a significant difference in pollution levels, where the upstream water has a severe pollution status (total score -32, class D), while the downstream water is at a pollution status (total score -23, class C). This difference indicates that upstream pollution is more severe than downstream, most likely due to more intensive mining activities in the upstream area, including soil erosion, mine waste disposal and sedimentation. Dissolved Oxygen (DO) and dissolved iron (Fe) were the main indicators of pollution in both areas, with the highest negative scores upstream (-10) compared to downstream (-8). Total Suspended Solid (TSS) and pH parameters also showed a contribution to the decline in water quality, illustrating the direct impact of mine effluents affecting the physical and chemical stability of the water.

Conditions downstream were slightly better, possibly due to natural sedimentation processes and water mixing that reduced contaminant concentrations. This emphasizes the need for close monitoring of mining activities in upstream areas to reduce their impact on the overall river ecosystem. Li et al., (2020) who stated that pollution in fresh waters is often caused by human activities, such as agriculture, mining and industry, which contribute to the increase of organic and inorganic materials in water, the situation in the Sebamban River also shows a similar pattern.

Low TDS indicates that the water is not polluted by significant dissolved solids, while stable temperatures are important for maintaining the thermal balance of the ecosystem. The That temperature stability and low TDS are important indicators of good water quality, as drastic changes in these parameters can cause stress to aquatic organisms and reduce overall water quality. Therefore, it is important to maintain these conditions in order to maintain biodiversity and ecosystem function in the Sebamban River.

According to research by Labbaik et al., (2018) significant pH fluctuations and high TSS are often associated with increased anthropogenic activities, such as mining and urbanization, which require stricter environmental management measures to reduce their impact on aquatic ecosystems. Therefore, mitigation measures should be taken immediately to reduce the sources of pollution and improve the water quality of the Sebamban River.

Sebamban River Mitigation Policy

Based on the water quality results and water quality status of the Sebamban River, which shows a moderately polluted condition with a total score of -42 (Class C), mitigation policies that need to be implemented should focus on reducing sources of pollution, both from anthropogenic activities such as mining, agriculture, and from waste and industrial runoff. Suggested measures include implementing more efficient waste management technologies, controlling soil erosion to reduce total suspended solid (TSS), and regular monitoring of water quality to ensure the stability of parameters such as pH and dissolved oxygen (DO). In addition, education programs and community involvement in keeping the river clean are essential to reduce direct contamination by garbage and household waste. This policy is in line with the ecosystem-based approach that aims to improve water quality and maintain the balance of the river ecosystem in a sustainable manner. The results of the research analysis are presented in the following table:

Table 3. Results of Pollution Impact Analysis

No	Question	Main Answer	Percentage of Respondents (%)
1	Sebamban River water quality condition now compared to before industrial activities	Water quality is murkier	65%
		Water quality remains the same	15%
		Water quality is cleaner	10%
		Water quality cannot be assessed	10%
2	Signs of pollution in the Sebamban River due to industrial activities	Water smells and is abnormally colored	85%
		There is only a slight change	15%
3	Community opinion on the water quality of Sebamban River now compared to before	Water quality is getting worse	75%
		No change	20%
		Water quality is better	5%
4	Changes that indicate a decrease in water quality due to	Cloudy water and fewer plants	80%

	industrial activities	Plants grow more vigorously	5%
		No significant change	15%
5	Policy effectiveness in reducing pollution	No policy	50%
		Not effective	30%
		Moderately effective	15%
		Very effective	5%
6	Water in Sebamban River is polluted	Always polluted	55%
		Yes	35%
		Sometimes polluted	10%
7	Main cause of pollution	Mining activities	60%
		Oil palm plantations	20%
		Community activities	20%
8	Frequency of pollution due to industrial or community activities	Often	50%
		Sometimes	25%
		Rarely	15%
		Never	10%
9	Activities that contribute most to pollution	Mining activities	70%
		Oil palm plantations	20%
		Community activities	10%
10	Water quality is getting worse due to industrial activities	Yes, very bad	80%
		No, it stayed the same	15%
		Getting better	5%

Source: Primary data (2024**)**

IV. Discussion

The results of research on the impact of Sebamban River pollution involving 108 respondents showed that the majority of respondents felt that there was a significant decrease in water quality due to industrial activities. As many as 65% of respondents assessed that the water quality of the Sebamban River was murkier than before industrial activities, while only 15% said the water quality remained the same, and 10% felt the water quality was cleaner or could not be assessed. Clear signs of pollution were also recognized by 85% of respondents, namely the presence of odor and changes in water color, while another 15% reported only slight changes.

Comparing the current water quality compared to before, 75% of respondents revealed that the water quality had worsened. In contrast, 20% saw no change, and only 5% felt that the water quality had improved. Visual changes such as murkier water and a decrease in the number of plants around the river were recognized by 80% of respondents as indications of deteriorating water quality, while only 5% saw plants around the river growing more vigorously and 15% felt there was no significant change.

The effectiveness of policies in overcoming pollution, 50% of respondents stated that no policies were implemented, and 30% considered that existing policies were ineffective, only 15% called the policies quite good, while 5% felt that the policies were very effective. This data reflects the community's perception that environmental management efforts in this area are still minimal or inadequate.

Water in the Sebamban River is polluted, more than half of the respondents 55% stated that the water is always polluted, while another 35% claimed that the water is indeed polluted, but perhaps not always. Only 10% felt that the water was only sometimes polluted. This shows that pollution in the river is a constant problem in the eyes of the local community.

The main cause of pollution according to the majority of respondents, 60%, was mining activities. In addition, 20% of respondents cited palm oil plantations as a cause, and another 20% identified community activities as a factor in pollution. This confirms that industrial activities, particularly mining, are considered most responsible for the decline in water quality in Sebamban River.

Respondents also revealed that the frequency of pollution due to industrial or community activities is quite frequent, with 50% of respondents saying that pollution occurs regularly. A total of 25% claimed that pollution only occurred sometimes, 15% felt that pollution rarely occurred, and 10% stated that pollution never occurred.

The activity considered to contribute most to river pollution is mining, as mentioned by 70% of respondents. Palm oil plantations were the second biggest cause according to 20% of respondents, while only 10% considered community activities as the main contributor. This highlights the large role of mining in the degradation of environmental quality in the area.

80% of respondents stated that water quality is getting worse due to activities such as mining, palm oil plantations or community activities. Only 15% felt that water quality had stayed the same, and 5% thought it had improved. This data shows a strong view among the community that industrial activities have significantly worsened the condition of the Sebamban River.

Similar to Rosanti et al., (2021), The results of this study show that industrial activities, especially mining, have had a major impact on the decline of Sebamban River water quality. Despite policy efforts

recognized by a small number of respondents, a more effective approach is still needed to reduce pollution and improve environmental conditions in the area. Mining has unique characteristics, such as dependence on non-renewable natural resources, high risks, and significant impacts on the environment [6]. Therefore, strict regulations and good supervision are needed so that mining practices can run sustainably and have minimal negative impacts, especially around water areas.

Environmental damage due to mining Wohlfart et al. (2017) the impact of mining on the River. Mining activities cause water quality degradation and ecosystem damage. This shows that although mining provides economic benefits, its impact on the environment can be very detrimental if not managed properly. These results are in line with Yuniarti & Biyatmoko (2019) research in South Kalimantan, which examined water pollution in the Jaing River, a tributary of the Barito watershed. Mining activities around the river cause a decrease in water quality, as evidenced by the analysis of mildly polluted water status due to the conversion of land functions into mining areas (Riyandini, 2020)

The decline in water quality due to mining activities has an impact on aquatic ecosystems and the lives of surrounding communities. Polluted water not only affects river flora and fauna, but also reduces the availability of clean water for residents. Mining results in a decrease in water quality. Therefore, more stringent environmental policies and the implementation of environmentally friendly mining practices are needed. Without concrete action, negative impacts on the environment will continue to occur and jeopardize the ecosystem in the long run [10].

Salim, (2012) reminds us that the non-renewable nature of mining demands a strategy that balances economic gain and ecological sustainability. Poorly planned exploitation can force the industry to seek new locations, expanding the impact of environmental damage. Strategies to reduce pollution impacts need concrete policies and actions. These could include clean mining technologies, strict waste treatment systems, and post-mining rehabilitation. Without these efforts, pollution and environmental damage will only continue.

Pointed out that mining-induced pollution increases microbes from waste can increase the risk of gastrointestinal diseases such as diarrhea, as polluted river water can contain pathogens that are harmful to human health. Water pollution by garbage and waste contributes to the emergence of skin infections, as dirt and chemicals dissolved in water can cause irritation and infection of the skin. Who pointed out that the accumulation of garbage that is not managed properly can cause bad odors that interfere with public comfort and environmental quality [11];[12].

Flooding is also a significant environmental impact associated with waste accumulation around rivers, as identified by 46.30% of respondents. Showed that garbage clogging waterways can result in a decrease in the flow capacity of the river, which in turn increases the risk of flooding. Drainage systems and cause flooding problems. Overall, mitigation policies such as those contained in the Sebamban River Mitigation Policy need to be considered to address this issue.

Environmental cases regarding the water quality of the Sebamban River in Tanah Bumbu District have occurred. Several reports indicate significant pollution affecting the river's water quality, including elevated levels of organic matter, pathogenic bacteria and other contaminants due to sewage and industrial discharges. Identified that the water quality of the Sebamban River is impaired by human activities and the accumulation of poorly managed waste.

Liquid waste disposal permits that outlet to the Sebamban River vary in number and depend on the type of industry and business activities that exist. Based on data from the Environmental Agency of Tanah Bumbu Regency, there are several liquid waste disposals permits granted to industries and business facilities that have direct outlets to the river. More specific information on the number of these permits needs to be obtained from official local government documents.

Industries located along the Sebamban River include several sectors, such as wood processing and food processing industries. For example, there are palm oil processing and fishery product processing industries operating in this area, which have the potential to add to the pollution load of the river. The types of business activities located along the Sebamban River include agriculture, livestock and light industrial activities. Agriculture involves the cultivation of various crops, while animal husbandry usually involves raising livestock. Light industrial activities such as wood processing and food processing are also often found in the area [13].

The types of environmental permits issued to businesses along the Sebamban River include Environmental Permits and Liquid Waste Disposal Permits. Environmental Permits generally include environmental impact assessments (AMDAL) or environmental management efforts (UKL) and environmental monitoring efforts (UPL) that must be obtained before starting business activities. The suitability of activities on the banks of the Sebamban River with the Regional Spatial Plan (RTRW) of Tanah Bumbu Regency needs to be specifically examined in the RTRW document. However, in many cases, existing business activities on the riverbanks often require adjustments to the RTRW policy to ensure that the development of the area does not violate existing regulations.

The Tanah Bumbu District Government, particularly the Environmental Agency, has made various efforts in the management and control of Sebamban River pollution. Programs implemented include community education on the importance of keeping the river clean, monitoring of waste disposal, and enforcement of environmental regulations. Educating the community on the importance of keeping the river clean and its impact on health and the environment.

V. Conclusion

The water quality status based on the Storet method at two sample points, namely the upstream and downstream water quality status of the Sebamban River, shows a significant difference in the level of pollution, where the upstream water has a severe pollution status (total score -32, class D), while the downstream water is at a pollution status (total score -23, class C). Mitigation policies are needed that focus on reducing pollution from activities, especially the mining industry that causes waste, through strict regulations and supervision to maintain environmental sustainability.

References

[1] Wahyono, Suntaro, And Sutarno, "Pelaksanaan Dokumen Lingkungan Dalam Perlindungan Dan Pengelolaan Lingkungan Hidup Di Kabupaten Pacitan Tahun 2012.Jurnal EKOSAINS," J. EKOSAINS, Vol. IV, No. 2, Pp. 43–52, 2012.

[2] Menteri Negara Lingkungan Hidup, "Pedoman Penentuan Status Mutu Air," 2003. [Online]. Available: Http://Medcontent.Metapress.Com/Index/A65RM03P4874243N.Pdf

[3] X. Li, Y. Wang, J. Zhang, And L. Chen, "Impact Of Human Activities On Freshwater Pollution: A Global Assessment," J. Environ. Sci. Technol., Vol. 54, No. 8, Pp. 1234–1248, 2020.

[4] M. Labbaik, I.W.R., And M.A.P., "Environmental Pollution Status Of Badung River And Mati River In Bali Province Based On Bioindicators Of Phylum Annelida," J. Mar. Sci. Aquat., Vol. 4, No. 2, Pp. 304–315, 2018.

[5] D. Rosanti, D. Noviati, And Y. P. Putri, "Comparison Of Musi River Water Quality In Three Land Uses," Sci. J. Math. Nat. Sci., Vol. 18, No. 2, Pp. 231–236, 2021.

[6] H. S. Salim, Mineral & Coal Mining Law. Jakarta: Sinar Grafika, 2012.

[7] C. Wohlfart, B. Mack, G. Liu, And C. Kuenzer, "Multi-Faceted Land Cover And Land Use Change Analyses In The Yellow River Basin Based On Dense Landsat Time Series: Exemplary Analysis In Mining, Agriculture, Forest, And Urban Areas.," Appl. Geogr., Vol. 85, Pp. 73–88, 2017, Doi: 10.1016/J.Apgeog.2017.

[8] Y. Yuniarti And D. Biyatmoko, "Water Quality Analysis With Determination Of Water Quality Status Of Jaing River, Tabalong Regency," Jukung (Jurnal Tek. Lingkung., Vol. 5, No. 2, Pp. 52– 69, 2019, Doi: 10.20527/Jukung.V5i2.

[9] V. L. Riyandini, "PENGARUH AKTIVITAS MASYARAKAT TERHADAP KUALITAS AIR SUNGAI BATANG TAPAKIS KABUPATEN PADANG PARIAMAN," J. Sains Dan Teknol. J. Keilmuan Dan Apl. Teknol. Ind., Vol. 20, No. 2, P. 203, Dec. 2020, Doi: 10.36275/Stsp.V20i2.297.

[10] N. P. R. Artini, D. P. R. VA, And N. K. M. Fujiastuti, "PENELITIAN KUALITAS AIR SUNGAI BALIAN, TABANAN, BALI TAHUN 2018," J. Kesehat. Terpadu, Vol. 2, No. 1, Pp. 25–30, Dec. 2018, Doi: 10.36002/Jkt.V2i1.443.

[11] K. R. Smith And M. Ezzati, "HOW ENVIRONMENTAL HEALTH RISKS CHANGE WITH DEVELOPMENT: The Epidemiologic And Environmental Risk Transitions Revisited," Annu. Rev. Environ. Resour., Vol. 30, No. 1, Pp. 291–333, Nov. 2005, Doi: 10.1146/Annurev.Energy.30.050504.144424.

[12] U.N.E.P., From Pollution To Solution: A Global Assessment Of Marine Litter And Plastic Pollution. United Nations Environment Programme, 2021.

[13] A. Diansyukma, S. P. Saraswati, And A. T. Yuliansyah, "Analysis Of The Carrying Capacity And The Total Maximum Daily Loads Of The Karang Mumus Sub-Watershed In Samarinda City Using The WASP Method," J. Civ. Eng. Forum, Vol. 7, No. 2, P. 209, May 2021, Doi: 10.22146/Jcef.62826.