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Water quality study and water quality status using Storet and index method pollutants in Ratah River Mahakam Ulu Regency, East Kalimantan

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Abstract: The Ratah River is the largest subwatershed of the Mahakam River, located in the Mahakam Ulu Regency. The water of the Ratah River is utilized by surrounding communities along its banks for daily activities such as drinking, cooking, and washing. In addition to settlements along the river, there are several permits, including palm oil business permits (IUP), palm oil mills (PKS), forest utilization business licenses (PBPH), and mining permits for coal. This study aims to analyze the water quality and status of the Ratah River in Mahakam Ulu Regency, East Kalimantan, using the Storet method and Pollution Index (IP). Data were obtained from measurements of physical, chemical, and biological parameters at four observation stations representing upstream to downstream areas. The analysis results indicate that most parameters do not meet class I environmental quality standards (Government Regulation No. 22 of 2021). Based on the Storet method, during the dry and rainy seasons, all parameter stations exceeding the quality standard are COD; during the rainy season, all parameter stations exceeding the standard are Fecal Coli; while at stations II and III during the dry season and station I during the rainy season, the parameter exceeding the standard is TSS. The water quality status at most stations falls into the lightly to moderately polluted category. Meanwhile, according to the Pollution Index method, most stations indicate light to moderate pollution.

Keywords: *Mahakam Ulu, Pollutant index, Ratah River, Storet method, Water quality.*

1. Introduction

Water is compound important to support all form life on earth. Activities House stairs, agriculture, animal husbandry until business and commercial need clean water. along with development development and growth resident need will clean water also increase, while the amount of clean water available the more limited Likewise with the water quality is getting better decreasing. Clean water sources obtained from river water or lakes, ground water, sea water, or rain water.

Mahakam Ulu Regency is located in East Kalimantan, which is traversed by a large river, namely the Mahakam River, which flows from its upper reaches to its lower reaches. From this river, there is also a tributary, namely the Ratah River, which stretches from the border of Central Kalimantan along the Laham District and is named by the local residents. The Ratah River is the largest sub-basin of the Mahakam River within Mahakam Ulu Regency, stretching 106.762 km. Along the Ratah River, there are several settlements/villages, including Nyaribungan Village at the uppermost part, Long Gelawang, Danum Paroy, and Muara Ratah Village. In addition to the settlements along the Ratah River, there are also several permits, including Oil Palm Plantation Business Permits (IUP), Oil Palm Mills (PKS), and Forest Utilization Business Permits (PBPH), as well as mining permits for coal. From

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various activities that are along river flat Of course will impact to quality, river water discharge and its impact on the standard river water quality flat and also for Mahakam River. Some data from cases studied in the Mahakam River, particularly in the Sebenaq River, which is part of the Mahakam River, show a pollution index classified as lightly polluted with a pollutant index method of 2.8284. Research conducted by in the Belayan River area, a tributary of the Mahakam River, showed mild pollution in the area with a fairly high TSS value of 3859.5 tons/day [1].

The water from the Ratah River is used by the communities living along its banks for daily activities such as drinking, cooking, and bathing, washing, and toilet facilities (BWT). Therefore, it can be said that the communities in the Ratah River area are highly dependent on the river water. The activities or dependence of the community on the Ratah River also affect the quality and condition of the Ratah River, as well as the health of the communities along the Ratah River. Based on this, the researcher conducted a monitoring of the water quality of the Ratah River. Research on the monitoring of the water quality of the Ratah River is necessary to determine the quality status of the river water for the benefit of the surrounding communities.

Common methods used for determining water quality status, namely STORET method and method Index Pollution [2]. The test parameters are as follows: the quality of water used is the parameter used in studies This are pH, DO, BOD, COD, TSS, NO_3-N, T- Phosphate, *Fecal Coli*, these parameters represent condition a river water in a way general, and used For determination of water quality status in the Regulation of the Minister of Environment and Forestry Republic of Indonesia Number 27 of 2021 Concerning Index Quality Environment Life [3].

2. Materials and Methods

2.1. Study Area

The research location on the Ratah River is a tributary of the Mahakam River and includes the settlements of Kampung Danum Paroy, Kampung Long Gelawang, and Kampung Nyaribungan. Water samples were collected, river cross-section data was recorded, in-situ parameter testing was conducted, and a general overview of the area around each station was provided:

Table 1.
Study Locations.

No.	Station Name	Coordinates
1	Ratah River Estuary	X = 115° 24' 6.041" E °; Y= 0° 18' 5.056" N
2	Ratah River Bridge	X= 115° 22' 44.982" E; Y= 0° 17' 11.460" N
3	Long Gelawang	X= 115° 21' 58.475" E; Y= 0° 17' 46.049" N
4	Nyaribungan Village	X = 115° 5' 23.140" E; Y = 0° 8' 37.905" N

Laboratory for water quality testing, namely Laboratory of the Center for Standardization and Industrial Services in Samarinda.

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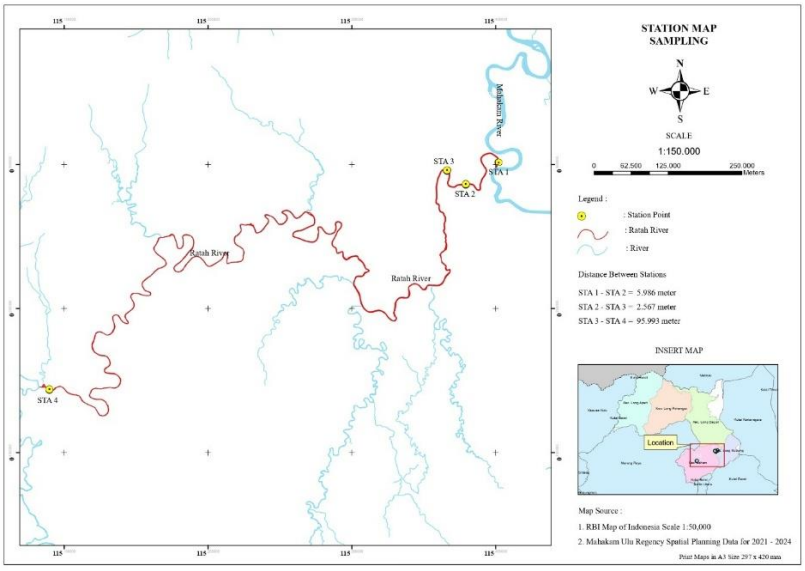

Figure 1.
Ratah River Map.

Table 2.
Research Parameters.

Sample	Parameter	Quality standards	Reference
The	Residue Suspended (TSS)	50 mg/L	SNI 6989.3-2019
	Degree Acidity (pH)	6 – 9	SNI 6989.11-2019
	Oxygen Dissolved (DO)	6 mg/L	Standard Methods-Ed- 23:2017
	Total Phosphate	0.2 mg/L	SNI 6989.31-2021
	Nitrate	10 mg/L	SNI 06-2480-1991
	Need Oxygen Biochemistry (BOD5)	2 mg/L	SNI 6989.72:2019
	Need Chemical Oxygen (COD)	10 mg/L	SNI 6989.2.2019 (Spectrophotometry)
	Fecal Coliform	100 counts /100L	APHA 23rd 9221 E AND C. 2017

2.2. Water Discharge

Methods used in river discharge determination that is method profile River (Cross Section). In the method Here, debit is the result of multiplication between wide cross section river in a way vertical with rate flow [4].

$$Q = A \times V$$

Where:
Q = Flow rate (m/s);
A = Cross-sectional area vertical (m);
V = Speed flow river (m/s).

2.3. Making River Profile

To determine the cross-sectional area of a river, a river profile must be determined. The cross-sectional area (A) of a river is the sum of all parts of the cross-section, calculated by multiplying the horizontal distance interval by the water depth. The formula is as follows [5]:

$$A\ (m^2) = L_1D_1 + L_2D_2 + \ldots\ldots\ldots L_nD_n$$

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Where:
L = Width of cross section horizontal (m)
D = Depth (m)

2.4. Storet Method Water Quality Status

The method for determining water quality status is to use the US-EPA (Environmental Protection Agency) rating system, which classifies water quality into four classes, namely [2]:

Table 3.
Storet Method Status Classification.

No.	Class	Score	Criteria	Qualification
1	A	0	Very well	Fulfil standard quality
2	B	-1 to -10	Good	Blackened light
3	C	-11 to -30	Currently	Blackened currently
4	D	≥ -31	Bad	Blackened heavy

2.5. Water Quality Status Index Method Pollution (IP)

This method has been regulated in accordance with Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 27 of 2021 concerning Environmental Quality Index [3]. The formula used in determining the Pollutant Index is as follows:

$$Pij = \sqrt{\frac{(Ci/Lij)_M^2 + (Ci/Lij)_R^2}{2}}$$

Description:
Lij: Concentration of water quality parameters listed in water quality standards (J)
Ci: Concentration of water quality parameters in the field
Pij: Pollution index for water use (J)
(Ci/Lij) M: Maximum Ci/Lij value
(Ci/Lij) R: Average value of Ci/Lij

This method can directly link the level of pollution with whether or not the water can be used for specific purposes and with specific parameter values. The evaluation of the IPj value is:

Table 4.
Index Status Classification Polluter (IP).

IPj Value	Water Quality
0-1.0	Good Condition
1.1-5.0	Light Pollution
5.0-10.0	Medium Contamination
>10.0	Heavy Pollution

3. Results and Discussion

3.1. River Water Discharge

Range the amount of water discharge from the Sebenaq River shown in the table as follow:

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Table 5.
Speed Current, Cross-sectional Area and River Water Discharge.

No.	River Name	Dry Season Period			Rainy Season Period		
		Speed Current (m/d t k)	Cross-sectional area (m²)	Discharge (m³/s t k)	Speed Current (m/d t k)	Cross-sectional area (m²)	Discharge (m³/s t k)
1.	Station -I	6,136	696.72	4,275.07	1,242	811.19	1,007.50
2.	Station -II	2,347	644.46	1,512.55	2,005	663.35	1,330.02
3.	Station -III	2,005	520.56	1,043.72	1,117	584.75	653.17
4.	Station -IV	1,793	195.25	350.08	1,891	228.95	432.94

4. Profile River Crossing

4.1. Profile Penampang Station I (Muara Sungai Ratah)

In general profile cross section river at Station I, namely the Ratah River Estuary show pattern curved and not symmetrical, with side right (from direction in the image) more step compared to side left. Cross-sectional area river filled with water at station I in the dry season drought of 696.72 m², while in the dry season Rain of 811.9 m².

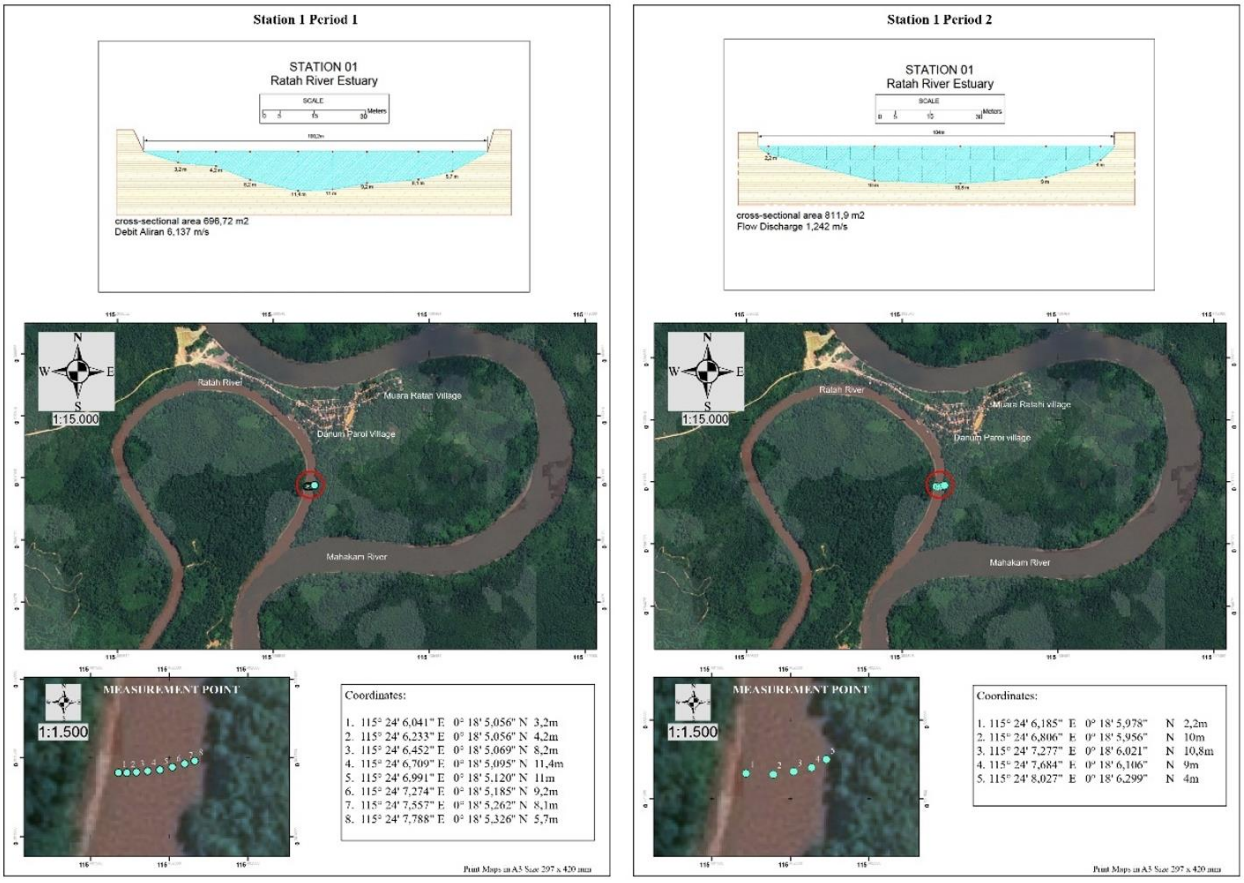

Figure 2.
Station I Cross section Profile (Muara Sungai Ratah).

4.2. Profile Penampang Station II (Sungai Ratah Bridge)

Profile cross section river at location Station II is Ratah River Bridge show form tend hollow and somewhat symmetrical, but there is A little imbalance depth on the side left and right. Cross-sectional

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area river. Cross-sectional area river filled with water at station II in the dry season drought of 644.46 m^2, while in the dry season Rain of 663.35 m^2.

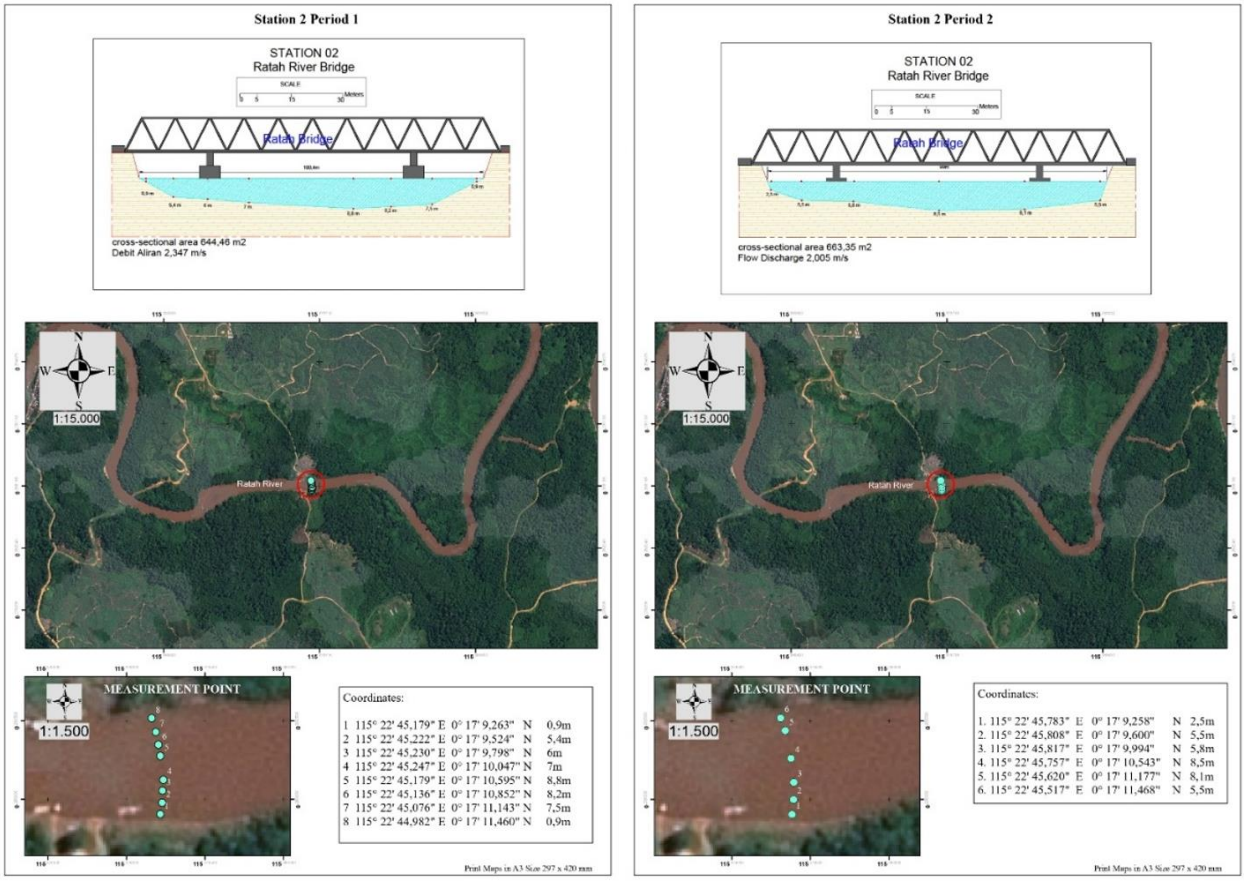

Figure 3.
Profile Cross Section Station II (Sungai Ratah Bridge).

4.3. Profile Penampang Station III (Long Gelawang Village)

At Station III, namely Long Gelawang, the U-shaped river cross-section indicates that the riverbed is more eroded in the middle than at the edges. The area of the river cross-section filled with water at Station III during the dry season is 520.56 m^2, while during the rainy season it is 584.75 m^2.

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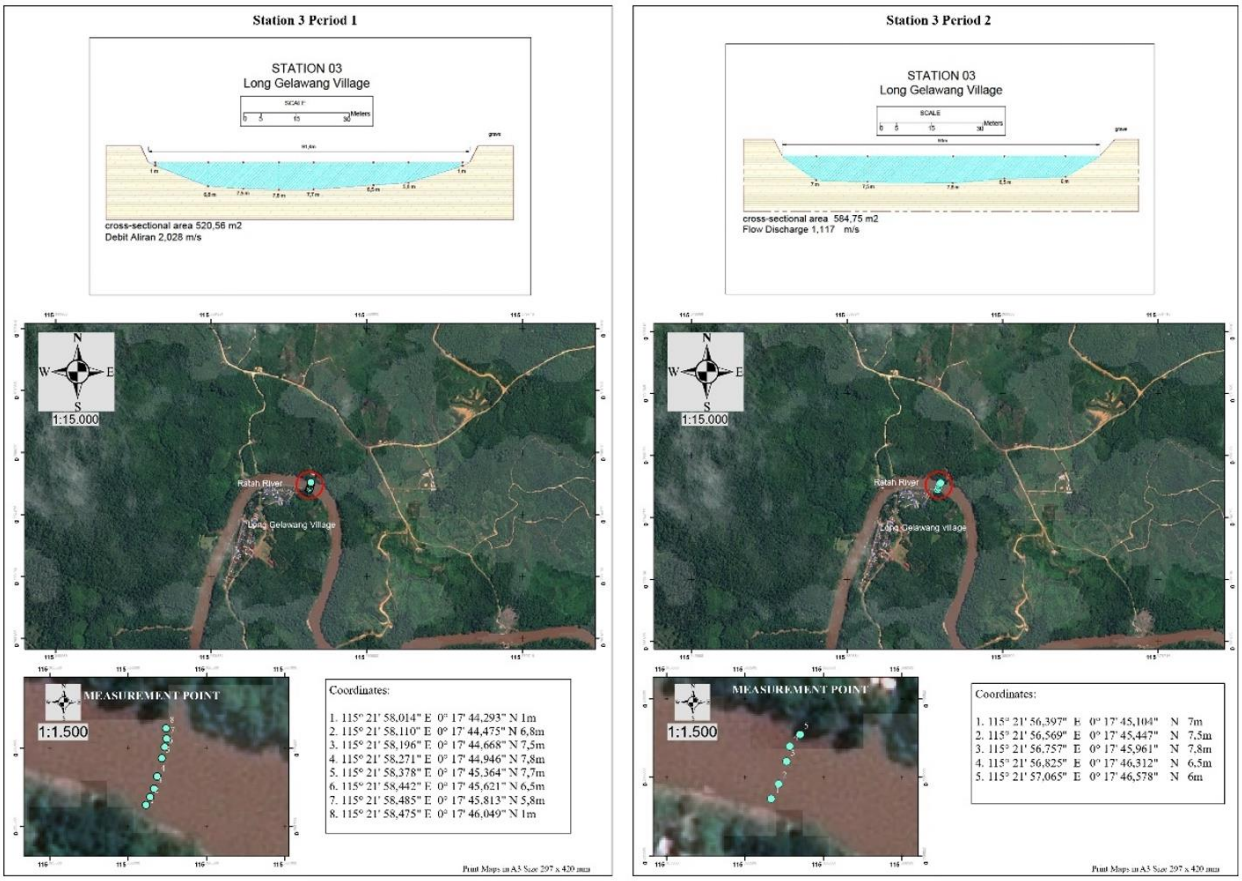

Figure 4.
Profile Cross section Station III (Long Gelawang Village).

4.4. Profile Cross section Station IV (Nyaribungan Village)

The Ratah River, which passes through the Nyaribungan Village Area, is one of them area the upper reaches of the river narrow compared to station others. Cross-sectional area river filled with water at station IV in the dry season drought of 195.25 m², while in the dry season Rain of 228.95 m².

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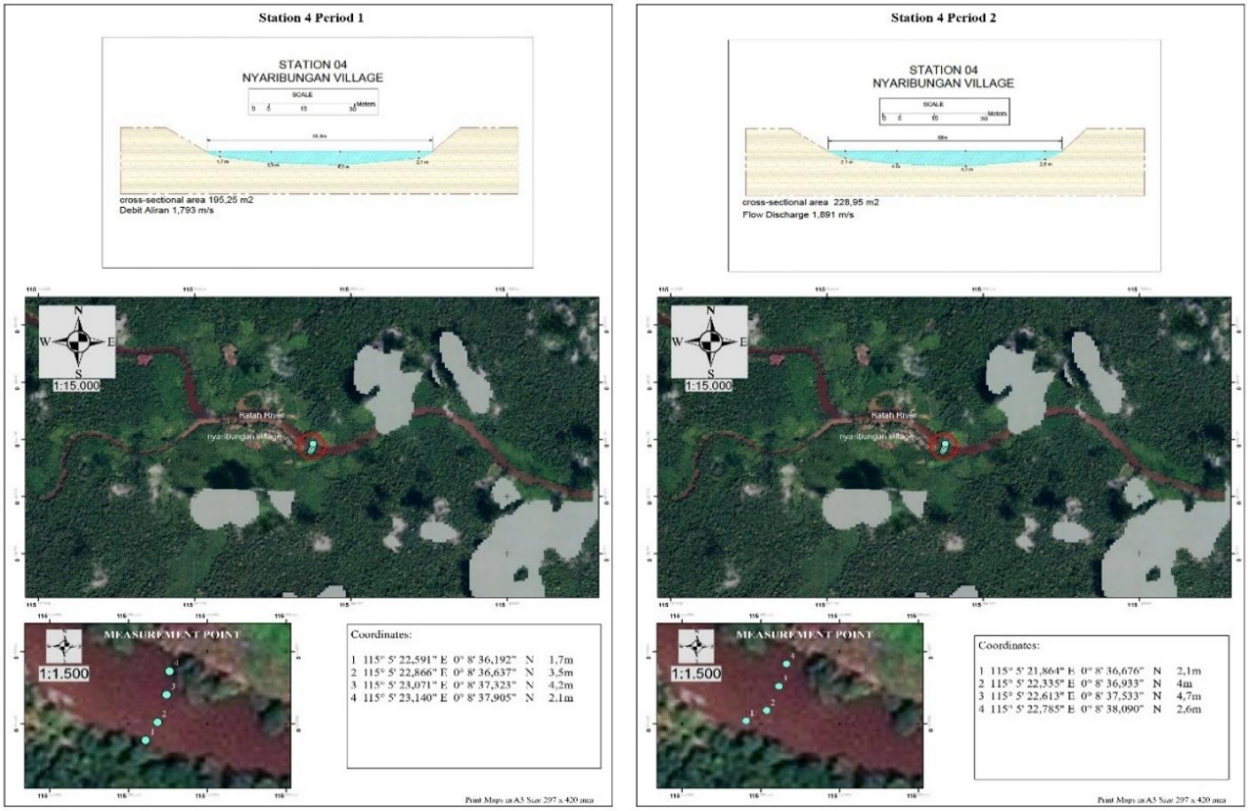

Figure 5.
Profile Cross section Station IV (Nyaribungan Village).

4.5. Water Quality

In Overall, of the 8 water quality parameters analyzed, most big Still is at in allowable range based on standard quality in Government regulations Number 22 of 2021 Attachment V for Class I. As for the analysis Sebenaq River water quality presented in the following table.

Table 6.
Results of Analysis of Ratah River Water Quality during the Dry Season Period.

No.	Parameter	Unit	Water Quality Standards	Station			
				I	II	III	IV
A	Physics						
1	TSS	mg/L	50	11	68	130	29
B	Chemistry						
2	pH		6-9	6.79	6.78	6.68	6.62
3	Dissolved Oksigen (DO)	mg/L	6	6.70	6.88	6.24	6.71
4	BOD	mg/L	2	1.82	1.62	1.32	1.60
5	COD	mg/L	10	13.01	10.57	14.13	**18.62**
6	Nitrat (NO_3-N)	mg/L	10	0.6323	0.1116	0.1115	0.6376
7	Total Phosphate (PO_4)	mg/L	0.2	0.0169	0.0210	0.0362	0.0232
C	Biology						
8	*Fecal Coli*	Amount/100L	100	30	30	30	30

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Information:
BML: Government Regulation No. 22 of 2021 Class I.

Table 7.
Results of Ratah River Water Quality Analysis during the Rainy Season Period.

No.	Parameter	Unit	Water Quality Standards	Station			
				I	II	III	IV
A	**Physics**						
1	TSS	mg/L	50	**64**	14	**47**	4
B	**Kimia**						
2	pH		6-9	7.81	7.21	6.79	6.68
3	Dissolved Oxygen (DO)	mg/L	6	6.15	7.25	6.22	6.54
4	BOD	mg/L	2	1.85	1.79	2.53	1.49
5	COD	mg/L	10	***53.09***	***55.77***	***57.10***	***54.43***
6	Nitrat (NO_3-N)	mg/L	10	0.935	1.010	0.961	0.424
7	Total Posfat (PO_4)	mg/L	0.2	<0.01	<0.01	<0.01	<0.01
C	**Biologi**						
8	*Fecal Coli*	Amount/100L	100	**280**	**280**	**4600**	**2400**

Information:
BML : Government Regulation No. 22 of 2021 Class I.

4.6. pH Parameters

Measurement pH value in Ratah River obtained that in all station good in period season Rain and also season drought, the result Still fulfil standard quality class I according to PP No. 22 of 2021. pH value in the rainy season drought range between 6.62 – 6.79, while in the rainy season Rain range between 6.68 – 7.81. pH value is influenced by input waste organic and also inorganic to the river body [5]. As shown in Figure 6, the pH of Ratah River water tends to be higher (more alkaline or neutral) during the rainy season than during the dry season for the following reasons:

a. During the season rain, river water volume increase Because overflow from rainwater and streams from area around. This causes: Concentration of acid ions (such as H) in river water become lower Because diluted, so the pH rises (more approach neutral). Compound pollutants that are acid also comes diluted, reduced its acidity.

b. Rainwater flowing on the surface land carries soil minerals, such as calcium carbonate ($CaCO_3$), magnesium, and compounds language other to the neutralizing river sour in water so that increase the pH because language neutralize H^+ ions.

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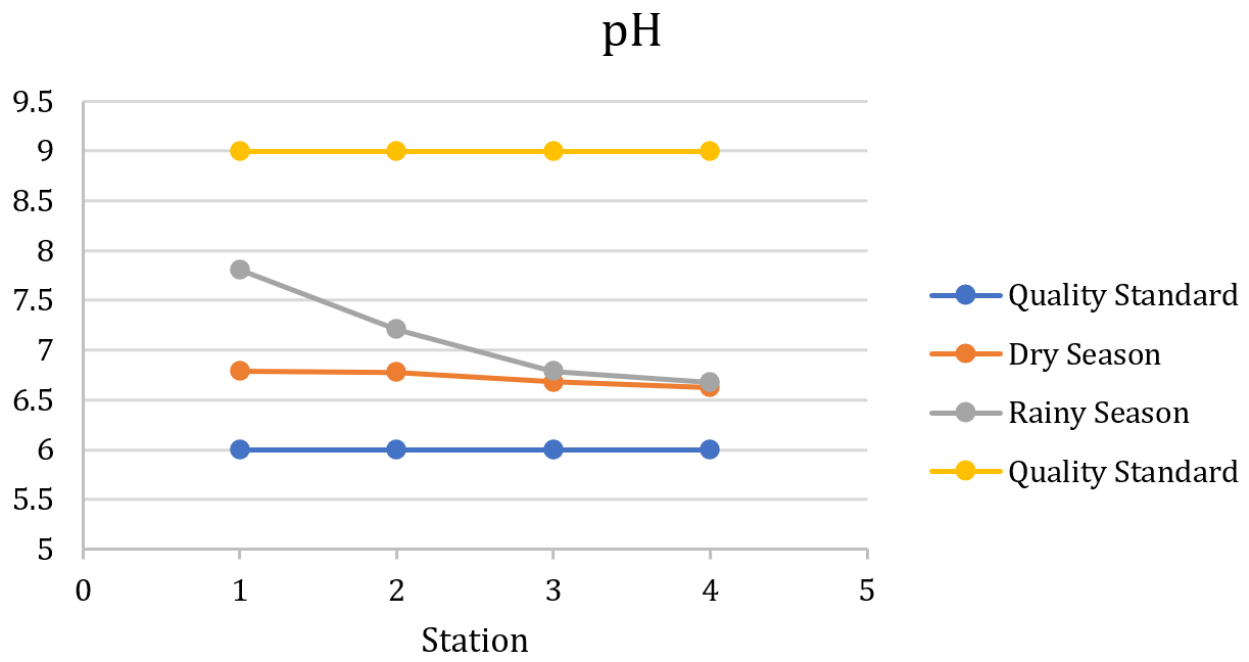

Figure 6.
pH Parameter Curve.

4.7. TSS Parameters

TSS concentration at stations II and III of the Ratah River during the rainy season dry season of 68 mg/L and 130 mg/L respectively, in the dry season rainfall at station I was 64 mg/ L exceed standard quality class I according to PP No. 22 of 2021 with mark maximum 50 mg/L. The things that influence improvement TSS concentration is suspected because existence input material to the body of the river, while influencing decline TSS concentration is rate small stream of water so that some of the TSS is deposited [6]. Test results TSS value shows that concentration the smallest namely at station I with value of 11 mg/L in the rainy season dry season and at station IV with value of 4 mg/L in the rainy season rain, thing This due to because in season drought marked with rainfall Rain low matter This cause A little overflow surface from upstream and area around river. However as seen in Figure 7., the increase TSS values at station II (Ratah River Bridge) and station III (Long Gelawang Village) during the dry season drought is the highest, thing This it is possible because on both the station at the moment flow shrink Because influence season drought existence disturbance from activity man like boat, taking sand, and disposal waste by the community living around the station.

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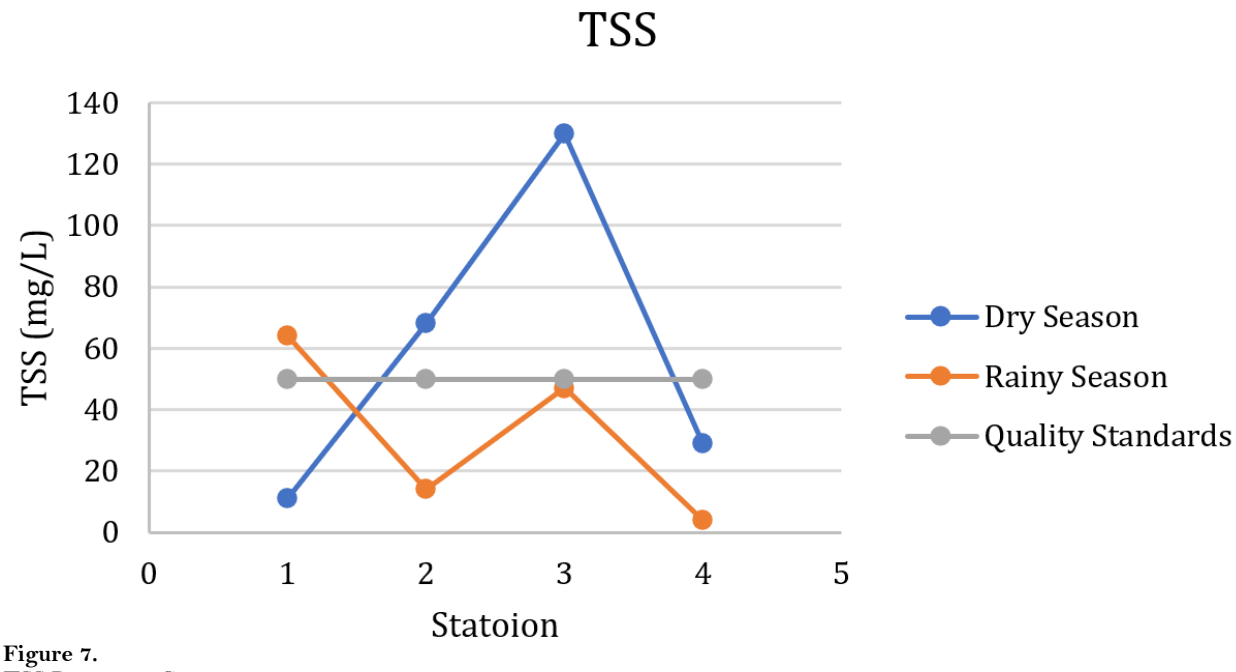

Figure 7.
TSS Parameter Curve.

4.8. DO Parameters

DO concentration in all station good in season drought mupun season Rain Still fulfil standard quality class I PP no. 22 years 2021 with minimum value of 6 mg/L. In the rainy season drought DO concentration is in the range 6.24 – 6.71 mg/L, while in the dry season Rain between 6.15 – 7.25 mg/L. Concentration oxygen high dissolved (DO) can support self-purification process [7]. As seen in Figure 8., the decrease DO concentration in season rain, influenced by the increase material organics carried by runoff water Rain to the river body, increasing material the organic causes the descent DO concentration, where more Lots oxygen used for the decomposition process compound organic by microorganisms so that increase wide cross-section and water discharge of the Ratah River compared to backwards with DO concentration

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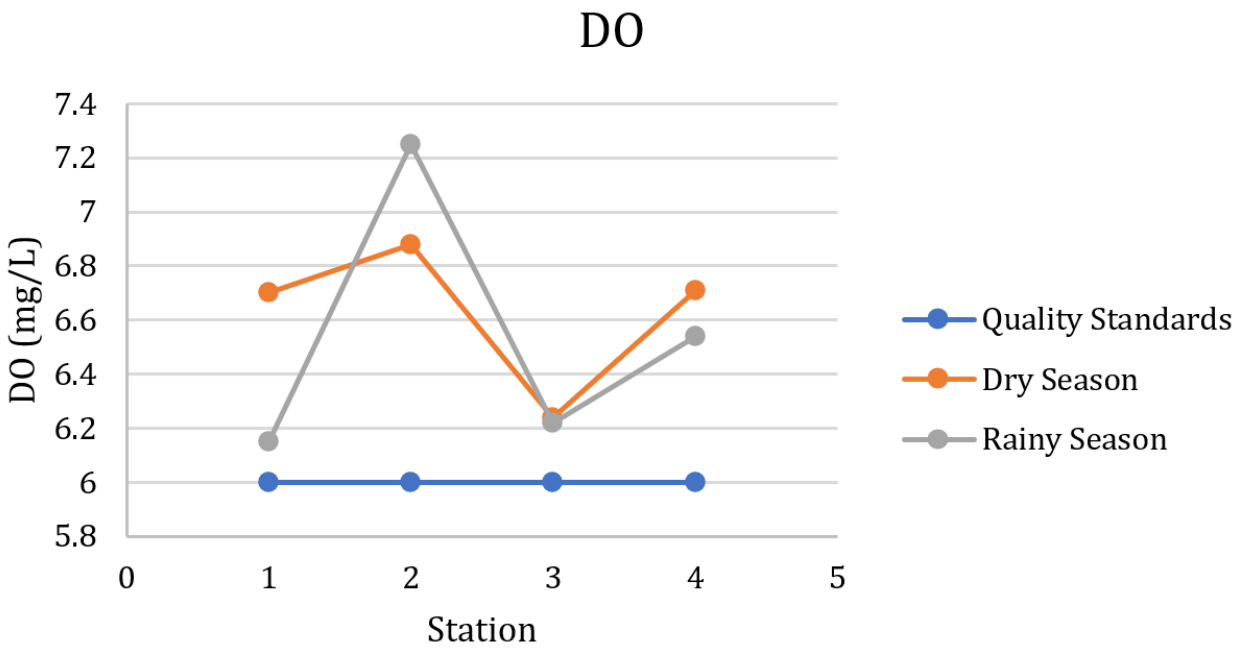

Figure 8.
DO Parameters Curve.

4.9. BOD Parameters

BOD concentration is measured value in 5 days, where BOD concentration in all station river Ratah in season drought and also season Rain Still fulfil standard quality class I PP no. 22 years 2021 with mark maximum 2 mg/L. BOD concentration in the rainy season drought ranges from 1.32 – 1.82 mg/L while in the dry season Rain between 1.49 – 2.53 mg/L. Related BOD parameters with ability natural deep water clean self -purification [8]. BOD concentration that meets the standard quality show that there is willingness oxygen sufficient dissolved oxygen (DO) for the self -purification process. As seen in Figure 9., no there is significant difference to BOD concentration is good in season drought or in season rain, thing This show that the Ratah River own ability good natural in clean self (self-purification).

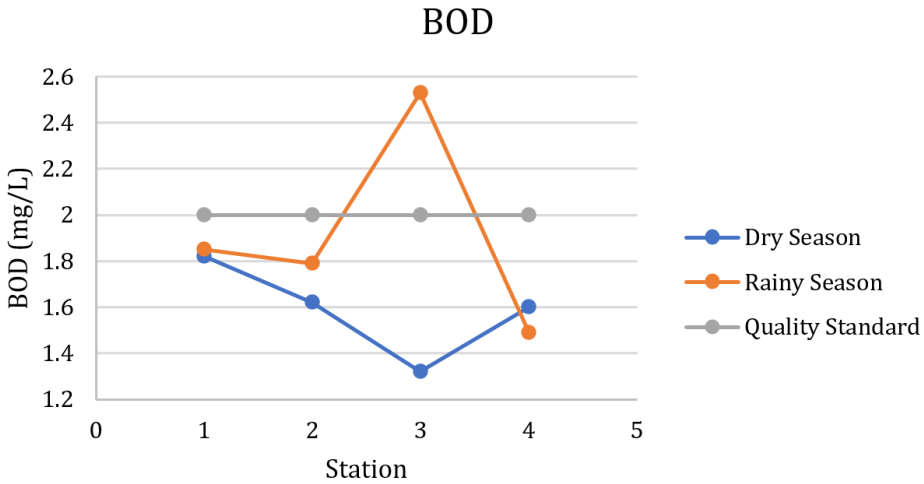

Figure 9.
BOD Parameter Curve.

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4.10. COD Parameters

Concentration in all Sungai Ratah station in season drought and also season Rain has exceed standard quality class I PP no. 22 years 2021 with mark maximum 10 mg/L. COD concentration in the rainy season drought range 10.57 – 18.62 mg/L, while in the dry season Rain between 53.09 – 57.10 mg/L. High COD value indicates level pollution that occurs [9]. Materials measurable organic in COD is material easy organic unraveled or difficult ones unraveled in a way biological [10]. COD concentrations exceeding standard quality indicates entry pollutant to the sufficient water body of the Ratah River height, source these pollutants can originate from the process of decay in a way experience that is degradation from natural that is swamp which is in the upper reaches of the Ratah River, then from activity settlements of people who throw away rubbish to water bodies around the Ratah River, as well activity transportation land and rivers that can just existence spills material burn in to a body of water, where a number of point road crossing with the Ratah River. As seen in Figure 10., The increase in COD concentration during the rainy season is higher than during the dry season, possibly due to the influx of organic matter from around the Ratah River carried by rainwater runoff. This is proportional to the increase in the cross-sectional area/discharge of the Ratah River.

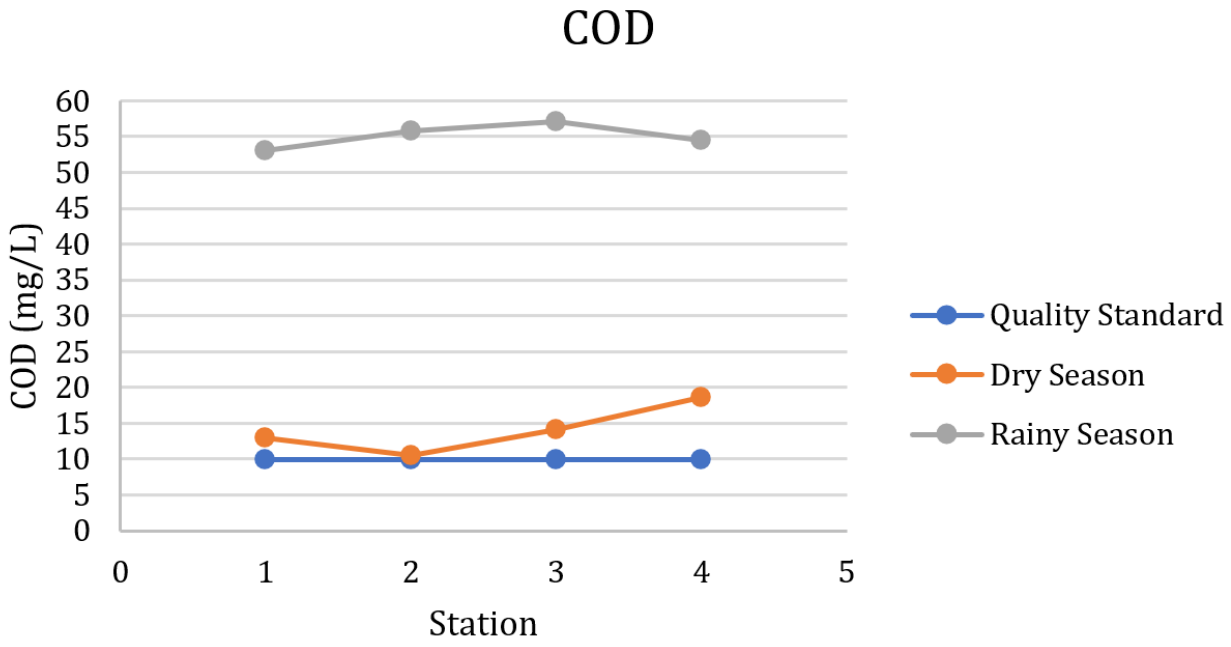

Figure 10.
COD Parameter Curve

Quite a difference Far between BOD and COD values indicate that in the Ratah River there is more Lots material difficult organic unraveled in a way biological compared to material easy chemistry unraveled in a way biological. Against COD value exceeds standard quality can counted burden pollution actual, namely with multiply between concentration COD measured by water discharge. Pollution load actual COD parameters in Sungai Ratah shown in Table 4.4 as follow:

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Table 8.
Pollutant Load Actual COD.

No.	River Name	Pollutant Load (g/s)	
		Dry Season	Rainy Season
1	Station I (Muara Sungai Ratah)	55,618.71	53,488.07
2	Station II (Sungai Ratah Bridge)	15,987.63	74,175.03
3	Station III (Long Gelawang)	14,747.80	37,279.07
4	Station IV (Nyaribungan Village)	6,518.55	23,565.17

4.11. Nitrate Parameters (NO 3 -N)

Concentration nitrate in all Ratah River Station good in season drought and also season Rain Still fulfil standard quality class I PP no. 22 years 2021 with mark maximum 10 mg/L. Concentration nitrate in season drought range 0.1115 – 0.6376 mg/L, while in the rainy season Rain mark lowest 0.424 and the value highest 1.01 mg/L. The activity agriculture will produce overflow nitrate and phosphate [11]. Concentration nitrate that meets standard quality can understood that around the Ratah River Not yet too Lots activity agriculture, where activity existing agriculture Most of Still managed in a way traditional. As seen in Figure 11., increasing concentration nitrate in season Rain it is possible Because heavy rain can cause erosion, which releases particle nitrogen rich soil to in water system. Humidity tall during season Rain can increase activity microbes inside soil, which accelerates the processes of mineralization and nitrification, resulting in more Lots nitrate which then Can washed to the water.

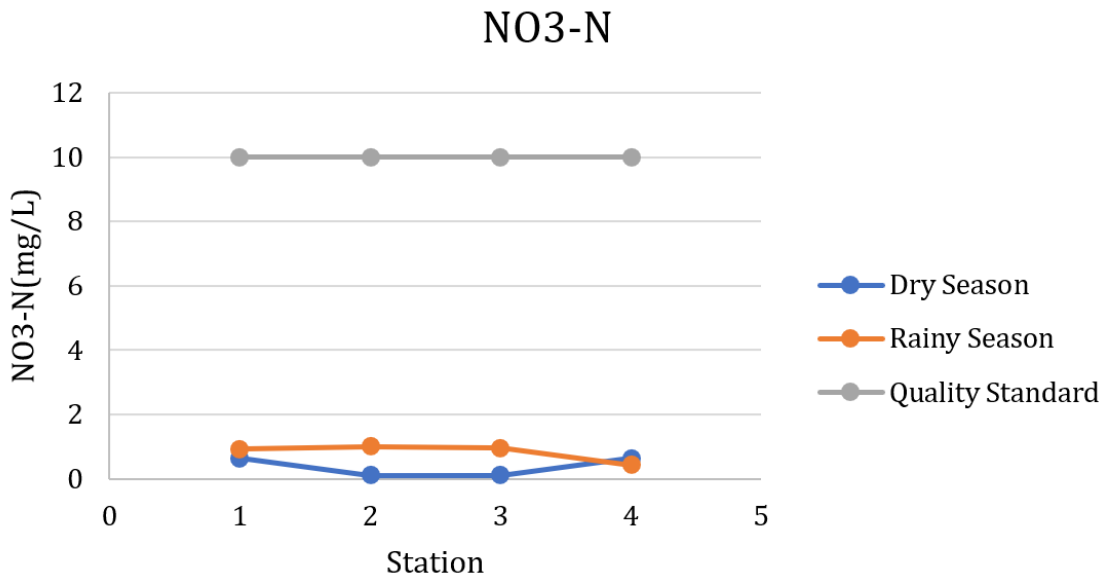

Figure 11.
Nitrate Parameter Curve

4.12. Total Phosfat Parameters (T-Phosfat)

Total phosphate concentration in all Ratah River Station good in season drought and also season Rain Still fulfil standard quality class I PP no. 22 years 2021 with mark maximum 0.0362 mg/L [12]. Total phosphate concentration in the rainy season drought is below the detection limit testing laboratory. The total concentration of phosphate that meets standard quality can understood that around the Ratah River Not yet too Lots activity agriculture, where activity existing agriculture Most of Still managed in a way traditional. As seen in Figure 12., total concentration phosphate good in season drought and also season Rain You're welcome be under fulfil standard quality matter This show

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that in the season rain, runoff water that enters to the body of the Ratah River No there is pollutant phosphate, so that No There is influence improvement wide cross-section and water discharge of the Ratah River to total phosphate concentration.

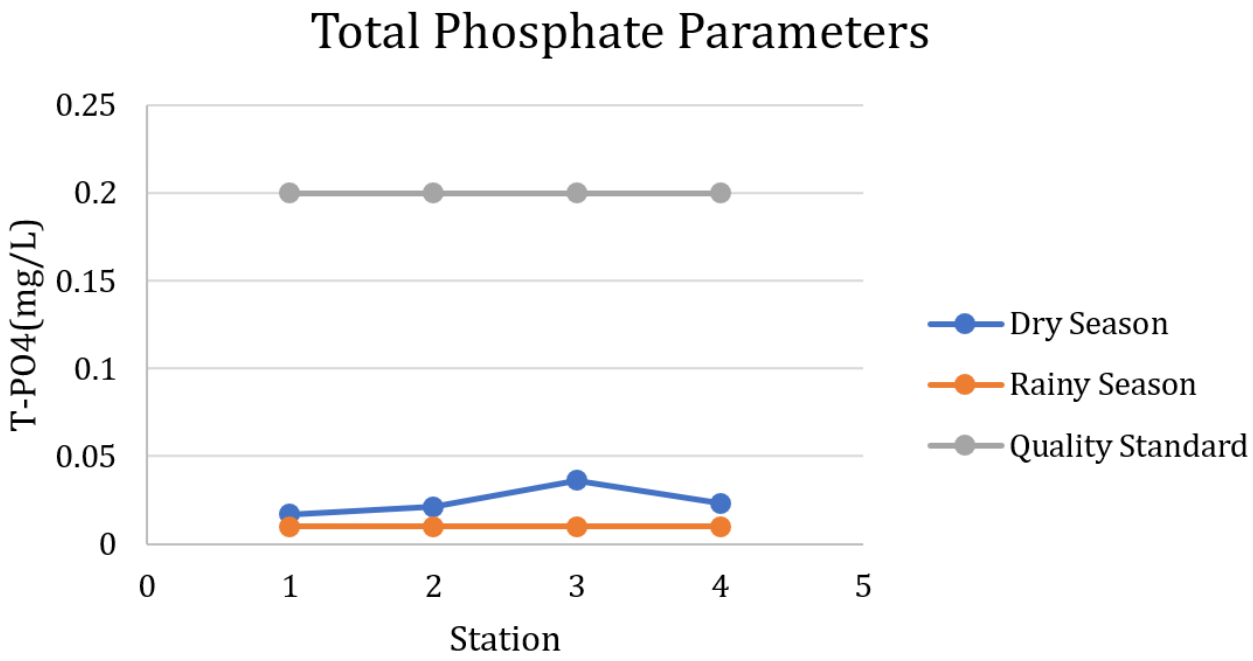

Figure 12.
Total Phosphate Parameter Curve.

4.13. Fecal Coli Parameters

Fecal Coli values for the dry season at all stations were below the quality standard, while for the rainy season at all stations the values were above the quality standard of Class I PP No. 22 of 2021 with a maximum value of 100 counts/100 L [12]. Fecal Coli is bacteria that originate from feces man or animals, as well as waste domestic and waste agriculture. So that existence content Fecal Coli in river water indicates existence MCK activities, agriculture or existence animals around the river.

As seen in Figure 13., in the season rain all over Ratah River Station mark Fecal Coli exceeds standard quality, thing This it is possible Because presence of runoff water the rain that brings material from around the river, which can just contain feces from animals around the river. As is well known, people living near the Ratah River keep pets such as chickens, cats, dogs, and others. Thus, the increase in the cross-sectional area and water discharge of the Ratah River is directly proportional to the increase in fecal coliform values.

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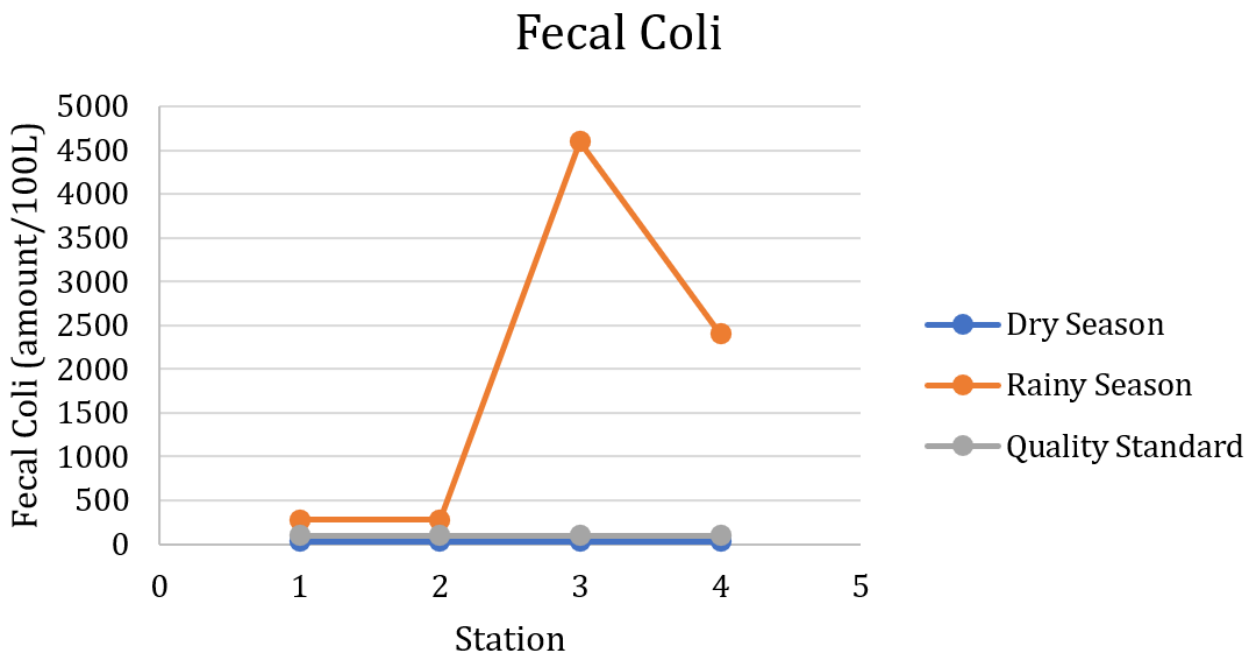

Picture 13.
Fecal Coli Parameter Graph.

4.14. Water Quality Status STORET Method

Based on the calculation results determination of water quality status using STORET method, results are obtained in the following Table.

Table 9.
Ratah River Water Quality Status with the STORET Method.

No.	River Name	Conditions	STORET Score	Status
1.	Station I (Ratah River Estuary)	Currently	-23	Medium Contamination
2.	Station II (Ratah River Bridge)	Currently	-26	Medium Contamination
3.	Station III (Long Gelawang)	Currently	-29	Medium Contamination
4.	Station IV (Nyaribungan Village)	Currently	-21	Medium Contamination

Results of calculating the water quality status of the Ratah River use The STORET method obtained results for all station with polluted status Where are you STORET score obtained mark namely -30 at stations I, II, and III and -28 at station IV.

4.15. Water Quality Status Index Method Polluter

Quality status calculation results according to method Index Polluter presented in the Table following.

Table 10.
Water Quality Status of the Ratah River with Index Method Polluter.

No.	River Name	Average PIj value	Status
1.	Station I (Ratah River Estuary)	3.295	Light Pollution
2.	Station II (Ratah River Bridge)	3.560	Light Pollution
3.	Station III (Long Gelawang)	4.490	Light Pollution
4.	Station IV (Nyaribungan Village)	3.730	Light Pollution

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Results of calculating the water quality status of the Ratah River use method Index Polluter results were obtained throughout station his status that is blackened light.

4.16. Comparison of Water Quality Status between STORET and Index Methods Polluter

Methods used in Determination of water quality status according to the Decree of the Minister of State for the Environment Number 115 of 2003 is STORET method and method Index Polluters [3], while in the Regulation of the Minister of Environment and Forestry Number 27 of 2021 Index Method Polluter used for determine Index Water Quality [4]. In this study, both methods were used to determine the water quality status of the Ratah River. The comparison of the results of the water quality status of the Sebenaq River is shown in the following table:

Table 11.
Comparison of Sebenaq River Water Quality Status between the STORET Method and the Index Method Polluter.

No.	River Name	STORET method		Index Method Polluter	
		STORET Score	Status	Average PIj value	Status
1.	Station I (Ratah River Estuary)	-23	Medium Contamination	3.259	Lightly polluted
2.	Station II (Sungai Ratah Bridge)	-26	Moderately polluted	3.560	Lightly polluted
3.	Station III (Long Gelawang)	-29	Moderately polluted	4.490	Lightly polluted
4.	Station IV (Kampung Nyaribungan)	-21	Moderately polluted	3.730	Light Pollution

Comparison results in the table above between STORET method with method Index Pollutants, water quality status in the method Index Pollutant tend better compared with STORET method. Water quality status of the Ratah River all over station according to The STORET method shows situation contaminated while, while according to method Index Pollutant show situation contaminated light.

For interest evaluation and also taking policy related management of the Ratah River, party related recommended using higher water quality status low status, in matter This namely the water quality status of the Ratah River according to STORET method with polluted status is. This is for greater protection. Good to preservation of the Ratah River.

Water quality status of Sungai Ratah is affected by parameter values that exceed standard quality namely Fecal Coli, COD and TSS. Handling effort against Fecal Coli parameters exceeding standard quality in Sungai Ratah, can done with policy improvement means sanitation and clean water for society until society no again do MCK activities in Sungai Ratah. Meanwhile effort handling against COD parameter values that exceed standard quality namely with do spatial arrangement, where on the border of the Ratah River with a radius of 50 M set as strip green, as well as residential areas society as well as activity others to fulfill the river 's boundary conditions. Arrangement The Ratah River border can also be useful for prevent erosion as well as improvement fast sedimentation the bottom of the Ratah River.

4.17. Connection Quality of Ratah River with Public Health in the Surrounding Area Station Sampling

COD (Chemical Oxygen Demand) levels that exceed quality standards in aquatic environments indicate high levels of organic pollution. COD is a measure of the amount of oxygen needed to chemically break down organic (and inorganic) matter in water. If COD is too high, it means that the water is polluted by excessive organic waste, such as domestic, industrial, or agricultural waste. Exposure to water or environments with high COD levels can cause various diseases, depending on the type of pollutants present. For example, skin diseases can result from direct contact with contaminated water containing harmful organic compounds and microorganisms. This can result in diseases such as dermatitis, skin infections, itching, and rashes with symptoms including red, painful, swollen skin, and open wounds. Based on a list of diseases from patient visits in 2024 obtained from the Kampung

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Nyaribungan, Kampung Long Gelawang, and Kampung Danum Paroy Community Health Centers, there were cases of dermatitis that were likely caused by high COD levels in the Ratah River.

5. Conclusion

Study results about water quality and water quality status of the Ratah River as follow:

1. The water quality of the Ratah River meets Class I quality standards according to Government Regulation No. 22 of 2021 during the dry season and rainy season for all parameter stations exceeding the quality standard is COD, during the rainy season for all parameter stations exceeding the quality standard is Fecal Coli, while at stations II and III during the dry season and station I during the rainy season, the parameter exceeding the quality standard is TSS.
2. The results of the Ratah River water status study show that water quality according to the STORET method is moderately polluted, and according to the Pollutant Index method, it is slightly polluted.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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