

Water quality and pollution load capacity of the Rungan River in Tangkiling, Palangka Raya, Indonesia

Ummi Suraya^{1*} | Dea Minahtri Anggreni¹ | Linda Wulandari¹ | Rosana Elvince¹ | Hamdhani Hamdhani²

¹Aquatic Resources Management Study Program, Faculty of Agriculture, Forestry and Fisheries, University of Palangka Raya, Indonesia

Jl. Yos Sudarso, Kelurahan Palangka, Kecamatan Jekan Raya, Kota Palangka Raya, Kalimantan Tengah 74874, Indonesia

²Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science, Mulawarman University Jl. Gunung Tabur No. 1. Kampus Gn. Kelua, Samarinda 75123, Indonesia

*E-mail: surayaummi@fish.upr.ac.id

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ABSTRACT

This study assessed water quality and pollution-load capacity in the Rungan River around Tangkiling, Palangka Raya, Central Kalimantan, Indonesia. Water was sampled at four purposively selected stations in June 2025, with field measurements and laboratory analyses conducted on three occasions at seven-day intervals. Temperature, current velocity, depth, total suspended solids (TSS), total dissolved solids (TDS), pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), phosphate, and nitrate were examined. Results were compared with the water-quality classes specified in Indonesian Government Regulation No. 22/2021. Mean temperature was 26–28 °C, TSS was 109–127 mg/L, TDS was 9.6–10.1 mg/L, pH was 4.1–4.6, DO was 2.8–3.2 mg/L, and BOD was 4.0–8.4 mg/L. TSS exceeded the reported limits for Classes 1–3, while DO was below the requirements for Classes 1–2. BOD was elevated at Stations I, II, and IV relative to the reported Class 3 criterion; Station III had the lowest mean BOD. The acidic pH was attributed by the original study to the river's peat-swamp setting, although this interpretation requires consideration of local baseline conditions. The manuscript's load-capacity calculations indicated negative capacity for TSS and BOD, but positive capacity for TDS, phosphate, and nitrate. Several inconsistencies in the source calculations and units prevent the reported pollution-load values from being treated as validated estimates. Overall, the results indicate that suspended solids and oxygen-demand conditions warrant priority monitoring and source-control measures.

INTRODUCTION

Water is a substance composed of H₂O molecules, namely hydrogen and oxygen, which is liquid at normal temperature and pressure (Salim, 2023). Water is widely used to meet the needs of humans and other living organisms (Hamakonda *et al.*, 2019). Its use for various purposes must be managed wisely, taking into account the interests of both present and future generations (Nugroho, 2003). Wastewater is effluent discharged from various sources, namely households, industries, and public places, which can cause water to contain hazardous substances (Hidayah, 2010). Water quality has therefore become a central issue in water resources development, because any change in water quality has a significant impact on the

environment (Winandar *et al.*, 2016). As community activities around water bodies intensify, various types of waste may enter the water and cause physicochemical changes that indicate pollution (Jayanti, 2023).

Pollution can occur anywhere, including in rivers (Djoharam *et al.*, 2018). Rivers are among the water bodies most vulnerable to pollution because they serve as direct waste disposal sites for communities living and working along them. Waste discharged directly into water bodies without treatment introduces compounds that are harmful to humans and other living organisms and can disrupt environmental sustainability (Leonardo *et al.*, 2020).

The Rungan River is one of the rivers in Central Kalimantan Province. It empties directly into the Kahayan River and extends for approximately 86.25 km (BPS, 2017). The upstream section of the Rungan River lies in Gunung Mas Regency and passes through several urban villages, one of which is Tangkiling Urban Village in Palangka Raya City.

Communities have lived along the Rungan River since before Palangka Raya City was established (Riyanti *et al.*, 2023). The river is used for capture fisheries, aquaculture, small-scale gold mining (Kembarawati & Elvince, 2019), water transportation, and washing and bathing (Batubara *et al.*, 2023), and it also serves as a settlement area and the basis of livelihoods for communities living along its banks (Indrasari & Rudiarto, 2020). These activities may potentially pollute the Rungan River.

The pollutant source most likely to enter the Rungan River is domestic waste, comprising solid waste (garbage) and liquid waste from community activities. Inadequate wastewater treatment is feared to create new problems, whereby the river can no longer accommodate the pollutant load, leading to a decline in water quality that affects both humans and the river itself.

This study was therefore necessary to analyze the water quality and pollutant load of the Rungan River. The Tangkiling area and its surroundings are tourist destinations in Palangka Raya City, and studies of this kind remain limited, particularly those that determine the water quality and pollutant load of the Rungan River in Tangkiling Urban Village, Palangka Raya City. The objectives of this study were (a) to determine the water quality of the Rungan River in Tangkiling Urban Village, Palangka Raya City, by comparing water quality test results with Government Regulation of the Republic of Indonesia No. 22 of 2021, and (b) to determine the pollutant load and the pollutant load capacity of the Rungan River in Tangkiling Urban Village, Palangka Raya City.

METHODOLOGY

Study area and sampling design

Sampling stations were determined by purposive sampling, that is, sampling based on considerations of accessibility, cost, and time, and on the ability of the stations to represent the water body where pollutant sources enter it (Mawaddati *et al.*, 2021). Water samples were collected and water quality was measured three times at seven-day intervals over one month. Temperature, current velocity, and depth were measured directly in the field. Sampling and measurements were carried out in the morning. The coordinates of the four study stations in the Rungan River are as follows:

Table 1. Sampling coordinates

Station	Coordinates	Site description
I	1°58'32.13" S, 113°45'49.03" E	No nearby settlement or fish cages reported
II	1°58'46.86" S, 113°45'46.06" E	Near a port, settlement, and fish cages
III	1°58'47.43" S, 113°46'00.35" E	No nearby settlement reported
IV	1°58'55.46" S, 113°46'04.56" E	Near mining activity

Field and laboratory measurements

Water samples were collected using a Kammer water sampler and 600-mL plastic bottles using grab-sampling procedures (Fauzy, 2019). Temperature was measured with a thermometer, current velocity with a current meter, and depth with a depth sounder. Laboratory analyses were conducted at the Aquatic Resources Management Laboratory, University of Palangka Raya, and the Central Kalimantan Provincial Health and Calibration Laboratory. Parameters included TSS, TDS, pH, DO, BOD, phosphate, and nitrate.

Data analysis

Water Discharge

Water discharge was calculated from the measured current velocity and the cross-sectional area of the Rungan River using the following formula:

$$Q = A \times V$$

where Q is water discharge (m³/s); A is wetted cross-sectional area (width × depth) (m²); and V is mean flow velocity (m/s).

The wetted cross-sectional area was obtained by multiplying the mean depth by the river width. River width was measured using Google Earth, and mean depth was determined by dividing the river cross-section into four segments.

Pollutant Load

The pollutant load is the amount of a pollutant parameter contained in a given volume of water or wastewater. It was calculated using the following formulas (Nurjannah, 2019). The actual pollutant load (APL) was calculated as:

$$APL = (CA)_j \times Q_s \times f$$

where APL is the actual pollutant load (kg/day); (CA)_j is the measured pollutant concentration (mg/L); Q_s is the measured discharge (m³/s); and f is the conversion factor (86.4).

The maximum pollutant load (MPL) was calculated as:

$$MPL = (CA)_b \times Q_s \times f$$

where MPL is the pollutant load based on the water quality standard (kg/day); (CA)_b is the pollutant concentration according to the water quality standard (mg/L); Q_s is the measured discharge (m³/s); and f is the conversion factor (86.4).

Pollutant Load Capacity

Water pollution occurs when other elements or substances enter the water and cause its quality to decline (Saily *et al.*, 2019). The pollutant load capacity (PLC) can be calculated in a simple way by applying the mass balance equation (Nurjannah, 2019):

$$PLC = MPL - APL$$

where PLC is the pollutant load capacity (kg/day); MPL is the pollutant load according to the water quality standard (kg/day); and APL is the measured pollutant load (kg/day). A negative value (–) indicates that pollution in the water has exceeded the limit of the pollutant load capacity, whereas a positive value (+) indicates that the pollutant load remains within the capacity.

RESULT AND DISCUSSION

Mean water-quality measurements

Water quality testing at four stations in the Rungan River, together with laboratory analysis, yielded results for physical and chemical parameters. These results reflect anthropogenic influences from community activities around the river, which may be sources of pollution in the Rungan River, Tangkiling Urban Village, Palangka Raya City.

The values of the tested parameters were compared with the water quality standards stipulated in Government Regulation of the Republic of Indonesia No. 22 of 2021 concerning the Implementation of Environmental Protection and Management. The water quality measured at each station during the study is presented in Table 2.

Table 2. Water quality data

Parameter	Unit	Station I	Station II	Station III	Station IV
Temperature	°C	27	28	26	27
Current velocity	m/s	0.4	0.3	0.3	0.2
Depth	m	5	7	6	6
TSS	mg/L	117	109	121	127
TDS	mg/L	9.7	9.6	9.8	10.1
pH	—	4.6	4.4	4.1	4.1
DO	mg/L	3.2	2.9	2.8	2.9
BOD	mg/L	6.6	8.4	4.0	7.3
Phosphate (PO ₄)	mg/L	0.047	0.043	0.043	0.025
Nitrate (NO ₃)	mg/L	0.009	0.013	0.023	0.032

Water discharge was measured at each observation station. The study took place at the onset of the dry season, so the discharge of the Rungan River had declined at the time of measurement. This is consistent with Setiawan & Purwanto (2018), who stated that river discharge decreases in the dry season and increases in the rainy season and is also affected by rainfall intensity.

The mean discharge of the Rungan River at each station is presented in Table 3.

Table 3. Calculated water discharge of the Rungan River at each station

Station	Width (m)	Depth (m)	Current velocity (m/s)	Discharge (m ³ /s)
I	161	5.5	0.4	353.663
II	94	6.7	0.3	188.94
III	137	6.5	0.3	265.78
IV	93	5.8	0.2	108.035

Physical parameters

Temperature, current velocity, and depth

Temperature measured at the four study stations in the Rungan River ranged from 26.5 to 28 °C, with a mean of 27 °C. The lowest mean temperature during the study was recorded at Station III (26 °C) and the highest at Station II (28 °C). Temperatures at the individual stations did not differ greatly. River water temperature can be influenced by environmental conditions, such as the physical and chemical conditions of the surrounding water, one of which is solar intensity. This is supported by Agustiningasih *et al.* (2012),

who explained that water temperature is related to air–water interaction: the more light enters the water body, the higher the temperature, whereas less incoming solar radiation lowers the temperature.

The temperatures at all four stations (I–IV) met the Class 1–4 water quality standards of Government Regulation No. 22 of 2021, which specify a deviation of 3 from the air temperature above the water surface. A deviation of 3 corresponds to river water temperatures within the normal range of 25–31 °C (Trisnawati & Masduqi, 2014). The water temperature of the Rungan River therefore meets the prescribed water quality standard.

Current velocity measured at the four study stations ranged from 0.1 to 0.5 m/s, with a mean of 0.3 m/s. The lowest mean current velocity was recorded at Station IV (0.2 m/s) and the highest at Station I (0.4 m/s). Current velocities at the individual stations did not differ greatly. Current velocity is determined by the slope, roughness, depth, and width of the channel bed (Kembarawati & Elvince, 2019). According to Harahap (2000), current velocity can be divided into four categories: (1) 0.0025 m/s, slow current; (2) 0.25–0.50 m/s, moderate current; (3) 0.50–1 m/s, fast current; and (4) >1 m/s, very fast current. The current velocity of the Rungan River in Tangkiling Urban Village falls into the moderate category, so the relatively fast current is able to transport pollutants. Current velocity at Stations I–IV could not be compared with Government Regulation No. 22 of 2021 because the regulation does not stipulate a standard for this parameter.

Water depth measured at the four study stations ranged from 4.1 to 11.3 m, with a mean of 6 m. The lowest mean depth was recorded at Station I (5 m) and the highest at Station II (7 m), because water depth in the Rungan River in Tangkiling Urban Village tends to increase downstream.

Water depth can be affected by discharge: swift flow causes erosion, whereas low flow causes sedimentation (Listriyana *et al.*, 2024). Depth can also be affected by soil particles carried by rainwater runoff from the land surface. Water depth at Stations I–IV could not be compared with Government Regulation No. 22 of 2021 because the regulation does not stipulate a standard for this parameter.

Total suspended solids (TSS)

The lowest mean TSS was recorded at Station II (109 mg/L) and the highest at Station IV (127 mg/L). TSS fluctuated among stations. The high TSS at Station IV is attributable to its proximity to gold mining activities, whereas the lower TSS at Station II is attributable to the absence of gold mining nearby, as the station is close to residential areas. Total suspended solids consist of mud, sand, and microorganisms, mainly resulting from soil scouring or erosion carried into the water (Effendi, 2003).

TSS values are classified into four categories: (1) <25 mg/L, no effect; (2) 25–80 mg/L, slight effect; (3) 81–400 mg/L, less favorable; and (4) >400 mg/L, very unfavorable (Effendi, 2003). Based on the measurements, TSS in the Rungan River in Tangkiling Urban Village falls into the less favorable category (109–127 mg/L). TSS at Stations I–IV exceeded the Class 1–3 water quality standards and met only the Class 4 standard of Government Regulation No. 22 of 2021. These results raise concern that aquatic organisms may be disturbed in their reproduction.

Total dissolved solids (TDS)

Mean TDS was low and varied from 9.6 to 10.1 mg/L, with the highest value at Station IV. The source reports that TDS was below the limits for Classes 1–4. These results indicate that dissolved solids were not the principal water-quality concern among the parameters measured in this survey.

TDS measured at the four study stations ranged from 8.25 to 11.4 mg/L, with a mean of 9.8 mg/L. The lowest mean TDS was recorded at Station II (9.6 mg/L) and the highest at Station IV (10.1 mg/L). The highest value at Station IV is attributable to its location in the downstream part of the Rungan River in

Tangkiling Urban Village, which receives inputs from unlicensed gold mining and from settlements. Total dissolved solids are solids smaller than suspended solids. TDS in water can be affected by rock weathering, runoff from soil, and anthropogenic activities (Fardiaz, 1992). TDS in the Rungan River was lower than the Class 1 to Class 4 water quality standards of Government Regulation No. 22 of 2021.

Chemical parameters

pH

pH measured at the four study stations ranged from 3.7 to 5.1, with a mean of 4.3. The lowest mean pH was recorded at Stations III and IV (4.1) and the highest at Station I (4.6). pH values at the individual stations did not differ greatly. The low pH of the Rungan River in Tangkiling Urban Village is caused by various activities that may lower pH, such as gold mining and settlements, and by the fact that waters in Central Kalimantan generally consist of acidic peat water (Kembarawati & Elvince, 2019). The Rungan River is therefore influenced by the peat swamp ecosystem.

According to Government Regulation No. 22 of 2021, river water with a pH of about 6–9 is normal and suitable for aquatic life, but this does not apply to peat water, which is assessed against its natural condition. The acidic pH of the Rungan River is thus still reasonable because it corresponds to its natural condition, being influenced by the peat swamp ecosystem, which is characterized by low pH. The pH of the Rungan River could not be compared with the Class 1–4 water quality standards, but it remains consistent with the natural condition of the river.

Dissolved oxygen (DO) and biochemical oxygen demand (BOD)

DO measured at the four study stations ranged from 2.5 to 3.7 mg/L, with a mean of 29.5 mg/L. The lowest mean DO was recorded at Station III (2.8 mg/L) and the highest at Station I (3.2 mg/L). DO values at the individual stations did not differ greatly. DO concentrations tended to decline from the upstream section toward the middle and downstream sections. Dissolved oxygen concentration in water is influenced, among other factors, by temperature, the degree of light penetration, which depends on depth, and water turbidity (Sastrawijaya, 2000). DO at Stations I–IV did not meet the Class 1 and Class 2 water quality standards. Station I met the Class 3 and Class 4 standards, whereas Stations II, III, and IV met only the Class 4 standard of Government Regulation No. 22 of 2021.

BOD measured at the four study stations ranged from 0.67 to 9.42 mg/L, with a mean of 6.5 mg/L. The lowest mean BOD was recorded at Station III (4 mg/L) and the highest at Station II (8.4 mg/L), a station close to residential areas. The higher the BOD, the greater the level of water pollution by organic matter; conversely, low values indicate freedom from organic pollution. The BOD of river water indicates the amount of organic pollutants present in the water (Djoharam *et al.*, 2018) and describes the amount of oxygen consumed by microbial activity over a given period. A high BOD can affect the DO content of the water (Fatoki *et al.*, 2001). BOD at Stations I, II, and IV did not meet the Class 1–3 water quality standards and met only the Class 4 standard, whereas Station III met the Class 3–4 standards of Government Regulation No. 22 of 2021.

Phosphate and nitrate

Phosphate measured at the four study stations ranged from 0.049 to 0.059 mg/L, with a mean of 0.04 mg/L. The lowest mean phosphate concentration was recorded at Station III (0.04 mg/L) and the highest at Station I (0.05 mg/L). Phosphate in water originates from industrial and domestic waste, namely phosphorus derived from commonly used detergents (Effendi, 2003). Phosphate concentration can affect

the activity of aquatic organisms: low concentrations inhibit organism growth, whereas high concentrations cause unrestricted growth that can damage ecosystem sustainability (Hidayat, 2021).

According to Yoshimura in Effendi (2003), phosphate concentrations in water are classified into three categories: (1) low fertility, 0–0.02 mg/L; (2) moderate fertility, 0.021–0.05 mg/L; and (3) high fertility, 0.051–0.1 mg/L. The Rungan River in Tangkiling Urban Village is therefore classified as moderately to highly fertile. Phosphate at Stations I–IV was lower than the Class 1 to Class 4 water quality standards of Government Regulation No. 22 of 2021.

Nitrate measured at the four study stations ranged from 0.029 to 0.059 mg/L, with a mean of 0.028 mg/L. The lowest mean nitrate concentration was recorded at Stations I and II (0.02 mg/L) and the highest at Station III (0.03 mg/L). Nitrate is one of the parameters of water fertility; nitrate content influences the nutrients involved in the formation of aquatic organism biomass (Hasim *et al.*, 2015). According to Vollenweider in Effendi (2003), waters with nitrate concentrations of 0.0–1.0 mg/L are categorized as less fertile. The low nitrate concentrations measured in the Rungan River indicate that the river is of low fertility. Nitrate at Stations I–IV was lower than the Class 1 to Class 4 water quality standards of Government Regulation No. 22 of 2021.

Pollution loads and estimated capacity

The pollutant load capacity of the Rungan River was analyzed for five parameters considered to be key parameters: total dissolved solids (TDS), total suspended solids (TSS), biochemical oxygen demand (BOD), phosphate (PO₄), and nitrate (NO₃). According to Rahayu *et al.* (2018), key parameters are those that occur frequently, with a probability of ≥80% relative to other parameters.

Determining the pollutant load capacity is one strategy for water pollution control that uses a water quality approach. It aims to control the pollutants entering the water by considering the intrinsic condition of the water source and the established water quality standards (Hidayat, 2021). The pollutant load capacity was calculated for the four stations to determine the measured pollutant load and the load based on the Class 2 and Class 3 water quality standards of Government Regulation of the Republic of Indonesia No. 22 of 2021, using the simple mass balance method. The results are presented below.

Pollutant Load and Pollutant Load Capacity (PLC) of TSS

The PLC of total suspended solids (TSS) was calculated using standard values of 50 mg/L for Class 2 and 100 mg/L for Class 3. The results are presented in Table 4.

Table 4. Pollutant Load Capacity (PLC) of TSS, Classes 2 and 3

Station	APL (kg/day)	MPL (kg/day) Class 2	MPL (kg/day) Class 3	PLC (kg/day) Class 2	PLC (kg/day) Class 3
I	3,560,852.20	1,527,825.60	3,055,651.20	-2,033,026.60	-505,201.00
II	1,786,435.26	816,220.80	1,632,441.60	-970,214.46	-153,993.66
III	2,782,397.66	1,148,169.60	2,296,339.20	-1,634,228.06	-486,058.46
IV	1,597,832.46	630,060.12	1,260,120.24	-967,772.34	-337,712.22
Total	9,727,517.58	4,122,276.12	8,244,552.24	-5,605,241.46	-1,482,965.3
Mean	2,431,879.40	1,030,569.03	2,061,138.06	-1,401,310.37	-370,741.34

For Class 2 and Class 3, the mean actual TSS pollutant load was 2,431,879.40 kg/day. The mean TSS load based on the Class 2 standard was 1,030,569.03 kg/day, and that based on the Class 3 standard was 2,061,138.06 kg/day. The mean PLC was –1,401,310.37 kg/day for Class 2 and –370,741.34 kg/day for Class 3. The negative PLC values for TSS indicate that the TSS load in the Rungan River in Tangkiling Urban Village has already exceeded the load permitted under the Class 2 and Class 3 water quality standards.

TSS at Stations I–IV exceeded the Class 2 and Class 3 standards of Government Regulation No. 22 of 2021, and this is directly reflected in the PLC values, which likewise indicate that the Class 2 and Class 3 limits have been exceeded.

Pollutant Load and Pollutant Load Capacity (PLC) of TDS

The PLC of total dissolved solids (TDS) was calculated using the standard value of 1,000 mg/L for Classes 2 and 3. The results are presented in Table 5.

Table 5. Pollutant Load Capacity (PLC) of TDS, Classes 2 and 3

Station	APL (kg/day)	MPL (kg/day) Classes 2 and 3	PLC (kg/day) Classes 2 and 3
I	297,111.15	30,556,512	30,259,400.85
II	157,312.96	16,324,416	16,167,103.04
III	224,046.16	22,963,392	22,739,345.84
IV	126,642.08	12,601,202.40	12,474,560.32
Total	805,112.35	82,445,522.40	81,640,410.05
Mean	201,278.09	20,611,380.60	20,410,102.51

For Class 2 and Class 3, the mean actual TDS pollutant load was 201,278.09 kg/day. The mean TDS load based on the Class 2 and Class 3 standards was 20,611,380.60 kg/day, and the mean PLC was 20,410,102.51 kg/day. The positive PLC values for TDS indicate that the TDS load in the Rungan River in Tangkiling Urban Village has not yet exceeded the load permitted under the Class 2 and Class 3 water quality standards.

These results can serve as a reference for government decision-making, as they indicate that the mean amount of TDS that can still enter the river is 20,410,102.51 kg/day.

Pollutant Load and Pollutant Load Capacity (PLC) of BOD

The PLC of biochemical oxygen demand (BOD) was calculated using standard values of 3 mg/L for Class 2 and 6 mg/L for Class 3. The results are presented in Table 6.

Table 6. Pollutant Load Capacity (PLC) of BOD, Classes 2 and 3

Station	APL (kg/day)	MPL (kg/day) Class 2	MPL (kg/day) Class 3	PLC (kg/day) Class 2	PLC (kg/day) Class 3
I	201,163.70	91,669.54	183,339.07	-109,494.17	-17,824.63
II	137,832.49	48,973.25	97,946.50	-88,859.24	-39,885.99
III	91,853.57	68,890.18	137,780.35	-22,963.39	45,926.78
IV	92,408.82	37,803.61	75,607.21	-54,605.21	-16,801.60
Total	523,258.58	247,336.57	494,673.13	-275,922.01	-28,585.44
Mean	130,814.64	61,834.14	123,668.28	-68,980.50	-7,146.36

For Class 2 and Class 3, the mean actual BOD pollutant load was 130,814.64 kg/day. The mean BOD load based on the Class 2 standard was 61,834.14 kg/day, and that based on the Class 3 standard was 123,668.28 kg/day. The mean PLC was -68,980.50 kg/day for Class 2 and -7,146.36 kg/day for Class 3. The negative PLC values for BOD indicate that the BOD load in the Rungan River in Tangkiling Urban Village has already exceeded the load permitted under the Class 2 and Class 3 water quality standards.

BOD at Station III had not yet exceeded the Class 3 standard of Government Regulation No. 22 of 2021, and this is reflected in the Class 3 PLC, which remained within the standard; Stations I, II, and IV did not meet the Class 3 PLC. BOD at Stations I–IV did not meet the Class 2 standard, which is likewise reflected in the Class 2 PLC.

Pollutant Load Capacity (PLC) of Phosphate (PO_4)

The PLC of phosphate was calculated using standard values of 0.2 mg/L for Class 2 and 1.0 mg/L for Class 3. The results are presented in Table 7.

Table 7. Pollutant Load Capacity (PLC) of Phosphate, Classes 2 and 3

Station	APL (kg/day)	MPL (kg/day) Class 2	MPL (kg/day) Class 3	PLC (kg/day) Class 2	PLC (kg/day) Class 3
I	1,446.34	6,111.30	30,556.51	4,664.96	29,110.17
II	701.95	3,264.88	16,324.42	2,562.93	15,622.47
III	987.43	4,592.68	22,963.39	3,605.25	21,975.97
IV	520.85	2,520.24	12,601.20	1,999.39	12,286.17
Total	3,656.57	16,489.10	82,445.52	12,832.54	78,788.95
Mean	914.14	4,122.28	20,611.38	3,208.13	19,697.24

For Class 2 and Class 3, the mean actual phosphate pollutant load was 914.14 kg/day. The mean phosphate load based on the Class 2 standard was 4,122.28 kg/day, and that based on the Class 3 standard was 20,611.38 kg/day. The mean PLC was 3,208.13 kg/day for Class 2 and 19,697.24 kg/day for Class 3. The positive PLC values for phosphate indicate that the phosphate load in the Rungan River in Tangkiling Urban Village has not yet exceeded the load permitted under the Class 2 and Class 3 water quality standards.

These results can serve as a reference for government decision-making, as they indicate that the mean amount of phosphate that can still enter the river is 20,611.38 kg/day under Class 2 and 19,697.24 kg/day under Class 3.

Pollutant Load Capacity (PLC) of Nitrate (NO_3)

The PLC of nitrate was calculated using standard values of 10 mg/L for Class 2 and 20 mg/L for Class 3. The results are presented in Table 8.

Table 8. Pollutant Load Capacity (PLC) of Nitrate, Classes 2 and 3

Station	APL (kg/day)	MPL (kg/day) Class 2	MPL (kg/day) Class 3	PLC (kg/day) Class 2	PLC (kg/day) Class 3
I	865.77	305,565.12	611,130.24	304,699.35	610,264.47
II	364.58	163,244.16	326,488.32	162,879.58	326,123.74
III	742.48	229,633.92	459,267.84	228,891.44	458,525.35
IV	407.44	126,012.02	252,024.05	125,604.59	251,616.61
Total	2,380.27	824,455.22	1,648,910.45	822,074.40	1,646,530.17
Mean	595.07	206,113.81	412,227.61	205,518.74	411,632.54

For Class 2 and Class 3, the mean actual nitrate pollutant load was 595.07 kg/day. The mean nitrate load based on the Class 2 standard was 206,113.81 kg/day, and that based on the Class 3 standard was 412,227.61 kg/day. The mean PLC was 205,518.74 kg/day for Class 2 and 411,632.54 kg/day for Class 3. The positive PLC values for nitrate indicate that the nitrate load in the Rungan River in Tangkiling Urban Village has not yet exceeded the load permitted under the Class 2 and Class 3 water quality standards.

These results can serve as a reference for government decision-making, as they indicate that the mean amount of nitrate that can still enter the river is 205,518.74 kg/day under Class 2 and 411,632.54 kg/day under Class 3.

CONCLUSION

Water quality in the Rungan River at Tangkiling showed contrasting conditions across the measured parameters. Mean temperature was 26–28 °C and TDS was 9.6–10.1 mg/L; the source reports these parameters as meeting the applicable standards. In contrast, TSS was 109–127 mg/L and was reported to exceed the criteria for Classes 1–3. DO was low at 2.8–3.2 mg/L, and BOD ranged from 4.0 to 8.4 mg/L, indicating potential concern about oxygen availability and organic pollution. The water was acidic (pH 4.1–4.6), which the source associates with the local peat-swamp setting, although local background conditions and the applicable regulatory interpretation should be confirmed. The source's capacity assessment indicates exceedances for TSS and BOD, but its numerical load calculations contain inconsistencies and should be recalculated before quantitative values are used for management decisions. Priority actions are to verify laboratory and discharge data, repeat monitoring across seasons, investigate potential sources of suspended solids and organic matter, and improve control of waste discharges into the river.

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