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THE INFLUENCE OF ANTHROPGENIC ACTIVITIES ON THE WATER AND SEDIMENT QUALITY INDEX IN THE KRUENG BARO RIVER FLOW IN PIDIE REGENCY

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ABSTRACT

In the Pidie Regency area in general, there are still problems with its watershed (DAS), namely pollution due to domestic and non-domestic waste disposal and illegal mining which is part of the population's activities (anthropogenic) which continues to increase as a form of the population's efforts to meet their needs. In PIDIE District the watershed consists of the Teunom River Watershed, the Baro River Watershed, and the Krueng Baro River Watershed. With the increasing anthropogenic activity in the Watershed in PIDIE Regency, especially in the Kreung Baro River Watershed, this indicates the need to take action through the identification, mapping and assessment of the Watershed as an important effort to prevent further pollution and decrease water quality and sedimentation. This study uses the Pollution Index (PI) method so that the quality of water in the watershed will be easily controlled and in accordance with water quality standards and in accordance with what has been set by the government. and the Sediment Quality Guidelines (SQGs) method which can determine the appropriate levels in sediments in the watershed. The water quality of the Krueng Baro River, Pidie Regency using the Pollutant Index (PI) method with a value of 3.8062 for drinking water designation (class 1) is moderately polluted, different when compared to data obtained from the Aceh Provincial Government in 2022 with a value 2.5496 classified as moderately polluted. The water for agricultural purposes (class IV) with a value of 0.4569 is classified as fulfilling the water quality standard requirements. Likewise, the data carried out by the Government of Aceh with a value of 0.2848 is classified as fulfilling the water quality standard requirements for agriculture. Sediment quality in Krueng Baro, Pidie Regency with data processing using the Sediment Quality Guidelines (SQGs) method with a value of 0.0002, this value is the same as the value carried out by the Aceh Provincial Government, which is classified as a moderate negative effect of heavy metals on biota.

KEYWORDS: Kreung Baro River, Anthropogenic, PI Method, SQGs Method

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1. INTRODUCTION

Pidie Regency has several watersheds consisting of watersheds, one of which is the Krung Baro River. This river has a flow capacity of more than 250 liters/second. Several rivers in Pidie Regency are currently used for various daily needs and also as a source of raw water, one of which is the Krung Baro River (RPJM Pidie Regency, 2019).

With the population growth of Pidie Regency which continues to increase and the development of its utilization for households, fishery business activities, agricultural business activities, livestock business activities, and tourism business activities. However, on the other hand, the lack of public awareness has resulted in the river still being a place for household and industrial waste disposal, this has resulted in changes in the condition and quality of water in the Pidie River Basin (DAS). This makes the river directly or indirectly as a necessity of life and as a place for waste disposal, both household and industrial waste

Domestic, industrial and agricultural waste will affect the existence of river environmental components. An example is the indication of the influence of tofu and sago factory waste disposal activities in the Krung Baro watershed in 2020 which is suspected to be the cause of death of aquatic biota due to pollution of tofu and sago factory waste. allegedly related to illegal gold mining activities in the area, as well as pollution of the Krueng Baro River water related to sand and stone mining activities.

Then the presence of potential mineral resources in the Krueng Baro River Basin in the form of illegal group C minerals such as sand and stone (sirtu) which are currently being mined using heavy equipment, has had an impact on river sedimentation. The uncontrolled excavation C mining activity has resulted in erosion on the outskirts of the Krueng Baro River Sub-watershed. In the Krueng Baro watershed in the Pidie district, the presence of various human activities has changed the condition of the water so that it cannot be reused adequately by residents who use it daily.

2. Formulation of the problem

Based on the background and formulation of the problems that have been stated above, the objectives of this research are:

1. Identify the water quality index of the Krueng Baro River Basin in Pidie District using the Pollution Index (PI) method.
2. Identifying the sediment quality index of the Krueng Baro River Basin in Pidie District using the Sediment Quality Guidelines (SQGs) method.
3. Comparing Primary data and Secondary data obtained from the local government.

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3. Problem Boundary

So that the discussion of the problem can be more on target, the author provides the following limitations:

1. The scope of research is only on water and sediment quality
2. The data used for comparison is data from the Provincial Government

4. Literature review

4.1 Watershed

Watershed (DAS) is the harmony of living things where there is a series of cooperation between biotic, non-biotic and human variables. In addition, according to Law Number 37 of 2012 concerning Administration of Watersheds (DAS) it is stated that a Watershed (DAS) is a land area which is a unit with waterways and their sources. obtained from rainfall into the lake or into the sea.

4.2 Water Quality

Water quality is an idea about water and living things, matter, energy or different parts in water. Water quality can be known by investigating or testing synthetic, physical and natural boundaries or appearance tests (smell and shade). Here are some of the boundaries that can be investigated:

1. Synthetic limits include: Body, COD, Ph, DO, Nitrate, sulfate, all out phosphate, Pb, Cu, and Hg.
2. Actual limits include: shade, aroma, turbidity, temperature, TDS and TSS.
3. Natural boundaries include: organic entities and microorganisms in water.

4.3. Quality Standards for Water Quality

Surface water quality depends on the environment, but is expected to support the life of aquatic animals, support their lives, and add aesthetic value. The water quality criteria underlying this classification are based on the degree of good water quality and its potential for use in certain beneficial water applications. Most surface waters are usually classified by purpose. Basins are complex megasystems containing physical, biological and human systems that interact to form an integrated ecosystem.

4.4. Water Quality Parameters

Quality monitoring really needs to be done so that the quality of the river is maintained from the risk of pollution that occurs both naturally and as a result of anthropogenic activities. This monitoring is carried out in accordance with the water quality standards contained in Government Regulation Number 82 of 2001 related to this matter, so in this study there were 10 (ten) parameters that were used as data references.

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4.5. Pollution Index (PI)

Climate Pastor Announcement Strategy No. 115 of 2003 concerning Pollution Records (PI), the costs of PIj are not fully resolved in the following way (Nemerow and Sumitomo, 1970):

1. A boundary is selected that if the cost of the border is low, the water quality will rise to the next level.
2. Selected Convergence standard limits values that have no range.
3. Cj/Lij values are determined for each inspection area, in three ways, specifically.

Table 4.1 Pollution Index (PI) Criteria

No	Pollution Index Criteria (PI)	Information
1	0 ≤ PI ≤ 1,0	Meets Quality Guidelines (Great)
2	1,0 ≤ PI ≤ 5,0	Highly Contaminated (Slightly Dirty)
3	5,0 ≤ PI ≤ 10	Completely Contaminated
4	PI ≥ 10,0	Heavily Contaminated (Very Dirty)

Source: Minister of State Decree LH No. 115, 2003

4.6. Sediment Quality Guidelines Method (SQGs)

The Sediment Quality Guidelines (SQGs) method for this price can be determined in the following way (Fairey et al., 2001):

Parameters are selected if the price of the parameter is low then the water quality will improve. PEL-Qi values were calculated for each parameter at each sampling location by means of:

Table 4.2 Quality Guidelines Criteria (SQGs)

No	Pollution Index (PI)	Information
1	SQG-Q<0,1	Adverse consequences of heavy metals on biota. The low one
2	0,1< SQG-Q<1	Adverse effects of heavy metals on moderate biota
3	SQG-Q≥1	Adverse consequences of heavy metals on high biota

Source: Minister of State Decree LH No. 115, 2003

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5. Data Collection and Processing

5.1 Pollution Index Calculation (PI)

In this study there were 6 parameters to be taken consisting of pH, TDS, TSS, COD, DO and BOD. After testing each water parameter taken at each point, primary data is obtained as can be seen in table 4.1 below:

Table 4.1 Water Quality Parameter Data for the Kreung Baro River, Pidie Regency

Parameter	upstream	Middle	Downstream
pH	7,32	7,37	7,39
TDS	92,68	103,1	114,40
TSS	221,8	217,6	334,6
COD	6,40	11,2	9,60
DO	6,59	6,85	6,70
BOD	5,07	2,84	5,28

Information:
pH = Degree of acidity or alkalinity
TDS = The amount of solute dissolved in water
TSS = Suspended solids in water
COD = Oxygen needed by water
DO = Oxygen contained in water
BOD = The amount of oxygen in the water

The secondary data for testing water quality parameters reported by the Province of Aceh in 2022 include pH, TDS, TSS, COD, DO, and BOD which can be seen in table 4.2 as follows:

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Table 4.2 Water Quality Parameter Data for the Kreung Baro River Regional Office for Sumatra 1 Aceh

Parameter	upstream	Middle	Downstream
pH	7,20	8,29	7,97
TDS	95,58	126,1	101,3
TSS	17	20,6	34,0
COD	10,20	11,89	40,78
DO	7,28	7,38	7,53
BOD	1,89	1,3	3,19

Source: Sumatra River Basin 1 Aceh Province Hydrology and Water Quality unit

Based on the calculation of the PI in accordance with the Decree of the state minister for the Environment Number 115 of 2003, the calculated value of the PIj for Class I water quality standards for drinking water at each sample point is as follows:

Based on the calculation of the PI in accordance with the Decree of the State Minister for the Environment Number 115 of 2003, the calculated value of the PIj for Class I water quality standards for drinking water at each sample point is as follows:

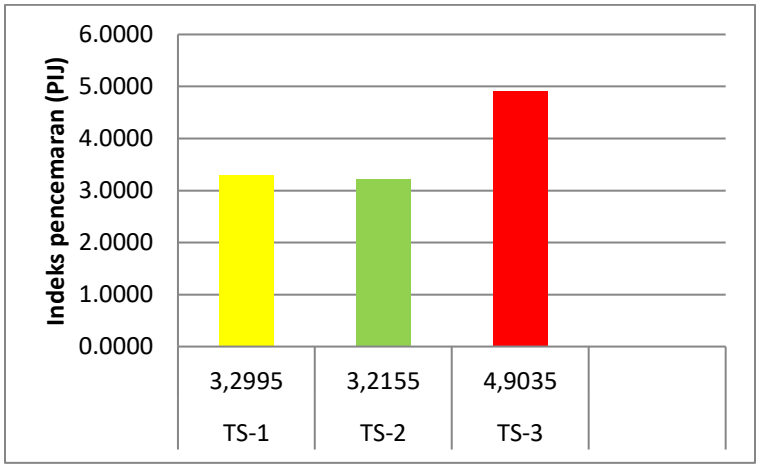

Figure 4.10 Calculation of Class I Water Quality PIj (Lab Results)

Based on the calculation of the PI in accordance with the Decree of the State Minister for the Environment Number 115 of 2003, the calculated value of the PIj for Class I water quality standards for drinking water at each sample point is as follows: based on data obtained from the Aceh Provincial Government, which we can see in the following table:

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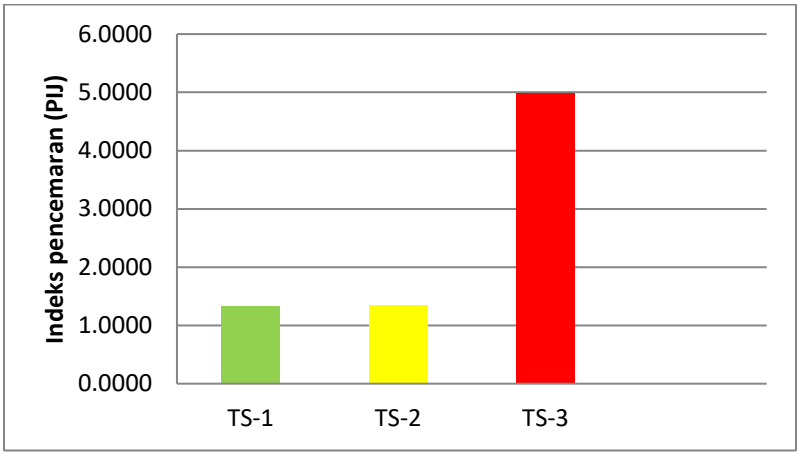

Figure 4.11 Calculation of Class I Water Quality PIj Aceh Provincial Government

Based on Figure 4.11 above, the PIj calculation based on the results of data carried out in the Laboratory at the upstream point obtained a value of 1.3268 which is in the group of slightly polluting pollutants. Whereas at the midpoint with a value of 1.3423 is a slightly polluting group, the downstream point also has a value of 4.9798 which is classified as a slightly polluted group as well.

Based on the calculation of the PI in accordance with the Decree of the State Minister for the Environment Number 115 of 2003, the calculated value of the PIj for Class IV water quality standards for drinking water at each sample point is as follows:

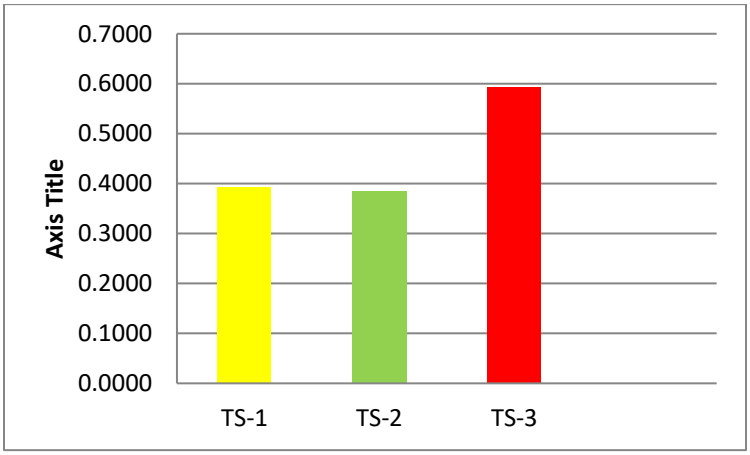

Figure 4.12 Calculation of Class I Water Quality PIj (Lab Results)

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Based on Figure 4.12 above, the PIj calculation based on the results of data carried out in the Laboratory at the upstream point obtained a value of 0.3922 which is in the good and good group for agricultural water. Whereas at the midpoint with a value of 0.3847 is a good group to use as agricultural water, the downstream point results also have a value of 0.5937 belonging to the good group to use as agricultural water.

Furthermore, the PIj calculation is based on data obtained from the Aceh Provincial Government, which we can see in the following table:

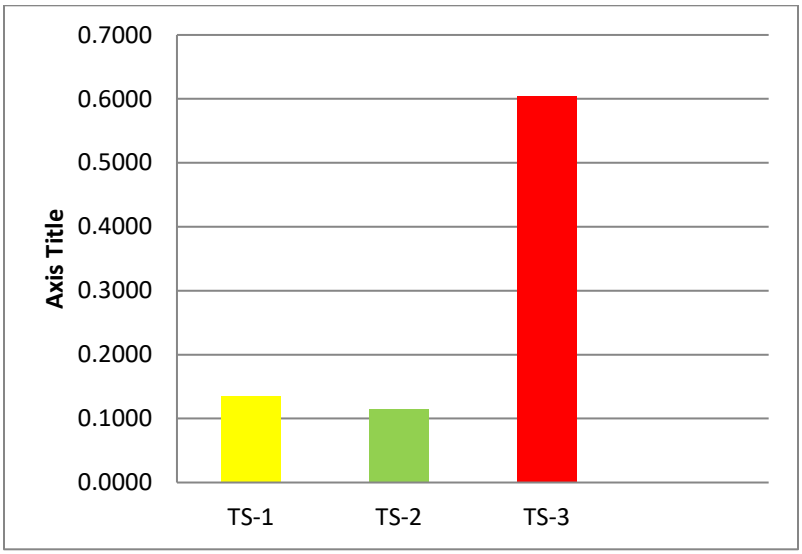

Figure 4.13 Calculation of Class IV Water Quality PIj Aceh Provincial Government

Based on Figure 4.13 above, the PIj calculation based on the results of data carried out in the Laboratory at the upstream point obtained a value of 0.1352 which is in the good and good group for agricultural water. Whereas the midpoint with a value of 0.1144 is a group that is good for use as agricultural water, the downstream point results with a value of 0.6048 are classified as good for use as agricultural water.

5.2 Calculation of Sediment Quality Guidelines (SQGs)

Heavy metal concentrations in sediments will always be higher when compared to heavy metal concentrations in waters. This is because heavy metals have properties that easily bind organic matter and settle to the bottom of the waters, then they will merge with Hutagalung sediments (1991) in Paramita, et al., (2017). Increased levels of heavy metals in waters will result in heavy metals that were previously needed as a metabolic process that can turn toxic to aquatic organisms. Heavy metals will accumulate in

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sediments and biota through gravity processes, besides that according to Nurula (2015) currents are an important factor in the distribution of heavy metals in waters. Current speed is affected by the depth and width of the river, the current will be faster if the waters are narrower and shallower. Sediment with a muddy texture will bind heavy metals more easily. The deposition of heavy metals in suspended sediments will certainly affect the quality of the sediment and the bottom of the waters as well as the surrounding waters. The results of the SQG-Q calculations for this study are listed in the Appendix with the graphs shown in the following figure:

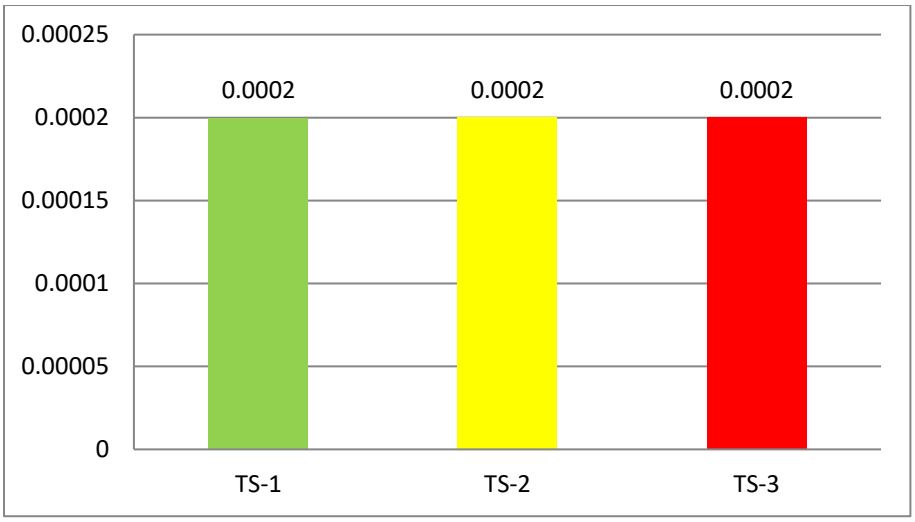

Figure 4.20 Calculation Results SQG-Q

5.3 Atropogenic effects on water quality

The occurrence of pollution in the river is certainly caused by the life around it both in the river itself and anthropogenic activities as users. The dominant effect of pollution that is very visible is the damage caused by humans in quantity depending on their lifestyle. Every riverbank that is densely populated with settlements, it is certain that the canals leading to the river body will be seen (Sukadi, 1999).

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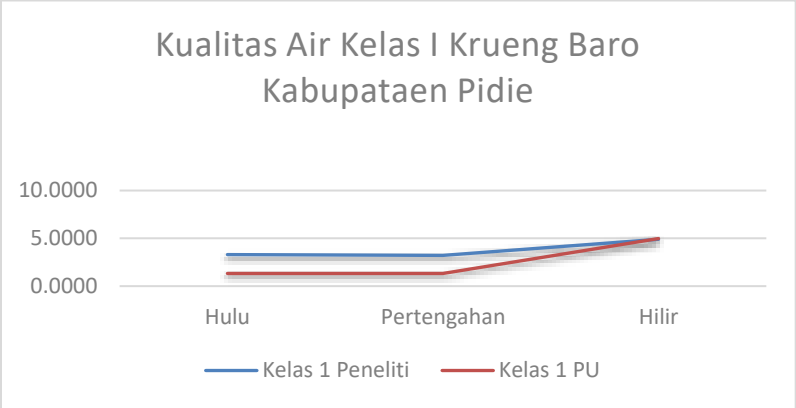

Figure 4.21 Comparison Results of Class I PI Calculations

From the data in Figure 4.21, we can conclude that class 1 water quality for Kreung Baro is not suitable for use as a source of drinking water because it does not comply with the water quality standards that have been set based on Government Regulation of the Republic of Indonesia Number 22 of 2021 concerning Implementation and Management of the Environment. And from the data we can also conclude that there is an increase in pollution, especially in the upstream and mid-points, while in the downstream areas it is still relatively the same, this is due to anthropogenic pollution around the upstream to mid-points.

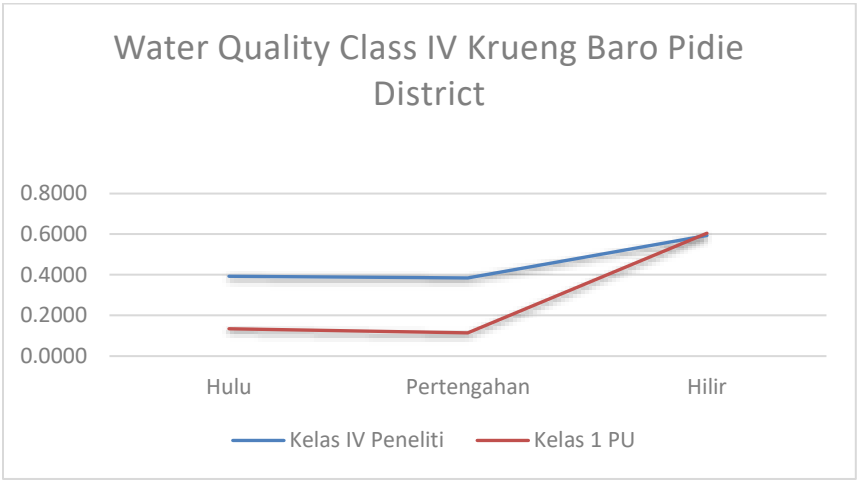

Figure 4.22 Comparison Results of Class IV PI Calculations

From the data in Figure 4.22, we can conclude that class IV water quality for Kreung Baro is not suitable for use as a source of drinking water because it does not comply with the water quality standards that have

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been set based on Government Regulation of the Republic of Indonesia Number 22 of 2021 concerning Implementation and Management of the Environment. However, the quality of Krueng Baro's water is still suitable for use as agricultural water. And from the data we can also conclude that there is an increase in pollution from upstream points, midpoints, and downstream points, there are still not many changes in both the data from this research and the data conducted by the Provincial Government of Aceh. This is due to anthropogenic pollution around the river, not much change in its activities.

5.4 Atropogenic Effects on Sediments

Increased anthropogenic activities around the Krueng Baro river flow will cause heavy metal levels in the waters which will result in heavy metals that were previously needed as metabolic processes to turn into poisons for aquatic organisms. Heavy metals will accumulate in sediments and biota through gravity processes, besides that according to Nurula (2015) currents are an important factor in the distribution of heavy metals in waters.

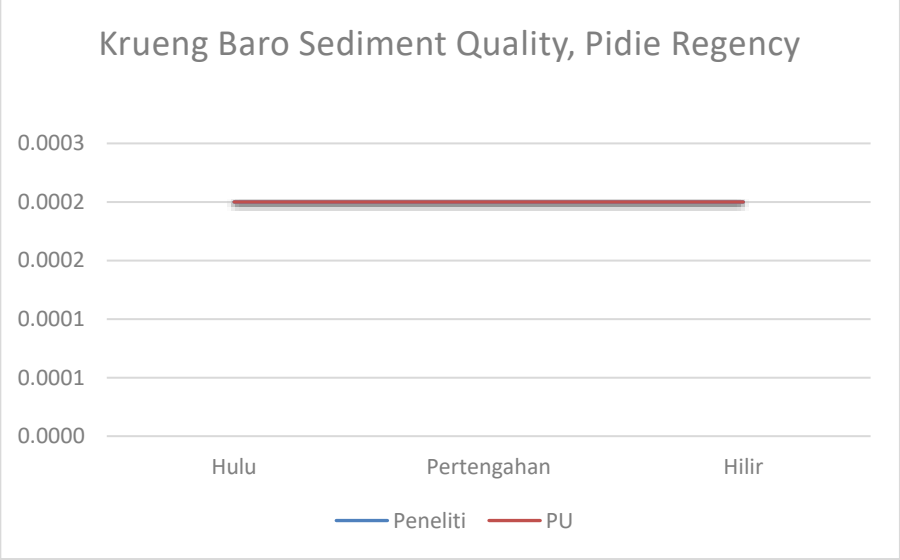

Figure 4.22 Calculation Comparison Results SQG-Q

In the picture above, we can both the data generated from the research and the data obtained from the Government of Aceh, which are relatively the same, starting from the upstream, mid-point, and downstream points, obtaining a SQG-Q value of 0.0002, which is classified as a negative effect of heavy metals on biota. moderate, that means there is not much anthropogenic pollution around the Krueng Baro stream, Pidie Regency.

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5. CONCLUSION

Based on the data and discussion in this study, it can be concluded as follows:

1. The water quality of the Krueng Baro River in Pidie Regency using the Pollutant Index (PI) method with a value of 3.8062 for drinking water designation (class 1) is moderately polluted, different when compared to data obtained from the Aceh Provincial Government in 2022 with a value of 2.5496 classified as moderately polluted. The water for agriculture purposes (class IV) with a value of 0.4569 is classified as fulfilling the water quality standard requirements. Likewise, the data carried out by the Government of Aceh with a value of 0.2848 is classified as fulfilling the water quality standard requirements for agriculture.
2. Sediment quality in Krueng Baro, Pidie Regency, with data processing using the Sediment Quality Guidelines (SQGs) method with a value of 0.0002, this value is the same as the value carried out by the Aceh Provincial Government, which is classified as a negative effect of heavy metals on moderate biota. It is still controlled anthropogenic activities around the Krueng Baro river flow.

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