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Impact of Hydroelectric Power Plant Construction on Water Quality and Socio-Economics in Kerinci Regency

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Abstract
Introduction: *The construction of Hydroelectric Power Plant (PLTA) in Kerinci Regency is part of the fulfillment of renewable energy needs that offer clean and sustainable energy solutions, but the impact on the environment and society needs to be assessed in terms of water quality, economy and society around the project.y.* ***Objective:*** *This study aims to conduct a study related to the impact of hydroelectric power plant construction on water quality and socio-economics in Kerinci Regency.* ***Method:*** *descriptive quantitative approach with primary data from water quality measurements and community surveys. The water parameters tested include TSS, temperature, pH, DO, COD, BOD, and turbidity. Socio-economic analysis was conducted through questionnaires to 30 respondents, and statistical tests using Wilcoxon to determine significant differences before and after the construction of the PLTA.* ***Result and Discussion:*** *All water quality parameters meet class II quality standards, some even meet class I. The DO value is also above the minimum limit, indicating that the quality of dissolved oxygen remains good. From the socio-economic aspect, there was a significant change in the number of farmers and entrepreneurs decreased, while the number of employees increased drastically. Community income also increased significantly from before to after construction, and the results of the Wilcoxon test showed a significant difference (p <0.05).* ***Conclusion:*** *the construction of the hydroelectric power plant does not reduce water quality because all parameters are still within the established quality standards and has a significant positive socio-economic impact.*

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Introduction

Humans are creatures that cannot be separated from energy, including electrical energy. Human needs for electrical energy are also increasing due to the increasing human population and human lifestyle, but on the other hand the supply of electricity, especially in Indonesia, is also decreasing. This is based on evidence of the discovery of rotating electricity in the regions as an effort to save electricity. (Pangemanan et al., 2024). Based on the dwindling electricity supply, countries with relatively high average rainfall certainly have very large water resources that may be able to overcome some of the existing electricity problems, especially in Indonesia. The problem of electrical energy and the abundance of water resources in Indonesia is a problem and a solution that can be engineered. Utilizing water resources as a Hydroelectric Power Plant (PLTA) can be realized in order to obtain electricity supply for areas that have difficulty obtaining it. (Pratama et al., 2023).

One of them is Jambi Province which is currently supplied from the Sumbagselteng interconnection system through a 150 kilovolt (kV) transmission line with the highest peak load in 2020 of 385 megawatts (MW). Fulfilling the need for electricity requires the construction of generating, transmission and distribution facilities by considering the potential of local primary energy sources. Jambi Province has the potential for primary energy sources consisting of 2228.3 million stock tank barrels (MMSTB) of petroleum, natural gas of around 5,517.8 billion cubic feet (BCF), coal of around 2,224.9 million tons, minihydro and microhydro potential of around 477 megawatts (MW).

Fulfillment of the electricity needs requires the construction of generating, transmission and distribution facilities by considering the potential of local primary energy sources. Jambi Province has the potential of primary energy sources consisting of 2228.3 million stock tank barrels (MMSTB) of petroleum, natural gas of around 5,517.8 billion cubic feet (BCF), coal of around 2,224.9 million tons, mini-hydro and micro-hydro potential of around 477 megawatts (MW). The hydroelectric power plant in Jambi Province is located in Kerinci Regency, Jambi Province, Indonesia, which is already running and 80% is almost complete. The project area is 377 km from Teluk Bayur Port, and around 400 km from Jambi, the capital of Jambi Province.

The hydroelectric power plant utilizes the discharge of the Merangin River and Lake Kerinci. As the second largest watershed in Indonesia, the Batanghari watershed has an area of around 4.5 million hectares located in Jambi Province and 18% in West Sumatra Province. (Utami et al., 2018). The Batanghari watershed is divided into several sub-watersheds, one of which is the Batang Merangin - Tembesi watershed, which is the largest watershed of the Batanghari watershed with an area of 13,718.54 km2 which flows through five districts, namely Kerinci, Sarolangun, Merangin, Batanghari and Tebo districts. (Ilfan & Arwin, 2019). The average discharge of the Merangin River is 59.4 m3/second. Hydroelectric power plants must be built only from new equipment and materials.

The power plant will be equipped with 4 (four) generating units, consisting of a turbine with a capacity of 89.3megawatt MW Vertical Francis Turbine, Main Transformer 16.5 / 150 kilovolt (kV). The electric power generated by the power plant is distributed through a 150kilovolt transmission line. A 150kilovolt line with a total length of approximately 2.5 km was built from the power plant transfer center to the existing 150 kilovolt transmission line from the nearest PLN grid system in this part of Jambi Province. The 150kilovolt power plant switch yard and related transmission lines connected to PLN's 150 kilovolt Power Grid System are designed and built to accommodate the power generated by the Power Plant. Based on the existing potential, the realization of the electric power load can be done with a power plant project such as a hydroelectric power plant. The use of hydroelectric power plants as a renewable energy source has significant advantages compared to other energy sources. First, water is a renewable resource with a natural rain cycle, thus ensuring long-term availability. Second, unlike fossil fuels, hydropower does not produce greenhouse gas emissions during operation, making it an environmentally friendly solution to climate change. However, hydropower development is not without challenges. (Pratama et al., 2023).

Hydroelectric power is one of the clean and mature renewable energy (ET) technologies among other renewable energy technologies that have extraordinary potential globally. In 2020, Hydroelectric Power contributed 58.3% of the total other renewable energy in the generation sector. The household sector is the largest electricity demand, followed by industry and business. The increase that occurred in 2011 compared to 2020 was 54.3%(Nurfaida et al., 2024). All development activities basically have an impact on the environment, both positive (beneficial) and negative (harmful) impacts.(Doni Prasetyo & Alimuddin, 2018). Just as the construction of a hydroelectric power plant has positive and negative impacts on the community in whose area the hydroelectric power plant is built, among others, it encourages economic growth for the surrounding community, such as adding new jobs for the community. For example, people who used to work as farmers can work at the hydroelectric power plant.(Kayupa, 2019).

(Pangemanan et al., 2024) Hydropower does contribute to achieving renewable energy targets and supporting water/energy supply security. On the other hand, hydropower is also responsible for ecosystem damage, especially when barriers block natural river flows with ecological, hydrological and morphological consequences. (Tria Melati et al., 2022). Environmental damage and low public awareness of the importance of protecting the environment encourage the need for concrete and systematic implementation of sustainable development. Environmental damage occurs due to the high level of exploitation of natural resources to meet economic interests without being accompanied by awareness of protecting the environment. (Allifah et al., 2023).

The environmental implications of dam construction, for example, can affect freshwater ecosystems, alter river flow patterns, and potentially affect communities that depend on those rivers. Therefore, it is important for planners and developers to consider the environmental and social impacts of any hydropower project. From an environmental perspective, dam construction can distort natural ecosystems. The creation of large reservoirs can block fish migration, alter wildlife habitats, and even cause forests to be flooded, which can then produce methane as vegetation decomposes.(Pratama et al., 2023) The construction of this hydroelectric power plant is one of the government's programs to improve the welfare of its people. However, this has actually caused conflict among the people because of different assumptions in responding to this, such as the loss of livelihoods due to the loss of land, so that the community is pro and con with this government program. This is because before the hydroelectric power plant construction plan was carried out based on previous research conducted by Padang State University in 2014 related to Kerinci Lake water, Batang Merangin water and clean water, it was known that the water quality parameters, namely TSS, temperature, COD, exceeded the water quality standards and only the BOD, PH and DO parameters did not exceed the quality standards.

In addition, the impact of the construction of the hydroelectric power plant that has reaped pros and cons from the community by looking at it from different perspectives. The pro community sees that with the hydroelectric power plant, they will feel prosperous, safe, and even enjoy unlimited electricity. While the anti-community sees the impact that will be caused. The social and economic impacts of the construction of the hydroelectric power plant in Kerinci Regency are that some people lose their land, there are complaints, doubts and concerns from the community to PT. Kerinci Merangin Hidro because of the possibility of a decrease in water quality, because this construction requires a lot of water, and other impacts that occur are the emergence of social jealousy due to the number, composition and specifications of the workforce needed and the desire to work from the community in carrying out the construction of the Kerinci Regency hydroelectric power plant.

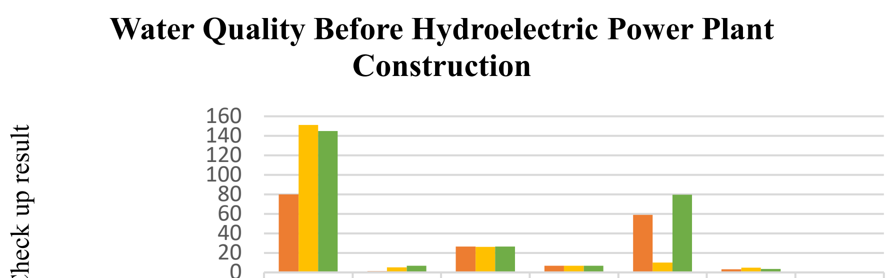
Development is the responsibility of the government that must be carried out for the public welfare. Therefore, in terms of information or socialization for each project plan, the government or company honestly and openly conveys to the public what economic, social, political and environmental impacts will be felt by the community. Development also needs to pay attention to existing environmental conditions, from the physical side (soil, water, air), biotic (flora, fauna), and culture (culture, interaction between humans). Environmental quality conditions will tend to continue to decline if not balanced with the concept of sustainable development planning in an effort to preserve existing environmental functions (Warlina, 2019). Based on this, it is urgent to conduct a study related to the impact of hydroelectric power plant construction on water quality and socio-economics in Kerinci Regency.

Method

The research method used is quantitative with a descriptive design. The population in this study were all areas passed by the Hydroelectric Power Plant (PLTA) construction project in Kerinci Regency, both for the surrounding community and the user community. The population in this study was the Muara Hemat Village and Batang Merangin Village areas totaling 720 families. In terms of water quality, sampling was carried out at the Kerinci Lake outlet location (02 ° 07'29.2 "S, 101 ° 31'33.6" E), then at the dam outlet (02 ° 08'08.2 "S, 101 ° 31'23.2" E) and the tailrece outlet (02 ° 08'06.9 "S, 101 ° 31'34.5 "E) sampling was carried out every three months by PT. Jambi Lestari Internasional. While in terms of socio-economic aspects, the number of samples in this study was 30 respondents. In this study, the environmental quality aspect uses secondary data taken from the results of the environmental laboratory of PT. Jambi Lestari Internasional, while the socio-economic aspect uses primary data collected directly by researchers by distributing research questionnaires to 30 respondents.

Results and Discussion

Based on previous research conducted by Padang State University in 2014 related to Kerinci Lake water, Batang Merangin water and clean water from the community, it is known that the water quality parameters, namely TSS and COD, exceed the water quality standards and only the BOD, Temperature, PH and DO parameters do not exceed the quality standards. This indicates that there is damage to water quality. The following is a comparison of water quality before the construction of the hydroelectric power plant.

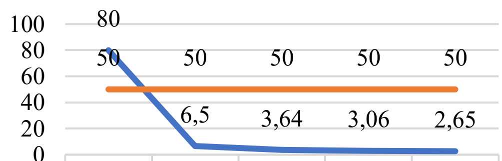


	TSS	Kekeruhan	Suhu	pH	COD	DO	BOD
Outlate Danau Kerinci	80	1,4	26,6	6,85	58,9	3,1	0,1
Outlate Bendungan	151	5,1	26,2	6,85	10,2	4,8	0,52
Outlate Tailrace	145	6,8	26,6	6,85	79,6	3,4	0,16

Figure 1 Water Quality Before Hydroelectric Power Plant Construction
Source: Processed Secondary Data of Padang State University, 2014

Based on the graph above, it shows that before the construction of the hydroelectric power plant, each water quality parameter, namely TSS, turbidity, temperature, COD, DO exceeded the water quality standards, while the BOD parameter did not exceed the quality standards. However, after the construction of the hydroelectric power plant, the results of the comparison of water quality before and after the construction of the hydroelectric power plant can be seen as follows:

Total Suspended Solid **(TSS)** are solids suspended in water, in the form of organic and inorganic substances. TSS can be in the form of sand, mud, clay, phytoplankton, zooplankton, bacteria, fungi, and other particles. The results of TSS measurements from the initial hue to the time of construction in 2024 can be seen as follows:



	2014	2021	2022	2023	2024
TSS	80	6,5	3,64	3,06	2,65
Baku Mutu	50	50	50	50	50

Figure 2 Comparison Graph of TSS Parameter Concentration Values from Initial Hue to Construction at Kerinci Lake Outlet

Based on Figure 2 above, it can be seen that the results of TSS measurements at the Kerinci Lake outlet when starting the construction of the regulating weir in 2021 until the construction until 2024 did not show any significant difference. The TSS value decreased in 2021 compared to the initial hue where the TSS value at the initial hue was 80 mg/l, this was caused by illegal sand mining that occurred in the upper reaches of the Siulak River and around Lake Kerinci. This shows that the presence of regulating weir based on TSS parameters does not have a negative impact on water quality.

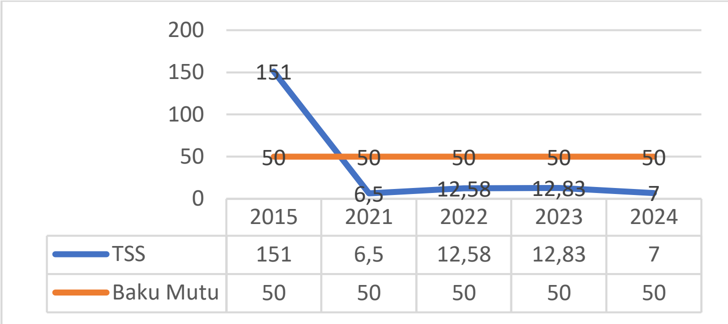


Figure 3 Comparison Graph of TSS Parameter Concentration Values from Initial Hue to Construction at the Dam Outlet

Based on Figure 3 above, it can be seen that the results of TSS measurements at the dam outlet before the construction of the regulating weir (2021) until the construction until 2024 did not show any significant difference. If a comparison is made at the time of the initial hue and when the construction activity was carried out, there was actually a decrease, although in 2022 to 2024 there was a fluctuation in the TSS value where in 2022 it was 12.58 mg/l, 2023 12.83 mg/l, and in 2024 7 mg/l where the TSS value in 2024 decreased compared to the initial hue. This shows that the presence of regulating weird based on TSS parameters does not have a negative impact on water quality.

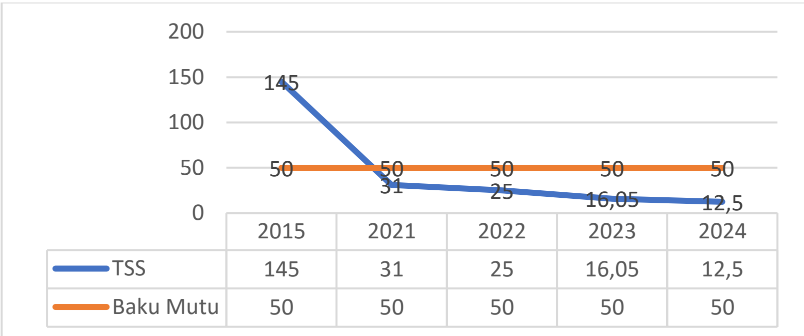


Figure 4 Comparison of TSS Parameter Concentration Values from Initial Hue to Construction at Tailrace Outlet

Based on Figure 4 above, it can be seen that the results of TSS measurements at the Tailrace outlet before the construction of the regulating weir (2021) until the construction until 2024 did not show any significant difference. If a comparison is made at the time of the initial hue and when the construction activity was carried out, there was actually a decrease, although in 2022 to 2024 there was a fluctuation in the TSS value where in 2022 it was 25 mg/l, 2023 16.05 mg/l, and in 2024 12.5 mg/l where the TSS value in 2024 decreased compared to the initial hue. This shows that the presence of regulating weird and dams based on TSS parameters does not have a negative impact on water quality.

Turbidity, the results of measuring the Turbidity parameters from the initial hue to the time of the 2024 Reguleting Weir construction can be seen as follows:

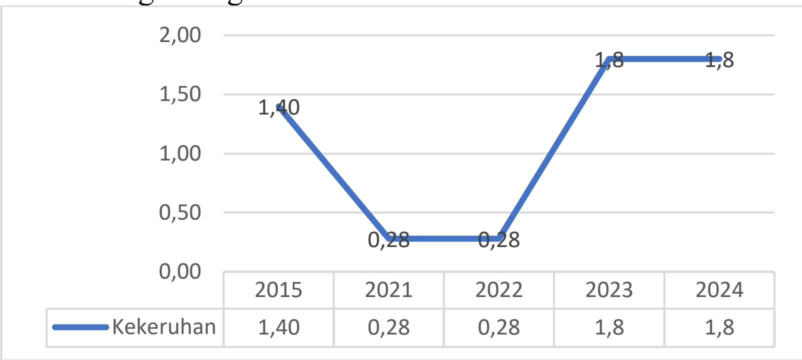


Figure 5 Comparison of Turbidity Parameter Concentration Values from Initial Hue to Construction at the Kerinci Lake Outlet

Based on Figure 5 above, it can be seen that the measurement results carried out from the initial hue to 2024 at the Kerinci Lake Outlet show turbidity at a safe value to enter class II quality standards. The turbidity value at the initial hue was 1.40 NTU, then decreased in 2021 to 0.28 NTU, which is the same value obtained in 2022. In 2023 the turbidity value increased to 1.8 NTU and was the same as in 2024.

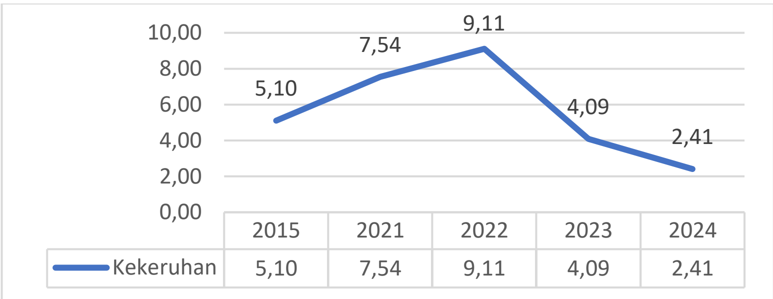


Figure 6 Comparison of Turbidity Parameter Concentration Values from Initial Hue to Construction at the Dam Outlet

Based on Figure 6 above, it can be seen that the measurement results carried out from the initial hue to 2024 at the Dam Outlet show turbidity at a safe value to enter class II quality standards. The turbidity value at the initial hue was 5.1 NTU, then increased in 2021 to 9.11 NTU, in 2022 to 9.11 NTU and continued to decrease, namely in 2023 4.09 NTU and 2024 with a value of 2.41 NTU.

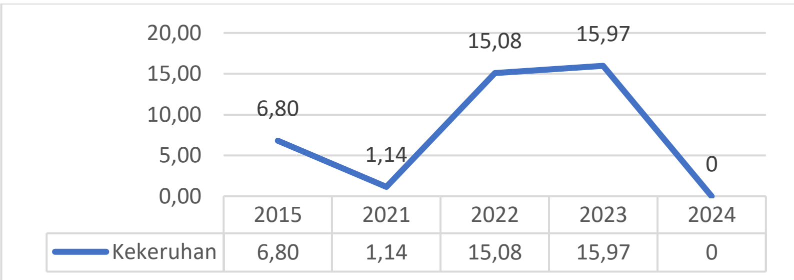


Figure 7 Comparison Graph of Turbidity Parameter Concentration Values from Initial Hue to Construction at Tailrace Outlet

Based on Figure 7 above, it can be seen that the measurement results carried out from the initial hue to 2024 at the Tailrace Outlet show turbidity at a safe value to enter class II quality standards. The turbidity value at the initial hue was 6.8 NTU, then decreased in 2021 to 1.14 NTU, in 2022 there was an increase to 15.08 NTU and in 2023 to 15.97 and there was a significant decrease in 2024 to 0 NTU.

Temperature is one of the factors for the sustainability of chemical and biological processes in water. Based on temperature measurements from the initial hue to the construction period of Reguleting Weir 2024, the temperatures showed different but not too far apart. This is influenced by the season factor when sampling, the ambient air temperature, and sunlight exposure when sampling. According to the provisions of the class II water quality standards in PP No. 22 of 2021, the water temperature has a deviation of 3 (25 - 31 oC) from the ambient air temperature. Based on the results of temperature measurements from the initial hue to the 2024 construction at the regulating weir, the results are in accordance with the quality standards in the range of 28 - 30 oC and can be seen as follows:

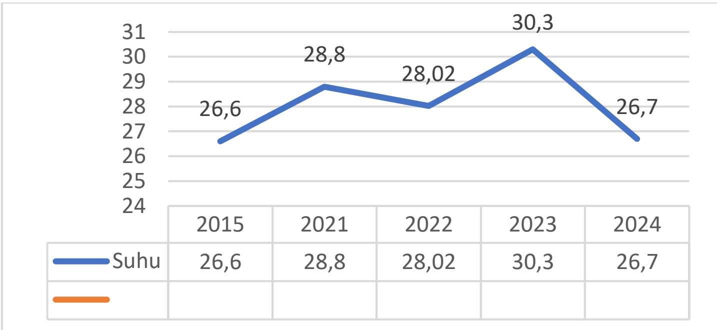


Figure 8 Comparison of Temperature Parameter Concentration Values from Initial Hue to Construction at the Kerinci Lake Outlet

Based on Figure 8 above, it can be seen that the measurement results carried out from the initial hue to 2024 at the Kerinci Lake Outlet show the temperature at a safe value to enter the class II quality standard. The temperature at the initial hue was 26.6 oC, then there was an increase in 2021, namely 28.8oC and a decrease in 2022, namely 28.02 oC and there was another increase in 2023, namely 30.3 oC and there was a decrease that was not too significant, namely 26.7 oC. This shows that the difference in temperature from the initial hue to 2024 is still in accordance with the provisions of the class II water quality standard in PP No. 22 of 2021, the water temperature has a deviation of 3 (25 - 31 oC).

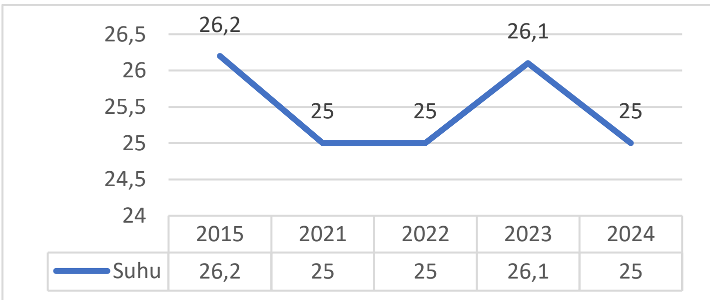


Figure 9 Comparison of Temperature Parameter Concentration Values from Initial Hue to Construction at the Dam Outlet

Based on Figure 9 above, it can be seen that the measurement results carried out from the initial hue to 2024 at the Dam Outlet show the temperature at a safe value to enter the class II quality standard. The temperature at the initial hue was 28.2 oC, then decreased in 2021, namely 25 oC and decreased again in 2022, namely 25 oC and increased again in 2023, namely 27.6 oC and there was an increase that was not too significant, namely 26.1oC in 2023 and decreased again to 25 oC in 2024. This shows that the temperature difference from the initial hue to 2024 is still in accordance with the provisions of the class II water quality standard in PP No. 22 of 2021, the water temperature has a deviation of 3 (25 - 31 oC).

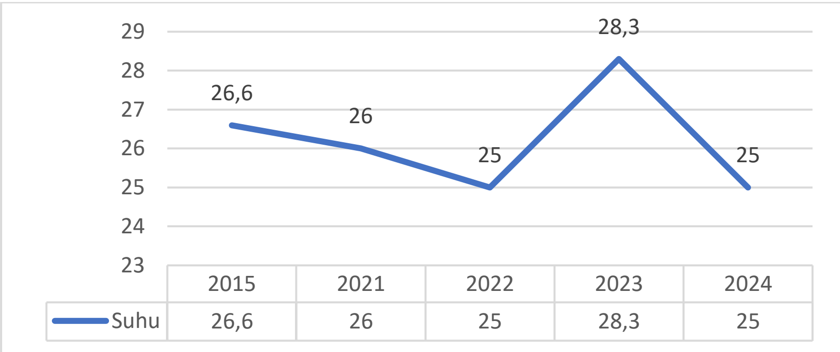


Figure 10 Comparison of Temperature Parameter Concentration Values from Initial Hue to Construction at the Tailrace Outlet

Based on Figure 10 above, it can be seen that the measurement results carried out from the initial hue to 2024 at the Tailrace Outlet show the temperature at a safe value to enter the class II quality standard. The temperature at the initial hue was 26.6oC, then decreased in 2021 to 26 oC and decreased again in 2022 to 25 oC and increased again in 2023 to 28.3 oC and decreased again to 25oC. This shows that the temperature difference from the initial hue to 2024 is still in accordance with the provisions of the class II water quality standard in PP No. 22 of 2021, the water temperature has a deviation of 3 (25 - 31 oC).

pH, The degree of acidity or pH describes the potential activity of hydrogen ions in a solution expressed as the concentration of hydrogen ions (mol/l) at a certain temperature. The degree of acidity of the water also affects the resistance of organisms, where low pH will disrupt the absorption of oxygen by organisms, a good pH level is a pH level that still allows biological life in the water to run well. Based on pH measurements from the initial hue to the construction period of the Reguleting Weir 2024, it shows that it still meets the value of the class II quality standard range, namely 6-9 based on Government Regulation No. 22 of 2021. Based on the results of pH measurements from the initial hue to the 2024 construction at the regulating weir, the results are in accordance with the quality standards in the range of 6.85 - 7.99 and can be seen as follows:

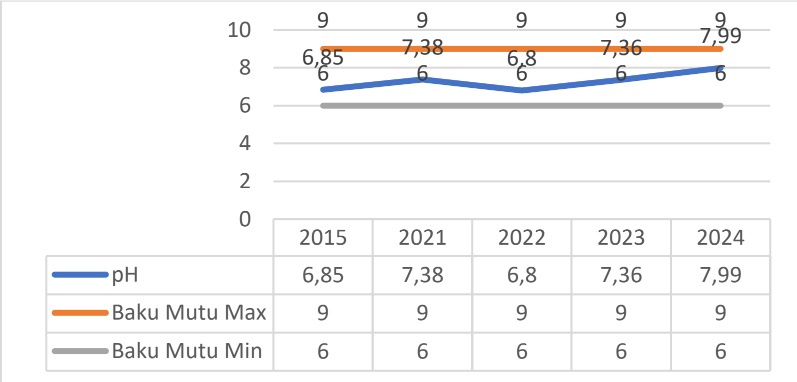


Figure 11 Comparison of pH Parameter Concentration Values from Initial Hue to Construction at the Kerinci Lake Outlet

Based on Figure 11 above, it can be seen that the results of pH measurements at the Kerinci Lake outlet before and during the construction of the regulating weir show that the water pH ranges from 6.85 to 7.99. The measurement results still meet the standard quality range value for class II, namely 6-9 based on Government Regulation No. 22 of 2021. The highest pH value was obtained during construction in 2024, namely 7.99, while the lowest pH value was during construction in 2022, namely 6.8. The increase in pH value in 2024 was due to increasing construction activities, but the values obtained were still in accordance with existing quality standards.

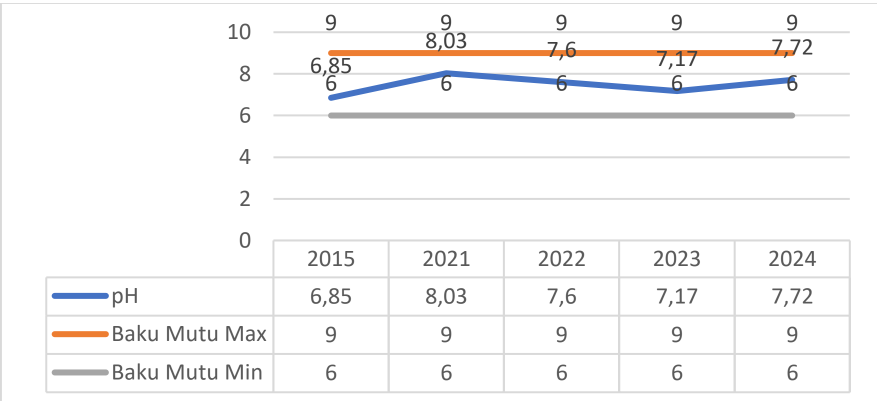


Figure 12 Comparison of pH Parameter Concentration Values from Initial Hue to Construction at the Dam Outlet

Based on Figure 12 above, it can be seen that the results of pH measurements at the Dam outlet before and during the construction of the regulating weir show that the water pH ranges from 6.85 to 8.03. The measurement results still meet the standard quality range value for class II, namely 6-9 based on Government Regulation No. 22 of 2021. The highest pH value was obtained during construction in 2024, namely 7.72, while the lowest pH value was during construction in 2014, namely 6.85. The increase in pH value in 2024 was due to increasing construction activities, but the values obtained were still in accordance with existing quality standards.

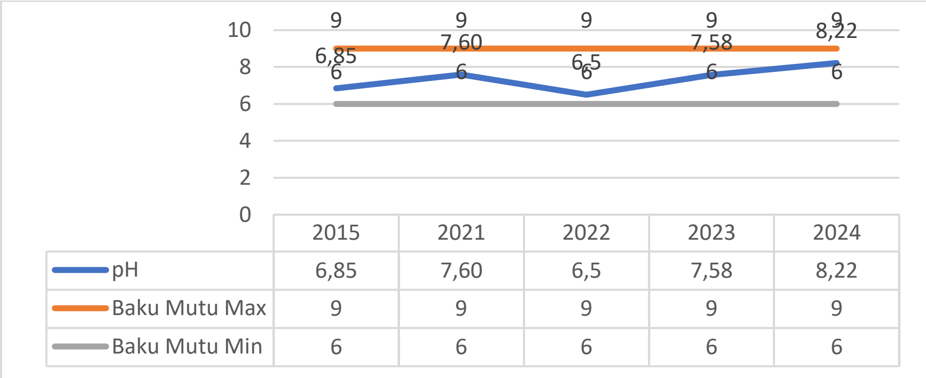


Figure 13 Comparison of pH Parameter Concentration Values from Initial Hue to Construction at Tailrace Outlet

Based on Figure 13 above, it can be seen that the results of pH measurements at the Tailrace outlet before and during the construction of the regulating weir show that the water pH ranges from 6.1 to 8.22. The measurement results still meet the standard quality range for class II, namely 6-9 based on Government Regulation No. 22 of 2021. The highest pH value was obtained during construction in 2024, namely 8.22, while the lowest pH value was during construction in 2022, namely 6.5. The increase in pH value in 2024 was due to increasing construction activities, but the values obtained were still in accordance with existing quality standards.

Chemical Oxygen Demand **(COD)**, COD parameter describes the oxygen requirement needed to chemically break down pollutants or the amount of oxygen needed to oxidize organic matter in water. COD is a parameter used to measure the level of organic pollution by domestic and industrial waste. The results of measuring the COD concentration value can be seen as follows:

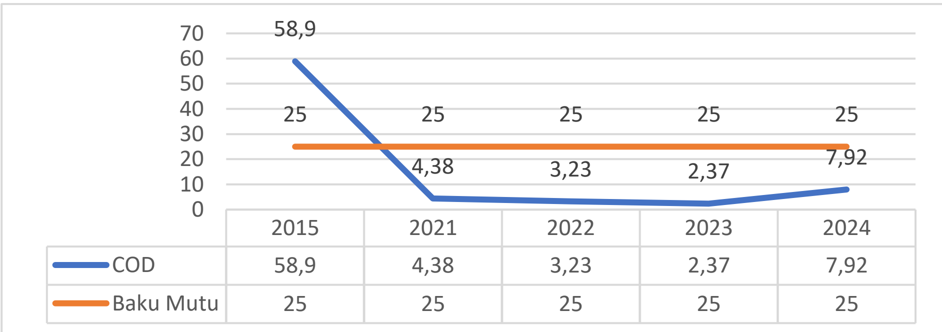


Figure 14 Comparison of COD Parameter Concentration Values from Initial Hue to Construction at the Kerinci Lake Outlet

From the results obtained from the beginning of the construction of the regulating wire construction until the construction of 2024 there was no significant increase, and this is far from the initial color (2014) where the COD value was 58.9 mg / l which indicated that there was damage to the water quality of Lake Kerinci. Although there was an increase in the year (2024), the standard quality value was still far below the class II standard quality value of 25 mg / l and could be classified as a class I standard quality value which had a value of 10 mg / l.

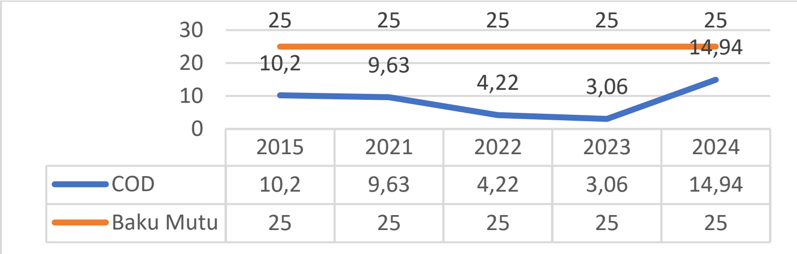


Figure 15 Comparison of COD Parameter Concentration Values from Initial Hue to Construction at the Dam Outlet

From the results obtained from the initial rina to the 2024 construction, there was no significant increase, where at the initial rina the COD value was 10.2 mg/l and the 2024 construction increased to 14.94 mg/l. This shows that the standard quality value is still far below the class II standard quality value of 25 mg/l and can be classified into the class I standard quality value which has a value of 10 mg/l.

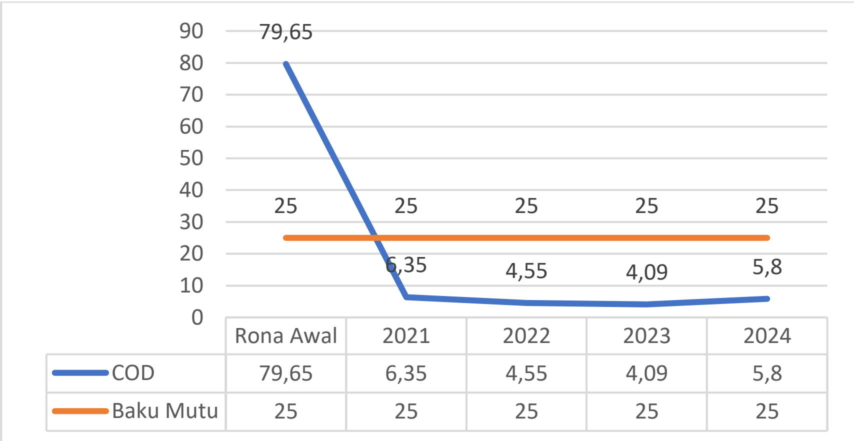


Figure 4.15 Comparison of COD Parameter Concentration Values from Initial Hue to Construction at the Power Plant Outlet

From the results obtained from the initial hue, there was a significant increase, this was caused by too much organic and non-organic material being infiltrated into the water due to domestic household waste along the Merangin River. And there was a drastic decrease when entering the initial hue due to the construction of a hydroelectric power plant in the Dam area which caused industrial waste to accumulate in the Dam construction area. Then there was a significant decrease during the initial hue of construction (2021), where during the initial hue the COD value was 79.60 mg/l and the 2021 construction dropped to 6.35 mg/l. This shows that the standard quality value is still far below the class II standard quality value of 25 mg/l and can be classified into the class I standard quality value which has a value of 10 mg/l.

Dissolved Oxygen (DO), Oxygen dissolved in water is very much needed to support aquatic life. The results of measuring DO parameters can be seen as follows:

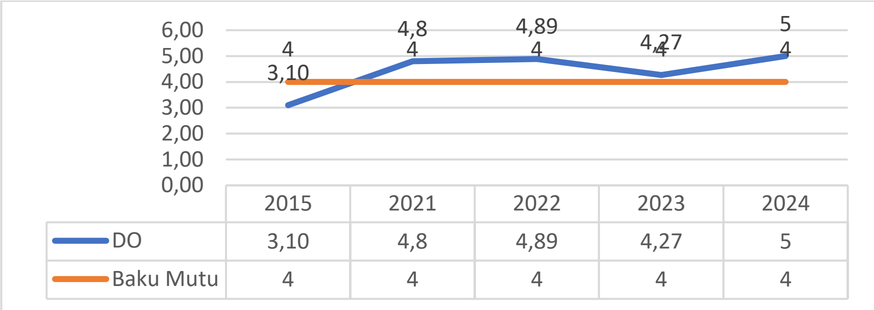


Figure 16 Comparison of DO Parameter Concentration Values from Initial Hue to Construction at the Kerinci Lake Outlet

The results of dissolved oxygen measurements at the outlet of Lake Kerinci during the initial hue to construction in 2024 ranged from 4.8 - 5 mg / l. There was no significant difference where at the initial hue the dissolved oxygen value was 4.8 mg / l and at the time of construction it was 5 mg / l. This shows that the higher the quality of dissolved oxygen, the better it is to improve the quality of river water and make aquatic life healthier.

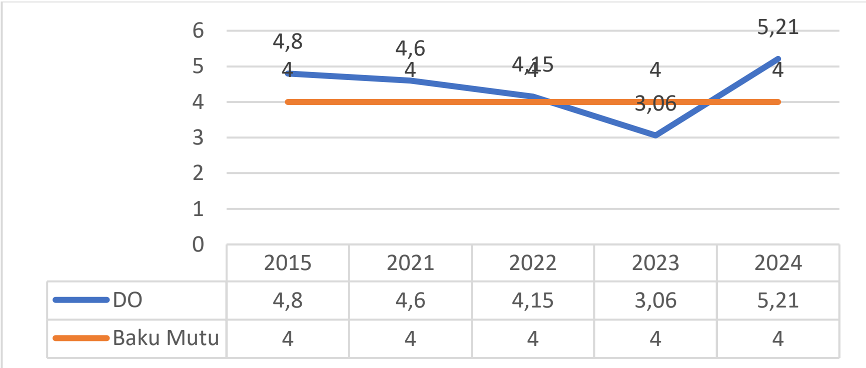


Figure 17 Comparison of DO Parameter Concentration Values from Initial Hue to Construction at the Dam Outlet

The results of dissolved oxygen measurements at the outlet of the Dam during the initial hue to construction in 2024 ranged from 4.8 - 5.21 mg / l. There was no significant difference where at the initial hue the dissolved oxygen value was 4.8 mg / l and during construction it was 5.21 mg / l. This value is above the minimum value of the class II quality standard for the DO parameter which is 4 mg / l and is close to the class I quality standard value according to PP No. 22 of 2021. This is caused by aeration in the Kerinci dam outlet area

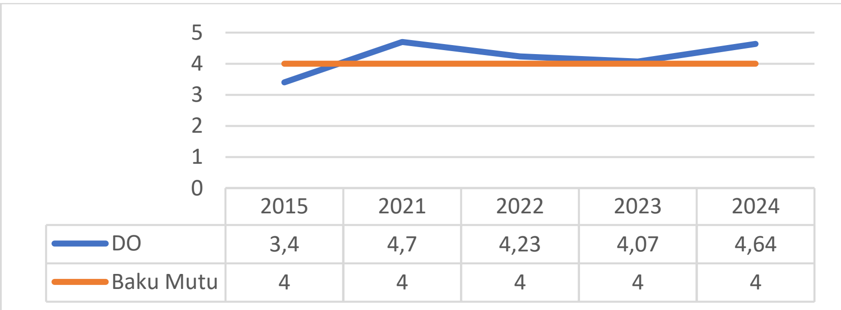


Figure 18 Comparison of DO Parameter Concentration Values from Initial Hue to Construction at Tailrace Outlet

The results of dissolved oxygen measurements at the Tailrace outlet during the initial hue to construction in 2024 ranged from 4.7 to 4.64 mg/l. There was no significant difference where at the initial hue the dissolved oxygen value was 3.4 mg/l and during construction it was 4.7 mg/l. This value is above the minimum value of the class II quality standard for the DO parameter which is 4 mg/l according to PP No. 22 of 2021. **Biological oxygen demand (BOD),** BOD parameter describes the amount of dissolved oxygen needed by microorganisms to decompose organic matter in water. BOD indicates that a river is polluted by organic matter. High BOD can cause a decrease in DO in the water. The results of measuring the BOD concentration value can be seen as follows

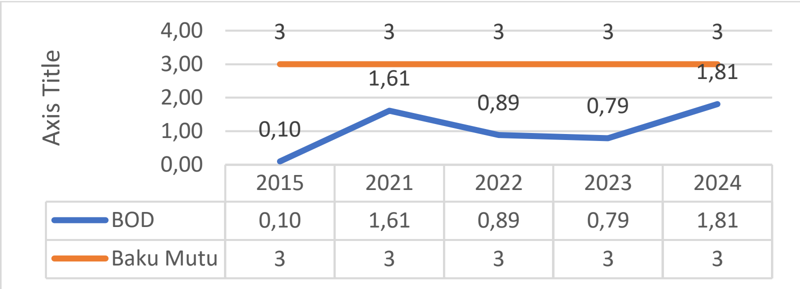


Figure 19 Comparison of BOD Parameter Concentration Values from Initial Hue to Construction at Kerinci Lake Outlet

The results of dissolved BOD measurements at the Kerinci Lake outlet during the initial hue to construction in 2024 ranged from 0.10 to 1.81 mg/l. There was no significant difference where at the initial hue the dissolved oxygen value was 0.10 mg/l and at the time of construction in 2024 it was 1.81 mg/l. This value is in accordance with the class II quality standard for the DO parameter which is 3 mg/l and can be included in the class I quality standard which is 2 according to PP No. 22 of 2021.

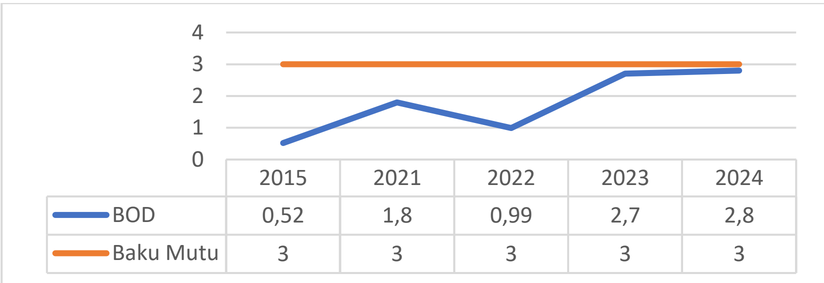


Figure 20 Comparison of BOD Parameter Concentration Values from Initial Hue to Construction at the Dam Outlet

The results of dissolved BOD measurements at the Dam outlet during the initial hue to construction in 2024 ranged from 0.52–2.8 mg/l. There was no significant difference where at the initial hue the dissolved oxygen value was 0.52 mg/l and at the time of construction in 2024 it was 2.8 mg/l. This value is in accordance with the class II quality standard for the DO parameter which is 3 mg/l and can be included in the class I quality standard which is 2 according to PP No. 22 of 2021.

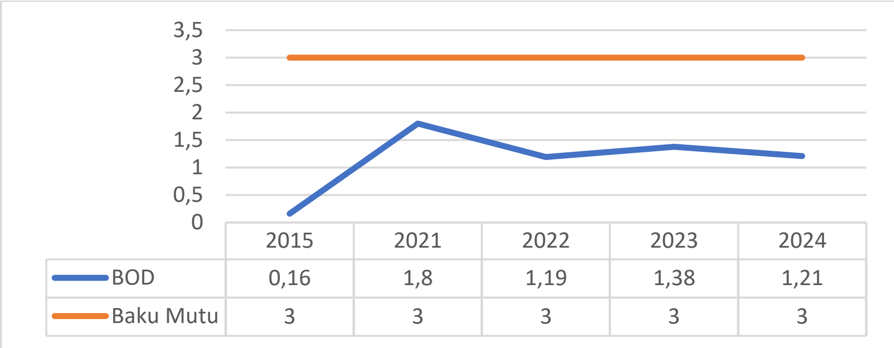


Figure 21 Comparison of BOD Parameter Concentration Values from Initial Hue to Construction at Tailrace Outlet

The results of dissolved BOD measurements at the Tailrace outlet during the initial hue to construction in 2024 ranged from 0.16–1.8 mg/l. There was no significant difference where at the initial hue the dissolved oxygen value was 0.16 mg/l and at the time of construction in 2024 it was 1.21 mg/l. This value is in accordance with the class II quality standard for the DO parameter which is 3 mg/l and can be included in the class I quality standard which is 2 according to PP No. 22 of 2021. The higher the BOD content, the higher the level of pollution in the waters.

The construction of the Hydroelectric Power Plant provides employment opportunities by prioritizing local residents to become workers for the Merangin Hydroelectric Power Plant Construction in Kerinci Regency, where the recruitment and placement of workers is adjusted to the needs and skills they have, so that the impact and comparison of the Construction of the Hydroelectric Power Plant on the socio-economy in Kerinci Regency.livelihoods of residents before and after the hydropower project there are some changes in percentage. Changes for the community livelihood of farmers from 34% to 7% and self-employed from 20% to 14%. And there was a significant increase in the livelihood of employees from 0% to 73%, this is because the construction of the Merangin Hydropower Plant in Kerinci Regency has been fully implemented, so that the workforce needed has begun to increase. Statistically, the influence of the hydropower construction project on the livelihood of the community is as follows

Table 1

Results of Difference Test (Wilcoxon) of Community Livelihoods After Hydroelectric Power Plant Construction

Ranks				
		N	Mean Rank	Sum of Ranks
Job After - Job Before	Negative Ranks	0[a]	.00	.00
	Positive Ranks	30[b]	15.50	465.00
	Ties	0[c]		
	Total	30		
a. Job After < Job Before				
b. Job After > Job Before				
c. Job After = Job Before				
Asymp. Sig. (2-tailed)				.000

Based on the results of the analysis using the difference test (Wilcoxon) presented in table 1 above, it is known that as many as 30 respondents (100%) experienced an increase in the type of livelihood. The results of the analysis also showed a significance value of 0.000 ($p < 0.05$) so that there was a significant difference in livelihood as a criterion for socio-economic variables after the hydropower construction project in

Kerinci Regency. Before the project, residents made a living as farmers, laborers, traders, and entrepreneurs as seen in Figure 4.1. After the project, there was an increase in the type of livelihood to become project workers with the type of livelihood. This shows an increase in people's livelihoods, namely with the largest percentage being employees. With the changes in livelihoods before and after the hydropower development project in Kerinci Regency, monitoring parameters from the aspect of community income were also seen, which were collected and analyzed descriptively quantitatively with the minimum standard of the Jambi Provincial Minimum Wage (UMP). The changes that occurred can be seen in table 2 as follows

Table 2
Results of Difference Test (Wilcoxon) of Community Income After Hydroelectric Power Plant Construction

Ranks

		N	Mean Rank	Sum of Ranks
Salary_after - Salary_before	Negative Ranks	0[a]	.00	.00
	Positive Ranks	30[b]	15.50	465.00
	Ties	0[c]		
	Total	30		
a. Salary_after < Salary_before				
b. Salary_after > Salary_before				
c. Salary_after = Salary_before				
Asymp. Sig. (2-tailed)				.000

Based on the results of the analysis using the difference test (Wilcoxon) presented in table 2 above, it is known that as many as 30 respondents (100%) experienced an increase in income after the hydropower project. The results of the analysis also showed a significance value of 0.000 ($p <0.05$) so that there was a significant difference in income as a criterion for socio-economic variables after the hydropower construction project in Kerinci Regency. Before the hydropower construction project, the largest source of income for residents was in the income range of Rp. 1,500,000 to Rp. 2,500,000 and after the hydropower construction project, the largest source of income for residents was in the income range of Rp. 3,000,000 to Rp. 7,000,000. At the income level, business actors experienced an increase with an average income before and after the construction of the project, the average income of the community in Batang Merangin District, Kerinci Regency.

With the construction of the Hydroelectric Power Plant (PLTA) in Batang Merangin District, Kerinci Regency, it turns out that information was found that the existence of the PLTA is not only as a PLTA, over time it has also been developed as a regional tourist destination. The Kerinci PLTA has great potential to become a tourist destination, especially the location of the Kerinci dam on the Kerinci - Bangko national road axis, besides the location of the regulating weird is also around Lake Kerinci, which is the second largest lake in Indonesia. In addition to enjoying the beauty of the lake and Mount Kerinci, visitors can learn about the process of generating hydroelectric power at the PLTA. There are many tourist activities that can be done, such as taking pictures, enjoying the scenery, and maybe rafting or other water activities around the lake. In addition, the area around the PLTA is also equipped with culinary meatballs, Padang rice, coconut ice, and others.With the arrival of visitors who consider the PLTA as a tourist attraction and local residents who sell, this indirectly also affects the livelihoods and income of the community in Batang Merangin District, Kerinci Regency.

The construction of a hydroelectric power plant carried out in a community environment can have a positive impact on the community, namely economic growth and economic movement in the community environment. This is based on the absorption of labor and the existence of hydroelectric power plants as tourism. The findings of this study have several strategic policy implications for local governments, technical institutions, and hydropower project managers. In terms of the environment, although in general water quality is still within the threshold of quality standards, fluctuations in parameters such as DO are a signal of the need for more responsive and ecosystem-based water quality monitoring. This monitoring is not only technical in nature, but must also consider long-term changes due to the presence of large-scale infrastructure such as hydropower. Therefore, overall, hydropower projects have consequences that require an intersectoral policy approach, covering environmental, social, and economic aspects in an integrated manner. This emphasizes the need for local governments and related stakeholders to adjust regional development and management policies to the new dynamics that arise due to the development of strategic infrastructure such as hydropower.

Conclusion

Based on the research that has been conducted, it can be concluded that the Impact of Hydroelectric Power Plant Construction on Water Quality in Kerinci Regency as measured through the parameters TSS, Turbidity, Temperature, pH, COD and BOD, it is known that there are no parameters that do not meet the class II quality standard value, there are even several parameters that meet the class I quality standard value. However, the DO parameter has a value above the minimum class II quality standard value for the DO parameter which is 4 mg/l according to PP No. 22 of 2021 and the Impact of Hydroelectric Power Plants on Social and Economic in Kerinci Regency that the livelihoods of residents before and after the PLTA project there were several changes in percentage. Changes for the community livelihood of farmers from 37% to 7% and self-employed from 24% to 14%. And there was a significant increase in employee livelihoods from 0% to 61% and based on the results of the analysis using the difference test (Wilcoxon) showed a significance value of 0.000 ($p < 0.05$) so that there was a significant difference in income as a criterion for socio-economic variables after the hydropower construction project in Kerinci Regency.

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