Volume: 13 | Number: 02 | October 2024 | ISSN: 1907-4247 (Print) | ISSN: 2477-4863 (Online) | Journal Homepage: https://cantilever.id

Cantilever

Jurnal Penelitian dan Kajian Bidang Teknik Sipil

OPEN ACCESS

Research Article

The Environmental Evaluation of the Sp. Opi – Babatan Saudagar – Srijabo Road

Achmad Abraham Setiawan Armo[1,*], Hendry Wijaya[1], Yulindasari Sutejo[2], Saloma[2], Restu Juniah[3], and Fathunnisa[4]

[1]The Public Works Agency for Highways and Spatial Planning of South Sumatra Province, Palembang, Indonesia
[2] Civil Engineering Department, Universitas Sriwijaya, Indralaya, Indonesia
[3]Mining Engineering Department, Universitas Sriwijaya, Indralaya, Indonesia
[4] PT. Intimulya Multikencana, Bandung, Indonesia

Received: 21 February 2024, Accepted: 16 January 2025, Published: 31 January 2025

Abstract

The Public Works Agency for Highways and Spatial Planning of South Sumatra Province has the task of deconcentration in the field of roads and has authority over 88 roads with a length of 1,779.27 km spread across 17 districts and cities in South Sumatra Province. Not all provincial roads have an environmental evaluation document. The objective of the current research was to evaluate the environmental impact resulting from road operational activities in South Sumatra Province by taking data on ongoing activities, geological and topographic conditions, flora and fauna, socio-economic and cultural activities in the area, as well as measuring quality standards, which include air quality standards, noise, vibration, and water quality standards on the Sp. OPI - Babatan Saudagar - Srijabo Road. The conclusion of the current research shows that the ambient air quality, noise intensity, and vibration are still good and meet quality standards. The potential hydrogen (pH) and dissolved oxygen (DO) parameters in the Ogan River branch at the time of sampling for surface water quality did not meet the quality standards due to the type of soil, which tends to be acidic. Furthermore, the results of groundwater quality analysis show that the pH of groundwater measured in all locations is less than 6.5 or does not meet quality standards, which can cause an unpleasant taste when consumed, so processing is needed to increase the pH of groundwater.

Keywords: *air quality, environmental, road operations, water quality.*

1. INTRODUCTION

The Government of the Republic of Indonesia has issued regulations regarding the implementation of environmental protection and management in 2021. Every business and non-business entity that is responsible for the activities that have been carried out is obliged to carry out an environmental evaluation. The Public Works Agency for Highways and Spatial Planning of South Sumatra Province has the task of deconcentration in the field of highways and has authority over 88 road sections with a length of 1,779.27 km spread across 17 districts and cities. Not all operational road sections have environmental evaluation documents. Operation of road infrastructure activities to serve vehicle traffic generates exhaust emissions, which have the potential to cause a decrease in air quality due to increased levels of dust produced, thereby increasing the levels of pollution produced [1, 2]. Vehicle traffic activities on the road contribute to organic aerosols, CO_2, concentrations of particulate matter (PM), black carbon, and polyaromatic hydrocarbons, while biomass burning significantly contributes to organic aerosols, PM, sulfate, nitrate, and chloride [3-10]. Research related to risky driving behavior reduces accidents, but air pollution can also cause more accidents due to impaired physiological function and cognitive performance [11-15]. Furthermore, flyovers have higher traffic-related carbon emissions than ground vehicles. In addition, flyovers in urban areas have higher noise barriers and higher vehicle speeds [16]. The relationship between air pollution and climate change policies in the road transport sector has been explored in several countries, and modernization and electrification have been found to be the most effective strategies [17-21]. Water

*Corresponding author: achmadabraham@ymail.com

DOI: https://doi.org/10.35139/cantilever.v13i2.345

pollution is a complex problem involving various things, and efforts to control pollution in an ecosystem can be made by monitoring water quality over a certain period of time so that the status of the water quality standard is known [22].

This research was conducted to evaluate the environmental impact resulting from road operational activities in South Sumatra Province by paying attention to the relationship between the activity components that are the source of the impact, the impact produced by the source of the impact, the environmental baseline affected, the relevant quality standards for environmental protection and management with the source of the impact and the resulting impact, the effectiveness of management and monitoring efforts that have been carried out, as well as information on activities and environmental conditions in the surrounding area.

2. MATERIALS AND METHODS

Research Location

The focus of the research was on the Sp. OPI – Babatan Saudagar – Srijabo road with a length of 34.942 km with initial coordinates of 3° 03’ 36.10” S, 104° 47’ 18.47” E, and final coordinates of 3° 20’ 16.13” S, 104° 46’ 48.85” E (Figure 1).

This research describes ongoing activities, geological and topographic conditions, flora and fauna, socio-economic, cultural, and other activities in the area, as well as measurements of air quality standards, noise, vibration, surface water, and groundwater quality standards.

2.2. Data Source

The primary data collection required in this research is physical and chemical aspects, including air quality, noise, vibration, surface water quality, ground water quality, land use, biological aspects, including flora and fauna, water biota, and social-economic and cultural.

Determining the location of ambient air quality samples based on densely populated settlements affected by South Sumatra Province Road activities and locations with lots of community activity and near rice mill locations.

The location for measuring ambient air quality is carried out at two points, namely:

- Srijabo Village Settlement in Sungai Pinang District, with coordinates 03° 20’ 13.15” S, and 104° 46’ 46.98” E (U.06.1);
- Sungai Lebung Village Settlement in South Pemulutan District, with coordinates 03° 13’ 21.77” S and 104° 45’ 34.29” E (U.06.2)

Figure 1. Research location

Determining the location for sampling ambient air quality is based on considering wind direction and speed and following applicable standards and how to test total suspended particles using High Volume Air Sampler (HVAS) equipment with the Gravimetric Method.

To determine the noise level at the research location, measurements were taken at the same two locations by taking air quality samples. Noise level measurements are carried out with a sound level meter, which is usually measured from the dB (A) sound pressure level for ten minutes for each measurement, and readings are taken every five seconds.

The noise intensity did not change much during 24 hours because the traffic density along the road relatively did not change much, so instantaneous sampling was carried out, which can represent a picture of the noise intensity along the road [23].

Sampling for vibrations was taken in Lebung Panjang Village, Pemulutan District, with coordinates of 3° 15 ‘44.19” S and 104° 45’ 00.76” E. Location determination was based on areas that are vulnerable to vibrations, such as bridges and areas busy with vehicles.

Sampling of surface water quality in rivers to see the possible influence of road activities was carried out in two locations, namely:

- Ogan River, in Sejangko Village, Rantau Panjang District, with coordinates 3° 06’ 43.51” S and 104° 47’ 09.89” E.
- Ogan River Branch, in Lebung Jangkar Village, Pemulutan District, with coordinates of 3° 15’ 44.19” S and 104° 45’ 00.76” E.

DOI: https://doi.org/10.35139/cantilever.v13i2.345

The groundwater quality samples are located in Sungai Lebung Village, South Pemulutan District, with coordinates of 3° 13' 21.77" S and 104° 45' 34.29" E. For land use, biological aspects include flora and fauna, aquatic biota, socio-economic and cultural aspects, carried out using interview techniques and direct observation at the location.

Secondary data collection includes topographic and geological maps, climatology, population data, health and social data, road network data, and spatial planning information.

Data Analysis

The environmental components affected in this research are the physical-chemical, biological, socio-economic, and cultural environmental components. The initial stage of research involves identifying and evaluating impacts relevant to the activity and analyzing all the data to obtain conclusions.

The methods for analyzing ambient air quality samples are divided into two categories: direct measurement in the field for several parameters such as humidity, temperature, wind speed, and cardinal directions, and analysis in an accredited laboratory. The results of the ambient air quality samples have been compared with quality standards based on the Republic of Indonesia Government Regulation, Number 22 of 2021, Appendix VII concerning Ambient Air Quality Standards. Noise sample measurements have been compared with quality standards in accordance with the Decree of the Minister of Environment, Number: 48/MENLH/ XI/1996 concerning Noise Level Standards.

The implementation of water sampling affects the accuracy of laboratory analysis results. Considering that errors during sampling will affect the structure and physico-chemical composition of the sample water, accuracy in sampling is absolute.

Some of the requirements that must be met include: equipment, auxiliary materials, sampling facilities, sample volume, work pattern, preservation method, and collection time [24, 25].

3. RESULTS AND DISCUSSION

The results of the research and discussion were presented in several subsections, namely: ongoing activities, geological and topographic conditions, flora and fauna, socio-economic and cultural, other activities in the area, and quality standard measurements.

Ongoing Activities

The research location was in the Ogan Ilir Regency, South Sumatra Province, in five sub-districts and twenty-three villages. The Sp. OPI - Babatan Saudagar - Sri Jabo Road is outside the forest area or is in another use area, referring to the indicative map for termination of granting business permits for approval of use of forest areas or changes to the designation of new forest areas in primary natural forests and peatlands in 2023 period one issued by the Ministry of Environment and Forestry of the Republic of Indonesia.

Based on surveys and overlays with land use maps, outside the road space covered in the research, plantation, agricultural, and residential land dominate. At the initial station (STA 0+000) to STA 03+000, land use was dominated by shrubs, and at STA 09+000 to STA 33+000, land use was dominated by dry land farming mixed with shrubs, land farming, rice fields, and the body of water was the Ogan River. The settlements include those located at STA 2+100, STA 15+000, STA 21+000 to STA 27+000 which are on the banks of the Komering River, and at the end, STA 34+942. The starting point of the Sp. Opi – Babatan Saudagar – Srijabo Road is connected to the South Ring Road (Palembang), which is a national road connecting to the Jakabaring Sport City area and Palembang City. At the final STA, it is connected to the Meranjat -Bts. Kota Kayu Agung National Road. On this section, there are non-level crossings on the Kayu Agung - Palembang Toll Road, while the other connected road networks are district roads and village roads.

Sp. OPI – Babatan Saudagar – Srijabo Road was previously an Ogan Ilir district road, and at the beginning of 2023, its authority status was upgraded to become a provincial road. Based on the results of the road condition survey, in 2023, 88.6% will be in stable condition, and the remaining 11.4% will be in unstable condition. The existing road pavement type consists of 5.3 km of concrete and 29.642 km of asphalt. According to road inventory results, Sp. OPI - Babatan Saudagar – Sri Jabo Road has a road width of 4.5 – 5.0 m with varying road shoulder widths of 0.5 – 1.0 m for the left and right sides.

Based on a traffic survey conducted from October 12 to October 18, 2023, the average daily vehicle traffic is 2,380 motor vehicles, 873 light vehicles, 117 medium vehicles, and 6 heavy vehicles. Peak hours are generally from 5 to 6 pm on weekdays and 9 to 10 am on holidays (Figure 2). The road capacity on this section is 1,300.8 pcu/hour, and the volume per capacity is between 0.24 and 0.26 with service level B, which means the traffic flow on the road is stable at all times.

On the Sp. OPI - Babatan Saudagar – Srijabo Road, there are 18 bridges, excluding non-level crossings of the Kayu Agung – Palembang toll road, with spans varying between 6 and 72 m and a width of 3.6 - 4.8 m. Generally, it is still a pipe bridge and

DOI: https://doi.org/10.35139/cantilever.v13i2.345

a steel plate floor with a permitted vehicle capacity for light to medium loads (Figure 3).

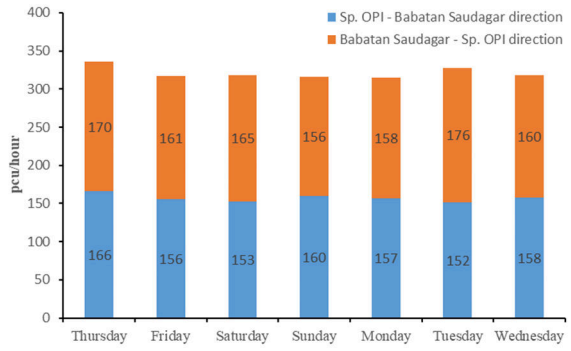

Figure 2. Peak vehicle hours

Geological Conditions and Topography

Based on the geological map, the study area consists of two lithological units, namely, from old to young: the Kasai Formation (QTk), consisting of tuff, sandy tuff, and tuff sandstone with coal inserts. In the weathered part, it forms a type of silty clay soil containing sandy, brown, soft, and firm material. Furthermore, alluvium (Qa), composed of sand, silt, and clay, is soft and easily separated.

The topography of the Sp. OPI - Babatan Saudagar - Srijabo Road is in the form of sloping plains, with the land use around the route consisting of a dominance of mixed gardens, settlements, rice fields, and ponds. This road section is adjacent to a canal stretching from Tanjung Raja to Pemulutan, and to the left of the canal is the flow of the Ogan River, which in several places shows a meandering pattern. The direction of the flow of the Ogan Canal and River is from south to north, and it empties into the Musi River. The slope angle of the land slope ranges from 3% to 5% and 5–8%, and the land elevation ranges from 4 to 17 m above sea level.

Obstacle factors that could potentially occur on The Sp. OPI – Babatan Saudagar – Srijabo Road is flooding and land subsidence. Based on the results of the secondary data survey, areas that would flood around Pemulutan Barat were identified, originating from the canals and the Ogan River. The height of this potential flood area is 4-5 m above sea level. The potential for subsidence is predicted in the track area formed by the deposition of swamps and alluvium on soft sand, silt, and clay soil types.

Flora and Fauna

Even though the Sp. OPI – Babatan Saudagar – Srijabo Road is a swamp, most of it has been turned into rice fields planted with rice (Oryza sativa). Apart from that, there are also settlements and gardens where there are cultivated plants. To see the types of plants found on the Sp OPI – Babatan Saudagar - Srijabo Road, forty-five types of plants were found. These plant types consist of fruit trees, ornamental plants, industrial plants such as acacia (*Acacia tomentosa*), mahogany (*Swietenia mahagoni*), oil palm (*Elaeis guineensis*), and also wild plants (Table 1).

Figure 3. Several distributions of bridges at the location

At the research location, 13 species of birds were found, none of which were protected, and the diversity of bird species was moderate. If we look at the bird habitats, generally all the bird species found like to live in open habitats. This shows that the location of each section of this road is open, namely mixed plantations, rubber plantations (Hevea brasiliensis), and oil palm plantations (Elaeis guineensis).

Table 1. A Type of wild plant that grows on the side of the road

Local name	Scientific name	Family
Rumput tidur	Mimosa pudica	Fabaceae
Sambung rambat	Mikania sp.	Asteraceae
Teki	Cyperus sp.	Cyperaceae
Terung takokak	Solanum torvum	Solanaceae
Paku	Nephroepis sp.	Dryopteridaceae
Paku laut	Acrostichum aureum	Polypodiaceae
Mahang	Macaranga sp.	Euphorbiaceae
Alang alang	Imperata cylindrica	Poaceae
Dadap	Erythrina variegata	Fabaceae
Eceng gondok	Eichhornia crassipes	Pontederiaceae
Harendong	Melastoma affine	Melastomataceae

The types of animals recorded from interviews with the public are water snakes (*Homalopsis buccata*) and natural fish, except for farmed fish such

DOI: https://doi.org/10.35139/cantilever.v13i2.345

as tilapia (*Oreochromis niloticus*). Apart from that, there are still freshwater shrimp (*Macrobrachium sp*.) which is an indicator that the water quality at the location is still good.

Socio-economic and Cultural

The public's perception of road activities, or an interpretation of the activities and their impacts, was found through interviews conducted in order to gather information regarding environmental management from socio-economic and cultural aspects of the operation and maintenance of provincial roads (Figure 4).

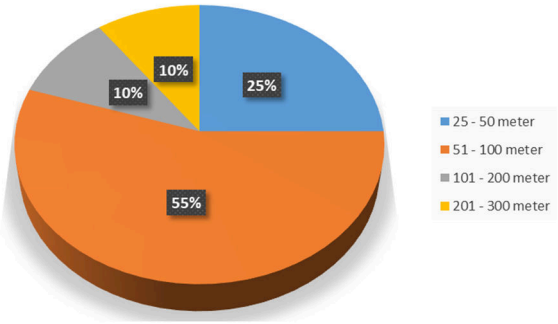

Figure 4. Distance of the respondent's residence to the provincial road

By reviewing the respondent's identity, the closest distance to the respondent's residence is less than 25 m, and the furthest is 300 m. The largest group of respondents was distributed over a distance of 25–100 m (55%). Based on the length of stay group, the majority is the group of residents who have lived 21–26 years. This information shows that respondents have sufficient experience regarding the benefits and risks of the roads where they live.

Farmers, workers in the private sector, entrepreneurs, government employees, teaching staff, and laborer made up the respondents' job categories (Table 2). The farmer group makes up 45 percent of the workforce at the road location, followed by private sector employees (15%) and self-employed people (15%).

Table 2. Work type of respondent at the road location

Type of work	% respondent
Farmer	45
Private sector employee	15
Self-employed	15
Government employees	5
Teaching staff	5
Laborer	15

In terms of the benefits of the existence of roads for the surrounding community, 35% of respondents stated that it was a trigger for regional openness that was connected to other areas with a good road network (Table 3). Another benefit is that the existence of this road supports the smooth running of residents' agricultural activities (25%), which is related to the respondents' most dominant type of work, environmental safety (25%), and increased population mobility (15%).

Table 3. Opinios of respondents regarding the presence of provincial road

The benefits of having a road	% respondent
Become a trigger for regional openness	35
Supports agricultural activities	25
Increasing population mobility	15
Supports environmental safety	25

Apart from the benefits, respondents were also asked whether there were any risks associated with the existence of the road. Interview results showed that as many as 20% stated that there was a risk that the road would reduce traffic discipline for road users, while the majority of respondents (80%) stated that there was no risk from the existence of the road. Further interviews regarding this problem resulted in the conclusion that improving road quality causes road users, especially motorbikes, to tend to drive vehicles at high speeds and has the potential to cause accidents.

Table 4. Opinions of respondents regarding the availability of jobs due to the existence of roads

Type of opinion	% respondent
There are job opportunities from operational activities and road maintenance	55
No need for job opportunities, already have your own job	40
There are no job opportunities from road maintenance activities	5

To find out the public's opinion regarding job opportunities for local residents during the operation and maintenance of provincial roads, 55% of respondents stated that service providers (contractors) had provided job opportunities for local residents; 40% of respondents considered that local residents did not need job opportunities because they had their own jobs; and another 5% think there are no job opportunities from service providers for local residents.

In the results of an interview survey with respondents who live in the research location, as many as 75% of respondents answered that there was environmental management of road management, and 20% stated that there was no operation and maintenance of road construction because there were still damaged roads. Then the remaining 5% think that road environmental managers have not carried out regular monitoring of the condition of provincial roads (Table 5).

DOI: https://doi.org/10.35139/cantilever.v13i2.345

Table 5. Views of respondents regarding environmental management of roads

Opinions regarding environmental management	% respondent
Environmental management has been carried out through operational activities and the maintenance of road construction	75
There is no repair of road damage	20
There is no monitoring of road conditions	5

Other Activities Around the Location

Other activities in the study area (Figure 5), namely: industrial activities in the form of wood processing, warehouses, batching plants, and chicken farming. Agricultural activities consist of farming and gardening activities, where the majority of land use in the study location is rice fields, rubber plantations, timber plantations, and oil palm plantations. Agricultural activities include the movement of farmers to agricultural land, irrigation of agricultural land, transportation of harvests, and other activities.

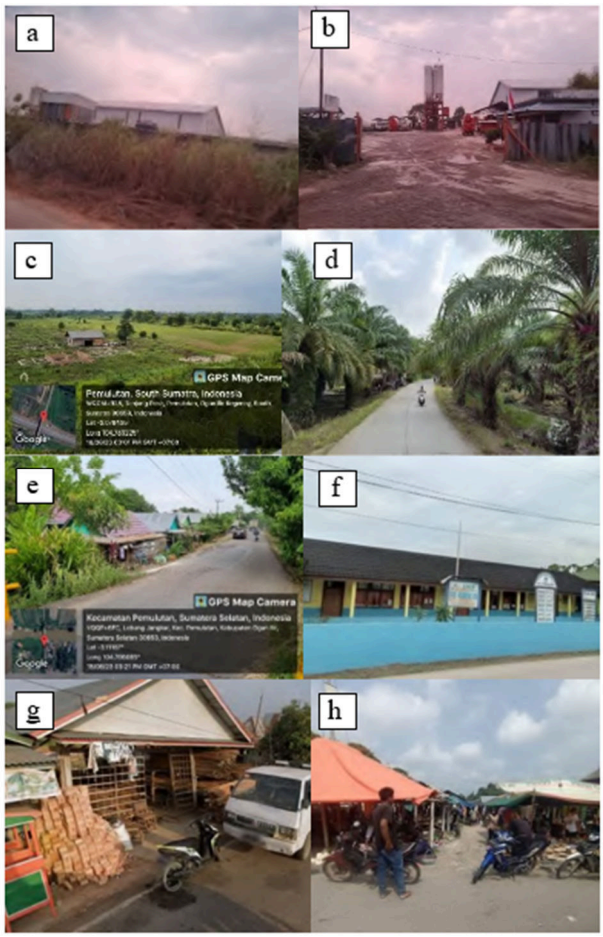

Figure 5. Surrounding environmental conditions: (a) wood processing; (b) batching plant; (c) rice fields; (d) oil palm plantations; (e) residential areas; (f) educational activities; (g) building shop; and (h) market

Residential settlements closest to the study area are along the road, where the density varies greatly depending on the conditions of each area. Educational activities are teaching and learning, and along the road there are school buildings.

Quality Standard Measurement

The air quality conditions in the study area at the time of sampling were still good, in accordance with the results of air quality measurements, where all measured parameters still met quality standards (Tabel 6).

Table 6. Air Quality Measurement Results

Parameter	Unit	Quality standards	Test results U.06.1	Test results U.06.2
Sulfur Dioxide (SO_2)	µg/m^3	150	102.6	115.8
Carbon Monoxide (CO)	µg/m^3	10,000	5,928.6	5,986.2
Nitrogen Dioxide (NO_2)	µg/m^3	200	162.5	169.8
Plumbum (Pb)	µg/m^3	2	<0.0015	<0.0015
Non-Methane Hydrocarbons (NMHC)	µg/m^3	160	20.6	22.8
Total Suspended Particulate < 100 µ (TSP)	µg/m^3	230	178,2	188,6
PM_{10}	µg/m^3	75	58.5	60.2
$PM_{2,5}$	µg/m^3	55	36.2	38.6
Oxidant (O_3)	µg/m^3	150	26.5	26.2
Ammonia (NH_3)	ppm	2.0	0.065	0.072
Hydrogen Sulfide	ppm	0.02	0.0082	0.0088
Temperature	°C	-	29.5	33.8
Humidity	%	-	51.6	48.2
Wind velocity	Km/ hour	-	1.1	0.8
Wind direction	-	-	S-U	S-U

The noise conditions in the study area at the time of sampling were still good and still met the Noise Level Standards (Table 7).

Table 7. Results of measuring noise intensity

Sampling location	Unit	Results	Quality standards
K.06.1	dB(A)	47.8	55
K.06.2	dB(A)	42.6	55

The vibration measurement results still meet category A vibration level standards, namely that the vibrations caused do not cause damage. This happened because, at the time of observation, there were no activities that caused significant vibrations. Table 8 shows vibration level measurement results.

Table 8. Vibration level measurement results

Measurement time	Unit	Measurement result	Category
11:45 am	mm/sec	0.25	A

Taking quality standard samples can be seen in the Figure 6. Measurement of surface water quality conditions at the research location by taking samples during the day, then analyzing them in the laboratory (Table 9). Determining the surface water quality sampling location is at the location of the receiving

DOI: https://doi.org/10.35139/cantilever.v13i2.345

water body, which is affected by road operational and maintenance activities.

Figure 6. Taking quality-standard samples

Table 9. Surface water quality analysis results

Parameter	Unit	Quality standards	Test results U.06.1	U.06.2
Physics				
Temperature (in situ)	^{0}C	Deviation 3	27.0	28.0
Total Dissolved Solid (TDS)	mg/L	1.000	132	258
Total Suspended Solid (TSS)	mg/L	50	39.6	42.5
Organic chemistry				
pH	mg/L	6 - 9	6.02	5.98
Ferrum (Fe)	mg/L	-	0.92	0.98
Manganese (Mn)	mg/L	-	0.052	0.058
Zing (Zn)	mg/L	0.05	0.023	0.025
Cadmium (Cd)	mg/L	0.01	<0.0025	<0.0025
Plumbum (Pb)	mg/L	0.03	<0.0042	<0.0042
Sulfate (SO_4)	mg/L	300	62.32	66.6
Flouride (F)	mg/L	1.5	0.36	0.38
Chloride (Cl)	mg/L	300	19.2	20.6
Ammonia free (NH_3-N)	mg/L	0.2	0.022	0.026
Nitrate, as N (NO_3)	mg/L	10	2.62	2.68
Nitrite as N (NO_2)	mg/L	0.06	0.026	0.032
Biochemical Oxygen Demand (BODs)	mg/L	3	1.92	2.02
Chemical Oxygen Demand (COD)	mg/L	25	5.62	6.8
Dissolved Oxygen (DO)	mg/L	>4	2.4	2.2
Cobalt (Co)	mg/L	0.2	0.00	0.00
Nickel (Ni)	mg/L	0.05	0.00	0.00
Selenium (Se)	mg/L	0.01	<0.0012	<0.0012
Total Nitrogen	mg/L	15	<0.003	2.52
Tembaga (Cu)	mg/L	0.02	<0.003	<0.003
Chromium (Cr)	mg/L	0.05	<0.003	<0.003
Sulfide (H_2S)	mg/L	0.002	0.00	0.00
Total Phosphate as P (PO_4)	mg/L	0.2	0.056	0.062
Inorganic chemistry				
Phenol	mg/L	0.005	0.00	0.00
Oil and fat	mg/L	1	0.055	0.062
Total detergent	mg/L	0.2	0.052	0.059

Based on the results of the laboratory analysis, surface water quality at all sampling locations is still good and meets quality standards. Parameters that do not meet quality standards include pH in the Ogan River and DO parameters at all locations. This is caused by the type of soil, which tends to be acidic. To see the condition of groundwater quality, samples were taken at previously determined research locations during the day, and the results were analyzed in the laboratory (Table 10).

Table 10. Groundwater quality analysis results

Parameter	Unit	Quality standards	Test results
Fisika			
Smell	-	-	No smell
Total Dissolved Solid (TDS)	mg/L	<300	102
Turbidity	NTU scale	<3	1,1
Temperature	^{0}C	± 30 ^{0}C	27
Color	TCU scale	10	3,2
Chemistry			
pH	-	6,5 – 8,5	6,08
Ferrum (Fe)	mg/L	0,2	0,09
Manganese (Mn)	mg/L	0,1	0,07
Nitrate, as N (NO_3)	mg/L	20	1,90
Nitrite as N (NO_2)	mg/L	3	0,088
Chromium (Cr)	mg/L	0,01	<0,003
Organic chemistry			
Organic substances ($KMnO_4$)	mg/L	10	2,6

Based on the results of the groundwater quality analysis, the pH measured at all locations was lower than 6.5 or did not meet the quality standards, indicating that the groundwater condition was acidic. The pH value that meets the quality standards for drinking water based on Minister of Health Regulation Number 2 of 2023 ranges from 6.5 - 8.5. A low pH value of groundwater can increase the corrosiveness of metal objects, cause an unpleasant taste when consumed, and can cause the toxicity of chemical compounds that can harm health. Therefore, processing is needed to increase the pH of the water.

4. CONCLUSION

The conclusion of this study is as follows:

1. The Sp. OPI - Babatan Saudagar - Srijabo Road has been operating with a road stability of 88.6%. The pavement structure is dominated by asphalt for 29.642 km. The road has a service level of B, which means that the traffic flow on the road is stable at all times.
2. The road is a sloping plain with land use consisting of mixed gardens, settlements, rice fields, and ponds. Areas of potential flooding around Pamulutan Barat originating from canals and the Ogan River and potential subsidence are estimated in the track areas formed by swamp and alluvium deposits on soft sand, silt, and clay soil types;
3. The conditions of ambient air quality, noise intensity, and vibration at the time of sampling

DOI: https://doi.org/10.35139/cantilever.v13i2.345

were still good and met quality standards. The pH parameters in the Ogan River when sampling surface water quality and the Dissolved Oxygen (DO) parameters did not meet the quality standards due to the type of soil, which tends to be acidic;

4. Based on groundwater quality analysis, the measured pH is less than 6.5 or does not meet quality standards. A low pH value can increase the corrosiveness of metal objects, cause an unpleasant taste when consume, and cause the toxicity of chemical compounds that can harm health. Therefore, processing is needed to increase the pH of the water.

ACKNOWLEDGEMENTS

We would like to express our sincere thanks for the availability of funding for this research which is sourced from the Provincial Road Implementation Activity, with contract, Number: 700/00230/DLJP /KPA.KONTRAK/VIII/2023 at the Public Works Agency for Highways and Spatial Planning of South Sumatra Province.

REFERENCES

[1] P. Zhao, Z. Li, Z. Xiao, S. Jiang, Z. He, and M. Zhang, "Spatiotemporal characteristics and driving factors of CO2 emissions from road freight transportation," *Transp Res D Transp Environ*, vol. 125, Dec. 2023, doi: 10.1016/j.trd.2023.103983.

[2] A. M. Mbandi, C. S. Malley, D. Schwela, H. Vallack, L. Emberson, and M. R. Ashmore, "Assessment of the impact of road transport policies on air pollution and greenhouse gas emissions in Kenya," Sep. 01, 2023, *Elsevier Ltd*. doi: 10.1016/j.esr.2023.101120.

[3] F. Fachinger, F. Drewnick, and S. Borrmann, "How villages contribute to their local air quality – The influence of traffic- and biomass combustion-related emissions assessed by mobile mappings of PM and its components," *Atmos Environ*, vol. 263, Oct. 2021, doi: 10.1016/j.atmosenv.2021.118648.

[4] M. Sangaramoorthy *et al.*, "Particulate matter, traffic-related air pollutants, and circulating C-reactive protein levels: The Multiethnic Cohort Study," *Environmental Pollution*, vol. 332, Sep. 2023, doi: 10.1016/j.envpol.2023.121962.

[5] A. Stohl *et al.*, "Evaluating the climate and air quality impacts of short-lived pollutants," *Atmos Chem Phys*, vol. 15, no. 18, pp. 10529–10566, Sep. 2015, doi: 10.5194/acp-15-10529-2015.

[6] K. Li, H. Liao, Y. Mao, and D. A. Ridley, "Source sector and region contributions to concentration and direct radiative forcing of black carbon in China," *Atmos Environ*, vol. 124, pp. 351–366, Jan. 2016, doi: 10.1016/j.atmosenv.2015.06.014.

[7] S. C. Anenberg *et al.*, "Impacts and mitigation of excess diesel-related NO x emissions in 11 major vehicle markets," *Nature*, vol. 545, no. 7655, pp. 467–471, May 2017, doi: 10.1038/nature22086.

[8] Z. Klimont *et al.*, "Global anthropogenic emissions of particulate matter including black carbon," *Atmos Chem Phys*, vol. 17, no. 14, pp. 8681–8723, Jul. 2017, doi: 10.5194/acp-17-8681-2017.

[9] H. W. Vallack, O. O. Olawoyin, W. K. Hicks, J. C. I. Kuylenstierna, and L. D. Emberson, "The Global Atmospheric Pollution Forum (GAPF) emission inventory preparation tool and its application to Côte d'Ivoire," *Atmos Pollut Res*, vol. 11, no. 9, pp. 1500–1512, Sep. 2020, doi: 10.1016/j.apr.2020.05.023.

[10] K. Vohra *et al.*, "Rapid rise in premature mortality due to anthropogenic air pollution in fast-growing tropical cities from 2005 to 2018," *Sci Adv*, vol. 8, no. 14, Apr. 2022, doi: 10.1126/sciadv.abm4435.

[11] Y. H. Shr, W. Hsu, B. F. Hwang, and C. R. Jung, "Air quality and risky behaviors on roads," *J Environ Econ Manage*, vol. 118, Mar. 2023, doi: 10.1016/j.jeem.2023.102786.

[12] P. Apparicio, J. Gelb, M. Carrier, M. È. Mathieu, and S. Kingham, "Exposure to noise and air pollution by mode of transportation during rush hours in Montreal," *J Transp Geogr*, vol. 70, pp. 182–192, Jun. 2018, doi: 10.1016/j.jtrangeo.2018.06.007.

[13] M. Brauer *et al.*, "Taking a Stand against Air Pollution—The Impact on Cardiovascular Disease," *Circulation*, vol. 143, no. 14, pp. E800–E804, Apr. 2021, doi: 10.1161/circulationaha.120.052666.

[14] D. E. Schraufnagel *et al.*, "Air Pollution and Noncommunicable Diseases: A Review by the Forum of International Respiratory Societies' Environmental Committee, Part 2: Air Pollution and Organ Systems," Feb. 01, 2019, *Elsevier Inc*. doi: 10.1016/j.chest.2018.10.041.

[15] A. S. V. Shah *et al.*, "Short term exposure to air pollution and stroke: Systematic review and meta-analysis," *BMJ (Online)*, vol. 350, Mar. 2015, doi: 10.1136/BMJ.h1295.

[16] D. N. Lu, H. Di He, H. M. Zhao, K. F. Lu, Z. R. Peng, and J. Li, "Quantifying traffic-related carbon emissions on elevated roads through on-road measurements," *Environ Res*, vol. 231, Aug. 2023, doi: 10.1016/j.envres.2023.116200.

[17] N. Dharmala *et al.*, "Win-win transportation strategies for India: Linking air pollution and climate mitigation," *Energy and Climate Change*, vol. 3, Dec. 2022, doi: 10.1016/j.egycc.2022.100072.

[18] W. J. Requia and H. F. Azevedo de Melo, "Effectiveness of public policies related to traffic emissions in improving air quality in Brazil: A causal inference study using Bayesian structural time-series models," *Atmos Environ*, vol. 319, Feb. 2024, doi: 10.1016/j.atmosenv.2023.120291.

[19] X. R. Fang *et al.*, "Assessing the effects of short-term traffic restriction policies on traffic-related air pollutants," Apr. 01, 2023, *Elsevier B.V.* doi: 10.1016/j.scitotenv.2023.161451.

[20] H. Zhang, K. Tang, W. Feng, X. Yan, H. Liao, and N. Li, "Impact of Short-Term Emission Control Measures on Air Quality in Nanjing During the Jiangsu Development Summit," *Front Environ Sci*, vol. 9, Jul. 2021, doi: 10.3389/fenvs.2021.693513.

[21] H. Wang *et al.*, "Health benefits of on-road transportation pollution control programs in China," 2015,doi:10.1073/pnas.1921271117/-DCSupplemental.

[22] D. Pharma and A. F. Walukouw, "Analysis of Pb Levels as Pollutant in the Waters of the Sentani Lake, Jayapura-Indonesia: Study of Determining Water Quality," 2017. [Online]. Available: www.derpharmachemica.com

[23] D. Montes González, J. M. Barrigón Morillas, and G. Rey-Gozalo, "Effects of noise on pedestrians in urban

environments where road traffic is the main source of sound," *Science of the Total Environment*, vol. 857, Jan. 2023, doi: 10.1016/j.scitotenv.2022.159406.

[24] T. Van Renterghem, E. Vermandere, and M. Lauwereys, "Road traffic noise annoyance mitigation by green window view: Optimizing green quantity and quality," *Urban For Urban Green*, vol. 88, Oct. 2023, doi: 10.1016/j.ufug.2023.128072.

[25] M. Śmieszek, A. Lavrov, V. Mateichyk, J. Mościszewski, V. Fedorov, and V. Yanovskyi, "Analysis of Traffic Noise Pollution Using Siemens Tecnomatix Plant Simulation," *Transportation Research Procedia*, vol. 74, pp. 157–163, 2023, doi: 10.1016/j.trpro.2023.11.125.

[26] A. Pascale, E. Macedo, C. Guarnaccia, and M. C. Coelho, "Smart mobility procedure for road traffic noise dynamic estimation by video analysis," *Applied Acoustics*, vol. 208, Jun. 2023, doi: 10.1016/j.apacoust.2023.109381.

[27] K. R. Czech, "The Impact of the Type and Technical Condition of Road Surface on the Level of Traffic-Generated Vibrations Propagated to the Environment," in *Procedia Engineering*, Elsevier Ltd, 2016, pp. 1358–1367. doi: 10.1016/j.proeng.2016.06.160.

[28] J. M. Barrigón Morillas, D. Montes González, and G. Rey Gozalo, "A review of the measurement procedure of the ISO 1996 standard. Relationship with the European Noise Directive," Sep. 15, 2016, *Elsevier B.V.* doi: 10.1016/j.scitotenv.2016.04.207.

[29] Badan Standardisasi Nasional, "SNI 6989.57:2008 Air dan Air Limbah - Bagian 57: Metoda pengambilan contoh air Permukaan," 2008.

[30] Badan Standardisasi Nasional, "SNI 6989.58-2008 Air dan Air Limbah - Bagian 58: Metoda pengambilan contoh air tanah," 2008.

DOI: https://doi.org/10.35139/cantilever.v13i2.345