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The Study of Air Quality and Risk Assessment at the Location of the Planned Railroad Between Makassar-Parepare, South Sulawesi, Indonesia

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ABSTRACT

The National Railway Master Plan, it is stated that the target of developing the railway network in South Sulawesi Province is to connect areas that have the potential for transporting passengers and goods to support the development of integration between districts. The construction of the railway line has the potential to reduce air quality and health risks to the community around the location. This study aims to assess air quality and its risks during the construction of the railway line from Makassar to Parepare as a reference for environmental management and monitoring plan documents. Air sampling was made using multiple impinger and dust with a hi-volt dust sampler and then analyzed in the laboratory and compared with the Air Pollution Standard Index. Analysis of potential pollutants on health was carried out using the Environmental Health Risk Assessment method. The results showed that the air quality at the time of the study was still below the threshold value, and the environmental health risk assessment was still below the value with RQ > 0.1 except for SO_2 in adults. The conclusion of the study shows that the air quality at the time of the construction of the railway line is still relatively good, and environmental management and monitoring have been carried out quite well based on the direction of the environmental management and monitoring plan including implementing a green open space management program.

INTRODUCTION

Rail transportation is a cheap and safe mode of land transportation, so it is very suitable for developing economic countries such as Indonesia, but in reality, in the land transportation system, the current rail transportation mode is relatively underdeveloped compared to other land transportation modes, this is due to inadequate supporting infrastructure (Saremi 2020). The development of railway infrastructure in Indonesia needs to be developed in all parts of Indonesia so that economic development can develop properly and evenly to all corners of the region which will have a significant impact. have impact on the condition of the national economy (Siagian 2017). Based on the South Sulawesi provincial government regulation number 0003/P2T-BKPMD/9.24.N/VII/04/2015 in the implementation of the construction of the railway line, it is necessary to study the monitoring and management of the Makassar-Parepare railway line referring to the Environmental Impact Analysis document. which has been compiled. and declared worthy (Isworo 2019). Refers to environmental monitoring and management documents, especially in assessing the impact of air quality and health risks around the construction site (He et al. 2009).

The government regulation concerning the Air Pollutant Standard Index is officially used for determining air quality standards, this is in accordance with the decree of the Minister of the Environment number: KEP 45/MENLH/10/1997 concerning Indonesia's Air Pollutant Standard Index. The parameters used are particulates (PM_{10}), sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), and nitrogen dioxide (NO_2) (Istiqomah & Marleni 2020)

The studies on the impact of air quality on the construction of the Makasar-Parepare railways need to be supported by a study of environmental health risk analysis as one of the environmental management tools used to protect the public health due to the effects of poor air quality. The Environmental health risk analysis is used as an environmental impact approach which is a tool to identify, understand, and predict the conditions and characteristics of pollutants that have the potential to pose health risks (Khan 2018)

This study aims to determine the condition of air quality and the level of health risk of residents living at the construction site of the Makassar-Parepare railway so that it can be input for stakeholders in formulating environmental management and health risk control.

MATERIALS AND METHODS

The air quality parameters measured are: Total Suspended Particulate, Sulfur Dioxide (SO_2), Nitrogen dioxide (NO_2), Carbon monoxide (CO), Pb (Lead), and Hydrocarbons (HC) based on the predetermined Air Pollutant Standard Index parameters by the Ministry of Environment and Forestry of the Republic of Indonesia (Putra & Sitanggang 2020)

Sampling locations and air quality sampling were carried out at location points covering 5 districts in South Sulawesi Province. Sampling locations that represent the location of settlements, public facilities, as well as trade, and services are given in Table 1.

Fig. 1 is the sampling location. Primary data on ambient air quality was collected by air sampling, measurement, and laboratory analysis. Air samples were taken with the Multiple Impinger tool. This air sample is then given a preservative

Table 1: Data collection methods and justification for air quality sampling period 1 (August 2019) and period 2 (October 2019).

Location	Coordinate	Number of measurement points	Method	Technical justification
Makassar	S: 05°06'40.72" E: 119°26'18.49"	1 sample point at the location of New Port Makassar	24 hours sampling, laboratory analysis	Air quality sampling locations are representative:
Maros	S: 05°02'19.32" E: 119°32'24.15" (Period 1) and S: 05°00'54.35" E: 119°32'57.49" (Period 2)	2 sample points at Marussu and Mandai locations	24 hours sampling, laboratory analysis	a) Location of paths traversed by equipment and material mobilization vehicles
Pangkep	S: 04°52'22.74" E: 119°35'04.35" (Period 1) and S: 04°49'54.64" E: 119°34'11.65" (Period 2)	2 sample points in Minasa Te'ne and Pangkajene locations	24 hours sampling, laboratory analysis	b) Residential settlements around the project site
Barru	S: 04°49'54.64" E: 119°34'11.65" (Period 1) S: 04º24'07.32" E:119º37'48,52"(Period 2)	2 sample points on Baru and Sepee locations	24 hours sampling, laboratory analysis	
Parepare	S: 03°59'26.37" E:119°38'45.65"	1 sample point in the location area of Soreang	24 hours sampling, laboratory analysis	

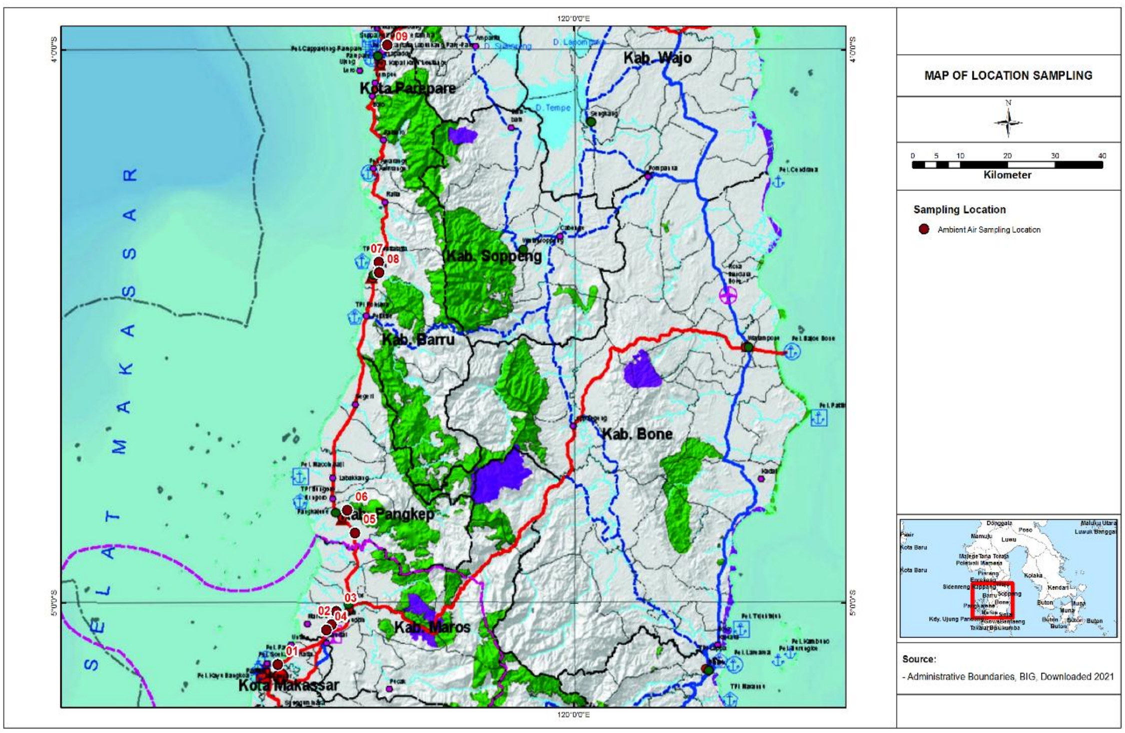

Fig. 1: Sampling location.

(H_2SO_4 or $HgCl_2$) and then analyzed in the laboratory, for dust particles, samples are taken with a dust sampler (hi-volt tool) and then analyzed in the laboratory (Sahu & Sahu 2019) The air quality parameter analysis methods are presented in Table 2.

Analysis of air quality parameter data by comparing the data from the sample analysis with the applicable ambient air quality standards, while the calculation of health risks refers to the Environmental Health Risk Assessment guidelines of the Indonesian Ministry of Health (Gusti & Yurnal 2019). Risk calculation is performed on the elements Total Suspended Particulate, NO_2, SO_2, and Pb as follows (Licina et al. 2017):

$$I = \frac{\mathrm{C}\ x\ \mathrm{R}\ x\ \mathrm{tE}\ x\ \mathrm{fE}\ x\ \mathrm{Dt}}{\mathrm{Wb}\ x\ \mathrm{tavg}}$$

Where:
I: Intake
C: Concentration
R: Intake rate ($m^3.hour^{-1}$)
tE: Exposure time per day ($hour.day^{-1}$)
fE: Frequency of exposure in a year ($day.year^{-1}$)
Dt: Duration of exposure, realtime (30 years projection)
Wb: Weight (kg)
t_{avg}: average period, 30 years × 365 days/year (non carcinogenic) or 70 years × 365 days/year (carcinogenic)

The level of risk of non-carcinogenic effects is expressed in the notation Risk Quotient (RQ) which is obtained through the following equation (Das 2020). The Table 3 provides information on non-carcinogenic risk rate.

$$RQ = \frac{Ink}{RfC}$$

Where,

RQ > 1, so the concentration of risk agents will have an impact on health.

RQ ≤ 1, so concentration is not yet at risk of causing health effects.

RESULTS AND DISCUSSION

The study was conducted on the existing condition of the Makassar-Parepare railway line which includes several segments, namely the ongoing segment and the completed segment. Segment 1: The construction of railroad crossings in Barru Regency, with a length of ± 20 km KM 76+200 to KM 92+300 has been completed. Segment 2: The construction of the railway line that crosses Barru-Palanro Regency along ± 40 Km, in the process of completion at KM 73+600 to KM 76+200 and KM 92+300 to KM 119+150 along 28 km. Segment 3: The construction of a 62.95 km railway crossing in the Barru-Mandai district in the development plan. Management and monitoring studies are carried out periodically so that the construction of the railway line is completed.

Air Quality

Based on a review of the environmental impact analysis document that during the construction phase of the railway line construction, especially in land clearing, material transportation, excavation, or soil stockpiling, the construction of flyovers can cause a decrease in ambient air. Fig. 2 is the source of the impact of activities that cause a decrease in air quality.

Table 4 shows the results of the comparison between air

Table 2: Air sample collection and analysis methods.

No	Parameter	Data collection	Analysis method	Quality standards (Azis 2011)
1	Total Suspended Solids	Sampling, laboratory analysis	Gravimetry (Hamiresa et al. 2006)	230 $\mu g.Nm^{-3}$
2	NO_2	Sampling, laboratory analysis	Saltzman (Ramadhani 2018)	150 $\mu g.Nm^{-3}$
3	SO_2	Sampling, laboratory analysis	Spectrophotometer (Ashadi 2020)	365 $\mu g.Nm^{-3}$
4	Pb	Sampling, laboratory analysis	Atomic Absorption Spectrophotometer (Ferreira et al. 2018)	0.5 $\mu g.Nm^{-3}$
5	CO	Sampling, laboratory analysis	Titrimetric (Wu et al. 2019)	10.000 $\mu g.Nm^{-3}$
6	HC	Sampling, laboratory analysis	Gas chromatography (Johnsen 2017)	160 $\mu g.Nm^{-3}$

Table 3: Information on non-carcinogenic risk rate.

Notation	Information
Non-carcinogenic intake	The intake is calculated using the formula of non-carcinogenic intake exposure through the inhalation tract
RFC (Reference of Concentration)	The reference value of risk agents in exposure to the inhalation tract is contained in the literature. www.epa.gov/iris (Dourson 2018)

quality during the preparation of the environmental baseline for the 2014 environmental impact analysis activity and the results of monitoring period I (1 August 2019) and period II (17 October 2019) and then carried out health risk analysis on Pb, Total Suspended Solid, SO_2 and NO_2 (Table 5). Environmental Management standard indicators, based on government regulation no. 41 of 1999 concerning air pollution control (Maryati 2012), and regulation of the governor of South Sulawesi No. 69 of 2010 concerning quality standards for environmental damage criteria (Zakaria & Aly 2020) and air quality index EPA (Bishoi et al. 2009). Fig. 3 is the air quality measurement activity.

Air quality monitoring activities were carried out in Barru Regency as a sampling location to monitor construction activities that have been carried out since 2018 and the construction of the "fly over" railroad since 2019, while air quality monitoring activities were carried out in Maros regency, Pangkep regency, Makassar city, and Parepare regency aim to monitor pre-construction stage activities since 2019.

The results of the comparison of air quality measurements during the preparation of the initial environmental assessment environmental impact analysis (2014) and environmental monitoring periods 1 and 2 (2019) in Makassar, Maros, Pangkep, Maros, Baru, and Parepare, for the parameters of Total Suspended Particulate, Carbon Monoxide (CO), Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Hydrocarbon (HC), Lead (Pb) the results are below the quality standard index, even the results of air quality measurements in environmental monitoring activities are lower than the results of measurements in when preparing environmental baselines for environmental impact analysis activities (Istiqomah & Marleni 2020)

Temperature is one of the meteorological factors that affect the dispersion of pollutants in the ambient air. The temperature range at the location of the air quality sampling ranged from 28.1^{o}C-36.2^{o}C. This condition is relatively in the uncomfortable zone > 27.1^{o}C (Indonesian Thermal Comfort Standard SNI T-14-1993-03). However, all workers involved in the construction of the railway line have used protective equipment to deal with thermal discomfort due to temperature, while the community around the project location has adapted to the tropical temperature (Ussiri & Lal 2017). Wind speed is also one of the meteorological factors that affect the dispersion of pollutants in the ambient air. The measurement results based on table 4, the wind speed values at the study site ranged from 0.5 $m.s^{-1}$ - 4.9 $m.s^{-1}$, including the rather calm category (Beaufort scale) so they are relatively unobtrusive (Hasan et al. 2017). Air humidity affects the dispersion of pollutants in the ambient air. Sampling results show that humidity ranges from 36.2% - 58.98% (warm comfortable category). Standard Procedures for Energy Conservation Technical Planning in Buildings is 60% still meets the requirements (Huang et al. 2020). The results of CO measurements at the sampling locations ranged

Fig. 2: Activities of land clearing, material transportation, flyover construction, excavation or stockpiling of soil and excavators.

Fig. 3: Measurement of air quality for period 1 and period 2.

Table 4: The comparison of air quality in the preparation of environmental baselines environmental impact analysis (2014) and environmental monitoring Period 1 (August 2019), and Period 2 (October 2019).

		Makasar			Maros					Pangkep				
Parameter	Unit	EIA (2014)	Period 1	Peri-od 2	EIA (2014)	Periode1 1*)	Period 1 2*)	Period 2 1*)	Period 2 2*)	EIA (2014)	Period 1 1*)	Period 1 2*)	Period 2 1*)	Period 2 2*)
Air temperature	^0C	33	31.85	31.4	35.1	30.75	31	28.9	31.3	36.2	30.9	28.1	31.5	32.2
Humidity	%	44.3	40.8-65.9	63.3	39.7	44.4-60.2	46.6-	50.7	58.98	44.2	36.2-48.3	38.3	57.87	45.49
Wind velocity	$Km.hour^{-1}$	4.9	1.6	0.9	4.45	1.25	0.85	0.9	0.5	2.85	1.35	0.5	2.04	2.04
Dust (TSP)	$\mu g.Nm^{-3}$	96.46	212	153	96.83	209	204	60	56	93.72	184	194	66	63
Carbon Monoxide (CO)	$\mu g.Nm^{-3}$	755.73	<1150	7450	754.65	<1150	<1150	1198	5230	800.76	2108	<1150	2393	7865
Sulfur Dioxide (SO_2)	$\mu g.Nm^{-3}$	72.86	<8.28	150	73.34	<8.28	<8.28	35	65	70.38	<8.28	<8.28	56	113
Nitrogen Dioxide (NO_2)	$\mu g.Nm^{-3}$	37.06	<6.5	2	38.76	<6.5	<6.5	<0.4	<0.4	33.6	<6.5	<6.5	<0.4	<0.4
Hydrocarbons (HC)	$\mu g.Nm^{-3}$	-	29.8	10	-	<30.5	29.4	2	3	-	29.6	29.7	3	11
Lead (Pb)	$\mu g.Nm^{-3}$	<0.01	0.01	0.01	<0.01	<0.01	<0.002	0.004	0.01	<0.01	<0.002	<0.002	0.01	0.006

		Baru			Parepare					Air Pollution Index
Parameter	Unit	EIA (2014)	Period 1	Period 2	EIA (2014)	Period 1 1*)	Period 2 2*)	Peri-ode 1 1*)	Period 2 2*)	Quality standards
Air temperature	^0C	33.8	31.05	30.7	35.1	30.5	30.5	28.9	31.3	No Standard
Humidity	%	41	44-53.2	49.65	39.7	44-60	46-60	50.7	58.98	No Standard
Wind velocity	Km/hour	3.8	1.35	0.33	4.45	1.25	1.35	0.9	0.5	$5\ Km.h^{-1}$
Dust (TSP)	$\mu g.Nm^{-3}$	75.93	225	76	96.83	209	204	60	56	$230\ \mu g.Nm^{-3}$
Carbon Monoxide (CO)	$\mu g.Nm^{-3}$	790.16	1342	5971	754.65	<1150	<1150	198	5230	$10.000\ \mu g.Nm^{-3}$
Sulfur Dioxide (SO_2)	$\mu g.Nm^{-3}$	59.6	<8.28	120						$365\ \mu g.Nm^{-3}$
Nitrogen Dioxide (NO_2)	$\mu g.Nm^{-3}$	38.11	<6.5	<0.4	38.76	<6.5	<6.5	<0.4	<0.4	$150\ \mu g.Nm^{-3}$
Hydrocarbons (HC)	$\mu g/Nm^3$	-	30.3	10	-	<30.5	29.4	2	3	$160\ \mu g.Nm^{-3}$
Lead (Pb)	$\mu g.Nm^{-3}$	<0.01	0.01	0.01	<0.01	<0.01	<0.002	0.004	0.01	$0.5\ \mu g.Nm^{-3}$

Note :
EIA = Environmental Impact Assessment
Quality standards based on government regulation no. 41 of 1999, regulation of the governor of South Sulawesi No. 69 of 2010, and air quality index EPA

from 755.73 g.Nm^{-3} - 5230 g.Nm^{-3}, this value is still below the threshold value of the Air Pollution Standard Index, which is 10.000 g.Nm^{-3}. Carbon monoxide (CO) gas above the threshold value is an inhibitor of the respiratory chain, an inhibitor of oxidative phosphorylation, and breaks the oxidative phosphorylation circuit in cells (Stucki & Stahl 2020). NO_2 and SO_2 levels in the air if they are above the Air Pollution Standard Index will have a negative impact, which can cause respiratory tract irritation and increased mucus secretion in the lungs. The NO_2 measurement results ranged from 0.4 g.Nm^{-3}-38.11 g.Nm^{-3} below the threshold value of 150 g.Nm^{-3} and the SO_2 measurement results ranged from 8.28 g.Nm^{-3}-150 g.Nm^{-3} (threshold value of 230 g.Nm^{-3}) (Agus 2020). Exposure to total suspended particulate in humans for a long time can irritate the respiratory system and can even enter the lungs, depositing in the alveoli, causing a chronic obstruction. The measurement results at the sampling location ranged from 56 g.Nm^{-3} - 209 g.Nm^{-3}, this value is below the threshold value of 230 g.Nm^{-3} (Gusti & Yurnal 2019). Pb levels can cause lead poisoning caused by the accumulation of these substances in human body tissues, even Lead (Pb) can be biomagnified in food web systems and is carcinogenic. The measurement results ranged from 0.01 g.Nm^{-3} - 0.004 g/Nm^{3} below the threshold value of 0.5 g.Nm^{-3} (Ali et al. 2019).

Environmental Health Risk Analysis

Environmental Health Risk Analysis is one of the risk management tools used to protect public health due to the impact of poor air quality (Glasson & Therivel 2019). The legal basis for Environmental health risk analysis in the study of environmental impacts is the Minister of Environment Regulation No. 05 of 2012 (Susanto & Mulyono 2018). Environmental health risk analysis used as an environmental impact assessment approach is a tool to identify, understand, and predict environmental conditions and characteristics that have the potential to pose health risks (Cohrssen & Covello 1999) The results of a public health survey of 80 residents in the study area showed that in the last 6 months as many as 25% of the population had complaints of health problems, while the remaining 75% said they had no complaints of illness. Most complaints related to influenza (10.0%). cough (8.75%) and fever (6.25%). Incidents of flu and cough symptoms specifically related to construction activities occurred in Barru Regency, where residents lived around the flyover construction site. Further evidence is needed on the correlation between improved air quality and public health conditions around the railway line construction site by conducting an environmental health risk analysis (Glasson & Therivel 2019).

Based on Tables 5 and 6, the health risk assessment is still in the good category, at the Risk Level Value < 1 (RQ < 1), and the impact of air quality does not need to be controlled. The possible health risk in a small population is the SO_2 parameter that indicates the potential risk to the adult population (Irianto & Kusumayati 2020)

Fig. 4: Air quality management activities.

Table 5: The results of the risk analysis at the Makassar-Parepare railway construction site in the monitoring period 1.

Period 1		Makassar			Mandai, Maros			Marusu, Maros			Minasatene, Pangkep		
Category	Parameters	Concentration [μg.Nm^{-3}]	Intake [mg.kg^{-1}.day^{-1}]	Risk Level	Concentration [μg.Nm^{-3}]	Intake [mg.kg^{-1}day^{-1}]	Risk Level	Concentration [μg.Nm^{-3}]	Intake [mg.kg^{-1}day^{-1}]	Risk Level	Concentration [μg.Nm^{-3}]	Intake [mg.kg^{-1}.day^{-1}]	Risk Level
Man	Pb	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Woman	Pb	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Children	Pb	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Man	TSP	212	0.06	0.02	209	0.06	0.02	204	0.06	0.02	184	0.05	0.02
Woman	TSP	212	0.07	0.03	209	0.07	0.03	204	0.07	0.03	184	0.06	0.03
Children	TSP	212	0.03	0.01	209	0.03	0.01	204	0.03	0.01	184	0.03	0.01
Man	SO_2	8.28	0.00	0.09	8.28	0.00	0.09	8.28	0.00	0.09	8.28	0.00	0.09
Woman	SO_2	8.28	0.00	0.11	8.28	0.00	0.11	8.28	0.00	0.11	8.28	0.00	0.11
Children	SO_2	8.28	0.00	0.05	8.28	0.00	0.05	8.28	0.00	0.05	8.28	0.00	0.05
Man	NO_2	6.50	0.00	0.09	6.50	0.00	0.09	6.50	0.00	0.09	6.50	0.00	0.09
Woman	NO_2	6.50	0.00	0.11	6.50	0.00	0.11	6.50	0.00	0.11	6.50	0.00	0.11
Children	NO_2	6.50	0.00	0.05	6.50	0.00	0.05	6.50	0.00	0.05	6.50	0.00	0.05
Period 1		Pangkajene, Pangkep			Baru, Barru			Soreang, Parepare					
Category	Parameters	Concentration [μg.Nm^{-3}]	Intake [mg.kg^{-1}.day^{-1}]	Risk Level	Concentration [μg.Nm^{-3}]	Intake [mg.kg^{-1}.day^{-1})	Risk Level	Concentration [μg.Nm^{-3}]	Intake [mg.kg^{-1}.day^{-1}]	Risk Level			
Man	Pb	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00			
Woman	Pb	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00			
Children	Pb	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00			
Man	TSP	194	0.05	0.02	225	0.06	0.03	226	0.06	0.03			
Woman	TSP	194	0.07	0.03	225	0.08	0.03	226	0.08	0.03			
Children	TSP	194	0.03	0.01	225	0.03	0.01	226	0.03	0.01			
Man	SO_2	8.28	0.00	0.09	8.28	0.00	0.09	8.28	0.00	0.09			
Woman	SO_2	8.28	0.00	0.11	8.28	0.00	0.11	8.28	0.00	0.11			
Children	SO_2	8.28	0.00	0.05	8.28	0.00	0.05	8.28	0.00	0.05			
Man	NO_2	6.50	0.00	0.09	6.50	0.00	0.09	6.50	0.00	0.09			
Woman	NO_2	6.50	0.00	0.11	6.50	0.00	0.11	6.50	0.00	0.11			
Children	NO_2	6.50	0.00	0.05	6.50	0.00	0.05	6.50	0.00	0.05			

Table 6: The results of the risk analysis at the Makassar-Parepare railway construction site in the monitoring period 2.

Period 2		Makassar			Palantikang, Maros			Mandai, Maros			Pangkep		
Category	Param-eters	Concentra-tion [µg. Nm^{-3}]	Intake [mg.kg^{-1}. day^{-1}]	Risk Level	Concentra-tion [µg. Nm^{-3}]	Intake [mg.kg^{-1}. day^{-1}]	Risk Level	Concentra-tion [µg. Nm^{-3}]	Intake [mg. kg. $^{-1}$.day^{-1}]	Risk Level	Concentra-tion [µg. Nm^{-3}]	Intake [mg. kg^{-1}·day^{-1}]	Risk Level
Man	Pb	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
Woman	Pb	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
Children	Pb	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
Man	TSP	153	0.04	0.02	60.0	0.02	0.01	56.0	0.02	0.01	63.0	0.02	0.01
Woman	TSP	153	0.05	0.02	60.0	0.02	0.01	56.0	0.02	0.01	63.0	0.02	0.01
Children	TSP	153	0.02	0.01	60.0	0.01	0.00	56.0	0.01	0.00	63.0	0.01	0.00
Man	SO_2	150	0.04	1.58	35.0	0.01	0.37	65.0	0.02	0.69	113	0.03	1.19
Woman	SO_2	150	0.05	2.01	35.0	0.01	0.47	65.0	0.02	0.87	113	0.04	1.52
Children	SO_2	150	0.02	0.89	35.0	0.01	0.21	65.0	0.01	0.38	113	0.02	0.67
Man	NO_2	2.00	0.00	0.03	0.40	0.00	0.01	0.40	0.00	0.01	0.40	0.00	0.01
Woman	NO_2	2.00	0.00	0.03	0.40	0.00	0.01	0.40	0.00	0.01	0.40	0.00	0.01
Children	NO_2	2.00	0.00	0.02	0.40	0.00	0.00	0.40	0.00	0.00	0.40	0.00	0.00
Period 2		Pangkajene, Pangkep			Baru, Barru			Soreang, Parepare					
Category	Param-eters	Concentra-tion [µg. Nm^{-3}]	Intake [mg. kg^{-1}. day^{-1}]	Risk Lev-el	Concentration [µg.Nm^{-3}]	Intake [mg.kg^{-1}. day^{-1}]	Risk Level	Concentra-tion [µg. Nm^{-3}]	Intake [mg. kg^{-1}.day^{-1}]	Risk Level			
Man	Pb	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00			
Woman	Pb	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00			
Children	Pb	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00			
Man	TSP	66.0	0.02	0.01	76.0	0.02	0.01	27.0	0.01	0.00			
Woman	TSP	66.0	0.02	0.01	76.0	0.03	0.01	27.0	0.01	0.00			
Children	TSP	66.0	0.01	0.00	76.0	0.01	0.01	27.0	0.00	0.00			
Man	SO_2	56.0	0.02	0.59	120	0.03	1.26	27.0	0.01	0.29			
Woman	SO_2	56.0	0.02	0.75	120	0.04	1.61	27.0	0.01	0.36			
Children	SO_2	56.0	0.01	0.33	120	0.02	0.71	27.0	0.00	0.16			
Man	NO_2	0.40	0.00	0.01	0.40	0.00	0.01	0.40	0.00	0.01			
Woman	NO_2	0.40	0.00	0.01	0.40	0.00	0.01	0.40	0.00	0.01			
Children	NO_2	0.40	0.00	0.00	0.40	0.00	0.00	0.40	0.00	0.00			

Policymakers will carry out air quality management activities by implementing a green open space management program with a minimum area of 10% (Maryanti et al. 2017) Some references that the Angsana plant (Pterocarpus indicus) can reduce CO_2 up to 70% SO_2 up to 50% (Laksono & Damayanti 2015) and; the Tamarind plant (Tamarindus indica) can reduce CO_2 up to 80% and SO_2 up to 90% and the umbrella plant Tiara (*Felicium decipiens*) can reduce CO_2 up to 70% and SO_2 up to 60% (Kusminingrum 2008).

Air Quality Management

Air quality management at the Makassar-Parepare railway construction site has been carried out properly through compliance evaluation so that all air quality parameters are below the threshold value. Management is carried out by regularly watering locations that have the potential to generate dust, limiting vehicle speed to a maximum of 40 $km.h^{-1}$, especially when passing through residential areas, installing traffic signs for speed limiting, avoiding material spills during the transportation process by covering the material with tarpaulins and every wheel of the vehicle that will leave the project site is cleaned in the cleaning poo (Fig. 4).

Caption: a) Periodic watering in potential locations. b) Installation of traffic signs around construction activity sites c) Material transport trucks have used tarpaulin covers on the tailgates, d) Cleaning up spilled material. e) Placing traffic control officers when transporting materials

CONCLUSIONS

Parameters Total Suspended Particulate, Carbon Monoxide (CO), Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Hydrocarbons (HC), Lead (Pb) are below the quality standard Air Pollution Index, and the level of health risk (RQ) < 1.

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