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Monitoring of Surface Water Quality in Train Development Activities Plan between Makasar and Parepare, South Sulawesi Indonesia

Slamet Isworo[1*], Poerna Sri Oetari[2], Indah Nur Alita[2] and Tosan Adji[2]

[1]*Departement of Environmental Health, Universitas Dian Nuswantoro, Jl. Imam Bonjol 207, Semarang 50131, Central Java, Indonesia.*
[2]*Environmental Impact Assessment, PT. Mitra Adhi Pranata, Jl. Cemara IV No. 45, Padangsari, Banyumanik, Semarang 50263, Central Java, Indonesia.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Case Study

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ABSTRACT

Background and Objectives: The plan for the construction of the Makassar - Parepare railway line is the priority for the development of the land transportation mode in South Sulawesi. The development plan has received an environmental permit which was then continued with a monitoring study.

Methodology: Descriptive analysis methods are then compared with quality standards based on South Sulawesi Governor Regulation No. 69 of 2010. Physical parameters with organoleptic and conductivity methods. Heavy metal parameters using the Atomic Absorption Spectrophotometry method. Aquatic biota parameters are based on the Shannon wiener diversity index.

The Results: The measurement results of the pre-construction stage addressing parameters that exceed the quality standard are turbidity. Measuring the monitoring period I, all parameters still meet quality standards, except Total Dissolved Solids and Cadmium, while other parameters are not required. Measurement. Period II, at all measurement locations the parameters of Total Dissolved Solids, Total Suspended Solid, Chemical Oxygen Demand and Dissolved Oxygen exceed the quality standards of the Diversity Index (H') results of the pre-construction period with the value

*Corresponding author: E-mail: slamet.isworo@dsn.dinus.ac.id, slametisworo512@gmail.com;

(H') = 1.92, (D) = 66, (E) = -, mild pollution waters category. Period 1 (H') = 0.24, (D) = 0.88, (E) = 0.35, the category of moderately polluted. Period II (H') = 0.78, (D) = 0.22, (E) = 0.49, the category of moderately polluted waters.

Conclusions: Monitoring results show an increase in surface water pollution from mild to moderate.

Keywords: Environmental monitoring; surface water; physical; chemical and biological parameters; diversity index; environmental pollution.

1. INTRODUCTION

Indonesia as an active country to improve the economy in all regions, therefore adequate supporting infrastructure is needed. Therefore, it is necessary to develop the most effective and appropriate transportation infrastructure for the vast territory of Indonesia, in this case, the Indonesian government is developing a railroad transportation mode. The development of land transportation mode which is the priority of the Indonesian government in the Sulawesi island region is the rail transportation mode, which is the acceleration of the development of railroad infrastructure that connects the city of Makassar and the city of Parepare and is expected to improve the economy in Sulawesi and its surroundings [1]. The development of the Trans Sulawesi Railway is expected to foster economic stimulus and facilitate transportation between regions on the island of Sulawesi. The railway will also be integrated with Hasanuddin International Airport in Maros Regency, Garongkong port in Barru [2].

Referring to the Law of the Republic of Indonesia No. 23/2007 concerning Railways, and Government Regulation No. 56/2009 on Railroad Operations has been mandated to prepare Railways Master Plans related to current conditions, strategic environmental studies, spatial planning, transportation feasibility, railroad technology, national development paradigms, the role of private investment in supporting the railway sector [3]. Indonesian Minister of Transportation Regulation Number PM. 43 of 2011 concerning the National Railway Master Plan, that the target of developing the railroad network in Sulawesi Island is to connect regions / cities that have the potential to transport passengers and goods or large-scale, high-speed commodity products, with low energy use and support city development integrated through the integration of cities in the coastal region, both industry and tourism and agropolitan (The city based of agribusiness) [4,5].

Regulation of the Minister of Environment and Forestry of Indonesia in No 38/2019, the construction of railroad tracks on a large scale is required to conduct an analysis study of environmental impacts and be advanced with a study of environmental management and environmental monitoring of impacts due to activities [6]. The Study on Environmental Impact Analysis of the development of the railroad line between Makasar and Parepare has been carried out and approved by the Regional Government of South Sulawesi so that as a follow-up, the development of a monitoring study on the impacts of the activity is needed [5]. The railroad line between Makassar-Parepare is one of the tracks proposed in the study of the preparation of a master plan for the development of a railroad track on the island of Sulawesi. The Makassar-Parepare Railroad Development Plan along ± 146.75 km across five regencies/cities in the province of South Sulawesi, namely Makassar City, Maros regency, Pangkep regency, Barru regency and Parepare city [7].

The environmental monitoring study in this study was carried out on surface water quality, namely the physical, chemical parameters and diversity status of plankton and benthos in the area of the study site [8]. The indicators of pollution in water bodies can be assessed based on changes in water quality physically, chemically and biologically, so that it is used in estimating and providing an overview of the level of water pollution. Physical parameters that can be used to determine the level of water pollution are turbidity, odor and color, chemical parameters that can be used to determine the level of water pollution are the acidity of the water (pH), dissolved oxygen, and biochemical oxygen demand while biological parameters are phytoplankton and zooplankton as bio-indicators of the level of water pollution [9]. Biological parameter indicators can be assessed based on saprobity index through analysis of the composition and abundance of phytoplankton, zooplanton and benthos in the waters [10,11]. Another method that can be used to assess an aquatic quality is to assess the physical and chemical quality of a waters including parameters such as pH, water temperature, color, conductance, temperature, total dissolved solids, total suspended solid, total alkalinity, dissolved oxygen, chemical oxygen demand, biochemical oxygen demand and dissolved metal concentrations [9].

Environmental monitoring in the Makassar-Parepare railroad development plan is devoted to monitoring surface water quality and aims to determine the impact caused at the start of the activity compared to the conditions at the time the research was conducted.

2. MATERIALS AND METHODS

2.1 Location of Activities

The site of the conservation construction of the railroad construction between Makasar-Parepare which manages the administration of the area in South Sulawesi which includes the construction of the 142 km and 4.74 km railroad. The location of the Makassar-Parepare railroad development plan passes through five districts / cities is Makassar city, Maros district, Pangkep district, Barru district, and Parepare city (Fig. 1).

2.2 Schedule of Activities

The monitoring work was carried out in October and November 2019 on the track at KM.73 + 600 in the city of Makassar - Km.76 + 200 to Km.92 + 300 - KM.119 + 150 in the city of Parepare.

2.3 Basis for Environmental Monitoring

The basis for conducting an Environmental Monitoring of the Makassar-Parepare Railway Development is an Environmental Impact Analysis document that has been declared feasible by the South Sulawesi Provincial Government's Environmental Agency No. 0003 / P2T-BKPMD / 9.24.N / VII / 04/2015. In this study environmental monitoring is only carried out at the pre-construction stage and part of the construction (construction phase has not yet been completed) with a focus on monitoring surface water quality.

2.4 Description of Location of Activities

The Makassar-Parepare railroad development is carried out along the Makassar-Parepare line, starting from the Tallo station in Makassar at 0 + 000 km to the Soreang station in Parepare at 142 + 565 km along ± 142 km and 4.74 km, with the location of the alignment at Garongkong Port. Based on the results of the activities of implementing the environmental monitoring plan, the components of activities that have an impact

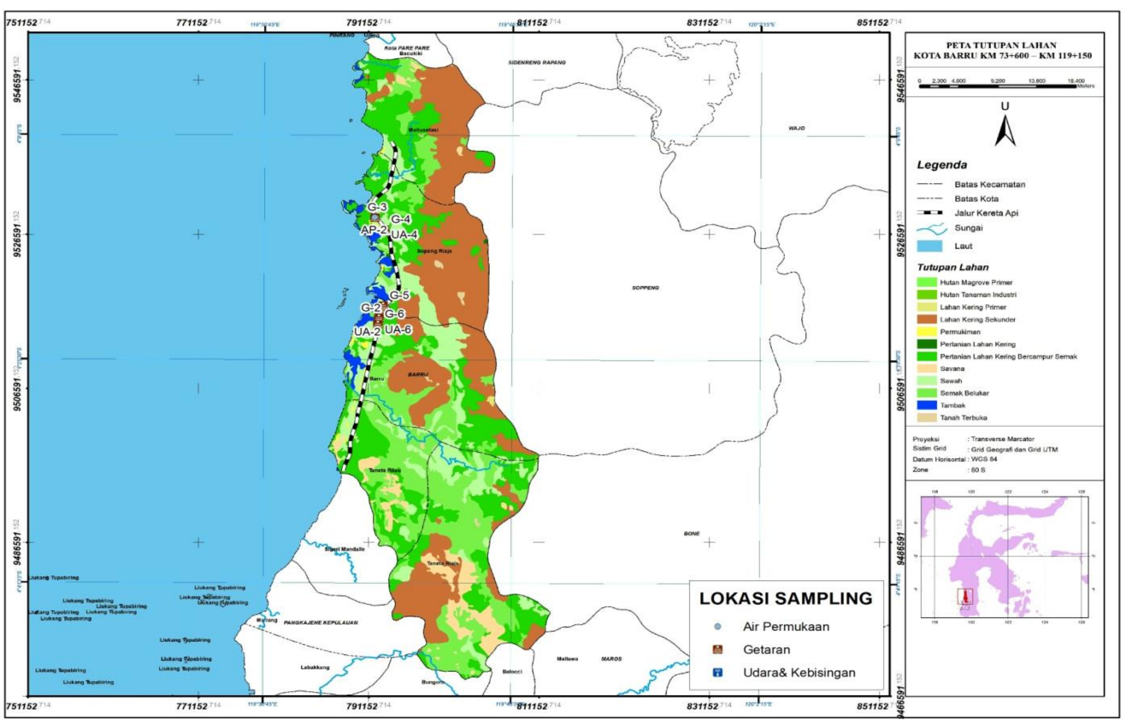

Fig. 1. Sampling location on the Makassar-Parepare railroad development route

and the components of the environment affected during the activity phase will be identified. Pre construction phase, most of the activities are land acquisition and acquisition. At this stage the impact on surface water quality is not significant, the construction phase includes the stage of land clearing activities, fly over construction, terminal construction activities, excavation of land and material transportation activities. this activity can cause a decrease in the quality of surface water quality, changes in the composition of types of aquatic biota and a decrease in land productivity, operation stage (this stage has not been implemented. This research was focused on monitoring surface water quality at the planned train development site from Makassar city to Parepare city at a predetermined monitoring sampling point based on validated environmental impact assessment documents.

2.5 Surface Water Quality

a. Method of collecting data

Surface water sampling is carried out at a predetermined location based on the direction of the analysis of environmental impact documents and then followed by laboratory analysis. The method of data analysis was carried out in a descriptive analysis and compared with South Sulawesi Governor Regulation No. 69 of 2010, concerning surface water quality standards.

b. Description of type and source of impact

Description of the type of impact is a decrease in surface water quality, while the source of the impact is an activity tahat causes a decrease in the quality of surface water, most of the sources of impact are affected by excavation/landfill activities in the railroad construction process.

c. Location of monitoring

The monitoring location is carried out on a river that represents 5 regencies/cities that are crossed by a railroad development plan, which is a river that crosses Makassar city, Maros district, Pangkep district., Barru district, and Parepare city are in accordance with the railroad tracks.

d. Environmental parameters (physics and chemistry)

The monitored environmental parameters include physical parameters such as odor, taste, temperature, color, turbidity, Total Dissolved Solids, Total Suspended Solids. Chemical parameters include PH, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), ammonia (N), arsenic (As), iron (Fe), cadmium (Cd), chloride (Cl), chromium (Cr), hardness ($CaCo_3$), manganese (Mn), zinc (Zn), sulfate (SO_4), copper (Cu), fat oil, Methylene blue active substances/MBAS (detergent), Phenol, Electrical Conductivity, Ca and Phosphate. The biological parameter is *Escherichia coli*, *total coli form*, plankton and benthos diversity.

e. Direction of Environmental Monitoring

The direction of monitoring refers to Government Regulation No. 82 of 2001 concerning Management of Water Quality and Water Pollution Control and South Sulawesi Governor Regulation Number 69 of 2010, concerning quality standards for environmental damage criteria. The time and frequency of monitoring at least once during the excavation / stockpiling stage of the construction of the Makassar-Parepare railway.

f. Surface Water Analysis Results

Water quality measurements are carried out in rivers representing 5 regencies / cities that are traversed by the Makassar-Parepare railroad, with the following sampling locations: location (1) Tallo River, Tallo district, Makassar city, coordinates: S 05°06'16.05 "E 119°26'48.27" , location (2) Maros River, Pallantikang village, Maros Baru district, coordinates: S 05°00'51.58 "E 119°33'00.25", location (3) Pute River, Maccini Baji Village, Lau District, Maros Regency Coordinates: S 04°56'20.65 "E 119°35'12.10", location (4) Minasatene River, Minasatene Village, Minasatene, Pangkep Regency Coordinates: S 04°49'34.76 "E 119°34'11.14", Location 5, Kali Kali Clean River. Padoang Doangan Village, Pangkajene Regency, Pangkep Regency Coordinates: S 04°49'44.91 "E 119°33'43.91" Location (6) Period I: Barru River, Kiru-Kiru Village, Soppeng Riaja District, Barru District Coordinates: S 04°15'32.27"E 119°37'51.15", whereas in Period II samples were taken in the side track embankment embankment area. Garongkong Harbor, Barru Regency Coordinates: S 04°22'42.52 "E 119°37'40.69", location (7) Parepare River, Parepare city coordinates: S 04°02'52.75 "E 119°37'51.39" [12]. The Tables 1,2,3 is the result of surface water (river) quality analysis.

Table 1. The results of the analysis of surface water quality during the environmental impact analysis period on 2-4 October 2014

No	Parameter	Unit	Quality standards	Result analysis						
			Class	Sampling Location						
			IV	1	2	3	4	5	6	7
A.	**Physical**									
1	*Odor*	-	(-)	Normal	Normal	Normal	Normal	Normal	Normal	Normal
2	Taste	-	-	Normal	Normal	Normal	Normal	Normal	Normal	Normal
3	*Temperature*	°C	Deviasi 5	27,8	28	28	28,2	28,1	28,2	27,8
4	Color	TCU	(-)	10	5	10	5	5	5	10
5	*Turbidity*	NTU	(-)	5,88	1,4	4,11	2,88	1,54	3,01	5,88
6	Total *Dissolved Solid*	mg/l	2000	25400	24700	20800	20800	23000	22200	25400
B.	**Chemical**									
1	Aluminum (A l)	mg/l	(-)	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
2	Ammonia as N	mg/l	(-)	0,14	0,12	0,13	0,12	0.3	< 0.05	0,14
2	Arsenic (As)	mg/l	(-)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
4	Besi / Iron (Fe)	mg/l	(-)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
5	Cadmium (Cd)	mg/l	0,01	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
6	Chloride (Cl)	mg/l	(-)	23.286	21341	10.105	18.343	20.348	19167	23.286
7	Chromium (Cr)	mg/l	(-)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
8	Cyanide (CN)	mg/l	(-)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
9	Fluoride (F)	mg/l	(-)	0.4	0,16	< 0.05	0,37	0,36	0,81	0.4
10	Hardness ($CaCO_3$)	mg/l	(-)	7273.54	5236.54	3781.54	5818.54	580.54	677.54	7273.54
11	Manganes (Mn)	mg/l	(-)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
12	Nitrate as N	mg/l	20	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	1.21	< 0.1
13	Nitrite as N	mg/l	(-)	0.02	< 0.01	0.1	0.01	0.14	0.01	0.02
14	pH	-	5 - 8.5	7.1	7.09	7.34	7.08	7.57	7.45	7.1
15	Zinc (Zn)	mg/l	2	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
16	Selenium (Se)	mg/l	0,05	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
17	Sulfate (SO_4)	mg/l	(-)	2007.5	1981	< 0.2	1495	1865.5	1.73	2007.5
18	Copper (Cu)	mg/l	0,2	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005

Table 2. Results of analysis of surface water quality during the monitoring period 1 on 2-4 October 2014

No	Parameter	Unit	Quality standards	Result analysis						
			Class	Sampling Location						
			IV	1	2	3	4	5	6	7
A	**Physics**									
1	Bau			Normal	Normal	Normal	Normal	Normal	Normal	Normal
2	Rasa			Normal	Normal	Normal	Normal	Normal	Normal	Normal
3	Suhu	°C	Air temp. ±5	29.30	28.30	28.80	30.50	29.70	30.10	29.90
4	TDS	mg/L	2000	31	7,650	20,000	9,890	14,200	191	29,600
5	Kekeruhan	NTU	-	0.83	5.69	1.08	0.88	7.08	1.17	7.99
6	Warna	Pt/Co	-	8.47	5.39	16.16	36.17	2.69	76.97	8.08
B.	**Chemistry**									
1	pH	pH unit	5,0-8,5	7.91	7.91	7.48	7.55	7.28	7.77	7.85
1	Nitrat (N)	mg/L	20	<0,05	0.745	0,094	<0.05	0.419	0.428	<0.05
2	Amoniak (N)	mg/L	-	<0,01	0.145	0.132	0.141	0.5	0.058	0.761
3	Arsen (As)	mg/L	1	0.0082	<0.00005	<0.00005	<0.00005	<0.00005	0.006	0.0012
4	Selenium (Se)	mg/L	0,05	<0,006	<0,006	<0,006	<0,006	<0,006	<0,006	<0,006
5	Cadmium (Cd)	mg/L	0,01	0.076	0.023	0.048	0.029	0.036	0.012	0.08
6	Tembaga (Cu)	mg/L	0,2	0.07	<0,004	0.04	0,02	0,02	<0,004	0.05
7	Besi (Fe)	mg/L	-	0.14	0.04	0.07	0.03	0.04	0.04	0.14
8	Mangan (Mn)	mg/L	-	0.08	2.57	0,07	0,06	<0,03	<0,03	0.06
9	Seng (Zn)	mg/L	2	0.025	0.025	<0.004	<0.004	0.028	0.013	0.028
10	Chlorida (Cl)	mg/L	-	19869	4449	11996	5898	8297	11	16120
11	Cyanida (CN)	mg/L	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
12	Fluorida (F)	mg/L	-	1.87	0.59	1.44	2.55	1.75	1.02	4.6
13	Chromium (Cr)	mg/L	-	0.042	<0.00004	0.037	0.023	0.025	0.006	0.064
14	Kesadahan ($CaCO_3$)	mg/L	-	5408	704	3824	1864	2524	114	5368
15	Aluminium (Al)	mg/L	-	0.066	0.149	0.045	0.049	0.039	0.065	0.052
16	Sulfat (SO_4)	mg/L	-	925	685	867	736	663	53	813

Table 3. Results of analysis of surface water quality during the monitoring period II on 11 November 2019

No	Parameter	Unit	Quality standards	Result analysis						
			Class	Sampling location						
			IV	1	2	3	4	5	6	7
A. Physics										
1	Taste	Normal		Normal	Normal	Normal	Normal	Normal	Normal	Normal
2	*Temperature*	-	°C	26	23	29	29	30	26	31
3	Total *Dissolved Solid*	2000	mg/L	680	816	720	482	332	648	792
4	TSS	400	mg/L	140	86	258	122	146	103	74
5	DHL	-	µmhos/cm	>6000	>6000	>6000	>6000	>6000	>6000	>6000
6	*Turbidity*	-	NTU	19	8	3	0,2	5	15	9
7	Color	-	TCU	2	7	13	48	6,5	7	4
B. Chemistry										
1	pH	5--9	pH Unit	7,5	7,4	7,2	6,7	6,5	7,4	7,7
2	BOD	12	mg/L	4	76	68	12	60	11	52
3	COD	100	mg/L	188	236	197	297	166	183	82
4	DO	0	mg/L	8	7	6	8	9	9	6
5	Besi / Iron (Fe)	-	mg/L	0,7	0,1	0,6	0,4	0,3	0,3	0,3
6	Cadmium (Cd)	0,01	mg/L	0,06	0,1	0,02	0,01	0,01	0,02	0,02
7	Chloride (Cl)	-	mg/L	195	106	301	97	110	141	198
8	Chromium (Cr)	-	mg/L	0,1	0,2	0,2	0,03	0,1	0,1	0,1
9	Hardness ($CaCO_3$)	-	mg/L	300	168	427	155	159	252	281
10	Manganes (Mn)	-	mg/L	0,1	0,4	0,1	0,01	0,01	4,7	0,04
11	Seng (Zn)	2	mg/L	0,3	0,1	0,2	0,1	0,1	0,2	0,2
12	Sulfat (SO_4)	-	mg/L	4	0,2	0,8	0,3	0,4	14	2
13	Tembaga (Cu)	0,2	mg/L	0,1	0,1	0,1	0,1	0,1	0,1	0,1
14	Phospat	5	mg/L	0,1	0,04	0,2	0,03	0,03	0,1	0,3
15	Calcium	-	mg/L	5	13	27	11	19	24	16
16	Nitrogen	-	mg/L	0,1	0,1	0,1	0,1	0,1	0,1	0,1
17	Minyak & Lemak	1000	mg/L	0,4	0,3	0,2	0,1	0,2	0,2	0,3
18	Detergen (MBAS)	200	mg/L	0,12	0,1	0,1	0,1	0,1	0,08	0,11
19	Fenol	1	mg/L	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001
20	Arsenic (As)	1	mg/L	0,3	0,1	0,1	0,1	0,05	0,1	0,1
21	Total Coliform	100000	jml/100mL	480	320	360	300	300	330	330
23	Salinitas		°/∞	25	25	25	25	25	25	25

During the monitoring period II, an assessment of plankton and benthos conditions was carried out to determine the quality of the river waters, so that the validity of the assessment would be better. Sampling of aquatic biota is carried out on rivers in the district of Maros because the construction process will begin in January 2020.

2.6 Quality of Aquatic Biota (Phytoplankton & Zooplankton)

a. Type of Impact and source of impact

The type of impact is the composition of the type of aquatic biota while the source of the impact is the existence of excavation and landfill activities in the railway line development process.

b. Location of environmental monitoring

Monitoring locations on the river that represent 5 districts/cities through which the planned railway line construction is in Makassar City, Maros Regency, Pangkep Regency, Barru Regency, and Parepare City. Environmental parameters monitored are the composition of aquatic biota types as indicators of water quality.

c. Method of collecting data

Water sampling at the designated sampling point and followed by laboratory analysis for aquatic biota. Data analysis method: Descriptive analysis by comparing with the initial baseline of development based on the results of the Approved Environmental Impact Analysis with the results of the current analysis.

Plankton and benthos samples were taken at the same sampling point. Phytoplankton and zooplankton sampling were taken using plankton nets with a size of 30-50 μm for phytoplankton and 0.2 mm for zooplankton then given 10% formalin. Plankton and benthos samples are identified using key identification guidelines diversity index analysis based on Shannon-Wiener standard [13].

d. Period of Environmental Monitoring

The period of Environmental Monitoring is carried out by taking samples which are carried out in 2 periods during the stage of excavation / stockpiling of material for the construction of the Makassar-Parepare railroad.

e. The results of the analysis of the quality of aquatic biota

One way to monitor water quality can be done with biological research using phytoplankton indicators. Phytoplankton is used as indicators of water quality because of their short life cycle, very fast response to environmental changes [14]. Phytoplankton are the main producers that produce organic material and oxygen that are useful for aquatic life through photosynthesis. The effects of sunlight in the process of photosynthesis also cause phyto-plankton to be distributed horizontally [15].

Table 4. Plankton diversity in period I

Phytoplankton						
Species	**Family**	**Division**	**ni**	**(%)**	**H’**	**D**
Aphanizomenon sp.	Nostocaceae	Cyanophycota	152	41,67		
Chromulina sp.	Chromulinaceae	Ochrophyta	139	38,10		
Oscillatoria sp.	Oscillatoriaceae	Cyanobacteria	30	8,33		
Coelastrum sp.	Scenesmaceae	Chlorophyta	4	1,19		
Merismopedia sp.	Merismopediaceae	Cyanobacteria	39	10,71		
Abundance (Ind./L)			364	100		0,34
Taxa (S):	5					
Diversity Index (H '):	1,23					
Uniformity Index (E):	0,77					
Dominance Index (D):	0,34					
Zooplankton						
Species	Famili	Filum	ni	(%)	H’	D
Favella sp.	Ptychocylididae	Ciliophora	9	40,00	0,37	
Brachionus sp.	Brachionidae	Rotifera	13	60,00	0,31	
Abundance (Ind./L)			22	100	0,67	0,52
Taksa (S) : 2						
Diversity Index (H '):	0,67					
Uniformity Index (E):	0,97					
Dominance Index (D):	0,52					

Table 5. Plankton diversity in period II

No.	Phytoplankton	Total	No.	Phytoplankton	Total	No.	Zooplankton	Total
1	*Amphiprora sp.*	-	18	*Hemiaulus sinensis*	1061	1	*Acartia sp.*	-
2	*Amphora sp.*	1061	19	*Laudenia borealis*	6366	2	*Nauplius*	1061
3	*Bacillania paradoka*	2122	20	*Navicula sp.*	3183	3	*Microstella sp.*	2122
4	*Bacteriastrum hyalinum*	5305	21	*Nitzschia longissima*	5305	4	*Copepoda sp.*	`
5	*Bacteriastrum varians*	2122	22	*Nitzschia seriata*	16976	5	*Condonellopsis frigida*	2122
6	*Biddulphia mobiliensis*	-	23	*Nitzschia sigma*	3183	6	*Favela campanula*	1061
7	*Biddulphia sinensis*	2122	24	*Pleurosigma angulatum*	-	7	*Leprotintinnus bottnicus*	5305
8	*Chaetoceros brevis*	1061	25	*Pleurosigma elongatum*	3183	8	*Leprotintinus nordqvistii*	4244
9	*Chaetoceros curvisetum*	5305	26	*Pleurosigma sp.*	-	9	*Prodon sp.*	-
10	*Chaetoceros didymus*	4244	27	*Rhizosolenia alata*	3183	10	*Tintinnopsis gracilis*	1061
11	*Chaetoceros laevis*	-	28	*Rhizosolenia arafurensis*	2122	11	*Tintinnopsis radix*	3183
12	*Chaetoceros sp.*	1061	29	*Rhizosolenia calcar-avis*	3183	12	*Tintinnopsis sp.*	6366
13	*Coscinodiscus asteromphalus*	3183	30	*Rhizosolenia stolterfothii*	5305			
14	*Coscinodiscus sp.*	6366	31	*Rhizosolenia sp.*	2122			
15	*Dytilum sol*	2122	32	*Surirella sp.*	2122			
16	*Eucampia sp.*	-	33	*Thalassionema nitzchiodes*	6366			
17	*Gunardia flaccida*	4244	34	*Thalassionema rauenfeldii*	12732			
	Total species (Cell / m3)	116.7					Total species (Cell / m3)	31,830
	Number of taxis	28					Number of taxa	10
	Diversity Index (H ’)	4,43					Diversity Index (H ’)	3,06
	Uniformity Index (E)	0,92					Uniformity Index (E)	0,92
	Dominance Index (C)	0,88					Dominance Index (C)	1,06

Table 6. Results of benthos sample analysis in period 1

Spesies	Family	Phylum	ni	(%)	H'	D
Batillaria sp.	Batillariidae	Mollusca	42	93,33	0,06	0,8711
Nerita sp.	Neritidae	Mollusca	3	6,67	0,18	0,0044
Abundance (Ind./L)			45	100	0,24	0,88
Taxa (S) : 2						
Diversity Index (H ') : 0.24						
Uniformity Index (E) : 0.35						
Dominance Index (D) : 0.88						

Table 7. Results of benthos sample analysis in period II

Species	Total
Gastropoda *(Gastropoda sp.)*	52
Arthropoda *(Microstella sp).*	7
Oligochaeta *(Tubifex sp.)*	3
Number of Individuals (Cell / m3)	62
Number of taxa	3
Diversity Index (H ')	0,78
Uniformity Index (E)	0,49
Dominance Index (C)	0,22

Therefore, Plankton and the benthic saprobity index can be used as a bioindicator of water pollution. The Plankton sample was taken in 2 time periods, namely the period I was conducted on August 1, 2019, while the period II was conducted on October 19, 2019, in the Maros River, Regency Maros (S 05°00'51.58"E; 119º33'00.25").

To determine the condition of the composition, abundance and diversity of benthos species found in water bodies around the planned location, then benthos samples were taken. Benthos samples were taken on August 1, 2019, for the period I and on October 22, 2019, for period II sampling at the Maros River, Regency. Maros (S 05°00'51.58"E; 119º33'00.25"). Results of analysis of benthos samples in the water bodies around the planned location during the period I and period II are presented in the Tables 6 and 7.

3. RESULTS AND DISCUSSION

3.1 Surface Water

Based on the results of laboratory analysis of surface water quality sampling in period I at the seven sampling locations, it was found that the quality of river water measured by most of the parameters still met the quality standard, except for the concentration of Total Dissolve Solid (TDS) and Cadmium (Cd) at all measurement points, while several other parameters there is no quality standard where the levels in river water are quite high, including Ammonia, Chloride, Hardness 500 mg/lt, Sulfate 250 mg/lt and Florida (only at location 1 and location 4). The classification of Hardness in surface water is hardness <50 mg.lt = Low, hardness 50 mg / lt - 150 mg / lt = Medium, hardness 150 mg / lt - 300 mg / lt = high, hardness> 300 mg / lt = Very high, the standard level of chloride in the water surface is <from 100 mg / liter, the standard sulfate concentration <500 mg / l, the standard ammonia concentration in river water <0.5 mg / L. and Flouride concentration standard <1.5 mg / liter. Government Regulation No. 82 of 2001 which regulates the standard quality requirements for class I surface water, that is, water intended for drinking water and other designations that require water quality equal to these uses.

The results of measurements of the total content of dissolved solids) in almost all locations did not meet the quality standards that exceeded 2000 mg / L (Table 2). The highest Total Dissolved Solution measured at the Tallo River location in Makassar (new port) is 31,300 mg / L. The high Total Dissolved Solution indicates that the river water quality has been polluted by both organic and inorganic substances, with a high total Dissolved solid concentration causes increased violence ($CaCO_3$). The high concentration of Total Dissolve Solid due to the disposal of industrial wastes, such as wastewater often containing soap molecules that are soluble in water, detergents and surfactants, is supported by high levels of Ammonia, Cadmium and Chloride. While the results of surface water quality measurements in period II, the results of the analysis of seven sampling locations showed that river water quality measured by most parameters still met the quality standards, except for the Cadmium (Cd) concentration and chemical oxygen demand at almost all measurement points, while some other parameters have no quality standards (governor's regulation of South Sulawesi) where the level in river water is quite high, including Clorida, Chromium, Hardness ($CaCO_3$), Manganese, Sulfate, Calcium and Nitrogen.

The Chemical Oxygen Demand (COD) value exceeds the quality standard (measurement values range from 82 to 297 mg / l, chemical oxygen demand quality standard of 100 mg / l), this indicates that river water has experienced organic pollution, bearing in mind one of the indications if river water has experienced organic pollution is the high value of chemical oxygen demand. The chemical oxygen demand value is inversely proportional to the dissolved oxygen value, if the chemical oxygen demand value is high then the dissolved oxygen value becomes low.

The results of the measurement of dissolved oxygen parameters at all measurement points are in the range of 6-9 mg / l. The pollution in the surface water is very much influenced by internal and external factors. External factors include temperature and dissolved oxygen, so the higher the surface water temperature, the dissolved oxygen value tends to fall. Given that dissolved oxygen (do) is needed by all living bodies for breathing, metabolic processes or exchange of substances which then produce energy for growth and metabolism, besides oxygen is also needed for oxidation of organic and inorganic materials.

The main source of oxygen demand in waters comes from the process of free air diffusion and photosynthesis of chlorophyll organisms that live in the waters. From the measurement results of total suspended solids, almost all locations have an average total suspended solids of 74 - 258 mg / l, so that the total value of suspended solids at all measurement points still meets the quality standards of the Governor of South Sulawesi No. 69 of 2010 concerning quality standards and criteria for environmental damage which is 400 mg / L, with a high total suspended solids value, the turbidity value will be higher and affect the dissolved oxygen value in the waters. Suspended solids in the waters can cause photosynthesis of organisms to be inhibited because sunlight cannot penetrate into the waters. Photosynthesis is an oxidation reduction reaction process that produces oxygen which is a source of oxygen in these waters [16].

Evaluation of surface water quality trends in the main parameters of river water quality during bridge construction activities is the total of suspended solids, turbidity, and temperature parameters. Bore pile construction activities that produce muddy co-material, in the implementation of drilling mud containing mud material discharged directly into the river water body, which will cause a decrease in river water quality, namely an increase in temperature and an increase in TSS which results in increased turbidity. When preparing the environmental impact analysis document in 2014, the surface water quality temperature at the time of measurement was below 30°C, while at the time of monitoring the environmental quality measurement period I in 2019 in July, the average temperature measured was 28.3 - 30.5 and in the measurement period II in October the average surface water temperature was 23°-31°C. This shows that at the time of the study analysis the impact of the climate environment is still in normal conditions and with increasing years the air temperature at the location of the activity is higher, especially in the dry season. Water temperature is very influential in the chemical, physical and biological processes in the waters so that changes in temperature in the water will cause changes in all processes in the waters. The total suspended solid level when measuring river water quality in 2018 shows the value of total suspended solid is quite low, but at the time of measurement in period II, the total suspended solid value tends to increase, the total suspended solid value increases in the range of 74-258 mg / l. It is estimated that later during the bridge construction activity, which is when there is a piling activity, river water quality will increase in value of total suspended solid in river water.

Critical level evaluation in periode I, the results of measurements at all locations of water sampling showed that the quality of river water measured by most parameters still met the quality standards, but the measurement of total dissolve solid content of almost all locations did not meet the quality standards of the Governor of South Sulawesi No. 69 of 2010 concerning quality standards and criteria for environmental damage (exceeding 2000 mg / L). The highest total dissolve solid content measured at the location of the Tallo river in Makassar (New port) is 31,300 mg / L. In period II, the sampling locations showed that the quality of river water measured by most parameters still met the quality standards, except the concentration of Cadmium (Cd) and chemical oxygen demand (Cadmium measurement values ranged from 0.01 to 6.06, the Cadmium quality standard was 0.01 mg / l) while the COD measurement values range from 82 to 297 mg / l, the Chemical Oxygen Demand (COD) quality standard is 100 mg / l).

Evaluation of compliance based on the Environmental Impact Assessment document is a management recommendation regarding the impact of deterioration in surface water quality due to landfill/excavation activities the technological approach that is necessary to do is with optimizing the intensity of landfill/excavation activities in the dry season, and vice versa, minimize these activities in the rainy season. Avoid oil spills and fuel from heavy equipment used by providing used oil storage areas and the management of dugouts/waste immediately transported out of the construction area and should not be stacked on the edge / around the construction area. In the construction of the makasar-parepere railway line, a clear management direction is needed referring to government regulation No. 82 of 2001 concerning management of water quality and water pollution control [17]. South Sulawesi Governor Regulation Number 69 of 2010, regarding quality standards for environmental damage criteria and based on monitoring results, excavation / backfilling activities for the railroad lines that have caused impacts on the deterioration of surface water quality have been well managed, including management through excavation / stockpiling activities carried out in the dry season. Fuel from used heavy equipment. Thus, the proponent has made management efforts in accordance with the directions in the environmental monitoring plan document.

3.2 Quality of Aquatic Biota (Phytoplankton & Zooplankton)

Assessment of the quality of aquatic biota (phytoplankton & zooplankton) shows that the quality of aquatic biota based on the plankton diversity index is the result of identification in the period I sampling of water samples in the Maros River, reflecting 5 species of species with a total of 364. Phytoplankton found were from the Monera Kingdom from the Cyanophyta division, the Cyanophyceae class included Aphanizomenon sp., *Oscillatoria sp* and *Merismopedia sp*. Also identified phytoplankton from Kingdom Chromista from the Ochrophyta division of the Chrysophyceae class namely *Chromulina sp*. Furthermore, it was identified from Kingdom Plantae from the Chlorophyta division of the Chlorophyceae class namely *Coelastrum sp*. The table shows that the type of phytoplankton most found in the Maros River is from the Cyanophyceae class, Aphanizomenon sp. with a total of 152 individuals. Phytoplankton analysis was carried out using a biological index at a research station on the Maros river namely diversity index (H '), uniformity index (E), and dominance index (D). The diversity index (H') of phytoplankton at the sampling location is 1.23 cells / l. based on the phytoplankton diversity index (H') included in the medium category with a value of $1 < H' < 3$ means the stability of a moderate biota community, moderate diversity, moderate distribution or moderate polluted water quality status [18]. Phytoplankton Uniformity Index (E) at the research station on the Maros river is 0.77. The value of the Phytoplankton Uniformity Index approaching 1 indicates that the number of individuals of each species is equal or even [19]. The stable community indicates that the spread of the number of individuals is generally uniform [20]. Dominance index (D) describes the presence or absence of species that dominate other types. The calculation result of the phytoplankton dominance index (D) in the Maros river is 0.34. According to Simpson's dominance criteria [21] states that the dominance index value is between $0 \; C \leq 0.5$ which means no genus dominates, whereas $0.5 \; C < 1$, this shows that at the sampling location there is no dominating genera or community structures in a stable state [22]. Whereas in the period II plankton diversity table, it showed that the value of the phytoplankton diversity index (H ') at the sampling location was 4.43 cells / l. based on the results of the Diversity Index (H'), shows that a value of $H' > 3$ means high species diversity (high diversity, the stability of the ecosystem in a stable state and high productivity). The Value of Uniformity Index (E) of phytoplankton at the sampling location is 0.92 which means that the value is close to 1 which indicates that the number of individuals of each species is evenly distributed. As for the value of abundance index/dominance (D) of phytoplankton at the sampling location which is as much as 0.88 means that the number is close to 1, the smaller the uniformity of a population and there is a tendency for a type to dominate the population.

Zooplankton are animal plankton in various forms and most of them are primary herbivores that live floating or floating with passive movements [23]. Water quality is not only determined based on physical, chemical but also biological parameters, one of which is by seeing zooplankton diversity as bioindicator [24]. Based on the analysis of the diversity of Zooplankton in the sampling location, namely the Maros river in the period I, zooplankton of kingdom Protozoa from the Ciliata class, *Favella sp*., Was found with a total of 9 species. Also identified zooplankton of kingdom Animalia from Monogononta class, namely *Brachionus sp*. Species, a number of 13 species and is the type of Zooplankton that is mostly found in the Maros river. While in period 2 zooplankton were identified from kingdom Arthropods from Phylum Crustaceans there were 4 species with the highest number of individuals namely *Copepoda sp*., As many as 5305 species. Zooplankton from Filum Ciliata is the most found species, *Tintinnopsis sp*. as many as 6366 species.

Zooplankton analysis was performed using the calculation of biological indices namely abundance index, diversity index (H '), uniformity index (E) and dominance index (D) [25]. The diversity index (H') of zooplankton at the sampling location during the period I was 0.67 cells / l and during period II it was 3.06 cells / l. based on the zooplankton diversity index (H ') in the period I measurement included in the category with a value of H <1 means that the biota community is unstable or the quality of water is heavily polluted. Whereas in the second period based on the results of the Diversity Index (H'), showing that the value of H'> 3 means high species diversity (high diversity, stable ecosystem stability, and high productivity). The zooplankton uniformity index (E) at 1 research station in the Maros river in the first period was .97 and in the second period was 0.92. The uniformity index values close to 1, then the number of individuals of each species is the same or almost the same or the number of individuals of each species is distributed equally [26]. Stable communities show that the spread of the number of individuals is generally uniform. The dominance index (D) describes the presence or absence of species that dominate other types. The result of the zooplankton dominance index (D) in the Maros river in the period I was 0.52 and in period II it was 1.06.

According to Simpson's dominance criteria [27], states that the dominance index value is between 0 <C ≤ 0.5 which means no genus dominates, whereas 0.5 <C <1 there is a genus that dominates this matter indicating that at the sampling location during period I there were no genera that dominated or the community structure was stable. Whereas in period II, where the number indicates approaching number 1, it means that there are species that dominate [28].

Benthos are aquatic base organisms, both animals and plants, both living on the bottom surface and at the bottom of the fairy [15]. These animals play several important roles in waters such as in the process of decomposition and mineralization of organic material that enters waters and occupies several trophic levels in the food chain [29]. Based on the results of the identification of the types of benthos found in the Maros river location, in the first period, it was found that the benthos species which were mostly found were Batillaria sp. whereas in period II the species which were found the most were *Gastropoda* sp. Diversity index, uniformity, and dominance are indices that are often used to evaluate an aquatic environmental condition based on biological conditions. This relationship is based on the fact that unbalanced environmental conditions will also influence an organism that lives in water [30]. Based on the Shanon-Wiener equation it is known that for the location of the Maros river observed in a period it has a diversity index (H ') of 0.24 (H' <1) so that it is categorized as low species diversity. In period II it has a diversity index (H ') of 0.78 which means that species diversity is low. Benthos abundance shows a uniformity index value (E) in a period I of 0.35 while in period II of 0.49 it means that the numbers in both periods are close to 0 this shows the low / uneven uniformity of benthos (the number of individuals of each species is uneven [31]. The dominance index value (D) in the period I was 0.88, the dominance index value was said to be high because it approached number 1 which means there was a type of dominance in the community. The high dominance indicates that the place has a low species richness with uneven distribution. The existence of dominance indicates that not all benthos have the same adaptability and survival abilities in one place. While in period II the value of the Dominance Index was obtained at 0.22 (close to 0) meaning there were no dominant species, the diversity index (H ') of 0.78 meant low species diversity. if it is compared then benthos abundance shows the uniformity index value (E) in the period I of 0.35, while in period II of 0.49 means that the numbers in both periods are close to 0 this shows the uniformity of benthos that is low/uneven (the number of individuals of each species is uneven). The dominance index value (D) in the period I was 0.88, the dominance index value was said to be high because it approached number 1 which means there was a type that dominated the community. The high dominance indicates that the place has a low species richness with uneven distribution [32]. The existence of dominance indicates that not all benthos have the same adaptability and survival ability in a place. While in period II the value of the dominance index was obtained at 0.22 (close to 0) meaning that there were no dominant species.

Evaluation of aquatic biota trends, is the Evaluation of trends in the composition of quatic biota types during excavation and landfill activities for the railway line at the construction stage is carried out by comparing the results of identification and analysis in this period compared with the results of identification and trends in previous periods, namely the two monitoring periods in August 2019 and October 2019 as well as trends during the Environmental Impact Analysis conducted in 2014 and monitoring conducted in 2019 [33].

Plankton and benthos sampling is only done in the Tallo river with the consideration that the planned construction process will start immediately in the area. Classification of surface water pollution based on benthic diversity index and plankton community [34], as indicated in Table 8.

Based on the results of plankton sampling in the Tallo River, the average Diversity Index is 1.92. This shows that the waters of the Tallo River are indicated to have experienced minor pollution. As for the results of sediment sampling, it was found that only one benthic organism was observed, namely the Lumbricus sp species from the phylum Annelida, with an average abundance of 66 individuals/ m2. The abundance and diversity of Benthos species that dominate shows that the waters of the Tallo river contain a lot of organic matter and those waters also indicated to have experienced minor pollution.

The critical level evaluation aquatic biota based on the results of the analysis of the presence of benthos in. the waters from time to time experiencing worsening which shows that the river is in the category of mild to heavily polluted when seen from the analysis of the diversity index (H').

Compliance Evaluation (compliance evaluation) Aquatic Biota is at management related to the composition of aquatic biota types during excavation and stockpiling activities for Railways is a derivative impact from the impact of a decrease in surface water quality, so that the management that has been carried out is the same as managing the surface impacts of water quality degradation such as carrying out landfill / excavation activities during the dry season and

Table 8. Classification of surface water pollution based on diversity index of benthic and plankton communities

Pollution degrees	Community diversity index
Not contaminated> 2.0	> 2,0
Contaminated lightly 1.6 - 2.0	1,6 – 2,0
Medium contaminated 1.0 - 2.0	1,0 – 2,0
Severely polluted <1.0	< 1,0

Table 9. Environmental monitoring plan based on evaluation of trends in the composition of aquatic biota types

Identification period	(H’)	(D)	(E)	Conclusions
Environmental Impact Analysis -2014	1,92	66	-	The Tallo River waters contain a lot these organic materials and waters, too indicated has experienced minor pollution
Periode I - 2019	0,24	0,88	0,35	Species diversity is low. The presence of the Mollusca phyla in a waters may indicate that Maros waters are moderately polluted
Periode II - 2019	0,78	0,22	0,49	Low species diversity, low / uneven benthos uniformity, and no species dominating so it can be said that the condition of the river is heavily polluted

gradually. Therefore, the proponent has obediently carried out the directives contained in the Environmental Monitoring plan document.

4. CONCLUSION

The construction of railway lines, especially at the stage of excavation / landfill, can cause a decrease in the quality of surface water (river), therefore environmental monitoring is needed. The results of monitoring activities in period 1, the quality of river water measured by most parameters still meet the quality standards, except for the concentration of TDS and Cadmium (Cd) at all measurement points, while several other parameters that do not have a quality standard where the level in river water is high enough, including Ammonia, Chloride, Violence, Sulfate and Florida (only on the Tallo and Minasa Te'ne rivers). Surface water quality measurements for Period II, all locations measuring COD values exceeded the quality standard (measurement values ranged from 82 to 297 mg / l, COD quality standards 100 mg / l), this indicates that river water has experienced organic pollution. the measurement results of DO parameters at all measurement points are in the range of 6-9 mg / l. TSS content measurement results showed that almost all locations had an average TSS value of around 74 - 258 mg / l.

The composition of aquatic biota types based on the results of the Diversity index (H') is classified as moderate and the quality of water is included in the medium polluted category. Benthos species found were identified from the Mollusca phylum with a diversity index (H ') of 0.24 (H' <1) so that it was categorized as low diversity. The presence of the Mollusca phylum in water can indicate that the water is moderately polluted.

DATA AVAILABILITY

All relevant data has been listed on paper along with supporting information files. This research will help researchers to uncover critical areas of the planned development of the railroad between Makassar and Parepare, so that impacts can be monitored so that disruptions to surface water quality and diversity of aquatic biota can be managed properly

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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