

## **Correlation Analysis between River Water Quality and Community Socio-Economic Condition: Case Study of Jangkok River, Mataram City**

**Analisa Keterkaitan Antara Kualitas Air Sungai Dengan Kondisi Sosial Ekonomi Masyarakat: Studi Kasus Sungai Jangkok, Kota Mataram**

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### **Abstract**

Social and economic conditions of riverbanks are observed based on several parameters, namely income level, education level, family size, waste management facilities and sanitation facilities. These parameters are correlated with the Total Coliform parameters generated from surface water quality monitoring by the Environment Agency of Mataram City. The data collection method was carried out by interviewing 300 respondents who lived on the Jangkok River banks. Data analysis and correlation used the SPSS program. The analysis showed that the socio-economic conditions of the community of Jangkok river banks contributed to the value of the Total Coliform parameter. Therefore, the strategy of involving various stakeholders and implementing an economic innovation could be used as a strategy by the Government of the Mataram City for improving the social and economic conditions of the Jangkok River banks community. Furthermore, the Government of Mataram City also required to do a number of things including structuring the Jangkok River area so that the potential pollutants entering the water body could be reduced or even eliminated, making regulations that apply a punishment and reward system towards sustainable river management, and implementing a multistakeholder model for the Jangkok River region management.

*[Kondisi sosial dan ekonomi masyarakat bantaran sungai diamati berdasarkan beberapa parameter yaitu tingkat pendapatan, tingkat pendidikan, ukuran keluarga, fasilitas pengelolaan sampah dan fasilitas sanitasi. Pengambilan parameter tersebut juga*

*dikorelasikan dengan potensi pencemar terhadap parameter Total Coliform yang dihasilkan dari pemantauan kualitas air permukaan oleh Dinas Lingkungan Hidup Kota Mataram. Metode pengumpulan data dilakukan dengan wawancara terhadap 300 responden yang tinggal di bantaran Sungai Jangkok. Analisis data dan korelasi menggunakan program SPSS. Dari hasil analisis menunjukkan bahwa kondisi sosial ekonomi masyarakat di bantaran Sungai Jangkok memberikan kontribusi terhadap nilai parameter Total Coliform. Oleh karena itu strategi pelibatan berbagai pemangku kepentingan dan menjalankan program inovasi ekonomi dapat dijadikan strategi oleh Pemerintah Kota Mataram dalam meningkatkan kondisi sosial dan ekonomi masyarakat bantaran Sungai Jangkok. Lebih lanjut, Pemerintah Kota Mataram juga perlu melakukan beberapa hal antara lain penataan wilayah bantaran Sungai Jangkok sehingga potensi pencemar yang masuk ke badan air bisa dikurangi bahkan dihilangkan, membuat regulasi yang menerapkan sistem punishment and reward untuk menuju pengelolaan sungai yang berkelanjutan, dan melakukan implementasi model multistakeholder untuk pengelolaan wilayah Sungai Jangkok.]*

**Keywords:** social, economic, total coliform, riverbanks, multistakeholders, correlations test

## I. Introduction

River is an ecosystem that is very important for human life. Many cities in Indonesia, including Jakarta, Surabaya, and Bekasi, use rivers that flow through their regions as raw material for clean water, so the quality of river water as raw material is very crucial. Several other cities use the river for aquaculture support activities (*keramba*) and as a water supply for rice fields through the irrigation system. The definition of a river according to Government Regulation Number 38 of 2011 is a flow or container of natural and/or artificial water in the form of a water drainage network and water in it, starting from the upstream to the estuary, bordered right and left by a boundary line. With the importance of the function of rivers for human life, maintaining the quality of rivers is the main thing that must be done. However, based on the 2015 Atlas of Indonesian Water Quality Status (KLHK, 2016), 68% of rivers in Indonesia are heavily polluted, 24% are moderately polluted, 6% are lightly polluted and only 2% meet good quality status. The data represents 670 sampling points in 83 rivers spread across 33 provinces throughout Indonesia as shown in Figure 1.

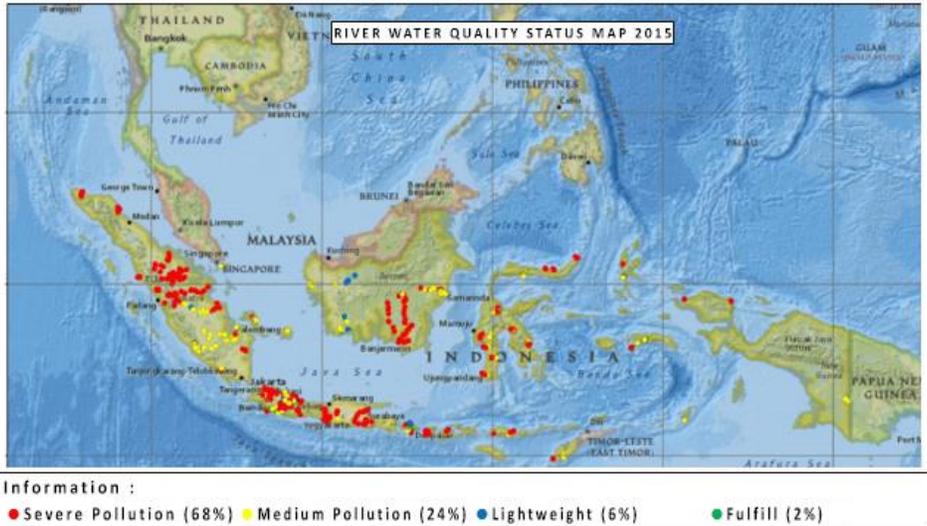


Figure 1. Map of River Water Quality Status (KLHK, 2016)

Mataram city is traversed by several large rivers, including Jangkok and Ancar. The use of the river by riverbank communities includes washing, fish farming and water spinach cultivation. However, from year to year, the level of use of the river decreases along with the condition of the river. In addition, the public's perception that rivers are 'big' garbage dumps also aggravate the river's condition.

By looking at the current conditions, it is necessary to make a preliminary study to see if there is a correlation between the decline in river quality and the social and economic levels of the people living on the riverbanks. It is hoped that the results of this study will become input for the Mataram City Government for strategic steps in maintaining the quality of rivers in the City of Mataram.

Some of the problems discussed and described in this article are the social and economic conditions of the people on the banks of the Jangkok River, the correlation between river quality as a fixed variable (dependent variable) with social and economic conditions as independent variables, availability of supporting instruments for river quality management, and an overview of stakeholder linkages through a multi stakeholder engagement approach framework. So far, no reference has been found to discuss this problem for the Jangkok River, Mataram City. Furthermore, to answer the existing problems, interviews were conducted with respondents who lived in the upstream, middle and downstream parts of the Jangkok River, Mataram City. Statistical analysis of data using the help of the SPSS program.

## II. Literature Review

The river is an area prone to flooding and is a very important ecological and hydrological area of the river. If the function of the riverbanks is disturbed due to settlement, it will cause environmental problems. River banks have an ecological function as a buffer zone for water management and are green corridors. As a buffer zone and a green corridor, the riverbanks bridge the existence of habitats and terrestrial ecosystems with water. The disruption of the function of disturbed river banks will directly disrupt the habitat and ecosystem.

### a. River Water Quality

Limited residential land and low economic conditions have made the riverbanks often used as a place of settlement, as was the case in Mataram City, which made the riverbanks a place of settlement. Referring to Government Regulation (PP) No 47/1997 that for residential areas, the width of the bank is only for inspection roads, namely 10 -15 meters. The existence of settlements and other activities that dispose of waste into rivers are generally a source of decline in river water quality. The Ministry of Environment and Forestry (KLHK) regularly publishes an Environmental Quality Index (IKLH) where one of the components to be monitored is river water quality as shown in Table 1. The monitoring parameters used are Total Suspended Solid (TSS), Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Phosphate, Fecal Coli, and Total Coliform.

**Table 1.** IKLH Criteria and Indicators

Indicator	Parameter	Weight
River Water Quality	TSS	30%
	DO	
	BOD	
	COD	
	Total Fosfat	
	Fecal Coli	
	Total Coliform	
Air Quality	SO <sub>2</sub>	30%
	NO <sub>2</sub>	
Land Cover Quality	Land cover area and vegetation dynamics	40%

Source: KLHK, 2018

From the results of monitoring and calculations by the Ministry of Environment and Forestry, it was found that the Water Quality Index (IKA) for West Nusa Tenggara (NTB) was only in the range of 20.25, while the Air Quality Index (IKU) and the Land Cover Quality Index (IKTL) are 88.02 and 61.27, respectively (KLHK, 2018). This shows that the quality of surface water in NTB

Province is mostly polluted or has exceeded the quality standard. Furthermore, the Indonesian Institute of Sciences (LIPI) noted that the Regional Drinking Water Company (PDAM) was only able to meet the needs of 40% of community water needs from the existence of existing raw water sources.

For the condition of river water quality in Mataram City also contributed to the low IKA of NTB Province, especially the Total Coliform parameter. The results of monitoring conducted by the Mataram City Environmental Service (DLH, 2018) and the River Basin Agency (BWS, 2018) show similar results related to the completion of the Total Coliform parameter as shown in Table 2, where Government Regulation (PP) Number 82 of 2001 requires a standard Total Coliform of 5,000 MPN/100 ml for Class II rivers.

**Table 2.** Results of Monitoring the Quality of the Jangkok River – *Total Coliform*

Data source	Monitor Point - Parameters <i>Total Coliform (MPN/100ml)</i>		
	Upstream	Middle	Downstream
BWS (2017)	54.000	240.000	-
DLH (2018)	35.000	240.000	240.000

Source: BWS, 2017 & DLH, 2018

**b. Socio-Economic Conditions of Riverbank Communities**

Social and economic conditions are general terms commonly used to describe the position of respondents to the population where the respondent is located. In relation to the social and economic conditions of the riverbank community (related to river water quality), several parameters used to illustrate this are, among others, income, education level, sanitation system and waste management system. Several studies related to rivers have been carried out, including the status of water quality (Ali, Soemarno, & Purnomo, 2013; Effendi, Adimas Kristianiarso, & M Adiwilaga, 2013; Septine, Priyono, Yuliani, & Sayekti, 2013), river restoration through a citizen lawsuit scheme (Quina, 2017).

From several studies, it can be seen that riverbank communities are included as pockets of poverty for urban areas. Susilawati, Sugiyanta, & Suawarni (2018) note that more than 60% of respondents who live on the banks of the Cungkeng River, Karang City Village, Bandar Lampung, have an income below the average income of the people of Bandar Lampung City. This has a positive correlation with the level of education and employment of the people on the banks of the Cungkeng River, where 78% of the respondents have basic education, and 70% of the respondents have a livelihood as fishermen. Income and education level will also determine your waste management and sanitation system. Waste management includes disposal and transportation systems, while the sanitation system includes the technology used in *mandi-cuci-kakus* (bathing-washing-toilet/MCK) waste management.

**c. Public Private Partnership in River Management**

One method of cooperation in carrying out an activity is known as a Public Private Partnership (PPP), where cooperation is carried out by multi-stakeholders. The PPP application is used to increase a sense of ownership of an activity. PPP puts forward the concept of sharing roles for all stakeholders involved. This method is felt to be effective so that the application and successful application of the method can be found all over the world. One example is the application of PPP for activities or projects financed by the Inter-American Development Bank (IADB)/the Multilateral Investment Fund (MIF), where one of the distributions is as shown in Figure 2 (GEF, 2013).



Source: GEF, 2013

Figure 2. Example of PPP Distribution

### III. Methods

The quality of river water has a very strong influence on the activities on the banks of the river. The activities of the people along the river are certainly correlated with the level of income and the level of community education. These two premises lead to the need to change the socio-economic conditions of the people along the river to become a sustainable river.

This study was designed with research using observational and survey methods with correlational techniques, which is a type of research that seeks to suggest whether there is a relationship between the independent and dependent variables. Interviews were conducted with the people on the banks of the Jangkok River, Mataram City, where the sampling was carried out purposively with the Judgmental Sampling technique. The sample size also refers to the Slovin formula with an accuracy of 95%.

$$n = \frac{N}{1 + N e^2} \quad (1)$$

where:

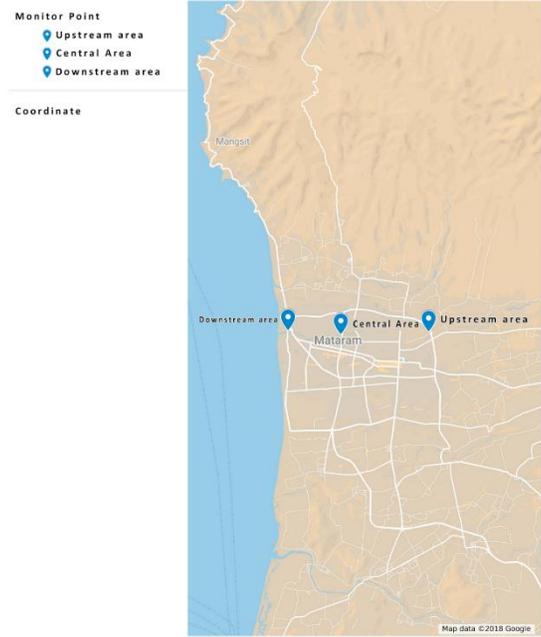
n = number of samples; N = total population; e = fault tolerance limit

Total respondents interviewed were 300 respondents representing each location: upstream (100 respondents), middle (100 respondents), and downstream (100 respondents). The location of the sampling point (interview) is as shown in Table 3 and Figure 3.

**Table 3.** Location of the Interview

Area	Location	Respondents
Upstream	<ul style="list-style-type: none"> <li>• Rungkang Jangkok</li> <li>• Kebon Jaya Barat</li> <li>• Kebon Jaya Timur</li> </ul>	100 people
Middle	<ul style="list-style-type: none"> <li>• Kebon Bawak Timur</li> <li>• Bawak Bagek Utara</li> <li>• Kampung Pelita</li> <li>• Gapuk</li> <li>• Perigi's areas</li> <li>• Pejeruk</li> </ul>	100 people
Downstream	<ul style="list-style-type: none"> <li>• Kampung Melayu</li> <li>• Kampung Banjar</li> <li>• Sintung</li> </ul>	100 people

**River Monitoring Locations**



**Figure 3.** Sampling Location Map

The interview data in the form of qualitative data will be converted into a coding system so that it can be used as input data in the SPSS software. The coding system formulation uses numeric variables so that it is possible to carry out further processing in the SPSS software. The validity and readability tests were carried out using SPSS software.

The validity test is used to measure the validity level of an instrument or variable. The instrument item analysis technique for testing empirical validity uses Pearson Correlation Product Moment (Mason & Douglas, 1999). This technique is used to determine the correlation between two variables and the calculated correlation value is valid, if  $r_{count} > r_{table}$ , with a level of significance of 5%. While the readability test is used to measure the consistency of a measuring instrument in research (Singarimbun & Effendi, 1995). The reliability of the instrument or question is determined using the Alpha Cronbach approach.

#### **IV. Results**

The social and economic conditions of the riverbank communities were observed based on several parameters, namely income level, education level, family size, waste management facilities and sanitation facilities. Taking these parameters is also correlated with the potential for pollutants to the Total Coliform parameter that is generated from surface water quality monitoring by the Mataram City Environmental Agency.

In terms of income, the riverbanks have an income of less than IDR. 500,000/month (44.7%) is below the standard poverty line set by the World Bank (\$ 1.9/day). The education level of the people on the banks of the Jangkok River is dominated by Elementary-Secondary Education (SD-SMP) which is 57.6% of the total respondents, while the family size owned by the riverbank community is more than 6 people per house (67.3%). Waste management carried out by the people along the river is quite helped by the existence of a Tōsa motorbike which is a government program, however, there are still some people who throw their garbage directly into the river (17%). One of the factors that contributed to the increase in the Total Coliform parameter in the Jangkok River was the disposal of waste from the toilets of the riverbank community, where around 21.7% of the people on the banks of the Jangkok River still disposed of their MCK activity waste directly into the Jangkok River. An overview of the components mentioned above is presented in Figures 4a-4d.

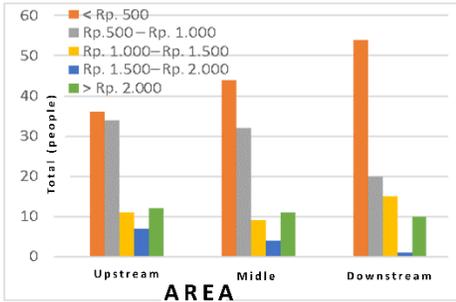


Figure 4a. Income

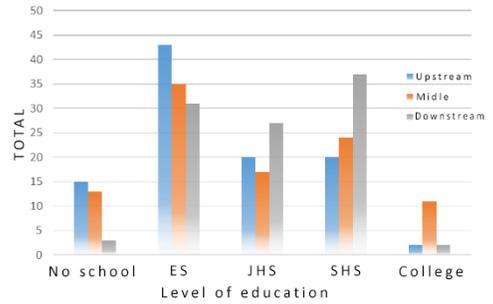


Figure 4b. Education

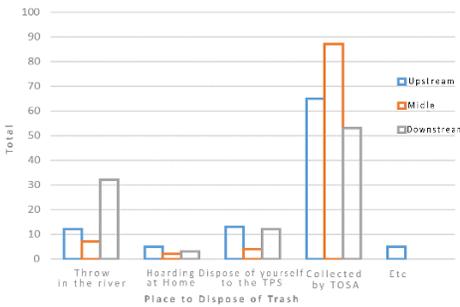


Figure 4c. Waste management



Figure 4d. Sanitation Facilities

a. *Statistic Test*

For the statistical test that is done is the correlation test, validity test and reliability test. One example of the parameter being tested is to find out the correlation between fixed variables (E-Coli monitoring) and variable variables (waste management and sanitation facilities) as shown in Table 4.

Table 4. Variable Correlation Test

		Correlations				
		Monitoring Results E-Coli	MCK Facilities	Place to Dispose of Trash	Facility Management Trash	MCK Drain System
Monitoring Results E-Coli	Pearson Correlation	1	.245**	-.071	-.070	-.024
	Sig. (2-tailed)		.000	.219	.229	.680
	N	300	300	300	300	300
Facility MCK	Pearson Correlation	.245**	1	.133*	.061	.238**
	Sig. (2-tailed)	.000		.022	.294	.000
	N	300	300	300	300	300
Place to Dispose of Trash	Pearson Correlation	-.071	.133*	1	.509**	-.110
	Sig. (2-tailed)	.219	.022		.000	.056
	N	300	300	300	300	300
Trash management facilities	Pearson Correlation	-.070	.061	.509**	1	-.076
	Sig. (2-tailed)	.229	.294	.000		.187
	N	300	300	300	300	300
MCK Drain System	Pearson Correlation	-.024	.238**	-.110	-.076	1
	Sig. (2-tailed)	.680	.000	.056	.187	
	N	300	300	300	300	300

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

From the results of statistical analysis using SPSS, it can be seen that the variable E-Coli monitoring results are significantly influenced by the MCK facility variable with a Pearson Correlation value of 0.245.

Another statistical test that is carried out is the validity test, where a test can be said to have high validity if the test performs its measuring function, or provides precise and accurate measurement results in accordance with the test objectives. The testing technique that is often used to test the validity at SPSS is to use the Pearson bivariate, this analysis is by correlating the score of each item with the total score. The total score is the sum of all items. From Table 5, it can be seen that  $r_{count} > r_{table}$  (0.133) so it can be concluded that the question items have a significant correlation to the total score (declared valid).

**Table 5. Validity Test**

		MCK facilities	MCK Drain System	Education	Income	Waste Management Facility	Place to Dispose of Trash	Family Size	Total value
MCK facilities	Pearson Correlation	1	.238(**)	.194(**)	-0.028	0.061	.133(*)	0.022	.417(**)
	Sig. (2-tailed)		0	0.001	0.63	0.294	0.022	0.705	0
MCK Drain System	Pearson Correlation	.238(**)	1	.127(*)	.251(**)	-0.076	-0.11	0.01	.519(**)
	Sig. (2-tailed)	0		0.028	0	0.187	0.056	0.857	0
Education	Pearson Correlation	.194(**)	.127(*)	1	.378(**)	.120(*)	.125(*)	-0.051	.542(**)
	Sig. (2-tailed)	0.001	0.028		0	0.039	0.031	0.383	0
Income	Pearson Correlation	-0.028	.251(**)	.378(**)	1	0.108	0.09	0.009	.576(**)
	Sig. (2-tailed)	0.63	0	0		0.062	0.121	0.874	0
Waste Management Facility	Pearson Correlation	0.061	-0.076	.120(*)	0.108	1	.509(**)	0.109	.432(**)
	Sig. (2-tailed)	0.294	0.187	0.039	0.062		0	0.058	0
Place to Dispose of Trash	Pearson Correlation	.133(*)	-0.11	.125(*)	0.09	.509(**)	1	0.003	.438(**)
	Sig. (2-tailed)	0.022	0.056	0.031	0.121	0		0.955	0
Family Size	Pearson Correlation	0.022	0.01	-0.051	0.009	0.109	0.003	1	.382(**)
	Sig. (2-tailed)	0.705	0.857	0.383	0.874	0.058	0.955		0

\*\* Correlation is significant at the 0.01 level (2-tailed). \* Correlation is significant at the 0.05 level (2-tailed).

The last test that is done is the reliability test. Reliability or reliability is the consistency of a series of measurements or a series of measuring instruments. In research, reliability is the extent to which the measurement of a test remains consistent after being repeated on the subject and in the same conditions. The level

of reliability is empirically indicated by a number called the reliability coefficient (alpha). From Table 6, it can be seen that the Alpha Cronbach's number is 0.666 (= 0.7) so it can be said that the reliability of all the tests used is sufficient (sufficient reliability).

**Table 6. Reliability Test**

Case Processing Summary			Reliability Statistics	
		N	%	
Cases	Valid	300	100.0	Cronbach's Alpha
	Excluded <sup>a</sup>	0	.0	
	Total	300	100.0	.666
				8

a. Listwise deletion based on all variables in the procedure.

**b. Stakeholders**

The success of a program depends on the involvement of stakeholders. The Jangkok River, which is one of the icons of the City of Mataram, has several stakeholders including the Government (City Government, River Basin Hall), Community, Private, and Non-Governmental Organizations (NGOs) as shown in Figure 5. Each stakeholder has their respective roles. which leads to the same goal of creating a clean and sustainable river, the Government as the regulator is tasked with making laws and regulations, including Mataram City Regional Regulation Number 15 of 2003 concerning River Boundary, Mataram City Regional Regulation Number 10 of 2008 concerning Solid Waste Management. In addition to its function as a regulator, the Government is obliged to socialize and supervise implementation. The stakeholder element who plays a central role is the community whose daily activities are along the river within a radius of 30 meters. The community here can be at the individual or group level. The private sector as one of the stakeholders must be involved in preserving rivers, the presence of the private sector through the Corporate Social Responsibility (CSR) program is an important part of the interaction between stakeholders.



**Figure 5. Stakeholders**

## **V. Discussions**

The results of the analysis show that the high value of the Total Coliform parameter in the Jangkok River is much influenced by the social and economic conditions of the people who live on the riverbanks. The condition of sanitation facilities is influenced by the relatively low income level of the people on the banks of the Jangkok River. In addition, the level of education also contributes to the pattern of waste management carried out by the people on the banks of the Jangkok River.

This condition has implications for the behavior patterns of the people on the banks of the Jangkok River which causes an increase in the potential for river pollution, such as the disposal of domestic liquid waste from MCK activities directly into the river. Observing the conditions that occur in the field requires the involvement of all stakeholders to realize a sustainable river.

One of the strategies that can be implemented is to create synergy between stakeholders (multi-stakeholder synergy). However, several steps need to be taken in order to make the synergy effective. These steps include role sharing, commitment, clear regulations (punishment and reward), innovation and creative economy (innovation and creative economics), and thematic areas.

## **VI. Conclusion**

Creating a sustainable river is the responsibility of all parties, including the people who live along the river. The social and economic conditions of the people on the banks of the Jangkok River are variables that contribute to increasing the value of the Total Coliform parameter in the Jangkok River (Upstream, Middle, and Downstream). Role sharing models and economic creative programs can be strategic choices to improve the social and economic conditions of the people on the banks of the Jangkok River.

Furthermore, the research results show that the Mataram City Government needs to reorganize the area along the banks of the Jangkok River so that the potential for pollutants entering water bodies can be reduced or even eliminated. Making regulations that apply a punishment and reward system towards sustainable river management. Implement a multi-stakeholder model for the management of the Jangkok River area.

### **Acknowledgement (jika ada)**

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### **Disclosure and Conflicts of Interest**

There is no conflict of interest in this study.

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