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Microplastic Contamination in Yogyakarta's Rivers: Spatial Analysis and Factor Assessment to Identify Key Pollutants

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***Abstract*—River water quality monitoring aims to determine the state of river water quality and to ensure its safety for human health and the sustainability of its use. Some important parameters that are often used to measure river water quality include chemical oxygen demand (COD), biological oxygen demand (BOD), total suspended solids (TSS), pH, Temperature, and microplastic content. This study uses multiple linear regression to determine which factors contribute significantly to river water quality. Samples were collected from the Winongo, Gadjah Wong, Bulus, Oyo, Belik, Tambakbayan, Opak, and Kuning rivers in Daerah Istimewa Yogyakarta (DIY) and distributed in 20 points. The results of the correlation matrix show the relationships between the variables in the data. The DO variable has the most substantial relationship with microplastics, suggesting that water quality, measured by oxygen levels, may be related to microplastic pollution. The relationship between pH and Temperature is also moderate. However, other relationships tend to be weak, suggesting that other factors may be more influential in determining these variables' relationships. The multiple linear regression model shows that an increase in pH, a decrease in Temperature, an increase in DO, and a decrease in TSS will increase the amount of microplastics. Furthermore, through spatial analysis and geographically Weighted Regression (GWR) modelling, DO significantly affects 12 observation points and does not affect eight. The spatial approach shows that the causes of river water pollution are different in each location. Therefore, each site's treatment is also different according to its characteristics.**

Keywords— microplastics, pollutants, spatial analysis, Geographically Weighted Regression (GWR), multiple linear regression.

I. INTRODUCTION

For the sustainable management of water resources, monitoring of river water quality is essential [1]. Monitoring river water quality aims to determine river water quality by calculating the Water Quality Index. It is quantifying water quality by condensing extensive data into a singular value between 0 and 100. Water quality in aquatic systems can be assessed by examining variations in physical, chemical, and biological characteristics influenced by anthropogenic or natural factors [2]. The primary parameters to determine water quality include pH, Temperature, conductivity, dissolved oxygen, biochemical oxygen demand, nitrate, chloroform [3], total suspended solids (TSS), Temperature, and microplastic content. COD and BOD are the two most prevalent indices of organic pollution [4]. COD measures the amount of oxygen required, under specified standard reaction conditions, to mineralize the organic constituents of water samples [5]. Biological Oxygen Demand (BOD) quantifies the dissolved oxygen aerobic bacteria need to metabolize organic substances in water. It signifies water quality and the extent of organic contamination, influencing the health of aquatic ecosystems [6]. Both parameters indicate the level of organic pollution in the water. In addition, TSS is related to suspended particles that can affect water clarity and harm aquatic life [7]. Additional characteristics, like pH and Temperature, influence chemical reactions and aquatic organisms, with significant alterations in these factors potentially harming

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the environment. Temperature and pH significantly affect chemical reactions and aquatic biota. The study found that extreme temperatures and decreasing pH adversely impacted Daphnia's growth, reproduction, and survival, highlighting their critical roles in aquatic ecosystems and responses to environmental changes. Meanwhile, due to its significant impact on the food chain and human health, the presence of microplastics in water is beginning to receive global attention.

Microplastics are recognized as a global problem due to their widespread presence from various sources, significant impacts on marine life and ecosystems, and potential health risks to humans, as highlighted in the research paper's discussion on environmental and health implications [8]. Water quality degradation would reduce activity in sectors dependent on environmental quality [9]. However, the increasing population and its needs result in pollution. One of the sources of pollution is plastic waste, which will degrade into microplastics and cause adverse effects on the environment. Microplastics are little plastic particles resulting from the breakdown of more extensive plastic materials [10]. The origin of microplastics in aquatic environments is classified into two main sources: primary microplastics, which are plastics produced directly as microparticles, and secondary microplastics, which result from the degradation of larger plastic debris (>5 mm) through a combination of physical, chemical, and biological processes. Microplastics are a new pollutant concerning global environmental issues [11], especially in aquatic environments. Microplastics have been found in several waters in Indonesia.

Microplastics in aquatic environments are predominantly affected by human activities, especially the improper disposal of plastic trash and the discharge of untreated wastewater. According to [12], the presence of microplastics in aquatic environments is affected by community garbage, specifically discarded beverage bottles and food packaging (PET) and plastic containers and textiles (PP), underscoring the necessity for focused waste management strategies. Studies on microplastic pollution in Yogyakarta are still minimal. Previously, research only focused on water's physical, chemical, and biological parameters without considering the presence of microplastics. Microplastics measuring less than 5 mm have been widely found in the river sediments that traverse the city of Yogyakarta. [13] compared the abundance of microplastics in the Opak River and Progo River sediments in the Bantul Regency. Investigating the microplastic abundance in these sediments revealed that all samples analyzed contained microplastics. The Progo River exhibited a mean microplastic abundance ranging from 209.37 to 1,173.25 particles/kg, while in the Opak River, the mean abundance varied from 314.54 to 3,729.67 particles/kg. The highest microplastic abundance was found in the sediment samples from the Opak River, with an average of 1,799.33 ± 1,430.87 particles/kg. The microplastic pollution phenomenon in Yogyakarta is not exclusive to rivers; it has also been observed in the sea. [14] state that shark and skipjack tuna in the waters of Depok have been contaminated with microplastics, with skipjack tuna being 94% more contaminated than sharks. Each month, the increase in microplastic abundance in shark and skipjack tuna reaches 14% and 26%, respectively.

Several factors must be considered when analyzing the presence of plastic in water systems. Firstly, the movement of plastic in water is influenced by currents, tides, and sedimentation at the base of the water body. Plastic bottles, toothbrushes, bags, packing materials, and fishing nets deteriorate over time owing to environmental factors such as sunlight, wave action, and mechanical stress [15]. The river water quality parameters examined in this study are pH, Temperature, BOD, COD, TSS, and microplastics. The objective of this study is to ascertain which factors significantly contribute to river water quality using multiple linear regression. The study will employ analysis and multiple linear regression to express a change in the functional relationship between dissolved oxygen concentration (DO) and changes in the physicochemical parameters of Temperature (T), total suspended solids (TSS), and dissolved hardness (Dh) in the Secang River, as stated in [16].

To track regional differences in pollution, modeling analysis techniques are commonly used. Regression analysis is a statistical method for determining the relationship between response variable(s) and predictor variable(s) [17]. [18] use multiple regression models to analyze the impacts of natural, social, and economic factors on microplastic pollution distribution, highlighting how these variables, including population growth and GDP, influence microplastic density in freshwater bodies across different regions. Regression analysis is widely used in many domains to ascertain how predictor variables affect response variables[19]. Creating a linear regression technique that accounts for spatial effects—specifically, spatial heterogeneity that arises in spatial data with heteroscedasticity—is known as Geographically Weighted Regression (GWR). Geographically Weighted Regression (GWR) is an advancement of linear regression that incorporates spatial effects, namely spatial heterogeneity in spatial data exhibiting heteroscedasticity [19]. Geographically Weighted Regression (GWR) is a localized modelling technique utilized to estimate regression models characterized by spatially changing correlations [20]. The GWR approach will yield local parameter values, meaning they are specific to a single observation site and distinct from parameters at other sites. In the social and geographical sciences, GWR is a valuable model for examining spatially nonstationary relationships between variables[21].

This study highlights the importance of monitoring river water quality, focusing on microplastic contamination in Yogyakarta's rivers. The study also used a Geographically Weighted Regression (GWR) model to analyze spatial variations in the influence of water quality parameters on microplastics at 20 observation points, which showed that the factors causing water pollution are different at each location. This research provides new insights into the interactions between water quality parameters and microplastics. It offers a solid basis for policymaking in environmental management and more effective microplastic pollution mitigation strategies.

II. METHOD

a. Tools and materials

The equipment needed for the research includes: plankton net, sample bottles, cooler box, spray bottle, stainless container, glassware, pH meter, DO meter, thermometer, magnetic stirrer, oven, vacuum Buchner, desiccator, ladle, Whatman filter paper. Meanwhile, the materials needed are river water, aquades, H_2O_2, NaCl, and $FeSO_4$.

b. Sample collection

River water samples were collected at the Winongo River, Gadjah Wong River, Bulus River, Oyo River, Belik River, Tambakbayan, Kuning River, and Opak River, distributed across 20 points. The sampling was conducted from August 14-26, 2024. Sample collection was conducted by SNI 03-7016-2004 [22] regarding the sampling procedures for monitoring water quality in a river basin area through grab sampling. The coordinates of the sample collection are presented in Table 1. The distribution of river water sampling points can be seen in Figure 1.

TABLE 1.
COORDINATES OF THE SAMPLE COLLECTION LOCATION

No	River	Code	Latitude	Longitude
1	Belik	BLK-02	7.82663889	110.3865833
2	Belik	BLK-03	7.87469444	110.3920278
3	Bulus	BLS-01	7.87258333	110.3659722
4	Bulus	BLS-02	7.9125	110.3667222
5	GadjahWong	G-03	7.77697222	110.3575556
6	GadjahWong	G-04	7.78966667	110.3566944
7	GadjahWong	G-05	7.80836111	110.3537222
8	GadjahWong	G-06	7.84033333	110.3485556
9	Kuning	KUN-03	7.78355556	110.4393889
10	Kuning	KUN-04	7.82725	110.4367778
11	Oyo	OY-04	7.95183333	110.3801389
12	TambakBayan	T-03	7.82161111	110.4228611
13	TambakBayan	T-04	7.85161111	110.4297222
14	Winongo	W-03	7.78966667	110.3688611
15	Winongo	W-04	7.80163889	110.3713611
16	Winongo	W-05	7.80613889	110.3744167
17	Winongo	W-06	7.81563889	110.3748056
18	Winongo	W-07	7.85161111	110.3753889
19	Winongo	W-08	7.87263889	110.3834167
20	Opak	OP-02	7.83252778	110.4519167

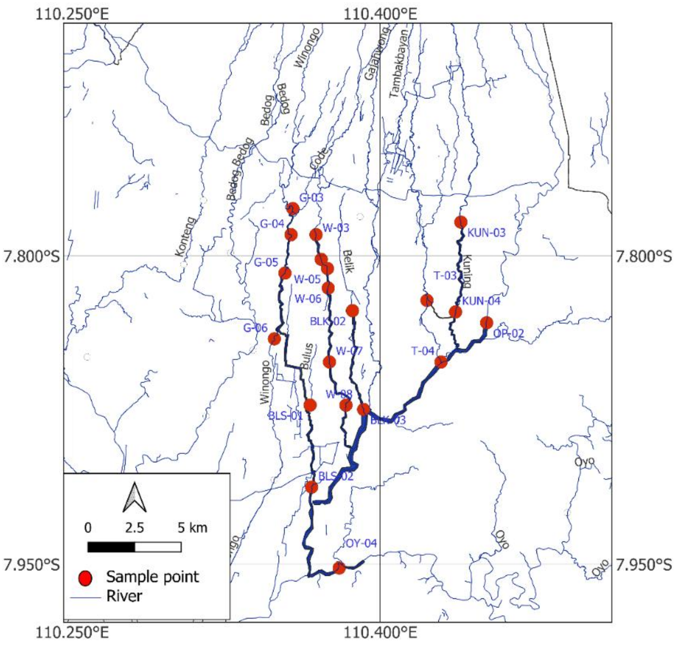

Figure 1. Sampling point

Testing water quality parameters for pH measurement according to SNI 06-6989.1-2004, for temperature measurement according to SNI 06-6989.2-2004, for COD measurement according to SNI 06-6989.35-2020 and BOD according to SNI 06-6989.12-2004, for TSS according to SNI 06-6989.57-2019 [23]. The method used for microplastic measurement is also used for this test, the National Oceanic and Atmospheric Administration (NOAA) method [24].

b. Analysis Method

Descriptive analysis and regression modeling are the analytical methods used in this study. Descriptive data aims to provide an overview of water quality based on the measured parameters and data patterns based on geographical location. Next, the regression modelling referred to is multiple linear regression, which aims to determine the effect of Temperature, pH, DO, and TSS on microplastics.

The general model of the linear regression equation is in the Equation (1)

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_k X_{ki} + \epsilon_i \quad (1)$$

With Y as the dependent variable, X_1, X_2, …, X_k as the independent variables, β_0, …, β_k as the parameters to be estimated, ϵ_i as the residual, and i = 1, 2, …, n as the observations. Thus, the model for microplastic analysis is

$$Microplastic_i = \beta_0 + \beta_1 Temperature_i + \beta_2\, pH_i + \beta_3 DO_i + \beta_4 TSS_i + \epsilon_i \quad (2)$$

After estimating the model parameters in Equation (2), residual assumption tests, including normality, homoscedasticity, and multicollinearity, must be conducted to ensure the model's validity. Modelling (1) is a global regression model. The residual assumptions are often unmet if this model is applied to spatial data, such as river water quality data. An alternative, a local regression model, is GWR. The GWR is a global regression model (OLS) converted into a weighted regression model [25]. Parameter values will be computed for each location, resulting in distinct regression parameter values for each site. The equation model is as follows [26]:

$$y_i = \beta_0(u_i, v_i) + \sum_{k=1}^{p} \beta_k(u_i, v_i) x_{ik} + \varepsilon_i \quad (3)$$

with

y_i : response variable at location i (i = 1, 2, ... , n)

x_{ik} : predictor variable k at location i (i = 1, 2,..,n)

(u_i, v_i) : longitude and latitude coordinates of point i at a geographic location

$\beta_k(u_i, v_i)$: regression coefficient k at each location or realization of the continuous function $\beta_k(u,v)$ at point i

ε_i : error assumed to be identically, independently, and normally distributed with mean zero and constant variance σ^2.

Parameter estimation at each location i in Equation (1) through Weighted Least Square (WLS) is in Equation (4).

$$\hat{\boldsymbol{\beta}}(i) = \left(\mathbf{X}^T \mathbf{W}(i) \mathbf{X}\right)^{-1} \mathbf{X}^T \mathbf{W}(i) \mathbf{y} \quad (4)$$

where X = matrix of data from the independent variable, **y**= vector of the dependent variable, and W (i) is the weight matrix.

III. RESULTS AND DISCUSSION

a. Water quality measurement results

The data description is presented in Table 2. With an average of 1500 mg/L, microplastic content can be considered very high at all sampling points. This figure exceeds all quality standards. Furthermore, the DO content at all sampling points exceeds the quality standards with an average of 5.6 mg/L. TSS averages 30.2 mg/L, where two sampling points exceed the quality standards. Meanwhile, the pH parameter is still within the quality standard limits.

TABLE 2.
DESCRIPTION OF RIVER WATER QUALITY PARAMETERS

Variable	Quality Standard	Lowest	Average	Highest
Microplastics (mg/L)	20	750	1500	2100
pH	6-9	6	6.15	7
Temperature (^{0}C)		23	24.95	28
DO (mg/L)	4	5.6	23.245	98
TSS (mg/L)	50	1	30.2	182

b. Correlation Between Parameters

Initial identification of the influence between river water quality parameters, precisely Temperature, pH, DO, and TSS on microplastics. The results are presented in Table 2. The correlation coefficient 0.4936 between the DO parameter and microplastics has the most substantial relationship with microplastics. The increase in microplastics may be related to the increase in dissolved oxygen. This can be explained through the mechanisms of physical and chemical interactions in aquatic ecosystems. Microplastics can affect the solubility of oxygen in water, where the presence of microplastic particles can increase the surface area for chemical and biological reactions that support the increase in DO levels. Research shows that microplastics can serve as habitats in the decomposition process, affecting dissolved oxygen levels. Research shows that although the concentration of microplastics increases, dissolved oxygen (DO) remains stable due to sufficient aeration in the experimental environment [27]. Table 3 shows Correlation coefficient values between Temperature, pH, DO, TSS, and microplastics.

TABLE 3.
CORRELATION COEFFICIENT VALUES BETWEEN TEMPERATURE, PH, DO, TSS, AND MICROPLASTICS.

Variables	Microplastics	pH	Temperature	DO	TSS
Microplastic	1	0.234	0.147	0.493	-0.296
pH	0.234	1	0.411	0.270	0.031
Temperature	0.147	0.411	1	0.394	-0.096
DO	0.493	0.270	0.394	1	-0.280
TSS	-0.296	0.031	-0.096	-0.280	1

The water temperature at the sampling point varies according to the season. The water temperature varied from 23 to 28 °C during the study period. The average water temperature at the surface of this river is 24.9 °C. Considering the shallow depth of the water layer, the temperature differences in these rivers can be explained by the direct influence of the air temperature. [28].

The correlation coefficient between Temperature and microplastics is 0.147. This indicates that higher temperatures also lead to higher microplastic content. The effect of Temperature in some cases includes an increase in Temperature that generally accelerates the degradation process of smaller microplastics. Meanwhile, the degradation of microplastics into smaller particles can expand their spread in the environment and increase the risk of exposure to organisms. Moreover, high temperatures can cause the release of additives contained in plastics, such as dyes, plasticizers, and flame retardants. These substances can pollute the environment and potentially be harmful to organisms.

Other references state that increased temperatures can reduce the abundance of microplastics through degradation processes, whether thermal degradation, photodegradation, or biodegradation. [29] Temperature plays a crucial role in enhancing the process of microplastic breakdown in aquatic environments, which is called the photodegradation of plastics. Photodegradation is a degradation process caused by UV light, which can break down plastic molecules into small particles or microplastics. In the biodegradation process, high temperatures can enhance the activity of microorganisms involved in plastic biodegradation. Microorganisms like bacteria can break plastic molecules into small particles or microplastics.

The correlation coefficient between pH and microplastics is 0.234. This indicates that the higher the pH, the higher the microplastic content. Like Temperature, pH can affect the degradation process, pollutant adsorption, and the interaction of microplastics with their surrounding environment. Acidic conditions (low pH) can accelerate the degradation of certain plastics, especially those containing specific functional groups. Acids can trigger hydrolysis, which is water molecules' breakdown of chemical bonds in plastics.

Based on the research [30], pH will affect the abundance of microplastics. Pellet microplastics are commonly found in waters with acidic pH. Additionally, rainfall affects the distribution of microplastics into the environment, as increased flow causes frequent/intense collisions between particles in the water [31]. This positive correlation suggests that microplastics are more prevalent in samples with higher acidity or alkalinity (pH) levels.

The negative correlation coefficient between TSS and Microplastics, which is -0.296, explains that the increase in TSS is inversely proportional to the concentration of microplastics. That is, the higher the TSS concentration, the lower the plastic concentration. [32] state that TSS impacts the dynamic behaviours of microplastics, influencing their accumulation in aquatic habitats. Local hydrodynamics and water chemistry, particularly total suspended solids (TSS), are essential in the movement and retention of microplastics.

The relationship between pH and Temperature is also moderate. However, other relationships tend to be weak, indicating that other factors may be more influential in determining these variables' relationships. Temperature regulates the existence of aquatic creatures [33]. The Temperature of a particular water system typically influences the solubility of chemicals inside it. Some compounds dissolve markedly in water at elevated temperatures, while others do so at reduced temperatures[34], [35]. High temperatures usually help microorganisms degrade microplastic [32]. This is in line with other research findings that show that Temperature and pH significantly influence each other in the context of water quality [36].

The negative correlation between TSS and DO means that high TSS contributes to water turbidity, which reduces light penetration. Research shows that truss particles can block the light needed by phytoplankton for photosynthesis, reducing the production of dissolved oxygen (DO) in the water.

c. Modelling Factors Affecting Microplastics

Modelling factors affecting microplastics is conducted through multiple linear regression analysis, as shown in Equation (2). The estimated model parameters are presented in Table 4.

TABLE 4.
REGRESSION MODEL PARAMETER ESTIMATION

Variable	Parameter Estimation	Std.Error	T value	P value
Intercept	1127.180	846.149	0.1928	0.600
pH (X1)	126.329	128.950	0.3351	0.668
Temperature (X2)	-17.245	27.119	0.5297	0.795
DO (X3)	4.149	1.651	0.0176	0.149
TSS (X4)	-1.728	21.469	0.2488	0.453

The results of the parameter estimation above can be written in the following mathematical Equation:

$$Y = 1127.180 + 126.329X1 - 17.245X2 + 4.149X3 - 1.728X4$$

The interpretation of the model is that if all independent variables are constant, the variable for the amount of microplastics is 1127.180 mg/L. The pH variable has a regression coefficient of 126.329, indicating that each 1-unit increase in pH will increase the amount of microplastics by 126.329 mg/L. A positive coefficient indicates a proportional relationship, meaning that microplastics will be high if the pH is high. The regression coefficient is -17.245 for the temperature variable. This means that for every 1℃ increase in temperature, there is a 17.245 mg/L decrease in the amount of microplastics. A negative coefficient indicates an inverse relationship, meaning that microplastics will be high if the Temperature is low. The DO variable has a regression coefficient of 4.149, indicating that every increase of 1 mg/L in dissolved oxygen (DO) concentration will increase the amount of microplastics by 4.149 mg/L, assuming other variables remain constant. A coefficient of -1.728 is assigned to the TSS variable. This means that for every 1 mg/L increase in TSS, the amount of microplastics will decrease by 1.728 mg/L, holding other variables constant. This indicates a negative relationship between TSS and the amount of microplastics.

The results of the variable significance test with the null hypothesis indicate that the variables are insignificant with α=5%, concluding that there are no significantly influential variables. The variables pH, Temperature, DO, and TSS do not have a significant effect. Therefore, a stepwise regression was conducted to obtain the best model and the most influential variables. Table 4 shows the estimation of DO and microplastic regression model Parameters.

TABLE 5.
ESTIMATION OF DO AND MICROPLASTIC REGRESSION MODEL PARAMETERS

Variable	Parameter Estimation	Std.Error	T value	P value
Intercept	1391.361	107.61	12.996	0.000
DO (X3)	4.674	2.648	1.765	0.0946

The results of the parameter estimation above can be written in the following mathematical Equation:

$$Y = 1391.361 + 4.674\,X3$$

This model shows that DO significantly affects microplastics at a significant level (α) of 10%. This is evidenced by a P value of 0.0946, less than the significance level (α) of 10%. This result reinforces the previous correlation analysis, which indicated a strong correlation between DO and microplastics.

The DO variable has a regression coefficient of 4.149. This means that for every 1 mg/L increase in dissolved oxygen (DO) concentration, the amount of microplastics increases by 4.149 mg/L. All other variables are held constant. This value indicates a positive relationship between DO and microplastics, meaning that the higher the dissolved oxygen level, the higher the concentration of microplastics in the observed waters, with the note that the influence of other variables is considered constant in this model. The regression modelling results in Table 4 have also been tested for residual assumptions and have been shown to meet the normal and identical distribution assumptions. However, they do not meet the assumption of independence. This indicates the presence of spatial autocorrelation. Therefore, spatial GWR modelling needs to be conducted.

Table 6 below shows the results of GWR modelling. According to [37], GWR can provide deeper insights into the relationships between variables at different locations, which traditional regression models cannot capture. GWR performs local regression at many sites to estimate localized coefficients. This allows for comparing model coefficients to see if regression relationships exhibit geographical variation [26]. This model provides different models for each observation based on the varying characteristics of microplastics at each location. The data consists of 20 observation points, resulting in 20 model equations. These different models also show that the influence of DO varies at each location.

TABLE 6.
GWR MODEL PARAMETER ESTIMATES BETWEEN DO AND MICROPLASTIC

No	Latitude	Longitude	Parameter Estimation DO coefficient	Std. error	t value	P value
1	7.827	110.387	4.770	2.749	1.735	0.091*
2	7.875	110.392	5.058	2.795	1.809	0.081*
3	7.873	110.366	4.961	2.786	1.781	0.084*
4	7.913	110.367	5.195	2.953	1.759	0.087*
5	7.777	110.358	4.404	2.885	1.527	0.124
6	7.790	110.357	4.485	2.829	1.585	0.114
7	7.808	110.354	4.587	2.780	1.650	0.103
8	7.840	110.349	4.739	2.754	1.721	0.093*
9	7.784	110.439	4.542	2.870	1.582	0.114

No	Latitude	Longitude	Parameter Estimation DO coefficient	Std. error	t value	P value
10	7.827	110.437	4.877	2.787	1.750	0.088*
11	7.952	110.380	5.481	3.348	1.637	0.105
12	7.822	110.423	4.814	2.771	1.738	0.090*
13	7.852	110.430	5.026	2.789	1.802	0.082*
14	7.790	110.369	4.515	2.818	1.602	0.111
15	7.802	110.371	4.594	2.783	1.651	0.103
16	7.806	110.374	4.627	2.773	1.669	0.100
17	7.816	110.375	4.682	2.758	1.697	0.096*
18	7.852	110.375	4.877	2.753	1.771	0.086*
19	7.873	110.383	5.018	2.787	1.800	0.082*
20	7.833	110.452	4.944	2.818	1.754	0.088*

Note: *) Significantly influential.

The influence of DO on microplastics at each location is observed from the P value. A P value less than the significance level (α) of 10% indicates that DO significantly affects microplastics. From the P values in Table 5, DO significantly affects 12 observation points and does not affect eight observation points. The illustration of DO significance at each point is presented in Figure 2. DO is insignificant at 8 sample points at the northern and southern ends, namely 3 points in the Gadjahwong River, 3 in the Winongo River, 1 in the Oya River, and 1 in the Kuning River. Meanwhile, DO is significant at 12 other observation points.

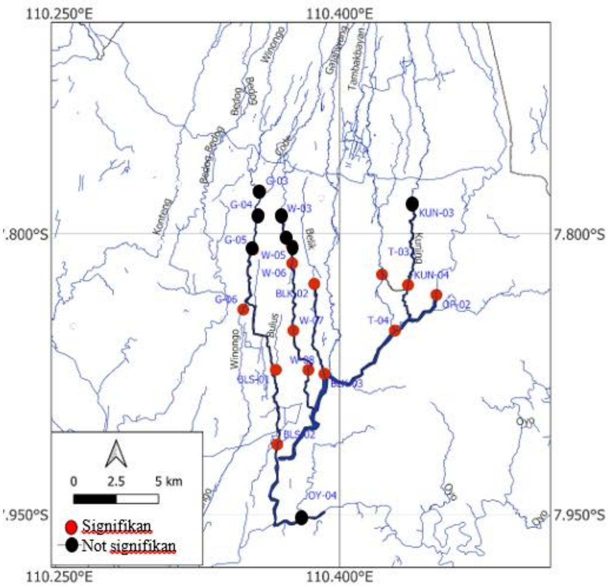

Figure 2. DO significance at each point

d. Steps to address river pollution based on the influence of DO on microplastics

Dissolved Oxygen (DO) or dissolved oxygen in water plays an important role in aquatic ecosystems, including the degradation process of organic materials. DO does not generate or increase the amount of microplastics in the water. However, DO indirectly affects microplastics. High DO levels can accelerate the degradation process of organic materials, including existing microplastics. The degradation of existing microplastics is very dangerous because it reduces their size. The smaller the microplastics due to degradation, the easier it is for these particles to enter the bodies of living organisms, including humans. They can be inhaled, ingested through seafood, or penetrate the skin. Conducting routine tests to monitor microplastic and dissolved oxygen (DO) levels in rivers to understand the impact of pollution on ecosystems can reduce microplastic pollution.

IV. CONCLUSION

The analysis results found that with an average of 1500 mg/L, microplastic content can be considered very high at 20 sample points. Even those figures exceed all quality standards. The results of the correlation matrix show the relationships between the variables in the data. The DO variable has the most substantial relationship with Microplastics, where higher DO levels correspond to higher microplastic levels.

This research reveals a significant correlation between dissolved oxygen (DO) concentration and microplastic levels, with regression analysis indicating that each 1 mg/L increase in DO corresponds to a 4.674 mg/L rise in microplastics. These findings can be utilized to mitigate microplastic concentrations based on dissolved oxygen content or other associated parameters.

The results of this modelling provide benefits as a basis for policy-making related to environmental management and microplastic pollution control. Accurate information about the location and concentration of microplastics helps the government and related agencies formulate mitigation strategies and protect aquatic ecosystems.

Thus, the results of this study provide new insights into the interactions between water quality parameters and microplastics. In addition, they provide a strong foundation for environmental management policy making and more effective microplastic pollution mitigation strategies.

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