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RESEARCH ARTICLE

THE IMPACT OF LAND COVER ON WATER QUALITY IN THE CENTRAL BEDADUNG SUB-WATERSHED, JEMBER INDONESIA

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ABSTRACT

The Central Bedadung Watershed (DAS) is an urban watershed susceptible to pollution due to human activities. Within this watershed, raw water collection is conducted by Perundam Tirta Pandalungan in Jember Regency. This study aims to assess water quality and analyze the impact of land cover on water quality in the Central Bedadung Sub-Watershed. A quantitative descriptive method was employed, utilizing one-tailed Spearman correlation analysis. The grab sampling method was used to collect samples from five locations during the low-discharge dry season. The tested parameters included temperature, pH, Total Dissolved Solids (TDS), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Dissolved Oxygen (DO). Water quality was evaluated based on Government Regulation Number 22 of 2021, Class I. The results indicated that temperature and BOD levels exceeded the specified quality standards. However, TDS, pH, and DO levels at all sample points complied with the quality standards. The Spearman correlation test revealed that land cover, particularly built-up and agricultural areas, significantly influenced water quality parameters, with a significance level (Sig. > 0.05). The relationship strength ranged from moderate to very strong. Water quality in the Central Bedadung Sub-Watershed met quality standards for TDS, pH, and DO. However, the Spearman correlation test indicated that land cover had no significant effect on water quality, with a significance level (Sig. > 0.05) and a relationship strength ranging from moderate to very strong.

KEYWORDS

River water quality, Bedadung River, Spearman correlations, Land Cover

1. INTRODUCTION

A watershed is defined as a land area enclosed by ridges or mountains (Rana and Suryanarayana, 2021). Unlike administrative boundaries, watershed boundaries are determined by natural topography and often encompass multiple administrative regions. The primary function of a watershed is to collect, store, and regulate the movement of precipitation, ultimately directing water into the main river system before discharging it into the sea through a designated outlet (Garg et al., 2021).

Rivers play a crucial role in sustaining human life and supporting economic development. However, the expansion of urban and industrial areas poses a significant risk of polluting rivers and other water sources (Asadollah et al., 2021). Therefore, continuous water quality monitoring is essential to mitigate and manage water contamination effectively.

Continuous development can negatively impact the functionality of river water, making it essential to regulate waste pollution and preserve the surrounding environment to maintain river sustainability. River pollution occurs when water quality declines and no longer meets its designated use. Water quality standards are established under Government Regulation No. 22 of 2021 on Environmental Protection and Management. The presence of pollutants or harmful substances in river systems can disrupt aquatic organisms and ecosystems, serving as key indicators of water pollution (Morin-Crini et al., 2022).

Sources of river water pollution include both domestic and non-domestic waste, such as household, industrial, and agricultural discharge. Water pollution is characterized by physical, chemical, and biological parameters. Physical indicators include observable characteristics such as odor, color, and turbidity. Chemical parameters, such as organic compounds, pH levels, and heavy metal concentrations, often originate from industrial waste. Biological factors, including microorganisms, also play a significant role in water contamination (Morin-crini et al., 2022).

Land cover plays a crucial role in determining river water quality. Changes in land use and cover are primarily driven by human activities, including intensive agriculture, deforestation, urban expansion, and population growth (Musetsho et al., 2021). The research asserts that land use has a profound impact on water quality, highlighting the need for sustainable water management practices (Amaefule et al., 2023; Cheng et al., 2022). Development within watershed areas is intended to enhance community well-being across multiple sectors. However, regions with high population densities and extensive agricultural activity often experience a decline in river water quality. In contrast, areas with substantial forest cover can function as natural water purification zones, contributing to improved water quality (Francini et al., 2022). Additionally, changes in spatial patterns along rivers can lead to thermal pollution, further affecting aquatic ecosystems (Naimaee et al., 2024).

The Central Bedadung Watershed is predominantly characterized by built-

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up land due to its urban location. Additionally, the land cover includes agricultural land, gardens, water bodies, forests, open land, and shrubs (Cendikia et al., 2022). The diverse land cover characteristics significantly impact water quality and its utilization. The Bedadung River serves as a source of raw water, managed by Perundam Tirta Pandalungan in Jember Regency. The designated raw water intake locations for Tirta Pandalungan are situated within the Kaliwates and Patrang Districts (Elida Novita, 2020). The extensive use of raw water by residents of Jember City underscores the need for continuous water quality monitoring to ensure its suitability for various applications. A decline in water quality within the Central Bedadung watershed can significantly impact the availability of clean water for the community, increase raw water treatment costs, and disrupt the aquatic ecosystem's balance. Therefore, this research is crucial not only in an academic context but also as a foundation for more effective policymaking in water quality management.

This study underscores the critical importance of water quality and its alignment with intended uses. Within the Bedadung Watershed, water serves multiple purposes, primarily as a raw water source, necessitating strict adherence to water quality standards. The findings emphasize that land cover plays a significant role in influencing water quality, with different land cover types leading to variations in water quality outcomes. Research indicates that areas with forest land cover generally exhibit better water quality than those with minimal forest cover by (Nowak et al., 2022). Similarly, a study in the Bialo River Basin found that primary forest land cover is preferable to shrub land and dryland agriculture, as evidenced by lower temperature, turbidity, color, Total Suspended Solids (TSS), and Biochemical Oxygen Demand (BOD) values, alongside higher Dissolved Oxygen (DO) levels by (Anriana et al., 2020). Additionally, research on rivers in Sleman District, using the Spearman correlation analysis, revealed a negative correlation between agricultural and urban land use and river water quality by (Hamidi and Kamulyan, 2022). In contrast, grassland and forest land cover demonstrated a positive association with improved water quality.

Despite these findings, a gap remains in research utilizing Sentinel-2A land cover data to assess the correlation between land cover and water quality using the Spearman correlation method. Furthermore, there is limited research on its specific impact within the Central Bedadung Sub-Watershed. Therefore, this study aims to analyze the influence of land cover on water quality in the Central Bedadung Watershed.

2. Material And Methods

2.1 Study Area

The Bedadung Sub-Watershed is located within the administrative boundaries of Jember Regency, spanning latitudes 08°02'15"–08°17'15" south and longitudes 113°35'45"–113°47'45" east. It is a key component of the Bedadung Watershed, which is designated as one of Indonesia's 108 national priority watersheds. Within the Tengah section of the Bedadung Sub-Watershed, two primary water sources contribute to its flow: one originating from the west, specifically the Argopuro volcano complex, and the other from the east, sourced from the Raung volcano. The sub-watershed covers an area of 27,043.4 hectares and extends across multiple districts, including Ajung, Arjasa, Kaliwates, Pakusari, Patrang, Sukorambi, and Sumbersari. Among these, Ajung District encompasses the largest area at 6,005.3 hectares, while Kaliwates District is the smallest, covering 2,561.2 hectares.

2.2 Method

This study employed a descriptive quantitative research approach, focusing on numerical data analysis processed through statistical methods. The study area encompassed a 3-kilometer radius around the river. A purposive sampling technique was used to select five sampling points, chosen based on factors such as surrounding land cover, waste sources, and water utilization. These criteria were established to assess the characteristics of water quality within the Bedadung Watershed. Figure 1 illustrates the selected sampling points.

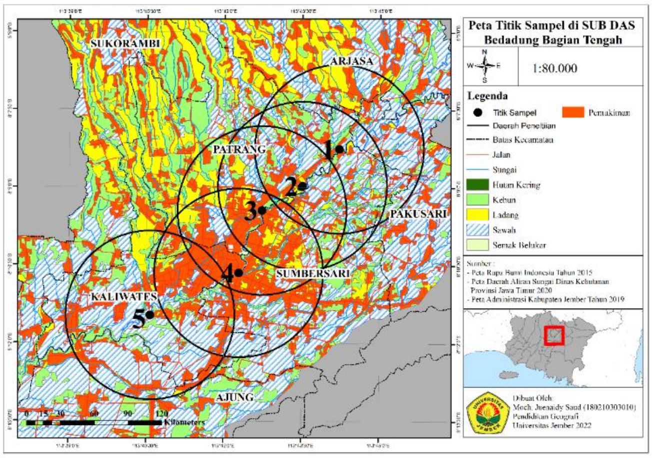

Figure 1: Study area and Sampling Point at Central Bedadung Sub Watershed, Jember Regency.

2.3 Data Collection Techniques

Water sampling in this study was conducted using the grab sampling method, which involves collecting a sample at a specific point in time to represent the characteristics of a water body (Chaffin et al., 2021). Water sampling was conducted on September 9, 2023, at the predetermined sample points (Figure 1). Field measurements and laboratory analyses were performed to assess key water quality parameters, including temperature, Total Dissolved Solids (TDS), pH, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Dissolved Oxygen (DO). These parameters were then compared against Class 1 water quality standards as outlined in Government Regulation No. 22 of 2021. Land cover data were derived from Sentinel-2A imagery, categorizing built-up areas, forested land, agricultural land, and open land. Image classification was performed using the supervised classification technique with the maximum likelihood method. The maximum likelihood classifier, based on Bayes' theorem, assumes that each class within each spectral band follows a normal distribution, making it a widely used supervised classification approach (Norovsuren et al., 2019). The classification utilized bands 2, 3, and 4 of the Sentinel-2A imagery, each with a 10-meter resolution, employing a natural color combination. The data were acquired on May 20, 2023. The accuracy of the resulting land cover map was evaluated using an error matrix, which provides a cross-tabulation of correctly and incorrectly classified samples in comparison to a reference dataset (El Fels and El Ghorfi, 2022).

Table 1: Water Quality Class 1 in Government Regulation Number 22 of 2021

PARAMETERS	UNIT	CLASS I
Temperature	$°C$	Deviation 3
Dissolved Solids	mg/L	1000
pH	mg/L	6-9
BOD	mg/L	2
COD	mg/L	10
DO	Mg/L	6

2.4 Data Analysis Techniques

The relationship between water quality and land cover was analyzed using the Spearman correlation test. The Spearman correlation is a non-parametric statistical method used to evaluate the association between two variables without assuming a specific frequency distribution (Zhang, 2024). Unlike parametric correlation methods, which require normally distributed data, the Spearman correlation is suitable for ordinal-scale data and does not require normality.

In this study, the Spearman correlation test was applied to examine the relationship between land cover and each water quality parameter at the designated sampling points. By assessing the influence of land cover on water quality at each site, this study aims to determine the extent of its impact. The results of this analysis are presented in tabular format.

The spearman correlation test is a non-parametric statistic and the data are not normally distributed (Zhang, 2024). The significance criterion in the spearman correlation test is if the significance value is 0.05 or 0.01 (1-tailed). The correlation direction criterion can be seen from the correlation coefficient number, if the value lies between +1 then the relationship between the two variables is unidirectional and if the co-correlation coefficient value is -1 then the relationship between the two variables is not unidirectional. When the value of the first variable increases then both variables will decrease. The criteria for the level of correlation strength are as follows: The spearman correlation test is a non-parametric statistic and the data are not normally distributed. The significance criterion in the spearman correlation test is if the significance value is 0.05 or 0.01 (1-tailed). The correlation direction criterion can be seen from the correlation coefficient number, if the value lies between +1 then the relationship between the two variables is unidirectional and if the co-correlation coefficient value is -1 then the relationship between the two variables is not unidirectional. When the value of the first variable increases then both variables will decrease. The criteria for the level of correlation strength are as follows:

1) Correlation coefficient value of 0.00 – 0.25 = very weak relationship
2) Correlation coefficient value of 0.26 – 0.50 = sufficient relationship
3) Correlation coefficient value of 0.51 – 0.75 = strong relationship
4) Correlation coefficient value of 0.76 – 0.99 = very strong relationship
5) Correlation coefficient value of 1.00 = perfect relationship

3. Results

3.1 Water Quality of Central Bedadung River

Based on field measurements and laboratory test results, the findings are presented in Table 2. The temperature parameter exhibits variations across sampling points, with recorded values ranging from 29.5°C to 30.4°C (Table 2). Sample point 5 recorded the highest temperature, while sample point 3 had the lowest.

Table 2: Water Quality Measurement Result

Sampling Location	Temperature(°C)	TDS (mg/L)	pH	BOD (mg/L)	COD (mg/L)	DO (mg/L)
Sample Point 1	30,4	103	8,3	4,7	33,5	9,59
Sample Point 2	30,2	119	8,1	2,4	21,5	10,14
Sample Point 3	29,5	107	8,3	2,2	9	9,53
Sample Point 4	30,2	150	8	2,6	13,5	9,86
Sample Point 5	32	106	8,4	2,6	14	7,97
Class I Water Quality Standards	Deviation 3	1000	6-9	2	10	6

The Total Dissolved Solids (TDS) parameter ranges from 103 mg/L to 150 mg/L (Table 2). Sample point 1 recorded the lowest TDS concentration at 103 mg/L, while sample point 4 had the highest concentration at 150 mg/L. The average TDS concentration across all sample points was 117 mg/L.

Based on Table 2, the pH in the central Bedadung watershed ranges from 8 to 8.4. The pH value shows almost the same tendency at each point of the sample. Sample point 4 has the lowest pH value with a value of 8. The highest pH value was found at sample point 5 with a value of 8.4.

Based on Table 2.. The range of BOD values is 2.2 mg/L to 4.7 mg/L. the highest BOD value is located at sample point 1 with a value of 4.7 mg/L, while the lowest value is located at sample point 3 with a value of 2.2 mg/L. Based on the measurement measurements made, the COD value in each sample shows a decrease from sample point 1 to sample point 3 and an increase from sample point 3 to sample point 5 (Table 2.). The COD value from the measurement results has a range between 9 mg/L to 33.5 mg/L. The sample point with the highest COD value is at sample point 1 with a value of 33.5 mg/L, while the lowest is at sample point 3 with a value of 9 mg/L.

Table 2. shows an increase in values from sample point 1 to sample point 2 and a relative decrease from sample point 2 to sample point 5. The Do value at all sample points has a range between 7.97 mg/L to 10.14 mg/L. At sample point 2 is the sample point with the highest DO value with a value of 10.14 mg/L. While at sample point 5 is the lowest with a value of 7.97 mg/L.

3.2 Land Cover of Central Bedadung Watershed

Mapping based on Sentinel-2A imagery sourced a land cover map of the central Bedadung sub-watershed. The land cover is classified into four types: forest land, agricultural land, built-up land, and open land. Land cover maps can be seen in Figure 2.

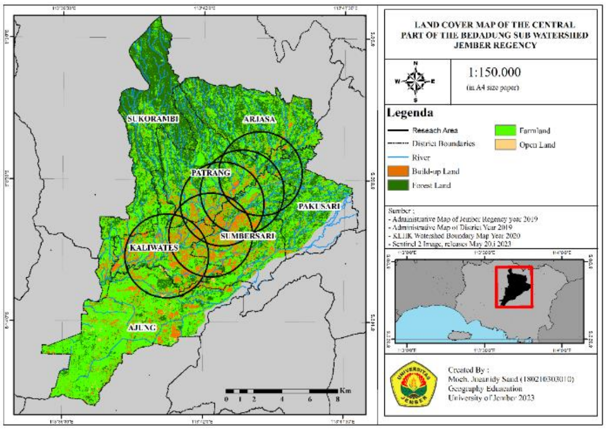

Figure 2: Land Cover Map of Central Bedadung Sub Watershed

In Figure 2. shows that land cover in the central Bedadung sub-watershed is dominated by agricultural land which is shown in light green. Dark green indicates the presence of forest land, mango indicates open land and or-en indicates built-up land.

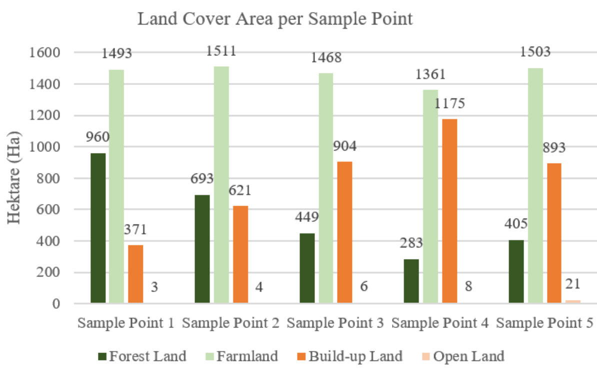

Figure 3: Land Cover Area per Sample Point

Based on Figure 3, agricultural land dominates all sample points. Sample point 2 has the highest proportion of agricultural land, while sample point 4 has the lowest. Forested land is most prevalent at sample point 1 and least at sample point 4. Built-up land is most extensive at sample point 4 and least at sample point 1. Open land is most prominent at sample point 5 and least at sample point 1.

Among the sample points, the largest total area is observed at sample point 1 (960 ha), followed by sample point 2 (693 ha). Sample point 2 has the most extensive agricultural land (1,511 ha), followed closely by sample point 5 (1,503 ha). Built-up land is most extensive at sample point 4 (1,175 ha), followed by sample point 3 (904 ha). The largest open land areas are found at sample point 5 (21 ha) and sample point 4 (8 ha).

3.3 Spearman Correlation Test of Water Quality to Land Cover

The analysis of land cover in relation to water quality was conducted using the Spearman correlation test. This statistical test assessed the relationship between two variables: land cover parameters and water quality parameters. The land cover parameters considered in the analysis included forested land, agricultural land, built-up land, and open land. Meanwhile, the water quality parameters examined were temperature, Total Dissolved Solids (TDS), pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), and Chemical Oxygen Demand (COD). The results of the Spearman correlation test are presented in Table 3.

Table 3: Results of Spearman Correlation of Land Cover to Water Quality

Variable		Forest Land	Farmland	Build-up Land	Open Land
Temperatur	Correlation Coefficient	0,051	0,154	-0,462	0,205
	Sig. (1-tailed)	0,467	0,402	0,217	0,370
	N	5	5	5	5
TDS	Correlation Coefficient	-0,600	0,700	0,700	0,300
	Sig. (1-tailed)	0,142	0,094	0,094	0,312
	N	5	5	5	5
pH	Correlation Coefficient	0,205	-0,667	-0,359	0,205
	Sig. (1-tailed)	0,370	0,109	0,276	0,370
	N	5	5	5	5
DO	Correlation Coefficient	0,200	0,600	-0,100	-0,500
	Sig. (1-tailed)	0,374	0,142	0,436	0,196
	N	5	5	5	5
BOD	Correlation Coefficient	0,154	0,205	-0,410	-0,154
	Sig. (1-tailed)	0,402	0,370	0,246	0,402
	N	5	5	5	5
COD	Correlation Coefficient	0,700	0,100	-.900	-0,600
	Sig. (1-tailed)	0,094	0,436	0,019	0,142
	N	5	5	5	5

Based on Table 3, the temperature parameter exhibits the lowest significance value in built-up land, with a significance level of 0.217 and a negative correlation of -0.462, indicating a moderate relationship. The TDS parameter shows the lowest significance in both agricultural and built-up land, with an identical significance value of 0.094 and a correlation coefficient of 0.7, signifying a strong relationship.

For the pH parameter, the lowest significance is observed in agricultural land, with a significance value of 0.109 and a negative correlation of -0.667, which denotes a strong relationship. The DO parameter has its lowest significance value in agricultural land as well, with a value of 0.142 and a correlation coefficient of 0.6, indicating a strong relationship.

Regarding BOD, the lowest significance value is found in built-up land, with a significance of 0.246 and a negative correlation of -0.41, reflecting a moderate relationship. Lastly, the COD parameter exhibits the lowest significance value in built-up land, with a significance of 0.019 and a negative correlation of -0.900, representing a very strong inverse relationship.

4. Discussion

Based on the field and laboratory test results for water quality, as presented in Table 2, temperature variations are observed across the sample points, ranging from 29.5 to 30.4°C. Sample point 5 exhibits the highest temperature, while sample point 3 records the lowest. However, these results indicate that the temperature parameter exceeds the standards established in Government Regulation Number 22 of 2021, which sets the Class 1 water quality standard between 22 and 28°C. Water temperature is influenced by several factors, including elevation, solar radiation intensity, and the extent of canopy or vegetation cover surrounding the river, all of which play a crucial role in regulating thermal conditions (Richter et al., 2024). Human activities significantly influence water temperature fluctuations. The discharge of heated or cooled wastewater into water bodies, along with deforestation in watersheds that reduces canopy cover, are primary contributors to these variations. Increased river water temperatures can have detrimental effects on overall water quality by altering key physicochemical parameters, potentially disrupting aquatic ecosystems and reducing the suitability of water for various uses (Grahan et al., 2024).

Water quality in terms of Total Dissolved Solids (TDS) parameters exhibited relatively consistent results across various sample points, with values ranging from 103 mg/L to 150 mg/L (Table 2.). The comparison of TDS values with quality standards, as per Regulation Number 22 of 2021 for raw water, reveals variations in measurement results. These differences are primarily attributed to the discharge of domestic waste, particularly from built-up land areas surrounding rivers. Additionally, TDS levels in water are influenced by soil runoff and rock weathering (Zhou et al., 2021). Elevated concentrations of TDS in water bodies can be attributed to various human activities in the surrounding areas.

The results of measuring pH parameters at each sample point have relatively the same value. The measurement results from all sample points have values that are in accordance with Government Regulation Number 22 of 2021. The pH values at all sample points ranged from 8 to 8.4, all of which had built-up land on the banks of rivers (Table 2.). This is a factor in the high pH of domestic waste from household activities either directly or indirectly (Bera et al., 2022).

BOD measurements that have been carried out have significant differences. BOD at sample point 1 is the sample point with the highest BOD value with a value of 4.7 mg/L, while at other sample points has a relatively stable value with a range between 2.2 to 2.6 mg/L (Table 2.). Based on Government Regulation Number 22 of 2021, the BOD parameter does not meet the requirements as raw water. Biochemical Oxygen Demand (BOD) is a key indicator of water quality, representing the amount of oxygen required by microorganisms to decompose organic matter in water. Higher

BOD levels indicate increased organic pollution, as more oxygen is consumed during the microbial oxidation process. In densely populated areas, the generation of organic waste is significantly higher, leading to elevated BOD levels due to the increased oxygen demand for decomposition (Pani et al., 2024). This can result in oxygen depletion in water bodies, adversely affecting aquatic ecosystems and water quality.

The results of COD measurements at each sample point have varying values with a range of 9 to 33.5 mg/L (Table 2.). Based on Government Regulation Number 2 of 2021, all sample points do not qualify as raw water, except for sample point 3 with a COD value of 9 mg/L. In the study, high COD was caused by the discharge of household wastewater along the river. The utilization of rivers for washing can also cause high COD. At sample point 3, direct household waste disposal is relatively smaller than other sample points. COD can be affected by human activities around rivers by disposing of waste in rivers or waters (Ngatia et al., 2023).

In Table 2. shows an increase in value from sample point 1 to sample point 2 and a relative decrease from sample point 2 to sample point 5. The DO value at all sample points has a range between 7.97 mg / L to 10.14 mg / L. At sample point 2 is the sample point with the highest DO value with a value of 10.14 mg / L. While at sample point 5 is the lowest with a value of 7.97 mg / L. High and low DO can be caused by sedimentation which can reduc DO levels in river water (Gao et al., 2024). Based on Government Regulation Number 22 of 2021, the quality standard value for class 1 DO is 6 mg / L, the higher the better. The measurement results carried out by all sample points are above the requirements which means they are categorized as safe.

The effect of land cover on water quality did not have a significant effect based on the results of the Spearman correlation test. The correlation results of temperature parameters showed the final significance value in built-up land cover, with a significance of 0.217 and a strong but insignificant negative correlation (-0.467) (Table 3.). Built-up land cover has no effect on temperature, but there is a strong inversely proportional relationship: as built-up land cover increases, water temperatures tend to decrease. This is not in accordance with the research of Li et al (2021) temperatures will increase with the increasing number of built-up land upstream to downstream which can cause sources of pollution resulting from human activities such as animal husbandry, settlements, agriculture and tourism. The intensity is increasing from upstream to downstream and the heat exchange between water and the surrounding air is increasing so that there is an increase in temperature (Briciu et al., 2020).

In the TDS parameter, the correlation results are close to significant for built-up land and agricultural land, with a significance of 0.094 and a strong positive correlation (0.700) (Table 3.). Although not significant, there is a strong association that suggests that increasing agricultural and developed land can increase TDS values. In accordance with research conducted by Ramadhawati et al conducted on the Cisade River stated that more community activity would affect water quality (Ramadhawati et al., 2021). Forest land can improve the quality of water available in waters, but developed land in the form of settlements can be a source of pollution in the waters and reduce water quality (Asnake et al., 2021). As as study stated TDS in water is affected by runoff from agricultural and residential land, soil contamination subjected to leaching and waste from households to (Pangastuti et al., 2022). Environmentally based land use and treatment can be used to improve the quality of water resources (Silva, 2023).

Land cover built up on pH parameters has a significant correlation with a value of 0.276 and a strong negative correlation (-0.359) (Table 3.). Although it has no direct effect on pH, an increase in built-up land can significantly lower the pH value. This is not in accordance with research conducted by (Gule, 2023). The results of the study show that pH parameters have a relationship with land cover in the form of residential or built-up land. Changing land cover and an increase in residential land will cause pH to increase. The increase in the area of land built in the form of settlements is due to the number of residents who continue to increase from year to year (Wahida et al., 2022).

In the BOD parameter, built-up land cover showed a significance of 0.019 and a very strong negative correlation (-0.900) (Table 3.). Built-up land has no effect on BOD, but it has a strong correlation that is inversely proportional: an increase in built-up land leads to a decrease in the value of BOD. The results of this test are not in accordance with the research conducted by (Giao et al., 2021). The study showed a relationship between residential land and positive BOD concentration values. The larger the residential area, the greater or higher the concentration of values on the BOD parameters.

The results of the correlation test between Chemical Oxygen Demand (COD) and the divided land, with a significance value of 0.019 and a negative correlation of -0.900 (Table 3.). A strong relationship was found between the two, where an increase in built land was associated with a decrease in COD value, and vice versa. This research is not in line with previous research, which shows a positive correlation between COD and residential area by (Hastuningrum et al., 2020). The results of this test are not appropriate because it shows that the increase in built land has no effect on COD parameters, although it has a strong negative correlation. The increasing size of residential areas can increase COD concentrations, especially because domestic waste such as kitchen waste and soap requires oxygen to decompose in waters (Ghaly et al., 2022).

In the DO parameter, agricultural land cover has a significance value close to (0.142) and a strong positive correlation (0.6) (Table 3.). Farmland does not affect DO, but there is a strong relationship that suggests that increasing farmland can increase the value of DO. This is not in accordance with research conducted DO can be affected by both organic and non-organic waste by (Koul et al., 2022). Organic and non-organic waste that pollutes a body of water requires dissolved oxygen or DO for the raining process. This can reduce DO levels in these waters. In addition, other factors such as temperature, sunlight sensitivity, water turbidity levels and canopies or vegetation that cover some of these waters can also affect DO levels. Temperature in cold waters can be the cause of high levels of DO in a water and also vice versa if the temperature is too hot, the dissolved DO will decrease (Mugwanya et al., 2022).

The results of this research indicate that it is not relevant to previous research. The use of sample area restrictions affects the correlation results. Using a combination of different area boundaries can be done for better results.

5. Conclusion

The conclusions that can be drawn from the discussion that has been conveyed include: Water quality in the Central Bedadung Sub-Watershed exhibits variations across different parameters, with temperature and Biochemical Oxygen Demand (BOD) exceeding the specified quality standards based on Government Regulation Number 22 of 2021, while Total Dissolved Solids (TDS), pH, and Dissolved Oxygen (DO) remain within acceptable thresholds. Chemical Oxygen Demand (COD) parameters mostly exceed quality standards, except at sample point 3, which complies with regulatory limits. Water quality based on land cover, as indicated by the results of the Spearman correlation test, found that built-up and agricultural land cover has some influence on water quality parameters, with a significance level of (Sig. >0.05) and a relationship strength ranging from moderate to very strong. Developed land has the potential to contribute to domestic waste, especially in areas along the riverbanks of the Central Bedadung watershed. The study also highlights that human activities, including wastewater discharge, deforestation, and land use changes, play a crucial role in influencing water quality. Elevated temperatures, particularly at sample point 5, suggest that urbanization and reduced canopy cover contribute to thermal pollution, while higher BOD levels indicate increased organic matter decomposition due to higher waste generation in densely populated areas. Although the correlation between land cover and water quality was not statistically significant, strong relationships were observed for certain parameters, such as an inverse correlation between built-up land and BOD and COD, which contrasts with previous research suggesting that urban expansion leads to increased organic pollution. Similarly, TDS values were found to be influenced by agricultural runoff and soil erosion, aligning with existing studies on watershed dynamics. These inconsistencies may be attributed to sample area limitations and differences in spatial boundaries, which could have affected the observed correlations. Establishing a boundary of 3 kilometers from the sample point in the research provides relevant insights for future studies and aids in identifying areas for further investigation. Therefore, future research should consider expanding the study area and incorporating more diverse land cover types to gain a comprehensive understanding of the relationship between land use and water quality in urban watersheds. Additionally, long-term monitoring and seasonal assessments are recommended to capture temporal variations and provide more accurate insights into water quality trends over time. Understanding these dynamics is crucial for developing effective watershed management strategies, mitigating pollution sources, and ensuring sustainable water resource utilization in urban and suburban environments. This research serves as a foundational basis for delineating specific area boundaries in subsequent studies and can contribute to improving water quality management efforts in the Central Bedadung Sub-Watershed.

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