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Research Article

Analysis of Water Quality on Environmental Health of the Kahayan Riverside, Palangka Raya City, Central Kalimantan

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Abstract

The settlement and housing environment is a basic human need and is also a determinant of public health. According to Palangka Raya City Health Office, in 2019, the number of people with the disease suffered by people related to diseases caused by the environment originating from Bukit Hindu community health centre and Pahandut community Health Center. In two years, the five dominant diseases were 1958 people with diarrhoea, 1329 people with typhoid and paratyphoid fevers, 939 people with infection of intestinal diseases due to other bacteria, 205 people with viral pneumonia and 148 people with pulmonary TB, which is influenced by environmental factors such as the quality of water. The purpose of this study was to analyze water quality on environmental health in settlements on the banks of the Kahayan River. This study using the Mix Method, namely data collection is conducted qualitatively and quantitatively. Data analysis was carried out using the "Non-Metric Multidimensional Scaling" (NMDS) statistical method with R software of the Vegan package. The findings in the research are that the highest BOD value is found on the banks of the Pahandut Seberang river of 1.98 mg/L, the maximum COD of 46.63 mg/L was found on the banks of the Pahandut Seberang river. The results of this E. Coli study were a maximum of 1000 Total/100ml on the banks of the Pahandut Seberang river. This study recommends the importance of the need for enforcement of existing regulations, for example, the Governor's Regulation on Stopping Open Defecation, the need for synchronizing regulations for regions that have certain cultures and conditions, prioritizing Appropriate Technology such as floating septic tanks and independent RPS, and group and social engineering is needed to changing people's perceptions about the use of public toilets.

Keywords
Health, environment, Water Quality, Kahayan River, Multidimensional Scaling

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Introduction

The settlement and housing environment is a basic human need and is also a determinant of public health (Chumo et al., 2021; Leder et al., 2021; Patel, Dean, Edge, Wilson, & Ghassemi, 2019; Rosenthal, 2021; Sarkar & Bardhan, 2021; Weimann et al., 2020; Wu et al., 2020; Zerbo, Delgado, & González, 2020). This is because almost half of human life will be at home so that the quality of the house will greatly affect their health condition (Organization, 2004). Homes should become the places that are free from distractions and capable of protecting from extreme heat and cold, rain and sun, wind, pests, and disasters such as floods and earthquakes, as well as pollution and disease (Matsumoto, Tsuzuki, & Susanti, 2017; von Seidlein et al., 2017). Health is a human right and, at the same time, an investment for the success of nation-building (Bieler, 2017; Voon & Mitchell, 2018).

As a country that is trying to fulfil the basic needs of the community, including healthy housing and the environment, the Indonesian government has launched the Healthy Indonesia program, namely a condition where everyone lives in a healthy environment, behaves in a clean and healthy life, has access to health services and has the highest degree of the health (Department of Health of the Republic of Indonesia, 2004). This program includes a clean and healthy environment as a component of creating quality Indonesian people. In this context, environmental health means the physical environment and the social environment. Environmental health will be realized if the supporting elements are met, namely the availability of clean water, beautiful nature, far from disease Shaffer et al. (2019), and supported by a healthy and intelligent social environment (Koehler et al., 2018).

Health problems that often occur in Indonesia and other developing countries in terms of the environment can generally be seen from poor water quality, low public understanding of sanitation, and poor hygiene conditions (Malolo, Kumwenda, Chidziwisano, Kambala, & Morse, 2021; Rahmasary, Koop, & van Leeuwen, 2021). This situation is caused by uncontrolled natural exploitation either in the form of household waste and factory waste which the environment itself cannot support. Poor quality of water and sanitation is the cause of the development of various diseases and creates vulnerability for the community)-Cissé, 2019 (

In general, the quality of water used for consumption (drinking water) must be maintained from the source of supply to the point of consumption. Rapid assessment of water quality using a variety of different techniques and analysis of appropriate data can provide information on water quality safety and its predictions for the future. Parameters that are often used for rapid assessment of water quality are microbiological quality parameters, parameters that cause water rejection by consumers, and chemical health risks (Dong, Wang, Yan, Xu, & Zhang, 2015; Widianto, Hasan, Aprilliani, & Herawati, 2020; Zhang et al., 2021).

The province of Central Kalimantan is geographically unique because it has 11 (eleven) major rivers, tributaries and thousands of small river branches connected to oxbow (horseshoe) lakes and other inundation areas. The Dayak community, in general, is very dependent on the river to fulfil their daily needs and being a residential area in the form of lanting houses (floating houses) as a form of local wisdom. The population living on the river banks in each regency/city in Central Kalimantan amounted to 860.426 people, for the city of Palangka Raya equal to 37.816 people (Sharma et al., 2018). The report from J. D. Putro and Zain (2021) states that on the banks of the Kahayan River, Palangka Raya City, there are 452 types of lanting houses, 623 stilt houses with 245 pieces of toilet facilities (lanting latrine). The total population of the Kahayan riverbank of Palangka Raya City in Pahandut Urban village is 6.224 people and Pahandut seberang Urban village is 1.636 people with a total population of 7.860 people.

The poor quality of water consumed by the people along the Kahayan riverbank is closely related to the number of sufferers of diseases caused by environmental conditions. Environmental harm caused by natural resource extraction, particularly in watershed areas, appears to be a growing concern, and thus far, from the perspective of Plankton is commonly utilized in aquatic and water resources as a sign of environmental deterioration (Gómez-Díaz, Krömer, Carvajal-Hernández, Gerold, & Heitkamp, 2017). Data from the Bukit Hindu Community Health Center and Pahandut Community Health Center shows that in 2018 and 2019, there were five dominant diseases, namely diarrhoea (1.958 patients), typhoid and paratyphoid fever (1.329 patients), intestinal infections due to other bacteria (939 patients), viral pneumonia (205 patients) and pulmonary TB (148 patients) (Dhini, 2019). The ecological factor is the main priority factor in improving the quality of

slum settlements .(Angriani, Ruja, & Bachri, 2018) Based on this description, it is important to find out more about water quality on environmental health in settlements on the banks of the Kahayan River. The results of this study are expected to provide a basis for the formulation of a more integrated policy towards riverbank area management in the city of Palangka Raya.

Research Method

Time and Location of the Research

The research was conducted from September to December 2020. The water sampling point is determined by the sample survey method, namely, dividing the research area into segments or points that are expected could represent the research population. Determination of the location of water sampling is carried out through three stages, namely geometric correction, digitization, overlay and location analysis. Geometric correction is carried out by rectification using a geographic coordinate system with reference to the World Geodetic System 1984 (WGS1984).
Sanitation and hygiene data were collected through interviews, questionnaires, and observations. The research location, namely station 1, represents the upstream Kahayan watershed located on the river in the Tumbang Rungan Urban village, Pahandut Subdistrict, Palangka Raya, station 2 is located in the middle of the Kahayan River in Pahandut Seberang Urban village, Pahandut Subdistrict, Palangka Raya and station three is located in the downstream of the Kahayan River in Bereng Bengkel Urban village, Sabangau Subdistrict, Palangka Raya (Figure 1). Sampling of water quality at each station was carried out 3 times with the point of collection adjusting the settlements of the people living in the area.

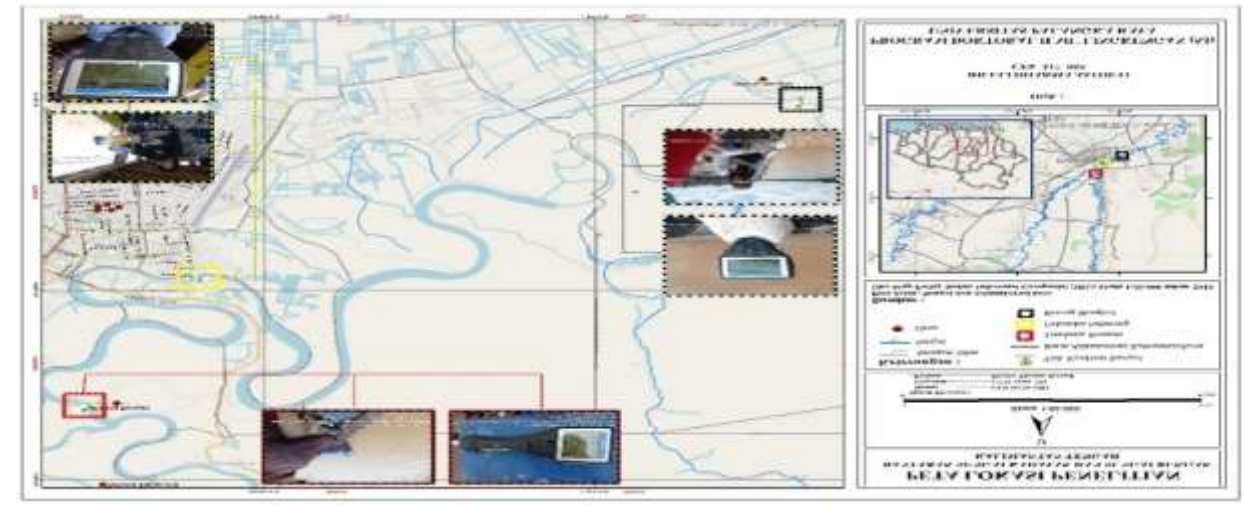

Figure 1. Sampling location

Population and Sample

Social data is taken from people who live in settlements on the banks of the Kahayan River. The research population is residents in 3 Urban villages, namely Tumbang Rungan Urban village, Pahandut Seberang Urban village and Bereng Bengkel Urban village, Palangka Raya City. The sample of this study was taken from residents who live on the banks of the Kahayan River using simple random sampling, where each member or unit of the population has the same opportunity to be selected as a sample. To obtain the number of samples that represent each village, then taken proportionally according to the number of heads of the family in each Urban village. The sample size is determined using the formula:

$n = N/Nd^{2+1}$

Information
n = Number of samples
N = Total population
d = degree of confidence

With the number of household heads of 2098 and a degree of confidence of 90%, a sample of 95 people was found. The selection of respondents is carried out according to predetermined criteria, namely housing conditions, completeness of sanitation conditions, the surrounding environment according to the parameters and variables used.

Research Variables and Operational Definitions

Research variables consist of independent variables and dependent variables. The independent variables consist of water quality, sanitation, and hygiene in 3 urban villages on the banks of the Kahayan River, Palangka Raya City, in 2020. In contrast, the dependent variable is the environmental health status of the residents in that location. Operational definitions of research variables are presented in Table 2.

Table 2.
Operational definition of research variables

No	Variable	Definition	Measuring instrument	Measurement method
1.	Independent Variable			
	a. Water quality	Water conditions for consumption that meet physical, chemical and biological requirements	• Water quality checklist • Laboratory examination	• Interviews and observations • Laboratory Test
	a. Sanitation	Supervision on the human environment can lead to bad consequences to human health, including removing wastewater, garbage, and drainage.	Questionnaire and checklist	Interviews and observations
	b. Hygiene	All efforts to maintain, protect and improve physical and mental health, both for the community and individuals, are the basis for the continuation of a healthy life and the improvement of health.	Questionnaire and checklist	Interviews and observations
2	Dependent variable Environmental Health Status	An optimum environmental condition or state so that it has a positive effect on the realization of optimal human health status includes: housing, disposal of human waste (faeces), provision of clean water, waste disposal, disposal of dirty water (waste).	Questionnaire and checklist	Interviews and observations

A brief description of the research variables is as follows.

1) The water aspect studied is in the form of the number of people living in riverside/banks settlements towards the diseases that may occur in the surrounding community. In terms of water quantity: about the amount of water available per person per day; the amount of clean water

from water sources; and reliable water supply. In terms of quality: the amount of water available per person per day; the amount of clean water from water sources; and reliable supply. In terms of accessibility: how far is the source of clean water; Are there problems with disabled, elderly and vulnerable populations; other water sources; and the possibility of facilitate for residents.
2) The sanitation aspect includes the available facilities as well as the number and distribution of facilities. In terms of facilities: any facilities; how are the vulnerable groups: disabled elderly, whether open defecation a threat to health, hand washing facilities, and whether the toilet meets health requirements. In terms of practice: the tradition of defecating and using WC, water for rectal cleaning, communal toilets, and pregnant and menstruating women. In terms of technique: local materials for the sanitation manufacture, and the appropriate existing technology.
3) Hygiene aspects are related to community behaviour, namely healthy living behaviour, handwashing behaviour after open defecation, waste disposal, water storage and handling, as well as food storage and handling. Disposal of solid waste, breastfeeding (hygienic), cooking utensils, health services – Community health centres, communities involved in education, and adequate health promotion.

Data Analysis

Data analysis was carried out using the "Non-Metric Multidimensional Scaling" (NMDS) statistical method with two stages as follows:

1. Stages of attributes determination in each analyzed aspect. At this stage, attributes are compiled that can describe the condition of each aspect being studied.
2. Stages of the assessment of each attribute on an ordinal scale. At this stage, each attribute compiled in stage one is then given a score according to the condition of the attribute intended based on the ordinal scale.

The ranking (score) is arranged based on the order of the smallest value to the largest value both quantitatively and qualitatively and not based on the order of values from the worst to the best value, for example: (0) occurred a decrease of less than 10%; (1) occurred a decrease of 10-25%; (2) occurred a decrease of 25-50%; (3) occurred a decrease of more than 50%. In this attribute, a score of zero is the best score, and a score of three is the worst score. The data analysis techniques carried out namely: (1) determining the attributes of the economic, environmental and social dimensions and determining critical attributes with multidimensional scaling (MDS) and leverage analysis; (2) prospective analysis to obtain key variables.
The data analysis techniques carried out namely: (1) determining the attributes of the economic, environmental and social dimensions and determining critical attributes with multidimensional scaling (MDS) and leverage analysis; (2) prospective analysis to obtain key variables. The analysis of environmental health status consists of assessment of public health status, environmental health risk assessment, and assessment of the degree of public health (Stern, 2010). Assessment of health status can be indicated by the morbidity rate, which is a number that shows the level of pain or the number of people who are sick / have complaints about their body condition (Costa Jr & McCrae, 1987). The health status of the community has a close relationship with the stages of socio-economic and environmental development conditions, where the relationship between socio-economic and environmental development and public health status can be reciprocal (Monaghan, 2008).

Results

Characteristics of Respondents

Respondents of this study were the communities around the banks of the Tumbang Rungan river, Kahayan Pahandut Seberang river and Bereng Bengkel river. Characteristics of respondents, including age, education and occupation are presented respectively in Table 3, Table 4 and Table 5.

Table 3.
Characteristics of respondents based on educational level

Educational Level	Tumbang Rungan		Pahandut Seberang		Bereng Bengkel		Total	
	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)
Bachelor	2	6.25	2	6.25	2	6.25	6	6.25
High School or equivalent	4	12.50	10	31.25	10	31.25	24	25.00
Junior High School or Equivalent	16	50.00	12	37.50	12	37.50	40	41.67
Elementary School	9	28.13	8	25.00	8	25.00	25	26.04
Uneducated	1	3.13	0	0.00	0	0.00	1	1.04
Total	**32**	**100**	**32**	**100**	**32**	**100**	**96**	**100**

Table 3 shows that the highest level of education in the 3 (three) research locations is Junior Highschool or Equivalent amounted to 41.67%, while the least is level of uneducated amounted to 1.04%. It will possibly have an impact on its relationship with employment and income that would be generated.

Table 4.
Characteristics of respondents based on age

Age (year)	Tumbang Rungan		Pahandut Seberang		BerengBengkel		Total	
	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)
30-35	7	21.88	6	18.75	15	46.88	28	29.17
36-40	11	34.38	8	25.00	12	37.50	31	32.29
41-45	3	9.38	6	18.75	1	3.13	10	10.42
46-50	5	15.63	4	12.50	2	6.25	11	11.46
>50	6	18.75	8	25	2	6.25	16	16.67
Total	**32**	**100**	**32**	**100**	**32**	**100**	**96**	**100**

Table 4 shows that according to the age group of respondents from the three research locations, the highest is still in the productive age range (36-40 years), namely equal to 32.29%, while the low age of respondents is 41-45 years old amounted to 10.42%. At a productive age, humans have matured physically, biologically and are at the peak of their activities.

Table 5.
characteristics of respondents based on occupation

Occupation	Tumbang Rungan		Pahandut Seberang		Bereng Bengkel		Total	
	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)
Fisherman	5	15.63	2	6.25	4	12.50	11	11.46
Labor	13	40.63	15	46.88	16	50.00	44	45.83
Merchants	6	18.75	6	18.75	5	15.63	17	17.71
Housewife	6	18.75	7	21.88	6	18.75	19	19.79
Civil Servant	2	6.25	2	6.25	1	3.13	5	5.21
Total	**32**	**100**	**32**	**100**	**32**	**100**	**96**	**100**

Water Quality

The results of laboratory tests on chemical and biological parameters of water on the banks of the Kahayan River are presented in Table 6.

Table 6.
Results of analysis of chemical and biological parameters of water quality

No.	Parameter	Unit	Class Quality Standard	Laboratory Results		
				I	II	III
1.	Temperature	◦C	Deviation 3	27.63	27.77	28.33
2.	pH		IV (5-9)	4.46	4.90	5.27
3.	BOD	mg/L	II (3)	1.24	1.98	1.08
4.	COD	mg/L	II (25)	28.8	46.63	33.90
5.	Iron (Fe)	mg/L	I (0.3)	0.69	0.47	0.55
6.	*E. Coli*	jml/100ml	0	800	1000	767

Temperature parameters show the average value on the banks of the Tumbang Rungan river is 27.63◦C, the banks of the Pahandut Seberang river is 27.77◦C. The banks of the Bereng Bengkel river is 28.33◦C; it can be said that they are not much different and still meet the water quality standards according to Government Regulation of the Republic of Indonesia No. 82 of 2001. The results of the measurement of the average pH of the water on the banks of the Tumbang Rungan river is 4.46, the banks of the Pahandut Seberang river are 4.9, and the banks of the Bereng Bengkel river is 5.27, from the results of this research the maximum pH is found on the banks of the Bereng bengkel river while the minimum is found on the banks of the Tumbang Rungan river, the results of the classification of quality standards are in class IV with a quality score of 5-9.
Laboratory results show that the average BOD value on the banks of the Tumbang Rungan river is 1.24 mg/L, the banks of the Pahandut Seberang river is 1.98 mg/L, and the Bereng Bengkel river bank is 1.08 mg/L, As for the results of this BOD research, the maximum is found on the banks of the Pahandut Seberang river, while the minimum is on the banks of the Bereng Bengkel river, so that it can be said included in quality standard 2 and not much different and still meet the quality standards of water quality in accordance with Government Regulation of the Republic of Indonesia No. 82 of 2001, according to Rahmawati, 2011 states that organic matter is generally in the form of waste that can decompose or be degraded by microorganisms, so that when it is discharged into waters it will increase BOD. In this study, the data obtained experienced ups and downs in the BOD value which was caused by the flow of water starting from upstream to downstream.
The results of laboratory studies for the average value of COD on the banks of the Tumbang Rungan river is 28.80 mg/L, the Pahandut Seberang Riverbanks is 46.63 mg/L, and the Bereng

Bengkel riverbanks is 33.90 mg/L, the results of this COD research that the most maximal on the banks of the Pahandut Seberang river while the least are on the banks of the Tumbang Rungan river, so it can be said that it is included in the class 2 quality standard with a quality score of 25 and is not much different and still meets the water quality standards in accordance with Government Regulation of the Republic of Indonesia No. 82 of 2001.

The average value of iron (Fe) on the banks of the Tumbang Rungan river is 0.69 mg/L, the Pahandut Seberang Riverbank is 0.47 mg/L, and the Bereng Bengkel riverbank is 0.55 mg/L, The results of this research for iron (Fe), the most maximal located on the banks of the Tumbang Rungan river while the minimum is found on the banks of the Pahandut Seberang river, so it can be said that it is included in the class 1 quality standard with a quality score of 0.3 and is not much different and still meet the water quality standard in accordance with Government Regulation of the Republic of Indonesia No. 82 of 2001.

The total average value of E. Coli on the banks of the Tumbang Rungan river is 800 jml/100ml, on the banks of the Pahandut Seberang river is 1000 jml/100ml, and the banks of the Bereng Bengkel river is 767 jml/100ml, the results of this E. Coli research, the most optimal found on the banks of the Pahandut Seberang river while the minimum is on the banks of the Bereng Bengkel river, so it can be said to exceed the quality standard and cannot be used as drinking water.

NMDS (Non-Metric Multidimensional Scaling) Statistical Test

NMDS (non metric multidimensional scaling) analysis was carried out with the aim of analyzing the relationship between water quality from laboratory tests, sanitation, hygiene, and physical water quality in 3 (three) research locations, namely Tumbang Rungan, Pahandut (Upstream), Pahandut Seberang. (Middle), and Bereng Bengkel (Downstream). The results of the detailed NMDS analysis are presented in Figure 3.

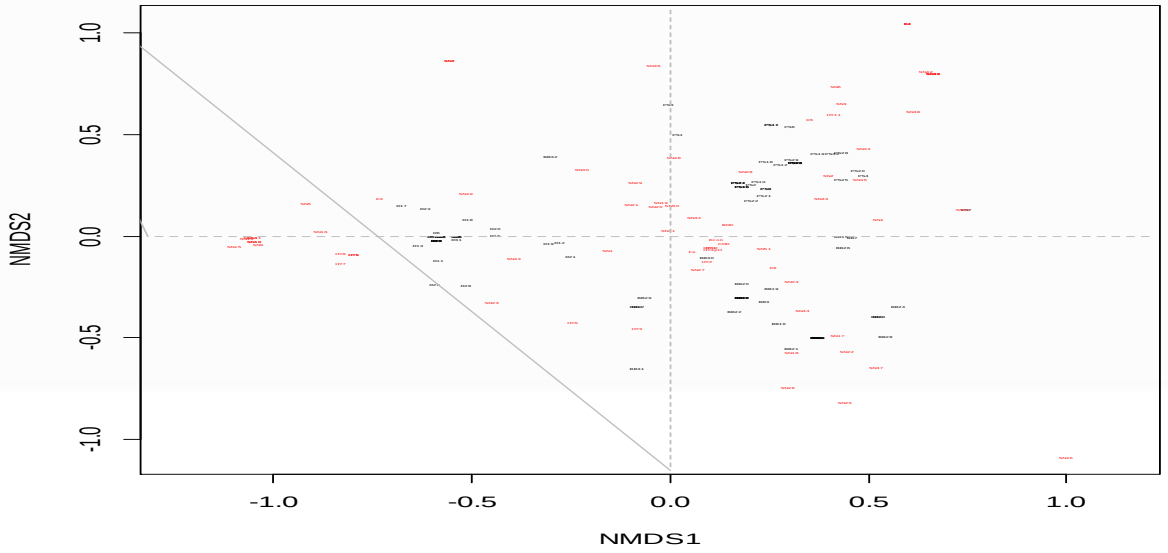

Figure 3. Biplot graph of non-metric multidimensional scaling (NMDS)

Information: Scores NMDS all variables (*red font*): Water Quality Parameters (pH, COD, BOD, Fe and Ecoli), Sanitation (SN1, SN2, up to. SN51), Hygiene (HY1, HY2, up to H11) and Perception on Water Quality, K (K1, K2, up to K6), with the number of data (object, *black font*, object code: R = Rungan, PS = Pahandut Seberang, BB = Bereng Bengkel) = 96 respondents, at each station (zonation) namely Rungan, Pahandut and Bereng Bengkel. NMDS1: First NMDS scores axis, NMDS2: Second NMDS scores axis.

The NMDS Biplot Graph in Figure 2 is a spatial (multidimensional) brief description of the data object and parameter variables of water quality, sanitation, hygiene and respondents' perceptions of water quality (physically). Briefly, the data is transformed using Wisconsin (sqrt(Y))

and then calculated such that the distance between objects and variables with dissimilarity from Bray-Curtis (semi-metric dissimilarity). From the dissimilarity matrix, the MDS (Multidimensional global Scaling using monoMDS) score is calculated, which is then multidimensionally plotted into a graph called a biplot.
From the four quadrants that exist in NMDS 1 and NMDS 2 are positively correlated, and vice versa must be negatively correlated, obtained data from the total respondents who still use river water as their daily needs for toileting, throwing children's feces into the river, there is no scheduled desludging of feces, there are still many who throw household waste into the river, there are still those who defecate into the river, which causes higher E Coli in the Bereng Bengkel upstream. This is supported by field data which shows that there are more levels of education at junior high school or equivalent (37,50%), more have the occupation as housewives (18,75%), with more age groups 30-35 years (46,88%).
Based on the NMDS distribution pattern, it can be said that the value of the relationship between rapid assessment of water quality, sanitation, hygiene in settlements on the banks of the Kahayan River, Palangka Raya City is obtained with a maximum value of run 20 stress of 0.103, with the achievement solution that has been determined by the calculation of the NMDS statistical test where the results show that the relationship and linkage between Water Quality, Sanitation and Hygiene at the research study site is analyzed using NMDS (non-metric multidimensional scaling) (Figure 12). The NMDS Biplot Graph in Figure 13 is a spatial (multidimensional) brief description of the data object and variable parameters of water quality, sanitation, hygiene and respondents' perceptions of water quality (physically). Briefly, the data is transformed using Wisconsin (sqrt (Y)) and then calculated such that the distance between objects and variables with dissimilarity from Bray-Curtis (semi-metric dissimilarity). From the dissimilarity matrix, the MDS (Multidimensional global Scaling using monoMDS) score is calculated, which is then multidimensionally plotted into a graph called a biplot.
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Discussion

Based on the results of the water quality analysis above, it shows that the highest concentration of Chemical Oxygen Demand (COD) occurs at the second location point in the Pahandut Seberang area with a value of 46.63 mg/L, where this point has exceeded the quality standard set by government regulations on water quality. High COD pollution as a result of the existence of various activities and disposal of the resulting waste, including the activities of home industries, settlements, and livestock. This finding is supported by Sirianuntapiboon and Nimnu (1999), that the presence of high chemical oxygen demand (COD) and organic nitrogen concentrations characterizes the wastewater in fish processing. This is because the upstream and downstream areas are increasing due to residential activities and organic waste materials in the form of waste that can be decomposed or degraded by microorganisms so that if discharged into waters, it will increase Biochemical Oxygen Demand (BOD) (Kaunang, Rompas, Tumbol, & Lasut, 2018). Waters with high COD values are undesirable for fisheries and agriculture purposes (Akar, 2021; P. G. L. Putro & Hadiyanto, 2021). The large amounts of organic matter in the water will absorb oxygen in water, thereby reducing the amount of dissolved oxygen. According to UNESCO, (UNEP, 1992) in (Kaunang et al., 2018), the COD value in unpolluted waters is usually less than 20 mg/l.
The increase in COD levels is also influenced by the BOD parameter, which is thought to be because, during its journey, the water flow from upstream to downstream receives a lot of waste from the people on the banks of the Kahayan River. So, the greater the BOD level, it is an indication that the waters have been polluted. The level of biochemical oxygen (BOD) in water whose level of pollution is still low and can be categorized as good waters range from 0 - 10 ppm (De Rose et al., 2005). If the concentration of river water pollutant load is above the quality standard and the carrying capacity of the pollutant load is still positive (+), then the pollutant load indicates that the pollutant entering the river still meets the carrying capacity of the river pollutant load. On the other

hand, if the pollutant load is below the quality standard line of the pollution load and the carrying capacity of the pollutant load is negative (-), then the pollutant entering the river body has exceeded the carrying capacity of the river pollutant load (Arya, Sariffuddin, & Bilqis, 2019; Gumelar et al., 2017; Jiatong, Cao, Wang, & Zhang, 2021). In addition to the increase in COD concentration, other parameters also experienced an increase, namely E.Coli with the highest value of 1000 ml/100ml in Pahandut Seberang hamlet and the lowest value of 767 ml/100ml in the Bering Bengkel section. This is due to community activities that dispose of latrines and river waste disposal, both wastes originating from activities in the market and waste originating from community activities around the river. Domestic waste pollution will have an impact on the availability of clean water, where the availability of good quality water sources is very little due to the lack of public awareness of environmental pollution. One of the microbiological pollutions that occur in the waters is the abundance of coliform bacteria and microorganisms that indicate contamination by pathogenic bacteria, namely Escherichia coli. The pollution of domestic waste, especially household waste along the Kahayan River is very worrying because the very high concentration of E. Coli bacteria far exceeds the acceptable quality standard.

Hudson, Baker, and Reynolds (2007), the large number of bacteria is influenced by the presence of organic waste discharged into river bodies. This organic waste comes from livestock activities, especially pigs that dispose of waste into water bodies without any processing process and increased domestic waste disposal due to bathing and washing activities of local residents. Water pollution by pathogenic bacteria, and other parasites or viruses, can occur in the raw water source or occur when processed water flows from the processing center to consumers. In some developing countries, including Indonesia, rivers, lakes, ponds, and canals are often used for various purposes, for example, for bathing, washing clothes, for disposing of sewage (feces), so that water bodies become heavily polluted by viruses, pathogenic bacteria, and parasites. others (McElroy, 1996). In addition, according to Purwanti, Widyorini, and Ghofar (2019) regarding sampling that has a high frequency of entry of waste will also affect the development of E. coli bacteria because E. coli bacteria are most commonly found in waters that receive a lot of input in the form of waste.

Conclusion

Finally, this research has the potential to improve wastewater handling. The findings of this research could be beneficial in identifying the maximum BOD value of 1.98 mg/L is discovered on the banks of the Pahandut Seberang river, while the lowest value of 1.08 mg/L is found on the banks of the Bereng Bengkel river; therefore, it is still within the quality standard. According to the study's findings, the highest COD concentration was found on the banks of the Pahandut Seberang river, while the lowest concentration was found on the banks of the Tumbang Rungan river, putting it in the class 2 quality standard with a quality score of 25 mg/L. This E. Coli investigation found a maximum of 1000 Total/100ml on the banks of the Pahandut Seberang river and a minimum of 767 Total/100ml on the banks of the Bereng Bengkel river, indicating that the water exceeds the quality limit and should not be used. The need of enforcing current legislation, such as the Governor's Regulation on Stopping Open Defecation, the need for synchronizing regulations for regions with specific cultures and conditions, and prioritization are all discussed in this paper. To change people's perceptions about using public restrooms, appropriate technology such as floating septic tanks and independent RPS, as well as group and social engineering, are required.

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