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Risk Assessment Study of Domestic Wastewater Pollution in North Kolaka Regency: Geographic Information System Approach

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ABSTRACT
Background: The community in North Kolaka Regency already has an open system of household waste water disposal, but there are still many found in a damaged, cracked and even perforated condition. In addition, there are also those who make the channel not watertight by digging the soil in the form of a ditch. They also still use a stool that is not tight on one side. The purpose of this study was to determine the risk index of domestic wastewater pollution.
Method: This type of research is quantitative research with geographic information systems approach. Data was collected by survey method using questionnaires and observation sheets. The sample in this study was 5,320. Data analysis using equal interval on Quantum GIS application version 3.26.0.
Result: In the parameters of the safe suspect tank, most of the 5,320 respondents (99%) have an unsafe suspect septic tank, while 1% have a safe suspect tank. For the parameters of pollution due to the disposal of the contents of the septic tank, most of the 5,320 respondents (99.8%) are not safe against contamination of the contents of the septic tank, while 0.2% is classified as safe. And for the parameters of pollution due to waste water discharge channels from 5,320 respondents, most (73%) are classified as unsafe and the remaining 27% are classified as safe.
Conclusion: North Kolaka Regency 4 Districts with a risk index value are included in the moderate risk category, namely Tolala, Porehu, Central Pakue, and North Pakue Districts. 6 Districts are included in the high risk category, namely Batu Putih, Ngapa, Tiwu, Lasusua, Ranteangin, and Wawo Districts. While the other 5 sub-districts are in the very high category, namely Pakue, Watunohu, Kodeoha, Katoi, and Lambai sub-districts.

KEYWORDS: Domestic Wastewater, Risk Pollution, Risk IndeksGeographic Information System.

INTRODUCTION

Waste originating from bathrooms, kitchens, laundry, home industries and human waste (feces) is household waste. This waste has the potential to pollute the surrounding environment, especially since there are a large number of them and they are not handled properly. Most Indonesian people dispose of household waste in the surrounding environment, and even dispose of waste into drainage which flows directly into the river. This can also have an impact on aspects of public health.In Indonesia, household waste is one of the problems that exist in society. The increase in the amount of household waste occurs in line with the very rapid increase in population[1]. In North Kolaka Regency, the population in 2020 will reach 137,659 people [2]. This amount will certainly affect the production of domestic waste. Waste from household activities that is not managed properly will have a negative impact on the environment and society. Waste management is also related to waste water disposal facilities both in terms of construction and safety to the surrounding environment.

The results of the initial survey showed that some people in North Kolaka Regency already had open system household sewerage channels, but many were found to be in a state of disrepair, cracks and even holes. Apart from that, there are also those who make the canal not watertight by digging the ground in the form of a ditch. This situation will have an impact on environmental pollution around it. In addition, the source of pollution from domestic wastewater is a place where human excrement is stored. Most of the people of North Kolaka Regency still use the cubluk type, with the risk that some of the sides are not waterproof so that it can contaminate the surrounding soil. The shelter without a soaking hole and an uncemented bottom has environmental and health impacts. Sewage pipes connected to waterways contaminate fresh water sources leading to faecal

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contamination of the water supply, and disease outbreaks. Likewise, some people still consider open disposal of sewage sludge as normal[3].

Residents who deviate from a healthy lifestyle, own a sewerage system and own a latrine, as well as high rates of open defecation can contribute to the risk of environmental pollution.[4]. This situation can have a negative impact on the environment and society. Therefore, it requires attention from both the local government and the local community. One of the negative impacts on society can be causing infectious diseases in the community such as diarrhea[5]. In carrying out interventions to improve domestic waste management by local governments, it requires a risk assessment study of domestic wastewater pollution with the aim of knowing the risk index category of each region, so that it can be known which areas are priority interventions by using the resources owned by the local government.

MATERIALS AND METHODS

This type of research is quantitative research with a geographic information system approach. Data collection was carried out by survey method using questionnaires and observation sheets. The sample in this study were 5,320 respondents with residential houses as the object of observation. Each village was represented by 40 respondents, so that a sample size of 15 districts in North Kolaka Regency was obtained. The number of respondents in each district differs based on the number of villages. The sampling technique for each village was simple random sampling.

The parameters used to assess the risk index for domestic wastewater contamination in the assessment are the safety of the fecal storage tank, pollution due to the contents of the fecal storage tank, and pollution due to the wastewater disposal system. This parameter is taken from the environmental health risk assessment (EHRA) study parameters[6].

The research was carried out from July to September 2021 in North Kolaka Regency. Determination of the weight of the risk index for each parameter is based on the weight of the risk index of the EHRA study. While determining the risk category from the risk index value using the equal interval model (interval value) with 3 levels of risk, namely moderate risk, high risk, and very high risk. The application used to determine the value of the risk level with the equal interval model is the Quantum GIS application version 3.26.0[7]

RESULTS AND DISCUSSION

Assessment of Domestic Wastewater Parameters

Based on the results of a survey at the study site using questionnaires and observation sheets, using three parameters, namely the safety of suspected septic tanks, pollution due to disposal of septic tank contents and pollution due to wastewater disposal systems. The distribution of respondents based on these three parameters is presented in Table 1.

Table 1. Distribution of Respondents Based on Domestic Wastewater Parameters in North Kolaka Regency Year 2021

District	Suspect septic tank				Pollution Due to Disposal of Septic Tank Contents				Pollution of Waste Water Sewers			
	Unsafety		Suspect safe		Unsafety		Safety		Unsafety		Safety	
	n	%	n	%	n	%	n	%	n	%	n	%
RanteAngin	280	100.0	0	0.0	279	99.6	1	0.4	213	76.1	67	23.9
Lambai	278	99.3	2	0.7	278	99.3	2	0.7	278	99.3	2	0.7
Wawo	279	99.6	1	0.4	279	99.6	1	0.4	178	63.6	102	36.4
Lasusua	479	99.8	1	0.2	479	99.8	1	0.2	313	65.2	167	34.8
Katoi	240	100.0	0	0.0	240	100.0	0	0.0	195	81.2	45	18.8
Kodeoha	480	100.0	0	0.0	480	100.0	0	0.0	410	85.4	70	14.6
Tiwu	279	99.6	1	0.4	279	99.6	1	0.4	194	69.3	86	30.7
Ngapa	476	99.2	4	0.8	480	100.0	0	0.0	380	79.2	100	20.8
Watunohu	319	99.7	1	0.3	319	99.7	1	0.3	313	97.8	7	2.2

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Pakue	438	99.5	2	0.5	438	99.5	2	0.5	359	81.6	81	18.4
Pakue Utara	360	100.0	0	0.0	360	100.0	0	0.0	199	55.3	161	44.7
Pakue Tengah	398	99.5	2	0.5	398	99.5	2	0.5	249	62.2	151	37.8
BatuPutih	440	100.0	0	0.0	440	100.0	0	0.0	280	63.6	160	36.4
Porehu	280	87.5	40	12.5	320	100.0	0	0.0	217	67.8	103	32.2
Tolala	240	100.0	0	0.0	240	100.0	0	0.0	106	44.2	134	55.8
TOTAL	**5.266**	**99.0**	**54**	**1.0**	**5.309**	**99.8**	**11**	**0.2**	**3.884**	**73.0**	**1.436**	**27.0**

Table 1 above shows that for the parameters of a suspected safe septic tank, out of 5,320 respondents, the majority (99%) had a suspected unsafe septic tank, while 1% had a suspected safe tank. For the parameters of pollution due to disposal of septic tank contents, most of the 5,320 respondents (99.8%) were not safe against contamination of septic tank contents, while 0.2% was classified as safe. And for the parameters of pollution due to SPAL from 5,320 respondents, the majority (73%) are classified as unsafe and the remaining 27% are classified as safe.

Unsafe septic tanks are caused by the use of fecal storage tanks with pit-type construction and only a small proportion dispose of feces in open areas such as yards, gardens and at sea. This type of cubluk is not watertight on one side, thus allowing the contents of the reservoir to seep into the surrounding soil, thereby contaminating the water sources used by the community. Children playing around the excrement holding tanks are also at risk from contamination. Unsafe disposal of feces is also significantly associated with environmental enteropathy and growth retardation in children[8]..

Pollution due to the disposal of the contents of the feces storage tank results in the presence of feces around the house and sources of drinking water. Both of these are significant risk factors for the occurrence of infectious diseases such as diarrhea, especially in children under 5 years of age[9]. The contents of the feces storage tank pollute the environment, one of which is the water source used by the community. This happens because the distance between the water sources used by the community is dug wells less than 10 meters, so there is a very high possibility of faecal contamination of the water source. Research conducted by BromoKusuma Ahmad et al (2020), and Margaret R. Sapuete (2010) states that there is a relationship between the construction of septic tanks and the content of E. Coli in dug well water [10][11]. Therefore, transformational changes in the community environment may be needed before significant impacts occur with faecal contamination [12]

Another parameter that has the risk of polluting the environment is pollution due to the waste water disposal system (SPAL). The SPAL of most people in North Kolaka Regency is of the open type, apart from being open the conditions are broken/holes/cracked, so that the wastewater discharged through the SPAL originating from household activities will partially flow into the surrounding soil or seep into the ground and contaminate water sources. . Household waste that flows through the SPAL is not treated first so that the waste water contains hazardous materials. This material can also contaminate the river which is the upstream of the SPAL used by the people of North Kolaka Regency. Therefore, it is necessary to have domestic wastewater treatment at the household, community and city center levels[13].

Domestic Wastewater Pollution Risk Index

After the assessment was carried out, the calculation of the risk index for domestic wastewater pollution in North Kolaka Regency was carried out. To determine the risk index, the value taken is the percentage value of each parameter which describes a risky situation, namely the septic tank is suspected to be unsafe, pollution due to unsafe septic tank contents, and unsafe pollution from the wastewater disposal system. Each parameter is given a weight of 33.33%. the risk index value can be seen in Table 2.

No	District	Suspect Unsafe Septic Tank	Pollution Due To Disposal Of Unsafe Septic Tank Contents	Pollution Due to Unsafe Waste Water Sewers	Total
1	RanteAngin	33,3	33,2	25,4	91,9
2	Lambai	33,1	33,1	33,1	99,3

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3	Wawo	33,2	33,2	21,2	87,6
4	Lasusua	33,3	33,3	21,7	88,3
5	Katoi	33,3	33,3	27,1	93,7
6	Kodeoha	33,3	33,3	28,5	95,1
7	Tiwu	33,2	33,2	23,1	89,5
8	Ngapa	33,1	33,3	26,4	92,8
9	Watunohu	33,2	33,2	32,6	99,1
10	Pakue	33,2	33,2	27,2	93,6
11	Pakue Utara	33,3	33,3	18,4	85,1
12	Pakue Tengah	33,2	33,2	20,7	87,1
13	BatuPutih	33,3	33,3	21,2	87,9
14	Porehu	29,2	33,3	22,6	85,1
15	Tolala	33,3	33,3	14,7	81,4

Then the total risk index value is entered into the Quantum GIS application and the risk level is analyzed using the equal interval mode. Because the total risk score for each district is above 50%, the risk level is divided into three levels, namely medium, high and very high. In order to obtain a map of the level of risk of domestic wastewater pollution in North Kolaka Regency as follows:

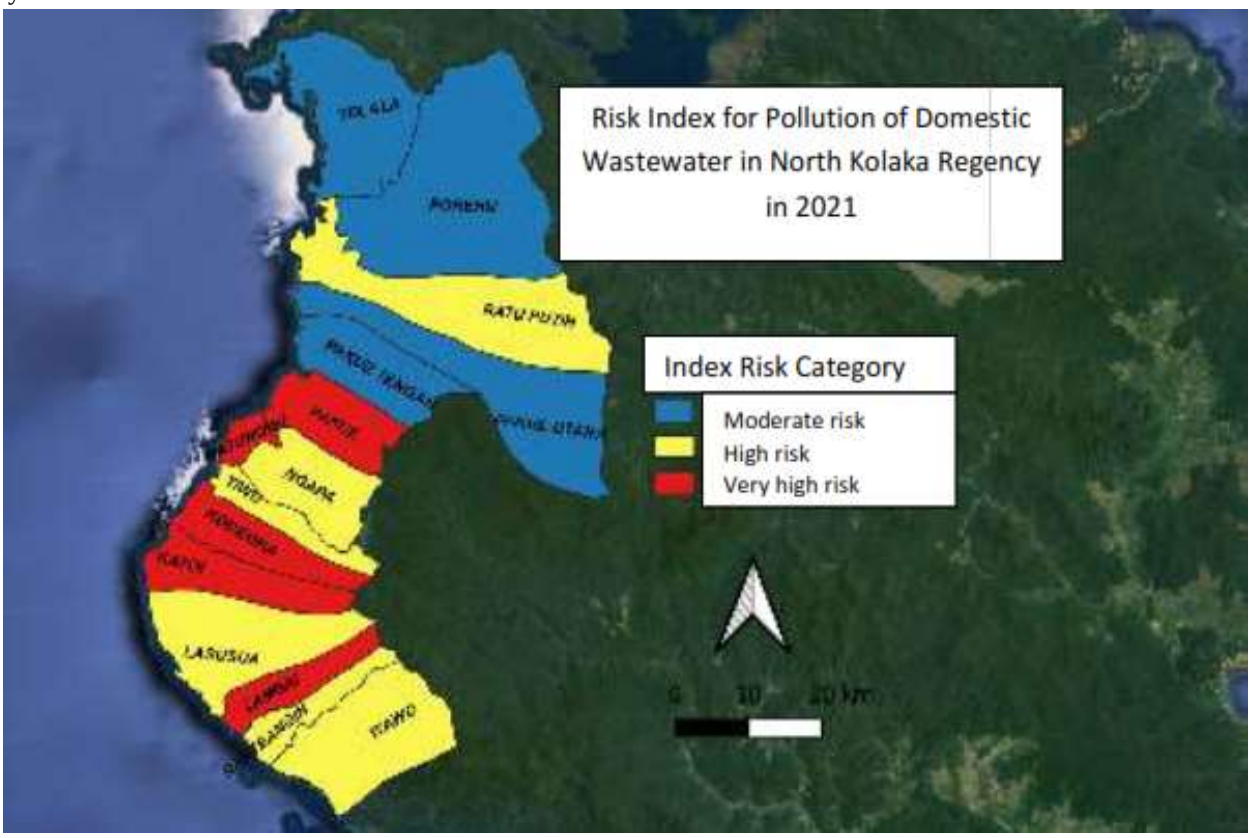

Fig 1. Map of the Risk Index Categories of Domestic Wastewater Pollutionin North Kolaka Regency in 2021

Based on Figure 1, it is known that in North Kolaka Regency there are 4 Districts with risk index values included in the moderate risk category, namely Tolala, Porehu, Central Pakue, and North Pakue Districts. 6 Districts are included in the high risk

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category, namely Batu Putih, Ngapa, Tiwu, Lasusua, Ranteangin, and Wawo Districts. While the other 5 districts are in the very high category, namely Pakue, Watunohu, Kodeoha, Katoi, and Lambai Districts.

Districts with a very high risk index category are a priority in the intervention to improve domestic wastewater disposal facilities. Indicators like this can be used as the basis for long-term monitoring of the quality of sanitation facilities and infrastructure in an area. Therefore, monitoring of water quality is needed, with targeted observations and examination of the relationship between risk and water quality, it is important to identify priority interventions to be carried out[14]. As well as the need for an economical and feasible solution to overcome the pollution of antibiotics contained in household waste to the aquatic environment[15]. One method of treating domestic wastewater that is quite simple is artificial wetlands. The results showed that artificial wetlands in the short term could be relied upon to treat domestic wastewater with high organic and nutrient concentration characteristics[16].

Long-term treatment of domestic sewage carries a high risk of contamination of shallow groundwater in wetlands. This study provides suggestions for the management of the construction and operation of artificial wetlands that an anti-seepage layer should be constructed to reduce the risk to groundwater, and management should be strengthened[17][18]. Wetlands are sometimes accidentally formed naturally and can function to remove pollutants in the long term with more appropriate strategies [19]. For open sewerage conditions, there should be no stagnant water. The flow is built so that the water flows smoothly. In dry conditions downstream pollutant concentrations will decrease[20].

CONCLUSION

North Kolaka Regency has 4 sub-districts with risk index values included in the moderate risk category, namely Tolala, Porehu, Central Pakue and North Pakue Districts. 6 Districts are included in the high risk category, namely BatuPutih, Ngapa, Tiwu, Lasusua, Ranteangin, and Wawo Districts. Meanwhile, the other 5 districts are in the very high category, namely Pakue, Watunohu, Kodeoha, Katoi, and Lambai Districts. It is necessary to pay attention to areas with very high risks as priority areas for improvement of domestic wastewater management, so as to reduce the risk of pollution to the surrounding environment, and reduce the negative impact on society.

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