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WATER AND SANITATION SERVICE: A PRIORITY TO IMPROVE QUALITY OF SLUM AREAS IN PONTIANAK CITY BASED ON STAKEHOLDERS' PREFERENCES

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ABSTRACT: Water and sanitation facilities of an area are important aspects that affect the quality of life, health and environment. Pontianak City, Indonesia is known as the "Equator City." There are 150.16 hectares of slum areas in this city. The existence of these slum areas is mostly due to the lack of basic facilities and infrastructure, and lack of public understanding about the importance of a healthy and quality environment. The government has made efforts over the past 5 years to improve the quality of water and sanitation infrastructure in slum areas in order to achieve the 2030 SDGs and to ensure the universal accessibility of water and sanitation and their sustainable management. This research was conducted to determine the priority of stakeholders in Pontianak City in improving the provision of water and sanitation infrastructure in slum areas. The methods of Analytic Hierarchy Process (AHP) were used, with the approach referring to the Indonesian Minister of PUPR No. 14 of 2018 concerning Prevention and Quality Improvement of Slum Housing and Settlements. The results (CR value < 0.1) showed that the Pontianak City stakeholders prioritized 0.30 the provision of drinking water in slum areas, 0.25 solid waste management, 0.23 wastewater management, and 0.22 environmental drainage. An in-depth priority study by various relevant stakeholders is needed to improve the quality of slum areas.

Keywords: Pontianak City, Slum area, Stakeholders, Water and sanitation

1. INTRODUCTION

In several cases in Indonesia, riverbanks are often the location for the emergence of slum settlements due to low supervision and lack of good urban governance. This is also the case in Pontianak City, where settlement development tends to focus more on areas around rivers, road networks and ditches because it has a lowland typology [1]. Along with the development of Pontianak City, the population of slum settlements has increased over the last 5 years. It's influenced by population growth and urbanization. The resident built these areas spontaneously and privately alongside the rivers and ditches. It is well-known as "river culture" due to the adaptive characteristics of its residents in their physical, social, and economic life [2].

There were slum settlements of 70.51 hectares with various levels of slum in 2015 (light, medium and heavy) and due to the results of the latest regulation issued by the Pontianak Mayor Decree Number 1063.1/D-PRKP/2020, it becomes 150.16 hectares of slum settlements with a light level. The existence of these slum settlements in Pontianak is mostly due to the lack of basic facilities and infrastructure quality and also lack of public understanding about the importance of a healthy and quality environment [3]. Because of this failure, there will be serious repercussions for both the health of humans and the environment. At a crucial stage in the process of sanitation planning, the lack of involvement from both governmental and non-governmental stakeholders is one of the primary factors that contribute to the problems [4]. So far Indonesia has worked to achieve universal access to health as mandated by the sixth Sustainable Development Goal (SDG) [5].

The AHP technique is one way to facilitate users' access to the relative weights of a number of criteria or options in relation to a specific criterion in an approach that is both straightforward and easy to understand. Raters are still able to determine whether one criterion is more important than another, even if quantitative ratings are not available. This method is simple, rational, and most often used for weighting. In this paper, AHP is used in consideration of priorities for improving clean water and sanitation in the slum areas of the study site in Pontianak City. The main objective of this research paper is to identify stakeholder priorities, and to compare them with the current condition of clean water and sanitation management. As a result, valuable information can be obtained regarding stakeholder preferences and their impact on current existing conditions and the

appropriateness of water and sanitation management which may be conflicting.

2. RESEARCH SIGNIFICANCE

This study investigates the effect of improving the quality of slums based on the main priorities of stakeholders on water and sanitation. We compare the current conditions where the improvement of water and sanitation quality in slum areas is based on stakeholder priorities. Therefore, it is important that this study is carried out as a reference for academics and the government in improving the quality of sanitation in slum areas by stakeholders who need to have a basis for setting priorities, so that other aspects of sanitation are not neglected in management.

3. STUDY AREA

The study was conducted in three slum areas in Pontianak City, namely the Panglima A. Rani Area (RT 01, 02, and 03) in Tambelan Sampit Subdistrict, RA Kartini (RT 01) in Tengah Subdistrict and Kayu Manis in Sungai Jawi Luar Subdistrict (RT 04, 05, and 08). The selection of this area refers to the Decree of the Mayor of Pontianak Number 1063.1/D-PRKP/Year 2020, which is the determination of slum areas in Pontianak City. The selection of the area is based on Deltares data where the area is in a water sensitive area, besides that it also has the characteristics of a densely populated area, high poverty rate, flood risk, and passes through drainage channels or rivers.

4. RESEARCH METHODS

4.1 Data Collection Method

Descriptive research is used to describe the existing conditions related to water and sanitation at the study site. The survey method was used to collect primary data, where closed-ended questions were used as a tool. This is done to compare field conditions with stakeholder priorities related to increasing access to clean water and sanitation.

The existing condition data collection uses cluster random sampling to ensure the probability of respondents in the selected group. The Yamane method was used to determine the number of samples using the formula in Eq. (1). The total sample in this study amounted to 127 households with a margin of error of 10%. In Yamane's formula, refers to the sample size (n), population size (N), and margin of error (e).

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

Prioritization is needed to determine the level of importance and contribution of each exposure indicator to its impact. Criteria and indicators for increasing access and demand for drinking water, environmental drainage conditions, facilities and infrastructure for domestic wastewater management, and solid waste management systems, refer to the Indonesia Minister of PUPR Regulation No. 14 of 2018 concerning Prevention and Quality Improvement of Slum Housing and Settlements. Stakeholders who responded include: Department of Environment and Forestry (DLHK) of West Kalimantan Province, Department of Environment (DLH) of Pontianak City, Department of Health (Dinkes) of Pontianak City, Department of Public Housing and Settlement Areas (DPRKP) of Pontianak City, Department of Public Works and Public Housing (DPUPR) Pontianak City, Head of each study location, Head of RW and non-governmental groups.

A weighting method is required to determine the priority of these indicators. Therefore, the method used in this study is AHP because this method is simple, rational and most often used for weighting indicators. The type of questionnaire used for determining priorities is a pairwise comparison questionnaire. The principle that must be applied to the pairwise comparison method is Logical Consistency, the ratio of consistency by looking at the consistency index. Logical consistency states a measure of whether or not an assessment/weighting is consistent in the pairwise comparison matrix. This happens because of the inconsistency of respondents in giving preferences [4]. One way to measure consistency is through a consistency index (CI). In Eq. (2), n represents the alternative being compared and λ max represents the largest eigen value of the pairwise comparison matrix.

$$CI = \frac{(\lambda\, max - n)}{(n-1)} \quad (2)$$

If the CI is 0 then the assessment decision is the same as the number of criteria being compared. The higher the CI value, the higher the level of inconsistency of the comparison decisions that have been made. The consistency index of the random matrix with a scale of 9 (1-9) and its inverse is called the Random Index/RI. Based on Saaty and Vargas (2006) obtained the average value of the Random Index as in Table 1 [6].

Table 1 Average value of random index

1	2	3	5	6	7	8	9
0	0	0,58	0,90	1,12	1,24	1,41	1,45

If the values of CI and RI have been obtained, then the next step is to find the value of Consistency Ratio (CR) with formulated by Eq. (3).

$$CR = \frac{CI}{RI} \quad (3)$$

Next is to make a combined assessment, namely by using the geometric mean [4]. X represents the sample value and n represents the number of samples. The geometric mean is formulated as follows by Eq. (4).

$$G = \sqrt[n]{x_1 \times x_2 \times \ldots \times x_n} \quad (4)$$

4.2 Data Analysis

The results of the closed questions and the AHP were analyzed using descriptive statistics, and Microsoft Excel was used for the processing and illustration of the results. The information that was gathered, which was supported by documentation and direct observation, will be used to describe the current state of the slum area that is located in the area under study [7].

5. RESULT AND DISCUSSION

5.1 Water and Sanitation in Slum Households

In this study, the classification of drinking water refers to the three-step ladder used by the WHO/UNICEF Joint Monitoring Program (JMP), piped water inside buildings, as well as other improved sources and unimproved sources [8]. Fig. 1 exhibit the source of drinking water in the study area based on JMP classification. The use of community drinking water is generally classified into the other improved sources category, where the source of drinking water is rainwater. Fig. 2 shows the existing condition of managing household rainwater which is stored in a water reservoir without further processing. The remainder is from unimproved sources, where the source of drinking water is refilled water and bottled water. However, in the RA Kartini and Kayu Manis areas, some people do not treat rainwater first. Rainwater is not always a good clean water source that is ready to be consumed; physically, it does not have color, taste, and clarity, however, rainwater is affected by the area where the rain falls [9].

Table 2 shows that the majority of riverside households used river water directly without any treatment. Households in the city used portable water, whereas wells and rainwater were also used for bathing and washing needs. According to the PUPR standard Number 14/PRT/M/2018, a community's minimum drinking water needs are <60 liters/person/day. As much as 83% of households in slum settlements in this study's location did not meet minimum water needs.

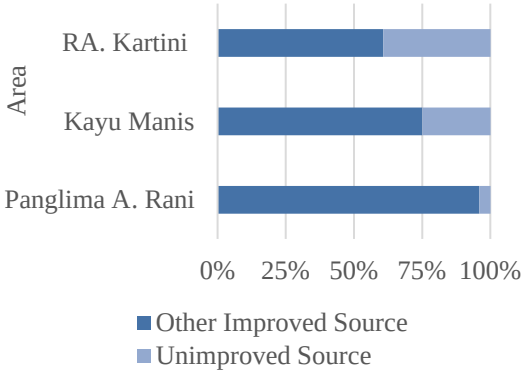

Fig. 1 Drinking water sources in slum areas based on the JMP three-ladder classification (n=127)

Fig. 2 Existing condition of rainwater management

Table 2 Clean water sources of households in slum areas

Household Water Source	Area		
	Panglima A. Rani	Kayu Manis	RA. Kartini
River water	88%	62%	-
Portable water	12%	34%	78%
Well water	2%	34%	22%
Rainwater	2%	7%	22%

The management of domestic wastewater at the study sites showed that the management was 100% unsafe. As shown in Table 3, generally, households that were located on the riverside were at the basic level of sanitation, and households in the city were at the level of shared sanitation. Moreover, the septic tanks that the community owns did not meet technical standards. Fig. 3 shows the existing condition of public toilets with traditional septic tanks made by the community that are not impermeable. Meanwhile, in households that did not have a septic tank, some directly discharged their waste into water bodies and drainage channels. Therefore, the function of

the drainage channel was still mixed with domestic wastewater discharge. This was made worse by the fact that there was still a practice of defecation in the river, the highest occurrence being in the Kayu Manis Area. The practice of defecating in public is one of the problems that plague the developing world and is the root cause of the spread of diseases that cause diarrhea [10]. The unsafe management of domestic wastewater can produce high levels of nutrients in the waters and cause environmental degradation, such as eutrophication [11].

Table 3 Sanitation ladder of households in slum areas

Sanitation Ladder	Area		
	Panglima A. Rani	Kayu Manis	RA. Kartini
Safety Managed	-	-	-
Basic	84%	66,2%	30,4%
Shared	2%	-	65,2%
Unimproved	2%	-	-
Open Defecation	12%	33,8%	4,4%

Fig. 3 Existing condition of wastewater management

The condition of solid waste in slum areas, especially in the Kayu Manis and Panglima A. Rani areas, which is located on the riverside, can be seen by the large mass of garbage scattered or piled in the area. This is partly due to the habit of riverside residents throwing garbage into the Kapuas River. For household solid waste management, as shown in Fig. 4, generally, the community collected their waste individually into containers that have been provided at several locations. The waste transportation system used was the HCS (Hauled Container System) system. However, the management of solid waste transported to landfills only reached around 53-87%. The community managed the remaining household waste by burning and throwing their waste into the river, as shown in Fig. 5.

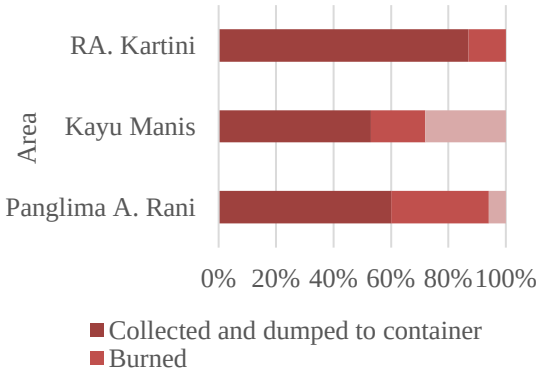

Fig. 4 Solid waste management of households in slum areas

Fig. 5 Existing condition of solid waste management

Burning trash and throwing it in rivers due to a lack of public awareness is a bad habit that can have long-term implications. In most cases, children will model their behavior after their parents. If children see their parents throwing trash into the river, there is a significant likelihood that the children will follow in their parent's footsteps and do the same [12]. The negative effects of littering can range from lessening a city's appeal from an aesthetic standpoint to polluting waterways and ecosystems [13].

The drainage concept that is still widely applied is the principle that rainwater needs to be dumped into the river as soon as possible. This causes the river to receive a load that exceeds its capacity, while not much water seeps into the ground [14]. Likewise, in this study, not all households had drainage channels. Especially in the Kayu Manis and Panglima A. Rani areas, several community houses were located above the river on stilts. In addition, the function of the drainage channel was still combined with the disposal of domestic wastewater such as bathing and washing, as shown in Fig. 6. As much as

84.4% of households dispose of gray water in drainage channels.

Fig. 6 Existing condition of drainage management

Table 4 Flood incidences of households in slum areas

Criteria	Area		
	Panglima A. Rani	Kayu Manis	RA. Kartini
Flood incidences	24% Several times a year	47% Once a year	48% Several times a year
Flood height	Adult knee	Adult knee	Adult knee
The flood dries up	Half-day	Less than 1 hour	Less than 1 hour

Table 4 indicates the incidence of flooding in the studied slum area. This research found that Panglima A. Rani and RA. Kartini areas were more vulnerable to flooding. Flood heights could reach the knee height of adults, with the receding time being less than 1 hour to half a day. At the study site, the factors that influenced the amount of flooding/puddle were the lack of drainage channels, drains for surface runoff, and high tides, especially in low-lying areas. Flooding/puddle was also caused by the small drainage potential of Pontianak City due to the area's flat topography. Therefore, the small drainage potential and influence of rising tides cause the water to flow slowly, so the process of determining flood areas takes a long time.

5.2 Stakeholder's Priority

Standard and interest groups are the two categories that can be used to classify the stakeholders in the water and sanitation planning process [15]. In this study, the opinions of interest groups were obtained as stakeholders because they are the most familiar with slum areas. Interest groups include political parties, civic organizations, and residents of the impact area. Each interest group has its point of view for evaluating potential alternatives and often has different relational systems of preference, thus creating competition and conflicts based on different group values [16]. According to the priority results by stakeholders shown in Table 5, the consistency value obtained was 0.043. The CR value was less than 0.1, so the results can be declared consistent. Therefore, the stakeholders' priorities according to priority weights are the provision of drinking water, followed by waste management, domestic wastewater management, and environmental drainage.

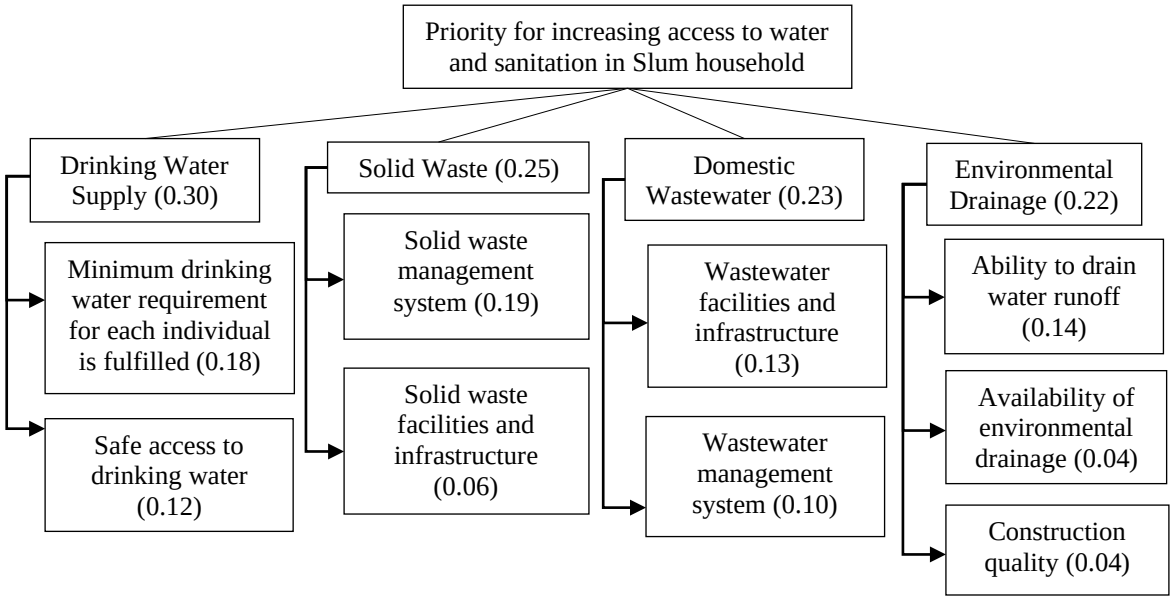

Fig.7 Hierarchy priority for increasing access to water and sanitation for households in slum areas

Table 5 Priorities for increasing access to water and sanitation

No.	Criteria	Priority vector	Rank
1	Drinking water supply	0.30	1
2	Domestic wastewater	0.23	3
3	Solid waste	0.25	2
4	Environmental drainage	0.22	4

This information was used to create the decision hierarchy structure shown in Fig. 7. From the existing criteria, each indicator that supported stakeholders in preventing and improving the quality of slum areas was also identified.

Fig. 7 shows the priority of stakeholders was as much as 0.30 in increased drinking water supply in slum areas. In supporting the increase in water supply, stakeholders prioritize the minimum drinking water requirements for each individual being met, which then provides safe access to drinking water. The existing condition of slum households, it shows that there were still 83% of households whose minimum water needs had not been met. Meanwhile, the provision of secure access is still not fully fulfilled. Households are still very dependent on rainwater and refill water to meet their drinking water needs. In fact, the management of rainwater is still not well managed by households.

In the second priority, 0.25 of stakeholders prioritized solid waste management. Indicators supporting the improvement of solid waste management are the technical requirements of the solid waste management system (domestic collection and sorting, environmental collection, environmental transportation, and environmental treatment) and technical requirements for solid waste facilities and infrastructure (household-scale waste segregation, TPS 3R, transportation facilities, transportation of environmental scale waste, and TPST). From the existing condition of slum households, 53-87% of solid waste was transported to landfills. Some households still managed their solid waste by throwing it into the river or burning it. Meanwhile, only 10.6% of waste sorting activities were conducted, with the selected waste being organic, plastic, or glass waste.

In the third priority, 0.23 of stakeholders prioritized domestic wastewater. The supporting indicators include the technical requirements for wastewater facilities and infrastructure (latrine/closet connected to a septic tank and the availability of a local or centralized sewage treatment system) and technical requirements for a wastewater management system (basic, proper and safe services). Based on the existing condition of slum households, households on the riverside were still at the basic level of sanitation, and households in the city center were at the level of shared sanitation. Meanwhile, households that did not have a septic tank would directly discharge their waste into water bodies or drainage channels.

For the last priority, as much as 0.22 of stakeholders prioritized environmental drainage. The supporting indicators include the ability of environmental drainage to drain water runoff, the availability of environmental drainage, and the quality of environmental drainage construction. Based on the existing conditions of slum households, the availability of environmental drainage already existed, but it was still unable to accept high water runoff in cases of changes in the climate. In addition, drainage channels were still mixed with domestic wastewater which caused environmental pollution. The majority of waterway managers and researchers also concentrated their attention on the contaminants that were already widely known to be present in urban waterways. These contaminants include nutrients, heavy metals, sediment, and various other types of physical and chemical contaminants. Freshwater ecosystems are also affected by a variety of other chemical properties of the water, such as the pH level, electrical conductivity, and ionic composition [17]. Therefore, it is difficult from a management point of view to identify urban pollutants and appropriately control them [18]. Within urban areas, it has come to everyone's attention that the imperviousness of catchment areas and the lack of drainage infrastructure are significant factors that influence the water quality, hydrology, and form of urban rivers [17].

However, despite the stakeholders' expression on the prioritization of clean water, there has not been an increase in access to clean water and sanitation in slum households, as the domestic wastewater management has a fairly severe condition, and the sanitation ladder is at the basic sanitation and shared sanitation levels. Finally, domestic wastewater has been indicated to contaminate the soil and/or the Kapuas River. In achieve sustainable and accepted improvement in sanitation especially for lower income neighborhoods, a project should have direct or indirect economic impact to the community [19].

6. CONCLUSION

The priorities for increasing access to clean water and sanitation were determined based on stakeholder perceptions. These priorities include drinking water management (0.30), solid waste management (0.25), domestic wastewater management (0.23), and environmental drainage management (0.22). The existing conditions of water and sanitation in slum areas were still unsafe and unsustainable. Domestic wastewater

management and drainage had the highest risk of affecting environmental quality. This indicates that the priority of stakeholders in slum areas has not been able to improve the quality of slum areas. Therefore, stakeholders need to conduct deeper studies on the priorities of clean water and sanitation supply and management in slum areas. One of them is by considering improvements in the management of the most at-risk priority to improve the quality of clean water and sanitation in these areas.

7. ACKNOWLEDGMENTS

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