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Study on Greywater Management Achievements in Sukolilo, Surabaya City

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ABSTRACT: Improper greywater management degrades environmental quality and public health. Community-based Total Sanitation (STBM) aims for 100% open defecation-free (ODF) status and 50% greywater management. In 2023, Surabaya achieved 100% ODF, but greywater management targets remain unmet, especially in the sanitation-prone Sukolilo District. This research assesses greywater management in Sukolilo, focusing on technical and social aspects, and offers strategy recommendations. Surveys and interviews were conducted for primary data, with secondary data from relevant literature and regional documents. Data analysis was descriptive, qualitative, and quantitative. The technical analysis revealed that greywater channels are not connected to infiltration wells or treatment systems. Social analysis showed low community awareness and behavior regarding greywater management. Improvement strategies include repairing channels to be closed, watertight, and connected to on-site treatment systems with infiltration wells or communal biofilter treatment, allowing the community to use treated water for irrigation. Enhancing public knowledge through continuous education by health workers and related parties and facilitating community efforts through Focus Group Discussions (FGDs) involving community leaders, government, and experts is also essential.

KEYWORDS: *Community based total sanitation, Greywater management, Sanitation, Sukolilo, STBM*

I. INTRODUCTION

Population growth causes an increase in domestic wastewater, resulting in increased sanitation risks (Uyun et al., 2019). Low awareness and understanding regarding domestic wastewater management impacts reducing environmental quality. Improper domestic wastewater management can contaminate the environment, cause odors, and become a means of breeding disease vectors (Azizah et al., 2021). Around 70% of domestic wastewater is greywater and contains many nutrients, heavy metals, and pathogenic bacteria (Pandey et al., 2014). Large quantities of greywater will cause severe problems if not appropriately managed (Shankhwar et al., 2015). A study by *Perum Jasa Tirta* in *Kali Surabaya* stated that 87% of pollutant sources came from domestic wastewater, including greywater. According to the Surabaya City Environmental Service, 50% of the pollution in the Surabaya River comes from greywater (Pratiwi & Purwanti, 2015).

Indonesia's National Medium-Term Development Plan (RPJMN) 2020-2024 targets universal access to sanitation in the form of 0% open defecation, 15% safe access, and 90% decent access. Community-Based Total Sanitation (STBM) is a national sanitation strategy consisting of 5 behavioral change pillars to improve access to basic sanitation so that people can access adequate sanitation as targeted by the Sustainable Development Goals (SDGs).

The fifth pillar of STBM targets 50% greywater management, with three conditions: no puddles due to greywater, tight and closed channels, and the channels connected to infiltration wells or domestic wastewater treatment systems. Surabaya has achieved the First Pillar of STBM with 100% ODF in 2023. Surabaya's Regional Medium-Term Development Plan (RPJMD) until 2024 targets access to safe sanitation at 20%, but currently, access to safe sanitation in Surabaya has only reached 1.4%. Thus, greywater management is the next challenge for Surabaya in achieving STBM and RPJMN.

Sukolilo District is a sanitation-prone area based on the 2022 Surabaya City EHRA study. Greywater management in Sukolilo District still needs to have an on-site system, either on an individual scale or a communal scale. Thus, fulfilling greywater management achievements in this area can be a priority for the Surabaya City government. This research is aimed at assessing

the achievements of greywater management in Sukolilo District, Surabaya City, based on technical, and social aspects, as well as determining strategies that can be used to improve greywater management achievements in Sukolilo District, Surabaya City.

II. MATERIALS AND METHOD

A. Data Collection

Primary data was obtained from observations of existing conditions in the study area, and surveys of the community using questionnaires to 100 respondents randomly spread across the entire Sukolilo District.

B. Analysis and Discussion method

The technical aspects analysis of greywater management achievements was conducted by scoring each requirement of the 5th STBM pillar:

- There are no visible puddles around the house because of greywater; score 0 if there are visible puddles around the house due to greywater. Score 1 if there are no visible puddles around the house due to greywater.
- Wastewater channels are tight and closed; score 0 if there are no tight and closed channels. Score 1 if there is a channel, but it is not tight and closed. Score 2 if there is a tight and closed channel.
- Channels connected to infiltration wells and wastewater treatment systems; score 0 if not connected to infiltration wells and IPAL. Score 1 if connected to an infiltration well. Score 2 if connected to IPAL.

Selecting a greywater management system is analyzed by scoring the technical factors such as population density, land availability, clean water sources, depth of groundwater level, and topography. The results of the analysis will determine the type of treatment system that can be used and the appropriate treatment alternatives.

Analysis of social aspects includes knowledge, behavior, willingness, and ability of the community regarding sanitation and greywater management. The analysis was conducted using the Gutman Scale scoring, with class length 100 and number of classes 3; low (score 0 – 33.33), moderate (score 33.34 – 66.66), and high (score 66.67 – 100).

III. RESULTS AND DISCUSSION

A. Technical Aspects

The results of the technical analysis in **Table 1** show that the achievement of greywater management requirements in Sukolilo District is 52%. This is because some greywater channels are tight and closed. A lack of greywater channels connected to infiltration wells or IPALs causes greywater channels to discharge into rivers. Thus, Sukolilo District still needs to achieve the target for greywater management in the 5th pillar of STBM.

Table 1. Results of the Analysis of Greywater Management Achievements in Sukolilo

Requirement		Score	Amount	Valuation
(a)		(b)	(c)	(b x c)
1	There are no visible puddles around the house because of greywater			
Score 0	: There are visible puddles around the house due to greywater	0	0	0
Score 1	: There are no visible puddles around the house due to greywater	1	100%	1
Total			100%	1
2	Wastewater channels are tight and closed			
Score 0	: There are no tight and closed channels	0	0	0
Score 1	: There is a channel, but it is non tight and closed	1	48%	0.48
Score 2	: There is tight and close channel	2	52%	1.04
Total			100%	1.52
3	Channels connected to infiltration wells and wastewater treatment systems			
Score 0	: Not connected to infiltration wells and IPAL	0	95%	0
Score 1	: Connected ti infiltration well	1	0	0
Score 2	: Connected to IPAL	2	5%	0.1
Total			100%	0.1
Total 3 requirements achievement				52%

Analysis of selecting a greywater management system is determined based on weighting scoring of some influential technical factors. According to Yuliani et al. (2013), Soedjono et al. (2010), also Astuti & Kusumawardani (2017), technical factors that influence the selection of a greywater management system are population density, land availability, clean water sources, depth of groundwater level, and land topography. A final valuation above 3.1 is highly recommended for an off-site greywater management system. While the final score is below 3.1, it is considered that you can still use the on-site system (Rifai & Nugroho, 2007). **Table 2** shows the analysis results of selecting a greywater management system in Sukolilo District show a final score of 2.00, so the greywater management system that can be implemented in Sukolilo District is an on-site system.

Table 2. Results of Analysis of The Selection of Greywater Management Systems

Score	Technical Factor	Number	Score	Weight	Valuation
	I. Population density			50%	0.79
1	<100 People/ha	43%	0.43		
2	100-150 People/ha	57%	1.14		
3	150-200 People/ha				
4	>200 People/ha				
		Total score	1.57		
	II. Land availability			20%	0.61
1	available, distance between house 5-10 m	11%	0.11		
2	available, distance between house <5 m	25%	0.5		
3	Not available, distance between house 5-10 m	12%	0.36		
4	Not available, distance between house <5 m	52%	2.08		
		Total score	3.05		
	III. Cleanwater sources			10%	0.1
1	>75% piping	100%	1		
2	75-50% piping				
3	50-25% piping				
4	<25% piping				
		Total score	1.00		
	IV. Groundwater level			10%	0.4
1	>12 m				
2	12-8 m				
3	8-4 m				
4	4-0 m	100%	4		
		Total score	4.00		
	V. Topoghraphy			10%	0.1
1	<1000 masl	100%	1		
2	1000-2000 masl				
3	2000-3000 masl				
4	>3000 masl				
		Total score	1.00		
Final Score					2.00

The choice of technology for appropriate and efficient greywater treatment depends on environmental conditions and the social characteristics of the community (Sembiring & Safithri, 2023). Greywater management with an onsite system can be done individually or communally. Either by modifying conventional septic tanks to process black and greywater or by building a communal wastewater treatment plant (Wirawan, 2019). The infiltration field can also be used because the absorption field is familiar information for the public. It is just that the implementation of the technology still needs to be appropriately understood by the public (Soedjono et al., 2010). The choice of greywater treatment technology will impact the effluent produced (Rahmadani & Ridlo, 2020). Based on the survey results, 74% of respondents admitted wanting to manage greywater to be reused for watering activities. Utilizing greywater for watering plants can reduce environmental pollution while

encouraging people to enjoy planting without wasting clean water (Fu'adah & Setyowati, 2016). Thus, alternative technologies that can be used are the Infiltration field and Biofilter wastewater tratment. In addition to selecting alternative greywater processing alternatives, to improve greywater management achievements, it is also necessary to repair existing channels so that they meet the requirements, namely closed and impermeable channels.

B. Social Aspects

The analysis results in **Table 3** show that public knowledge about greywater still needs to be improved. The lack of education received by the community has a significant influence on the level of community knowledge. **Table 4** and **Table 5** shows that people who do not know about greywater management and people who do not know about the impacts are people who have never followed/received counseling. Thus, the level of public knowledge regarding greywater management is influenced by the history of outreach regarding greywater.

Table 3. Results of Analysis of The Level of Public Knowledge Regarding Greywater

Variable	Score	Class
History of education related to domestic wastewater	27	Low
Understanding of greywater management	15	Low
Understanding of the effects of greywater management	39	Moderate
Average	27	Low

Table 4. Correlation of Education History and Knowledge of Greywater Management

		Understanding of greywater management		Total
		Understand	Not understand	
History of education	Never	8	65	73
	Ever	7	20	27
Total		15	85	**100**

Table 5. Correlation of Education History and Knowledge of The Effects of Greywater Management

		Undertsanding of the effects of greywater management		Total
		Understand	Not understand	
History of education	Never	29	44	73
	Ever	10	17	27
Total		39	61	**100**

The results of the analysis show that community behavior towards greywater still needs to improve due to the lack of greywater management facilities. The lack of greywater management facilities has forced people to normalize the habits they have been carrying out up to now. This is shown by the low level of disturbance felt by the community regarding their greywater disposal habits in **Table 6**. The type of settlement does not influence the lack of greywater management facilities. **Table 7** shows the correlation between the type of settlement and greywater discharge. Both respondents who live in middle-class housing and those who live in rural areas dispose of their greywater into ditches or drainage channels. However, respondents who love middle-class housing have a more organized environment, so some already have greywater management facilities.

Table 6. Results of Analysis of Community Behaviour toward Greywater

Variable	Score	Class
Greywater discharge	5	Low
Perception of greywater	38	Moderate
Feelings about greywater discharge habits	18	Low
Average	20,33	Low

Table 7. Correlation between Type of Settlement and Greywater Discharge

		Type of settlement		Total
		Urban settlement	Middle housing	
Greywater discharge	Ditch/ darinage channel	83	10	93
	River/ lake/ water body	2	0	2
	Channel connected to IPAL	0	5	5
Total		85	15	100

The analysis results in **Table 8** shows that the community's desire and ability to manage greywater is moderate. The community desires to manage greywater communally but needs more independent management facilities. The significant investment costs required to build management facilities mean people object to building facilities independently. So, financial assistance is needed from the government and the private sector to build management facilities. Nevertheless, the community is willing to manage the facilities independently, supported by the ability to participate in regular training and finance operations and maintenance of the facilities at a moderate level.

Table 8 Results of Analysis of Community's Desire and Ability

Variable	Score	Level
Desire to manage wastewater	74	High
Desire to manage wastewater communally	61	Moderate
Self-supporting ability in building management facilities	2	Low
Desire to manage facilities independently	41	Moderate
Ability to participate in regular training	61	Moderate
Ability to finance operations and maintain facilities	58	Moderate
Total	49,67	Moderate

Increasing public knowledge is the main thing that must be done to achieve greywater management in STBM. The expected output from STBM is changes in people's behavior. Knowledge is essential to shape a person's behavior. Behavior based on knowledge will last longer than behavior not based on knowledge (Notoatmodjo, 2003). Several people are concerned about the impacts caused by unmanaged greywater, so it can be used as a trigger to take part in education regarding greywater management.

Outreach activities regarding greywater management need to be carried out continuously so that the knowledge gained by the community can form thought patterns and principles regarding sanitation and change community attitudes and behavior for the better. The high desire of the community to manage greywater to improve environmental cleanliness and the ability to manage facilities independently is a potential that can be developed to change community behavior. Thus, social aspect strategies that can be implemented to improve greywater management achievements are:

1) Increasing public knowledge through continuous education by health workers as the front guard and other related parties.
2) Facilitate the community's desire to manage greywater through FGD (Focus Group Discussion) involving community leaders, government, and experts.

IV. CONCLUSION

The greywater management achievements in Sukolilo District, Surabaya City, based on technical and social aspects, are as follows: Only 52% of technical requirements are met due to non-tight, open greywater channels not connected to infiltration wells or treatment plants. Consequently, effective greywater management is lacking. Socially, there is low community knowledge and behavior regarding greywater management, yet a high desire for a cleaner environment exists. To improve, strategies include repairing channels to be closed, watertight, and connected to on-site treatment systems with infiltration wells or communal biofilter IPAL for irrigation use. Additionally, public knowledge should be increased through continuous education by health workers and other related parties and facilitating community engagement in greywater management via Focus Group Discussions (FGDs) with community leaders, government, and experts.

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