

Evaluation Operational of Reduce Reuse Recycle Waste Treatment Facility (TPS 3R) in Bandung City (Case Study: TPS 3R Saling Asih and TPS 3R Hikmah)

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Abstract - Waste is a problem faced by the city where currently waste is still being transported to landfill without any waste processing first. Currently, Bandung City has a waste management problem because it does not have a final disposal site (TPA) especially for waste reduction at the source and currently the waste is processed at the Sarimukti Regional Landfill, West Bandung Regency. Currently, the achievement of waste reduction in Bandung City reached 14.46% (SIPSN, 2023). The purpose of this study is to determine the operational performance of TPS3R in Bandung City as a waste treatment facility. This research was conducted at two TPS 3R in Bandung City, namely TPS 3R Saling Asih II, Maleer Village and TPS 3R Hikmah, Panjunan Village. The method in this study uses quantitative through data collection carried out on the operational conditions of TPS 3R management of 5 aspects waste management in accordance with the. Technical Guidelines for the Implementation of Reduce Reuse Recycle Waste Treatment Facility Activities (2021). From the results of this study it is known that the operational status of the management of TPS 3R Saling Asih II is in very good condition and TPS 3R Hikmah is in good condition. Optimization of TPS 3R can be done through the formation of competent community groups through various training and monitoring of operational performance of TPS 3R.

Keywords: Reduce Reuse Recycle; Solid Waste; Waste Reduction; Treatment Facility

I. INTRODUCTION

Waste management is the task and responsibility of the government as regulated in Law of the Republic of Indonesia Number 18 of 2008. This responsibility is carried out to create integrated waste management conditions to improve public health and environmental quality. To realize improvements in public health and environmental health, activities are carried out to limit waste generation, recycling, reusing, and handling waste locally and centrally.

The concept of waste processing infrastructure at TPS 3R is to realize the implementation of 3R which has been developed internationally, namely reduce, reuse, and recycle. The purpose of this concept is to minimize waste disposed of at TPA and obtain the greatest benefit from all products that may still have economic value. The provision of reduce, reuse, recycle waste processing facilities (TPS 3R) is one form of approach to waste management on a communal/regional scale by involving the active role of the community and government (Adhi Surya Perdana, 2021).

The city of Bandung has problems in waste management because it does not have a TPA and currently its waste is processed at the Sarimukti Regional Landfill, West Bandung Regency. Currently, the Sarimukti Regional Landfill has exceeded its capacity. The plan is that the cost of handling waste at the TPA will be increased by 6-7 times and 82.23% of the waste produced in Bandung City can still be utilized, so it is very unfortunate if it is not

accompanied by efforts to process waste at the source.

Based on data from the National Waste Management Information System (SIPSN) by Environmental Ministry of Indonesia that in 2023, the achievement of waste reduction in Bandung City reached 14.46% or 72,838.53 tons/year. There needs to be an increase in waste reduction efforts, one of which is with a 3R-based Waste Treatment Facility so that it can reduce waste disposal to the TPA. TPS 3R was built by implementing the principle of participatory development, namely that the community must be directly involved in the construction of TPS 3R from the planning stage to operations to train independence and play a role in environmental management efforts (Maripah, 2017). This community-based TPS 3R certainly needs to be accompanied by monitoring efforts so that its operations can continue to run. The local government has an important role in the sustainability factor of TPS 3R, the local government can synergize with the community to formulate waste levy regulations, improve human resources for TPS 3R managers and provide program support. The operational functioning of TPS 3R in several regions in Indonesia is still not functioning optimally, while the rest are inactive or abandoned. This dysfunction is caused by various factors, including the lack of specific regulations at the village level, limited competent human resources, and minimal operational support from the government (Rahmawati A. Damiti, 2024).

This study was conducted at two TPS 3R locations in Bandung City, namely TPS 3R Saling Asih II located in Maleer Village and TPS 3R Hikmah located in Panjunan Village. The TPS 3R location was chosen because construction had been completed and operational performance could be improved. These two TPS 3R are residential area scale waste processing infrastructure. The processing carried out at both TPS 3R includes processing organic, inorganic and residual waste. TPS 3R is the hope of many parties to be a solution to waste problems in almost all big cities in Indonesia (Al Faruqi, et.al, 2023), so the aim of this research is to see the operational performance of TPS3R in reducing waste

generation in urban areas that is transported to TPA. From the results of this research, it is hoped that the potential and obstacles in operational management of TPS 3R can be identified so that sustainable waste management performance can be improved. Improvement and assurance of environmental management performance are needed for TPS 3R to be sustainable. The benchmark for management success is determined by the implementation of these aspects (Ribut Lupiyato, 2023).

II. METHODS

2.1 Location

This research was conducted in two TPS 3R in Bandung City. TPS 3R Saling Asih II is located at Jalan Kebon Gedang III RT 04 RW 12 Maleer Village, Batununggal Regency and TPS 3R Hikmah is located at Jalan Bojongloa, Gang Hikmah RT 04 RW 05 Panjunan Village, Astanaanyar Regency. This research was conducted from July to October 2022. **The location of both TPS 3R can be seen in Figures 1 and 2.**



Figure 1. Location of TPS 3R Saling Asih II (Google Earth Pro, 2024)

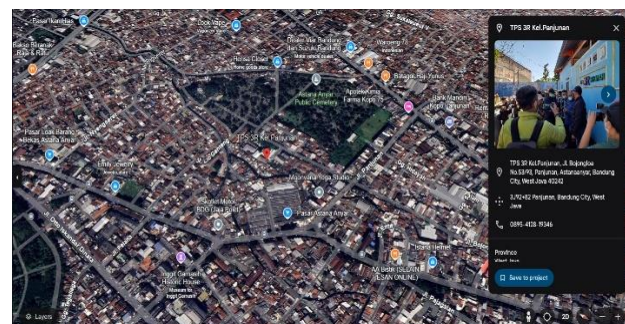


Figure 2. Location of TPS 3R Hikmah (Google Earth 2024)

2.2 Data Analysis Procedure

In order to collect data and information regarding the operational conditions of TPS3R management in Bandung City, namely TPS 3R Saling Asih II and TPS3R Hikmah, the stages carried out are preparation stage, primary and secondary data collection, as well as data processing and analysis. The research flow diagram can be seen in Figure 3.

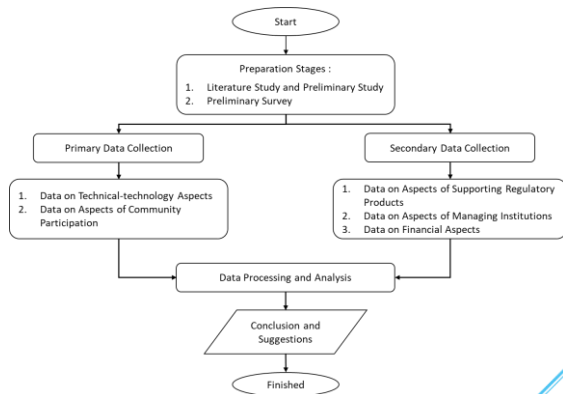


Figure 3. Research flow chart

Data collection was carried out on the implementation of five aspects of waste management at TPS 3R. Data analysis was carried out using quantitative descriptive analysis methods to obtain an overview of the 3R TPS studied and to make a comparison of the two 3R TPS. The evaluation method used is assessing the operational conditions of TPS 3R referring to the Technical Guidelines for TPS 3R FY 2021 of the Ministry of PUPR (2021) which consists of 21 indicators divided into five aspects, namely regulatory, technical-technological aspects, institutional aspects, financial aspects and aspects community participation. Each aspect has a different weight and each indicator has 3 (three) parameters with the same assessment level, namely 5, 3, and 1. The indicator values for each aspect are added up to produce an aspect value. The aspect value obtained is multiplied by the predetermined weight to produce a relative value. The total value of all aspects of TPS 3R functioning is obtained from the sum of the relative values of the five aspects. The five aspects reviewed to evaluate the functioning of TPS 3R can be seen in Table 1.

Table 1. Aspects, indicators, and weighting for TPS 3R evaluation

No.	Aspects	Indicator	Weight
1	Rule of law	Regional regulation on TPS 3R	5%
		TPS 3R development plan	
2	Technical-technology	Waste volume managed	30%
		Building and infrastructure conditions	
		Type of processing	
		Equipment condition	
		Organic waste processing	
		Volume of residue transported to landfill	
3	Institutional	Management organization	30%
		Organizational structure	
		Human resources	
		Agency legality	
4	Finance	Management administration	15%
		Institutional facilitation by local government	
		Financial condition	
5	Community participation	Financial management	20%
		Financial assistance from local government	
		Waste segregation by the community	
		Community	

No.	Aspects	Indicator	Weight
		dues	
		Economic impact	
		Customer development	

Source: Technical Guidelines for the Implementation of Reduce Reuse Recycle Waste Treatment Facility Activities, 2021

After calculating the total value of the five aspects, the functioning status of TPS 3R can then be obtained. The functioning status of TPS 3R can be seen in Table 2.

Table 2. TPS 3R functioning status

Category	Total Value
Very good	>19,0
Good	14,3 < N ≤ 19,0
Less	9,5 < N ≤ 14,3
Bad	<9,5

Source: Technical Guidelines for the Implementation of Reduce Reuse Recycle Waste Treatment Facility Activities, 2021

III. RESULTS AND DISCUSSION

TPS 3R Saling Asih II was built in 2019 and TPS 3R Hikmah was built in 2022 on an area of 200 m². These two 3R TPS process waste on a regional scale with a service coverage of 1-2 neighborhoods and the waste managed comes from household, commercial and street sweepings. The waste collection schedule at TPS 3R Saling Asih II is carried out every 2 (two) days and residents are charged Rp. 2,000.00/transportation, while at TPS 3R Hikmah waste collection is carried out 6 (six) days a week and waste collection fee is also charged. The system has not yet been implemented because TPS 3R was only built in 2021 so adaptations are still being made in its management. The initial planning locations for the two 3R TPS can be seen in Figure 4 and Figure 5.



Figure 4. Initial planning location of TPS 3R Saling Asih 2



Figure 5. Initial planning location of TPS 3R Hikmah

Waste processing carried out at both TPS 3R is the processing of organic, inorganic, and residual waste. Organic waste is processed into compost and as a feed for *Black Soldier Fly* (BSF) *maggots*. Inorganic waste is processed by further sorting according to its type and then sold to collectors and making anaerobic biofilter products from polyethylene terephthalate (PET) plastic bottles. The resulting residue is then disposed of at the nearest temporary disposal site (TPS) at no additional cost to the local government.

The results of the evaluation conducted can be explained as follows:

3.1 Regulatory/Legal Aspects

By looking at the current operational conditions of TPS 3R in Bandung City. Bandung City has local regulations regarding waste management, especially TPS 3R, which are contained in Bandung City Regional Regulation Number 9 of 2018 concerning Waste Management and Bandung Mayor Regulation Number 1426 concerning Regional Policies and Strategies in Household and Household Waste Management. Bandung City also has an environmental management plan in the field of waste, one of which is to build regional-scale TPS 3R infrastructure as stated in Bandung City

Regional Regulation Number 8 of 2011 concerning the Bandung City Regional Spatial Plan 2011-2031 but this has not been harmonized with the existing city sanitation strategy (SSK). Bandung's current SSK has not been updated since 2015 and should ideally be updated every 5 (five) years. Composting process at TPS 3R Saling Asih can be seen in Figure 6.



Figure 6. Composting Process at TPS 3R Saling Asih
Source: Survey Results , 2022

3.2 Technical-Technological Aspects

The average waste generation entering TPS 3R Saling Asih II and TPS 3R Hikmah can be seen in Table 3. The processing capacity at TPS 3R is planned to be 6 m³ (Sumarab et al., 2022). Based on the data in Table 3, the waste processing capacity of TPS 3R Saling Asih II exceeds the plan by 147% while TPS 3R Hikmah operates at 39.83% capacity. Waste generation and density of that TPS 3R can be seen in Tabel 3.

Table 3. Waste generation and density

TPS 3R	Waste Generation , Q	Density of Waste (Chaerul and Dewi, 2020)	Volume
	kg/hari	kg/m ³	m ³
Saling Asih II	681,03	76,862	8,86
Hikmah	184,00		2,39

Source: Analysis Results, 2022

The residue generated at both TPS 3R is still large. The residue produced is mixed waste and hazardous waste. The amount of residue that will be disposed of to the TPS can still be reduced by sorting B3 waste at TPS 3R. B3 waste commonly generated from households include electronic waste, cleaning and personal care/beauty packaging bottles, aerosol bottles packaging, expired medicines, and infectious

waste (masks, baby diapers, sanitary napkins). Records of waste processing at these two TPS 3R can be seen in Table 4.

Table 4. Waste Processing in TPS 3R

TPS 3R	Total Waste Incoming (kg)	Processed Waste				Untreated Waste	
		Organic		An-Organic		kg	%
		kg	%	kg	%		
Saling Asih II	71.508	31.659	44,27%	9.120	12,75%	30.729	42,97%
Hikmah	28.520,05	17.424,24	61,09%	1.373,39	4,81%	9.722,42	34,10%

Source: Survey Results, 2022

The buildings and infrastructure at both TPS 3R include hangars, offices, toilets, stalls, sorting areas. The existing buildings and infrastructure at both TPS 3R are functioning properly. In addition, the condition of the existing equipment must also be used for TPS 3R operations. Examples of equipment in TPS 3R are waste carts, compost filters, and waste containers. Composting area, office and roofed building can be seen in Figure 7 and Figure 8.



(a) TPS 3R Saling Asih II (b) TPS 3R Hikmah

Figure 7. Composting area
Source: Survey Results, 2022



(a) TPS 3R Saling Asih II (b) TPS 3R Hikmah

Figure 8. Office and Roofed Building
Source: Survey Results, 2022

3.3 Evaluation of Institutional Aspects

The institution that manages the two TPS 3R is the Saling Asih II and Hikmah Recipient and Beneficiary Community Group (KPP). KPP must have an organizational structure and its human resources must come from the area served by TPS 3R. (Armadi, 2021). The

organizational structure must at least have a chairman, treasurer, secretary, operations department and maintenance department. KPP's activeness is one of the operational drivers of TPS 3R and even improves the performance of TPS 3R. The existence of KPP can be supported by the legality of KPP in terms of transferring TPS 3R assets (Habib & Mahyuddin, 2021). The legality of the KPP is obtained from a certificate (SK) from the local sub-district and can be notarized. Apart from KPP's activeness, there needs to be a role for local governments as field facilitators. The two 3R TPS are currently being supervised by facilitators from the Bandung City Environment and Hygiene Department (DLHK). The facilitator's activities include providing education on waste processing at TPS 3R and efforts to socialize waste sorting in the community. Monitoring by facilitators from DLHK Bandung City can be seen in Figure 9.



(a) TPS 3R Saling Asih II (b) TPS 3R Hikmah
Figure 9. Monitoring by facilitators from DLHK Bandung City

Source: Survey Results, 2022

3.4 Evaluation of Financial Aspects

Financial management in TPS 3R must be organized with good administration in order to know the financial status in TPS 3R to be used as evaluation material. The financial condition in both TPS 3R when the research was conducted was *balanced*, namely the condition of income equal to expenditure. Financial management in both TPS 3R is carried out by the treasurer by recording all forms of transactions that occur in TPS 3R and the existing money is stored in the treasury. In addition, in an effort to assist TPS 3R operations, the local government through DLHK Bandung City provides funds for casual daily labor (THL) to TPS 3R. In addition to assisting in terms of funds, DLHK Bandung

City also provides equipment assistance for TPS 3R operations such as *boots*, waste buckets, trash bins, and personal protective equipment (PPE). Waste sorting and transportation of organic waste can be seen in Figure 10.



(a) (b)
Figure 10. Waste sorting by KPP Hikmah and Transportation of organic waste by KPP Saling Asih II

Source: Observation Results, 2022-2024

3.5 Evaluation of Community Participation Aspects

TPS 3R is built with community-based, therefore the key to the success of TPS 3R must also be supported by community participation. The community must sort their waste before the waste is transported by the transporters so as to improve the performance of TPS 3R. Based on questionnaires distributed to KPP and residents, some residents of TPS 3R Saling Asih II services have sorted their waste, while residents of TPS 3R Hikmah services have not sorted their waste so that waste sorting is carried out at TPS 3R. Currently, waste segregation is divided into three types, namely organic, inorganic, and residue. In addition to community participation in terms of waste segregation, the community is also charged a fee for handling their waste. The fee is paid to the officer during waste transportation. This fee arrangement is done to support TPS 3R operations such as for maintenance and equipment purchase.

3.6 Recapitulation of TPS 3R Operational Evaluation

Based on the analysis description above, the assessment of the operational conditions of the two TPS 3R can be seen in Table 5.

Table 5. Recapitulation of TPS 3R assessment

Aspek	Aspect Value			Relative Value	
	TPS 3R Saling Asih II	TPS 3R Hikmah	Weight	TPS 3R Saling Asih II	TPS 3R Hikmah
Regulation	8	8	5%	0,4	0,4
Technical-Technology	26	26	30%	7,8	7,8
Institutional	28	28	30%	6,9	6,9
Finance	11	11	15%	1,65	1,65
Community Participation	12	5	20%	2,4	1,0
	Total			19,15	17,75

Source: Analysis Results, 2022

Referring to Table 5, from the total score it is known that the operational status of the management of TPS 3R Saling Asih II is in very good condition and TPS 3R Hikmah is in good condition. The largest relative values of both TPS were contributed from the technical-technological aspect and the institutional aspect. The calculation results show that these two aspects are the two aspects with the greatest value supporting the operation of TPS 3R besides having the highest weighting among all aspects.

The regulatory aspect in question is the availability of local regulations governing the implementation of waste management in TPS 3R. Both TPS 3R received the same aspect score because both already have local regulations regarding waste management related to TPS 3R. Even though there is already a regulation at the city level, there needs to be a regulation that becomes the basis for the implementation of waste management in TPS 3R in each village.

The technical-technological aspect is an aspect that explains the activities carried out at TPS 3R and the system used. The technical-technological aspect can also see the ability of TPS 3R to reduce waste. The observation results show that the percentage of waste disposed of at the TPS 3R is still large, namely 42.97% at TPS 3R Saling Asih II and 34.10% at TPS 3R Hikmah. The residue produced is in the form of hazardous waste and mixed waste. Based on research conducted by Putra et al in 2019 hazardous waste generated in households can be sorted into electronic waste (used lamps, batteries, cables), cleaning and self-care/beauty packaging bottles, aerosol packaging bottles, expired medicines, and infectious waste (masks, baby diapers, sanitary napkins). So that in the container can be sorted based on the type of waste produced. Hazardous waste

containerization can be done using a container with a capacity of 40 Land when transporting it is carried out by a waste collector motorcycle labeled hazardous waste. (Wardana et al., 2015).

The institutional aspect is also an aspect that drives TPS 3R. This aspect explains the human resources involved in TPS 3R operations. The involvement of KPP and the government is very important so that the waste management target can be achieved and not only from one party. The activeness of the KPP is also important to encourage the community to be involved in waste management. Therefore, supervision and assistance are needed for KPP in order to maintain the performance of TPS 3R and even improve its performance. In addition, it is also necessary to increase competence for KPP so that TPS 3R management can continue to run and can produce an added value from the existence of TPS 3R. Increasing the competence of this institution can be done with regular education and training in collaboration with the government as a stakeholder.

For the financial aspect, both TPS 3R have balanced income and expenditure and also the local government of Bandung City is quite supportive of the activities that take place in TPS 3R by providing financial assistance and also operational equipment to support waste processing in existing TPS 3R. To be able to ensure the sustainability of processed waste products, it is necessary to study and develop the business process of buying and selling processed products.

In addition, the aspect of community participation is also an aspect that determines the running of TPS 3R. This aspect can assess the extent of community participation in the form of waste sorting and financial support in the form of fees as well as the perceived economic impact. Currently there are still residents who have not sorted their waste at TPS 3R, especially at TPS 3R Hikmah where community participation involvement is still low. Therefore, efforts are needed to awaken the community on the importance of waste segregation at the source. The importance of waste segregation can also be socialized along with the socialization of the economic potential

of waste management considering that currently in both TPS 3R there is no economic impact felt by residents. One example is the waste bank mechanism. Waste banks can also be a medium for educating residents to sort waste with *rewards* that will be given. Waste banks can also train people to be independent and able to manage their environment as a form of participation in reducing waste generation at the source.

IV. CONCLUSION

Based on the assessment of the operational conditions of TPS 3R referring to the Technical Guidelines for TPS 3R FY 2021 of the Ministry of PUPR (2021) at 2 TPS 3R in Bandung City, namely TPS 3R Saling Asih II and TPS 3R Hikmah, the operational status of the management of TPS 3R Saling Asih II is in very good condition and TPS 3R Hikmah is in good condition. Currently TPS 3R Hikmah is still classified as a newly built TPS 3R, so its implementation is still accompanied by adaptation from the KPP and the community. The biggest aspects that are the driving factors for the operation of TPS 3R are technical-technological, institutional and community participation aspects.

Waste sorting in households is still an obstacle in waste processing operations at 2 TPS 3R in Bandung City. The lack of waste sorting carried out at the source means there is no waste processing at TPS 3R and the volume of waste transported to TPA is still quite large, so the function of TPS 3R is categorized as deficient (Al Faruqi, et.al, 2023). Optimization of TPS 3R can be done by making serious efforts in forming a competent KPP through various training and monitoring. Community participation also needs to be increased with various waste management campaign efforts in collaboration with stakeholders. Periodic monitoring by stakeholders can also be a control in the operation of TPS 3R. In this case, the government can be involved in the process of educating residents, providing a legal umbrella, and providing operational facilities. The length of operation of TPS 3R can affect the success of TPS 3R. Coordination, socialization, and evaluation can be used as considerations for the development of TPS 3R. In this adaptation

effort, KPP Hikmah conducted a comparative study to other TPS 3R in Bandung City, one of which was TPS 3R Saling Asih II to share experiences in the operation of TPS 3R. Recommendations for future waste management include optimizing the TPS 3R built with a minimum service coverage of 500 houses (Athaya Dhiya Zafira, 2019).

The limitation of this research is that it was only carried out at 2 (two) TPS 3R locations in Bandung City, so it cannot represent the operational performance of waste reduction at TPS3R Bandung City as a whole. Further studies need to be carried out on the development of TPS3R sustainability strategies, optimization of design and processing technology, as well as studies of community participation in waste management. Operational evaluation of TPS3R like this can be carried out periodically by the Regional Government and/or TPS3R managers as a form of self-assessment, so that it can be known what components can be optimized for the operation of TPS3R.

Integrated of five aspects namely regulatory, technical-technological aspects, institutional aspects, financial aspects and aspects community participation will support the sustainability of the TPS 3R has been built.

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