IIJASS
IBN KHALDUN INTERNATIONAL JOURNAL OF APPLIED SCIENCES AND SUSTAINABILITY
e-ISSN : 0000-0000
p-ISSN : 0000-0000
https://ejournal.uika-bogor.ac.id/index.php/IIJASS Volume 1, Issue 1, pp.39-57

Sustainability Analysis of 3R Solid Waste Treatment Facility (Case Study at TPS 3R Cipaku Bogor)

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Received: May 29, 2023 **Accepted: June 01, 2023** **Published: June 03, 2023**

ABSTRACT

Waste management in Indonesia is regulated by constitution number 18 issued in 2008 concerning solid waste and for management of domestic or similar waste is operationally strengthened by the issuance of government regulation number 81 issued in 2012 concerning domestic solid waste management and similar domestic solid waste. Managingreducese, re-us,e, and recycling solid waste treatment facilities (TPS 3R) is a pattern of solid waste management approaches involving active roles and empowerment of community capacities. The sustainability analysis of the TPS 3R waste management system is needed to provide an overview for stakeholders in determining for improving waste processing performance. This research is important to know the sustainability status of the TPS 3R implementation activities that meet sustainability indicators from a scientific point of view. In addition, research related to the sustainability of the implementation of TPS 3R has never been carried out yet. The purpose of this study is 1) identify identifying actors to determine the sustainability of TPS 3R, 2) assess the assassessability of TPS 3R waste management systems, and 3)set recommendations for the TPS 3 waste management system. Collecting data was carried out from April to November 2017 and continued from June to July 2018. The research location was determined at TPS Cipaku located at Cipaku, South Bogor Sub-District (serving an unorganized d housing area). The sustainability indicatowerewas determined by an expert on the judgment method and sustainability status using the rapid appraisal techniques for fisheries (RAPFISH) method while the recommendations developed TPS 3R using the analytical hierarchy process (AHP) method. The conclusions of this study were as follows: 1) to assess the sustainability of TPS with ly of 33 indicators, 2) the sustainability status of TPS 3R Cipaku TPS was good; 3) The recommendation development based on the priority analysis at TPS 3R Cipaku the priority respectively were enhancing financial independence, the role of the parties, sorting waste (including hazard waste), enhancing quality of input and managing conflicts.

Keywords: AHP, RAPFISH, sustainability, TPS 3R

INTRODUCTION

Waste management in Indonesia is regulated in Law Number 18 of 2008 concerning Waste and is strengthened operationally with the issuance of Government Regulation Number 81 of 2012 concerning the Management of Household Waste and Similar Household Waste. In these laws and regulations, household waste management in Indonesia includes waste reduction and handling activities. Waste reduction includes activities to limit waste generation, waste recycling, and/or waste reuse. Waste handling activities consist of sorting, collecting, transporting, processing, and final processing of waste.

The biggest challenge for all cities in Indonesia including Bogor City is the success of the universal access target of sanitation which is campaigned with the symbol 100-0-100 which

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means that 100% of The Indonesian people can access drinking water sources that meet the feasibility standards, Indonesia is free (0%) from slums and 100% of the community gets sanitation services including waste services. In the technical subsystem of waste management operations in Indonesia in 2019, it is targeted that the volume of waste entering the landfill for a large city such as Bogor must reach 25% and produce 7.5% of the residual waste that will be brought to the landfill (Kemen PUPR 2016). In 2018 the President of the Republic of Indonesia issued Presidential Regulation (Perpres) Number 97 of 2017 concerning National Policies and Strategies (Jaktranas) Household Waste Management and Similar Household Waste which targets a 30% reduction in waste and waste handling to reach 70% of the generation rate by 2025.

Permen PU No. 3 of 2013 concerning the Implementation of Infrastructure and Waste Facilities in Handling Household Waste and Similar Household Waste explains that reducing waste starting from the source is the responsibility of all parties, both the government and the community. Current conditions, the selection and reduction of waste since its source is still inadequate so various movements still need to be carried out, both at the community level through the role of community leaders and non-governmental organizations (NGOs) or city/district governments. Optimism arises with the number of 3R (*Reduce - Reuse - Recycle) best practices* that are quite successful and can be replicated elsewhere, the waste reduction target is expected to be achieved (Kemen PUPR 2016).

The implementation of TPS 3R is a pattern of approach to waste management involving an active role and community capacity empowerment. Waste reduction with the community-based 3R method emphasizes more on how to reduce, utilize and process from the source where the main key is awareness and the active role of the community. This will be different if the activity is institution-based which means that it is only the duty and responsibility of certain institutions without involving the community. TPS Cipaku located in Cipaku Village, South Bogor District is one of the 3R TPS that serves irregular housing in Bogor City. Based on the information obtained by TPS 3R Cipaku has a unique history of waste problems. Starting from the absence of waste services from the Bogor City Cleanliness and Landscaping Service (before becoming DLH) in the area which caused frequent *open dumping* without management or disposed of borders or river flows that interfered with public comfort and health. In the TPS3R Profile report of Bogor City (DLH 2017), it is stated that TPS 3R Cipaku is a community-based 3R TPS (not apparatus/institution), built in 2014 and actively functioning, becoming the largest TPS in Bogor City, which is around 600 $m^{2.}$ TPS 3R Cipaku applies complete processing technology (*composting*, biogas, and incineration/combustion) and received the third-best performance assessment in Bogor city in 2016 with proof of certificate from the Mayor of Bogor.

The purpose of this study is first, to identify influential indicators or attributes that determine the sustainability of TPS 3R Cipaku; second, to assess its sustainability status in terms of five dimensions of sustainability, namely ecology, economy, socio-culture, technology-infrastructure, and institutional law; and thirdly formulate recommendations for its development. In turn, it is hoped that the research can provide an overview of the sustainable TPS 3R waste management system at the research site as well as provide the greatest benefit in supporting overall environmental management so that a clean, healthy and comfortable state is realized for the lives of the communities around the establishment of the 3R TPS. The main method for achieving this goal is using descriptive analysis, *Rapid Appraisal Techniques for Fisheries* (RAPFISH), and *Analytical Hierarchy Process* (AHP) analysis.

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RESEARCH METHODS

Time and Location of Research

The data collection time was carried out from April to November 2017 and was continued from June to July 2018. Data collection location at TPS 3R Cipaku

Cipaku Village, South Bogor District, Bogor City, which was designated intentionally (*purposively*) as a case study. This method is chosen to obtain the results of the analysis and conclusions of in-depth and detailed research. For a sustainability analysis using the RAPFISH method, the determination of a small unit of analysis (in this case the determination of the location of the study) can be carried out as stated by Varkey and Orland (TT). Sustainability research using multi-dimensional and multi-criteria ANALYSIS of RAPFISH with various units of analysis has been widely carried out, for example by Yusuf *et al.* (2016), Cahya (2015), Oktaviani (2015), Suryana *et al.* (2012) and Widiatmaka *et al.* (2015) using 1 (one) unit of analysis, Ramadan (2015) with 2 (two) units of analysis, Abdullah *et al.* (2004) used 4 (four) units of analysis and Nurmalina (2008) with 5 (five) units of analysis.

Data Collection and Analysis Procedures

Overall the objectives, methods, and methods of data collection are outlined in Table 1.

Table 1 Data collection activities and the resulting output

No	Purpose	Method	Metode Analysis
1	Formulating Indicators	Literary studies, expert consultations, surveys, and interviews	Descriptive, SPSS
2	Determining Sustainability Status	Measurements, surveys, and interviews	*RAP TPS 3R (Dari RAPFISH)*
3	Development Recommendations	Literature studies, consultations, surveys, and interviews of resource persons	*AHP*

Determination of TPS 3R Sustainability Dimensions and Indicators

The determination of the dimensions and sustainability indicators of TPS 3R is prepared based on literature studies and discussions with various relevant parties. For comparison, a reference to how to evaluate TPS 3R is used according to the technical guidelines for the implementation of TPS 3R which has been officially published by the Ministry of PUPR, management system standards such as ISO (*International organization for Standardization*) 9001 (Quality Management System) and ISO 14001 (Environmental Management System), a standard for business sustainability management systems that are widely known in Indonesia such as ISPO (*Indonesia Sustainable Palm Oil)*) and PHPL (Sustainable Production Forest Management). For indicators related to community perception, a survey was conducted with the population of the entire community who benefited from the existence of TPS 3R Cipaku totaling 630 Heads of Families (KK) registered in the records of TPS 3R managers called Non-Governmental Groups (KSM). Sourced from various previous studies (Kavanagh and Pitcher 2004, Pitcher and Prikshot 2001, Hartono *et al*. 2005, Fauzi and Anna 2002 which were widely used as references by subsequent researchers who used Rapfish techniques such as Jaya *et al.* 2010 and Susanthi 2018 (field of environmental management), Yudistirani 2015 (field of waste management), Wulandari 2016 (field of development of industrial areas), Rembet et al 2011 and Zainal et al. 2011 (field of fisheries), Widiatmaka et al. 2015, Dehen et al. 2013 (field of agriculture and plantations), Damanhuri and Padmi 2016, as well as management and sustainability

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system standards such as ISO 9001 (2015), ISO 14001 (2015), ISPO (Permentan No. 11 of 2015), PHPL (Perdirjen LHK P.14/2016) and PUPR (2014 and 2016) accompanied by consultations with experts (resource persons) to obtain an *expert judgment*, the indicators set to assess the status of sustainability consist of 5 dimensions covering 34 indicators. To validate the dimensions and indicators above, the *expert judgment* method is carried out which is one of several methods that are often used by researchers (Bockstaller *et al.* 2003 and Adiga 2014) in addition to statistical or quantitative approaches. A limited statistical approach is carried out to obtain public responses related to community indicators through surveys.

The respondents of this study consisted of 2 (two) groups. The first group of respondents was community respondents in the research area for several issues related to society about TPS 3R management activities. The number of respondents was set to at least 30 people (Silalahi 2012) with *a simple random sampling clustering* method from all communities who had received services from TPS 3R. Clustering (*clustering*) was carried out based on service zones (areas) based on the scope of neighboring neighborhoods or residents (RT / RW). A sample of respondents to TPS 3R Cipaku was taken from all service zones. The condition of the TPS 3R service recipient community is considered homogeneous so that the sample can be determined randomly, which is simple with a draw. Furthermore, the composition of community respondents was obtained as shown in Table 2. The primary data from the results of this survey were analyzed using the help of SPSS (*Statistical Package for the Social Science*) software version 16.

The second group of respondents is a group of personnel who are designated as *experts* who are believed to have a fairly good knowledge of the activities of the two TPS 3R. Primary data from this group of respondents at the initial stage to determine their response to the determination of dimensions and sustainability indicators of TPS 3R offered. In the next stage, from the same respondents, data were obtained for RAPFISH analysis by submitting an assessment questionnaire on the existence of the assessed 3R TPS. The resource persons consisted of staff responsible for coaching and supervision at the Ministry of Environment and Forestry (KLHK), Environment Agency of Bogor City, South Bogor District, Cipaku Village, Head of Ciremai Non-Governmental Group (KSM) and Chairman of paguyuban TPS 3R Bogor City. When using the analysis with AHP, the research resource persons consisted of the Ministry of Public Works and Public Housing (Kemen PUPR), the Bogor City Environmental Service (DLH), Cipaku Village, the Chairman of the RW, and finally the Chairman of the Ciremai of KSM.

Table 2. Composition of community respondents

Name of TPS 3R	Coverage Region Service	Cluster Unit	Number of Respondents (Household)
Cipaku	Cipaku Village	RW15 (TPS site), RW03, RW04 dan RW05	24
	Genteng Village	RW 05,06 and 07	7
		Total	31

Sustainability Analysis

To measure the sustainability of the 3R TPS, two questionnaire devices were used. The first questionnaire was submitted to the community who use the TPS 3R service to assess several indicators related to public perception. The second questionnaire is used to measure the perception of *experts* towards relevant indicators. RAPFISH analysis was carried out on a combination of primary data obtained from the first type of respondents and the second type. The software used is RAPFISH version 1.6. The median value is used because the data used is ordinal data (Usman *et al.* 1995 and

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Susanthi 2018). The stages of using this method in detail are presented in Figure 1 which is accompanied by mathematical equations to understand how RAPFISH works as quoted from Alder *et al.* (2000) also from Fauzi and Anna (2002).

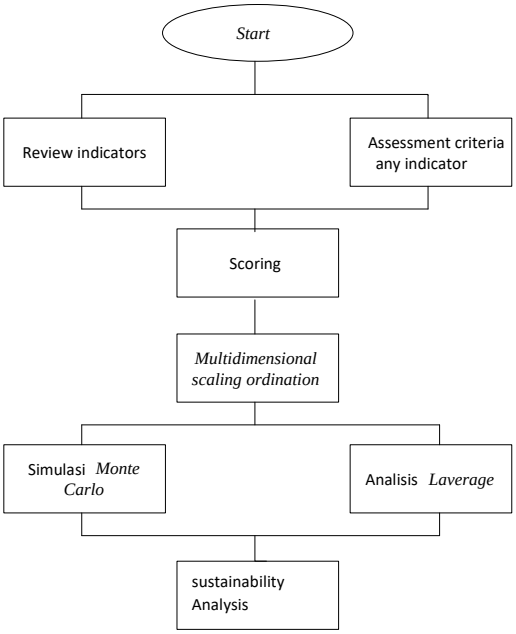

Figure 1. Stages of multidimensional scaling analysis RAPFISH

The most important thing in this analysis by looking at the mathematical equation is to calculate the distance between positions (*x, y, z,* ...) at a *euclidean distance* of dimension 2 with n (number of indicators) written with the equation:

$$d = \sqrt{(\ |x_1 - x_2\ |^2 + \ |y_1 - y_2\ |^2 + \ |z_1 - z_2\ |^2 + \cdots)}$$

The configuration or ordination of an object or point in the multi-dimensional is then proxied by regressing the *Euclidian* distance (d_{ij}) from the point I to point j with the point of origin (δ_{ij}), with α=intercept (the intersection of the ordinate axes when X=0), β=gradient/slope and ϵ=error, as follows:

$$dij = \alpha + \beta\delta ij + \epsilon ij$$

Then by using the ALSCAL algorithm to optimize the *squared distance (squared distance* = d_{ijk}) against the data squared (point of origin = o_{ijk}), which in three dimensions (i, j, k) is written in a formula called *S-Stress* as follows:

$$s = \sqrt{\frac{1}{m}\sum_{k=1}^{m}\left[\frac{\sum_i\sum_j(d_{ijk}^2 - o_{ijk}^2)^2}{\sum_i\sum_j o_{ijk}^2}\right]}$$

The squared distance is the Euclidian distance weighted and written:

$$dijk2 = \sum^{r} wka\ (xia - xja)2$$

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According to Firmansyah (2017), regression analysis in RAPFISH includes assessing stress(s) by doing *goodness of fit* is very important. For the continuous creation of the scale from "Not Good" to "Good" (0 to 100) on the x-axis, the upper point is +50 on the scale of the –y axis and the lower point is -50 on the scale of the –y axis referring to i = 1.2,.... n in detail is listed in Table 3. Sensitivity analysis is carried out using *leverage analysis* to see changes in the results of its multi-dimensional analysis. After a multi-dimensional analysis is obtained in the form of a change in *the root mean square* (RMS), which is used on the x-axis indicating the sustainability value while the y-axis is not taken into account, it is intended only to see the change of RMS.

Monte *Carlo* analysis was performed to evaluate the effect of errors on a 95% confidence level by estimating a certain statistical value. Analysis with the *Monte Carlo* method is useful for studying namely 1) the influence of errors in attribute scores caused by the understanding of conditions; 2) the influence of variations in scoring due to differences in opinion or judgment by different studies; 3) the stability of the multi-dimensional analysis process that is repetitive (iterative) and also looks at the quality of the stability of the reference points of the method carried out, and 4) an error in entering data or there is missing data (Firmansyah 2017).

Table 3. Index categories and sustainability status

Index value (%)	Category
0,00 – 25,00	Poor (unsustainable)
25,01 – 50,00	Less (less sustainable)
50,01 – 75,00	Moderate (moderately sustainable)
75,01 – 100,00	Good (sustainable)

Source: Wulandari (2016), Firmansyah (2017) dan Susanthi (2018)

Recommendations for TPS 3R Development Directives with AHP

The direction for the development of TPS 3R using AHP begins by determining the priority of indicators that are most sensitive to the status of sustainability to be improved from each dimension of sustainability (economic, social, ecological, technology-infrastructure, and legal-institutional) with the AHP approach. AHP is performed on all of the most sensitive (influential) attributes in each dimension of sustainability to see which attributes should be prioritized in improvement efforts in connection with plans to continue to develop the effectiveness of TPS 3R. From this scale of priorities, it is further discussed descriptively the steps that must be developed by the TPS 3R managers and interested parties. This study's hierarchy includes goals, actors, factors, and alternatives. The goal set is the sustainability of the management of TPS 3R.

The actors identified consisted of the Bogor City Environmental Agency (DLH), Lurah, RW Chairperson or community leaders, and KSM Chairperson. The selected factor is established based on the organizational resources relevant to the presence of TPS 3R. Finally, alternatives are obtained from each of the most sensitive indicators (only one indicator is taken) on each dimension of sustainability. This method is carried out with consideration for the simplicity of follow-up, especially for TPS 3R managers at the research site. The stages in the AHP method follow the description formulated by Saaty (1993). AHP can assess the consistency of data input by looking at its consistency index. The expected consistency is close to perfect for acceptable (valid) decisions. The weight of each sensitive attribute on each dimension of sustainability is calculated to determine the priority of improvement with the help of Expert Choice 11 software.

RESULTS AND DISCUSSION

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Overview of Research Objects

TPS 3R Cipaku is located in Cipaku Village, South Bogor District, Bogor City, precisely at geographical coordinates 6°38'24 LS and 106°48'40 BT. TPS 3R Cipaku is managed by KSM Ciremai, serving 7 RW in Cipaku and Genteng Villages. At the time of this study, TPS 3R Cipaku had the main waste processing technology consisting of composting, biogas generation (*biodigester*), and incineration (combustion furnace). The development of activities that are still pioneering is the processing of organic waste by utilizing *black soldier fly* (BSF) larvae, *Hermetia illucens* L. (Diptera: *Stratiomyidae*) which is not yet popular and has not been widely studied in Indonesia (Lena et al, 2017. The general characteristics of TPS 3R Cipaku can be seen in Table 4.

TPS 3R Sustainability Indicators

The results of the literature review and discussion with the speakers all approved the formulation of the dimensions and sustainability indicators of the TPS 3R offered with corrections to several assessment criteria in the questionnaire. From all the indicators studied, the results of the analysis showed that there was one indicator that could not be used because it was not statistically valid in processing social survey data, namely indicator number 18 on gender issues. The non-fulfillment of this statistical test is because respondents answering questions related to this indicator showed a single (absolutely homogeneous) answer. The results of the analysis showed that 33 indicators were set to be relevant indicators for the analysis of the sustainability status of TPS 3R as given in Table 5.

Table 4. General characteristics of TPS 3R Cipaku

Characteristics (Units)	Value or description
Land Area (m2)	1000
Building Area (m2)	600
Land status	Courtesy of Bogor City Gov' Total 6000 M^2
Number of employees/officers (people)	10
Service Target (Head of Family/household)*)	595
Service Realization (household)**)	630
Average waste input (m3/day)***)	5
Types of Waste Processing (Composting)	
	Available
□ Method/technique composting	Open Bin & hollow bamboo
□ Organic waste input capacity (kg/day)**)	122
Biodigester	Available
□ Type	Fixed dome (fiber)
□ Reactor size (m^3)	17
□ Solid compost produced on average (kg/day) *)	116
Incinerator	Available
Functions of waste banks	There are but few savers
Economical non-organic waste (average kg per month)	2854

*) Source: RKM Dokument

**) Regular reports KSM to DLH Kota Bogor 2017

***) Measurement data Desember 2017, specific gravity of the litter used in accordance with PU standards = 150 kg/m^3

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Sustainability Status of TPS 3R

The results of a detailed analysis obtained from the analysis of each identified dimension can be seen in Table 6 is equipped with a *kite diagram* which can be seen in Figure 3. The results of this study show that the sustainability status of the social and technological dimensions ranks highest which is in good status followed by other dimensions that have sufficient status. A combined (composite) analysis of primary data obtained from respondents of the first type and the second type, resulted in a RAP score – TPS 3R (modified name of RAPFISH) as shown in figure 3. The multi-dimensional RAP-TPS 3R for TPS 3R Cipaku is 77.94 which shows a good level of sustainability, monte carlo simulation results give a value of 76.35, *stress value* of 0.12, and R^2 (*square correlation)* of 0.96. The maximum limit of difference between RAP-TPS3R and Monte Carlo scores is 5 and the maximum Stress Value is 0.25 (Fauzi and Anna 2002). All of them show the meaning of accepting the results of the 3R TPS sustainability analysis.

Tabel 5. Indikator keberlanjutan TPS 3R

Dimension	Indicators	Reference
1. Technology and Infrastructure	1. Completeness and application of the main technology of processing	Ministry of PUPR 2016
	2. Processing capacity	Ministry of PUPR 2016
	3. Raw material input quality	Ministry of Public Works 2014
	4. Product quality	Ministry of PUPR 2016, SNI 19-7030-2004
	5. Ability to reduce residue	Ministry of PUPR 2016
	6. Quality of service (service)	Rangkuti 2006, ISO 9001 2015
	7. Condition of buildings and land for development	Ministry of PUPR 2016
2. Economy 8.	8. Direct economic benefits	Salim *et al*. (1999), Razak 2015 and Pitcher et al. 2013
	9. Financial independence	Ministry of PUPR 2016; Hartono et al. 2005, Pitcher 2001
	10.Willingness to pay the community	Ministry of PUPR 2016
	11.Product and service marketing programs	Hartono et al. 2005, Pitcher et al. 2013 and Pitcher and Preikshot 2001, Fauzi 2016
	12.Value and price of products/services	Hartono et al. 2005
	13.Financial opportunities and access	Fauzi and Anna (2002)
3. Social	14. Social conditions of society	Hartono et al. 2005
	15. Socialization and education	Hartono et al. 2005
	16. Level of community participation	Ministry of Pu 2014; Pitcher et al. 2013 and Hartono et al. 2005
	17. Conflict of interest	Pitcher et al. 2013, Hartono et al. 2005
	18. Gender issues	Kemen LH 2017, Hartono et al. 2005, Etliana 2005
	19. Absorption of labor	PU 2014, Pitcher et al. 2013, Hartono, et al. 2005
	20. Convenience of working at TPS 3R	Wibowo et al. 2014, Aslam et al. 2013

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Dimension	Indicators	Reference
4. Ecology:	21. Quality of the surrounding environment	Law 32/2009 and PerMenLH No. 16 /2012
	22. Ability to reduce pollution	Pitcher et al. 2013, Hartono et al. 2005
	23. Waste sorting (including hazardous and toxic waste - B3)	Pu Candy No 03/2013
	24. RTH Catechute	Bylaw RTRW No 8/1/2011
	25. Occupational safety and health (K3)	Permen PU No 03/2013, ISPO 2015 and PHPL 2016, Rimanto 2015
	26. Renewable energy alternatives	Pu Candy No 03/2013
5. Legal and Institutional	27. Legality and status of land	Pitcher et al. 2013, Kemen PU 2014
	28. Managing institutions	Ministry of Public Works 2014
	29. Law enforcement and regulation	Pitcher et al. 2013, Hartono et al. 2005, Kemen PU 2014
	30. The role between the parties	Hartono et al. 2005, Pitcher et al. 2013, ISO 9001 and ISO 14001
	31. Human resource management	Ministry of Public Works 2014
	32. Management system	Pitcher et al. 2013 and Kemen PU2014, ISO 9001 (2015)
	33. Cooperation with other parties	Solihatin *et al*. 2014
	34. Quality of activity reports	IAI PSAK 45 1998 and Pitcher et al. 2013

Table 6. Recapitulation of sustainability status and the most influential indicators

No.	Sustainability Dimensions	RAPTPS3R Score	Sustainability Status	The most influential indicators
1	Technology and Infrastructure	80.32	Good	Continuity and quality of inputs
2	Economics	72.26	Enough	Financial independence
3	Social	94.8	Good	Ability to handle conflicts
4	Ecology	66.04	Enough	Waste sorting (specifically B3)
5	Law and Institutions	71.67	Enough	The role of the parties

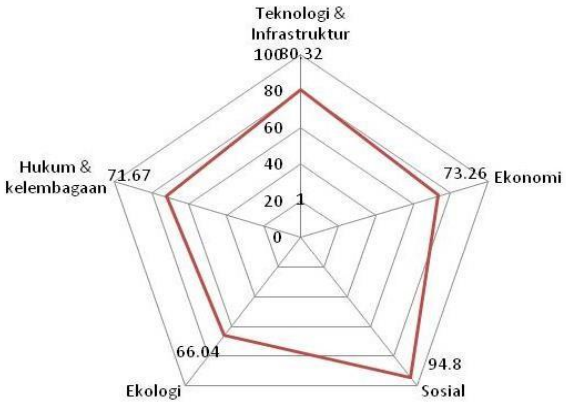

Figure 2. TPS 3R Cipaku sustainability kite diagram

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TPS 3R Development Recommendations

Priority Hierarchy of Sensitive Indicators

Recommendations for the development of TPS 3R are carried out through the analysis of sensitive indicators (leverage indicators) on each dimension of sustainability with *analytical hierarchy process* (AHP) techniques using *expert choice 11 software.* The speakers *(experts)* who were asked for their opinions consisted of the Ministry of Public Works and Public Housing (Ministry of PUPR), Environment Agency (DLH) Bogor City, Cipaku Village Head, RW Chairman, and Ciremai KSM Chairman. The preparation of the hierarchy and its results for TPS 3R Cipaku is carried out according to Figure 4.

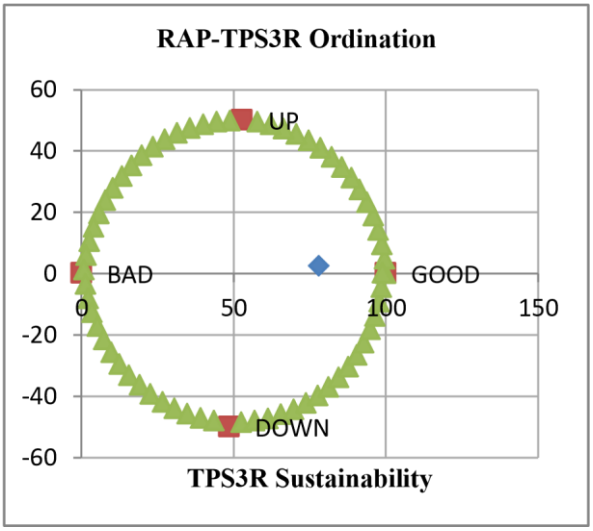

Figure 3. Multi-dimensional sustainability index ordination TPS 3R Cipaku

The development of TPS 3R to date and in the future is largely determined by the significant role and responsibility of the weighting results which shows that the important role consists of KSM as the manager of TPS 3R (0.405) followed by the role and responsibility of the Environmental Service (0.351) followed further by the role and responsibility of the Cipaku Village Head (0.158) and the Chairman of RW 15 Cipaku and community leaders (0.086). KSM The manager of TPS 3R is a representative of the user community and users, so the success of this program will largely depend on the active role (participation) community in every stage of activity, starting from the process of community preparation, socialization, planning, implementation of development, utilization and maintenance.

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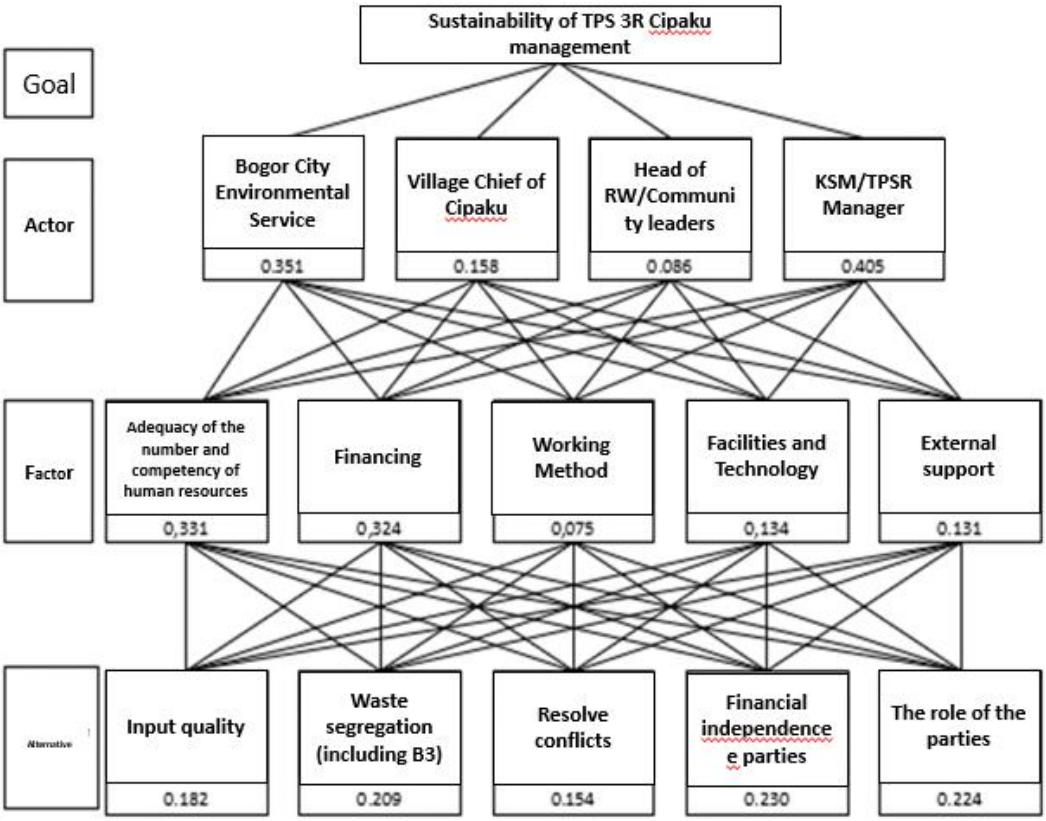

Figure 4. Hierarchy and Ahp Results of TPS 3R Cipaku Development

According to the technical guidelines for the implementation of TPS 3R (Kemen PU 2014 and Kemen PUPR 2018), the functions and responsibilities of the KSM when the TPS 3R has been built are to carry out operations and maintenance and infrastructure of the 3R TPS, attract, collect, manage waste dues/levies and manage funds according to regulations and report all money in and out to the community, marketing compost, and recycled materials and developing facilities and infrastructure supporting the 3R TPS, develop the quality of service and the number of TPS 3R customers, conduct campaigns about PHBS good health

Actor Role Analysis

The results of the AHP analysis show that in the hierarchy of actors' success, in themselves and environmental health and rallying partnerships with other parties. Given the many and heavy duties, roles, and functions of KSM, KSM must be formed as needed and equipped with various knowledge and the necessary skills including being given training. At the beginning of its formation, KSM had been equipped with a clear organizational structure and division of labor (*job description*) and was written in the RKM which was later strengthened by ratification by local officials, but it was not equipped with a notarial deed. In its provisions, if KSM will manage aid funds from other parties (APBN, APBD, CSR, and other assistance) then the Managing KSM organization must be a legal entity.

The district/city government in this case the regent/mayor acts as the person in charge of implementing the program in the district/city which is usually represented by the Environment Agency (DLH). The task of the Regency/ City government is to coordinate the implementation of the 3R TPS program in its work area, foster and control the implementation of the 3R TPS, provide operational cost funds (BOP) from the Regency/City APBD funds for the implementation of the 3R TPS and act as a supervisor for non-governmental groups (KSM). From the description above, it is clear that the

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significant role of the two who were then followed by other actors, Lurah as the coach and chairman of the RW and community leaders as the drivers of the running of this program which in practice a lot of administrative and technical support must also be played by these last three actors.

Factor Analysis

The next step of development is to establish influential factors in the management of the organization to achieve sustainability status. Barney (1991) states that the organization's resources are many that can take the form of assets, capabilities, processes, attributes, information, knowledge, etc. Barney classifies the resources of such organizations in the categories of physical, capital, and human resources. It is in the physical resources that there are elements of means and technology, processes or methods and technologies. Considering that TPS 3R is part of (subsystem) of the type of open organization, Muscalu et al. (TT) added the influence of external factors in the form of support from interested parties which will provide forms of influence in the form of competition between other waste managers, perceptions of beneficiaries and stakeholders, policy changes, economic conditions and technological developments outside. For TPS 3R Cipaku, the order of important factors includes the adequacy of the number and competence of human resources (0.331), financing (0.324), facilities and technology (0.134), external support (0.131), and work methods (0.074).

The important figures obtained in this study further reinforce the understanding that human resource problems are the most important part of the continuity of an organization. In the management of TPS 3R, the most important HR management activity is how managers and field officers can work well and comfortably amid waste processing matters that are left by many other people. The availability of field labor is one of the crucial ones. Not many people are interested in working in this sector except most because there are no other options. TPS 3R activities do not require special knowledge and skills, but it is the willingness to work with the important garbage. Workers certainly hope that their interaction with waste can be reduced by increasing the number of workers working. As a result of discussions with various related parties, the need for manpower for waste processing at TPS 3R is 1-2 people for the service of 100 households. This figure is ideal for TPS 3R Cipaku according to the number of services. The aspirations of workers who want to work with waste for a short duration must certainly be considered, especially when it is connected with the level of wages that have not reached the minimum wage (UMR). The turnover of labor should be suppressed so that activities do not have many obstacles. According to Mardianal et al. (2014), there is a very strong relationship between work satisfaction and the desire and action to stop working and find another job (turnover). For this reason, providing comfort and increasing their capacity must always be a concern.

Research by Hussein *et al.* (2014) shows that the better we pay attention to the elements of *human capital* carried out by an organization, the more the performance of workers will increase. The main part of the concern is how the ability and morale of employees can be improved. Providing opportunities to do creativity at work, and opportunities for workers to increase their understanding and knowledge through education and training (training). Education can be done formally or informally while training can be in the form of *in-house* or *public training, coaching, counseling,* and *mentoring*. The second priority of interest is the issue of operational financing and maintenance of TPS 3R. Experience shows that the most important sources of financing for TPS 3R are the contributions of service recipients and subsidies or operational cost support from the government budget (APBD). Operational and maintenance costs (BOP) consist of direct personnel costs (honorary collecting personnel, processing personnel, and security guards) and non-personnel costs (direct costs and fixed-overhead costs). For this financing, TPS 3R Cipaku is inseparable from the dependence on the two sources of financing above, so it can be said that both of them are not yet financially independent. Of course, the ideal financial condition will occur when the 3R TPS is no longer dependent on subsidies, accompanied by creative and

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innovative efforts to find other sources of income besides contributions, namely in the form of selling compost and economic non-organic waste and developing other forms of business.

Alternative Analysis of TPS 3R Development: TPS 3R Cipaku

To see the priority of interest in formulating recommendations for the development of TPS 3R Cipaku can be seen in Table 7.

Table 7. Important values of alternative development of TPS 3R Cipaku

Alternative	Important value (Priority)
Financial Independence	0.230
The role of the parties	0.224
Waste Sorting (including B3)	0.209
Input Quality	0.182
Conflict Resolution	0.154

Recommendations for the achievement of financial independence

Recommendations for achieving a level of financial independence top the list according to this analysis. The financial condition of TPS 3R to date has not been independent of the support of municipal government subsidies. The institutionalization of TPS 3R since it was designed in the implementation of this program is not intended to be completely financially free from government subsidies. The government's operational cost support (BOP) has been an important part of the success of this program. However, this financial independence is not impossible to realize if the 3R TPS can be developed on a business scale as it has been developed in many other places. Future efforts that can be made to implement these recommendations at TPS 3R Cipaku include:

(1) The entrepreneurial ability of TPS 3R managers must be improved by adding competencies through education, training, and based on the experience they have. The ability to formulate the design of the development of activities in the entrepreneurial context should be improved. Access to information for increased entrepreneurial insight and motivation must be wide open.

(2) The legal umbrella for the development of this entrepreneur must be prepared by the city government responsible for coaching (especially DLH Bogor City) so that managers can develop business creativity and innovation with very clear boundaries.

(3) Improving the quality and quantity of products and services to compensate for the increasing scale of the business must be prepared. The principles and requirements of quality management should be implemented in an adjusted manner.

Recommendations for the verification and improvement of the role of the parties

Future efforts that can be made to implement these recommendations at TPS 3R Cipaku include:

(1) All parties can play a role and take responsibility appropriately at least referring to the latest technical guidelines for the implementation of TPS 3R which have been issued by the Ministry of PUPR where the roles of the parties are explained more fully than the previous technical guidance guidelines.

(2) Managers and parties must be able to identify TPS 3R stakeholders including those related to the values and internal performance of TPS 3R then formulate positive and negative issues, the needs and expectations of each party. This information should be documented and *updated* regularly.

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(3) Create a collaboration forum permanently and work effectively to improve the quality of the role and cooperation of the parties. The existing form of the TPS 3R group can continue to be maintained and increased in its role.

Recommendations for increased waste sorting efforts including B3 waste

Future efforts that can be made to implement these recommendations at TPS 3R Cipaku include:

(1) Socialization and campaigning on the importance of sorting both during transportation and at TPS 3R must continue to be improved, especially public awareness regarding why it should be done and what the impact will be if this is not done more specifically related to the presence of B3 waste. This socialization needs to be carried out continuously and with patience considering that the value of this environment is generally *intangible* while the general public attaches great importance to the benefits that can be realized in the short term. Participation is a very important factor for the success of waste management programs to be successful, especially in urban areas (Nugraha, *et al*. 2018). The parties must be fully involved in this effort.

(2) The plan to issue an obligation rule by the city government to sort waste accompanied by a strict penalty if the sorting is not carried out must be realized. The survey of respondents showed that basically, the public objected to the issuance of regulations like this. However, the successes of various development programs everywhere at an early stage must be supported by strict but fair regulations and enforcement.

(3) The existence of hazardous and toxic waste (B3) needs special socialization considering that this theme requires specific skills to explain and handle it technically. In addition, facilities for handling in the community and at the 3R TPS must be provided ranging from storage at the source, transportation to treatment at the 3R TPS as well as difficult and costly final handling costs.

Recommendations for improving the quality of raw material inputs

Future efforts that can be made to implement these recommendations include:

(1) It also encourages the community to sort from the source so that waste can be managed from an early age in addition to being effective and efficient in the next processing even if the maximum can be an additional source of *income* for the use of waste that has been disaggregated. The community is also made aware of the high cost of waste processing in the future, especially the application of *tipping fees* where processing costs will be associated with the volume of waste processed.

(2) Giving full awareness to the officers at TPS 3R that the success of sorting at the source does not become a burden due to the loss of one of the alternatives of additional income for TPS 3R which in turn will reduce the income of officers. Make the success of reducing waste a collective target in the framework of increasing the capabilities of the waste management system in Bogor City in particular.

Recommendations for managing conflicts of interest

Future efforts that can be made to implement these recommendations include:

(1) Opening a more harmonious and open communication space that initially could be done by the right officials in the Bogor City DLH as has been done so far followed by collaborative steps between the parties by creating a communication forum accompanied by forms of written agreements related to conflict resolution and institutionalizing the collaboration to overcome the same thing does not happen again in the future.

(2) Immediately reorganize the KSM and TPS 3R to refresh while accommodating the opportunity for change for the good of all parties. This reorganization must be carried out openly through a democratic deliberative mechanism without closing the possibility

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of all parties who have the competence and interest to participate in managing the 3R TPS, including the old management if they are considered to have been properly responsible with evidence of the achievement of positive TPS 3R performance as it is today.

CONCLUSIONS AND RECCOMENDATION

Conclusion

The conclusions of this study based on the research objectives are as follows:

(1) Indicators for assessing the sustainability of TPS 3R amount to 33 with details of indicators on the dimensions of technology and infrastructure: completeness and application of the main technologies of processing, processing capacity, quality of raw material inputs, quality of products, ability to reduce residues, quality of services (services), condition of buildings and land for development; indicators on the economic dimension: direct economic benefits, financial independence, willingness to pay the public, marketing programs for products and services, value and prices of products/services, opportunities and access to finance; indicators on the social dimension: social conditions of society, socialization and education, the level of community participation, conflicts of interest, absorption of labor and comfort of working in TPS3R; indicators on ecological (environmental) dimensions: quality of the surrounding environment, ability to reduce pollution, waste sorting (including B3), RTH catechuting, occupational safety and health (K3) and renewable energy alalternatives; and indicators on the legal and institutional dimensions: legality and status of land, management institutions, law and regulatory enforcement, roles between parties, human resource management, management systems, cooperation with other parties, and the quality of activity reports.

(2) The sustainability status of each dimension for TPS 3R Cipaku successively for the sustainability of the technological dimension is good, the sustainability of the economic dimension is sufficient, the sustainability of the social dimension is good, the sustainability of the ecological dimension is sufficient and the sustainability of the legal and institutional dimension is sufficient. Compositely, the sustainability status of TPS 3R Cipaku is good.

(3) Development recommendations based on the important value of priority of the most influential indicators in sustainability at TPS 3R Cipaku successively according to their priorities are financial independence, the role of the parties, waste sorting (including B3 waste), improving input quality, and overcoming conflicts.

Recommendation

There are limitations and research suggestions that are quite influential on the results of this study so it is recommended:

(1) The determination of indicators is carried out by adding more comprehensive techniques not only through literature studies and discussions so that their validity is better.

(2) Experts for *the* application of the RAPFISH method need to be expanded and expanded and considered for their competence properly.

(3) Suggestions for management implications are 1) because RAPFISH is only able to carry out diagnosis, the sustainability status that has been owned must be maintained and improved with appropriate efforts because this sustainability status does not guarantee in the future without planning, preparing the necessary strategies and actions, conducting sustainability research with RAPFISH techniques in all 3R TPS to get a complete picture of the sustainability of the 3R TPS in Bogor City, 3) all interested parties are expected to take steps and provide support so that TPS 3R

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Cipaku can make *continual improvements* by paying attention to the most sensitive indicators that have been identified.

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