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Research Article

Strategy to Improve Community-Based Waste Reduction Potential (Case Study at TPS 3R Pudak Mesari, Darmasaba Village, Badung Regency)

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ABSTRACT

Introduction: The problem management garbage in Indonesia is still become challenges, especially in reduce embossment waste that ends up in landfills disposal final waste disposal site (TPA). TPS 3R (Reduce, Reuse, Recycle) is one of the expected solutions can increase effectiveness processing rubbish through role active society.

Objectives: Research This aiming for evaluate performance TPS 3R Pudak operational Mesari in Darmasaba Village as well as analyze potential reduction trash.

Methods: The research method used is approach descriptive with purposive and random sampling techniques on 100 heads family. Data analysis includes evaluation TPS 3R performance, mass balance calculation for determine potential reduction garbage.

Results: The results of the study indicate that the level of community participation still needs to be increased to optimize the waste management system. In addition, there is economic potential from inorganic waste processing that can be further utilized.

Conclusions: The conclusion of this study emphasizes the importance of community involvement and government support in increasing the effectiveness of TPS 3R in order to achieve the target of sustainable waste reduction.

Keywords: Waste management, TPS 3R, community participation, reduction potential, circular economy

INTRODUCTION

Garbage that is not managed with Good can become threat for life sustainable, because can damage environment, disturbing balance ecosystem, as well as threaten health humans and creatures life others. (Putra et al., 2023). Volume of waste dense in global cities is estimated will increase by 70% of year This until 2025, from 1.3 billion tons to 2.2 billion tons per year. This increase mainly occurs in cities in developing countries, one of which is Indonesia (Maulidar et al., 2022). According to the World Bank Data (2023), Indonesia in 2020 became the 5th largest waste producing country in the world, namely 65.2 million tons. The waste problem cannot be separated from the rate of urbanization which causes high consumption patterns in society so that the volume of waste generated is greater (Dobiki, 2018) however, it is not balanced by the provision of adequate facilities and infrastructure. Waste processing techniques still use the old paradigm, namely collect-transport-dispose, without processing it will increase the amount of waste generated to the final processing site (TPA) (Arisona, 2018).

Waste problems are the responsibility of local governments and the entire community (Nurcahyo and Ernawati, 2019). The quality of the environment in the world can be influenced by the behavior of the surrounding community, so that awareness and commitment to the environment are needed (Thamrin et al., 2022). Based on Presidential Regulation Number 97 of 2017 concerning the National Policy and Strategy for Household Waste Management and Similar Household Waste, waste management activities are divided into two, namely reduction and handling. Waste reduction through limiting waste generation, recycling waste and reusing waste or reduce, reuse, and recycle (3R) from the source scale. According to Law No. 18 of 2008 concerning waste management, efforts to reduce waste through TPS 3R (Ratri et al., 2022). TPS 3R is based on the 3R movement (reduce, reuse, recycle) which is more effective in reducing the quantity and improving the characteristics of waste that still needs to be further processed.

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The purpose of implementing the 3R concept is to reduce waste from its source and reduce residual waste that will be taken to the TPA (Harpi, 2022). Based on research conducted by Ratri et al (2022), TPS 3R Paba Asri can reduce waste by 54% and TPS 3R Pasuruan can reduce waste by 54.13% before being taken to the TPA. In principle, this program seeks to reduce waste from a communal scale so that it can help extend the life of the TPA by involving the active role of the government and the community (Lawa, 2021).

The area in Indonesia that experienced an increase in waste generation is Badung Regency. According to the National Waste Management Information System (SIPSN) in 2023, the amount of waste generation was 195,222.49 tons. An increase in waste generation of 63% from the previous year. The sanitation risk assessment (IRS) of Badung Regency in 2024, waste taken to TPS was 30.2%, burned 5.8%, thrown into holes and covered with soil 3.3%, thrown into holes but not covered with soil 4.5%, thrown into rivers/rivers/seas/lakes 4.4%, thrown into empty land/gardens/forests and left to rot 28.7% and left to rot 23.1% (Wiraatmaja and Putri, 2024). The problem faced in Badung Regency is the less than optimal waste management so that waste management is needed from the source level to reduce waste disposal to waste processing sites. The number of 3R TPS in Badung Regency is 34, but the management capabilities of the managers are still lacking, causing the 3R TPS that have been built to not run optimally so that the waste managed is still low. One of the 3R TPS in Badung Regency is the Pudak Mesari 3R TPS in Darmasaba Village serving the Darmasaba Village area. The sanitation risk index (IRS) value using the Environmental Health Risk Assessment (EHRA) approach, Darmasaba Village is categorized as very high risk with a value of 258, the highest sanitation risk index value is in the waste aspect (Wiraatmaja and Putri, 2024).

Based on the initial survey, waste transportation and processing in Pudak Mesari is only carried out twice a week which causes waste to pile up and leave an odor so that waste processing services are not optimal. The service area at TPS 3R is only 22%, namely 500 families out of 2,247 families. The waste processed is 4,170 kg/month from a total of 22,830 kg/month. Of the seven TPS 3R in Abiansemal District, TPS 3R Pudak Mesari is only able to process 18% of its waste compared to other TPS 3R. TPS 3R Jagapati Village can process 31% of its waste. According to Badung Regent Regulation Number 80 of 2018 concerning Regional Policies and Strategies in the Management of Household Waste and Waste Similar to Household Waste, the target for waste reduction in the Regency is 30% of the waste generation rate. Community participation in Darmasaba Village in waste management is still not optimal, not all people in Darmasaba Village have sorted organic and inorganic waste and have not been able to reuse waste as useful items. The people of Darmasaba Village do not yet know for sure that there is economic potential arising from waste management that is carried out properly and correctly so that it can become income for the community (Survey Results, 2024). So based on these problems, waste processing in Darmasaba Village is not yet optimal (Survey Results, 2024).

Community participation is the main key to achieving government program targets throughout Indonesia (Riyanto and Kovalenko, 2023). Communities who actively participate will support the operational efficiency of TPS 3R by providing sorted waste, facilitating the processing process, and even being directly involved in recycling activities. In addition, participation can increase environmental awareness, encourage behavioral changes in waste management, and help develop the economic value of waste through recycling and composting activities (Nopriani et al., 2022). Thus, the optimization of TPS 3R does not only depend on technical and management aspects, but is also greatly determined by the level of community participation and commitment in implementing the 3R principle (Reduce, Reuse, Recycle) in everyday life (Muhdar et al., 2024). Level of participation public analyzed with use Social Network Analysis (SNA) type rate of participation. This method used For measure relationship and knowledge between individual with a institution or group so that Can give information with level participation public in context certain (Barlic, 2018). Outer from analysis the made into indicator in determine selected scenario.

Study previous like Gita et al., (2022), with title " Analysis Infrastructure Place Management 3R Waste Based on Technical Aspects and Community Participation in Abiansemal Village, Badung Regency, Bali Province ". The TPS 3R infrastructure is very dependent from the magnitude participation public impact on sustainability operational from a infrastructure that will built on a area due to one of the form involvement public in subtraction rubbish is through sorting rubbish from source. Optimization done in order to be able to increase effectiveness and efficiency operations involving various aspect performance For increase operational. Evaluation TPS 3R performance with table monitoring and evaluation assessment functionality use rating scale method so that obtained evaluation performance

from a 3R TPS (Ayuningtias et al., 2023). Potential reduction rubbish is efforts made For reduce amount waste generated and transported to the landfill (Pradani) et al., 2022). Calculating potential reduction rubbish done with analysis mass balance for count trash that can processed and waste residue produced (Ratri et al., 2022). The main objective from analysis This is For ensure balance between inputs in the form of waste produced or collected with output that includes recycled waste recycle, burn, process, or discarded. Manager rubbish can identify stages of the management process that require development, such as improvement capacity recycle repeat or effort subtraction waste that is not processed. The more big potential reduction trash, then the more big potential mark economy trash that can obtained because of reduced waste can for sale as material standard secondary. Economic value in management rubbish show that management good trash contribute to protection environment, as well as produce benefit significant economic impact (Susilo et al., 2020). Based on research conducted in Pontianak by (Asdiantari et al., 2016), shows mark economy waste in residential areas of Pontianak City is Rp.163,632,081/ day. The potential economic value of residential waste in Pontianak City in 2016 was Rp.59,725,709,457/year. A comprehensive evaluation of the operational performance and functionality of TPS 3R, accompanied by an analysis of the level of community participation and the economic benefits generated provides a basis for developing alternative scenarios. Through this scenario-based approach, various future projections can be designed that consider various factors and possibilities. The scenarios are divided into three, namely the pessimistic scenario, the moderate scenario and the optimistic scenario. This scenario approach allows for a comprehensive analysis by considering various possible outcomes, from the most profitable to the most detrimental, thereby increasing the achievement of the specified waste reduction target (Schoemaker, 1995). The most appropriate and flexible scenario can be selected and implemented, providing a clear direction for efforts to increase the economic value of TPS 3R Pudak Mesari sustainably.

This study aims to evaluate the operational performance of waste processing at TPS 3R, analyze the potential for waste reduction, the level of community participation, and its economic value. The results of this study are expected to provide input for the Badung Regency Government in optimizing the operation of TPS 3R, increasing community participation, and supporting the economy in Darmasaba Village. In addition, this study is also useful for academics, readers, and the community in increasing insight and increasing awareness of the importance of waste management to protect the environment.

METHODS

This study uses a qualitative approach with a descriptive method that aims to understand and analyze strategies for increasing community-based waste reduction potential. This study was conducted at TPS 3R Pudak Mesari, Darmasaba Village, Badung Regency, from September 2024 to April 2025. The main focus of the study includes evaluating the operational performance of TPS 3R, analyzing waste reduction potential, the level of community participation, and the economic value of waste that can be generated. Using a sample of 100 heads of families selected through purposive and random sampling techniques, this study aims to identify factors that contribute to the effectiveness of waste management at the study location.

The research instruments used include direct observation, in-depth interviews, questionnaire distribution, and documentation and literature reviews. Data analysis was carried out through descriptive methods, operational performance evaluation,and mass balance analysis. The validity and reliability of the data were tested using the. The results of this study are expected to contribute to increasing the effectiveness of TPS 3R, both for local governments in formulating policies, communities in increasing participation, and academics in developing research in the field of community-based waste management.

RESULTS

Operational Performance Analysis Processing Garbage at TPS 3R Pudak Mesari

a. Aspect Product Supported Settings

Field law is a field about regulation from government local governing body about waste and TPS 3R. TPS 3R Pudak Mesari is one of the manifestations of the waste network system. The aspects of the supporting regulatory products consist of two indicators, namely the existence of regional regulations regarding TPS 3R and the TPS 3R development plan. Data regarding regulations were obtained by surveying the Badung Regency DLHK. The regulation that supports the existence of TPS 3R is Badung Regent Regulation Number 6 of 2023 concerning the detailed spatial

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plan for the Abiansemal planning area for 2023-2043, namely the construction of TPS 3R in each village. The TPS 3R regulation regulates; (1) The waste network plan includes TPS 3R and TPS, (2) TPS 3R is located in, SWP A in Block IA2, Block IA3, Block IA4, and Block 1.A.6; SWP B in Block IB1, Block IB5, and Block IB8; and SWP C in Block IC 1, Block IC3, and Block 1.C.8.

Based on the contents of Badung Regent Regulation Number 6 of 2023 concerning the detailed spatial planning for the Abiansemal planning area for 2023-2043, it only regulates the realization of the waste network system which includes the construction and development of TPS 3R in all sub-districts, but does not regulate the implementation of TPS 3R in detail.

There are several regulations governing waste management such as Badung Regent Regulation Number 6 of 2023 concerning the detailed spatial plan for the Abiansemal planning area for 2023-2043, Badung Regent Regulation Number 47 of 2018 concerning the Reduction of Plastic Bag Use, Badung Regent Regulation Number 48 of 2018 concerning Guidelines for the Implementation of Reduce, Reuse and Recycle through Waste Banks, Badung Regent Regulation Number 80 of 2018 concerning Regional Policies and Strategies in the Management of Household Waste and Waste Similar to Household Waste. There are regulations regarding household waste management (Reduce, Reuse, Recycle), but do not discuss the 3R TPS in detail. Thus, it can be concluded in the first indicator, there are regional regulations that regulate the waste network but do not regulate the implementation of 3R in detail. Thus, the first indicator has a value of three.

The second indicator is the development of TPS 3R, namely there is a TPS 3R development program in the RTRW and has revised the SSK. The Abiansemal RTRW 2023-2043 has the status of being in effect as a regional regulation and has been stipulated on February 17, 2023. Table 5.1 shows the indicator values based on the parameters of each indicator and the aspect values. There are two indicators in the regulatory product aspect. The indicator of the existence of regulations in the region regarding TPS 3R has an indicator value of 3 and the indicator of the TPS 3R development plan has an indicator value of 5. Then the number of aspect values in the regulatory product criteria is eight which is then carried out with a weight of 5% which produces a relative value of 0.4.

b. Technical Aspects- Technology

Aspect technology consists of on six indicator that is heavy rubbish managed, condition buildings and infrastructure, types management, condition equipment, production compost, and weight the resulting residue. Following is results analysis to a number of indicators technical-technology

1. Trash Weight Managed

Indicator heavy rubbish managed researched is presentation from heavy rubbish managed by TPS 3R compared to with the planned volume previously. Number successful trash reduced is 301.3 kg/ day. Waste that can be reduced is rubbish remainder food as much as 86.9 kg/ day, leaves as much as 127.7 kg/ day, plastic of 54.9 kg/ day and kratom paper of 31.8 kg/ day. Based on calculation, obtained heavy managed waste namely 18% with method count is do distribution between amount heavy trash that can reduced and amount heavy production rubbish multiplied with 100%. So indicator evaluation First worth 1, namely weight < 30% of capacity planned services

2. Condition buildings and infrastructure

TPS 3R has The area of the area is 1000 m2 which is divided become three part that is main hangar building covering an area of 250 m^2 consisting of on room processing (receiving area, shredding area, sifting area and composting area). TPS 3R hangar condition okay. The hangar own condition of roof, walls, frame on with good condition. Next building support covering an area of 60.1 m^2 consisting of on warehouse equipment, warehouse compost, warehouse stall, office manager, toilet and kitchen. Building support own good condition. Toilet, kitchen, office and warehouse own roof and wall conditions so that can functioning with OK. Next is a supporting area like a theme area holy, yard, vehicle parking, garden and TPS 3R signboard. So, the second indicator worth three.

3. Types of management

The type of processing at TPS 3R Pudak Mesari starts from waste sorting and processing. Waste sorting is carried out in each household and is carried out by the community. Waste sorting is carried out by the community, but not 100% of the community has sorted waste. The waste sorted by the community is organic and non-organic waste, namely

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food waste, leaf/twig/wood waste, and plastic waste. The sorting of organic and inorganic waste is still mixed with residual waste and has not been sorted by the community so that it is continued with waste sorting by officers. TPS 3R Pudak Mesari processes organic waste, namely composting. Figure 1. is the processing of organic waste. The composting technique used is the open windrow method. Furthermore, it is sprinkled with water to obtain a certain humidity. Each pile is given a minimum distance of 0.5 m for the air circulation process and operator circulation paths for pile control. Meanwhile, inorganic waste that can be recycled is collected to be sold to collectors, so that the processing type indicator is worth 3.

Figure 1. Composting

4. Condition equipment

The equipment at TPS 3R is available assist the management process garbage at TPS 3R begins from collection garbage, sorting waste and processing trash. There is a number of equipment found at TPS 3R such as truck, motor wheel three, hoe, machine enumerator compost, machine sieve compost. In Figure 2. Condition of the sieving machine equipment, shredder, truck, residue container and three-wheeled motorcycle. The compost shredder cannot function properly because there is damage to the machine so it needs to be repaired. So that for indicator condition equipment worth 3.

Figure 2. Composting Machine

5. Production compost

Production compost obtained from results with interview TPS 3R officers. Compost production is one of the organic fertilizers in the manufacturing process using organic materials such as food waste, leaves. This is because composting is done through decomposition which requires organic materials. Composting is the main activity at TPS 3R Pudak Mesari. The composting technique used is open windrow. The composting process using the open windrow technique is that organic waste is first chopped to get a smaller size and a wider surface. Then it is watered to get moisture and mixed with a liquid starter that can help speed up the decomposition process. Furthermore, a pile is made with a minimum distance of 0.5 m for air circulation paths and operator circulation paths in controlling the pile. The compost maturation process is 28-30 days and it is necessary to turn the pile periodically and regularly. After the compost is ripe, it is cooled and reaches the final humidity, which is according to room temperature. Then

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the compost is sifted and the compost is weighed and packaged (every 5 kg). Furthermore, it is stored in the warehouse and the compost is sold.

Based on the results of interviews with TPS 3R officers, the amount of waste that can be processed into compost per month is 6,437.5 kg/month from 22,606.5 kg/month of organic waste that comes in. The compost that has been collected is then sold at a price of Rp. 1,000/kg, so for compost production the indicator value is 1 because compost production is <70% of organic waste into compost. The following is the calculation of compost production at TPS 3R Pudak Mesari

TPS 3R compost production= $\frac{6.437,5}{22.606,5} \times 100\% = 28\%$

6. Weight of the resulting residue

Residue weight indicators obtained from interviews at TPS 3R. The data needed are incoming waste generation, the weight of waste that can be reduced. Residue weight is generated from the type of waste, namely food waste, leaves, twigs, plastic, cardboard, metal, glass, rubber, cloth, etc. Table 1. is the volume of residue transported to the TPA.

Table 1. Volume of residue transported to landfill

No	Types of waste	emergence waste (kg/ day)	Weight reduction (kg/ day)	Residual weight (kg/ day)
1.	Leftovers	238.5	86.9	151.6
2.	Leaf	228.8	127.7	101.1
3.	Branch Wood	286.2	0.0	286.2
4.	Plastic	304.8	54.9	249.9
5.	Paper Cardboard	117.6	31.8	85.7
6.	Metal	67.9	0.0	67.9
7.	Glass	58.3	0.0	58.3
8.	Rubber	76.6	0.0	76.6
9.	Cloth	81.6	0.0	81.6
10.	Etc	254.1	0.0	254.1
Total		1714.3	301.5	1413

Residual weight transported to landfill =$\frac{V_{residu}}{S_T}$ x 100%

Residual weight transported to landfill =$\frac{1413}{1714,3}$ x 100%

Residual weight transported to landfill = 82%

Information

$V_{res:}$ Residual volume

$S_{T:}$ total waste managed

Based on table 1., results subtraction embossment trash and weight trash that can reduced produce heavy residue rubbish that is of 1413 kg/ day. The percentage of residual volume that will be transported to the landfill, namely by 82%. So that indicator final has a value of 1 because the volume of residue transported to the landfill bigger of 40% of the total waste managed. Table 5. is calculation relative value on access technical-technological which has five indicators. The value of the indicator for the volume of waste managed worth 1, indicator condition buildings and infrastructure own mark indicator 5, indicator type management own mark indicator 3, indicator condition equipment own mark indicator 1, indicator production compost own mark indicator 1, and residual volume indicator transported to the landfill has mark indicator 1. Relative value obtained from amount mark aspect multiplied with weight that has been set. Amount mark aspects of the five indicators is six twelve later multiplied with weight by 30% so that produce relative value, namely by 3.6.

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c. Aspect Institutional

Aspect institutional used for can know condition institution manager at TPS 3R, structure organization, source Power human, legality institution, administration management at TPS 3R, and facilitation institutionalization by the local government. Weighting on the aspects This done with interviews conducted with TPS 3R officers.

1. Management institution

TPS 3R Pudak Management Institution Mesari is managed by KSM (Group) Community Self-Reliance) whose duties include as officers and manager's waste. KSM is a major actor in implementing programs at TPS 3R. The formation of KSM is through community deliberation with the form and structure of the organization that is in accordance with the needs of the community. So that the indicator value is five. This is in accordance with the objectives of TPS 3R based on the technical instructions of TPS 3R, namely TPS 3R involves the community and the main manager comes from the community.

2. Structure organization

Structure organization investigated for can know whether the administrators at TPS 3R are still there complete and functional active. Based on with results interview with TPS 3R Pudak officers Mesari, structure organization complete and characteristic active. The institution that manages TPS 3R Pudak Mesari is Group Utilization and Maintenance (KPP) Pudak Mesari. The managers and implementers of TPS 3R consist of a chairman, secretary, treasurer, business and economic section, operational and maintenance section, extension section and operator. The business and economic section plays a role in financial management and business development so that the operation of TPS 3R can be sustainable and generate profits. The operational, maintenance and operator section plays a role in collecting waste from residents' homes, processing waste, and selling the results of waste processing that has been carried out at TPS 3R, cleaning and maintaining facilities and infrastructure that have been used. The extension section has a role as an extension worker or information provider, education from agencies to cleaning officers and other communities. The number of employees at TPS 3R Pudak Mesari is 29 employees.

There are six indicators with different parameters. The indicators of the management institution at TPS 3R, organizational structure, human resources, and legality of the institution are worth 5. Meanwhile, the management administration at TPS 3R, and institutional facilitation by the local government have an indicator value of 3. The weight of the institutional aspect is 30%. The indicator value which is the aspect value based on the six indicators is 24 which is then multiplied by the weight. The calculation results mark aspect with weight produce mark relatively of 7.8.

d. Aspect Finance

1. Condition Finance

Aspect finance there is three indicators, namely condition finance, management finance and assistance finance from government. Data on finances were obtained from interviews with employees at TPS 3R. The financial condition indicator is worth three, namely sufficient monthly finances *(balance)*. Based on the interview, it is known that finances are neither lacking nor excess. Funds are allocated for operational costs, fuel costs and equipment maintenance costs. TPS 3R income comes from community contributions, sales of waste processing carried out at TPS 3R, sales of inorganic waste, and a budget from Darmasaba Village. Community contributions amount to thirty-five thousand rupiah per month. Expenditures at TPS 3R are equipment maintenance, vehicle fuel. The village provides financial assistance for KPP incentives.

2. Management finance

Indicator management finance investigated For Can know condition management finance at TPS 3R Pudak Mesari. Indicator This seen based on how TPS 3R manages recording finance. This data was obtained from an interview with the head of TPS 3R Pudak Mesari. Based on the interview results, TPS 3R Pudak Mesari currently uses a cash book for its finances and the funds are held by the treasurer.

3. Help finances from government

Indicator help finance from government investigated for can know help finances provided by the government in the form of operational funding assistance to TPS 3R Pudak Mesari. Based on interview with chairman of TPS 3R, TPS 3R gets help in the form of 2 trucks and 1 container for operational processes at TPS 3R so that can conclude that

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there is help operational, costs wages for employee obtained from government village. Table 5.4 below show mark relative to the aspect finance to three indicators. Indicator condition finance, management finance, and assistance finance from each government gets mark indicator three so that If added up will own mark aspect nine then multiplied with weight by 15%. So that obtained relative value of 1.35.

3. Aspect Participation

Community participation is an important component in the TPS 3R program. The participation aspect is studied to determine the role of the community or community involvement in the TPS 3R program and development. The participation aspect has four indicators, namely waste sorting by the community, community contributions, economic impacts, and customer development.

1. Sorting waste by the community
   Indicator sorting waste by the community investigated for can know big participation public in sorting garbage. Darmasaba community, only part big one who does sort garbage. Many people still merge organic and inorganic waste. Indicator values sorting waste by the community worth 3 because only some of which can sorting the trash and not yet done secata maximum.
2. Community contributions
   Indicator contribution public investigated for to know participation public in do payment contribution trash. Based on results interview, <60% of the population pay contribution appropriate time that is as many as 150 families out of 500 families. Many society that still in arrears up to two pieces of trash three month once. Indicator value sorting waste by the community worth 1.
3. Impact economy
   Indicators impact economy investigated for to know whether there is addition mark economy at the level community. The development of TPS 3R is expected can give benefit economy for customers and society surrounding areas. Based on results interview, impact the economy felt at TPS 3R is addition mark economy from results sell rubbish inorganic and processing organic waste as income side. Then you can conclude that impact economy existence construction of TPS 3R until moment This only in TPS 3R managers. Indicator value sorting waste by the community worth 3.
4. Development customer
   Indicator development public investigated for know development customers at TPS 3R. Based on results interview with TPS 3R officers, it is known that TPS 3R is operational first time in 2022 with customer totaling 500 families and still operate until now, but No there is addition amount Customers. Indicator values sorting waste by the community worth 1. Based on Table 5.5, the aspect four indicator with mark different indicators. Indicators sorting waste by the community own mark indicator three, indicators contribution public own mark indicator one, indicator impact economy owns mark indicator three, and indicator development customer own mark indicator one. All mark indicator the added up and produced mark aspect as big as eight. Then mark aspect multiplied with weight of 20% which will produce mark relative 1.6.

After done evaluation each indicator with the explanation, then can to be continued with do calculation value per aspect, weight relative value and total value. The following is the Evaluation Table at TPS 3R Pudak Mesari. Based on the evaluation results, it is known that TPS 3R Pudak Mesari has a value of 13.85 with a less category. The supporting product variable gets a value of 0.4, the technical-technological variable gets a value of 2.7, the institutional management variable gets a value of 7.8, the financial variable gets a value of 1.35, the participation variable gets a value of 1.8. The smallest variables are technical and technological. This is because the volume of waste that can be managed is only 18%, the organic waste used for the compost produced is only 28% and the residue produced is 83%. Thus, optimization is needed in the technical and technological sections such as paying attention to the weight of the waste managed, the percentage of waste reduction, equipment at TPS 3R and compost production at TPS 3R.

Mass Balance Analysis

Mass balance analysis is used for know big reduction and potential reduction rubbish existing in TPS 3R. Analysis This require data generation trash and weight rubbish based on its type.

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a. Production Rubbish

Waste production at TPS 3R was obtained from secondary data within 12 months. The waste collected is household waste, such as food waste, leaf waste, paper waste, plastic waste, cardboard waste, and others. Figure 3 is production garbage at TPS 3R Pudak mesari.

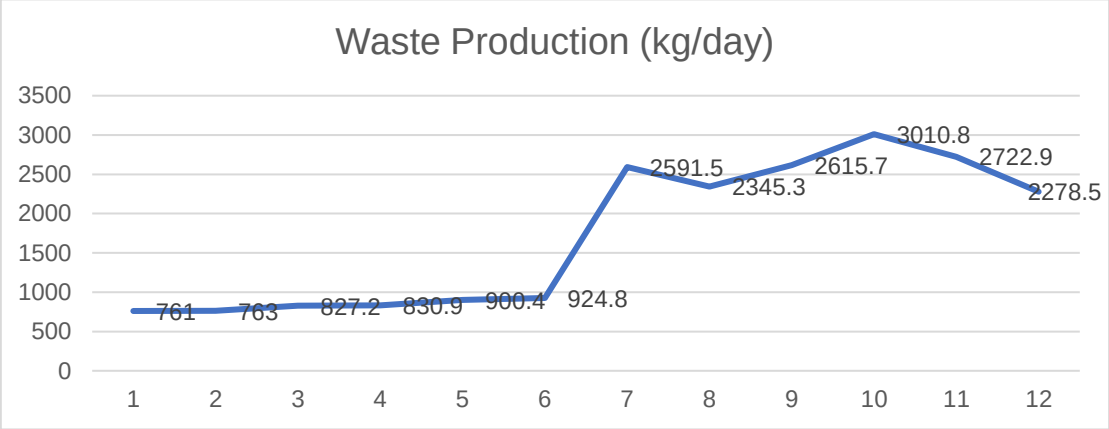

Figure 3. Waste Production

Amount waste generated at TPS 3R Pudak Mesari is 20572 kg/ day with an average of 1714.3 kg/ day. The most waste produced namely in the month October as much as 3010.8 kg/ day whereas the least amount of trash namely in the month January, which is 761 kg/ day.

b. Heavy rubbish according to the type

Weight of waste according to the type obtained from secondary data in 12 months. There are 10 types incoming garbage to TPS 3R, namely rubbish remainder food, garbage leaves, trash wood /twigs, plastic waste, trash paper / cardboard, trash metal, trash glass, trash rubber, trash cloth and others (diapers, soil, stone, ceramics, diapers, tissues, cigarettes, ash). Table 5 is the average weight rubbish according to its type.

Table 2. Average total waste

Waste composition	**Average weight of waste (kg)**
Food waste	238.5
Leaf	228.8
Branch Wood	286.2
Plastic	304.8
Paper Cardboard	117.6
Metal	67.9
Glass	58.3
Rubber	76.6
Cloth	81.6
Etc	254.1
TOTAL	1714.3

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Table 2. It can be seen that the average total waste entering TPS 3R is 1714.2 kg/day with the majority of the waste entering TPS 3R being wood/twig waste with a total of 286.2 kg. Followed by other waste such as pampers, soil, stones, ceramics, pampers, tissue, cigarettes, ash weighing 254.1 kg. The least amount of waste that goes to TPS 3R is glass waste with a total of 58.3 kg. Figure 5. Shows the percentage composition of waste entering TPS 3R

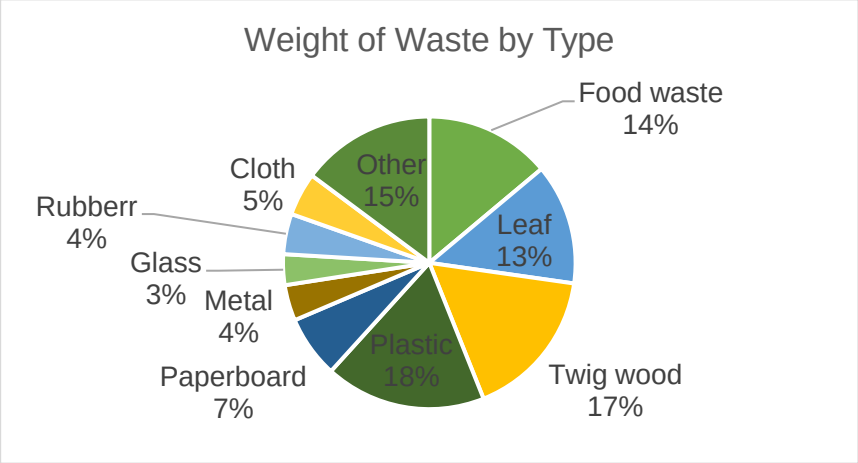

Figure 4. Percentage of Waste Composition at TPS 3R

c. Recovery factor of TPS 3R Pudak Mesari

Recovery factor is stated in percent obtained from mark reduction every composition recyclable waste repeat or used back. Activities recycling waste contained in TPS 3R, namely composting. Composting uses organic waste. For inorganic waste, sales are made to collectors. Figure 5 is percentage of recovery factor at TPS 3R Pudak Mesari.

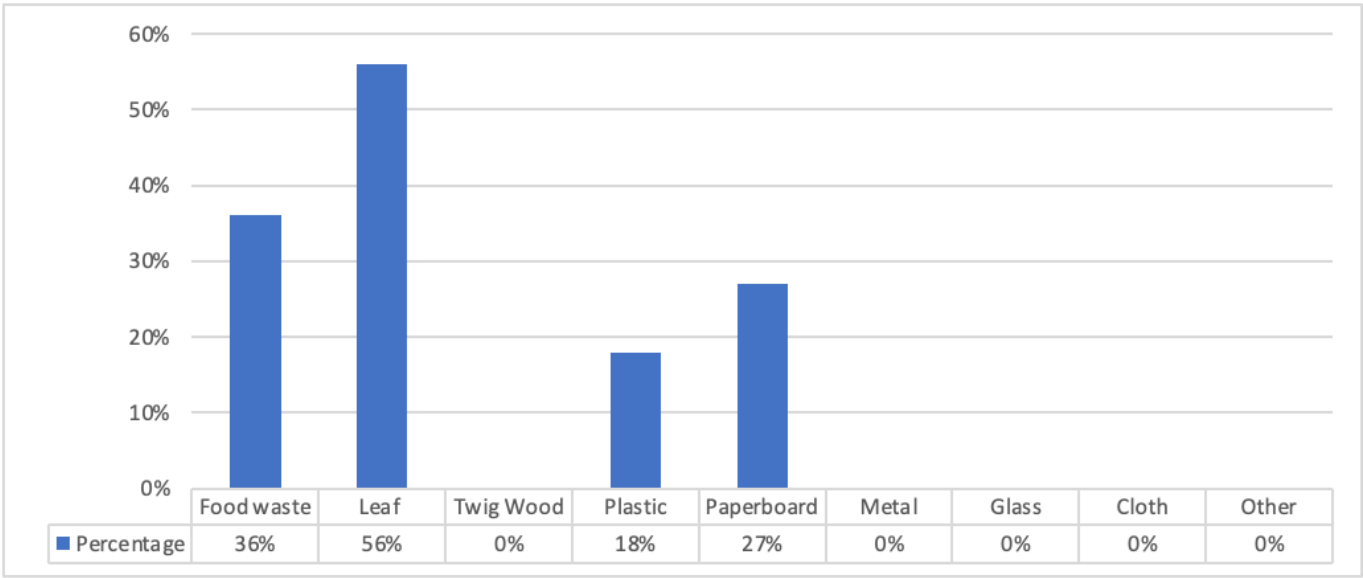

Figure 5. Recovery factor at TPS 3R Pudak Mesari.

Figure 5. It can be seen that the largest recovery factor value is found in leaf waste, followed by food waste. Leaves that can be composted are 127.7 kg/day and food waste is 86.9 kg/day. This waste is reduced through the composting process and successfully reprocessed into compost which can later be further used for sale. The next waste is plastic and paper amounting to 54.9 kg/day and 31.8 kg/day. The waste is sold to waste collectors. The lowest recovery factor value is plastic because the only plastic waste that is resold is bottle waste.

Based on the results of calculating the weight of waste and the recovery factor value, the amount of waste produced is 1714.3 kg/day with the amount of waste that can be reduced by 301.3 kg/day. This shows that the waste that can

be reduced at TPS 3R is only 18% of the total waste that goes to TPS 3R. It is necessary to optimize waste reduction up to 30% in accordance with Badung Regent Regulation Number 80 of 2018 concerning Regional Policies and Strategies in Managing Household Waste and Similar Types of Household Waste.

CONCLUSION

This study aims to evaluate the operational performance of TPS 3R Pudak Mesari, analyze the potential for waste reduction, the level of community participation, and the economic value of waste management. The results of the study indicate that waste management at TPS 3R Pudak Mesari is still not optimal, with a low level of waste reduction and limited community participation. The main factors influencing the success of TPS 3R include technical, institutional, and economic aspects. Mass balance analysis revealed that only a small portion of waste was successfully recycled, while unprocessed residue was still quite high. The level of community participation is also not optimal, indicated by low awareness of waste sorting and involvement in recycling activities.

The contribution of this study to the literature is to provide insight into the factors that influence the effectiveness of TPS 3R as well as a scenario-based approach to optimize waste management. These findings can be used by stakeholders in designing more effective and sustainable policies in reducing the burden of TPA through a community-based approach.

However, this study has limitations, including limited data coverage at one TPS 3R location, and has not considered social and cultural aspects in depth in the analysis of community participation levels. Therefore, further research is recommended to expand the scope of the study area, explore socio-cultural factors that influence community awareness, and develop more adaptive and innovative management methods to improve the effectiveness of TPS 3R in various regions.

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