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# Preparation of Sustainability Instruments for Community-Based on Solid Waste Management Programs: A Case Study of TPS3R in Sleman Regency, Yogyakarta

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**ABSTRACT**

The solid waste management system requires a community component that is directed through Community-Based Solid Waste Management (CBSWM) activities. One of the CBSWM activities in Indonesia is TPS3R (3R Waste Treatment Facility) or MRF (Material Recovery Facility). The fact on the ground was that many TPS3R management systems were not running optimally. This has the potential to hinder the sustainability of the TPS3R program. This sustainability can be assessed through proper instruments that measure program effectiveness. This research aims to develop an instrument for assessing the level of sustainability and experiment with it at TPS3R. The instrument is used to analyze the sustainability of the studied programs to determine which ones are feasible to continue. The instrument consists of 20 indicators, parameters, assessment scales, and weightings that are integrated into five aspects of waste management, including operational, technical, regulatory, community participation, financing, and institutional aspects. The research analysis method applied is the scoring method to assess the level of sustainability in TPS3R. The research was conducted at six TPS3R locations in Sleman Regency Yogyakarta. Experiments with the instrument revealed that each TPS3R received a distinct score and was classified according to the planned level of sustainability. The results of the sustainability level assessment are divided into three statuses: very sustainable, achieved by TPS3R Purwo Berhati with a percentage of 80%. Then, the sustainable status was achieved by TPS3R Brama Muda, TPS3R Mexicana, and TPS3R GIAAAAAT with percentages of 70%, 70%, and 78%, respectively. Finally, the status of fairly sustainable was achieved by TPS3R Ben Resik and TPS3R Randu Alas, at 58% and 57%, respectively. Based on the study's results, this instrument can be utilized in the sustainability assessment of TPS3R.

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## 1. Introduction

The waste problem in Indonesia is a pressing issue that remains unresolved. The 2023 National Waste Management Information System (SIPSN) report on waste management achievements indicates that the rates of waste reduction and waste handling are 12.03% and 45.23%, respectively. This percentage does not align with the 2023 waste management target outlined in Presidential Regulation Number 97 of 2017, which sets a 27% reduction target and a 72% reduction target. To overcome this, an approach to the community is needed through Community-Based on Solid Waste Management (CBSWM) activities. CBSWM activities aim to raise public awareness, responsibility, and concern for waste management. One example of CBSWM activities is the existence of processing activities at 3R (Reduce, Reuse, and Recycle) Waste Treatment Sites or Material Recovery Facility (MRF) (Putra, *et al.,* 2020; Putra, 2025).

According to the Technical Guidelines of the Ministry of Public Works, TPS3R is described as a community-scale empowerment activity with a regional scope. This processing emphasizes the concept of waste minimization, recycling, and reuse before processing is carried out at the Final Processing Site (TPA or landfill). The existing operational condition of TPS3R is that many management areas still do not run optimally. The cause of these problems is the lack of human resources to overcome the existing volume of waste, inadequate operational facilities and infrastructure, and limited resources for managing the TPS3R (Sunardi & Akliyah, 2023). This can affect the status of activity at the processing site, which is correlated with the sustainability of the TPS3R program. The success of TPS3R programs is also strongly influenced by social, institutional, and economic support. Strengthening social capital and social entrepreneurship is essential to enhance the sustainability of waste management (Zurbrügg *et al.,* 2012; Burhanuddin, 2024).

To ensure this sustainability, a sustainability assessment instrument is needed. The instrument plays a role in measuring the feasibility of the program and can help determine the effectiveness of the TPS3R. Currently, there are no specific guidelines or regulations that regulate these instruments. Therefore, it is necessary to conduct further studies on the preparation of relevant instruments to assess the sustainability of the TPS3R program. Restrictive local governance can act as a barrier to the success of community-based waste reduction programs (Latanna *et al.,* 2023; Putra, *et al.,* 2019).

Based on the problems that occurred, this research was conducted to develop a TPS3R sustainability instrument. These instruments help analyze the sustainability of programs and determine which ones are worth continuing. The instrument consists of several components, such as indicators and parameters, that are connected to 5 (five) aspects of waste management such as regulations, operational, technical, institutional, community participation, and financing. In the instrument, an assessment scale and assessment weight are required. After compiling the instrument, a simulation was conducted to assess the application of activities at TPS3R, resulting in a final assessment score.

## 2. Methods

### 2.1 Research Location and Time

The research time allocated for preparing the instrument and implementing the simulation is planned for 3 months, from May to August 2024. The research was conducted at TPS3R Sleman Regency, Special Region of Yogyakarta (DIY). The determination of the research location refers to the grouping of strata/classes, which are categorized as large, medium, and small, based on the amount of waste entering the TPS3R in a year. From each of these classes, 2 (two) locations were taken, and 6 (six) TPS3R locations were obtained. The determination of the location is only for the purpose of experimenting with instruments, not for fulfilling the number of sampling quotas. The locations of the selected 3R polling stations are described in Table 1.

**Table 1.** Research Location of TPS3R Sleman Regency

| No | Location | Classification | Address |
|---|---|---|---|
| 1 | TPS3R Ben Resik | Big | Jl. Gundengan Kidul, Tegal Domban, Margorejo, Tempel District, Kab. Sleman |
| 2 | TPS3R Purwo Berhati | | Babadan, Purwomartani, Kalasan District, Sleman Regency |
| 3 | TPS3R Brama Muda | Medium | Dayakan, RT 5/ RW 36, Sardonoharjo, Ngaglik District, Sleman Regency |
| 4 | TPS3R Randu Alas | | Candi Karang, Sardonoharjo, Ngaglik District, Sleman Regency |
| 5 | TPS3R Mexicana | Small | Taranan, Sinduharjo, Ngaglik District, Sleman Regency |
| 6 | TPS3R GIAAAAAT | | Gg. Murai, RT 29/ RW 11, Dusun Bawuk, Padukuhan VI, Minomartani, Ngaglik District, Sleman Regency |

### 2.2 Data Collection Methods

The data needed is divided into 2 (two), including primary data and secondary data. Primary data were obtained through interviews and field observations, while secondary data were obtained through literature studies and official waste websites that correlated with the research. The following information is provided regarding the data collection method in Table 2.

**Table 2.** Data Collection Methods

| No | Data Type | Data Recruitment | Data Collection Methods |
|---|---|---|---|
| 1 | Primary | Sustainability assessment of the TPS3R program | • Interview<br>• Field Observation |
| 2 | Secondary | Indicators and parameters of the sustainability assessment instrument of the TPS3R program | • Study Literature<br>• Guideline TPS3R 2021 |
| 3 | | Scale and weight of assessment instruments for the sustainability assessment of the TPS3R program | |
| 4 | | Method of assessing the sustainability instrument of the TPS3R program | |
| 5 | | Number of TPS3R in Sleman Regency | • Official website of Indonesia Solid Waste Management (www.sipsn.menlhk.go.id) |
| 6 | | The volume of waste entering TPS3R | |

### 2.3 Scoring/Weighting Method

There are 4 (four) steps to this method Alfianto (2017):

1. Parameter Rating Scale
   Each research parameter is assigned an assessment scale with different levels to support the sustainability of the program. The purpose of the scale is to assess the opinions and responses of

individuals or groups about the reality that occurs in the field (Kamulyan, 2018). The parameters are assigned a value range of 0 to 4, as detailed in Table 3.

**Table 3.** Parameter rating scale

| Value | Information |
|---|---|
| 4 | Very Good |
| 3 | Good |
| 2 | Sufficient |
| 1 | Insufficient |
| 0 | Bad |

Source: Rasyid *et al.* (2024)

2. Conformity Weighting
   The scoring method applies weights to the measurements in each indicator. The weighting serves to differentiate each level of the indicator, allowing it to be converted into numbers and processed in the scoring method. The weight is given to the many tests or related research that have been carried out.
   a) Weight 20 = Indicator performed ≥ 5 tests
   b) Weight 15 = Indicator performed 4 Scoring Suitability times of testing
   c) Weight 10 = Indicator performed 3 times of testing
   d) Weight 5 = Indicator performed 2 times of testing
3. Scoring Weighting
   The scoring weighting is obtained from the calculation between the conformity weight and the parameter assessment scale. This scoring weighting is also referred to as the relative value of the scoring method.
   Relative value =

$$(Valeu_{to-1} x conformity\ weighting_{to-1}) + .. + (Valeu_{to-n} x conformity\ weighting_{to-n})$$

4. Scoring Suitability
   The results of the scoring weighting calculation are adjusted to the suitability of the scoring with 5 (five) varying classifications. At this stage, the percentage of sustainability is used, which aims to facilitate the comparison of the final results at each TPS3R. Where its use creates a uniform standard or reference in presenting data. The following is a scale of sustainability levels described in Table 4.

**Table 4.** Sustainability Level Scale

| Sustainability Values | Percentage Sustainability | Category |
|---|---|---|
| 0 - 178 | < 20% | Highly Unsustainable (HU) |
| 179 - 356 | 21 - 40% | Not Sustainable (NS) |
| 357 - 534 | 41 - 60% | Fairly Sustainable (FS) |
| 535 - 712 | 61 - 80% | Sustainable (S) |
| 713 - 890 | > 80% | Highly Sustainable (HS) |

Source: Processed from Ismail (2018)

## 3. Results and Discussion

### 3.1 TPS3R Sustainability Instruments

In this study, a sustainability instrument was compiled to assess the level of sustainability at TPS3R. A successful waste management strategy requires balance among technical, economic, social, and environmental aspects (Atmanti *et al.,* 2018). In these instruments, there are assessment indicators, assessment parameters, and assessment scales. In the preparation of sustainability instruments at TPS3R, the first thing to do is to determine 5 (five) aspects of waste management as aspects of sustainability. Then, determine the indicators and parameters of the sustainability assessment instrument. This determination is based on literature reviews, including scientific articles, as well as waste guidelines, such as the TPS3R technical guidelines. Following this, a sustainability instrument was developed for assessing CBSWM programs. The last step is to validate the instrument with the supervisor to ensure that the indicators used as assessment tools are correct.

The sustainability assessment instrument helps collect primary data in the field consisting of 5 (five) aspects of waste management, namely operational technical, policy and regulation, financing, community participation, and institutions. The indicator helps explore problems and matters that generally occur in TPS3R. Additionally, the indicator is juxtaposed with parameters that have their levels, namely answers with values ranging from 0 to 4 for descriptions related to situations and conditions observed during fieldwork. Indicators and parameters are assessed through assessment weights, which facilitate the assessment process. The determination of the magnitude of the weight on the indicator is based on the order of the most important indicators. The order is determined by the frequency with which the indicator appears in various scientific articles. Current waste management models in Indonesia still lack critical components required for long-term sustainability (Lodan *et al.,* 2022). Table 5 is an instrument for assessing sustainability at TPS3R.

**Table 5.** TPS3R Sustainability Instrument

| No | Aspects | No. Indicator | Indicator | Parameter | Score | Weight |
|---|---|---|---|---|---|---|
| 1 | **Operational Technical** | 1A | Quantity of Managed Waste | The volume of waste managed is 100% of the planned service capacity or serving min. 200 households or ≥ 6 $m^3$/day | 3 | 20 |
| | | | | The volume of waste managed ≥ 30% and < 100% of the planned service capacity or serve between 60 - 200 households or ≥ 1.8 $m^3$/day to < 6 $m^3$/day | 2 | |
| | | | | The volume of waste managed < 30% of the planned service capacity or serves below 60 households or < 1.8 $m^3$/day | 1 | |
| | | | | No waste is managed from the service capacity | 0 | |
| | | 1B | Facility Condition | There are facilities and infrastructure to manage waste and function 100% | 3 | 20 |

| No | Aspects | No. Indicator | Indicator | Parameter | Score | Weight |
|---|---|---|---|---|---|---|
| | | | and Infrastructure | There are facilities and infrastructure to manage waste and function ≥ 50% | 2 | |
| | | | | There are facilities and infrastructure to manage waste and function < 50% | 1 | |
| | | | | All facilities and infrastructure to manage waste are no longer operating properly | 0 | |
| | | 1C | Management Type | There is a process of sorting, processing of more than 1 type of organic waste, and/or processing of inorganic waste (pressing or enumerating), as well as the sale of waste to collectors | 4 | 20 |
| | | | | There is a sorting process, organic waste processing only 1 type, and sale of waste to collectors | 3 | |
| | | | | There is a process of sorting and selling waste to collectors without the presence of organic waste processing | 1 | |
| | | | | No management at TPS3R | 0 | |
| | | 1D | Compost Production/Similar Products | Organic waste that can be processed into compost or other types is ≥ 40% of the organic waste that enters the TPS3R | 3 | 20 |
| | | | | Organic waste that can be processed into compost or other types is 20 - 40% of the organic waste that enters the TPS3R | 2 | |
| | | | | Organic waste that can be processed into compost or other types of < 20% of the organic waste that enters the TPS3R | 1 | |
| | | | | TPS3R does not produce compost or similar products | 0 | |
| | | 1E | Inorganic Waste (Recycled Waste) | Inorganic waste sold to collectors amounted to ≥ 75% of the inorganic waste that came out of TPS3R | 3 | 20 |
| | | | | Inorganic waste sold to collectors amounted to 30 - 75% of the inorganic waste that came out of TPS3R | 2 | |

| No | Aspects | No. Indicator | Indicator | Parameter | Score | Weight |
|---|---|---|---|---|---|---|
| | | | | Inorganic waste sold to collectors amounted to < 30% of the inorganic waste that came out of TPS3R | 1 | |
| | | | | No inorganic waste treatment | 0 | |
| | | 1F | Residual Waste Going to Landfill | Residue entering the landfill is ≤ 30% | 3 | 20 |
| | | | | Residue that enters the landfill is > 30% | 2 | |
| | | 1G | Environmental Management | There are odor control activities in waste and do not burn residual waste | 3 | 5 |
| | | | | There are waste odor control activities and/or residual waste-burning activities | 2 | |
| | | | | Not carrying out waste odor control activities and burning residual waste | 1 | |
| 2 | **Regulation** | 2A | Guidelines and Regional Regulations about TPS3R | TPS3R managers already know the regional guidelines and regulations related to waste management and have been implemented | 3 | 10 |
| | | | | TPS3R managers are aware of regional guidelines and regulations related to waste management but have not been implemented | 2 | |
| | | | | The manager of TPS3R is not aware of the guidelines and regional regulations related to waste management, and has not been implemented by the manager | 1 | |
| | | 2B | Policy About Waste Management (TPS3R) | TPS3R managers are already aware of policies, such as policy related to waste management (TPS3R) and have been implemented by the manager | 3 | 5 |
| | | | | TPS3R managers are already aware of policies, such as policy related to waste management (TPS3R), but have not been implemented by the manager | 2 | |
| | | | | TPS3R managers are not yet aware of policies, such as policy | 1 | |

| No | Aspects | No. Indicator | Indicator | Parameter | Score | Weight |
|---|---|---|---|---|---|---|
| | | | | related to waste management (TPS3R) and have not been implemented by the manager | | |
| 3 | **Community Participation** | 3A | Development TPS3R Customers | TPS3R customer addition of 15% per year from service coverage | 3 | 15 |
| | | | | TPS3R customer addition by 5 - 10% per year from service coverage | 2 | |
| | | | | There are no additional TPS3R customers | 1 | |
| | | | | TPS3R experiences a decrease in customers | 0 | |
| | | 3B | Public Knowledge about TPS3R | There is socialization regarding waste management from the TPS3R manager, and the community already understands about waste management | 3 | 5 |
| | | | | There is socialization regarding waste management from the TPS3R manager, but the community does not yet understand about waste management | 2 | |
| | | | | There has been no socialization regarding waste management from TPS3R managers | 1 | |
| 4 | **Financial** | 4A | Financial Condition of TPS3R | Financial conditions between income ≥ expenses | 3 | 15 |
| | | | | Financial conditions between income = expenses | 2 | |
| | | | | Financial conditions between income < expenses | 0 | |
| | | 4B | Assistance from the Government and External Parties | There is financial assistance and operational equipment from the government and/or external parties | 3 | 15 |
| | | | | There is financial assistance or operational equipment from the government and/or external parties | 2 | |
| | | | | There is no financial assistance and no operational equipment from the government and outside parties | 1 | |

| No | Aspects | No. Indicator | Indicator | Parameter | Score | Weight |
|---|---|---|---|---|---|---|
| 5 | **Institutional** | 5A | Human Resources | TPS3R managers have development targets; some workers carry out tasks according to their functions (collection, sorting, and waste processing) for a particular duration of work | 3 | 20 |
| | | | | TPS3R managers have development targets, but the workforce does not carry out their duties according to their functions (collection, sorting, and waste processing) for a particular duration of work | 2 | |
| | | | | TPS3R managers do not have development targets, and the workforce does not carry out their duties according to their functions (collection, sorting, and waste processing) for a particular duration of work | 1 | |
| | | 5B | Cooperation with External Parties (Waste Collector) | There is an agreement with the collector regarding the selling price of the waste and the waste collection schedule | 3 | 20 |
| | | | | There is no agreement with collectors regarding the selling price of waste and the waste collection schedule | 1 | |
| | | 5C | Organizational Structure | There is an organizational structure and active management in the management of TPS3R | 3 | 15 |
| | | | | There is an organizational structure, but the management is less active in the management of TPS3R | 2 | |
| | | | | There is no organizational structure | 1 | |
| | | 5D | Legality of the Institution | There is a Notarial deed, Government Official Policy, Village Decree, and/or Articles of Association and Bylaws of the Organization | 3 | 15 |
| | | | | There are Government Official Policy, Village decree, and Articles of Association and Bylaws of the Organization | 2 | |

| No | Aspects | No. Indicator | Indicator | Parameter | Score | Weight |
|---|---|---|---|---|---|---|
| | | | | There is a Government Official Policy or Village Decree | 1 | |
| | | 5E | Standard Operating Procedures (SOP) | There is a Standard Operating Procedure in place; it has been socialized and implemented by the management | 3 | 15 |
| | | | | There is a Standard Operating Procedure; it has been socialized, but the management has not implemented it | 2 | |
| | | | | There is no SOP | 1 | |
| | | 5F | Administration Management | Recording of the quantity of material (waste) that comes out is carried out | 3 | 10 |
| | | | | There is no recording at TPS3R | 1 | |
| | | 5G | Joining an Organization or Community between TPS3R | Join an organization or community between TPS3R at the provincial or district/city level | 3 | 5 |
| | | | | Not affiliated with any organization or community between TPS3R at the provincial or district/city level | 1 | |

Source: Research Analysis (2024)

### 3.2 Simulation and Analysis of TPS3R Sustainability Instruments

After preparing the instrument, the next step is to conduct a simulation and analyze the results of the TPS3R sustainability instrument, which yields varying scores. The characteristics of each TPS3R influence these variations. Then, the results of the assessment of the aspects describe the strengths and weaknesses of each TPS3R. The results of this simulation can serve as a reference for optimizing the management of TPS3R, thereby increasing its effectiveness and sustainability. Survey location of TPS3R shown in Figure 1.

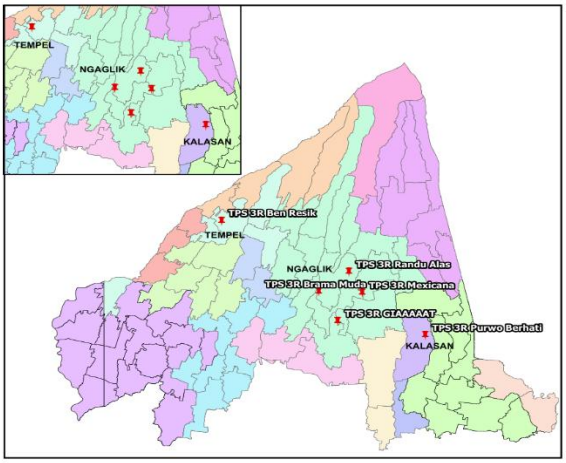


**Figure 1.** TPS3R Location in Sleman Regency

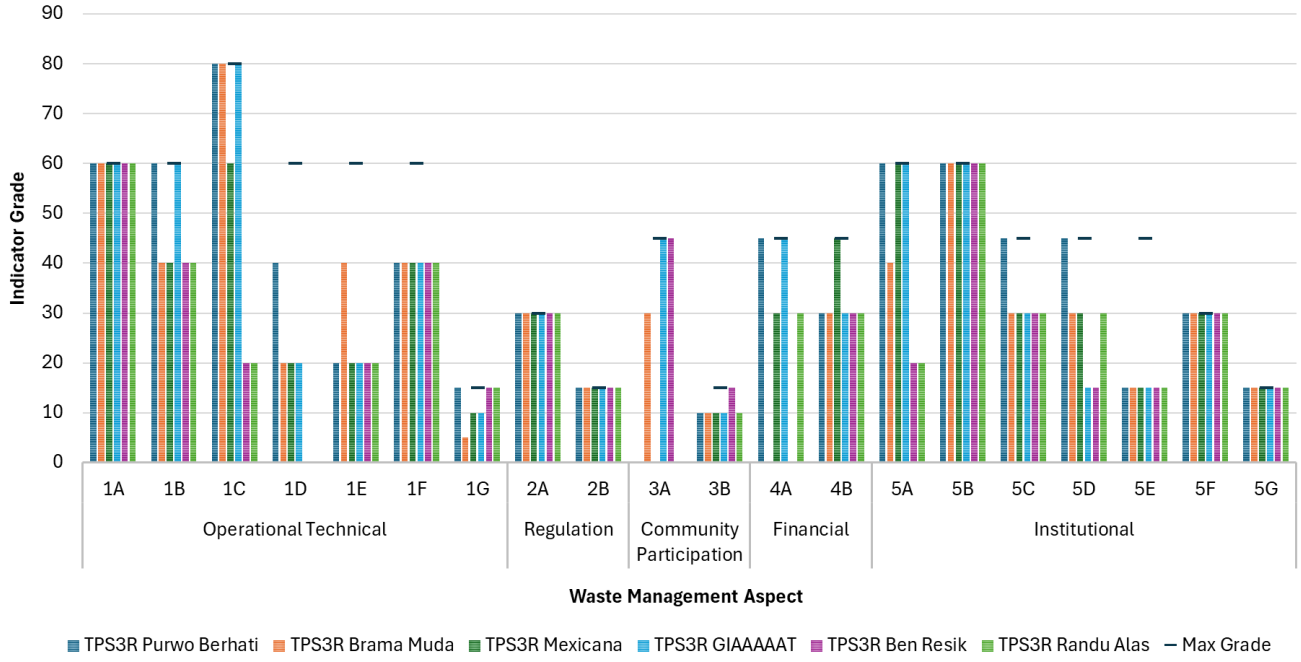


**Figure 2.** Results Recapitulation of the Sustainability Level Assessment of TPS3R in Sleman Regency

After mapping the sustainability level, a recapitulation of the results of the instrument assessment at the TPS3R studied was obtained. The results of the assessment are illustrated in Table 6 and Figure 3.

**Table 6.** Recapitulation of Sustainability Values of TPS3R Sleman Regency

| No | Location | Total Value Sustainability | Percentage (%) | Status |
|---|---|---|---|---|
| 1 | TPS3R Purwo Berhati | 715 | 80% | Sustainable (S) |
| 2 | TPS3R Brama Muda | 620 | 70% | Sustainable (S) |
| 3 | TPS3R Mexicana | 620 | 70% | Sustainable (S) |
| 4 | TPS3R GIAAAAAT | 690 | 78% | Sustainable (S) |
| 5 | TPS3R Ben Resik | 515 | 58% | Fairly Sustainable (FS) |
| 6 | TPS3R Randu Alas | 510 | 57% | Fairly Sustainable (FS) |

Source: Research Analysis (2024)

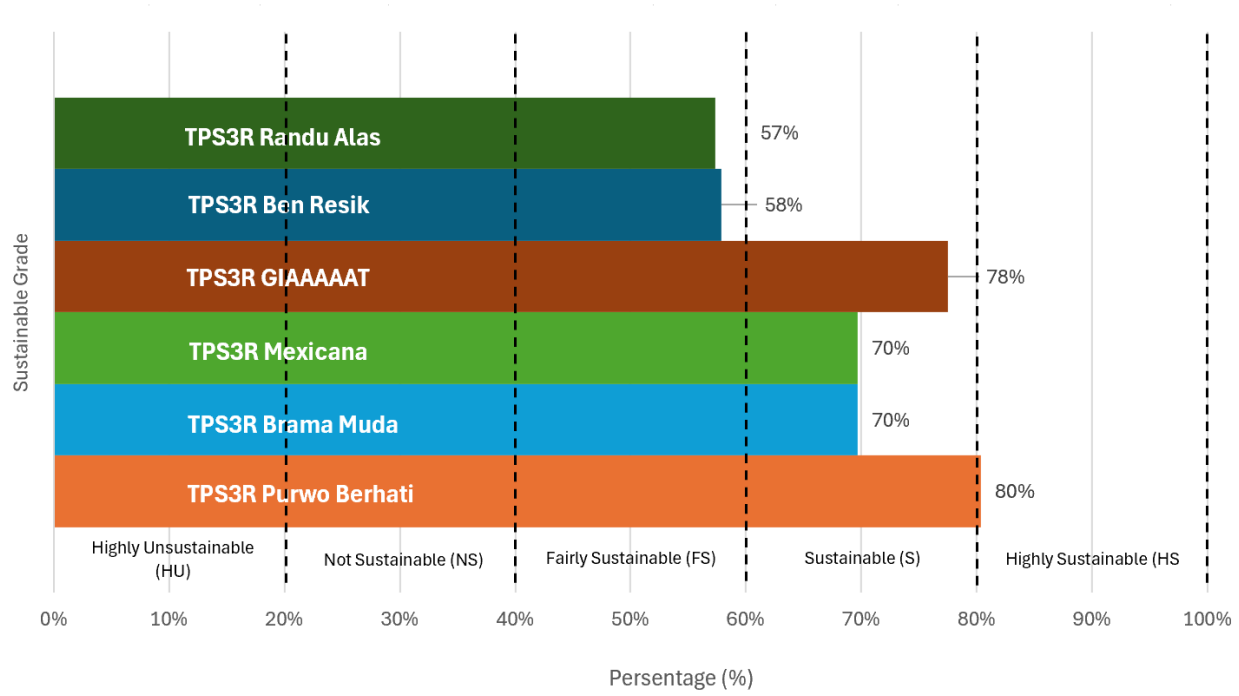


**Figure 1.** Sustainability Grade Graph of TPS3R Sleman Regency

The results of the sustainability assessment at each TPS3R were obtained based on 2 (two) levels of status, namely sustainable (S), and fairly sustainable (FS). The status (S) was achieved by TPS3R Purwo Berhati with a score of 715 with a percentage of 80%. Then, TPS3R Brama Muda with a score of 620, corresponding to a percentage of 70%; TPS3R Mexicana with a score of 620, also corresponding to a percentage of 70%; and TPS3R GIAAAAAT with a score of 690, corresponding to a percentage of 78%. Then, the status (FS) was obtained by TPS3R Ben Resik with a score of 515, corresponding to a percentage of 58%, and by TPS3R Randu Alas with a score of 510, corresponding to a percentage of 57%.

## 4. Conclusions

Based on the research that has been conducted, it was found that the TPS3R sustainability assessment instrument that was compiled obtained 20 (twenty) assessment indicators along with parameters that have their levels for determining the value in each aspect of TPS3R. Then, the instrument that has been compiled and tested in this study can be used for sustainability assessment at TPS3R because it has been adjusted to the management conditions of TPS3R, which refers to 5 (five) aspects of waste management.

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