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Evaluation of the Sustainability of Community-Based Drinking Water Supply Systems in Tasikmalaya Regency

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ABSTRACT

The Tasikmalaya Regency Government developed a Community-Based Water Supply System (SPAM) to accelerate the achievement of the sixth Sustainable Development Goal (SDG). However, the infrastructure faces challenges in terms of sustainability, particularly in relation to operational failures, maintenance, and a lack of community ownership. Referring to Norms, Standards, Procedures, and Criteria (NSPK), this study aims to analyze the sustainability of SPAM management comprehensively through a multidimensional approach that covers technical, institutional, financial, social, and environmental aspects to formulate appropriate intervention priorities. The research method combines an analysis of existing conditions and stakeholder perceptions in five SPAM location units. Secondary data refers to NSPK provisions, while primary data was obtained through field observations and structured interviews with 90 community respondents and 27 relevant stakeholders. Data analysis techniques used the Relative Importance Index (RII) and Confidence Interval (CI) for key factors, the Index Formula for sustainability levels, and the Development Priority Index (IPP) to compile development factor priorities. The results of the study show that the status of SPAM management is in the sustainable category with an average index of 72.89%. The most crucial factor identified is the existence of community fees. The recommended development priorities include strengthening regulations as an operational foundation, balancing the financial aspects between the affordability of fees and maintenance costs, and optimizing the technical performance of pumps. These findings emphasize the need for an integrative strategy to ensure reliable and long-term clean water services for the community.

Keywords: Community-Based SPAM; Infrastructure; Sustainability; Relative Importance Index (RII); Development Priority Index (IPP).

INTRODUCTION

The provision of safe and sustainable drinking water is one of the strategic issues in infrastructure development, especially in rural areas. Globally, limited access to safe drinking water remains a major challenge, particularly in developing countries, due to unequal service distribution, limited funding, and suboptimal water resource management (Aslam et al., 2016). This condition is further exacerbated by population growth, which significantly increases the demand for clean water and places additional pressure on existing drinking water supply systems (Suratmi, 2017).

In the policy context, ensuring access to drinking water is part of the global development agenda under Sustainable Development Goal (SDG) 6, which aims to ensure the availability and sustainable management of clean water. In Indonesia, efforts to achieve this target are reinforced through various national policies, including the Rencana Pembangunan Jangka Menengah Nasional (RPJMN), which targets universal access to safe drinking water. One of the strategies developed is the implementation of community-based Sistem Penyediaan Air Minum (SPAM), particularly in areas not served by formal systems such as Perusahaan Daerah Air Minum (PDAM) (Aminah & Wahyuni, 2020).

The community-based SPAM approach positions the community as the primary actor in the planning, management, and maintenance of the system. Theoretically, this approach is believed to enhance a sense of ownership and improve system sustainability due to direct community involvement in operations (Dyah & Djoko, 2020). However, in practice, many systems experience performance decline and fail to function optimally within a few years after implementation. These issues are generally associated with weak institutional capacity, limited operational funding, and low technical capacity among system managers (Andriyansyah, 2024; Farhan & Rahman, 2024).

Various previous studies have shown that the sustainability of community-based SPAM is influenced by multidimensional factors, including technical, institutional, financial, social, and environmental aspects. The technical aspect relates to infrastructure performance and raw water availability, while financial and institutional aspects are often dominant factors in ensuring operational continuity. In addition, community participation and user satisfaction levels play significant roles in maintaining service sustainability (Andriyanto et al., 2023; Febrianty & Atmadja, 2021).

Nonetheless, most existing research still focuses on partial or short-term post-implementation evaluations. Studies integrating multidimensional sustainability analysis with empirically based development priorities remain limited. In fact, identifying intervention priorities is crucial for supporting effective and evidence-based decision-making in community-based SPAM management.

This phenomenon is also observed in Tasikmalaya Regency, where several community-based SPAM units developed through the Dana Alokasi Khusus (DAK) program exhibit issues such as declining numbers of active users, operational disruptions, and suboptimal management systems. These conditions indicate a gap between actual performance and expected management standards, potentially threatening long-term system sustainability.

The urgency of this research is driven by several converging factors. First, the Tasikmalaya Regency government has invested significant resources in community-based SPAM development through the DAK program, yet many units exhibit problems, including decreased active users, operational disruptions, and weak management systems. Second, without proper intervention, these systems risk becoming completely nonfunctional within a few years, resulting in inefficient use of public resources and loss of access to safe water for communities. Third, the health and economic impacts of unsustainable water systems are substantial: waterborne diseases (e.g., diarrhea and typhoid) contribute to child mortality and reduced productivity, disproportionately affecting rural and low-income populations. Fourth, Indonesia's target of achieving universal access by 2030 requires not only new infrastructure development but also the sustained operation of existing systems—making sustainability evaluation a critical policy priority. Fifth, the current presidential administration's focus on infrastructure and basic service delivery further increases the relevance of evidence-based recommendations for improving SPAM management.

The novelty of this research is fivefold. First, it integrates four analytical components—existing condition evaluation against Norma, Standar, Prosedur, dan Kriteria (NSPK), Relative Importance Index (RII) factor analysis with Confidence Interval (CI), multidimensional sustainability index calculation, and Development Priority Index (Indeks Prioritas Pengembangan, IPP) determination—into a single comprehensive framework.

Second, it applies this framework to five SPAM units in Tasikmalaya Regency, providing the first systematic sustainability evaluation in this region. Third, it incorporates dual perspectives (community users, n = 90; stakeholders/managers, n = 27), capturing both user satisfaction and managerial capacity. Fourth, it identifies specific factor rankings using RII, highlighting the existence of community fees as the most critical factor, thereby providing empirical evidence for policy prioritization. Fifth, it produces a visual quadrant mapping of development priorities, enabling more targeted intervention strategies (Ulfarina et al., 2021).

Based on these issues, this study proposes an integrative approach to evaluating the sustainability of community-based SPAM through a combination of existing condition analysis, factor analysis using the Relative Importance Index (RII), sustainability assessment based on multidimensional indices, and development priority determination using the Development Priority Index (IPP). This approach is expected to provide a more comprehensive understanding of system conditions while generating more targeted and actionable intervention recommendations.

The objectives of this study are: (1) to evaluate the existing conditions of community-based SPAM management based on compliance with applicable standards; (2) to identify and analyze factors affecting the sustainability of SPAM management; (3) to assess the level of sustainability of community-based SPAM using a multidimensional approach; and (4) to determine priority development factors to enhance system sustainability in the future. This research is expected to contribute to the advancement of community-based drinking water management studies and serve as a foundation for formulating more effective and sustainable policies.

METHOD

This study uses a quantitative approach with the support of descriptive analysis to comprehensively evaluate the level of sustainability of the management of community-based Drinking Water Supply Systems (SPAM). This approach was chosen to measure existing conditions, identify factors that affect sustainability, and determine development priorities based on empirical data.

The research was carried out in Tasikmalaya Regency, West Java Province, on five community-based SPAM units, namely Bugel, Padakembang, Karanglayung, Pasirsalam, and Papayan SPAM. The selection of the location is based on the criteria of a system that has been operating for 1-4 years after construction and has not been served by a formal drinking water supply system.

Data collection was carried out in the period from July to September 2025 through field observations and surveys to respondents.

The data used in this study consisted of:

1. Primary Data, obtained through:
    a. Observation of the existing conditions of SPAM
    b. Questionnaire to the user community
    c. Structured interviews with managers and stakeholders
2. Secondary Data, obtained from:
    a. Related agency documents
    b. Standards and regulations (NSPK SPAM)

c. Relevant scientific literature

The research population included all users and community-based SPAM managers at the research site. The sample was determined by purposive sampling by considering the involvement of respondents in the management and utilization of SPAM.

The number of respondents in this study consisted of:

1. 90 respondents of the SPAM user community
2. 27 Stakeholders/Managers

The research variables were compiled based on the multidimensional approach of SPAM sustainability, which includes:

1. Technical Aspects: infrastructure performance, quality, quantity, and water continuity
2. Institutional Aspects: organizational structure, transparency, and managerial performance
3. Financial Aspects: contributions, operational and maintenance costs
4. Social Aspects: community participation and satisfaction
5. Environmental Aspect: protection of water sources

Each variable is described into measurable indicators used in the questionnaire instrument.

Data collection was carried out through several techniques, namely:

1. Field observation to assess the physical and operational condition of SPAM
2. The questionnaire uses a Likert scale to measure respondents' perceptions
3. Structured interviews to dig up information from stakeholders
4. Documentation to support technical and administrative data

Data analysis is carried out in stages as follows:

1. Evaluation of Existing Conditions

It is carried out by comparing field conditions with the NSPK SPAM standard to determine the level of system suitability.

2. Sustainability Factor Analysis

Using the method:

a. Relative Importance Index (RII) to determine the level of importance of factors
b. Confidence Interval (CI) to measure the level of confidence in assessment results

3. Sustainability Level Analysis

The level of sustainability is calculated using a score-based sustainability index of each indicator on five main aspects.

4. Development Priority Analysis

Use the Development Priority Index (IPP) to determine key factors that need to be improved in SPAM management.

To ensure the validity of the research results, the following are carried out:

1. Validity Test to measure the accuracy of research instruments
2. Reliability Test to ensure data consistency

RESULT AND DISCUSSION

A. Existing Conditions of SPAM Management

The results of the evaluation of the existing conditions show that community-based SPAM management in Tasikmalaya Regency has not fully met the operational standards set out in the Norms, Standards, Procedures, and Criteria (NSPK). These findings indicate a gap

between actual conditions in the field and the expected ideal conditions in a community-based drinking water supply system which can be seen in Table I.

Technically, some SPAM units are still experiencing obstacles in the form of suboptimal pump performance, limited reservoir capacity, and disruptions to the distribution network. This condition has a direct impact on the fulfillment of quality, quantity, and continuity (3K) aspects of drinking water services. The non-fulfillment of the 3K aspect shows that the infrastructure that has been built is not fully able to guarantee reliable and sustainable services.

In the institutional aspect, although most SPAM units already have a management organizational structure, the administration and governance systems are still not running optimally. Limitations in operational recording and financial transparency have the potential to reduce the level of public trust in managers. This condition is in line with the findings which state that weak institutions are one of the main causes of the low sustainability of community-based SPAM (Ulfarina et al., 2021).

From the financial aspect, the existence of community contributions is the main source of operational financing. However, in some SPAM units, the amount of contributions has not been able to cover operational and maintenance costs. This imbalance between revenue and costs leads to limitations in system improvement and development activities. These findings reinforce the results of research Ardana & Perenawa, (2019) which shows that the financial aspect is a critical factor in maintaining the sustainability of the system.

Meanwhile, in the social aspect, the level of community participation shows variation between locations. The decrease in the number of active users in some SPAM units indicates a decrease in the level of trust in the quality of service. From an environmental aspect, the condition of water sources is relatively still maintained, so it has not become the main limiting factor in the sustainability of the system.

Overall, the prevailing conditions show that the main problems lie in the institutional and financial aspects, which then have an impact on the technical and social aspects. This shows that the sustainability of community-based SPAM is not only determined by the availability of infrastructure, but also by the quality of the overall management of the system.

Table 1. Summary of Existing Conditions of Community-Based SPAM

Aspects	Key Findings	General Conditions
Technical	Pump performance is not optimal, distribution disruption	Enough
Institutional	The structure exists, the administration is not optimal	Less
Finance	Contributions have not yet covered operational costs	Less
Social	Community participation varies	Enough
Environment	Relatively maintained water source	Good

B. Analysis of Factors Affecting Sustainability

The results of the analysis using *the Relative Importance Index* (RII) method show that the sustainability factor of SPAM management is influenced by several main aspects, namely financial, institutional, technical, social, and environmental.

The factor that has the highest level of importance is the existence and regularity of community contributions which can be seen in Figure 1. This shows that the financial aspect

is the main foundation in maintaining the continuity of system operations. Without adequate financing support, maintenance and repair activities cannot run optimally.

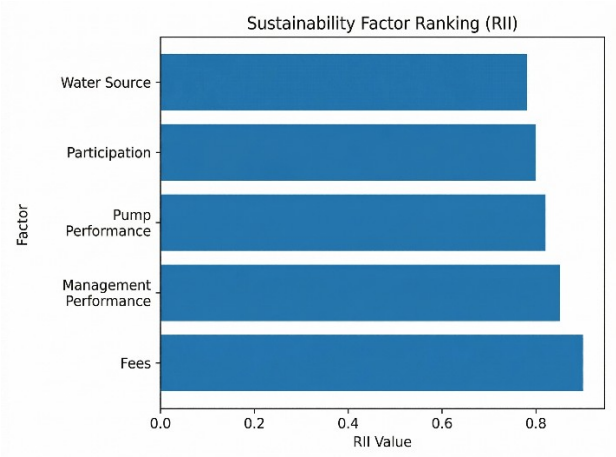

Figure 1. Sustainability Factor Rating (RII)

The dominance of community contribution factors shows that the financial aspect is the main foundation in maintaining the continuity of system operations. Without adequate financing support, maintenance and repair activities cannot be carried out optimally, which ultimately results in a decline in service quality. These findings are in line with Arikunto, (2010) which confirms that the sustainability of community-based systems is highly dependent on internal financing capabilities.

In addition, institutional factors such as managerial performance ranked second, which shows the importance of managerial capacity in system management. Managers who have good administrative and technical skills tend to be able to maintain the continuity of the system more effectively. This indicates that increasing the capacity of human resources is an important factor in community-based SPAM management.

Technical factors, particularly pump performance, also have a significant influence on the sustainability of the system. Poor infrastructure performance will reduce the quality of services, which in turn has an impact on community satisfaction and participation. The relationship between technical and social aspects shows the existence of a reciprocal relationship in the SPAM management system.

From a social aspect, community participation is an important factor that affects sustainability. High community participation not only increases the sense of ownership, but also contributes to the sustainability of financing through contributions. Meanwhile, environmental aspects such as water source protection have a relatively lower influence, but are still important in maintaining long-term sustainability.

These results show that community-based SPAM sustainability is the result of complex interactions between various factors, with financial and institutional aspects as the dominant factors.

C. Sustainability Level of SPAM Management

Based on the results of the calculation of the sustainability index, community-based SPAM management in Tasikmalaya Regency is in the **sustainable** category with an average value of **72.89%** as shown in Table 2.

Table 2. Average Value of the Sustainability Index by Aspect

Aspects	Index Value (%)	Category
Technical	75 – 80	Sustainable
Institutional	70 – 75	Sustainable
Finance	65 – 70	Enough
Social	68 – 72	Enough
Environment	75 – 80	Sustainable
Average	**72,89**	**Sustainable**

The technical and environmental aspects show a relatively higher value than the financial and social aspects. This indicates that infrastructure development and the availability of natural resources have been sufficiently supportive, but have not been balanced with the readiness of the management and financing system.

The low value in the financial aspect indicates that the system is still vulnerable to operational disruptions in the future. Dependence on community contributions in the absence of alternative financing mechanisms can be a major risk in the sustainability of the system. Meanwhile, social aspects that are not optimal show the need to increase public participation and awareness in maintaining the continuity of services.

These findings reinforce the concept that the sustainability of a system is not only determined by infrastructure performance, but also by institutional and financial sustainability [12]. Thus, although the system is generally in the sustainable category, there is a potential for a decline in performance if no intervention is made on aspects that are still weak.

D. Development Priority Analysis

The analysis of the Development Priority Index (IPP) shows that there are several main factors that need to be focused on in efforts to improve the sustainability of SPAM management.

The main priorities identified are the strengthening of regulations and institutions as the operational basis of the system. The existence of clear rules and transparent management is the key to increasing public trust and management effectiveness.

Furthermore, the financial aspect is an important priority, especially in adjusting community contributions to balance with the needs of operational and maintenance costs. A sustainable financing system is needed to ensure the continuity of services.

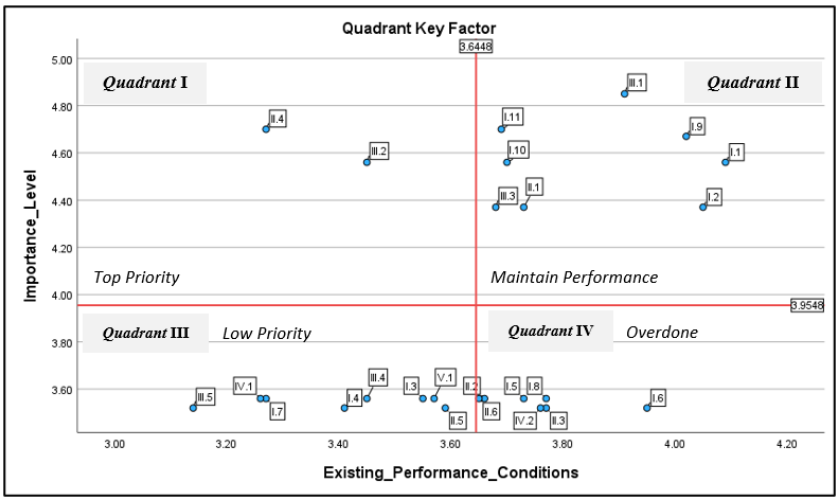

Figure 2. Mapping of Combined Key Factor Quadrants Based on *Importance* and Existing Performance as the Basis for Determining Priorities for Community-Based SPAM Development

Figure 2 shows the results of mapping the sustainability factors of community-based SPAM management using a key factor quadrant analysis that integrates the value of *importance* level and existing performance conditions. This mapping aims to identify intervention priorities based on the position of each factor in the four main quadrants (Asrasal et al., 2023).

Quadrant I (top priority) is an area with a high level of importance but has low performance conditions. The factors in this quadrant are the main focus in efforts to improve system sustainability, because they have a great influence on system performance but have not been managed optimally. Based on the results of the analysis, factors such as strengthening regulations and institutions as well as adjustments to public contributions tend to be in this quadrant, which indicates the need for strategic interventions to increase management capacity and financing stability (Daniel et al., 2021).

Quadrant II (maintain performance) consists of factors that have a high level of importance and have shown good performance. This quadrant factor needs to be maintained because it plays an important role in maintaining the sustainability of the system. In this study, technical aspects such as pump performance and water source conditions are generally in this quadrant, which shows that the existing infrastructure has functioned quite well and supported drinking water services (Susilawati, 2022).

Quadrant III (low priority) is a factor with a relatively low level of importance and performance. The factors in this quadrant are not a top priority in development, but they still need to be considered in the long term to prevent potential decline in system performance. Some specific social factors, such as the level of community participation in a particular location, can be in this quadrant.

Quadrant IV (overdone) shows factors with a relatively low level of importance but high performance. This indicates a potential inefficiency in resource allocation, where efforts made on these factors exceed the level of urgency for the sustainability of the system.

Overall, the results of the key factor quadrant analysis show that improving the sustainability of community-based SPAM needs to be focused on strengthening institutional

and financial aspects, which have proven to have a high level of importance but have not been supported by optimal performance (Whaley & Cleaver, 2017). This approach provides a solid foundation for the formulation of more effective and priority-based management strategies.

In the technical aspect, improving infrastructure performance, especially the pumping system, is the main focus. Optimization of maintenance and improvement of the technical capacity of the manager is required to reduce the risk of breakdowns and service interruptions.

Table 3. Development Priorities (IPPs)

Priorities	Development Factors	Remarks
1	Strengthening of regulations and institutions	System foundations
2	Adjustment of community contributions	Financial stability
3	Improved pump technical performance	Quality of service
4	Increased community participation	Social sustainability

The results of this analysis show that efforts to improve the sustainability of SPAM cannot be carried out partially, but require a comprehensive strategy by considering the linkages between aspects.

The results of this study show that the sustainability of community-based SPAM management is the result of interaction between technical, institutional, financial, social, and environmental aspects. The main finding produced is the dominant role of financial and institutional aspects in determining the sustainability of the system (Novriyansyah, 2025).

The interconnectedness between aspects shows that weaknesses in one aspect can affect other aspects. For example, weaknesses in the financial aspect will have an impact on the limited maintenance of infrastructure, which further reduces the quality of services and has an impact on community participation. This condition shows that there is a systemic cause-and-effect relationship in community-based SPAM management.

In addition, the results of this study show that the success of infrastructure development does not automatically guarantee the sustainability of services. This indicates that a development approach that focuses only on physical aspects needs to be balanced with strengthening non-technical aspects, especially institutional and financing (Suhendra & Prasetyanto, 2016).

Compared to previous research, the results of this study contribute in the form of an integrative approach that not only identifies sustainability factors, but also determines development priorities quantitatively (Wijayanto et al., 2015; Yasmita, 2023). Thus, the results of this study can be the basis for the formulation of more targeted policies in community-based SPAM management (Yati, 2021; Yuliani & Rahdriawan, 2015).

CONCLUSION

This study finds that community-based Sistem Penyediaan Air Minum (SPAM) management in Tasikmalaya Regency is generally moderately sustainable but still faces critical challenges that may threaten long-term system viability, particularly due to gaps between actual practices and expected standards in institutional and financial aspects. The Relative Importance Index (RII) analysis highlights financial factors—especially the availability and consistency of community contributions—as the most influential

determinants of sustainability, followed by institutional capacity (including managerial performance and organizational effectiveness) and technical factors related to infrastructure performance. These results emphasize that sustainability depends not only on physical infrastructure but also on robust governance and financing mechanisms. Future research should focus on longitudinal and comparative studies across regions, incorporating deeper analysis of governance models, tariff systems, and community engagement strategies to develop more adaptive and scalable frameworks for sustaining community-based drinking water systems.

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