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The Effect of the Existence of Management Groups and Fees on the Functionality of Community-Based Drinking Water Supply Systems in Jayawijaya Regency

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Keywords
community-based water supply system; drinking water sustainability; kp-spam; community contributions; institutional management

Abstract

Access to safe and sustainable drinking water remains a major challenge in rural and mountainous regions of Indonesia, including Jayawijaya Regency, Papua. Community-Based Drinking Water Supply Systems (SPAM-BM) have been developed to expand water access; however, the long-term functionality of these systems is often constrained by weak institutional management and inadequate financial sustainability. This study examined the influence of the Management Group (KP-SPAM) and community contributions on the functionality of community-based drinking water supply systems in Jayawijaya Regency.A quantitative approach was employed using stratified proportional random sampling. Data were collected from 270 respondents selected from a population of 1,312 active household connections across 18 KP-SPAM units. Data collection methods included questionnaires, observations, structured interviews, and document reviews. The data were analyzed using validity and reliability tests, classical assumption tests, multiple linear regression, t-tests, F-tests, and coefficient of determination analysis.The results indicated that the Management Group variable had a positive and significant effect on SPAM functionality ($\beta = 0.701$; $t = 12.467$; $p < 0.001$), demonstrating that effective institutional management plays a crucial role in ensuring system sustainability. In contrast, community contributions did not have a significant partial effect on functionality ($\beta = -0.092$; $t = -1.639$; $p = 0.102$), although they may contribute indirectly through their relationship with management performance. Simultaneously, both variables significantly influenced SPAM functionality, explaining 42.65% of the variance in system performance.SWOT analysis further revealed that the management system is positioned in Quadrant I, indicating strong institutional capacity and favorable external opportunities. Strengthening KP-SPAM governance, enhancing financial transparency, and improving community participation are therefore recommended to ensure the sustainability of community-based drinking water services in Jayawijaya Regency.

INTRODUCTION

In accordance with the mandate stated in the 2020–2024 National Medium-Term Development Plan (RPJMN), the Indonesian government aims to provide adequate drinking water services for all citizens. In addition, the government is also pursuing the Sustainable Development Goals (SDGs), particularly the target of ensuring access to safe and sustainable drinking water for all by 2030.

Jayawijaya Regency, in supporting efforts to achieve these targets, has implemented the construction of Drinking Water Supply Systems (SPAM) funded by the regional revenue and expenditure budget (APBD), the State Budget Community Direct Assistance (BLM), and the Government Assistance Fund for Communities (BPM). Community-based drinking water provision is intended for low-income communities that have not yet been served by adequate drinking water services. The planning, implementation, and management processes involve the user community so that, upon completion of infrastructure development, the system can be managed sustainably. This approach is particularly important considering that the region remains a priority area due to limited access to formal water services provided by regional water companies (PDAM) (Agustina, 2010).

The development of community-based drinking water facilities in Jayawijaya Regency is implemented by the central government through the Ministry of Public Works and Housing via the Community-Based Drinking Water Supply Program (PAMSIMAS), as well as by the Jayawijaya Regency Government through the Public Works and Spatial Planning Office. The SPAM infrastructure developed includes raw water units, production units, distribution networks, and household connections (SR). Raw water sources are derived from surface water and groundwater, which require operational costs for sustainable management.

Access to safe drinking water is a basic human right guaranteed by the constitution. In Jayawijaya Regency, geographical challenges and mountainous topography make it difficult to develop centralized drinking water infrastructure systems (PDAM) that can reach all districts and villages. Therefore, the Community-Based Drinking Water Supply System (SPAM-BM) serves as a vital alternative solution.

However, many of the facilities that have been built are damaged or do not function optimally in the long term. The main contributing factors are weak institutional capacity of the Management Group (KP-SPAM) and low community participation in paying contributions. Without competent management and sustainable community funding, operational and maintenance (O&M) costs cannot be adequately covered, leading to system failure.

An analysis of the Jayawijaya Regency SPAM Master Plan document and reports from the Drinking Water Supply System Management Information System (SIMSPAM) indicates that existing infrastructure faces several problems, including the absence of routine maintenance operations, a decline in the number of users, and malfunctioning facilities. Therefore, research is needed to evaluate the sustainability of community-based drinking water supply system management in Jayawijaya Regency.

To conduct this research, the first step was to develop assessment variables relevant to the conditions of community-based SPAM management in Jayawijaya Regency. The variables used to assess SPAM functionality are derived from a synthesis of regulatory frameworks and prior research on sustainable water management, covering technical, institutional, financial, social, and environmental aspects.

Based on the above background, the title of the thesis was " **The Influence of the Existence of Management Groups and Contributions on the Functioning of the Community-Based Drinking Water Supply System in Jayawijaya Regency".**

Problem Formulation

Based on the above background, research questions are obtained which are further formulated in the formulation of the following problem:

1. How does the existence and activity of KP-SPAM affect the functioning of SPAM in Jayawijaya Regency?
2. How does the collection of community contributions affect the functioning of SPAM in Jayawijaya Regency?
3. To what extent do the two simultaneously affect the sustainability of drinking water access?

Problem Limitations

The limitations of the research problem are as follows:

1. This research was only conducted in Jayawijaya Regency, with a focus on districts or villages that manage the Community-Based Drinking Water Supply System (SPAM-BM) through the PAMSIMAS program or other local government programs.
2. The subject of the study, with the main focus on the Management Group (KP-SPAM) as an organizational unit and the beneficiary community (customers/water users) as the contributing party to contributions.

3. Research variables. The KP-SPAM variable is limited to the aspects of legality, organizational structure, and activeness of management. The contribution variables are limited to the effectiveness of collection, the amount of the agreed tariff, and the regularity of payment by the community. The functional variables are limited to simple technical aspects, namely water quantity (adequacy), water quality (physically/visually), and continuity (smooth flow).

Research Objectives

The objectives of this research are:

1. Analyzing the institutional influence of KP-SPAM on the technical performance of drinking water facilities.
2. Evaluate the contribution of contributions to the financing of facility maintenance.
3. Provide recommendations for the appropriate SPAM-BM management model for socio-cultural characteristics in Jayawijaya.

RESEARCH METHODS

Data Types and Sources

Based on Arikunto (2010), the methods of data collection in this study were divided into three categories: human sources through interviews and questionnaires, document sources through document analysis, and field sources through direct observation at each SPAM unit. The details of data sources are presented in Table 3.1.

Table 1. Data Source Retrieval

Yes	Aspects	Variable	Data	Data Source
1	Technical	Raw Water Unit	Raw water technical data	Observations, documentation, questionnaires, and structured interviews
		Production Unit	Pump type, discharge	
		Distribution Unit	Reservoir capacity	
		Home Connection Unit	Number of SRs in the service area	
		Fulfillment of 3K elements	Water quality, quantity, continuity data	
2	Institutional	Management	Organizational structure	Observations, documentation, questionnaires, and structured interviews
		Management Rules	SOP management, AD/ART	
		User Satisfaction	User perception	Structured interviews
3	Finance	Contributions	User-issued contributions	Questionnaires and structured interviews

		Maintenance Operational Costs	SPAM operational costs	

Table 2. Advanced

Yes	Aspects	Variable	Data	Data Source
4	Social	Social Engagement	Community participation	Structured interviews and questionnaires
		Social Awareness	Community behavior	
5	Environment	Environmental Protection	Distance of water source to source of pollution	Observation, documentation, and structured interviews

Source: Arikunto, 2010

Population and Sample Determination Techniques

The determination of the number of samples in this study was carried out by stratified proportional random sampling technique and the determination of sample size using the Slovin formula, with a clear theoretical basis, so that the number of locations and the number of respondents used can be accounted methodologically. The first stage determines the number of locations (clusters), while the second stage determines the number of respondents in the selected location.

Research Population

The population in this study consists of two levels (multistage), namely:

1. The first stage of population (group/strata units), namely all Community-Based SPAM Management Groups (KP-SPAM) in Jayawijaya Regency which totals 69 groups/villages (Source: Public Works and Spatial Planning Office of Jayawijaya Regency, 2026).
2. The second stage population (elementary unit), namely all heads of families (KK)/home connections (SR) active as service users at KP-SPAM in Jayawijaya Regency, which amounts to 1,312 families/SR based on real data from the Jayawijaya Regency PUPR Office (2026).

Sampling Techniques

The sampling technique used is stratified proportional random sampling. The KP-SPAM population is first stratified according to the size of the service (number of house connections), then the number of respondents in each village/group is allocated proportionally to the actual number of house connections (SR), not by the same number. This technique was chosen so that each user has a selected opportunity that is proportional to the size of the population in each group, so that the sample is more representative of the diversity of service sizes, geographical, and socio-cultural between districts in mountainous areas with limited accessibility (Arikunto, 2010; Sugiyono, 2019).

Stratification and Location (First Stage)

Based on real data from the Jayawijaya Regency PUPR Office (2026), there are 69 KP-SPAM with a total of 1,312 active house connections (SR). The population of the group was grouped into three strata according to the size of the service, namely the small strata (≤ 15 SR; 50 villages, 558 SR), medium strata (16–50 SR; 15 villages, 342 SR), and large strata (> 50 SR; 4 villages, 412 SR). From each strata, groups were randomly selected so that 18 KP-SPAM were obtained representing the diversity of service sizes, geographical distribution between districts, and years of facility construction, as presented in Table 4.1.

Number of sample locations = 18 KP-SPAM (representing 3 service size strata)

Thus, the selected research locations are 18 KP-SPAM spread across various districts in Jayawijaya Regency and represent the three service size strata. This structured election aims to ensure the representation of small, medium, and large groups so that the results are not biased towards one class of facilities size only.

Determination of Number of Respondents (Second Stage)

The number of respondents was determined from the entire user population, namely 1,312 households/active house connections in KP-SPAM in Jayawijaya Regency based on real data from the PUPR Office (2026). In contrast to the previous approach which allocated the number of respondents equally (15 people per village), the determination of the number and allocation of samples in this study completely followed the number of house connections (water users) in each village. The total sample size was calculated using the Slovin formula (Sugiyono, 2019; Riduwan, 2015) to the real population:

N = 1,312 households/active household connection (real data for all KP-SPAM)

The calculation uses a margin of error of 5% (e = 0.05), which is chosen to keep the sample representative high:

$$n = N / (1 + N \cdot e^2) \quad (1)$$

$$n = 1{,}312 / (1 + 1{,}312 \times 0.05^2) = 1{,}312 / (1 + 3.28) = 1{,}312 / 4.28 \approx 307 \text{ respondents}$$

The results of Slovin's calculation at the 5% error level resulted in a minimum sample size of 307 respondents. The selection of a margin of error of 5% (not 10%) is intended to keep the sample size large and representative; For comparison, at E = 7% there were 177 respondents and at E = 10% only 93 respondents. Next, the sample was allocated proportionally according to the number of SRs per group (proportional allocation), not by the same amount, using the formula:

$$n_i = (SR_i/\Sigma SR) \times n \rightarrow \text{example: Ibele Village} = (100 / 420) \times 270 \approx 64 \text{ respondents}$$

With this formula, the number of respondents in each group varies according to the size of the user population (SR): villages with more home connections get more respondents, and vice versa. From the target of 307 respondents from Slovin's results, the number of questionnaires that returned and were worth analyzing was 270 respondents (response rate 88%). This figure of 270 has exceeded the minimum sample size required for multiple regression analysis. Details of the plan are presented in Table 3.2, while the proportional allocation per village is presented in Table 4.1.

Table 3. Draft Determination of Number of Locations and Respondents

Stages / Parameters	Basic Theory / Formula	Results
Population group (strata)	Data of the PUPR / SIMSPAM Office	**69**

Table 3.2 Advanced

Stages / Parameters	Basic Theory / Formula	Results
Population stratification (3 strata)	SR size: small/medium/large	**3 strata**
Number of sample locations	Randomly stratified	**18**
User population (all SR/KK)	Real data of the PUPR Office 2026	**1.312**
Margin of error (e)	Slovin (95% confidence level)	**5%**
Number of respondents (Slovin)	$n = N / (1 + N \cdot e^2)$	**307**

Allocation of respondents per group	Proportional thd SR: ni=(SRi/ΣSR)×n	**Varied**
Total Respondents	Realization (response rate 88%)	**270**

Source: Author, 2026

Sample Size Adequacy Test

The sample size analysed of 270 respondents (from the Slovin target of 307) has met the adequacy rule according to Roscoe (1975), who states that the appropriate sample size for most studies is in the range of 30 to 500, and for multivariate analyses (including multiple regression) the sample size should be at least 10 times the number of study variables. With three variables (X1, X2, and Y), the minimum recommended size is 30 respondents. Thus, the number of 270 respondents far exceeded the minimum limit and was within the ideal range, thus qualifying the adequacy and statistical feasibility for multiple linear regression analysis.

Data Collection Techniques

For data sourced from humans, the methods used are observation, questionnaires, structured interviews, and document studies, with details:

1. Observation: direct review of the physical condition of the reservoir and piping network at the research site.
2. Questionnaire: dissemination of a list of statements to respondents using the Likert Scale of 1–5.
3. Interview: question and answer with traditional leaders/village heads and KP-SPAM administrators to strengthen quantitative data.
4. Document study: collection of secondary data from the PUPR Office or related agencies in Jayawijaya Regency.

Data Analysis Techniques

Data is processed using a statistical application (SPSS) with the following stages:

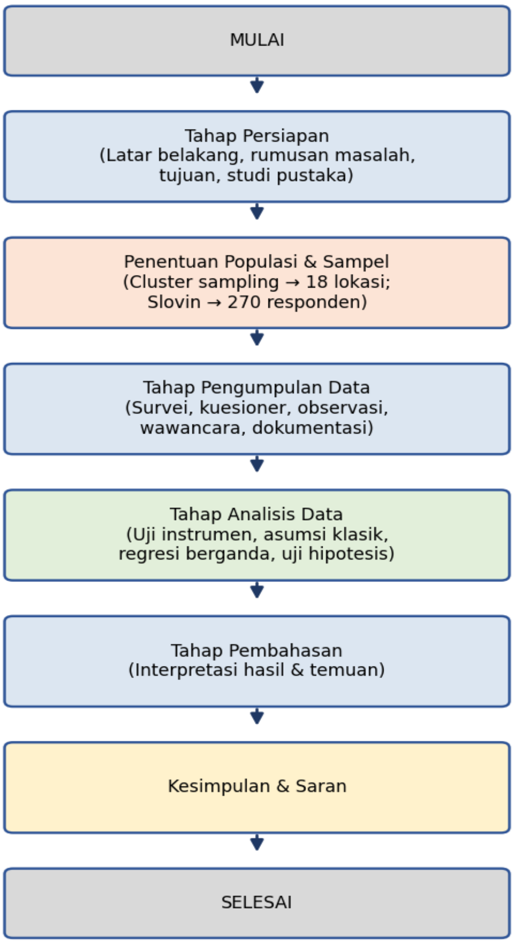
1. Instrument Test — validity test (measuring the accuracy of the questionnaire statement item) and reliability test (measuring the consistency of respondents' answers).
2. Classical Assumption Test — normality test, multicollinearity test, and heteroscedasticity test.
3. Multiple Linear Regression Analysis — used to test hypotheses with equations:

$$\mathbf{Y = a + b_1X_1 + b_2X_2 + e} \quad \textbf{(2)}$$

4. Hypothesis Test — A (partial) t-test to test the effect of X1 and X2 individually on Y; F test (simultaneous) to test the effect of X1 and X2 together on Y; and Coefficient of Determination (R^2) to see the percentage of influence of variable X on Y.

Research Flow Chart

Broadly speaking, the research process is arranged in several stages, namely the preparation stage (background preparation, problem formulation, objectives, and literature study), population and sample determination, data collection stage (survey, observation, documentation), data analysis stage, discussion stage, and final stage in the form of conclusions and suggestions. The research flow is shown in Figure 3.2.



Picture 1. Research Flow Chart

Source: Author, 2026

RESULTS AND DISCUSSION

Determination of the Number of Research Samples

As described in Chapter III (Subchapter 3.3), the determination of the number of samples in this study uses stratified proportional random sampling with the sample size calculated through the Slovin formula for the real population of users. A summary of its implementation at the implementation stage is as follows.

The first stage establishes the location. The population of the management group in Jayawijaya Regency amounted to 69 KP-SPAM with a total of 1,312 house connections (SR). The population was stratified according to the size of the service into three strata (small ≤ 15 SR, medium 16–50 SR, and large > 50 SR), then from each strata a group was randomly selected so that 18 representative KP-SPAM were obtained.

The second stage determines the number of respondents. The user population of all KP-SPAM amounted to 1,312 households/active home connection. With the Slovin formula at a 5% error level, $n = 1.312 / (1 + 1.312 \times 0.05^2)$ was obtained ≈ 307 respondents as the minimum sample size. The sample was then allocated proportionally according to the number of SRs per group, $ni = (SRi / \Sigma SR) \times n$, so that the number of respondents in each village varied according to the size of the user population (no longer equal to 15 people). This measure has met Roscoe's (1975) adequacy rule, which is in the range of 30–500 and far exceeds the limit of at least 10 times the number of variables.

Data collection was carried out through the distribution of Likert Scale questionnaires 1 to 5, observation of the physical condition of the facilities, structured interviews with KP-

SPAM administrators and village leaders, and document studies at the PUPR Office. Of the target of 307 respondents, 270 questionnaires that returned and were worthy of analysis (response rate 88%).

Respondent Characteristics

The majority of respondents were recorded as male (81.85%), while 18.15% were female. This composition needs to be interpreted carefully and does not mean that men are the ones who deal with drinking water the most in the family. The recording of the names of the respondents in this study follows the name of the head of the family according to the official home connection (SR) data on KP-SPAM, and in Jayawijaya Regency the head of the family is generally male, so the names listed on the customer list are dominated by men. Female respondents (18.15%) appeared mainly in households that did not have a male head of household (widow or woman as the head of household). In substance, the daily management of drinking water in the household (collecting, storing, cooking, and regulating water consumption) is mostly carried out by women/mothers; Therefore, filling out the questionnaire in most cases is represented or consulted to housewives as the main user of water, even if it is registered in the name of the head of the family. Thus, respondents' answers still reflect the experience of water use at the household level.

Most of the respondents (41.48%) have used the SPAM-BM service for 1 to 7 years, followed by users for more than 7 years (35.56%). Thus, the majority of respondents are seen as sufficiently understanding of the dynamics of management and the condition of water facilities in their villages.

To clarify the relationship between the year of construction of the facility and the length of its use by the community, the data of 18 KP-SPAM sample locations are presented in the form of a matrix in Table 4.3a. The length of use is calculated as the difference between the research year (2026) and the year of facility construction, then grouped into the service life category. This presentation makes it easier to read the age distribution of facilities as well as the number of users (home connections) and respondents in each age group.

The majority of the facilities where the sample is located are classified as new to very new: 8 KP-SPAM (44%) were built in the 2023–2025 period with a service life of 1–3 years, while the other 10 KP-SPAM were built in 2018–2019 with a service life of 7–8 years. The facilities built in 2025 will actually accommodate the largest number of house connections (195 SR), especially KP-SPAM Ibele and KP-SPAM Wame which are large-scale. This composition suggests that the functionality of the means needs to be analyzed taking into account the difference in service life, as new and old means face different maintenance challenges.

Test Research Instruments

Validity Test

The validity test uses the corrected item-total correlation technique. An item is declared valid if r-count is greater than r-table. At n = 270 (df = 268) and a significance level of 5%, an r-table of 0.1194 was obtained. The test results of all items are presented in Table 4.

Table 4. Instrument Validity Test Results

Variable	Item	r-count	r-table	Remarks
Managing Group (X1)	X1.1	0,583	0,1194	Valid
Managing Group (X1)	X1.2	0,794	0,1194	Valid
Managing Group (X1)	X1.3	0,833	0,1194	Valid
Managing Group (X1)	X1.4	0,802	0,1194	Valid
Managing Group (X1)	X1.5	0,581	0,1194	Valid
Community Contributions (X2)	X2.1	0,794	0,1194	Valid

Community Contributions (X2)	X2.2	0,856	0,1194	Valid
Community Contributions (X2)	X2.3	0,768	0,1194	Valid
Community Contributions (X2)	X2.4	0,625	0,1194	Valid
Community Contributions (X2)	X2.5	0,752	0,1194	Valid
Functionality of SPAM (Y)	Y.1	0,800	0,1194	Valid
Functionality of SPAM (Y)	Y.2	0,632	0,1194	Valid
Functionality of SPAM (Y)	Y.3	0,765	0,1194	Valid
Functionality of SPAM (Y)	Y.4	0,638	0,1194	Valid
Functionality of SPAM (Y)	Y.5	0,792	0,1194	Valid

Source: SPSS output (primary data processed), 2026

All 15 items have an r-count greater than the r-table (0.1194), with a range of 0.581 to 0.856. Thus, all items of the statement are declared VALID and suitable for use in the next analysis.

Reliability Test

The reliability test uses Cronbach's Alpha coefficient. The instrument is declared reliable if the Alpha value is greater than 0.70.

Table 5. Instrument Reliability Test Results

Variable	Cronbach's Alpha	Number of Items	Remarks
Managing Group (X1)	0,881	5	Reliable
Community Contributions (X2)	0,900	5	Reliable
Functionality of SPAM (Y)	0,885	5	Reliable

Source: SPSS output (primary data processed), 2026

The three variables obtained a Cronbach's Alpha value above 0.70, namely Management Group (0.881), Community Contributions (0.900), and SPAM Functionality (0.885). Thus, all instruments are declared RELIABLE with high internal consistency.

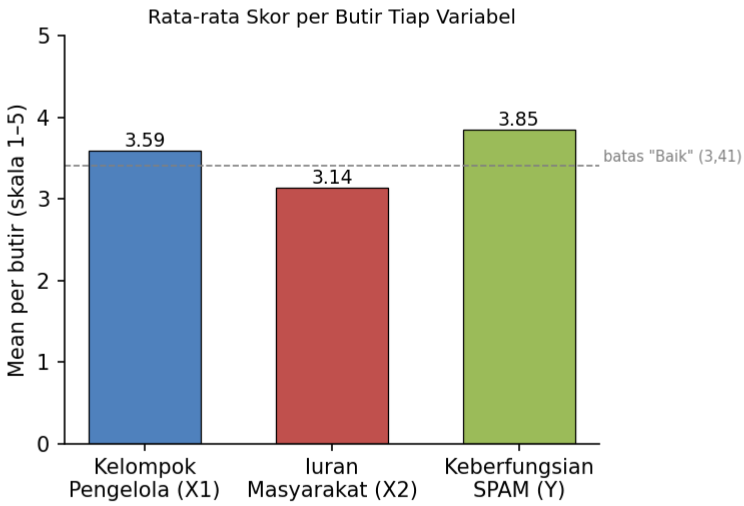
Descriptive Analysis of Research Variables

The score of each variable is a sum of five items so that it has a theoretical range of 5 to 25. Interpretation of the average score per item using the following categories: 1.00–1.80 (Poor); 1.81–2.60 (Poor); 2.61–3.40 (Sufficient); 3.41–4.20 (Good); and 4.21–5.00 (Excellent).

Table 6. Descriptive Statistics and Interpretation of Variable Averages

Variable	Mean Total	Mean per Grain	Categories
Managing Group (X1)	17,94	3,59	Good
Community Contributions (X2)	15,70	3,14	Enough
Functionality of SPAM (Y)	19,25	3,85	Good

Source: SPSS output (primary data processed), 2026



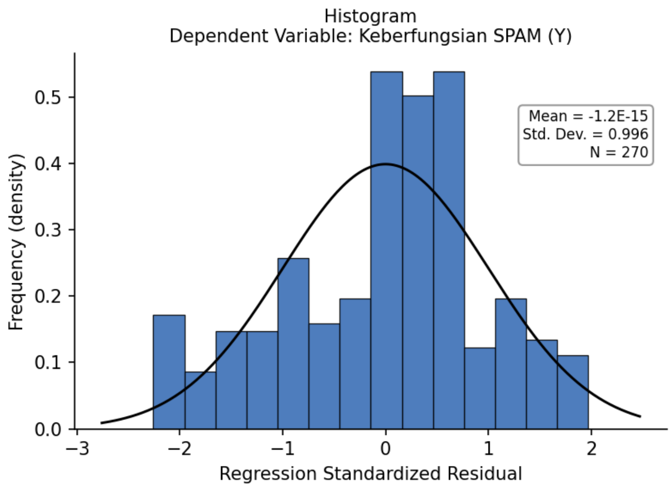
Picture 2. Average Score Chart per Item of Each Variable
Source: SPSS output (primary data processed), 2026

The variables of Management Group (mean per item 3.59) and SPAM Functionality (3.85) are in the Good category, while Community Contributions (3.14) are in the Sufficient category. These findings indicate that the KP-SPAM institution has been running and the facilities are relatively functioning, but the contribution aspect is still the weakest point, especially in the strictness of sanctions and the regularity of financial reporting.

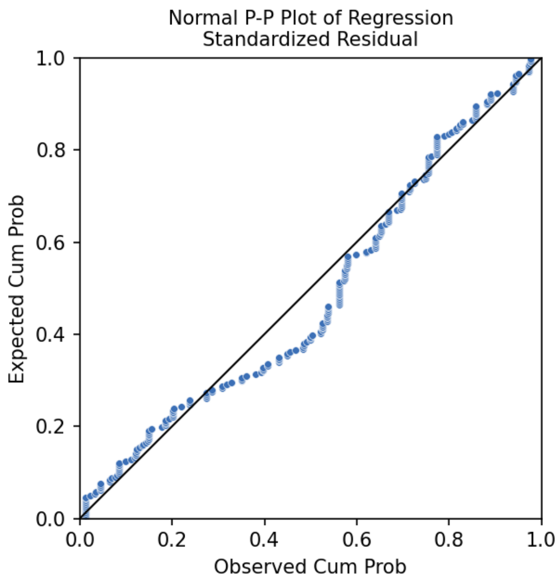
Classic Assumption Test

Normality Test

Normality tests were performed on the residual values of the model using the Kolmogorov-Smirnov One-Sample test (Lilliefors correction). A K-S statistical value of 0.122 was obtained with Asymp. Sig. (2-tailed) 0.001. The significance value is below 0.05, so statistically residual has not been fully distributed normally. However, the residual skewness value of -0.42 and curtosis (kurtosis) of -0.23 is still within the tolerance range (±1), and with a large sample size (n = 270) the regression estimate remains robust based on the central limit theorem. The residual distribution is shown in Figure 4.4 and Figure 4.5.



Picture 3. Residual Standardized Regression Histogram
Source: SPSS output (primary data processed), 2026



Picture 4. Normal P-P Plot of Regression Standardized Residual
Source: SPSS output (primary data processed), 2026

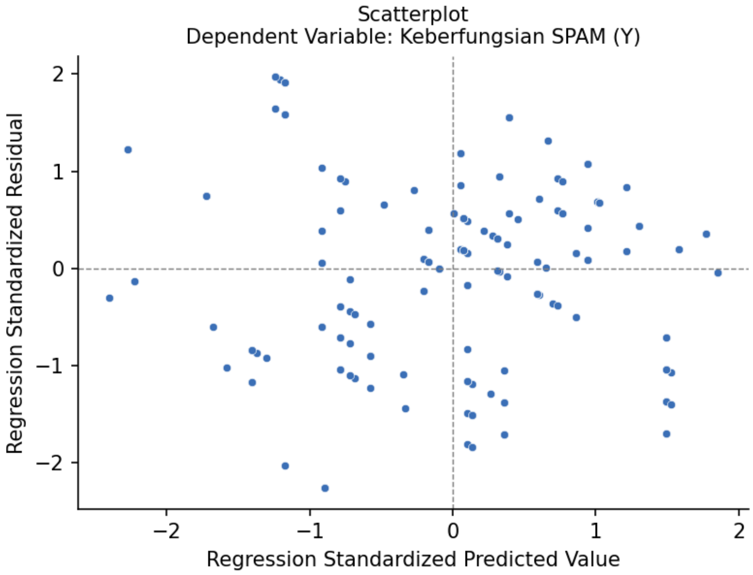
The histogram shows a residual distribution that is close to the normal bell, and the dots on the Normal P-P Plot relative to the diagonal line. This reinforces the conclusion that deviations from normality are mild and do not interfere with the validity of estimates at large sample sizes.

Multicollinearity Test

The test results showed a Tolerance value of 0.680 (greater than 0.10) and a VIF of 1.471 (less than 10) for both independent variables. Thus, the regression model is declared FREE of the symptoms of multicollinearity, so that the two independent variables can be used together in a single model.

Heteroscedasticity Test

The heteroscedasticity test uses the Glejser test, which is regressing the residual absolute value to the free variable. The significance value for the Community Contribution variable (X2) was 0.786 (greater than 0.05), while the Management Group variable (X1) was 0.000 (less than 0.05). These results indicate the presence of heteroscedasticity symptoms in the X1 variable. As a consequence, the interpretation of the precision level of the X1 coefficient needs to be done carefully, and the use of a robust error standard can be considered in advanced analysis. The residual point distribution pattern is shown in Figure 4.6.



Picture 5. Scatterplot Regression Standardized Residual vs Predicted Value
Source: SPSS output (primary data processed), 2026

Autocorrelation Test

The Durbin-Watson value obtained was 0.39. It should be emphasized that the data of this study is cross-sectional (cross-individual) and not time series data, so the autocorrelation test is basically irrelevant to be applied. The Durbin-Watson values that appear are more influenced by the order of data inputs grouped per group of managers, rather than by the existence of serial correlations between time.

Multiple Linear Regression Analysis

Multiple linear regression analysis was used to test the influence of the variables of the Managing Group (X1) and Community Contributions (X2) on the Functioning of SPAM (Y). The results of the estimated coefficient are presented in Table 4.7.

Table 7. Multiple Linear Regression Analysis Results (Coefficients)

Models	B	Std. Error	Beta	T	Sig.
(Constant)	7,615	0,910		8,369	0,000
Managing Group (X1)	0,724	0,058	0,701	12,467	0,000
Community Contributions (X2)	-0,086	0,053	-0,092	-1,639	0,102

Source: SPSS output (primary data processed), 2026 (a. Dependent Variable: SPAM Functionality)

Based on the Unstandardized Coefficients (B) column, the regression equation is obtained:

$$\mathbf{Y = 7.615 + 0.724\ X_1 - 0.086\ X_2}$$

Constant 7.615 indicates the base value of SPAM Functionality when X1 and X2 are zero. The X1 coefficient of +0.724 means that every increase in one unit of performance of the Management Group will increase the functionality by that value (positive direction), assuming other variables are fixed. The X2 coefficient of −0.086 is negative and small, indicating that once the influence of the Management Group is controlled, the unique contribution of the contribution variables to functioning is adirectional and relatively weak.

Hypothesis Testing

T test (Partial)

The t-test is used to test the influence of each independent variable partially. With df = n − k − 1 = 267 and α = 0.05 obtained a t-table of 1.969. The hypothesis is accepted if t-count is greater than t-table and the Sig. value is less than 0.05.

Table 8. Summary of t-test results (partial)

Variable	t-count	T-Table	Sig.	Verdict
Managing Group (X1)	12,467	1,969	0,000	H1 accepted
Community Contributions (X2)	-1,639	1,969	0,102	H2 rejected

Source: SPSS output (primary data processed), 2026

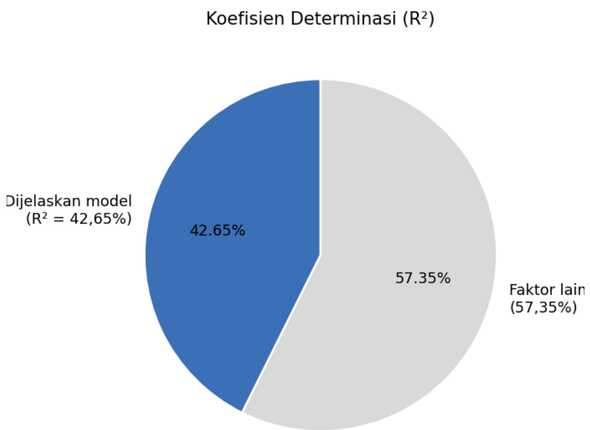
The Management Group variable has a t-count of 12.467 greater than the t-table (1.969) with a Sig. of 0.000 < 0.05, so H1 ACCEPTED: The Management Group has a positive and significant effect on functioning. On the other hand, the Community Contribution variable had a t-count of -1.639 with a Sig. of 0.102 > 0.05, so H2 was REJECTED: partially the contribution had no significant effect on functionality when tested with the Management Group variable.

F Test (Simultaneous)

The F-test is used to test the influence of the two independent variables together. With df1 = 2 and df2 = 267 obtained an F-table of 3.030. The test results resulted in an F-count of 99.286 which far exceeds the F-table (3.030) with a Sig. of 0.000 < 0.05. Thus, H3 ACCEPTED: The Management Group and Contributions simultaneously have a significant effect on the functioning of SPAM.

Coefficient of Determination (R^2)

The R Square value of 0.427 (Adjusted R Square 0.422) indicates that 42.65% of the variation in SPAM functionality can be explained by the variables of the Management Group and Contributions together, while the remaining 57.35% is explained by other factors outside the model, such as geographical conditions, reliability of raw water sources, and village government support. The proportion of the model's contribution is shown in Figure 4.7.



Picture 6. Determination Coefficient Diagram (R^2)

Source: SPSS output (primary data processed), 2026

Table 9. Recapitulation of Hypothesis Testing Results

Hypothesis	Statement	Results
H1	The Management Group has a positive and significant effect on the functioning of the	Accepted
H2	Contributions have a positive and significant effect on the functioning of the	Rejected
H3	The Management Group and Contributions simultaneously affect the functioning of the	Accepted

Source: Primary data processed, 2026

Discussion

The Influence of Management Groups (KP-SPAM) on Functioning

The test results proved that the Management Group had a positive and significant effect on the functioning of the facilities, even becoming the most dominant variable (beta 0.701). This finding is in line with Hidayat (2022) who found that managerial capacity and management leadership are strongly correlated with the physical condition of facilities. A clear organizational structure as well as neat administration ensure that each asset has a person in charge, so that damage can be dealt with faster. In the context of Jayawijaya, the figure of the group leader who is traditionally respected is the main driver of routine maintenance and mobilization of citizen participation.

These findings are reinforced by Daniel et al. (2023) who analyzed 28,936 PAMSIMAS projects in 33 Indonesian provinces and found that management quality is the only variable that is consistently positively correlated with the full functioning of the water system. Valcourt et al. (2020) through the mapping of rural water system factors in various developing countries confirmed that local institutional capacity is the leverage point with the highest influence value and the lowest dependency, making it the most strategic intervention point to improve service sustainability.

The Influence of Community Contributions on Functioning

Partially in the multiple regression model, contributions had no significant effect on functionality (Sig. 0.102). However, at the level of simple (bivariate) relationships, contributions were actually positively and significantly correlated with functionality ($r = 0.304$; Sig. 0.000). This pattern shows that the influence of contributions is mostly intertwined with the influence of the Management Group, considering that the two variables are strongly correlated with each other ($r = 0.566$). In other words, contributions tend to be healthy precisely when the management institution is strong, so that when institutional capacity is controlled, the unique contribution of contributions becomes insignificant. This finding is consistent with the low score on the item of strictness of arrears sanctions and financial reporting (Sufficient category at X2), which indicates the need to strengthen AD/ART billing and financial transparency so that the Full Cost Recovery mechanism as well as Willingness to Pay and Ability to Pay (Rizal et al., 2021) can run optimally.

These findings are in line with Al Djono and Daniel (2022) who explicitly state that without a functioning tariff system, there is no single fully functioning water system in the PAMSIMAS national dataset. They found that regular financial contributions (monthly contributions) had an odds ratio of 1.85–3.87 times more on functionality than non-financial participation at the beginning of the program. Daniel et al. (2021) through the system dynamics approach also showed that the loop of the financial sub-model is reinforcing: the availability of contribution funds encourages community development programs which in turn increase the willingness of citizens to continue to contribute financially.

Simultaneous Influence of Management Groups and Contributions

Simultaneously, the two variables explain 42.65% of the functionality of facilities with a significant F-test, confirming the thesis of Sumiyanto (2020) that the sustainability of SPAM is a balance of institutional and financial aspects. The results of this study place the KP-SPAM institution as the main determining pillar, while contributions play a supporting role as a supporting factor that works through institutional strength. For Jayawijaya Regency with its geographical challenges of mountains and distinctive customary social structures, institutional strengthening based on local wisdom combined with a fair and transparent contribution mechanism is the most relevant SPAM-BM model to ensure the sustainability of drinking water access.

At the national level, Daniel et al. (2023) proved that the combination of good management and a functioning tariff system is the strongest predictor of the full functioning of SPAM-BM in Indonesia. The study recommends that post-construction programs focus more on strengthening group governance and formalizing financing mechanisms, a relevant and urgent recommendation to be implemented in Jayawijaya Regency with its distinctive geographical and socio-cultural challenges.

SWOT Analysis of Community-Based SPAM Management Strategies

This subchapter answers the formulation of the third problem, namely formulating a community-based SPAM management strategy in Jayawijaya Regency through SWOT analysis. SWOT analysis is used to map internal factors (strengths and weaknesses) and external factors (opportunities and threats), then determine the strategic position of the managing organization in one of the quadrants as stated by Rangkuti (2016). The factors used are derived from the results of quantitative analysis in the previous subchapter, especially the finding that the management group (KP-SPAM) has a dominant effect on functioning, while community contributions have not had a significant effect.

Identification of Internal and External Factors

Identification of the strengths, weaknesses, opportunities, and threats of Community-Based SPAM management is presented in the SWOT matrix in Table 4.10 below.

Table 10. Community-Based SPAM Management SWOT Factor Identification Matrix

INTERNAL FACTORS — STRENGTH(S)	INTERNAL FACTORS — WEAKNESSES (W)
S1. The Management Group (KP-SPAM) was active and had a dominant effect on functioning (β = 0.701; t = 12.467). S2. The level of functional facilities is classified as good (average variable Y = 3.85). S3. The participation and sense of belonging to the community towards the facilities is quite high.	W1. The contribution system has not been effective and has no significant effect (mean X2 = 3.14; sig. 0.102). W2. Transparency in financial management and the application of sanctions are still weak. W3. The administrative capacity and group recording are still limited.
EXTERNAL FACTORS — OPPORTUNITIES (O)	**EXTERNAL FACTORS — THREATS (T)**
O1. Support for government programs (PAMSIMAS, Village Fund, DAK Drinking Water). O2. Opportunities for the implementation of usage-based (volumetric tariffs/contributions). O3. Continuous technical assistance from the PUPR Office and facilitators.	T1. Extreme topographic conditions and are prone to disasters that make maintenance difficult. T2. Decrease in the reliability/quantity of raw water sources. T3. Low compliance with paying contributions and dependence on central funds.

Internal Factor Weighting (IFAS) and External Factor (EFAS)

Each factor is weighted (indicating the level of importance, with the sum of the total weights equal to 1.00) and ratings (1–4), then multiplied to obtain the weighted score. The results of internal factor weighting (IFAS) are presented in Table 4.11 and external factors (EFAS) in Table 4.12.

Table 11. IFAS (Internal Factor Analysis Summary) Matrix

Yes	Strategic Factors	Weight	Rating	Score (Weight × Rating)
	Strengths			
1	The active and dominant role of KP-SPAM in the functioning of the	0,20	4	0,80
2	The functionality of the facilities is relatively good (Y = 3.85)	0,15	4	0,60
3	Participation and a sense of belonging are high	0,15	4	0,60
	Weaknesses			
1	The contribution system is not yet effective & insignificant (X2 = 3.14)	0,20	2	0,40
2	Financial transparency and weak sanctions implementation	0,10	2	0,20
3	Limited group administration/recording capacity	0,20	1	0,20
	Total IFAS	**1,00**		**S score = 2.00; Score W = 0.80**

The difference in strength and weakness scores results in an X-axis (internal) coordinate of 2.00 − 0.80 = +1.20.

Table 12. EFAS (External Factor Analysis Summary) Matrix

Yes	Strategic Factors	Weight	Rating	Score (Weight × Rating)
	Opportunities			
1	Government program support (PAMSIMAS, Village Fund, DAK)	0,20	4	0,80
2	Opportunities for the application of volumetric tariffs/dues	0,15	4	0,60
3	Continuous technical assistance of the PUPR Office	0,15	4	0,60
	Threats			

Table 13. Advanced

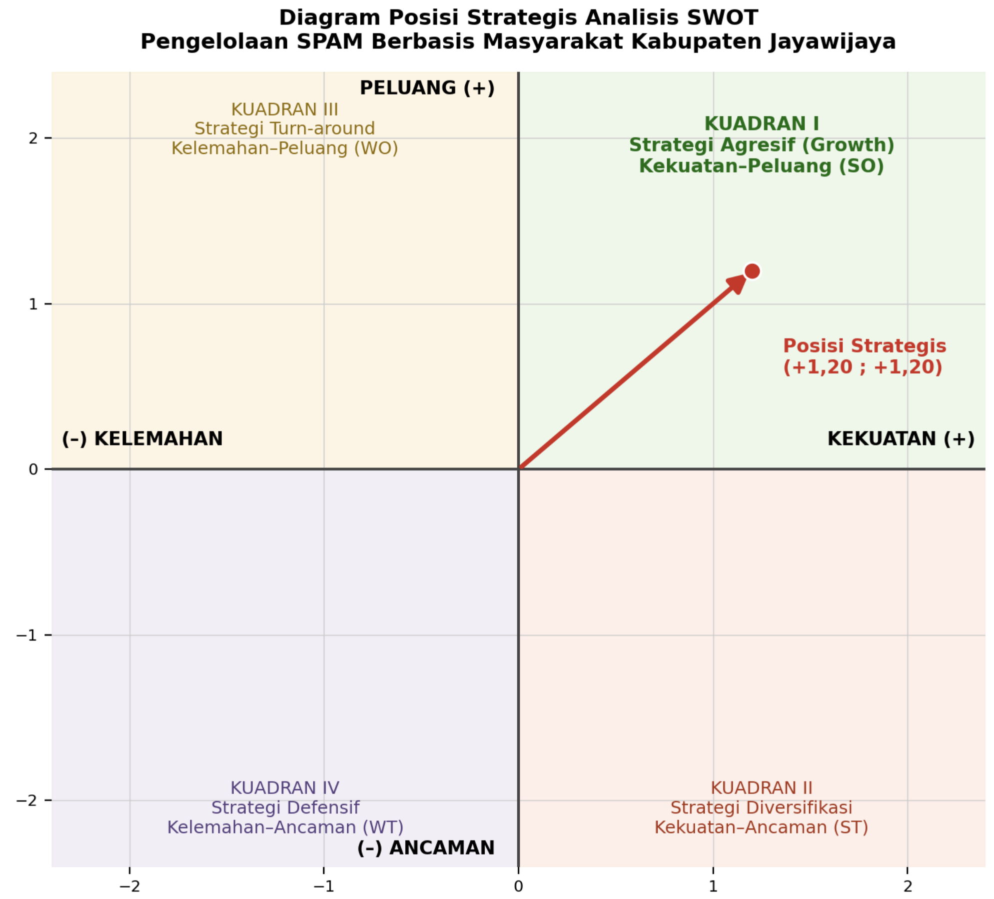
1	Extreme and disaster-prone topography	0,20	2	0,40
2	Decrease in the reliability/quantity of raw water sources	0,10	2	0,20
3	Low contribution compliance and dependence on central funds	0,20	1	0,20

Total EFAS	**1,00**	**O score = 2.00; T score = 0.80**

The difference between the opportunity and threat scores results in a Y-axis (external) coordinate of 2.00 − 0.80 = +1.20.

Quadrant Position and Strategy Formulation

Based on the weighting results, the strategic position of Community-Based SPAM management in Jayawijaya Regency is at coordinates (+1.20; +1.20). Since the value of the internal axis (X) and the external axis (Y) are both positive, the position falls on Quadrant I. Quadrant I indicates the most favorable situation: the organization has internal strengths that can be leveraged to seize external opportunities. The right strategy in this quadrant is an aggressive strategy (Growth Oriented Strategy), which is a strategy that utilizes power to seize opportunities (SO strategy). The position is depicted in Figure 4.8.



Picture 7. SWOT Analysis Strategic Position Chart (Quadrant I)

The strategy formulation based on a combination of internal and external factors is presented in the following SWOT strategy matrix (Table 4.13). Since the position is in Quadrant I, the prioritized strategy is the SO (Power-Opportunity) strategy.

Table 14. SWOT Strategy Matrix

Opportunity (O) → STRENGTH (S)	Opportunities (O) → WEAKNESSES (W)
SO (Aggressive) Strategy:1. Strengthening the role of KP-SPAM which is already	WO Strategy:1. Reorganize the contribution system through volumetric

dominant to optimize government programs (PAMSIMAS/Village Funds).2. Making a group that functions well as a model/pilot of management for other villages.	rates supported by government programs.2. Group financial administration & transparency training.

Table 15. Advanced

Opportunity (O) → STRENGTH (S)	Opportunities (O) → WEAKNESSES (W)
3. Utilizing the assistance of the PUPR Office to increase the capacity of managers.	
Threat (T) → STRENGTH (S)	**Threats (T) → WEAKNESSES (W)**
ST Strategy:1. Establish a maintenance reserve fund to anticipate damage due to topography/disasters.2. Community-based conservation and protection of raw water resources.	WT Strategy:1. Enforcement of rules of contributions and sanctions through deliberation.2. Encourage financial independence to reduce dependence on central funds.

Thus, the answer to the formulation of the third problem is that the community-based SPAM management strategy in Jayawijaya Regency is in Quadrant I and demands an aggressive strategy based on the institutional strength of KP-SPAM. The main priority is to strengthen and replicate well-functioning management groups, optimize government program support, and improve the contribution system—which has been a weakness—through the implementation of usage-based tariffs and increased transparency, so that the sustainability of community-based drinking water services can be maintained.

CONCLUSION

The Management Group (KP-SPAM) had a positive and partially significant effect on the functioning of community-based SPAM in Jayawijaya Regency, with a t-value of 12.467, which was greater than the t-table value of 1.969, and a significance value of 0.000, which was lower than 0.05. The standardized coefficient (beta) value of 0.701 indicated that KP-SPAM was the most dominant variable in the model. These findings were consistent with Daniel et al. (2023) and Valcourt et al. (2020). Thus, H1 was accepted.

Community contributions partially had no significant effect on the functioning of SPAM when controlling for the Management Group variable, with a t-value of -1.639 and a significance value of 0.102, which was greater than 0.05. This condition was caused by a strong collinearity between contributions and institutional factors (r = 0.566), indicating that contributions operate indirectly through institutional mechanisms. At the bivariate level, contributions remained positively and significantly correlated (r = 0.304). The average contribution score, which remained in the adequate category (mean = 3.14), indicated the need to strengthen collection mechanisms and financial transparency. Thus, H2 was partially rejected.

The Management Group and community contributions simultaneously had a significant effect on the functioning of SPAM, with an F-value of 99.286, which was greater than the F-table value of 3.030, and a significance value of 0.000. The coefficient of determination (R^2 = 0.427) indicated that both variables explained 42.65% of the variation in system functionality, while the remaining 57.35% was explained by other factors such as raw water conditions, mountainous topography, and village government support. Thus, H3 was accepted.

The results of the SWOT analysis showed that community-based SPAM management in Jayawijaya Regency was positioned in Quadrant I (coordinates +1.20; +1.20), indicating a condition that required an aggressive (Growth/SO) strategy. The recommended strategy was to leverage the institutional strength of KP-SPAM to capitalize on government program opportunities while improving weaknesses in the contribution system. This finding addressed the third research question.

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