Institutional Factor Analysis on the Sustainability of Community-Based Drinking Water Infrastructure in Sidenreng Rappang District

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Abstract

This study aims to analyze institutional factors affecting the sustainability of community-based drinking water infrastructure in Sidenreng Rappang District. The research was conducted in 31 villages/wards that are part of the Pamsimas Program locations. The survey was carried out using a purposive sampling method involving 62 respondents, consisting of members of the Drinking Water Supply Management Group (KP-SPAMS) and beneficiary community members. The study employed quantitative methods with SPSS (Statistical Package for the Social Sciences) as a statistical tool. The SPSS output shows that the t-test value for the institutional variable (X2) is t = 4.282 with a significance value of 0.000 < 0.05. This indicates a partial influence of institutional factors on infrastructure sustainability. The standardized beta value also shows that institutional factors (X2) significantly influence the program's sustainability, and among all variables, institutional factors have the highest B value, indicating they are the most dominant factor affecting the sustainability of drinking water infrastructure under the Pamsimas Program in Sidenreng Rappang District.

Keywords: *Institution, Sustainability, Infrastructure.*

INTRODUCTION

Drinking water and sanitation are human rights; every individual—men and women, children and the elderly, as well as persons with disabilities—has the same right to access safe drinking water and sanitation. Access to safe drinking water and sanitation is one of the key elements in achieving sustainable development (Suryani, 2020) (Ronika et al., 2022). This aligns with the sixth goal of the Sustainable Development Goals (SDGs), which is to ensure access to clean water and sustainable sanitation facilities for all (Setty et al., 2020) (Gupta & Bosch, 2022). Access to clean water is not only vital for health but also contributes to poverty reduction, improved well-being, and environmental sustainability (Permata et al., 2024)(Galeh et al., 2025). According to the WHO/UNICEF Joint Monitoring Programme, approximately 91% of the world's population has access to safely managed drinking water sources, yet disparities still exist in rural or village areas, especially in developing countries such as Indonesia (UNICEF and WHO, 2023). In Indonesia, the issue of access to drinking water and sanitation facilities remains a significant challenge. Based on a report released by the Central Statistics Agency (BPS) in 2022, 14.1% of Indonesians still do not have access to proper drinking water, and 7.7% of households lack access to adequate sanitation (Permatasari et al., 2023). Most of the underserved population lives in rural and remote areas. To address this challenge, the Indonesian government has developed several drinking water development programs, one of which is the Community-Based Drinking Water and Sanitation Program (PAMSIMAS) (D. S. Puspita et al., 2023).

The Pamsimas Program in Sidenreng Rappang District has been implemented from 2008 to 2021, covering 79 villages or urban wards spread across 11 sub-districts within the district, with an additional 8,736 household water connections established (Kurnia & Magriasti, 2022). The implementation of the Pamsimas Program in Sidenreng Rappang was divided into three phases: Pamsimas I (2008–2012) targeting 48 villages/wards, Pamsimas II (2013–2015) covering 21 villages/wards, and Pamsimas III (2016–2021) which included 10 villages/wards. According to a report by the Association of Drinking Water and

Sanitation Supply System Managers (KP-SPAMS), of the 79 water infrastructures built between 2008 and 2021, 5 villages had non-functioning systems, 3 villages had partially functioning systems, and the remaining 71 villages had fully functioning drinking water infrastructure (Perencanaan & Nasional, 2018).

Several previous studies on the analysis of sustainability factors in the Pamsimas program deserve attention. Among them is research identifying variables that influence the sustainability of drinking water supply systems, especially in Bantaeng Regency and other rural areas (T. M. D. Puspita, 2024). The variables studied included functionality, institutional factors, operational and maintenance aspects, and partnerships. Another study conducted in Dente Teladas Sub-district, Tulang Bawang Regency, identified independent variables such as technical, institutional, economic, social, and environmental factors, with the dependent variable being the sustainability of the Pamsimas Program, and community perspectives on program reliability as an intervening variable (Efendi et al., 2024). A study in Wajo Regency also examined the factors affecting the sustainability of the Pamsimas Program (Taufiq et al., 2022). focusing on functionality, institutional factors, the implementation of community contributions, and partnership variables. These three studies emphasize the importance of analyzing institutional factors and the extent of their influence on the sustainability of drinking water infrastructure in the Pamsimas program.

Research related to factors influencing the sustainability of community-based drinking water infrastructure has not previously been conducted in Sidenreng Rappang District. Mukherjee, N. and van Wijk stated that one of the main factors affecting sustainability is institutional capacity (Andriyanto et al., 2023), where institutions serve to implement and carry out the operational and maintenance plans of the established facilities, including fee schemes and the management processes of the drinking water infrastructure itself (Syamsurizal & Rahdriawan, 2022). Studies specifically examining the sustainability of community-based drinking water infrastructure in Sidenreng Rappang District remain limited. Most existing research has centered on broader regional comparisons or conceptual discussions of sustainability, often overlooking the contextual specificity of institutional dynamics in rural settings. This represents a critical research gap, particularly given the decentralized governance structure and diverse institutional capacities at the local level.

This study contributes to bridging that gap by providing a focused empirical investigation of institutional factors such as governance structure, technical and managerial competence, accountability mechanisms, and regulatory support that influence the long-term sustainability of PAMSIMAS infrastructure in Sidenreng Rappang. The contribution of this research lies in (1) presenting context-based quantitative evidence from an under-researched rural region, (2) developing a structured institutional variable measurement model, and (3) integrating statistical analysis with bibliometric mapping to substantiate the centrality of institutional governance in community-based infrastructure programs. These findings offer both theoretical enrichment to the sustainability discourse and practical implications for improving rural water service management in similar settings. So that, the aim of this study is to analyze the institutional factors influencing the sustainability of drinking water infrastructure in community-based programs in Sidenreng Rappang District.

METHOD

The method used in this research is a quantitative approach, which according to Noor is a research method that uses data in the form of numbers that can be measured objectively (Zulki, 2015). This method aims to test hypotheses or examine the relationships between variables by conducting systematic measurements. The research was carried out over approximately two months, from the end of November 2024 to the end of January 2025, in 31 villages/wards that were locations of the Pamsimas Program in Sidenreng Rappang District. The survey was conducted using a purposive sampling method involving 62 respondents, consisting of KP-SPAMS administrators and community members who benefited from the drinking water infrastructure. The selection of respondents in this study employed a purposive sampling technique, which is a non-probability sampling method commonly used in social science research where the researcher selects participants based on specific characteristics relevant to the research objectives. In this study, the sample comprised 62 individuals, including administrators of the Community-Based Drinking Water and Sanitation Management Group (Kelompok Pengelola Sistem Penyediaan Air Minum dan Sanitasi or KP-SPAMS) and community members who directly benefit from the infrastructure provided through the PAMSIMAS program.

The purposive sampling approach was deemed appropriate for this research due to the targeted nature of the inquiry, which required respondents with in-depth knowledge and direct involvement in the management, operation, or usage of community-based water infrastructure. KP-SPAMS administrators were selected because of their institutional roles in ensuring the continuity and sustainability of the system,

while beneficiary community members were included to represent the user perspective and capture insights regarding service delivery and institutional responsiveness. This sampling strategy enabled the researchers to obtain rich, relevant, and context-specific data aligned with the study's objective to assess the influence of institutional factors on infrastructure sustainability.

The first stage of the research involved preparing the research instrument in the form of a questionnaire comprising 30 question items, developed based on institutional aspects, which include organizational structure and governance, technical capacity and human resource management, transparency and accountability, as well as policy and regulatory support. The questionnaire used a 4-point Likert scale (1–4), selected to obtain decisive responses from respondents and avoid neutral answers that could influence the final results. The second stage was the data collection process, in which the questionnaire was distributed to 62 respondents (KP-SPAMS administrators and beneficiary communities of the Pamsimas Program). The researchers contacted respondents directly by sending the questionnaire in Google Form format (https://forms.gle/pyWSYjEPQ6eX8bX8A) and provided instructions on how to fill it out to facilitate accurate and complete responses.

This study employed a quantitative approach to analyze institutional factors influencing the sustainability of drinking water infrastructure in community-based programs in Sidenreng Rappang District, using SPSS (Statistical Package for the Social Sciences) as a statistical analysis tool. SPSS is a software application that offers advanced statistical analysis capabilities and data management in a graphical environment (Handayani et al., 2023). With its simple descriptive menus and dialog boxes, SPSS helps users easily understand and operate the program (Sonny et al., 2023). The use of SPSS enabled the researchers to conduct descriptive analysis, instrument tests (validity and reliability), classical assumption tests, hypothesis testing, multiple linear regression analysis, beta tests, and determination coefficient tests to identify the factors influencing the sustainability of community-based drinking water infrastructure in Sidenreng Rappang District.

RESULTS AND DISCUSSION

Validity Test

Table 1. Validity Test Result

No.	Variabel	Item	R hitung	Taraf Sig.	Ket.
1.	Kelembagaan	P10	0,824	0,000	Valid
		P11	0,859	0,000	Valid
		P12	0,836	0,000	Valid
		P13	0,915	0,000	Valid
		P14	0,842	0,000	Valid
		P15	0,821	0,000	Valid
		P16	0,864	0,000	Valid
		P17	0,796	0,000	Valid

Source: SPSS 22 Data Output, processed in 2025

Based on the SPSS output, all question items have a Pearson correlation (r-count) greater than the r-table value or a significance value (Sig. 2-tailed) less than 0.05. Therefore, it can be concluded that the items under the Institutional variable are valid. In this study, the validity test used the construct validity approach, which involves analyzing the correlation between the score of each item and the total score of all items, known as the item-total correlation.

Realibility Test

Table 2. Realibility Test Results

No.	Variabel	Cronbach's Alpha	N of Items	Keterangan
1	Kelembagaan	.942	8	Realibel

Source: SPSS 22 Data Output, processed in 2025

Based on the SPSS output, the Cronbach's alpha value is 0.942 > 0.60, indicating that the institutional variable (X2) is reliable and can be trusted. Therefore, this variable is eligible for further testing.

Multiple Linear Regression Analysis

Table 3. Multiple Linear Regression Analysis Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2.041	.751		-2.716	.009
	X1	.083	.056	.116	1.479	.145
	X2	.344	.080	.482	4.282	.000
	X3	.256	.056	.397	4.588	.000

Source: SPSS 22 Data Output, processed in 2025

Based on the SPSS output, the regression equation model can be formulated as follows:

$$\hat{Y} = -2{,}041 + 0{,}083\ X_1 + 0{,}344 X_2 + 0{,}256\ X_3$$

This multiple linear regression equation indicates that the institutional variable (X2) has a coefficient of 0.344, meaning that if Community Participation (X1) and Service Quality (X3) are held constant, an increase in the institutional factor (X2) will raise the sustainability of the program (Y) by 34,4%.

t-Test (Partial Test)

Table 4. t-Test (Partial) Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2.041	.751		-2.716	.009
	X1	.083	.056	.116	1.479	.145
	X2	.344	.080	.482	4.282	.000
	X3	.256	.056	.397	4.588	.000

Source: SPSS 22 Data Output, processed in 2025

Based on the SPSS output, the t-test value for the institutional variable (X2) is t = 4.282 with a significance level of $0.000 < 0.05$. This indicates that the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted, meaning there is a partial effect of the institutional variable (X2) on the sustainability of the infrastructure (Y).

Beta Test

Table 5. Beta Test Results

Model		Unstandardized Coefficients		Standardized Coefficients
		B	Std. Error	Beta
	(Constant)	-2.041	.751	
	X1	.083	.056	.116
	X2	.344	.080	.482
	X3	.256	.056	.397

Source: SPSS 22 Data Output, processed in 2025

Based on the standardized beta values, it can be concluded that variables such as Community Participation (X1), Institutional Factors (X2), and Service Quality (X3) have a significant influence on program sustainability. Among these, the institutional variable (X2) has the highest B value, indicating that it has the most dominant effect compared to the other independent variables.

The results of this study show that institutional factors play a strategic role in ensuring the sustainability of community-based drinking water supply systems. In the context of Gabriel Almond's systems theory, institutions serve as part of the conversion process, in which inputs—such as community participation and government policies—are transformed into actual policies and actions in managing drinking water services.

According to the SPSS output, the t-test value for the institutional variable (X2) is t = 4.282 with a significance level of 0.000, which is less than 0.05. This confirms that the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted: there is a partial influence of institutional factors (X2) on infrastructure sustainability (Y). The institutional aspects that influence the sustainability of water services include good governance. Research data show that effective governance is characterized by the presence of a clear organizational structure. Typically, community-based water supply systems are managed by a group or body such as KP-SPAMS (Drinking Water and Sanitation Supply Management Group).

The findings reveal that KP-SPAMS groups with a clear organizational structure are able to provide more optimal services compared to those without clear task distribution. Additionally, financial transparency and accountability are key findings of the study, indicating that financial transparency contributes significantly to service sustainability. In several cases, lack of transparency in financial reporting has led to distrust among the community toward the management group. This aligns with the study (Prasetyo, 2020), which stated that low transparency can hinder community participation in water service programs. Furthermore, regulatory support from local governments plays an important role in strengthening the institutional system of community-based water services. The study by Suryana showed that clear regulations can enhance the effectiveness of institutions in managing water services (Suryana, 2022). Similarly, Rakhmi concluded that institutional capacity significantly affects the sustainability of drinking water infrastructure, emphasizing that a well-managed institutional design can lead to more successful program outcomes (Rakhmi, Sjarlis et al., 2023).

These empirical findings are supported by a bibliometric analysis using VOSviewer, which maps the relationships between keywords in the literature related to the sustainability of drinking water infrastructure. The visualization highlights keywords such as *society*, *implementation*, *infrastructure*, *sustainability*, *strategy*, and *community participation* as central nodes that are closely interrelated. The variation in colors and line thicknesses in the visualization indicates the intensity of the relationships and the evolution of themes from 2019 to 2022. Keywords such as *sustainability*, *implementation*, *city*, and *infrastructure* show high connectivity, underscoring that institutional dimensions and community involvement are key determinants of sustainability in similar studies.
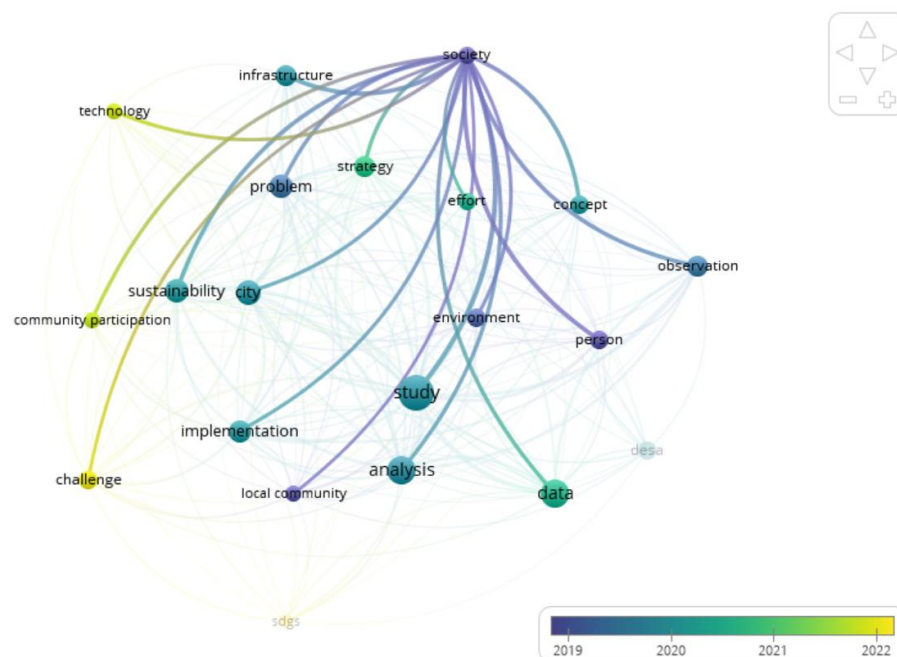
Source: VOSviewer Data Analysis

Conceptually, the strong correlation between institutional factors and sustainability demonstrated in this study aligns with the VOSviewer mapping, where *strategy* and *effort* act as connecting nodes among *society*, *sustainability*, and *infrastructure*. This suggests that sustainability is not solely dependent on technical aspects, but also on effective institutional strategies, active community participation, and clear regulatory support. In the local context of Sidenreng Rappang District, the institutional dimension is reflected in the role of the Community-Based Drinking Water and Sanitation Management Group (KP-SPAMS), which features a clear organizational structure, transparent governance, and accountable reporting mechanisms. These findings reinforce previous studies which asserted that strong institutional

structures significantly contribute to the sustainability of community-based drinking water programs. Moreover, regulatory support from local governments identified as a node in the VOSviewer map through the keywords *policy* and *environment* further enhances institutional effectiveness. This study indicates that KP-SPAMS organizations backed by local regulations and open reporting systems are more capable of maintaining infrastructure functionality in the long term.

Theoretically, these findings strengthen Gabriel Almond's systems framework, where institutions act as part of the conversion process, transforming social and policy inputs into sustainable public service outputs. Thus, the integration of quantitative and bibliometric results provides strong empirical evidence that strengthening institutional capacity is a key strategy in ensuring the sustainability of community-based drinking water infrastructure.

CONCLUSION

Based on the SPSS output, the t-test value for the institutional variable (X2) is t = 4.282 with a significance level of 0.000 < 0.05. This indicates a partial influence of institutional factors (X2) on the sustainability of drinking water infrastructure. The standardized beta value also shows that the institutional variable (X2) has a significant impact on program sustainability. Furthermore, this variable has the highest B value, making it the most dominant factor influencing the sustainability of drinking water infrastructure in the Pamsimas Program in Sidenreng Rappang District. This study contributes significantly to the understanding of the institutional role in the sustainability of community-based drinking water infrastructure. Theoretically, the findings are expected to enrich the academic discourse on sustainable management of water supply systems. The results also expand the existing literature and scientific insights into the factors that influence the sustainability of community-based water infrastructure and can serve as a reference for academics and researchers in the fields of water resource management and sustainable development.

This study has several limitations that should be acknowledged when interpreting the results and as considerations for future research. First, the geographical scope of the study is limited to certain villages that received the PAMSIMAS program, which limits the generalizability of the findings. Social, economic, and institutional conditions vary greatly across villages, so these results may not fully represent other regions. Second, the data collection method, which relied on questionnaires, may have introduced perception bias, as respondents may have been influenced by subjective factors such as personal involvement in the program or the desire to give socially "acceptable" answers. Some respondents may also have been reluctant to share information openly due to power dynamics or feelings of discomfort, particularly between community members and program managers. Third, this study has not fully explored external factors that could also affect sustainability, such as support from local government, the impact of climate change on water availability, or national policy dynamics that may influence PAMSIMAS operations. Recognizing these limitations, the researchers recommend that future studies be conducted with broader coverage, using mixed-method approaches, and involving more stakeholders and variables that affect the sustainability of community-based drinking water supply systems.

Moreover from a policy perspective, the findings suggest that local governments and program implementers should prioritize the development and reinforcement of community-based management institutions such as KP-SPAMS. This includes providing technical training, promoting transparent financial reporting, and enacting supportive local regulations. Institutional frameworks that are participatory, accountable, and well-governed are more likely to ensure the longevity and effectiveness of public service infrastructure in rural areas. Consequently, this study offers evidence-based insights that can inform future design, implementation, and evaluation of community-based water and sanitation programs in Indonesia and similar decentralized settings.

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