Determinants of the influence of community participation on the sustainability of local system community-based sanitation programs in Temanggung Regency

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Abstract. Community-based Sanitation (SANIMAS) is an activity to address sanitation problems in Indonesia. 88% of communities in Temanggung Regency dispose of domestic wastewater directly into the river without any prior treatment. As an effort to protect the environment, the SANIMAS program was developed with the Local Domestic Waste Management System (SPALDS). The objective is to identify the relationship between factors influencing community participation and the sustainability of the SANIMAS program. Factors influencing community participation are technological, institutional, financial and economic, socio-cultural, and environmental. Community participation is determined based on the SANIMAS program stages, namely input, process, and output as well as the sustainability of the SANIMAS program. This research uses the quantitative method of Partial Least Squares - Structural Equation Modeling (PLS-SEM) with Smart PLS version 3.0. The results of this study indicate that technological, institutional, financial and economic, and socio-cultural factors have a positive effect on community participation and sustainability. Technological, institutional, and socio-cultural factors have a significant effect on community participation and sustainability with T-statistic values 2.659, 2.136, and 2.73 and P-values 0.008, 0.033, and 0.007. These factors affect the positive and significant correlation of community participation to the sustainability of the SANIMAS program.

1 Introduction

Indonesia is among the most populated countries in Southeast Asia (ASEAN) with a total of 273.5 million citizens in 2020 [4]. Indonesia's population is one of the largest in the world, ranking fourth after China, India, and the United States [6]. About 85% of the population of some developing countries still lack access to safe sanitation [2]. In Indonesia, sanitation issues are also still a serious concern, especially in rural and remote areas that still face

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challenges in accessing adequate sanitation. Proper sanitation facilities are still inaccessible to numerous residents, namely hygienic latrines and good waste management systems [23]. One of the main sanitation challenges in Indonesia is the practice of open defecation (OP). The socio-cultural factors that pose a risk to public health have influenced the mentioned behavior, as they can lead to pollution of water sources and the spread of diseases such as diarrhea [13].

In The 2030 Sustainable Development Goals (SDGs) milestone of the UN agenda for sustainable development, goal number 6 focuses on access to clean water and sanitation for all [19]. The SDGs aim to address global challenges related to water scarcity, water pollution, insufficient sanitation facilities, and inaccessible potable water [20]. The SDGs target in 2030 is to achieve inclusive access to sanitation and hygiene as well as to end open defecation by concentrating more on women and people with disabilities [5]. Indonesia is targeting about 90% access to proper sanitation and 15% safe sanitation to meet the community by 2024 as a goal for the National Medium-Term Development Plan (RPJMN) 2022-2024 [22]. In order to achieve these targets, 85% of wastewater infrastructure development is directed towards localized systems, and the remaining 15% is developed through centralized systems in stages in high-density and strategic areas [10].

The Community-Based Sanitation Program (SANIMAS) is a program to address sanitation issues in achieving their targets [33]. The program aims to encourage clean and healthy living behavior (PHBS) and improve access to sanitation facilities [31]. The scope of the SANIMAS program in the supply of sanitation facilities and infrastructure in the community is divided into two activities, namely Management with a Centralized Domestic Wastewater Management System (SPALDT) and Management with a Local Domestic Wastewater Management System (SPALDS) [11].

The operation of the SANIMAS program in 2023 based on the Surat Edaran (SE) of the Directorate General of Human Settlements Number: 05/SE/DC/2023 dated January 25, 2023 concerning Technical Guidelines for the Implementation of Community-Based Infrastructure Activities of the Directorate General of Human Settlements stipulates that the criteria for implementing SANIMAS activities are focused through the Local Domestic Wastewater Management System (SPALD-S). SANIMAS SPALDS is a wastewater management system at the source location, then the processed products in the form of sludge are transported using a transportation device to the Regency/City scale Fecal Sludge Treatment Sub System [11]. Temanggung Regency is one of the areas that has implemented SANIMAS SPALDS located in rural areas. Centralized system land provision is by the requirements, one of which is land readiness, which is a land grant. This is one of the reasons for implementing the local system. SANIMAS SPALDS has also been implemented in several regencies and cities in Central Java including Kudus, Pati, and so on.

In Temanggung Regency, based on data from the DPRKPLH of Temanggung Regency in the achievement of sanitation access, it shows that access to proper sanitation has increased from year to year, namely in 2022 reaching 85.61% with safe access of 2.5%, so there is still 14.39% access to sanitation that is not feasible. The stunting rate in Temanggung Regency reached 20.25% in 2022 as reported in the news [17]. Another problem is that 88% of the community still discharges domestic wastewater into the river, this is evidence that community knowledge is still low, in line with the level of education that the majority of the community only reaches elementary school level. As an effort to protect the environment, a local system of domestic wastewater management is developed.

Then, the challenge that must be faced is the lack of community awareness and understanding of the importance of good sanitation practices and the benefits of the SANIMAS program, then limited knowledge about sanitation and its impact on health can lead to low community involvement and participation [33]. In this case, the community plays an important part in enhancing health and hygiene conditions in their area to reduce the risk

of spreading disease [3]. The SANIMAS program emphasizes the significance of the participation from the community and involvement in the planning, implementation, and management of sanitation provision [27]. In practice, communities need encouragement from various parties to create an adequate sanitation environment [29] In addition, community participation not only increases the success rate of the program but also contributes to its sustainability [1].

To ensure the success of the SANIMAS SPALDS program, several factors need to be considered. So this research was carried out to identify the determinants that influence community participation on the sustainability of the SANIMAS SPALDS program in the study area which can then be planned for program implementation optimization strategies to support program sustainability as a basis for program improvement.

2 Methodology

This research is a quantitative study conducted by filling out questionnaires by the beneficiaries of the SANIMAS Program in 2022 in the Temanggung Regency area. It was executed in three villages, these villages include Tanggulanom Village, Selopampang, Wonotirto Village, and Balesari Village with a total of 184 households. Based on the number of beneficiaries of the SANIMAS program, the number of samples was determined using the cluster random sampling method using the Yamane formula which resulted in a sample size of $65.17 \approx 66$ households.

This research was conducted using the non-experimental quantitative research method which is a research method by collecting numerical data to answer research questions without involving experimental settings. In this method, researchers use data collection tools such as surveys, interviews, and questionnaires which then analyze the data collected using statistical techniques to draw conclusions from the data collected [7]. The quantitative approach is applied to find the correlation between the independent variable and the dependent variable in this research model. In this research, the quantitative approach is used to identify the variables that influence community participation and sustainability of the SANIMAS Program in the study area. The research flow can be seen in Figure 1.

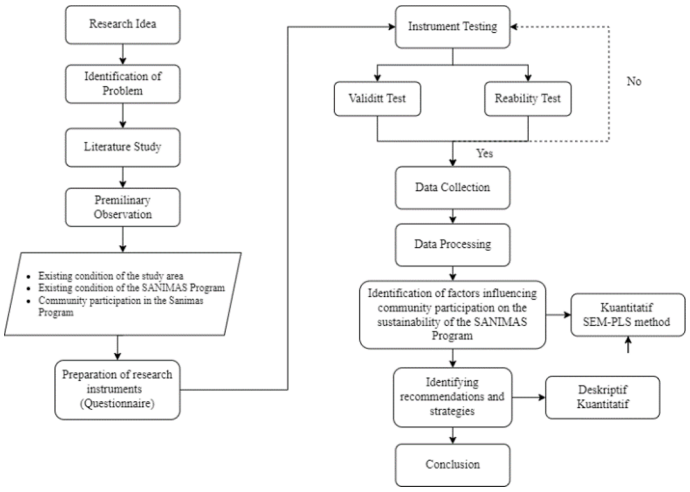

Fig. 1. The research flow

Variables are determined based on the FIETS framework, which includes technological, institutional, financial and economic, socio-cultural and environmental factors as endogenous

latent variables. Observation variables are determined based on some literature that is in accordance with the real conditions in the field based on the preliminary survey of the SANIMAS program in the study area. Furthermore, the variable level of community participation is determined based on the stages of implementation of the SANIMAS program from preparation to post-construction and sustainability is the outcome of the implementation of the SANIMAS Program in the region in which observation variables are determined based on the technical guidelines for the implementation of the SANIMAS Program in 2022.

These variables can be seen in **Table 1** below.

Table 1. Variables influencing factors of community participation

No	Variables	Reference
1	Technology (X1)	Setiawati et al., 2013, Daniel, Djohan, et al., 2021, ,Daniel, Prawira, et al., 2021,Sofyan et al., 2022 , Novanta, 2022
2	Instituions (X2)	Setiawati et al., 2013, Daniel, Djohan, et al., 2021, ,Daniel, Prawira, et al., 2021), Sofyan et al., 2022
3	Financial and Economic (X3)	Setiawati et al., 2013, Daniel, Djohan, et al., 2021, Paramitha, 2019, Daniel, Prawira, et al., 2021, Novanta, 2022, Sofyan et al., 2022
4	Socio-culture (X4)	Setiawati et al., 2013, Daniel, Djohan, et al., 2021, Paramitha, 2019; Susilawati et al., 2022, Fatimah et al., 2020
5	Environment (X5)	Setiawati et al., 2013, Daniel, Djohan, et al., 2021, Sofyan et al., 2022
6	Community Participation (Y)	Direktorat Sanitasi, 2023; Susilawati et al., 2022
7	Sustainability (Z)	Direktorat Sanitasi, 2023; Novanta, 2022,Setiawati et al., 2013

The data collection method used is the direct approach method which is carried out by asking questions directly to the community as a sample using a questionnaire and direct observation to the research location. Data collection techniques used are sourced from primary data (questionnaires distributed to samples of SANIMAS program beneficiaries) and secondary data (interviews with stakeholders, observation, and literature study).

Data analysis to determine the relationship between factors affecting community participation on the sustainability of the SANIMAS program is to use the Partial Least Square Structural Equation Method (SEM-PLS). According to [25] SEM is a technique of statistical modeling that is very cross-sectional, linear, and extensive. Included in this SEM is the analysis of the factor, path, and regression. The main concept of SEM-PLS is multivariate statistical analysis that does not require normally distributed data and does not limit the minimum amount of data. In other words, research with a small sample size (30-100) can be analyzed with SEM-PLS [30]. Adopted from research by [16] the level of community participation is intervening, namely being an intermediate or intermediary variable whose purpose is to see how the relationship between factors that do not directly affect sustainability but pass through the level of community participation first, which means to support sustainability. In determining the optimization strategy from the results of the determining factor, it is analyzed with descriptive quantitative. The concept of variable relationships can be seen in Figure 2.

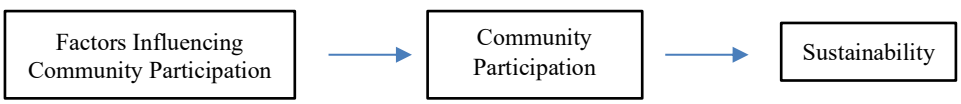

Fig. 2. Variable relationship concept

3 Result and discussion

3.1 Factors influencing community participation

Factor data obtained from the literature study as a reference for creating variables to measure significant factors that determine the sustainability of the SANIMAS program in Temanggung Regency using the Structural Equation Model (SEM) method. These research variables were then developed into a Structural Equation Model (SEM) analysis model presented in **Figure 3**.

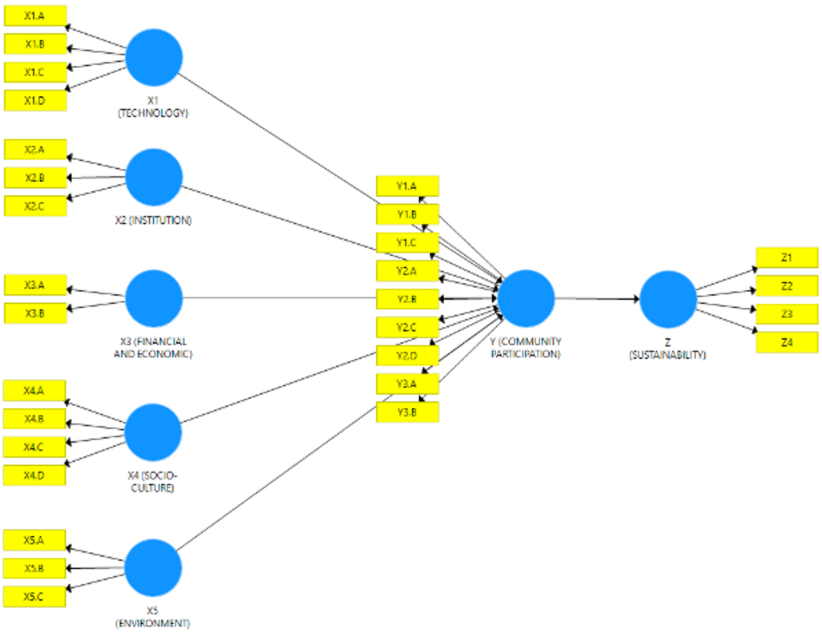

Fig. 3. Variable relationship model and indicators

The variables applied in the model are technological, institutional, financial and economic, socio-cultural, and environmental factors as endogenous latent variables, while community participation and sustainability as exogenous observation variables. The variables are shown in Table 2.

Table 2. Variable

Variable	Indicator
Technology (X1)	Knowledge and Accessibility of Technology (X1.A) Technology Availability and Reliability (X1.B) Sanitation Technology Infrastructure Support (X1.C) Technology Quality (X1.D)
Instituions (X2)	Institutional Availability and Quality (X2.A) Institutional Capacity (X2.B) Partnership and Collaboration (X2.C)
Financial and Economic (X3)	Financial and Economic Impact (X3.A) Operational and Maintenance Costs (X3.B)
Socio-culture (X4)	Community Awareness (X4.A) Community Participation (X4.B) Cultural Norms and Values (X4.C)

Variable	Indicator
	Women's Participation (X4.D)
Environment (X5)	Environmental Awareness (X5.A) Environmental Health (X5.B) Clean and Healthy Living Behavior (X5.C)
Community Participation (Y)	Input: Program Preparation and Planning Stage (Y1) Community Participation (Y1.A) Government and Organization Support (Y1.B) Socialization of SANIMAS Program (Y1.C) Process: Program Implementation Stage (Y2) Communication Between Stakeholders (Y2.A) SANIMAS Program Assistance by Field Facilitators (Y2.B) Government Involvement (Y2.C) Community Involvement (Y2.D) Output: Program Evaluation and Maintenance (Y3) SANIMAS Program usefulness and functionality (Y3.A) SANIMAS Program Operation and Maintenance (Y3.B)
Sustainability (Z)	Regulation and Institutionalization (Z1) Environmental Quality (Z2) Funding (Z3) SANIMAS Program Infrastructure Management (Z4)

3.2 Respondents characteristic

Respondents' characteristic from the research location is needed to support the initial hypothesis and further data analysis. In this study, respondents' personal data included age, gender, education level, occupation, income, number of households and family members in one house, length of stay, and home ownership status. The questionnaire consists of three sections of questions. The results of the first section include respondent's personal information such as gender, age, education, occupation, income, and other details, which are summarized in **Table 3** below.

Table 3. Respondent's characteristic

Characteristic		Total (Person)	Percentage
Gender	Male	55	83,3%
	Female	11	16,7%
Age	17 - 30 years	10	15,2%
	31 - 40 years	16	24,2%
	41 - 50 years	25	37,9%
	51 - 60 years	10	15,2%
	61 - 70 years	5	7,6%
Education	Not Schooling	5	7,6%
	SD	37	56,1%

Characteristic		Total (Person)	Percentage
	SMP	15	22,7%
	SMA/SMK	9	13,6%
	D3/D4	0	0,0%
	S1/S2/S3	0	0,0%
Job	Civil Servant/Army/Police	0	0%
	Private Employee/ Self-employed/ Trade	2	3%
	Farmers	40	61%
	Laborer	18	27%
	Housewife	3	5%
	Retired	1	2%
	Not yet / Not Working	2	3%
Income/month	less than 1.000.000	48	73%
	1.000.000 - 2.000.000	14	21%
	2.000.000 - 3.000.000	1	2%
	3.000.000 - 4.000.000	2	3%
	more than 4.000.000	1	2%
Number of family members in a house	1 - 2 people	5	8%
	3 - 4 people	42	64%
	5 people or more	19	29%

Based on the data above, there is still male gender dominance. This is due to the social layering system formed by society, thus differentiating the position and status between men and women. In addition, the level of education is quite low with the majority having a primary school background, so, naturally, the community has low knowledge about sanitation. The majority of the community works as farmers, which is in line with the low-income level of less than one million rupiah.

Furthermore, the second section focuses on domestic wastewater management in the community to understand how the community manages domestic wastewater before and after the implementation of the Sanima. Before and after the SANIMAS program, the majority of the community used public toilets without any wastewater management, and wastewater was directly discharged into the river. The data is summarized in **Table 4**.

Table 4. Wastewater management before and after SANIMAS program

Characteristic		Total (Person)	Percentage
Before SANIMAS Program			
Infrastructure Used Before SANIMAS Program	Private restroom	13	20%
	Public Restroom	42	64%
	In the River	9	14%
	House yard	2	3%
Wastewater Treatment Facilities	Pit	7	11%
	Septic Tank	1	2%
	Communal WWTP	0	0%
	Do not use / directly discharged into the river	58	88%
Ownership of Clean Water Source	Yes	63	95%
	No	3	5%
Clean Water Source	Mountain water source	43	65%
	Well water	1	2%
	Communal well water	5	8%
	PDAM/PAM	11	17%
Water Availability During Dry Season	Very less	12	18%
	Less	29	44%
	Fair	5	8%
	Very sufficient	20	30%
After SANIMAS Program			
Utilization of SANIMAS Program Infrastructure	Bathing	1	2%
	Washing	2	3%
	DEFECATION	5	8%
	Bathing and Defecation	3	5%
	Bathing, Washing, and Defecation	55	83%
Intensity of Use of SANIMAS Program Infrastructure	1 - 3 times	32	48%
	4 - 5 times	21	32%

Characteristic		Total (Person)	Percentage
	More than 5 times	13	20%
Use of Old Infrastructure After SANIMAS Program	Yes	30	45%
	No	36	55%

According to the SANIMAS program, the community used public toilets in carrying out daily activities without domestic waste treatment or directly flowing into the river. One of the requirements for the SANIMAS program recipients is to have a clean water source. However, in some areas, there is a shortage of water during the dry season, which is an obstacle to the sustainability of the SANIMAS program. After the SANIMAS program, the community experienced an increase in sanitation processing and knowledge. The community has carried out daily activities of bathing, washing, and toileting in the bathrooms that have been built. They feel that they have experienced improved hygiene, clean and healthy living behavior, and increased knowledge about the importance of sanitation. However, 45% of the beneficiaries still use the old public toilets to wash and defecate in the river, citing habit and lack of water at home during the dry season.

The third part is the community's knowledge and opinions regarding the SANIMAS program. The average beneficiary knows about the SANIMAS program from the village government where they were proposed by the village government to receive assistance through a data verification process. The data is shown in **Table 5** below.

Table 5. People's knowledge and opinions of the SANIMAS program

Characteristic		Total (Person)	Percentage
SANIMAS Program Information	Village Government	51	77%
	NGO	4	6%
	Socialization	11	17%
Benefits of the SANIMAS Program	Improving Community Health	12	18%
	Improve clean and healthy environment	54	82%
Diseases caused by poor sanitation	Diarrhea	54	82%
	Stunting	6	9%
	Itching	6	9%
Reasons Respondents are Involved in the SANIMAS Program	Because they want to use the restroom in a better and cleaner place	27	41%
	Proposed by the village government or NGOs	39	59%

3.3 Relationship between factors influencing community participation in the sustainability of the SANIMAS program with the SEM-PLS method

Measurement using SEM, the first step taken in analyzing the results of the SANIMAS program beneficiary community questionnaire is to evaluate the measurement model. This

process is intended to certify the justifiability and dependability of the model before the data results can be taken and interpreted. Based on the calculation results on SMART-PLS, the indicator loading value is more than 0.7. This has met the requirements by having a significant influence on latent variables. The structural model applied is shown in **Figure 4** below.

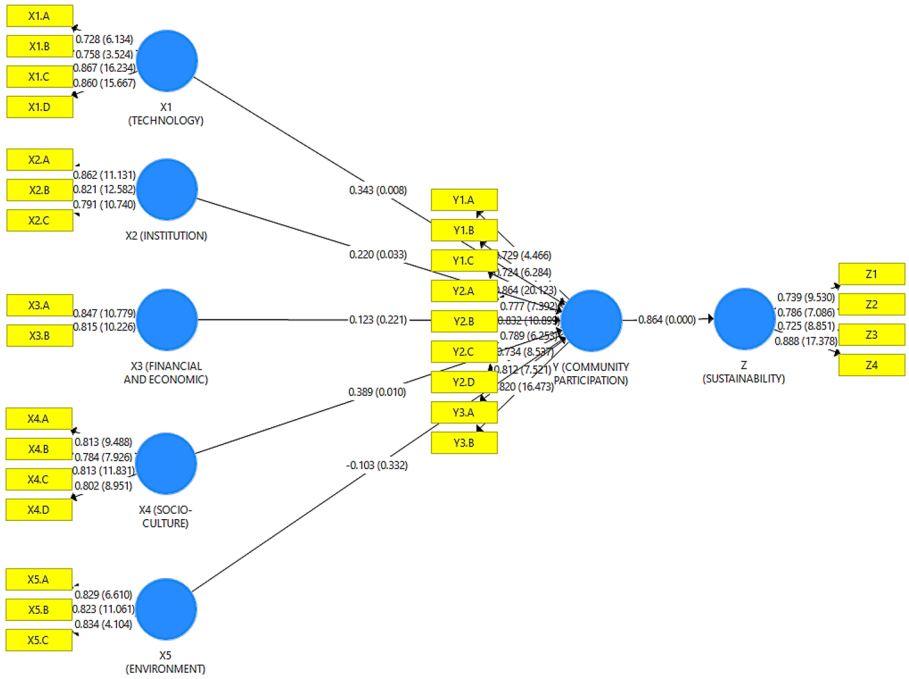

Fig. 4. Result of path coefficients

Convergent validity is decided based on the idea that measurements of a construct should be highly compatible [15]. Convergent validity on a construct with reflective indicators is evaluated by Average Variance Extracted (AVE). The requirement for the AVE value is equal to 0.5 or more. An AVE value of 0.5 or more can be interpreted as the construct can explicate 50% or more of its items' variance [32, 24]. Meanwhile, the reliability measurement uses Cronbach's Alpha or composite reliability value which is expected to be above 0.7 [15]. The results of the AVE and composite reliability values are shown in **Table 6**.

Table 6. AVE dan composite reliability value

Variable	AVE	Composite Reliability	Remaks
Technology	0.649	0.880	Retrieved
Instituions	0.681	0.865	Retrieved
Financial and economic	0.691	0.817	Retrieved
Socio-culture	0.645	0.879	Retrieved
Environment	0.687	0.868	Retrieved
Community Participation	0.621	0.936	Retrieved

Variable	AVE	Composite Reliability	Remaks
Sustainability	0.620	0.866	Retrieved

Measurement of path coefficients between constructs is done to see the importance and firmness of the correlation and to test the hypothesis. The value of path coefficients spans from -1 to +1. The closer to +1, the stronger the relationship between the two constructs. A relationship that is closer to -1 proves that the relationship is negative [24] The results of Path Coefficients are shown in **Table 7**.

Table 7. The result of path coefficients

Variable	Path Coefficient	T Statistics	P Values	Remaks
Technology - Community Participation	0.343	2.671	0.008	Significant
Institutional - Community Participation	0.220	2.141	0.033	Significant
Financial and Economic - Community Participation	0.123	1.227	0.221	Not Significant
Social and Cultural - Community Participation	0.389	2.598	0.010	Significant
Environment - Community Participation	-0.103	0.971	0.332	Not Significant
Community Participation - Sustainability	0.864	14.035	0.000	Significant

Based on the data above, socio-cultural variables have the greatest influence on community participation at 38.9% followed by technological variables at 34.3%, institutional variables at 22.2%, financial and economic variables at 12.3%, and environmental variables have a negative influence of -10.3%. Meanwhile, community participation has a very high influence on sustainability at 86.4%. This analysis was also carried out by assessing the significance of the effect of the strength of the correlation between the forming endogenous latent variables (sustainability). Based on Table 7, technological, institutional, and socio-cultural variables have a significant effect on the Community Participation variable, while other variables do not have a significant effect on community participation. The community Participation variable significantly affects the sustainability of the SANIMAS Program. The community considers that the ease of technology, ease of access, and technological knowledge are needed in sustainability and the community will enthusiastically participate. then institutions are needed to direct and guide the community in sustainability and the habits and culture of the community greatly influence the community in sanitation. Financial and economic variables are not significant in SANIMAS SPALDS because they have a smaller role but need to be improved and because SANIMAS infrastructure is an individual responsibility. In addition, environmental variables have no influence, which indicates that the community is less concerned about the environment. Previous research mentioned that financial and economic variables are aspects that need to be improved and environmental variables indicate that the community has a low concern for the environment [28].

4 Conclusion

The influencing factors on community participation include technological, institutional, financial and economic, socio-cultural, and environmental factors. Among these five factors, four factors positively influence community participation and sustainability, with their respective path coefficients being 34.3%, 22.2%, 12.3%, and 38.9%, in sequential order. This indicates a direct relationship between these factors and the participation of the community and the Sanitation and Health Program's sustainability. However, regarding the significance of the relationship between these factors and the participation of the community and the sustainability Sanitation and Health Program explained above, three factors namely, technology, institutional, and socio-cultural factors show significance based on the T-statistic values (> 0.196), which are 2.659, 2.136, and 2.73, and the P-values (< 0.05), which are 0.008, 0.033, and 0.007, respectively. Therefore, community participation significantly and greatly influences the sustainability of the Sanitation and Health Program, with path coefficients amounting to 85.9%, a T-statistic value of 14.035, and a P-value of 0.

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