Model for Improving Rural Community Capacity for Sustainability of Water Supply in Poncokusumo, Malang, East Java, Indonesia

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Abstract. The Indonesian government has not been able to serve 100% of the community's drinking water needs, especially rural communities. Rural communities meet drinking water needs in their areas by managing drinking water supply independently. Population growth, changes in land use, economic development, and environmental pollution have the potential to reduce the quantity and quality of water at its source. These changes require the ability to adapt the water supply community groups through management of endogenous and exogenous dynamism of organizations. This study aims to increase community capacity in managing the sustainability of water supply. The strategy to achieve the aim is based on a structural model developed. The structural model will show the factors determined that is the most influential and effective pathway to achieve the aims. This study uses survey techniques to collect data from community drinking water users provided by a community group of villages in the District of Poncokusumo, Malang, Indonesia. The analytical method is SEM-PLS with an analysis program using WarpPLS. Factors of the study are the social profile of the community, the regulatory/policy enforcement, the use of technology, the community empowerment, and the community capacity. Enforcement of regulations/policies is the most important factor influencing community capacity building in providing sustainable drinking. The effective path in the model is the social profile of the community developed through community empowerment. The important thing to include is embedding regulatory/policy enforcement in the community empowerment's agenda.

Keyword: Structural Model, Rural, Community Capacity, Indonesia.

1 Introduction

The Indonesian Constitution states that the earth, water and the wealth within it are owned by the state and used as well as possible for the welfare of society. Statues support implementation arrangement of the constitution. One of the statues regulates the management of water resources. The statue does not explain yet the institutions authorized to manage water resources. Malang Regency Government as a provider of community drinking water is not able to serve all its citizens, especially in rural areas. East Java Governor's instructions encourage the establishment of community water supply groups. Rural community water supply groups are responsible for ensuring the sustainability of drinking water sources, the sustainability of water distribution, and the improvement of rural community capability to

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participate [1]. The rural community as a whole and the water supply community groups are entities that jointly manage the water distribution system in the area.

Sustainable Development Goals 6.1 targets 100% access to safe drinking water by 2030. Access to safe drinking water must meet the requirements for ease of access, available as needed (sufficient), and free of contaminants. The UN resolution also states that everyone has the right to the adequacy, security, availability, and affordability of clean water for personal and domestic needs [2]. Rural communities as social capital for sustainable development, are responsible for the continuity of drinking water access. Responsibility for access to drinking water for all citizens faces challenges. They are population growth, changes in land use, economic development, and environmental contamination. The social profile of the rural community must be strengthened to be able to sustain the function of the environment and infrastructure to provide drinking water in the area.

Sustainability is a process of change in which natural resources, activities/businesses, technological and institutional developments are all synchronized and strengthened to meet current and future needs [3]. The rural community group that supplies drinking water is the right solution to empower communities through the use of technology with precision while continuing the ecology of water resources [4]. Community groups that manage drinking water supply require collaboration with external parties to ensure the development and sustainability of their services.

This study aims to analyze the influence community social profile, use of technology, enforcement of regulations/policies, and community empowerment on the model increase the capacity of rural communities in the provision of drinking water. The analysis determines the most influential factors and finds the most effective pathway to increase community capacity in managing the sustainability of water supply.

2 Research Methods

This research was in the form of a survey of community drinking water users provided by a community group of six villages in the District of Poncokusumo, Malang, Indonesia. Respondents were 119 people. The analytical method is SEM-PLS with an analysis program using WarpPLS [5]. The study was conducted in 2 (two) stages, namely the measurement of the outer model and the inner model [6]. Measurement of the outer model is the measurement of indicators on their respective variables [7]. The social profile of the community consists of four indicators, the regulatory/policy enforcement five indicators, the use of technology four indicators, community empowerment five indicators, and community capacity seven indicators. Measurement of the inner model is a measurement of the effects that occur between the variables. Determination of the fit model observed based on the theory and the results of previous studies [8]. It was determined that the social profile of the community is an exogenous variable and other variables become an endogenous variable. The variable increase in community capacity is the dependent and criterion of the structural model of research.

3. Results and Discussion

3.1 Model Fit and Quality Indices

The results of testing the model show that the research fit model has a value of Tenenhaus GoF (GoF) = 0.395, with a large fit category (small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36). The research model has a great fit in representing empirical research data. Average R-squared (ARS), Average Path Coefficient (APC), and Average Full Collinearity Variance Inflation Factor (AFVIF) as parameter of the quality of the research model have values indicate the model is accepted (Table 1).

Table 1. Quality Model Indices

No	Parameter	Value	Category	Explanation
1.	ARS	0.343, P<0.001	P < 0.05	Accepted
2.	APC	0.328, P<0.001	P < 0.05	Accepted
3.	AFVIF	1.224	Value ≤ 5=accepted, value ≤ 3.3=ideal	Ideal

In the model, the value of ARS means that the predictor variables explain the independent variables of 0.343.0 or 34.3%. So that on average the predictor variables in the model have not been able to explain 65.7% of the independent variables of the model. This finding opens up opportunities for wider research to find indicators and other variables that are relevant to the dependent variables. The ARS value of the study increases when new variables are found that significantly support community capacity building. APC value of 0.328 with a significance of P<0.001 in the model shows that the average direct effect given by the predictor variable to the dependent variables is 0.328. The AFVIF value of 1,224 is still smaller than the minimum ideal limit of 3.3, explaining that the research variables have an ideal quality with respect to free multicollinearity. Research variables are statistically safe from the similarity of meaning in one variable (vertical) or between variables (lateral). The values of GoF, ARS, APC, and AFVIF ensure that the research model is fitted with the empirical data of the study and meets the criteria of good (acceptable) model quality. (Kock, 2015).

3.2 Variable Profiles

The social profile of the community, based on the weight factor value, mainly reflected most strongly (0.860) by the honesty of individuals (S2) and the weakest (0.468) by the ability to use information (S4). The honesty of the community in using and managing infrastructure drinking water distribution systems is in a good category, with an average score of empirical indicators 3.78. Overall or a combination of indicators, the social variable is in a good category (3.43). The unfavorable category (2.63) lies in the ability of the community to use information (S4) which is also the weakest indicator of the social variable.

Social capital expressed as trust, norms, and social networking are applied in addressing the problems in society. Social networks are activities that involve the community in the form of volunteerism, participation in social groups, and involvement in charity groups. Social capital refers to the community's institutions and mechanisms interact with each other to solve the problems for the common good [5]. Table 2 shows that the social profile of the village people studied is in a good category. However, the community does not have the ability to use

information well so that social networks are not conducive to increasing the capacity of the community to provide drinking water.

Table 2. Profile of Social Variables.

No	Indicators	Weight Factor	Average of Empirical Score of Indicators	Average of Empirical Score of Variables
1.	S1	0.765	3.78	3.43
2.	S2	0.860	3.67	
3.	S3	0.768	3.64	
4.	S4	0.468	2.63	

Note the empirical score: ≤1 = bad , 1 <x≤2 = ≤ less , 2 <x≤3 = ≤ enough , 3 <x≤4 = ≤ good.

Policy and regulatory structuring (R1) and support of rural governance and associations (R4) in the management of drinking water supply systems are the strongest indicators in reflecting the regulatory/policy enforcement variables (table 3). The indicators are in a good category. Empirical score average of regulatory/policy enforcement variables in a good category (3.15). The indicator that is still not in a good category is the support of rural governance and community groups in managing the environment and water resources (R5) (2.90). Looking at the profile of this variable, the indicators of support of rural governance and community groups in managing the environment and water resources must be strengthened to ensure the enforcement of regulations/policies.

Table 3. Profile of Regulatory/Policy Enforcement Variables

No	Indicators	Weight Factor	Average of Empirical Score of Indicators	Average of Empirical Score of Variables
1.	R1	0.852	3.60	3.15
2.	R2	0.698	3.02	
3.	R3	0.532	3.21	
4.	R4	0.729	3.03	
5.	R5	0.654	2.90	

Note the empirical score: ≤1 = bad, 1 <x≤2 = less, 2 <x≤3 = sufficient, 3 <x≤4 = good.

The community evaluates the use of technology in distributing drinking water is in a good category (3.35). The extent of service areas and user (T3) (0.734) and on the suitability of technology with water sources (T1) (weight factor 0.739) are reflections of the technology used. The indicator as the weakest reflection of technology (0.546) is the ease of use (T2). The only indicator that is not in the good category (2.87) is the availability of spare parts (T4) for drinking water supply infrastructure (table 4). The availability of spare parts and the ease of use of infrastructure are parts that need to be followed up so that the community is more empowered/ involved.

Table 4. Profile of Technology Used Variables.

No	Indicators	Weight Factor	Average of Empirical Score of Indicators	Average of Empirical Score of Variables
1.	T1	0.739	3.66	3.35
2.	T2	0.546	3.40	
3.	T3	0.743	3.49	
4.	T4	0.654	2.87	

Note the empirical score: ≤1 = bad, 1 <x≤2 = less, 2 <x≤3 = sufficient, 3 <x≤4 = ≤ good.

Community empowerment is on average not in a good category yet. Communities are easy to access information (E3) and there is transparency in management (E4) of drinking water supply (table 5). However, the two indicators are the weakest reflection of the community empowerment variable. While the most important indicators are, guidance and training in infrastructure management (E1) and the utilization of information centers by the government (E5). E1 and E5 are in the category of not good. These two indicators are the main reflection of community empowerment. Guidance and training in managing infrastructure and the use of information centers by the government become a mirror that community empowerment is in a not good category.

Table 5. Profile of Community Empowerment Variables

No	Indicators	Weight Factor	Average of Empirical Score of Indicators	Average of Empirical Score of Variables
1.	E1	0.706	2.92	2.92
2.	E2	0.650	2.50	
3.	E3	0.570	3.47	
4.	E4	0.440	3.67	
5.	E5	0.719	2.04	

Note the empirical score: ≤1 = bad, 1 <x≤2 = less, 2 <x≤3 = sufficient, 3 <x≤4 = ≤ good.

The strength of the capacity of rural communities in the provision of sustainable drinking water is reflected through seven indicators, as shown in table 6. Greening implementation (CP3) is the strongest reflection (0.74) of the community capacity building variable. Greening implementation is in the moderate category (2.29). The implementation of environmental sanitation (CP 4) is also not in the good category (2.59). Both have a high weight factor. The high weight factor indicator becomes a strong reflection of the variables, thus increasing the categories of these indicators to be strategic in increasing the variable categories of community capacity.

Table 6. Profile of Community Capacity Variable

No	Indicators	Weight Factor	Average of Empirical Score of Indicators	Average of Empirical Score of Variables
1.	CP1	0.737	3.05	3.02
2.	CP2	0.589	3.33	
3.	CP3	0.74	2.29	
4.	CP4	0.722	2.59	
5.	CP5	0.559	3.20	
6.	CP6	0.588	3.33	
7.	CP7	0.449	3.37	

Note the empirical score: ≤1 = bad, 1 <x≤2 = less, 2 <x≤3 = sufficient, 3 <x≤4 = ≤ good.

3.3 Path Coefficients

The direct effect of the predictor variable on the dependent variable is expressed by the APC value (table 7). The social profile has a significant direct effect on community empowerment and technology used, and a weak significant direct effect on regulation/policy

enforcement. Social profiles do not have a direct effect on increasing community capacity. The use of technology has a significant direct effect on community empowerment, but does not have a direct effect on increasing community capacity. Enforcement of regulation/policy has a strong significant direct effect on the use of technology, community empowerment, and community capacity building. While community empowerment has a significant direct effect on increasing community capacity.

Table 7. Path Coefficients.

	Predictor			
Dependent	S	E	R	T
E	0.222**		0.412***	0.314***
R	0.134*			
T	0.204**		0.470***	
CP		0.326***	0.514***	

Note: *** = P <0.001, strong significant; ** = P <0.05, significant; * = P <0.1, significant weak; ns = not significant

3.4 Total Effects

Reviewing Table 7, it is possible that social profile, regulation/policy enforcement and the use of technology have an indirect effect on increasing community capacity through mediation. The mediation variables in this study are enforcement of regulations/policies, the use of technology, and community empowerment. The direct and indirect effects of each predictor variable on the dependent variable are expressed in the total effect (table 8).

Table 8. Total Effects

	Predictor			
Dependent	S	E	R	T
E	0.368***		0.572***	0.341***
R	0.134*			
T	0.268***		0.470***	
CP	0.189**	0.326***	0.701***	0.111**

Note: *** = P <0.001, strong significant; ** = P <0.05, significant; * = P <0.1, significant weak; ns = not significant

The social profile of the community influences community capacity building, especially through mediating community empowerment (0.368). The combined effects of total social profile (0368), enforcement of regulations/policies (0572), and the use of technology (0341) affect the total effect mediation of community empowerment (0.326) to increase the capacity of communities. Enforcement of regulations/policies is the largest total effect contributor to community empowerment (table 8).

Enforcement of regulations/policies affects the use of technology, community empowerment, and community capacity building. The arrangement of policies and regulations on water supply systems (R1) and the support of village officials and institutions in managing water supply system infrastructure (R4) are the strongest reflections for enforcement of regulations/policies factor. The direct effect of enforcing regulations/policies on community empowerment is greater than its indirect effect. Enforcement of regulations/policies

contributes most strongly to community empowerment, directly (0.412) and indirectly by mediating the use of technology (0.160).

The direct effect of regulation/policy enforcement (0.470) and direct (0.204) and indirect (0.064) effect of the social profile of the community influence the use of technology. The use of technology itself is reflected mainly from its suitability to the area and user (T3) and water sources (T1). The planning of drinking water supply systems with active community participation is more sustainable than the system built by the government or donor agencies. This is because the community feels they have and are able to operate and maintain the water supply system. Active community participation since the planning stage is in line with the ability to choose the right technology and the right needs and developments [4]. The use of technology transmits (mediates) the combination of regulatory/policy enforcement effect and community social profile to community empowerment.

Community empowerment should improve the social profile of the community so the community is able to involve in the management and supply drinking water in the region. Rural communities find their 'specific assets' through a long process of social and cognitive that results in a common understanding and common good. The results of this long process rearrange endogenous dynamism and the potential achievement of the intended social goals [8]. In this research, a long process is formulated in the form of a structural model. The information center (E5) and guidance & training in managing infrastructure (E1) are the strongest reflections on the community empowerment profile. The profile of community empowerment itself is still in the category of not good or sufficient (2.92) (table 5). The Effectiveness of the information centers and implementation of guidance and training in managing the public drinking water supply infrastructure, improve the profile of community empowerment. The improvement is tailored to the social profile of the community (0.368) that was served, regulatory/ (0.572) were enacted, and the technology used (0.341). Community empowerment combines the influence of all the factors and transmits it directly to community capacity building (0.326).

Community capacity building is influenced mainly by the total effect of regulation/policy enforcement (0.701) and community empowerment (0.326). Douglas (2018) writes that recent developments place endogenous processes on social capital, capacity building, and institutions as an area based-development concept. The endogenous process in this study manages the social profile of the community through enforcement of regulations/policies, the use of technology, and community empowerment, as a concept of increasing community capacity in providing regional drinking water. Enforcement of regulations/policies has the greatest total effect (table 6) on community empowerment (0.368) and the use of technology (0.470). The results of the analysis indicate the profile of enforcement/policy enforcement must be in the best category. Every indicator of enforcement/policy enforcement is upheld on every factor in the endogenous process. These indicators become a reference and target achievement for each factor studied so that there is a synchronization of influence from beginning to end.

Indicators of increasing community capacity, namely the implementation of greening (2.290) and environmental sanitation (2.590) are still not good. The two indicators are not directly related to the provision of community drinking water and its infrastructure, so it has not been well-paid attention. The category of both indicators should support the sustainability of the availability of drinking water sources. The water supply system should be suitable for the climate and environment of the region. Infrastructure choices must balance to selected technical and social sustainability criteria. The impact of the environment or potential degradation of water sources in rural areas is lower than in urban areas. However, the limited availability of clean water supplies calls attention to the potential for pollution or excessive

use of water sources [9]. The following indicators have a close relation to the implementation and suitability of greening and environmental sanitation activities. Support from villages officials and relevant associations for environmental management and water resources (R5), in the form of village regulations, policies, norms, and joint work programs.

These arrangements serve as a reference in guiding & training in managing infrastructure (E1) completely. Water supply infrastructure management must include environmental management (greening and sanitation). The government information center (E5) is a source of information from and for various related parties. Strategic information center as a vehicle, a collection of references and materials for village and community empowerment. Communities are able to use information (S4) when the correct information is easily accessed, guidance and training are received, and support from villages officials and relevant associations are obtained. Exogenous dynamism implements this pattern of increasing community capacity. Participation in infrastructure management (E2) by rural communities is determined by conducive trust, norms, knowledge, and working networks (internal and external).

3.5 Discussion

Theory, relevant prior research, and field studies are the basis in predicting the structural model of research. Figure 1.1 shows the diagram of the structural model of research.

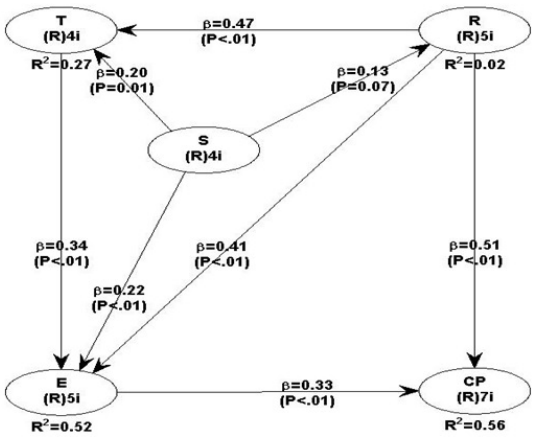

Fig. 1. Structural Model of Drinking Water Supply by Village Community Groups [S = Community Social Profile, R = Law / Policy Enforcement, T = Technology Use, E = Community Empowerment, CP = Community Capacity Building, (R) = Reflection, i = indicators, β = path coefficient, R^2 = coefficient of determination].

Noting Figure 1, all paths in the structural model are significant. Path with significantly weak (P <0.1) and low path coefficients (0.134) is the social profile of the community towards enforcement of policies/regulations. The direct relationship with the largest social profile (0.222) is towards community empowerment. Therefore, in this structural model, the social profile of the community mainly influences empowerment.

Enforcement of regulations/policies has a significant direct effect on the use of technology, community empowerment, and community capacity building. The path coefficient value greater than other path coefficient values. The enforcement of regulations/policies has

important/major effects on other research factors. The use of technology and community empowerment each only has one direct significant strong relationship to the dependent variable. Indirect influence, through mediation, gives the meaning of the structure/pattern of alignment with other factors of the model as part of the flow of influence on increasing community capacity.

Technical capacity depends on the availability of infrastructure for the operating system, the community trained to operate, and the quality of system construction. Social capital through organized experience makes it easy for communities to operate water supply rules/agreements. Community involvement in the planning phase contributes to the development of training and skills development, which is necessary for technical capacity. It must be recognized that the community does not always have adequate technical capacity for specific/special repairs and maintenance. External technical support must be available to help the community adjust, maintain and monitor system performance [9]. Sustainable development is a periodic improvement to meet the needs and conditions that are constantly changing / dynamic. Community participation, community empowerment, development, and rural governance are closely interrelated [4].

4 Conclusion

Enforcement of regulations/policies is the most determine factor to increase the capacity of rural communities in the provision of safe drinking water. Enforcement of regulations/policies influences all factors studied, namely to the social community, the use of technology, community empowerment, and community capacity. Regulations/policies become the reference, standard, evaluation parameters and development of drinking water supply units for rural communities. The People and villages enforce district government officials by implementing regulations/policies for the provision of drinking water and water resource management.

The social profile of the community influences the increase in community capacity in providing drinking water, especially by mediating community empowerment. Mediation for community empowerment combines the effects of enforcement of policies/policies, the use of technology, social profiles of the community, and indicators of community empowerment itself, to directly influence community capacity building.

The model of increasing the capacity of rural communities in managing the sustainability of drinking water supply is influenced mainly by the enforcement of regulations/policies and community empowerment. These two factors are important mediators of the model, which transmit the influence of the factors of social profile and the use of technology. Transmission of the influence of model factors determines the capacity building of the rural community that is able to guarantee the sustainability of drinking water supply in the region.

These results show that community capacity building must be managed through the design of empowerment programs. The empowerment programs are should be based on the standards and references developed and established by the government. This shows that even though the rural community group drinking water provider works independently, it must still comply with the standards and regulations set by the government. Compliance with the standards and regulations by rural community groups is a form of guaranteeing water supply services for rural communities. The task of the village to central government officials is to ensure that each

rural community group that supplies drinking water is able and has implemented the standards and regulations.

References

[1] M. A. Khoiruddin, "Identification of Social Capital in Sustainability of Community-Based Rural Drinking Water Management (Study at Sumber Maron HIPPAM, Karangsuko Village, Pagelaran District, Malang Regency)," *Student Sci. J. Fac. Econ. Bus. Univ. Brawijaya*, vol. 5, no. 1, pp. 1–15, 2017.

[2] R. Omarova, A.; Tussupova, K.; Hjorth, P.; Kalishev, M.; Dosmagambetova, "Water Supply Challenges in Rural Areas: A Case Study from Central Kazakhstan," *Int. J. Environ. Res. Public Health*, vol. 16, pp. 1–14, 2019.

[3] C. Seftyono, "Local Community in Valuing Ecosystem Services: Warga Kampung Code's Perspective on Kali Code Existence," in *Proceeding 1st Annual Indonesian Scholars Conference in Taiwan*, 2010, vol., no., p. .

[4] M. Dhakal, D.P.; Dahal, K.R.; Neupane, "Sustainable Community Water Supply System with Special Reference to Nepal," *Am. Sci. Res. J. Eng. Technol. Sci.*, vol. 45, no. 1, pp. 108–119, 2018.

[5] S. J. Debertin, D.L.; Goetz, *Social Capital Formation in Rural, Urban, and Suburban Communities*. Kentucky: University of Kentucky, 2013.

[6] N. Kock, "WarpPLS," *January*, 2015. .

[7] N. Kock, "Factor-based structural equation modeling with WarpPLS," *Australas. Mark. Journa*, vol. 27, pp. 57–63, 2019.

[8] D. J. Douglas, "Governance in Rural Contexts: Toward the Formulation of a Conceptual Framework," *EchoGéo*, vol. 43, pp. 1–15, 2018.

[9] F. O. Enéas da Silva, T. Heikkila, F. de A. de Souza Filho, and D. Costa da Silva, "Developing sustainable and replicable water supply systems in rural communities in Brazil," *Int. J. Water Resour. Dev.*, vol. 29, no. 4, pp. 622–635, 2013.