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Strengthening Raw Water Management in Rural Water Supply Systems: A Policy Model Using ISM in Tabanan, Bali

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Abstract The management of rural drinking water systems in Tabanan Regency, Bali, is predominantly community-based and deeply rooted in local socio-cultural values. However, several challenges—including limited raw water capacity, fragmented institutional coordination, and insufficient regulatory support—continue to hinder system sustainability. This study aims to develop a strategic policy model for strengthening raw water management in rural drinking water supply systems using the Interpretive Structural Modeling (ISM) approach. A mixed-methods sequential exploratory design was employed, integrating qualitative data from expert interviews with quantitative analysis through ISM. The findings identify three dominant institutional actors—the Bali-Penida River Basin Center, the Bali Regional Settlement Infrastructure Agency, and Traditional Villages—as key drivers in policy formulation. In addition, twelve priority needs and eleven critical constraints were identified, highlighting the importance of regulatory strengthening, institutional capacity building, and the integration of local wisdom through the Tri Hita Karana framework. This study proposes a comprehensive policy model that integrates technical, institutional, and socio-cultural dimensions to enhance sustainable water governance. The findings contribute to the advancement of decentralized water management policies applicable to rural contexts in developing countries. However, the study is limited by its reliance on expert judgment and regional specificity, indicating the need for further validation in broader contexts. The study also provides practical implications for policymakers by emphasizing the integration of local cultural values into environmental governance frameworks.

Keywords Raw Water Policy, Interpretive Structural Modeling, PAMDes, Bali

1. Introduction

The Indonesian central and regional governments have promoted the development of community-based drinking water supply infrastructure to meet basic public needs. In rural areas, the development of the clean water sector is intended to support communities that still lack safe and adequate access to clean water, particularly low-income groups [1]. In many cases, the facilities that have been developed are subsequently managed by local communities through institutions such as *HIPPAM* (*Association of*

Drinking Water Users).

Community-based rural water supply systems have been widely recognized as an important approach to expanding drinking water services in underserved areas [2]. Previous studies on community-based drinking water and sanitation programs have also demonstrated their relevance to the sustainability of rural water services [3]–[5].

In Bali Province, the development of drinking water supply systems is guided by *Governor Regulation No. 21 of 2016* on regional strategic policies for drinking water supply development. This regional strategy (*Jakstrada*) is aligned with the mandate of *Government Regulation No. 122/2015*, enabling local governments to adopt a more focused approach to the development of drinking water supply systems in their respective regions. These regional policies and strategies serve as important guidelines for implementation by the central government, provincial governments, district/city governments, private entities, and local communities.

According to the 2018 Bali Province report on regional strategic policies and drinking water supply systems, drinking water services are managed by both *PDAM* (the regional drinking water company) and community-based institutions such as *PAMDes* and *Pamsimas*. In this context, Pamsimas functions as a community-based service mechanism for providing basic drinking water services in rural areas.

However, the long-term sustainability of post-program rural water systems remains a major concern. Many villages that have benefited from assistance for the construction of water infrastructure and facilities continue to face difficulties in operating and maintaining these systems independently [5], [6]. In Tabanan Regency, PAMDes services are generally small-scale and independently managed, making institutional and technical sustainability particularly important.

Previous research in Bali reported that the sustainability status of raw water management in rural drinking water systems reached 63.52% in the ecological dimension, 51.82% in the economic dimension, 55.59% in the socio-cultural dimension, 49.30% in the technological dimension, and 51.20% in the institutional dimension [6]. These findings indicate that strengthening the implementation of *Tri Hita Karana* is essential to improving the sustainability of rural drinking water management strategies [7].

Tri Hita Karana has been widely discussed as a local philosophical foundation for sustainability in Bali [8]. Its application in the *Subak* irrigation system has also been documented in several studies [9]–[13]. In the context of rural drinking water systems, Tri Hita Karana has been examined as a local value framework for promoting sustainable raw water management in Bali [14]. Nevertheless, policies for raw water management in rural drinking water systems still require further development, particularly because the application of local wisdom may vary across regencies and cities.

Given this context, the present study aims to preserve the values of local wisdom while improving the management of rural drinking water systems. Specifically, this study analyzes three key elements in the development of raw water management policies in rural drinking water systems in Tabanan Regency: *actors, needs, and constraints*. These elements are critical because institutional actors strongly influence program implementation, while needs and constraints reflect the practical challenges faced in rural drinking water management.

This study employs *the Interpretive Structural Modeling (ISM)* method to analyze raw water management policy in rural drinking water systems. The novelty of this research lies in the integration of the ISM approach with local cultural values, particularly *Tri Hita Karana*, in order to formulate a strategic policy model for rural Bali. Unlike previous studies, this research provides a structured stakeholder map and prioritizes community-based institutional reform aligned with traditional values. In this setting, rural drinking water supply managed through *PAMDes* represents a community-based institutional arrangement at the village level, in which local communities are directly involved in system operation, maintenance, and service delivery [2]–[5].

2. Methods

2.1. Research Location

The study was conducted in *Tabanan Regency, Bali, Indonesia,* where rural drinking water supply systems are primarily managed through community-based schemes, namely *PAMDes* and *Pamsimas*. These systems play a significant role in providing drinking water services in rural areas, particularly in locations that are not fully covered by the regional water utility (*PDAM*).

PAMDes, as a community-managed water supply system, contributes substantially to fulfilling rural drinking water needs through locally managed infrastructure and institutional arrangements.

Figure 1 illustrates the geographical location of the study area, including the distribution of rural drinking water systems in Tabanan Regency.

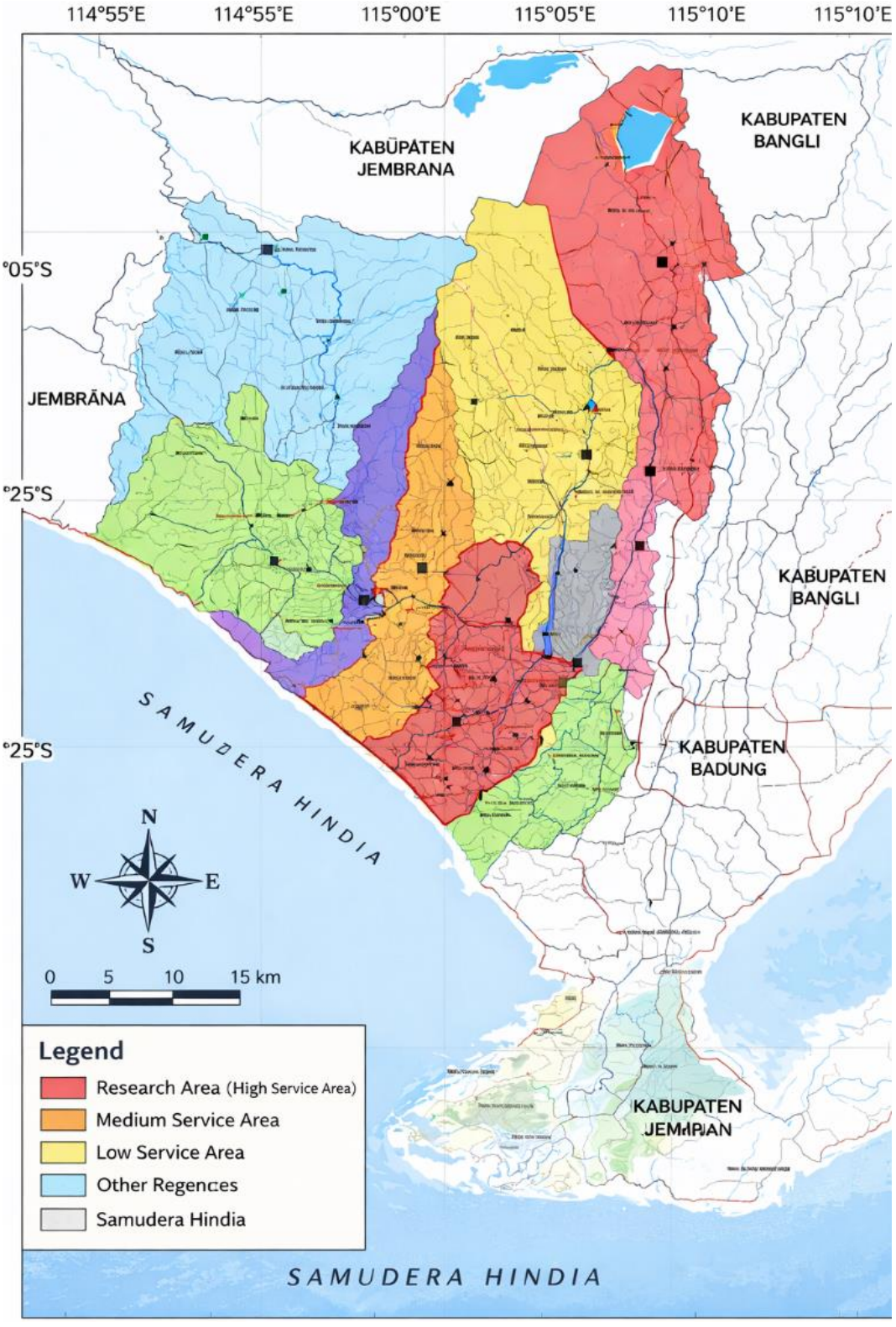

Figure 1. Research Location in Tabanan Regency, Bali, Indonesia

2.2. Data Collection Techniques

This study employed multiple data collection techniques to ensure comprehensive and reliable data acquisition. The methods used are as follows:

1. *Questionnaire Survey.* Data were collected using structured questionnaires designed to capture expert judgments on raw water management policies in rural drinking water systems. Questionnaires are widely

used as effective tools for collecting standardized data and enabling comparative analysis across respondents.

2. *Expert Respondents.* The study involved selected expert respondents with relevant knowledge and experience in rural water management. An expert is defined as an individual who possesses, or is recognized as possessing, superior knowledge regarding relevant data, models, and decision-making processes in a specific field [15], [16].

The expert respondents included representatives from key institutions, namely:

a. Bali-Penida River Basin Center
b. Bali Regional Settlement Infrastructure Center
c. Provincial Development Planning Agency (Bappeda)
d. Regency/City Development Planning Agency (Bappeda)
e. Provincial Public Works and Housing Office (PUPR)
f. Regency/City Public Works and Housing Office (PUPR)
g. PAMDes/Pamsimas coordinators

These stakeholders were selected due to their direct involvement in planning, managing, and implementing rural drinking water supply systems.

3. *Interviews, Observations, and Documentation.* In addition to questionnaires, data were collected through in-depth interviews, field observations, and document analysis. These methods were used to obtain contextual insights, validate survey findings, and ensure the reliability of the data.

2.3. Research Methodology

This study adopts a ***mixed-methods approach***, integrating qualitative and quantitative research techniques within a *sequential exploratory design*. Mixed-methods research refers to the systematic integration of qualitative and quantitative approaches to better understand research problems [17].

In this study, the research process was conducted in two sequential stages:

1. *Qualitative Stage.* Qualitative data were first collected through in-depth interviews with key stakeholders. This stage aimed to identify critical variables, institutional relationships, and contextual factors influencing raw water management in rural drinking water systems.
2. *Quantitative Stage.* The findings from the qualitative stage were then used to develop structured questionnaires, which were distributed to expert respondents. The quantitative stage aimed to validate and prioritize the identified variables using a structured analytical approach.

The rationale for adopting a sequential exploratory design lies in its ability to explore complex institutional and policy relationships in depth before validating them quantitatively. The integration of qualitative and quantitative findings was carried out during the interpretation phase, ensuring that contextual insights supported the analytical results.

2.4. Interpretive Structural Modeling (ISM)

Interpretive Structural Modeling (ISM) is a structured decision-support method used to analyze complex systems by identifying relationships among elements and organizing them into a hierarchical structure [18]. ISM has been widely applied in studies related to strategic planning, system analysis, and institutional decision-making [19]–[21].

Unlike conventional analytical methods that decompose problems into smaller components, ISM focuses on understanding the relationships among elements and constructing a systemic model. It is a core component of the *Interactive Management (IM)* approach, which emphasizes group knowledge and participatory processes to produce valid and relevant analytical outcomes.

ISM can be applied at various levels of abstraction, ranging from conceptual modeling to the development of detailed policy frameworks and action plans. It enables researchers and decision-makers to structure complex problems, identify key driving elements, and determine hierarchical relationships among variables.

Previous studies have successfully applied ISM to analyze institutional sustainability in natural resource management, including sustainable food village institutions in Central Bengkulu Regency [22] and sustainable raw water management systems in Konawe Regency, Southeast Sulawesi [23].

2.5. Analysis Techniques

The analysis of raw water management policy in rural drinking water supply systems was conducted using the *Interpretive Structural Modeling (ISM)* approach. This method involves the development of a hierarchical structure and classification of key elements influencing the system.

The analysis focuses on three main elements:

1. *Constraints*, representing challenges and limitations in sustainable raw water management
2. *Needs*, representing programs and actions required to support sustainable management
3. *Actors*, representing institutions and stakeholders involved in the management process

These elements were identified through qualitative exploration and subsequently structured using ISM to determine their interrelationships, levels of influence, and priority positions within the system.

The research design illustrating the relationships among actors, needs, and constraints in rural drinking water management policy in Tabanan Regency, is presented in Figure 2.

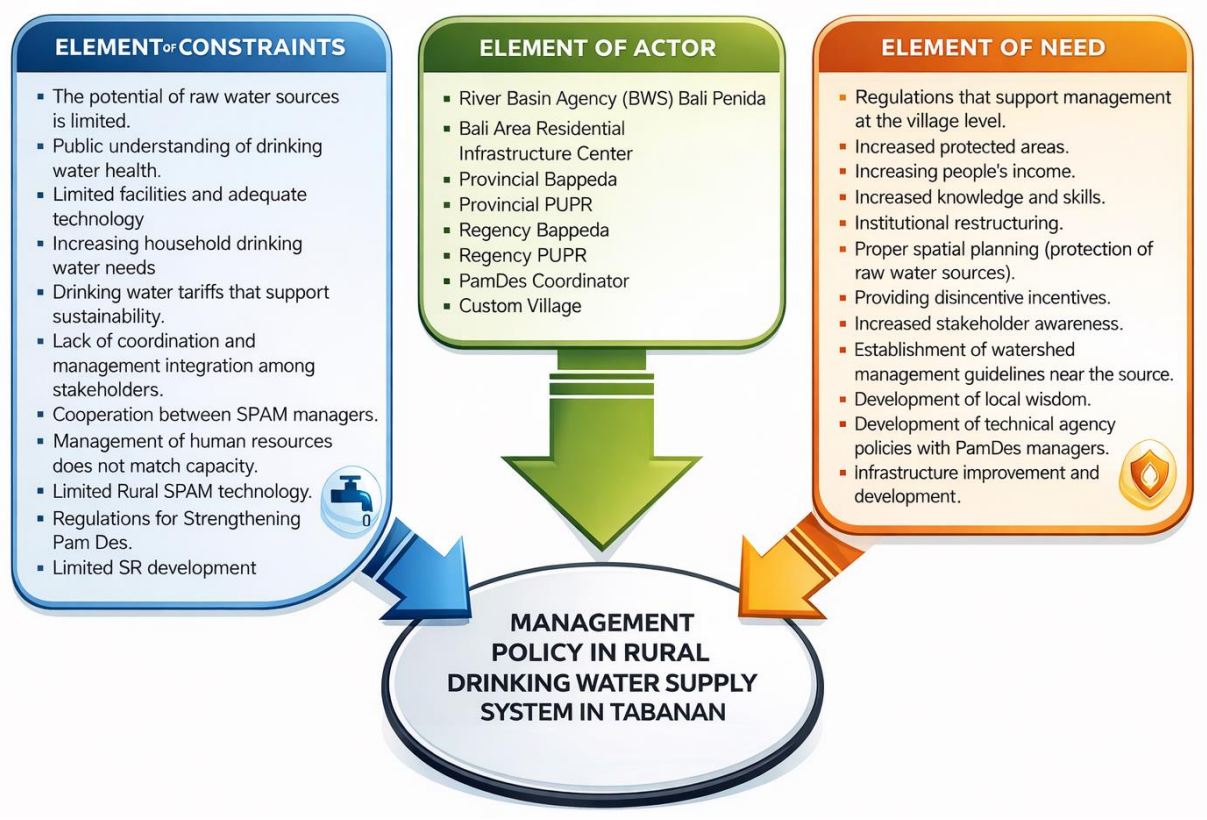

Figure 2. Research Design of Actor Elements, Constraints, and Needs in the Management of Rural Drinking Water Supply Systems in Tabanan Regency

3. Results and Discussion

Public policy emerges as a response to societal problems and reflects government efforts to address collective needs and public interests [24]–[26]. In this context, policy is formulated and implemented by multiple stakeholders, particularly government institutions, which play a central role in ensuring the fulfillment of public service obligations. Policy implementation, therefore, represents the interaction between institutional actors, resources, and operational mechanisms to achieve defined objectives.

Policy can be understood as a structured set of decisions, actions, and implementation strategies developed by relevant actors to address specific problems. Accordingly, policy formulation constitutes a critical stage in achieving institutional goals and ensuring effective governance [27]–[29].

The *Interpretive Structural Modeling (ISM)* method was employed to analyze the complexity of raw water management policies in rural drinking water supply systems. ISM facilitates the identification of contextual relationships among elements and organizes them into a hierarchical structure, enabling a clearer understanding of system interdependencies [18], [30].

In this study, the policy framework for raw water management in rural drinking water supply systems in Tabanan Regency is analyzed through three key elements: *actors, needs, and constraints.* These elements represent the institutional structure, programmatic requirements, and operational challenges within the system.

3.1. Actors in Raw Water Management

Rural drinking water supply systems (PAMDes) represent community-based institutional arrangements managed at the village level. These systems play a critical role in providing drinking water services, particularly in areas not fully served by PDAM. PAMDes operations include water distribution, infrastructure maintenance, system development, and tariff collection, all of which are managed directly by local communities.

The management of rural drinking water systems in Tabanan Regency involves multiple stakeholders with distinct roles and responsibilities. These include governmental agencies, technical institutions, and community-based organizations. The synergy among these actors is essential to ensure system sustainability and to bridge infrastructure and service gaps.

Based on regional policy documents such as *Jakstrada* and the *RISPAM of Tabanan Regency*, as well as expert judgment, eight key institutional actors were identified (Table 1).

Table 1. Actor Elements in the Management of the Rural Drinking Water Supply System in Tabanan Regency

No	Actor Elements
1	Bali Penida River Basin Office
2	Bali Regional Settlement Infrastructure Office
3	Provincial Bappeda
4	Bali Provincial Public Works and Public Housing Agency
5	District Bappeda
6	District Public Works and Public Housing Agency
7	PAMDes/Pamsimas Coordinator
8	Customary

Key Findings from ISM Analysis

The ISM results indicate that the most influential actors in raw water management policy are:

1. Bali-Penida River Basin Center (1)
2. Bali Regional Settlement Infrastructure Center (2)
3. Traditional Village Institutions (8)

The Bali-Penida River Basin Center plays a strategic role in managing water resources, including springs, surface water, and groundwater within the river basin (DAS). Its authority covers integrated upstream–downstream water resource management, making it a key driver in ensuring raw water availability.

The Bali Regional Settlement Infrastructure Center is responsible for the development and management of drinking water systems, including coordination with PDAM and rural water supply systems (PAMDes).

Meanwhile, *traditional villages* play a critical role in local governance, particularly in regulating water use, protecting water sources, and integrating cultural values into resource management.

From the ISM matrix classification, the Bali-Penida River Basin Center and the Settlement Infrastructure Center are positioned in *Quadrant III (linkage sector***)**, indicating high driving power and high dependence. This suggests that these institutions are both influential and sensitive to changes within the system. In contrast, traditional village institutions are positioned in *Quadrant IV (independent sector)*, indicating strong driving power but relatively low dependence, highlighting their strategic role in sustaining local water management practices.

3.2. Needs in Raw Water Management

The analysis identified **twelve key elements of needs** required to support sustainable raw water management in rural drinking water systems (Table 2). These needs represent policy, institutional, environmental, and socio-economic dimensions.

Priority Needs Based on ISM Analysis

The ISM results highlight several priority programs that are critical for achieving sustainable management:

1. *Regulatory Support for PAMDes (1*). Strengthening regulatory frameworks at the district and village levels is essential to support PAMDes operations. This aligns with Government Regulation No. 122/2015, which mandates local governments to ensure access to drinking water services.
2. *Expansion of Protected Areas (2).* Protecting catchment areas around water sources is crucial for maintaining ecological balance, preventing environmental degradation, and ensuring long-term water availability.
3. Improvement of Community Income (3). The development of rural water systems can support local economic activities, particularly small-scale enterprises, thereby increasing community income.
4. *Capacity Building (4*). Enhancing the knowledge and technical skills of PAMDes managers is critical for sustainable system operation. This includes training in technical management, financial administration, and infrastructure maintenance.
5. *Institutional Strengthening (5).* Organizational restructuring and optimization of human resources are necessary to improve the performance and efficiency of PAMDes institutions.
6. *Spatial Planning and Source Protection (6).* Integrating water source protection into spatial planning policies ensures the sustainability of raw water resources. In Bali, this is closely linked to customary regulations (*awig-awig*) and sacred spatial concepts.
7. *Incentive and Disincentive Mechanisms (7).* Economic instruments are needed to encourage community participation in protecting water sources and promoting sustainable practices.
8. *Stakeholder Awareness (8).* Increasing awareness among stakeholders enhances coordination and supports the implementation of sustainable management practices.
9. *Watershed (DAS) Management Guidelines (9).* A community-based, participatory approach is essential for effective watershed management, leveraging local knowledge and practices.
10. *Integration of Local Wisdom (10).* The implementation of Tri Hita Karana strengthens sustainability across ecological, social, and cultural dimensions.
11. *Policy Integration with Technical Agencies (11).* Collaboration between PAMDes and technical agencies, including PDAM, is necessary to enhance technical capacity and system performance.
12. *Infrastructure Development (12*). Upgrading and expanding infrastructure is essential to improve service coverage and system reliability.

Table 2. Elements of Needs in the Management of the Rural Drinking Water Supply System in Tabanan Regency

No	Elements of Needs
1	Regulations that support PAMDes management at the village level
2	Increasing protected areas
3	Increasing community income
4	Increasing knowledge and skills
5	Institutional restructuring
6	Appropriate spatial planning (protection of raw water sources)
7	Provision of incentives and disincentives
8	Increasing stakeholder awareness in PAMDes management
9	Determination of guidelines for watershed management near the source.
10	Increasing the implementation of local wisdom
11	Development of technical agency policies with PAMDes managers
12	Infrastructure improvement and development

Most of these elements are positioned in *Quadrant III (linkage sector),* indicating that they have strong interdependencies. This means that failure to fulfill one element may significantly affect the performance of others, thereby influencing overall system sustainability.

3.3. Constraints in Raw Water Management

The study identified *eleven major constraints* affecting the sustainability of raw water management in rural drinking water systems (Table 3). These constraints reflect technical, institutional, economic, and social challenges.

Table 3. Constraint Elements in the Management of the Rural Drinking Water Supply System in Tabanan Regency

No	Constraint Elements
1	Limited Raw Water Source Potential
2	Community understanding of drinking water health
3	Limited facilities and adequate technology
4	Increasing household drinking water needs
5	Drinking water tariffs that support sustainability
6	Lack of coordination and integration of management between related stakeholders
7	Cooperation between drinking water supply system managers (PDAM, PAMDes)
8	Management of human resources does not match capacity
9	Limited rural drinking water supply system technology
10	Lack of PAMDes strengthening regulations
11	Limited house connection development

Key Constraints Identified

The ISM analysis highlights several critical constraints:

1. *Limited Raw Water Source Capacity (1).* The available water discharge (approximately 1–3 liters/second) limits service expansion and household connections.
2. *Low Public Awareness of Drinking Water Quality (2).* Many communities still rely on untreated water and lack awareness of water quality standards.
3. *Limited Infrastructure and Technology (3).* Inadequate facilities and simple technology reduce system performance in terms of quantity, quality, continuity, and affordability.
4. *Increasing Water Demand (4).* Growing population and economic activities increase pressure on limited water resources.
5. *Unsustainable Tariff Structure (5).* Current tariffs are relatively low (IDR 10,000–20,000), limiting the financial capacity for system maintenance and expansion.
6. *Weak Regulatory Framework (10).* The absence of strong regulatory support at local levels weakens institutional sustainability.
7. *Limited Expansion of House Connections (11).* Service coverage remains constrained due to limited water supply capacity.

These constraints are predominantly located *in Quadrant III (linkage sector),* indicating that they are highly interconnected and must be addressed simultaneously. Failure to resolve these constraints will significantly hinder the sustainability of rural drinking water systems.

4. Conclusions

This study identified *eight key institutional actors* involved in sustainable raw water management within the rural drinking water supply system in Tabanan Regency. The results of the ISM analysis reveal that the *Bali-Penida River Basin Center, the Bali Regional Settlement*

Infrastructure Center, and *traditional village institutions* are the most influential actors in shaping and implementing raw water management policies. These institutions play a strategic role in integrating technical, institutional, and socio-cultural dimensions of water resource management.

The study also highlights a set of *priority policy strategies* required to strengthen sustainable raw water management. These include: (1) the development of regulatory frameworks supporting PAMDes at the village level; (2) expansion of protected areas around water sources; (3) enhancement of community income; (4) capacity building through improved knowledge and skills; (5) institutional restructuring; (6) integration of water source protection into spatial planning; (7) implementation of incentive and disincentive mechanisms; (8) increased stakeholder awareness; (9) establishment of watershed management guidelines; (10) strengthening the application of local wisdom, particularly *Tri Hita Karana*; and (11) improved coordination between technical agencies and PAMDes management.

Despite these strategic priorities, the study confirms that the rural drinking water supply system in Tabanan Regency continues to face significant constraints. These include limited raw water source capacity, low public awareness of drinking water quality, inadequate infrastructure and technology, increasing domestic water demand, unsustainable tariff structures, weak regulatory support, and limited expansion of household connections. These constraints are highly interrelated and require integrated policy interventions.

Importantly, the proposed policy strategies are not merely conceptual recommendations but are empirically grounded in stakeholder analysis and system modeling. They demonstrate a strong alignment between theoretical priorities and field-based realities, particularly in addressing institutional fragmentation, limited technical capacity, and unclear governance structures. At the same time, the implementation of these strategies may be constrained by regulatory overlap and limited human resources, which should be carefully considered in future policy design.

Overall, this study contributes to the development of *a context-sensitive policy framework* that integrates structural analysis (ISM) with local cultural values, providing a more holistic approach to sustainable rural water management in Bali.

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REFERENCES

[1] A. Masduqi, N. Endah, and E. S. Soedjono, "Sistem penyediaan air bersih perdesaan berbasis masyarakat: Studi kasus HIPPAM di DAS Brantas bagian hilir [Community-based rural clean water supply system: A case study of HIPPAM in the lower Brantas watershed]," in *Seminar Nasional Pascasarjana VIII ITS*, Surabaya, Indonesia, 2008.

[2] R. A. K. Roekmi, K. Baskaran, and L. H. C. Chua, "Community-based water supplies in Cikarang, Indonesia: Are they sustainable?," *Natural Resources Forum*, vol. 42, no. 2, pp. 108–122, 2018. doi: 10.1111/1477-8947.12137

[3] I. G. A. L. Yasmita, "Sustainability of community-based drinking water service system in Sukadana Village and Ababi Village, Karangasem Regency," *Journal of Social Science*, vol. 4, no. 3, pp. 763–769, 2023. doi: 10.46799/jss.v4i3.XXX *(cek DOI jika ada)*

[4] D. Daniel, T. P. Al Djono, and W. P. Iswarani, "Factors related to the functionality of community-based rural water supply and sanitation program in Indonesia," *Geography and Sustainability*, vol. 4, no. 1, pp. 29–38, 2023. doi: 10.1016/j.geosus.2022.12.002

[5] P. R. E. Kurniatin and I. R. Maksum, "Sustainable strategy for community-based drinking water supply (PAMSIMAS) post program in rural Indonesia," *Journal of Government and Public Policy*, vol. 9, no. 3, pp. 211–224, 2022. doi: 10.18196/jgpp.v9i3.14268

[6] I. G. N. K. Arsana, I. G. B. S. Dharma, M. I. Yekti, and I. P. G. Suryantara, "Status of raw water management sustainability based on local wisdom on rural water supply in Bali, Indonesia," *Civil Engineering and Architecture*, vol. 10, no. 7, pp. 3118–3134, 2022. doi: 10.13189/cea.2022.100725

[7] I. G. N. K. Arsana, M. I. Yekti, and S. P. C. Astiti, "Peningkatan implementasi Tri Hita Karana pada keberlanjutan pengelolaan penyediaan air minum perdesaan di Kabupaten Buleleng [Improving the implementation of Tri Hita Karana in the sustainability of rural drinking water supply management in Buleleng Regency]," *Jurnal Ketahanan Nasional*, vol. 30, no. 1, pp. 66–86, 2024. https://doi.org/10.22146/jkn.90282

[8] H. Hutasoit and R. Wau, "Menuju sustainability dengan Tri Hita Karana: Sebuah studi interpretif pada masyarakat Bali [Towards sustainability with Tri Hita Karana: An interpretive study of Balinese society]," *Business Management Journal*, vol. 13, no. 2, pp. 151–168, 2017. doi: 10.30813/bmj.v13i2.917

[9] W. Windia, S. Pusposutardjo, N. Sutawan, P. Sudira, and S. S. Arif, "Sistem irigasi Subak dengan landasan Tri Hita Karana sebagai teknologi sepadan dalam pertanian beririgasi [Subak irrigation system with Tri Hita Karana as a suitable technology in irrigated agriculture]," *SOCA: Jurnal Sosial Ekonomi Pertanian*, vol. 5, no. 3, 2005.

[10] W. Windia et al., "Transformasi sistem irigasi Subak yang berlandaskan konsep Tri Hita Karana [Transformation of the Subak irrigation system based on the Tri Hita Karana concept]," *SOCA*, vol. 5, no. 2, 2005.

[11] S. Astiti, N. W. Windia, and P. F. K. Lestari, "Penerapan Tri Hita Karana untuk keberlanjutan sistem Subak sebagai warisan budaya dunia [Implementation of Tri Hita Karana for the sustainability of the Subak system as a world cultural heritage]," *Jurnal Manajemen Agribisnis*, vol. 3, no. 1, 2015.

[12] M. I. Yekti, B. Schultz, I. N. Norken, A. H. A. Gany, and L. Hayde, "Learning from experiences of ancient Subak schemes for participatory irrigation system management in Bali," *Irrigation and Drainage*, vol. 66, no. 4, pp. 567–576, 2017. doi: 10.1002/ird.2140

[13] I. N. Norken, I. K. Suputra, and I. G. N. K. Arsana, "Implementasi Tri Hita Karana pada Subak Pulagan sebagai Warisan Budaya Dunia Di Kecamatan Tampaksiring, Kabupaten Gianyar [Implementation of Tri Hita Karana in Subak Pulagan as a World Cultural Heritage in Tampaksiring District, Gianyar Regency]," 2019.

[14] I. G. N. K. Arsana et al., "Implementation of Tri Hita Karana in sustainable management of rural drinking water supply system in Bali Province," in *ICASETM 2022*, 2022.

[15] R. Skjong and B. H. Wentworth, "Expert judgment and risk perception," in *ISOPE Conference*, 2001.

[16] S. C. Hora, "Expert judgment in risk analysis," 2009.

[17] J. W. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 4th ed. Sage Publications, 2017.

[18] D. P. Darmawan, *Pengambilan Keputusan Terstruktur dengan Interpretive Structural Modeling (ISM) [Structured Decision Making with Interpretive Structural Modeling (ISM)]*, Yogyakarta: Elmatera, 2017.

[19] J. N. Biswal et al., "Interpretive structural modeling-based framework for analysis of sustainable supply chain management enablers," *Journal of Operations and Strategic Planning*, vol. 1, no. 1, pp. 34–56, 2018. doi: 10.1177/2516600X18774169

[20] A. Chauhan, A. Singh, and S. Jharkharia, "ISM and DEMATEL approach for analysis of barriers of waste recycling," *Journal of the Air & Waste Management Association*, vol. 68, no. 2, pp. 100–110, 2018. doi: 10.1080/10962247.2017.1367731

[21] M. Bahadori et al., "Factors affecting strategic plan implementation using ISM," *International Journal of Health Care Quality Assurance*, vol. 31, no. 5, pp. 406–414, 2018. doi: 10.1108/IJHCQA-05-2017-0075

[22] H. Fariadi, "Analisis kelembagaan desa mandiri pangan dengan metode ISM [Analysis of food independent village institutions using the ISM method]," *Agritepa*, 2016.

[23] R. A. Surya et al., "Analisis kelembagaan pengelolaan air baku berkelanjutan dengan metode ISM [Institutional analysis of sustainable raw water management using the ISM method]," *Jurnal Ecogreen*, vol. 4, no. 2, pp. 99–109, 2018.

[24] W. N. Dunn, *Public Policy Analysis*, 5th ed. Routledge, 2015.

[25] D. L. Weimer and A. R. Vining, *Policy Analysis: Concepts and Practice*, 5th ed. Routledge, 2017.

[26] T. A. Birkland, *An Introduction to the Policy Process*, 4th ed. Routledge, 2019.

[27] E. Handoyo, *Kebijakan Publik [Public Policy]*, Semarang: Widya Karya, 2012.

[28] S. A. Wahab, *Analisis Kebijakan Publik [Public Policy Analysis]*, Jakarta: Bumi Aksara, 2021.

[29] Suharno, *Dasar-Dasar Kebijakan Publik [Basics of Public Policy]*, Yogyakarta: UNY Press, 2013.

[30] W. N. Dunn, *Analisis Kebijakan Publik [Public Policy Analysis]*, Yogyakarta: Hanindita Graha Widya, 2003.