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RESEARCH ARTICLE

Analysis of Clean Water Supply Service Quality at PDAM Tirta Tawar in Kemili Village, Central Aceh Regency

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Abstract
Clean water is an essential public need, and its provision at the local level is carried out by the Regional Water Supply Company (PDAM). In Kemili Village, Bebesen Subdistrict, Central Aceh Regency, customers of PDAM Tirta Tawar frequently experience service problems, including prolonged water outages, poor water quality, pipe blockages caused by sediment, and slow responses to customer complaints. Of the 268 registered customers in the village, only 90 remain active, while 178 are inactive, despite the overall growth of PDAM customers in Central Aceh Regency from 8,476 in 2020 to 9,035 in 2024. This study aims to analyze the quality of PDAM Tirta Tawar's clean water supply services in Kemili Village and identify the barriers affecting service delivery. A descriptive qualitative approach was employed, with data collected through in-depth interviews, observation, and documentation involving twelve informants from PDAM, village government, community leaders, NGOs, academics, and customers. The findings reveal that the quality of service has not met community expectations in terms of physical evidence, reliability, responsiveness, and empathy. Major problems include aging pipeline infrastructure installed in the late 1980s, sediment accumulation and pipe corrosion, an unscheduled rotational water distribution system, a shortage of field technicians, and ineffective communication with customers. The barriers identified consist of technical constraints, such as damaged pipelines and inadequate filtration; human resource limitations, including insufficient training and lack of written procedures; and institutional issues, such as weak coordination, limited infrastructure funding, and ineffective oversight mechanisms. The study recommends establishing a publicly accessible water distribution schedule, developing a digital complaint system, increasing transparency in service fees, and allocating government funding for pipeline replacement and sustainable PDAM oversight.

Keywords
Public Services; Clean Water Supply; PDAM; Service Quality; Service Barriers.

1 | INTRODUCTION

Clean water supply is a basic public need that the Indonesian government pursues through Regional Water Supply Companies (PDAMs), which are mandated by Law No. 25 of 2009 on Public Services, Law No. 17 of 2019 on Water Resources, Government Regulation No. 122 of 2015 on Drinking Water Supply Systems, and Ministerial Decree No. 63 of 2003 to deliver clean water access that is transparent, professional, and equitable. Despite this framework, clean water services in Indonesia still face uneven quality, limited rural access, and inadequate infrastructure, requiring continuous improvement in management and investment. PDAM Tirta Tawar serves several subdistricts in Central Aceh Regency, including Bebesen, Kebayakan, Lut Tawar, Pegasing, and Celala. Media reports and an initial interview indicated recurring complaints from residents about prolonged water outages of two to three days or even a week, murky water during the rainy season, and unresponsive handling of complaints (TribunGayo.com, August 4, 2025; Initial Interview, September 5, 2025). Customer records from 2020-2024 show active customers rising from 8,476 to 9,035, but inactive customers also rising from 3,112 to 3,232, indicating that growth in registration has not been matched by improved service quality. The pattern is most severe in Kemili Village, Bebesen Subdistrict, where of 268 registered customers only 90 (33.6%) remain active while 178 (66.4%) have become inactive - nearly two and a half times the regency-level inactive proportion of 26.4% (Table 1). This disparity points to conditions specific to Kemili Village, including hilly topography that affects water pressure, an exceptionally old pipeline network, and weak communication channels between PDAM and residents; the village was therefore selected purposively as the research location.

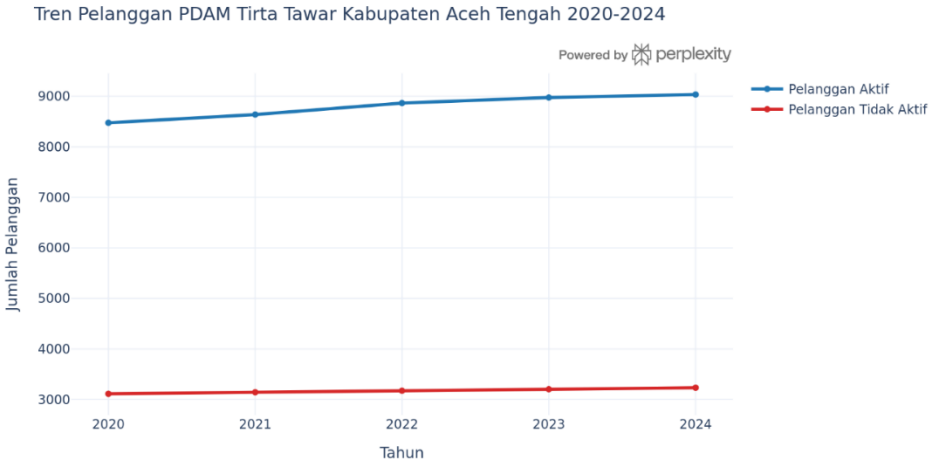

Figure 1. Trends in Active and Inactive Customers of PDAM Tirta Tawar, Central Aceh Regency, 2020–2024

Table 1. Comparison of Active and Inactive Customer Proportions

Region	Number of Registered Customers	Active Customers (%)	Inactive Customers (%)
Central Aceh Regency (2024)	12,267	9,035 (73.6%)	3,232 (26.4%)
Kemili Village (2024)	268	90 (33.6%)	178 (66.4%)

Prior research on PDAM service quality in Aceh - Melati (2019) on PDAM Tirta Daroy, Muliana (2022) on PDAM Tirta Meulaboh, Moliyana Dewi (2023) on PDAM Tirta Mountala, and studies by Idris (2023) and Septiani (2018) elsewhere - each applied Zeithaml's service-quality theory but did not examine a highland rural setting with hilly terrain, nor document customer attrition as severe as the two-thirds rate found in Kemili Village. This study addresses that gap. This study therefore asks: (1) how does PDAM Tirta Tawar's clean water service to Kemili Village perform across the tangibles, reliability, responsiveness, and empathy dimensions of service quality, and (2) what obstacles constrain that service delivery? Correspondingly, this study aims to assess service quality across those four SERVQUAL dimensions and to identify the barriers affecting service delivery, offering both an academic reference for public-service research and a practical evaluation framework for PDAM and local government policy in highland communities.

2 | BACKGROUND THEORY

2.1 Service Quality Theory

The analytical framework of this study employs the service quality theory developed by Zeithaml, Parasuraman, and Berry (1990), as cited in Hardiyansyah (2011), which divides service quality into five dimensions: tangibles (the

provision of adequate human and other resources), reliability (the delivery of accurate and correct service), responsiveness (the willingness to serve customers promptly), assurance (attention to ethics and morality in providing service), and empathy (the willingness to understand customers' desires and needs). This study focuses on four dimensions tangibles, reliability, responsiveness, and empathy as the primary framework for evaluating the services provided by PDAM Tirta Tawar to the residents of Kemili Village, as these four dimensions are most relevant to customers' direct experiences in receiving clean water services. The application of SERVQUAL theory to PDAM services requires specific adaptation to the water supply context. According to Tjiptono and Chandra (2016), service quality in public utilities can be measured through the gap between customer expectations and their perceptions of actual service delivery. Parasuraman *et al*. (1988) emphasized that service quality is not merely about technical specifications but also about how services are delivered to customers. This distinction is particularly relevant for PDAM services, where technical aspects (water pressure, flow rate, and distribution reliability) must be complemented by service aspects (customer communication, complaint handling, and billing transparency).

2.2 Relevance of SERVQUAL Dimensions to PDAM Services

The tangible dimension refers to the physical facilities, equipment, personnel appearance, and communication materials used in service delivery (Zeithaml *et al*., 1990). In the context of PDAM clean water services, tangibles include the condition of pipeline infrastructure, water treatment facilities, distribution equipment, and the overall appearance of service offices. According to Hardiyansyah (2018), inadequate physical infrastructure is one of the primary causes of poor service quality in Indonesian public utilities. For PDAM services, outdated pipelines, corroded fittings, and insufficient water treatment capacity directly affect customers' perception of service quality, as observed in studies by Melati (2019) and Muliana (2022), where aging infrastructure was identified as a major constraint on reliable water delivery. On the other hand, reliability refers to the ability to deliver promised services accurately and dependably (Parasuraman *et al*., 1988). For PDAM services, reliability encompasses consistent water availability, pressure stability, water quality meeting health standards, and accurate billing. Zeithaml *et al*. (1990) noted that reliability is the most important dimension of service quality for customers because it relates directly to the core service being delivered. As Rizal and Putri (2021) emphasized, customers expect clean water to be available when needed, without interruptions or quality deterioration. When PDAMs fail to provide reliable water supply, customer trust diminishes, leading to service abandonment and reliance on alternative water sources (Gunawan & Sari, 2022). Responsiveness involves the willingness to help customers and provide prompt service (Parasuraman *et al*., 1988). In the PDAM context, responsiveness includes the speed of complaint handling, the availability of staff to address customer concerns, and the efficiency of service delivery processes. According to Firdaus and Susanto (2023), responsiveness is particularly critical for public utilities because service failures (such as water outages or quality problems) require immediate attention. Studies by Hidayat and Mulyono (2021) found that slow complaint handling is one of the most common sources of customer dissatisfaction with PDAM services, as it reinforces perceptions of bureaucratic inefficiency. Lastly, empathy refers to the provision of caring, individualized attention to customers (Zeithaml *et al*., 1990). This dimension encompasses understanding customer needs, accessible communication, transparency in service provision, and treating customers as valued individuals rather than just account numbers. For PDAM services, empathy is demonstrated through clear communication about service disruptions, transparency regarding charges and service fees, and responsiveness to the specific challenges faced by customers in different locations (Wahyuni & Santoso, 2021). Prakoso and Dewi (2023) emphasized that customers who feel their needs are understood are more likely to maintain loyalty despite occasional service failures.

2.3 Previous Studies on PDAM Service Quality

Previous research has applied SERVQUAL or similar frameworks to evaluate PDAM services in various Indonesian locations, providing valuable insights into common challenges and best practices. Melati (2019) studied PDAM Tirta Daroy in Banda Aceh City and found that the public services provided were unsatisfactory due to a lack of accountability and empathy among staff in resolving on-site issues, even though the utility had implemented a more disciplined work culture and established a complaint service via official social media channels. This finding underscores that technical improvements must be accompanied by cultural and behavioral changes among service personnel. Muliana (2022) examined PDAM Tirta Meulaboh in West Aceh Regency and revealed that accessibility and distribution coverage remain limited, with issues such as pipe leaks, low water pressure, and ineffective management of human resources and capital. This study highlighted the structural constraints that limit service expansion in rural and peri-urban areas. Moliyana Dewi (2023) found that the quality of water bill payment services significantly influences customer satisfaction at PDAM Tirta Mountala in Aceh Besar, emphasizing that service quality extends beyond water delivery to include the entire customer service experience. Studies by Idris (2023) in Makassar City and Septiani (2018) in Bekasi Regency each highlighted employee productivity and the lack of public outreach through information media as factors affecting PDAM service quality. Idris (2023) demonstrated that employee performance directly affects service outcomes, while Septiani (2018) emphasized the importance of

proactive communication to manage customer expectations. These findings collectively suggest that service quality in PDAMs is multidimensional and requires attention to infrastructure, human resources, customer communication, and institutional capacity.

2.4 Concept of Service Provision

The concept of provision in this study is understood as the process of procuring, storing, and managing resources including piping infrastructure, human resources, and distribution systems to sustainably meet the community's clean water needs while adhering to the principles of efficiency, effectiveness, transparency, and accountability, as outlined by Firdaus and Susanto (2023). As a regionally owned enterprise, the Regional Water Supply Company bears a dual responsibility: to fulfill its public service function by ensuring that all segments of society have access to adequate clean water, while simultaneously performing an economic function that generates revenue for the regional budget through four main operational areas production, distribution, sales, and customer service (Siregar & Nasution, 2021). Public service principles, as articulated by Ridwan and Sudrajat (2008), emphasize that service provision must be open, professional, responsive, and accessible. Kurniawan and Widodo (2022) further identified that effective public service delivery requires clear standard operating procedures, adequate resource allocation, and ongoing monitoring and evaluation. In the PDAM context, these principles translate into reliable infrastructure, transparent billing, accessible complaint mechanisms, and accountable management practices (Ramadhan & Lestari, 2023).

2.5 Theoretical Framework

This study's theoretical framework integrates Zeithaml *et al.*'s (1990) SERVQUAL dimensions with Ridwan and Sudrajat's (2008) service provision principles, linked to the regulatory framework governing water resources and public services in Indonesia. The conceptual framework links laws and regulations related to water resources and public services to the phenomenon of problematic clean water distribution in the field; this is then analyzed using Zeithaml's service quality indicators and reinforced by the service principles that emphasize openness, professionalism, speed, and ease of service. This integrated framework enables comprehensive analysis of both technical and relational aspects of PDAM service delivery in the unique context of highland rural communities.

3 | METHOD

This study employs a descriptive qualitative approach conducted in Kemili Village, Bebesen Subdistrict, Central Aceh Regency the village with the highest proportion of inactive PDAM customers to understand the phenomenon of clean water service quality within its natural context (Creswell, 2014; Sugiyono, 2019). Kemili Village comprises eight hamlets (Kemala Pangkat, Mess Time Ruang, Jalan Lintang, Datu Kemili, Datu Sebahi, Terminal, Gempar Alam, and Perulangan) and was selected purposively for its 66.4% inactive-customer rate, hilly topography, pipeline network dating to the late 1980s, and documented customer complaints. Twelve informants were selected through purposive and accidental sampling to represent diverse stakeholder perspectives, as summarized in Table 2. Data were collected between January and March 2026 through semi structured interviews (45-90 minutes each, guided by the four SERVQUAL dimensions), participatory observation of infrastructure and distribution conditions, and documentation of customer records, permits, and field photographs.

Table 2. Research Informants

Stakeholder Group	Informants	Technique	Data Focus
PDAM Tirta Tawar	Head of Technical Department; Customer Service Staff	Purposive	Technical condition, resource limitations, complaint handling
Village Government	Head of Kemili Village; Village Secretary	Purposive	Village-level service issues, administrative coordination
Community / NGO	Chair of Kagayo; Hamlet community leader; Environmental NGO representative	Purposive	Community perspectives, advocacy, policy concerns
Academia	Public Administration academic	Purposive	Theoretical and policy analysis
Customers	Four customers across Jalan Lintang, Datu Sebahi, Terminal, and a long-term customer since 1978	Accidental / Purposive	Direct service experience across dimensions

Primary data (interview transcripts, field notes, observations) were complemented by secondary data, including PDAM customer records (2020-2024), operational documents, relevant regulations, and media reports. Data were analyzed using the interactive model of Miles, Huberman, and Saldaña (2014, as cited in Sugiyono, 2019) data reduction guided by the four SERVQUAL dimensions, thematic data display, and conclusion drawing verified through source and method triangulation, member checking, and an audit trail of research materials.

4 | RESULTS AND DISCUSSION

4.1 Results

4.1.1 Overview of the Research Location

PDAM Tirta Tawar is a regionally owned enterprise under the Regent of Central Aceh, delivering water through four operational areas: production, distribution, sales, and customer service. Its main raw-water intake lies in the Gegong area with a primary reservoir at Lelabu, treated through a simple alum and filtration process before gravity distribution to households. Kemili Village's eight hamlets fall within this service area, and hilly topography affects water pressure and the evenness of flow across hamlets. Findings are presented and discussed below across the four SERVQUAL dimensions, followed by the barriers to service delivery.

4.1.2 Tangibles (Physical Evidence)

The Head of PDAM's Technical Department, Mr. Hamli, explained that the core tangible problem is pipeline age: "some pipes have been in the ground for over twenty years; the old iron pipes are corroded, and their depth is sometimes non-standard, making them prone to breaking" (Interview, March 3, 2026). A network-replacement proposal has already been submitted to management but stalled for lack of budget. The Chair of Kagayo, Mr. Ikrar, went further, arguing that PDAM needs a total, not partial, revitalization of the piping system, since incremental repairs cannot resolve infrastructure that has already exceeded its technical service life (Interview, March 6, 2026). Ms. Annisa Agustina of Jalan Lintang Hamlet described a related but distinct problem: her household connection pipe is too small to deliver adequate flow, and enlarging it was offered only at an undisclosed extra cost (Interview, March 2, 2026). These findings echo Melati (2019) and Muliana (2022), who likewise found aging infrastructure the principal constraint on PDAM service quality in Aceh; corrosion here, however, is compounded by Kemili's hilly terrain, which further degrades pressure once pipe walls thin. Read against the provision principle in Government Regulation No. 122 of 2015 which requires infrastructure to remain fit for continuous operation across the full production to household chain the stalled replacement proposal reveals what can be termed an infrastructure debt: a known, alreadyidentified need whose renewal has been deferred so long that eventual repair will cost far more than timely maintenance would have. Shifting the cost of an undersized connection onto the customer, as in Ms. Annisa's case, similarly blurs where the provider's maintenance responsibility within that chain should end.

Table 3. Summary of Findings - Tangibles Dimension

Aspect	Key Finding	Implication
Pipeline condition	Corroded iron pipes over 20 years old; non-standard burial depth	Frequent, hard-to-detect leaks and disruptions
Maintenance approach	Reactive repairs only after complaints; replacement proposal stalled for lack of budget	Uneven service across hamlets; infrastructure debt accumulates
Household connections	Undersized pipes; upgrade costs undisclosed in advance	Limited flow; erosion of customer trust

4.1.3 Reliability

PDAM's Administration and Finance Head, Mr. Aulia Mustafa Kamal, explained the technical root of unreliable supply: "the gravity system we use is constrained during heavy rain and long dry spells. When it rains hard, flow increases but the water turns brown. During prolonged drought, discharge shrinks so distribution to Kemili customers becomes very uneven. Running the pumps a full twenty-four hours would also spike the electricity bill and raise costs passed on to customers, and treating water quality requires chemicals such as alum and chlorine that must be purchased and need their own dedicated processing facility" (Interview, February 24, 2026). Because raw water is drawn directly from unprotected rivers and springs, gravity supply lacks the buffer needed to withstand seasonal extremes, and the alternative of full pumping is constrained by cost - a trade-off PDAM's limited operating budget cannot easily absorb. Consequently, distribution to Kemili operates on a rotational basis with no official schedule. A customer in Datu Sebahi Hamlet described the resulting uncertainty: "the water becomes very muddy when it rains heavily, and sometimes we don't know when the water will come at all; we have to store water whenever it flows, but we never know when that will happen" (Interview,

March 4, 2026). This finding aligns with Muliana (2022), who found that distribution reliability at PDAM Tirta Meulaboh could not improve without addressing the physical infrastructure feeding it. Interpreted through Government Regulation No. 122/2015's requirement that a drinking-water system guarantee sustainable, adequate supply independent of uncontrollable natural conditions, a design that depends entirely on gravity without a buffer or reserve system falls short of the mandated sustainability standard the deficiency lies less in day to day operation than in the underlying system design. Mr. Hamli also described the resulting financial trap: constrained revenue prevents infrastructure investment, which perpetuates poor service and further limits revenue - a vicious cycle consistent with Gunawan and Sari's (2022) finding that eroded trust pushes customers toward alternative sources, compounding revenue loss.

Table 4. Summary of Findings - Reliability Dimension

Aspect	Key Finding	Implication
Distribution system	Gravity-fed supply with no buffer for rainy/dry-season extremes; 24-hour pumping constrained by cost	Rotational supply with no official schedule; outages of 2-3 days to a week
Water quality	Turbidity in the rainy season; chemical treatment (alum, chlorine) limited by budget and facilities	Health concerns; customers must store water opportunistically
Financial capacity	Poor service reduces revenue, which limits investment in infrastructure	Self-reinforcing cycle of underperformance

4.1.4 Responsiveness

Mr. Hamli acknowledged that additional field technicians cannot be hired while company revenue remains below normal, even though PDAM sends two to three staff annually to Perpamsi training in Medan or Bekasi - training whose benefit is undercut by field equipment that no longer functions properly (Interview, March 3, 2026). The Village Head, Mr. Fajaruddin, added a structural obstacle to repair speed: road-widening works have buried distribution pipes beneath the road surface, so that even a routine leak now requires breaking up asphalt before technicians can reach the pipe, lengthening every repair and every service disruption (Interview, February 25, 2026). Administratively, Mr. Aflianda, who also handles customer complaints, reported that complaints are still logged manually in a notebook, with no digital system, and that bill payment is accepted only through a single bank (Interview, February 24, 2026). A customer from Terminal Hamlet summarized the resulting frustration: "when I report a problem, they say they will send someone, but sometimes it takes days or weeks; I have to call many times before anyone comes to check" (Interview, March 5, 2026). These findings correspond to Hidayat and Mulyono's (2021) conclusion that slow complaint handling is among the most common sources of PDAM dissatisfaction, and contrast with Melati's (2019) finding that PDAM Tirta Daroy had already adopted a social-media complaint channel a gap that likely reflects differences in institutional capacity between an urban and a rural PDAM. Manual, paper-based complaint records cannot easily be aggregated to reveal recurring problem patterns, pushing service decisions toward intuition rather than evidence; this directly conflicts with Ministerial Decree No. 63 of 2003, which requires public services to be delivered efficiently and professionally, a standard that in the present era depends on reliable, quickly accessible data systems. Likewise, restricting bill payment to one bank, and burying pipes without preserving maintenance access, both work against the accessibility principle mandated by Law No. 25 of 2009 - responsiveness in this case is constrained as much by physical and administrative access as by staff willingness.

Table 5. Summary of Findings - Responsiveness Dimension

Aspect	Key Finding	Implication
Complaint handling	No standardized procedure; complaints logged manually with no digital system	Slow, untracked resolution; decisions rely on intuition, not data
Repair access	Pipes buried under widened roads; ageing network with limited technicians	Longer, costlier repairs and disruptions
Service access	Bill payment limited to a single bank; training not matched by working field equipment	Customer inconvenience; training investment underused

4.1.5 Empathy

Ms. Annisa Agustina's case illustrates the clearest empathy gap: a technical fix was offered without disclosing its cost, leaving her to choose between an unplanned expense or continued insufficient flow she stated that had the cost been disclosed from the outset, she would likely have accepted it, indicating that the issue was not the solution itself but the lack of transparency around it. The Chair of Kagayo reported that PDAM has never engaged in meaningful joint problem solving with community organizations, meeting criticism instead with budget constraints as a default, defensive response. A long term customer since 1978 captured the cumulative effect: "in the past, service was better; now it seems like no one cares about our problems, they just say they have no budget we are customers but we feel like we are begging for water" (Interview, March 3, 2026).

These accounts align with Wahyuni and Santoso (2021), who found that customers who feel understood remain loyal despite occasional service failures, and with Prakoso and Dewi (2023), who found the converse pattern of abandonment when customers feel unheard. The exclusion of community organizations such as Kagayo from joint planning directly contradicts the participatory principle of Law No. 25 of 2009, which requires public services to incorporate community aspirations and needs; a defensive, budget first communication style precludes the kind of collaborative problem-solving that principle envisions. For a customer of 46 years' standing to describe the relationship as "begging" signals more than dissatisfaction it reflects an erosion of the basic service relationship that public utilities exist to sustain.

Table 6. Summary of Findings - Empathy Dimension

Aspect	Key Finding	Implication
Transparency	Additional costs and fees not disclosed in advance	Customers feel misled; erosion of trust
Communication	No proactive information on disruptions; criticism met with a defensive "no budget" response	One-way communication; unresolved frustration
Community engagement	No meaningful cooperation with community organizations (e.g., Kagayo)	Solutions not co-created; long-term customer abandonment

4.1.6 Barriers to Service and Cross-Study Comparison

Taken together, the barriers to service in Kemili Village are technical, human resource related, and institutional, and are mutually reinforcing (Table 7). Technically, they combine corroded pipes over twenty years old, non-standard burial depth, undersized connections, and a gravity fed source with no buffer against seasonal extremes. In human resources, PDAM's unstable revenue prevents hiring technicians even as annual Perpamsi training continues without matching field equipment. Institutionally, network revitalization proposals have stalled for lack of funding, cooperation with community organizations is minimal, and as Mr. Ikrar observed coordination between PDAM and local government, which as the company's owner bears oversight responsibility, remains unclear, allowing service problems to recur without a decisive policy response (Interview, March 6, 2026).

Table 7. Categories of Obstacles to Clean Water Service Provision

Category	Specific Findings
Technical	Corroded iron pipes over 20 years old; non-standard depth; undersized household connections; gravity system without seasonal buffer
Human Resources	Technician hiring constrained by unstable revenue; training not matched by functional field equipment
Institutional	Stalled network-revitalization proposals; minimal community cooperation; unclear PDAM-local government coordination; payment limited to one bank

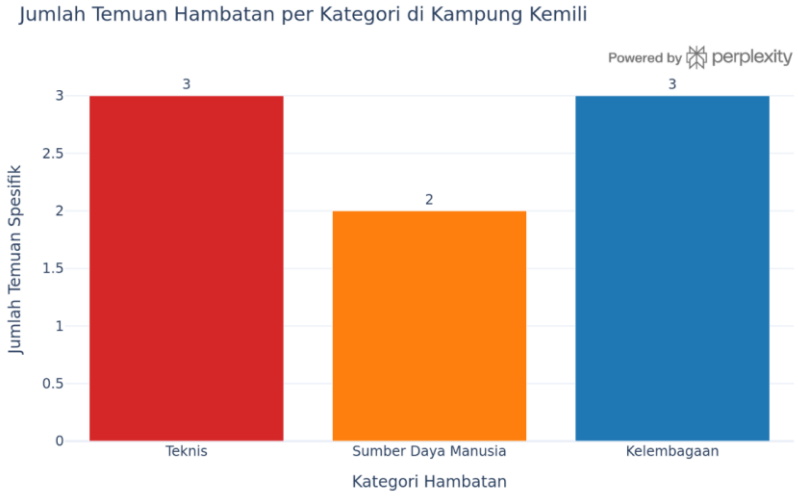

Figure 2. Number of Identified Obstacles by Category in Kemili Village

Compared with previous PDAM studies in Aceh, the pattern of problems is similar in kind infrastructure age (Melati, 2019; Muliana, 2022), accessibility and coverage limits (Muliana, 2022), and staff accountability and empathy gaps (Melati, 2019) but more severe in degree: Kemili Village's 66.4% inactive customer rate far exceeds anything previously documented in the Aceh PDAM literature, and its hilly topography and near total dependence on unbuffered gravity supply compound problems that in flatter, better-resourced service areas can be more readily managed. The findings of this study present several practical and theoretical implications for PDAM Tirta Tawar and local government. Practically, the results highlight five key priorities: the need for comprehensive (not incremental) pipeline replacement, with a focus on highland areas; the establishment of a buffer or reserve capacity to reduce reliance on unbuffered gravity supply; the implementation of a digital complaint-and-payment system that includes expanded partnerships with banks; the creation of an official, publicly communicated distribution schedule; and the necessity for structured, ongoing engagement with community organizations such as Kagayo. Theoretically, this study extends the application of SERVQUAL to a rural highland context, demonstrating that its four dimensions should be interpreted in conjunction with topography and infrastructure design, rather than solely as issues of provider behavior. The notably high inactive-customer rate indicates that customer attrition may serve as a more sensitive indicator of service quality failure than satisfaction surveys, particularly in areas where alternative water sources are available. Furthermore, the study reveals a vicious cycle linking infrastructure, revenue, and further deterioration, illustrating that the four dimensions of service quality are interdependent rather than independent. This finding aligns with the provision principle framework, which mandates continuous and adequately resourced service throughout the entire water supply chain.

4.2 Discussion

The discussion regarding the quality of clean water supply services at PDAM Tirta Tawar in Kemili Village reveals several constraints affecting service effectiveness. The findings of this study align with Melati's (2019) research, which indicated that aging infrastructure, such as corroded and non-standard pipes, is a primary factor hindering service quality. In Kemili Village, the condition of pipes that have been in the ground for over twenty years leads to frequent leaks and instability in water supply, resulting in inconsistent access for customers. This issue is compounded by a distribution system that relies solely on gravity without any buffer to manage seasonal fluctuations, as also identified in Muliana's (2022) study. This research found that PDAM's responsiveness to customer complaints is significantly low, creating dissatisfaction among residents. Limitations in complaint handling and a lack of transparent communication, as highlighted by Hidayat and Mulyono (2021), further exacerbate the relationship between customers and the service provider. Additionally, the minimal cooperation with community organizations, noted by Prakoso and Dewi (2023), indicates that community participation in service planning is severely lacking, resulting in uncoordinated solutions to existing problems. Thus, this study emphasizes the importance of improving infrastructure, enhancing responsiveness, and engaging the community in efforts to elevate the quality of clean water services in Kemili Village.

5 | CONCLUSIONS AND FUTURE WORK

The clean water services provided by PDAM Tirta Tawar to Kemili Village fall short of expectations across all four SERVQUAL dimensions. Tangibly, the pipeline network installed in the late 1980s is corroded and non-standard in depth, with undersized household connections. Reliability suffers because the supply depends entirely on an unbuffered gravity system vulnerable to seasonal extremes, resulting in rotational distribution without an official schedule and outages lasting two to three days or more. Responsiveness is limited by manual, non-digital complaint handling, pipes buried under widened roads that slow repairs, and a single-bank payment option. Empathy is undermined by undisclosed fees, defensive rather than collaborative communication, and the exclusion of community organizations from service planning—together leaving even a 46-year customer feeling, in his words, like he is "begging" for water. These barriers are technical, human-resource, and institutional, reinforcing one another: poor infrastructure depresses reliability and revenue, which in turn limits the investment needed to fix the infrastructure. Theoretically, this confirms that the SERVQUAL dimensions are interdependent, and that customer attrition (66.4% inactive in Kemili Village) can be a more sensitive failure indicator than satisfaction alone. Practically, without systematic infrastructure investment, digital transformation, clearer distribution communication, and genuine community engagement, this cycle is likely to continue. To address these issues, it is recommended that PDAM Tirta Tawar prioritize comprehensive pipeline replacement over partial repairs, especially in highland hamlets; develop reserve/buffer capacity to reduce dependence on unbuffered gravity supply during seasonal extremes; establish and publicize an official distribution schedule; implement a digital complaint and payment system with expanded bank partnerships; and disclose connection and service costs before offering technical solutions to customers. For local government, it is essential to allocate dedicated infrastructure funding, prioritizing the highest inactive-customer areas; establish sustainable oversight of PDAM that persists across changes in local leadership; support PDAM's digital and service innovation through regulation and financing; and

integrate PDAM service quality as a formal indicator in regional development planning. Future research should extend the study to other villages with differing topography for comparative analysis, apply quantitative methods to measure customer satisfaction and its statistical relationship to retention, conduct longitudinal research tracking service quality following infrastructure and digital reforms, and compare PDAM performance across regions to identify transferable best practices.

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