INKUBIS: Jurnal Ekonomi dan Bisnis
Volume 8, Issue 4, 3659-3670
e_ISSN: 2775-3913
https://inkubis.polteksci.ac.id/index.php/ink/index
DOI: doi.org/10.59261/inkubis.v8i4.557

Governing Tariff-Based Finance in Indonesian Public Water Utilities: A Conceptual Accountability Framework

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Article Info:

Article history:
Received: September 19, 2026
Revised: October 19, 2026
Accepted: November 07, 2026
Available Online: November 24, 2026

Keywords:
Accountability;
Financial Engineering;
Public Corporate Governance;
Tariff Regulation;
Water Utilities;
Indonesia

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Abstract

Background: Publicly owned water utilities must sustain essential service while balancing affordability, infrastructure renewal, and financial viability. This conceptual article addresses the accountability problem created when tariff, ownership, and budget decisions are institutionally separated.

Objective: This paper explains how fragmented ownership, tariff, and budget responsibilities can create an accountability gap in Indonesian regional water utilities (PDAM/BUMD), and classifies financing arrangements by economic substance, funding credibility, and disclosure.

Methods: Using theory synthesis and framework building, the paper integrates enterprise entity theory as the primary lens with common-agency and institutional perspectives, a transparent cash-flow model, and deterministic scenario testing. No utility-level empirical company data or participant interviews were analysed.

Results: The hypothetical scenario demonstrates that tariff increases, loss reduction, or subsidy recognition alone do not necessarily secure debt-service capacity because receipt timing and renewal costs alter cash sufficiency. Under explicitly constructed assumptions, an integrated package changes service-adjusted coverage from 0.67 to 1.43, while a cost shock reduces it below one. These values are illustrative scenario outputs, not estimates of any Indonesian utility. The framework specifies six non-compensatory decision gates and a staged 30–90 day dashboard.

Conclusion: The paper offers a testable mechanism linking decision rights, funding credibility, managerial response, and service outcomes. A service-adjusted coverage ratio complements accrual measures by making unfunded commitments visible, while explicit funding of low-income tariff protection supports intergenerational equity and basic water access. The framework remains conceptual and requires comparative field validation.

To cite this article: Setiawan, A., & Widodo, A. P. (2026). Governing Tariff-Based Finance in Indonesian Public Water Utilities: A Conceptual Accountability Framework. *INKUBIS: Jurnal Ekonomi dan Bisnis, 8*(4), 3659-3670. https://doi.org/10.59261/inkubis.v8i4.557

INTRODUCTION

A public water utility must deliver an essential service while remaining financially sustainable: an affordable tariff has limited value if an unfunded deficit later undermines reliability, while a financially comfortable utility can still fail its purpose if charges exclude low-income households. The problem is global as well as institutional. The World Bank estimates that developing countries spend about US$164.6 billion annually on water, yet meeting water-supply and sanitation goals requires an additional US$131.4–140.8 billion per year, implying that current spending must rise to roughly 2.7–3.0 times existing levels (Joseph et al., 2024). At the same time, UN-Water reports that insufficient finance constrains water-governance implementation in most countries, reinforcing the need to connect authorised obligations with credible funding. The

analytical problem is therefore how public decisions create, allocate, and discharge the obligations needed to sustain affordable service, not simply whether tariffs should rise.

Indonesia's regional water enterprises (PDAM or BUMD Air Minum) combine enterprise management, regional ownership, public budgeting and politically authorised tariffs; Government Regulation No. 54/2017 distinguishes the organs of regional public enterprises (Perumda) from regional limited-liability companies (Perseroda), both analytically distinct from DPRD's legislative and budget roles (Peraturan Pemerintah Nomor 54 Tahun 2017 Tentang Badan Usaha Milik Daerah, 2017). The tariff framework links pricing to public funding: Regulation No. 21/2020, amending Regulation No. 71/2016, requires district or city budget subsidies when tariffs are set below full cost recovery (Article 29A) and addresses restructuring and viability assessment (Article 29B), while the regional head retains tariff-setting authority under Article 25 (Peraturan Menteri Dalam Negeri Nomor 21 Tahun 2020 Tentang Perubahan Atas Peraturan Menteri Dalam Negeri Nomor 71 Tahun 2016 Tentang Perhitungan Dan Penetapan Tarif Air Minum, 2020).

A tariff order, an accounting entry and a bank receipt are distinct events: a decision can authorise a subsidised price without fixing when compensation arrives, and an asset can depreciate while its replacement remains unfunded. These gaps are not intrinsically misconduct, but raise the question of who bears any mismatch. Institutional weaknesses obstruct water-sector progress Evaristo et al. (2023), though governance-sustainability relationships are context-sensitive Bilalova et al. (2024), this study responds through a narrower mechanism, without assuming distress is always political.

Research on creative accrual accounting in the public sector is well documented Bisogno and Donatella (2022), so accounting choices in public water enterprises are not overlooked; the question here is narrower, concerning the link between funding commitments, cash execution and remedies within tariff governance.

Enterprise entity theory is the primary theoretical lens because the unit of accountability is the continuing water-service enterprise rather than any single officeholder. Common-agency theory and institutional theory are used as supporting lenses: common agency explains how multiple principals can generate conflicting objectives and funding uncertainty, while institutional theory explains how formal compliance can become detached from operating practice. Financial modelling then translates those governance conditions into observable cash and debt-service consequences.

Following Alvesson and Sandberg (2020) problematisation approach, this article questions whether public ownership guarantees adequately funded obligations, whether cost recovery equals cash sufficiency, and whether financial engineering is inherently manipulative when transparent cross-subsidies and credible tariff smoothing can allocate risk productively. Prior work has separately examined institutional weaknesses in water governance Evaristo et al., (2023), governance-sustainability relationships Bilalova et al. (2024), public-sector earnings management Bisogno and Donatella (2022), multiple-principal governance Voorn et al. (2019), and political timing in local-service finance (Swianiewicz et al., 2019). However, these streams do not jointly specify how decision-right fragmentation, funding credibility, and managerial-response classification combine to determine whether a tariff-based obligation is financially and accountably discharged. This underspecified connection constitutes the research gap addressed here.

Three questions organise the analysis: RQ1 asks how fragmented ownership, tariff and budget responsibilities generate an accountability gap; RQ2 asks under what conditions financing arrangements preserve service capacity rather than conceal an unresolved funding gap; RQ3 asks how these mechanisms translate into measurable decisions and comparative evidence.

The article offers three contributions: it defines an accountability gap in terms of observable commitments and residual funding exposure; it classifies financial arrangements by economic substance, funding credibility and disclosure rather than by name; and it translates the mechanism into a cash-flow demonstration, falsifiable propositions and an implementation protocol. Methodologically it adopts a theory-synthesis and framework-building approach to conceptual work (Jaakkola, 2020). No utility-level causal effect, prevalence estimate or completed interview study is asserted.

The enterprise perspective distinguishes the water-service organisation from the officeholders who exercise authority over it: Biondi (2020) emphasises the disconnection between equity investment, management and corporate control, and the focus here is continuity

of obligations to customers, creditors, employees and infrastructure beyond any electoral term. Customers provide recurring revenue without becoming equity investors; their accountability claims arise from the service relationship, and future users' interest in renewal gives enterprise continuity an evaluative criterion.

The accountability gap is a mismatch between the authority to approve an obligation, the resources committed to discharge it, and the ability of affected parties to obtain explanation and corrective action; it is not equivalent to poor financial performance, since an emergency may produce a deficit where decision rights are clear, while a surplus may coexist with opaque commitments. Following de Boer (2023), accountability requires an identifiable actor and forum, an obligation to explain, an opportunity for questioning and a remedy.

Panda and Leepsa (2017) review of agency theory provides a starting point for delegated decisions, but public water enterprises involve multiple mandates and principals. The mechanism proposed here is explicit: multiple principals can create conflicting objectives; conflicting objectives can delay or weaken funding commitments; funding uncertainty constrains managerial choices; managerial responses then determine whether the residual gap is disclosed, renegotiated, operationally absorbed, or obscured; and these responses shape the accountability outcome. Voorn et al. (2019) document multiple-principal problems in public-service settings, while Swianiewicz et al. (2019) shows that political timing may affect tariff-related decisions. These theories therefore generate directional expectations rather than serving as general background.

The model distinguishes pressure from response: tariff restraint may create a shortfall, while governance determines how it is addressed. Management can seek an explicit subsidy, phase investment, improve collections or renegotiate – or reporting may obscure the shortage; this range prevents a deterministic claim that low tariffs cause manipulation.

Institutional theory separates adoption of formal structures from their operating effects, patterns documented in recent public-sector applications George et al. (2020) a gap between a performance score and a financial indicator is not automatically ceremonial. Public value supplies the evaluative boundary: following Moore (2021), a response must be judged against public purposes and capacity, not financial optimisation alone, so improving coverage through unaffordable charges is not an unqualified success.

The proposed sequence runs from institutional decision rights and cost conditions, shaping the funding gap and commitment credibility, through agency pressures influencing the managerial response, to cash sufficiency, renewal and service; oversight moderates this path, while customer density, asset condition and household income remain contextual (Figure 1).

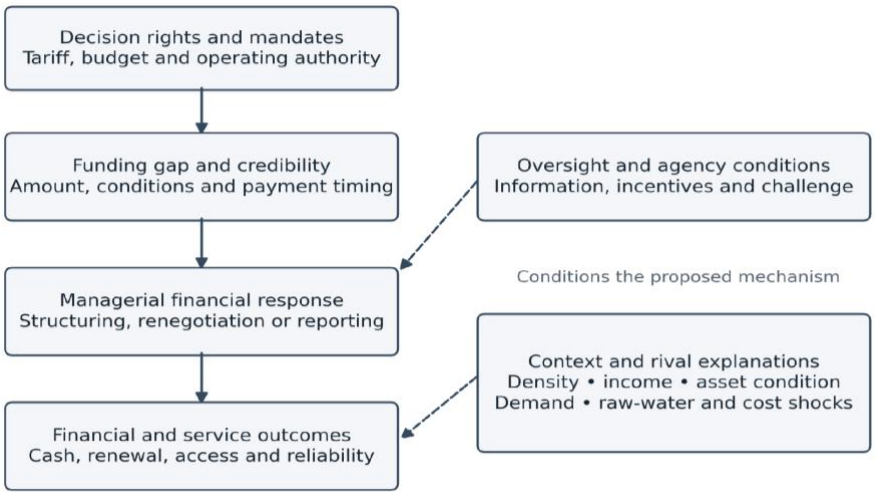

Figure 1. Proposed Accountability Mechanism
Source: Author-developed conceptual model.
Solid arrows show the proposed sequence; dashed arrows indicate conditioning influences. This is a conceptual model, not an estimated causal graph

Table 1 sets out the constructs of the mechanism and the evidence that would count for each.

Table 1
Constructs and Observable Evidence

Construct	Operational definition	Evidence required
Decision-right fragmentation	Separation of tariff approval, budget execution and enterprise management	Statutes, delegations, tariff and budget timelines
Funding credibility	Probability and timing of an authorised payment becoming usable cash	Appropriation, agreement, conditions, due date and bank receipt
Agency pressure	Documented conflict between assigned objectives and incentives	Minutes, performance contracts and corroborated accounts
Financial response	Change to price structure, cash timing, financing or recognition	Tariff schedules, contracts, ledger entries and cash bridge
Oversight effectiveness	Ability to identify a mismatch and require correction	Challenge records, audit follow-up and closure evidence
Financial-service outcome	Joint change in cash capacity, renewal and service access	Cash records, renewal plan, service tests and household bills

Source: Author-developed operationalisation. These are proposed constructs, not measured variables in a completed sample

1) Proposition 1: where tariff restraint creates a shortfall, an explicit and timely funding commitment should weaken the association between restraint and service-adjusted cash deficits.
2) Proposition 2: under similar funding pressure, effective challenge and disclosure should shift responses towards explicit renegotiation rather than unsupported reporting adjustments.
3) Proposition 3: apparent improvement in accounting performance without additional receipts or reduced cash costs should not improve contemporaneous debt-service capacity – a cash-identity prediction.
4) Proposition 4: the effectiveness of cross-subsidies should depend on customer mix, demand response and collection behaviour; raising the tariff of a small commercial segment may yield little durable compensation if customers reduce demand or leave the network.
5) Proposition 5: packages that explicitly protect renewal and basic service should be more resilient to shocks than those evaluated only against reported operating profit – requiring a horizon sufficient to observe renewal and service effects.

METHOD

This article is a conceptual study of the theory-synthesis and framework-building type, in which the contribution lay in integrating previously separate literatures into a testable structure rather than reporting new observations (Jaakkola, 2020; Rocco et al., 2022). The evidence base was assembled through a targeted, non-PRISMA review of peer-reviewed scholarship, official Indonesian regulations, international accounting standards, and sector-governance reports. Searches were conducted using combinations of the terms 'public water utility' OR 'water utility governance' with 'tariff', 'subsidy', 'accountability', 'multiple principals', 'earnings management', 'cash flow', and 'debt service'. The review focused primarily on sources published between 2016 and 2026, while retaining earlier foundational works where conceptually necessary. The final analytical corpus comprised the sources cited in the reference list. Because the original search was targeted rather than systematic and no complete search log was retained, database-level retrieval counts were not reported, as doing so would have created false precision. Selection prioritised direct relevance to decision rights, funding credibility, public-enterprise governance, or the financial identities used in the model, together with traceable legal and reporting authority.

The analysis comprised four documented activities. First, a claim audit was conducted to

verify numerical statements and legal propositions against traceable sources. Second, conceptual synthesis assigned enterprise entity theory the primary explanatory role, while common-agency and institutional theory were used only where they generated distinct predictions about the underlying mechanisms. Third, financial reconstruction distinguished accrual-based cost recovery from actual cash requirements and specified the financial identities governing receipts, renewal expenditure, and debt service. Fourth, deterministic scenario analysis applied these identities to author-constructed values selected to demonstrate sensitivity to the underlying mechanisms rather than to represent any named utility. Scenario parameters were selected to ensure internal coherence and permit transparent recalculation; every input, equation, and assumption was disclosed in the manuscript or Supplementary Material B. The proposed empirical protocol was not executed, and the scenarios were designed to test internal logic rather than prevalence or causal effects.

The empirical scope was deliberately narrow. Aggregate regional tabulations of utility financial health could not be reconciled with publicly available sources at the utility-year level and were therefore excluded. No national prevalence claim was made, as such a claim would have required a documented crosswalk, a regulation register, and traceable coding records, none of which were available. Ratios were also easily conflated: for an average tariff of IDR 5,281 against a cost of IDR 5,948, the shortfall represented approximately 11.21% of the cost, whereas the increase required to close that gap was approximately 12.63%—two figures that addressed different questions. Accusatory labels such as fictitious subsidy receivables required stronger evidence than aggregate stress indicators could provide. Accordingly, responses were classified using a typology and explicit evidentiary criteria. Recognising a receivable could not generate cash, but the absence of cash did not, by itself, establish that the receivable was fictitious.

The analytical strategy was abductive: theory proposed a mechanism, observable implications identified what would constitute supporting evidence, and competing explanations constrained interpretation. This approach combined thematic analysis, pattern matching, and explanation building (Braun & Clarke, 2019; Yin, 2018). Gioia (2021) offered a transparency-oriented approach to constructing inductive data structures; however, first-order concepts could not be reconstructed from national ratios and presented as participants' accounts. Therefore, no such concepts were reported in this study. Quality control rested on traceability: every scenario followed the same financial identities and units, and no statistical association was claimed in the absence of an appropriate dataset. Enworo (2023) trustworthiness criteria informed the proposed future fieldwork design rather than being used to certify interviews that had not taken place.

The intended empirical extension was an embedded, explanatory study of three to four regional water utilities, with each utility serving as a case and a tariff-funding decision episode constituting the embedded unit. Maximum-variation selection would be used to contrast funding credibility and oversight effectiveness (Eisenhardt, 2021; Yin, 2018). Evidence would be drawn from documentary records, financial reconciliation, and semi-structured interviews with management, supervisory bodies, budget authorities, auditors, and customers (Malterud et al., 2016). The evidence would be analysed abductively and triangulated across sources. Case-selection, interview, and ethics provisions were provided in Supplementary Material A.

RESULTS AND DISCUSSION

Results

Separating Accrual Recovery from Cash Sufficiency

A regulatory revenue requirement and a cash financing plan answer different questions. A stylised accrual requirement can be written as Equation 1, an analytical benchmark rather than a replacement for the applicable Indonesian tariff formula.

$$RR(t) = O(t) + D(t) + r(t) \times RAB(t) + Tax(t) - OtherRevenue(t) \quad (1)$$

Here O is operating expenditure, D regulatory depreciation, RAB the asset base and r an allowed return; financing costs sit in the return allowance and must not be added again, and capital expenditure entering both the asset base and the revenue requirement would double count recovery. Indonesian legal cost categories must be reconciled separately to this benchmark.

For cash analysis, billed tariff revenue is $B(t) = \Sigma P(g,t)Q(g,t) + F(t)$, where F denotes fixed-charge billings, and cash receipts C(t) comprise current-billing collections, arrears recovery and

other actual receipts, after refunds. A simple collection coefficient C(t) = c(t)B(t) is valid only for the simplified scenarios below, which exclude opening arrears; credited and cash subsidies must be recorded separately.

$$SCFADS(t) = C(t) + S_{cash}(t) - O_{cash}(t) - Tax_{cash}(t) - K_{critical}(t) \quad (2)$$

SCFADS denotes service-adjusted cash flow available for debt service; $K_{critical}$ is essential renewal paid from operating resources, excluding amounts already counted in operating maintenance. Because actual receipts and payments are used, no additional working-capital deduction is made; starting instead from an accrual surplus requires adjusting working capital and removing non-cash items, and the two routes should not be mixed.

$$DSCR_{service}(t) = SCFADS(t) / [Interest(t) + Principal(t)] \quad (3)$$

$$ClosingCash(t) = OpeningCash(t) + SCFADS(t) - DebtService(t) - K_{growth}(t) + NewDebt(t) + Equity(t) + CapitalGrants(t) - Distributions(t) \quad (4)$$

Equation 3's coverage ratio is analytical; lender covenants may define CFADS differently. A ratio below one indicates a shortage against included debt service; above one does not establish adequate liquidity or solvency, and debt-free utilities should report it as not applicable, using minimum cash and renewal coverage instead.

A loan-life coverage ratio divides discounted forecast cash over the remaining loan life by outstanding debt; it cannot be derived from a single annual ratio and requires discount rates, maturities and the lender's CFADS definition, none invented here.

A Classification Based on Substance and Evidence

Financial engineering is used here in the broad sense of structuring cash flows and contractual obligations (McArthur, 2024), classification asks whether an arrangement has a valid basis, credibly funds the obligation, and discloses who bears the residual risk. Cross-subsidies sustain low-cost basic service while the contributing segment remains willing to pay but become fragile as demand contracts, so assessment should compare actual household bills, not headline tariffs. Tariff smoothing is credible only with an explicit funding bridge and feasible recovery path; government-assistance recognition requires an applicable reporting basis, for which IAS 20 is a reference pending confirmation of the Indonesian framework (Foundation, 2026b). Useful-life changes may be justified by engineering evidence Foundation (2026a) and become a substantiated concern only once policy, asset condition and transaction evidence are examined Bisogno and Donatella (2022). Debt restructuring shifts timing but cannot remove an operating deficit, and off-balance-sheet commitments require a complete obligations register. Table 2 summarises the classification tests applied to each financial arrangement.

Table 2
Financial Arrangements and Classification Tests

Arrangement	Potentially legitimate function	Evidence that changes the assessment
Cross-subsidy and fixed charges	Distribute costs and support basic consumption	Household bills, customer mix, demand response and disclosure
Tariff smoothing	Phase a price adjustment over time	Funded bridge, recovery schedule and present-value reconciliation
Debt restructuring	Match payment dates to feasible receipts	Creditor agreement, total financing cost and post-restructuring cash
Subsidy recognition	Record an eligible and supportable public payment	Legal entitlement, conditions, collectability and receipt timing
Asset-life or capitalisation changes	Reflect revised estimates or qualifying assets	Engineering support, accounting policy and audit trail
Contractual or contingent finance	Procure investment and allocate risks	Guarantees, minimum payments, consolidation and full obligations

Source: Author-developed typology. Inclusion does not establish that an arrangement occurred in any sampled utility

Reproducible Scenario Demonstration

Baseline parameters are set within ranges commonly reported for medium-sized Indonesian water utilities in national sector performance reporting, so the scenarios stress-test a recognisable operating profile; they remain constructed values, not measurements of any utility. The stylised utility produces 10 million cubic metres annually, with 34% non-revenue water, a tariff of IDR 5,000/m^3, 95% collection, no fixed charges or arrears, operating cash expenditure of IDR 24 billion, renewal of IDR 4 billion and debt service of IDR 5 billion; taxes and new financing are zero. Losses are modelled as a single proportion; real NRW has physical and commercial components not convertible one-for-one into saleable volume. Expenditure is constant except in the cost shock, and the integrated package adds IDR 1 billion of renewal. Table 3 reports the resulting cash position for each scenario.

Table 3

Illustrative / Hypothetical Scenario Results for the Stylised Utility

Scenario	Billed volume (m m^3)	Tariff (IDR/m^3)	Collect-ion rate	Tariff receipts	Cash subsidy	Opex + critical renewal	SCFADS	Coverage (×)	Surplus/ (shortfall)	$S_{required}$ (k = 1.20)
Baseline	6.6	5,000	95%	31.350	0.0	28.0	3.350	0.670	(1.650)	2.650
Subsidy recognised, not received	6.6	5,000	95%	31.350	0.0	28.0	3.350	0.670	(1.650)	2.650
Subsidy paid (IDR 3 bn)	6.6	5,000	95%	31.350	3.0	28.0	6.350	1.270	1.350	2.650
Tariff increases 10%	6.6	5,500	95%	34.485	0.0	28.0	6.485	1.297	1.485	0.000
NRW falls to 29%	7.1	5,000	95%	33.725	0.0	28.0	5.725	1.145	0.725	0.275
Integrated package	7.1	5,250	97%	36.157	0.0	29.0	7.157	1.431	2.157	0.000
Integrated package + 10% cost shock	7.1	5,250	97%	36.157	0.0	31.4	4.757	0.951	(0.243)	1.243

Note: Cash amounts in IDR billion. Production 10 million m^3; debt service IDR 5 billion in every scenario. Operating cash cost is IDR 24 billion (IDR 26.4 billion under the cost shock); critical renewal is IDR 4 billion (IDR 5 billion in the integrated package). Coverage = SCFADS ÷ debt service. S required = max [0, k × debt service − SCFADS before subsidy]. A recognised but unreceived subsidy leaves every cash figure equal to the baseline. Values are author-constructed illustrations, not estimates for any utility; all inputs and formulas are reproduced in Supplementary Material B.

Source: Author calculations

As the illustrative Table 3 shows, the baseline constructed scenario produces a shortfall of IDR 1.65 billion after debt service; booking an unreceived subsidy leaves this unchanged, a paid subsidy of IDR 3 billion raises coverage to 1.27, and a 10% tariff increase gives 1.297. Loss reduction alone reaches 1.145, below an illustrative 1.20 threshold. The integrated package reaches 1.43, demonstrating complementarity only within the stated assumptions, not an estimated interaction in real utilities. A 10% cost increase reduces coverage to 0.951. These calculations are analytical stress tests: they identify which variables require empirical measurement and must not be interpreted as observed PDAM/BUMD performance.

Tariff Smoothing and Intertemporal Value

Deferring a benchmark tariff of IDR 5,500/m^3 from year 1 to year 2 reduces year-1 collections by IDR 3.135 billion; at an illustrative 8% discount rate, replacing this a year later requires IDR 3.3858 billion, implying a catch-up tariff of IDR 6,040/m^3 [$-3.135/1.08 + 3.3858/1.08^2 = 0$, in billions]. Value equivalence does not establish feasibility: the utility may lack cash before the catch-up receipt arrives, future households may be unable to absorb a larger bill, and a bridge loan's interest and repayment must enter the cash model, so present-value, liquidity and affordability conditions must hold simultaneously.

Distributional and Temporal Sensitivity

A 5% average tariff change does not raise every bill by 5%, since block tariffs and assistance eligibility change incidence; a household using 10 m^3 monthly moves from an IDR 50,000 to an IDR 52,500 bill as the tariff rises to IDR 5,250/m^3, shifting the bill-to-income ratio from 2.50% to 2.625% at IDR 2 million monthly income. Annual coverage can also conceal seasonal shortages, so an applied model should run monthly cash balances and vary subsidy delay, demand elasticity and collection performance.

Extending the Instrument Set: Ring-Fencing, Contracting and Covenant Design

The classification evaluates arrangements the utility already uses. It also identifies three instruments following from the cash identity that practice underuses, each attaching a funding commitment to an enforceable mechanism rather than an intention.

First, ring-fenced renewal funding. Because $K_{critical}$ is deducted before coverage is computed, renewal competes with every other payment when cash is short, and loses. A restricted account funded automatically as a fixed share of receipts, rather than by a year-end transfer decision, converts renewal from a discretionary residual into a prior claim. The share should follow the costed asset plan, not accounting depreciation; withdrawal rules and the authority able to waive them must be documented, because a reserve management may quietly redirect gives disclosure without protection.

Second, performance-based contracting for loss reduction. Reducing non-revenue water raises receipts only where recovered water becomes billed and collected consumption – precisely the quantity a contractor can be paid against. A shared-savings contract remunerating the counterparty from verified incremental collected revenue over an agreed baseline transfers delivery risk to the party able to manage it and avoids capitalising an unrealised saving. It requires an audited water balance and agreed baseline before signature; without them it relabels an uncertain forecast as a liability.

Third, covenant design. Lenders typically test accrual ratios that a recognised but uncollected subsidy receivable can satisfy while the borrower cannot pay. Because $DSCR_{service}$ is computed from actual receipts and payments net of essential renewal, it cannot be satisfied by a recognition entry, making it a candidate covenant for creditors seeking exposure to service capacity rather than reported surplus. Adoption would require agreement on $K_{critical}$ and restricted balances, turning funding credibility into a contractual condition. The same logic extends to blended structures releasing concessional funding against verified service and renewal delivery.

Discussion

Explaining the Accountability Mechanism

RQ1 is answered by locating the mismatch between authority, funding and remedy: the tariff-setting actor determines the revenue constraint while another process controls budget execution and management remains responsible for continuity, exposing the enterprise to an unfunded obligation – not public ownership itself, but the failure to connect these decisions. This extends the agency account by recognising that an agent may face genuinely incompatible public mandates rather than simply prefer private benefit: reported compliance is inadequate evidence of alignment when cash commitments remain unresolved, while documented renegotiation can demonstrate responsible management even when a target is missed.

RQ2 is answered by distinguishing arrangement form from economic effect: cross-subsidy, smoothing and restructuring are evaluated against their funding basis and residual risk, and the same instrument can be stabilising in one setting and fragile in another, so accounting presentation, annual cash capacity and intertemporal value cannot be treated as substitutes.

Novelty and Limits of the Contribution

The contribution to financial engineering is specific. First, the paper reclassifies utility financial arrangements by funding credibility and residual risk rather than instrument name, so the same device – cross-subsidy, smoothing, restructuring – is judged by whether an identified party has committed resources on enforceable terms. Second, it specifies a coverage measure a recognition entry cannot satisfy: built from actual receipts and payments net of essential renewal, SCFADS closes the route by which an accrual subsidy receivable improves a reported ratio without improving capacity, making it usable as a covenant rather than only a statistic. Third, it binds these

tests to non-compensatory gates and to instruments – ring-fenced renewal, shared-savings loss contracts, service-adjusted covenants – that attach the commitment at the point of decision. The claim, offered for testing, is that this integration exposes obligations existing indicator systems record separately and fail to connect.

International Relevance and Boundary Conditions

The mechanism is potentially relevant wherever tariff authority, budget responsibility and operational delivery are separated; transferability depends on comparable decision rights, not Indonesian terminology, and the OECD (2024) guidelines offer a governance benchmark rather than a substitute for national law. Application is narrower where a regulator holds binding revenue-setting authority, and physical circumstances matter: a high-cost, low-density area may need sustained public funding even under strong governance.

Limitations

The article offers no verified national panel or completed fieldwork, and its literature review is not exhaustive; the deterministic model cannot identify causal effects, estimate prevalence, rank regions or establish an optimal tariff, and its governance constructs require empirical calibration. These limitations define the next test: an empirical study should establish whether the accountability gap is observed consistently, whether alternative mechanisms explain the same events, and whether the proposed process improves forecasts and follow-up.

Practical Implications: A Measurable Decision Protocol

Sequential Gates Rather than a Compensating Score

RQ3 is addressed through six sequential gates that prevent strong performance on one dimension from offsetting failure of a basic legal or service condition. Each gate has a decision owner, observable evidence and a response to failure; thresholds in Table 4 are proposed planning rules, since binding legal, service and contractual requirements take precedence, and the protocol should be piloted before adoption.

Table 4
Sequential Decision Gates, Owners and Evidence

Gate	Condition tested	Decision owner	Evidence and indicators
1. Legal validity	The tariff decision and any compensating subsidy rest on a valid legal basis	Legal and finance; approved by the competent body	Tariff decision and approval record; applicable tariff regulation; binding legal requirements take precedence
2. Cost efficiency	Cost assumptions behind the tariff are efficient	Operations and finance, with independent challenge	Documented cost assumptions and record of independent challenge
3. Affordability	Basic-service bills remain affordable for low-income households	Customer and social-policy input	Actual household bills at basic consumption, including fixed charges; bill-to-income ratio
4. Funding credibility	A below-cost tariff is matched by an enforceable, timely funding commitment	Treasury, reviewed against actual agreements	Subsidy agreement, due date and bank receipt; on-time subsidy execution; unrestricted cash days (proposed floor: 30 days); service-adjusted coverage (proposed buffer: 1.20)
5. Renewal	Critical renewal is funded rather than deferred	Engineering	Costed asset plan; renewal coverage (funded critical renewal ÷ approved requirement)

Gate	Condition tested	Decision owner	Evidence and indicators
6. Accountability	Mismatches are explained and corrected	Supervisory body	Obligations register; reconciliation status; challenge records; corrective-action completion

Note: Thresholds are proposed planning rules subject to piloting and local calibration; binding legal, service and contractual requirements take precedence.
Source: Author-developed protocol

Gate 1 (legal validity) sits with legal and finance, approved by the competent body; Gate 2 (cost efficiency) involves operations and finance with independent challenge of cost assumptions; Gate 3 (affordability) needs customer and social-policy input; Gate 4 (funding credibility) is a treasury task reviewed against actual agreements; Gate 5 (renewal) requires engineering ownership; and Gate 6 (accountability) belongs to the supervisory body.

Indicators with Denominators and Action Rules

A practical dashboard should report unrestricted cash days, renewal coverage (funded critical renewal over the approved requirement) and on-time subsidy execution (cash paid by the due date over subsidy due, marked not applicable rather than 100% when nothing is due), each with its source, period, responsible officer and reconciliation status. Collection performance should separate current invoices from arrears recovery; NRW should carry the audited water balance; water-quality compliance needs the parameter, testing frequency and standard, with missing tests never counted as compliant. Initial implementation can adopt a 30-day unrestricted-cash floor and a 1.20 coverage buffer, subject to local calibration: a forecast breach triggers review before default, and no composite score may allow high collections to cancel a critical water-quality failure.

Implementation Sequence and Institutional Feasibility

Implementation can proceed in stages: within 30 days, management establishes the obligations register and reconciles billing, collection, subsidy status and critical renewal; by day 60, finance and operations produce a monthly baseline and downside cases while customer representatives review basic-service bills; by day 90, the competent bodies approve a funded package with assigned actions, followed by quarterly reviews of forecast against actual cash and service. These are proposed milestones, not achievements.

Gates 4 and 6 are politically exposed, because a regional head can gain electorally from restraining tariffs while deferring the compensating budget, and the utility absorbs the difference; a protocol relying on voluntary compliance here will not bind. The realistic levers are external: making the reconciliation of authorised subsidy against cash actually released an explicit object of statutory audit, so non-execution becomes reportable; incorporating funded-commitment execution into the governance indicators against which regional administrations are already assessed; and conditioning discretionary central transfers for water infrastructure on evidence that authorised compensation was disbursed. Each needs a legal basis and risks penalising service users for their government's default, so sequencing matters. Gate 4 becomes credible only when non-payment carries a cost for the party that authorised the tariff.

Evaluating Whether the Protocol Works

The pilot should predefine outcomes – documentation completeness, cash forecast error, on-time subsidy execution, funded-renewal delivery and corrective-action completion – assessed jointly with continuity, quality and affordability, since reduced forecast error alone does not establish improved service. An initial evaluation can compare decision episodes before and after implementation within each utility, controlling for concurrent changes in demand and funding, prioritising mechanism evidence over regressions with inadequate observations. The intended result is a replicable decision process whose benefits and limits can be observed, not a promise of reform.

CONCLUSION

The central governance problem in tariff-based public water finance is the connection between authorised obligations and credible resources. This article develops an enterprise-centred mechanism in which fragmented decision rights can create a funding gap, common-agency pressures influence managerial response, and oversight affects whether the residual exposure is transparently disclosed and remedied. The conceptual and numerical analysis shows that tariff changes, loss reduction, and subsidy payments have different cash effects, while apparent accrual improvement without receipts cannot by itself strengthen debt-service capacity. The scenario results are conditional illustrations rather than utility estimates.

The article contributes a classification of financial arrangements by economic substance, funding credibility, and disclosure; a service-adjusted coverage measure linking renewal and debt service; and a sequential protocol connecting authority, efficient cost, affordability, cash sufficiency, renewal, and accountability. Its principal limitation is the absence of utility-level empirical validation. Future research should test the propositions through comparative decision episodes in three to four regional water utilities using reconciled monthly cash data, documentary evidence, and interviews, including sensitivity to subsidy delay, demand response, collection performance, and oversight quality. Practical implementation belongs in the framework's implications: authorised subsidies should be reconciled to cash released, critical renewal should be ring-fenced, and service-adjusted coverage should complement accrual ratios in monitoring.

ACKNOWLEDGEMENT

The authors would like to thank the Indonesian Water Supply Companies Association (Perkumpulan Perusahaan Air Minum Seluruh Indonesia/PERPAMSI) and the Ministry of Public Works and Housing (Kementerian Pekerjaan Umum dan Perumahan Rakyat/PUPR) of the Republic of Indonesia for their support in the completion of this article. This research received no specific grant from any public, commercial or not-for-profit funding agency.

AUTHOR CONTRIBUTION STATEMENT

The first author was responsible for the conceptualisation, theoretical framework and writing of the article. The second author contributed to editing and layout of the manuscript.

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