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Organizational Modes and Water Service Performance: A 1995–2025 Meta-Analysis and Implications for PPPs and Regional Multiservice Companies (SRMs) in Morocco

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Abstract

Across LMICs, water governance varies; Morocco combines public régies, ONEE, delegated PPPs, and new SRMs, complicating evidence on "what works". Following PRISMA, a meta-analysis (1995–2025; 173 studies; 742 effects) harmonized efficiency, access, quality, equity, environmental, and governance outcomes with moderators. Pooled results favor PPP/delegated modes for efficiency (g≈0.22) and modestly for access and quality; equity tends negative; environmental effects are near zero. Regulatory capacity, KPI breadth, and yardstick competition strengthen performance; ownership alone is not decisive. In Morocco, SRM regionalization should embed transparent benchmarking and social tariffs to balance efficiency with inclusion.

Keywords: PPP; delegated management; SRM; yardstick competition; Morocco

Introduction

Across low and middle-income countries, the delivery of water and sanitation has oscillated between public, private, and hybrid arrangements,

with Morocco epitomizing this plural landscape through municipal régies, national provision by ONEE, long-term delegated management to private operators in major cities, and, most recently, the creation of regional multi-service companies (Sociétés Régionales Multiservices, SRM) to coordinate water, sanitation and electricity at a larger territorial scale (Bakker, 2010; Ménard, 2013). Consequently, debates on "what works" have often been polarized, pitting efficiency and investment arguments for public-private partnerships (PPPs) against equity and accountability concerns in favor of direct public provision (Hodge & Greve, 2007; Roehrich, Lewis, & George, 2014).

Yet, these debates increasingly converge on a nuanced proposition: organizational modes perform conditionally. That is, performance varies with asset specificity, contractual completeness, regulatory capacity, demand risk, and the intensity of yardstick competition among providers (Williamson, 1985; Hart, 2003; Laffont & Tirole, 1993). Accordingly, this article undertakes a meta-analysis to synthesize the comparative performance of organizational modes in water services, while situating Morocco as a crucial contextual testbed where multiple modes operate concurrently and are being re-regionalized. Meta-analysis is appropriate because the empirical literature reports heterogeneous estimates across methods, geographies, and indicators (Hodge & Greve, 2017). Furthermore, by modeling moderators (e.g., contract length; tariff regulation; social context), we can explain when and why a given mode outperforms alternatives (Bartik, 2012; Duvanova, 2014).

Problem statement

Despite abundant case studies and policy reports, decision-makers lack consolidated evidence on how alternative organizational modes compare on multi-dimensional outcomes—efficiency, access, quality, equity, environmental sustainability, and governance integrity—particularly in settings where modes coexist and compete, as in Morocco (Bakker, 2010; Ménard, 2013). Put differently, stakeholders know what arrangements exist, but not under which conditions each excels.

Hypotheses

Building on transaction-cost, principal–agent, property-rights, and relational contracting theories, we advance five testable hypotheses:

- **H1 (Efficiency):** Relative to direct public provision, long-term PPPs/concessions yield higher operational efficiency when asset specificity is high and performance is contractible, but the effect weakens under low regulatory capacity (Williamson, 1985; Hart, 2003; Laffont & Tirole, 1993).

- **H2 (Access & Quality):** Delegated management improves network expansion and service quality when tariff adjustment and investment obligations are credibly enforced; otherwise, expansion lags or cost recovery deteriorates (Guasch, 2004; Hodge & Greve, 2007).
- **H3 (Equity):** Public or community-based modes outperform on affordability and pro-poor coverage when cross-subsidies and social tariffs are embedded in institutional mandates (Ostrom, 1990; Bakker, 2010).
- **H4 (Environmental outcomes):** Performance on non-revenue water and wastewater treatment depends less on ownership and more on incentive alignment, data transparency, and sanctions; thus, mode effects are mediated by governance quality (Roehrich et al., 2014; Helm, 2010).
- **H5 (Competition between modes):** Yardstick competition—via benchmarking across coexisting régies, ONEE branches, PPPs, and SRMs—raises average performance when indicators are published and tied to rewards/penalties (Shleifer, 1985; Ménard, 2013).

A. Theoretical Foundations of Organizational Modes and PPP Performance

I. Conceptual Framework

We define organizational modes in urban water services as governance arrangements that structure rights, obligations, risk allocation, and accountability between public authorities, operators, and users, ranging from in-house municipal régies and national public utilities to delegated management (affermage/concession), PPPs, and community-based organizations (Bakker, 2010; Ménard, 2013). Crucially, modes are not mere ownership labels; they embed incentive systems, information flows, and enforcement technologies that shape behavior and outcomes (Williamson, 1985; Hart, 2003).

In meta-analytic terms, the primary outcomes include: (a) efficiency (operating cost per m^3, labor productivity, non-revenue water); (b) access (household connections, coverage rates); (c) quality and continuity (hours of supply, pressure, compliance with standards); (d) equity and affordability (share of low-income households connected; tariff incidence); (e) environmental sustainability (wastewater treatment coverage, energy intensity, leakage); and (f) governance/process (contract compliance, transparency, user satisfaction) (Hodge & Greve, 2017; OECD, 2015). For comparability, we translate diverse indicators into standardized effect sizes and model moderators (e.g., contract type; regulatory design; local capacity) (Lipsey & Wilson, 2001; Stanley & Doucouliagos, 2012).

Table 1. Core Organizational Modes in Urban Water and Their Boundary Conditions

Mode	Ownership & Control	Typical Contractual Form	Risk Allocation	Boundary Conditions (when mode fits)
Municipal régie/in-house	Public	Administrative (no market tender)	Public bears demand & investment risk	Small/medium systems; strong municipal capacity; equity mandate
National public utility (e.g., branch of a state utility)	Public	Administrative; service agreements	Public bears most risks; inter-jurisdictional pooling	Economies of scale; cross-subsidies; nationwide standards
Delegated management (affermage/concession)	Private operator; public owner of assets	Competitive tender with KPIs	Operator bears O&M (affermage) and often investment (concession)	High asset specificity; need for managerial expertise; enforceable KPIs
PPP (project/company)	Mixed	Project finance/SPV; long-term	Shared risks via contracts	Large capex; bankability; credible regulation
Community-based/non-profit	Collective	Social contract; MoUs	Shared; often subsidized	Remote areas; social capital; modest technical complexity

Source: Authors' synthesis drawing on Williamson (1985); Laffont & Tirole (1993); Hart (2003); Bakker (2010); Ménard (2013).

In addition, we conceptualize competition between modes as (i) ex ante competition for the market (tendering); (ii) ex post yardstick competition through benchmarking across operators; and (iii) institutional competition as authorities compare governance templates (Shleifer, 1985; Estache & Rossi, 2002). This triadic view is essential for Morocco, where régies, ONEE branches, legacy delegated contracts, and SRMs coexist within overlapping jurisdictions and multi-level regulatory arrangements (Ménard, 2013; Hodge & Greve, 2017).

Finally, because institutions matter, we treat regulatory capacity, contractibility of outputs, and socio-political accountability as moderators of mode performance. Thus, the meta-analytic model includes interaction terms between mode dummies and proxies for governance quality and market structure (Kaufmann et al., 2010; Roehrich et al., 2014).

II. Economic and Organizational Theories of PPP

Transaction-Cost Economics (TCE)

TCE predicts that as asset specificity and uncertainty rise, governance should migrate toward arrangements that minimize maladaptation and renegotiation costs, typically via long-term contracts with credible

safeguards or vertical integration (Williamson, 1985). In water services, distribution networks are highly specific and sunk, making opportunism via hold-up a salient hazard; PPPs/concessions may economize on political transaction costs when contracts include adaptive clauses and enforceable KPIs, but weak regulation can flip the result (Williamson, 1985; Ménard, 2013). Therefore, H1 follows: PPPs outperform public management on efficiency under high specificity and credible enforcement, but not otherwise (Williamson, 1985; Guasch, 2004).

Principal–Agent Theory

Because service quality and maintenance effort are only imperfectly observable, incentive contracts with monitoring and penalties should align operator effort with social objectives; however, multi-tasking (e.g., balancing cost minimization with quality) creates trade-offs (Holmström & Milgrom, 1991). In water, tariff paths and investment obligations must be paired with quality audits and user complaint mechanisms to avoid skimping on maintenance; absent this, efficiency gains may come at the expense of service quality or equity (Laffont & Tirole, 1993; Estache & Rossi, 2002). Hence H2 and H3 emerge: quality and access gains materialize only if incentive compatibility extends beyond cost metrics and embeds equity instruments (Laffont & Tirole, 1993; Hodge & Greve, 2007).

Incomplete-Contracting and Property-Rights

Because it is impossible to foresee all contingencies, water contracts are necessarily incomplete; the allocation of residual control rights (who decides when the contract is silent) shapes adaptation and innovation (Hart, 2003). Public ownership can protect social objectives but may dampen dynamic efficiency; private residual control can spur process innovation but risks under-providing non-contractible quality without strong oversight (Hart, 2003). The net performance effect thus hinges on regulatory competence and reputational capital (Hart, 2003; Spiller, 2013).

Relational Contracting and Hybrid Governance

Long-horizon projects depend on trust, dispute-resolution routines, and joint problem-solving; hybrid forms—typical of PPPs—thrive when formal contracts are complemented by relational governance and transparent performance dialogues (Baker, Gibbons, & Murphy, 2002). Where public capacities are thin, formal PPPs can underperform unless embedded in communities of practice (Ménard, 2013; Roehrich et al., 2014).

Public Value and Commons Perspectives

Beyond efficiency, water is a merit good and often a commons linked to human rights and environmental externalities; therefore, governance must protect equity, participation, and ecological integrity (Ostrom, 1990; Bozeman, 2007). Community-based management can be effective where social capital and monitoring are strong, but faces scale and technical constraints; conversely, large utilities—public or private—can pool risks and finance but may drift from local priorities (Bakker, 2010; Ostrom, 2010).

Across these lenses, the expected mode effects are conditional: PPPs dominate on efficiency when enforcement is credible; public/communal modes dominate on affordability and inclusion when mandates and subsidies are explicit; yardstick competition and transparency shift all modes upward (Hodge & Greve, 2017; Roehrich et al., 2014). These theoretical priors structure our coding of moderators and subgroup analyses. *(Baker et al., 2002; Bakker, 2010; Bozeman, 2007; Estache & Rossi, 2002; Guasch, 2004; Hart, 2003; Holmström & Milgrom, 1991; Laffont & Tirole, 1993; Ménard, 2013; Ostrom, 1990; Roehrich et al., 2014; Spiller, 2013; Williamson, 1985).*

Table 2. Theoretical Lenses and Testable Implications for Mode Performance

Theory	Core Mechanism	Implication for Water Services	Meta-analytic Moderator(s)
Transaction-Cost Economics	Safeguards minimize maladaptation	PPP/concession efficient with high asset specificity **and** credible enforcement	Contract length; dispute mechanisms; regulator independence
Principal–Agent	Incentives + monitoring align effort	Quality & access gains only with multi-task incentives and audits	KPI breadth; penalties; user-feedback systems
Incomplete Contracts/Property Rights	Residual control affects adaptation	Private control spurs innovation; risks under-provision of non-contractible quality	Tariff regime; quality audits; renegotiations
Relational Contracting	Trust and routines sustain cooperation	Hybrid forms perform when formal rules + relational norms cohere	Operator tenure; joint committees; transparency
Public Value/Commons	Equity and stewardship as objectives	Public/community modes protect affordability & inclusion with mandates	Social tariffs; subsidies; participation mechanisms
Yardstick Competition	Benchmarking disciplines all modes	Publication + incentives raise performance across the board	Benchmarking coverage; reward/penalty linkage

Source: Authors' synthesis based on Williamson (1985); Laffont & Tirole (1993); Hart (2003); Baker et al. (2002); Bozeman (2007); Ostrom (1990); Shleifer (1985); Hodge & Greve (2017); Roehrich et al. (2014).

Table 3. Performance Dimensions and Typical Indicators Used in Meta-analyses

Dimension	Illustrative Indicators	Notes on Harmonization
Efficiency	OPEX/m³; staff/1,000 connections; NRW (%)	Standardize to Hedges g; directionally align lower-is-better
Access	% households connected; new connections/year	Adjust for baseline coverage; control for urbanization
Quality/Continuity	Hours/day; pressure compliance; microbiological standards	Convert to standardized mean difference; quality composite
Equity/Affordability	Share of low-income connected; bill/income; pro-poor tariff share	Use income-normalized affordability thresholds
Environmental	Wastewater treatment coverage; leakage; energy intensity	Normalize by service area and climate zone
Governance/Process	Contract compliance; audits; satisfaction scores	Treat as ordinal; use robust variance estimation

Source: Authors' synthesis based on Hodge & Greve (2017); OECD (2015); Roehrich et al. (2014). *(Baker et al., 2002; Bozeman, 2007; Hodge & Greve, 2017; Laffont & Tirole, 1993; OECD, 2015; Ostrom, 1990; Roehrich et al., 2014; Shleifer, 1985; Williamson, 1985).*

III. Models of Competition Between Organizational Modes

Competition for the market

In concession or affermage systems, tendering is the primary competitive instrument: bidders compete on tariffs, investment, and service KPIs; the winner obtains a temporary monopoly (Demsetz, 1968). Transparent pre-qualification, performance-based selection, and credible threat of non-renewal determine discipline ex post (Guasch, 2004). In meta-analysis, we code the tender quality (open vs. direct award; number of bidders) to capture ex ante competition intensity (Estache & Rossi, 2002; Guasch, 2004).

Yardstick competition

Where multiple operators coexist across territories—public or private—benchmarking creates reputational and political pressure; if benchmarks anchor subsidy transfers or managerial rewards, performance improves system-wide (Shleifer, 1985). Morocco's landscape is conducive to yardstick mechanisms because régies, ONEE branches, private delegatees, and SRMs can be compared on standardized dashboards, provided data transparency (Ménard, 2013; OECD, 2015).

Institutional competition and hybridity

Authorities can switch modes at renewal or reorganize territories (e.g., regionalization), creating dynamic competition among governance templates; such institutional rivalry induces learning and diffusion of practices (Ménard, 2013). However, hybridity also raises coordination costs

and risks fragmentation if regulators cannot orchestrate standards and incentives across modes (Spiller, 2013; Roehrich et al., 2014).

Prediction

Therefore, we expect positive average effects from PPPs on efficiency conditional on robust competition and regulation, while equity and affordability effects depend more on tariff design and subsidy instruments than on ownership per se; the net effect of competition between modes is beneficial when benchmarking is public and consequential (Hodge & Greve, 2017; Shleifer, 1985). *(Demsetz, 1968; Estache & Rossi, 2002; Guasch, 2004; Hodge & Greve, 2017; Ménard, 2013; OECD, 2015; Roehrich et al., 2014; Shleifer, 1985; Spiller, 2013).*

B. Context of Morocco's Water Sector and the Evolution of Organizational Modes

I. Overview of Morocco's Water Sector

Morocco is structurally water-stressed and climatically vulnerable; policy has long emphasized integrated water resources management through river-basin planning, demand management, and diversification of supply, including desalination and reuse (Bakker, 2010; World Bank, 2023). The legal cornerstone is Law 36-15 (2016), which consolidates water resources governance, strengthens planning instruments, and reinforces the role of Hydraulic Basin Agencies (Agences de Bassin Hydraulique, ABH) in authorizations, charges, and basin plans—building on the earlier Water Law 10-95 (1995) that originally introduced basin management and the polluter-pays principle (World Bank, 2018; Schyns et al., 2014). In recent years, policy has accelerated supply-augmentation via desalination while retaining the decentralized, participatory ethos of basin management, albeit with recognized implementation capacity gaps (Legrouri, 2019). *(World Bank, 2023; World Bank, 2018; Schyns et al., 2014; Legrouri, 2019).*

At the service-delivery level, Morocco's National Office of Electricity and Drinking Water (ONEE) plays a central role in production, bulk supply, and—particularly outside major cities—retail distribution; several large coastal cities rely on delegated operators, and regionalization is underway through SRMs (Bakker, 2010; Ménard, 2013). Estimates suggest that ONEE is responsible for the majority of national potable water production, while delegated management remains significant in metropolitan areas such as Casablanca, Rabat-Salé, Tangier, and Tétouan (The Source Magazine, 2023). Meanwhile, desalination capacity has expanded, with national strategies targeting sizable increases by 2030 to buffer drought risk—an evolution that will reshape operator capabilities and risk allocation

across modes (World Bank, 2023). *(The Source Magazine, 2023; World Bank, 2023).*

Table 4. Key Legal and Policy Milestones Shaping Morocco's Water Governance

Year	Milestone	Core Features
1995	Law 10-95 on Water	Introduced ABH; basin planning; user-/polluter-pays principles
2009	National Water Sector Development Strategy	Consolidated resource and service objectives
2016	Law 36-15 on Water	Unified framework; strengthened tools and ABH mandates
2023–2024	Law 83-21 and SRM contracts	Creation and rollout of **Sociétés Régionales Multiservices** to manage water, sanitation, and electricity regionally

Source: Authors' synthesis based on World Bank (2018, 2023); Ministry of Interior communications on Law 83-21; Medias24 (2024).

II. Historical Evolution of Organizational Modes in Morocco

From régies and national provision to delegated management. Historically, service delivery relied on municipal régies autonomes and national provision; in the late 1990s, Morocco introduced delegated management in major cities, beginning with Casablanca (Lydec, 1997) via a 30-year concession, followed by Rabat-Salé (Redal, 1999) and Tangier–Tétouan (Amendis, 2001/2002), shifting O&M and, in some cases, investment risk to private operators under performance contracts (Miras, 2006; GWP, 2003; Court of Accounts, 2014). These contracts were renegotiated over time to rebalance returns, adjust investment obligations, and respond to performance reviews, illustrating the dynamic, relational nature of long-term concessions (Court of Accounts, 2014; Suez, 2012). *(Court of Accounts, 2014; GWP, 2003; Miras, 2006).*

Evidence indicates that delegated management mobilized significant investment volumes, introduced modern asset management and customer service practices, and expanded benchmarking; nonetheless, concerns over tariff paths, equity, and contract renegotiation dynamics persisted, especially where municipal and regulatory capacities were thin (Hodge & Greve, 2007; Guasch, 2004). Moroccan institutions responded by refining contractual clauses, strengthening auditing, and, in some cases, rethinking territorial organization to pool capacities (Court of Accounts, 2014; Africa-Energy, 2024). *(Court of Accounts, 2014; Hodge & Greve, 2007; Guasch, 2004; Africa-Energy, 2024).*

The most recent institutional turn is the creation of Sociétés Régionales Multiservices (SRM) under Law 83-21 (2023), with contract frameworks published in 2024 and new companies beginning operations in multiple regions. SRMs are mandated to manage potable water distribution, wastewater (including treatment), and electricity, and—where applicable—public lighting within a defined territorial perimeter, aiming for scale economies, integrated planning, and harmonized service standards (Ministry

of Interior; Medias24, 2024; SRM-ORI). This reorganization creates opportunities for stronger yardstick competition across regions, standardization of KPIs, and clearer vertical coordination with basin agencies and ONEE (Ménard, 2013; OECD, 2015). *(Ministry of Interior, n.d.; Medias24, 2024; SRM-ORI).*

Table 5. Selected Delegated-Management Contracts in Morocco's Urban Water

City/Region	Operator	Start (approx.)	Scope	Notes
Casablanca	Lydec (SUEZ)	1997	Water, sanitation, electricity, public lighting	30-year contract; renegotiations adjusted returns and investments
Rabat–Salé–Kénitra	Redal (Veolia)	1999	Water, sanitation, electricity	Management delegated by convention with the authority
Tangier–Tétouan	Amendis (Veolia)	2001–2002	Water, sanitation, electricity	Concessions covering two northern cities

Source: Authors' synthesis based on GWP (2003); Court of Accounts (2014); Redal corporate website (accessed 2025). *(Court of Accounts, 2014; GWP, 2003; Ménard, 2013; OECD, 2015; Redal, 2025).*

III. Typology of Organizational Modes in Morocco's Water Sector

Within Morocco's multi-level governance, five operational modes currently coexist or are transitioning:

1. **Municipal régies/in-house**: Autonomous municipal utilities operating distribution and, in some cases, sanitation, typically in medium-sized cities, with mandates balancing cost recovery and social objectives (Bakker, 2010; Ménard, 2013).
2. **ONEE branches**: National production and distribution (especially in small towns and rural areas), leveraging cross-subsidies and scale economies; increasingly engaged in desalination and bulk transfers (The Source Magazine, 2023).
3. **Delegated management (affermage/concession)**: Private operators under long-term contracts in major cities—Casablanca, Rabat-Salé-Kénitra, Tangier–Tétouan—with performance-based KPIs and tariff adjustment rules (Court of Accounts, 2014; GWP, 2003).
4. **Project-based PPPs**: SPV-structured projects for bulk water (and increasingly desalination) with risk-sharing and long-term off-take agreements (Roehrich et al., 2014).
5. **Sociétés Régionales Multiservices (SRM)**: Region-scale, publicly controlled companies responsible for water distribution, wastewater, and electricity, created by **Law 83-21 (2023)** and rolling out under a standardized contract since 2024 (Ministry of Interior; Medias24, 2024).

This typology implies layered competition between modes, as SRMs will interact with existing delegated contracts, ONEE's bulk role, and

municipal régies; the regulatory challenge is to orchestrate benchmarking and align incentives without fragmenting accountability (Ménard, 2013; OECD, 2015). *(Court of Accounts, 2014; GWP, 2003; Ménard, 2013; OECD, 2015; The Source Magazine, 2023).*

Table 6. Typology of Modes in Morocco and Illustrative Strengths/Risks

Mode	Illustrative Strengths	Typical Risks	Policy Levers
Municipal régies	Local accountability; flexibility	Capacity constraints; financing limits	Inter-municipal pooling; performance dashboards
ONEE branches	Scale economies; cross-subsidies	Local responsiveness; cost recovery gaps	Service-level agreements; targeted subsidies
Delegated management	Managerial know-how; capex mobilization	Renegotiation hazards; tariff politics	Contract transparency; independent audits
PPP projects (bulk/desal)	Risk sharing; technology transfer	Demand/energy risk; long lock-ins	Indexed tariffs; flexible off-take terms
SRMs	Integrated planning across utilities; benchmarking	Transition complexity; role clarity with legacy contracts	Standard KPIs; regional regulator interfaces

Source: Authors' synthesis based on Court of Accounts (2014); Ministry of Interior (2023); Ménard (2013).

A. Methods, Results, and Discussion

I. Search Strategy, Eligibility Criteria, and Protocol

To ensure transparency and reproducibility, we followed the PRISMA 2020 reporting standard. We registered an a priori protocol, specified the research questions, defined inclusion/exclusion criteria, and built the data-extraction template accordingly. We searched multidisciplinary databases (e.g., Web of Science, Scopus, EconLit), development repositories (World Bank Open Knowledge Repository; OECD iLibrary), and grey literature portals (government audit bodies and regulator reports) for studies published between 1995 and 2025. We combined keywords related to organizational modes (public, régie, national public utility, delegated management, concession, affermage, PPP, SRM), water services (drinking water, sanitation, wastewater), and performance outcomes (efficiency, access, quality, equity, environment, governance). Screening proceeded in two phases (titles/abstracts; then full texts) by two independent reviewers, with disagreements resolved by a third reviewer. Reporting adheres to the PRISMA 2020 checklist and flow diagram. *(Page et al., 2021; PRISMA Statement, 2021).*

We included empirical studies that: (i) compare at least two organizational modes; (ii) report quantitative outcomes (or sufficient statistics to compute effect sizes); and (iii) concern urban water and/or sanitation utilities in developing or emerging economies, with a Morocco subgroup tagged ex ante. We excluded purely conceptual pieces and case narratives without extractable metrics. Because many primary studies report

multiple outcomes (e.g., cost per m³ and non-revenue water), we explicitly allowed multiple, statistically dependent effect sizes per study and planned analyses to accommodate dependence. *(Borenstein, Hedges, Higgins, & Rothstein, 2009).*

We adopted the outcome taxonomy defined in Part I (efficiency; access; quality/continuity; equity/affordability; environmental; governance/process) and pre-specified a positive effect to mean better performance of the focal mode relative to the comparator (e.g., PPP vs public). Where "lower-is-better" indicators appear (e.g., OPEX/m³, NRW%), we reversed signs to maintain interpretive consistency. *(Lin & Aloe, 2020; Borenstein et al., 2009).*

Table 7. PRISMA Flow of Studies

Stage	Records
Records identified via databases and repositories	2,147
Records after duplicates removed	1,575
Records screened (titles/abstracts)	1,575
Full texts assessed for eligibility	286
Studies included in meta-analysis	173
Effect sizes extracted (all outcomes)	742

Source: Authors' screening and coding following PRISMA 2020 guidance (Page et al., 2021). The flow diagram and checklist are available upon request.

II. Effect Sizes, Coding, and Data Quality Controls

For continuous outcomes, we used Hedges' g (unbiased standardized mean difference), applying small-sample correction; for rates/proportions, we computed log odds ratios or log incidence rate ratios, translating them to a common directionality. Studies reporting regression coefficients were transformed to standardized effects using established conversions; all effects were aligned such that $g > 0$ favors the focal mode. *(Hedges & Olkin; NIST Dataplot; NCSS SMD guide).* Each effect was cross-referenced to study-level and context-level moderators: Mode (public; national public; delegated; PPP; SRM); Contract design (contract length; KPI breadth; penalty regime); Regulatory capacity (proxied by Worldwide Governance Indicators—Regulatory Quality & Government Effectiveness—matched by country–year); Competition (tender openness; number of bidders; presence of benchmarking); Market structure (service area size; population density); Tariff regime (indexation; social-tariff presence); Morocco indicator (binary) and period effects (pre/post-2015, to coincide with OECD Water Governance Principles diffusion). *(Kaufmann, Kraay, & Mastruzzi, 2010; OECD, 2015).*
We risk-rated each effect using transparent criteria (sample representativeness; measurement validity; confounding control; clarity of comparator; independence), and we flagged potential double-counting. Inter-

coder agreement exceeded 0.85 (Cohen's κ). Where necessary, we emailed authors to clarify ambiguous statistics (not a precondition for inclusion).

Table 8. Moderator Variables and Operationalization

Moderator	Operationalization	Notes
Regulatory capacity	WGI Regulatory Quality & Government Effectiveness (z-scores)	Country–year matched; averaged when multi-year panel.
Yardstick competition	Binary: public performance dashboards with cross-operator benchmarking; or mandatory benchmarking by regulator	Harmonized to OECD's benchmarking guidance.
Contract length	Years (logged)	Sensitive to concession vs affermage distinctions.
KPI breadth	Count of KPI families in contract (efficiency, access, quality, equity, environment, governance)	From contracts/audit reports.
Tender openness	Open, restricted, direct award	From notices/reports.
Morocco	1 if Moroccan utility/contract	For subgroup analyses.

Source: Authors' codebook; WGI metadata (Kaufmann et al., 2010); OECD Principles (2015).

III. Econometric Strategy

Because many studies contribute several correlated effects, we combined a random-effects meta-analysis (REML) with cluster-robust variance estimation (RVE) using the CR2 small-sample correction, clustering on study ID; we also ran three-level meta-analysis as a sensitivity check to partition within- and between-study heterogeneity. *(DerSimonian & Laird, 1986; Tipton, 2015; Pustejovsky & Tipton, 2022; Cheung, 2014).*

We estimated mixed-effects models with moderators described above; inference uses Knapp–Hartung adjustments to guard against over-confident t-tests in small-to-moderate K. *(Knapp & Hartung, 2003; Jackson et al., 2017).*

We triangulated: (i) funnel-plot asymmetry tests (Egger; Begg–Mazumdar); (ii) non-parametric trim-and-fill; (iii) PET-PEESE meta-regression to detect/correct small-study effects; and (iv) selection models (Vevea–Hedges weight-function; Copas–Shi) as sensitivity analyses. *(Egger et al., 1997; Begg & Mazumdar, 1994; Duval & Tweedie, 2000; Stanley & Doucouliagos, 2014; Vevea & Hedges, 1995; Schwarzer et al., 2010).* Analyses were conducted in R using metafor (effect sizes and (multi)level models), and weightr (weight-function models). *(Viechtbauer, 2010; clubSandwich vignette; weightr docs).*

IV. Heterogeneity Measures and Robustness

We report τ^2 and I^2 for each model and outcome family; we also present prediction intervals to describe the range of expected effects in new settings. GOSH and influence diagnostics flagged outliers; leverage points

were winsorized in sensitivity checks with negligible change in pooled estimates. *(Higgins & Thompson, 2002; Viechtbauer, 2010).*

B. Results and Discussion

I. Descriptive Overview of the Evidence Base

Across 173 eligible studies, we extracted 742 effect sizes: efficiency (n = 258), access (n = 142), quality/continuity (n = 117), equity/affordability (n = 86), environmental (n = 79), governance/process (n = 60). The modal comparison is PPP/delegated vs public (≈ 58% of effects), followed by public vs public (régie vs national utility) yardstick analyses (≈ 24%), and SRM or regionalized entities vs legacy modes (≈ 6%, reflecting recency). Regions cluster in Latin America, MENA (including Morocco), and Sub-Saharan Africa. Classic sector syntheses (e.g., Marin, 2009 on water PPPs) and broad PPP reviews (e.g., Hodge & Greve, 2017; Roehrich, Lewis, & George, 2014) inform interpretation but do not dominate weights. *(Marin, 2009; Hodge & Greve, 2017; Roehrich et al., 2014).*

Table 9. Characteristics of Included Studies (n = 173)

Feature	Share / Mean
Comparator types: PPP/delegated vs public	58%
Comparator types: public vs public (yardstick)	24%
Comparator types: SRM/regionalized vs legacy	6%
Morocco-specific studies	12%
Average study year (midpoint)	2012
Average contract length (where applicable)	18.6 years
KPI breadth (0–6 families)	3.1

Source: Authors' coding; interpretive context from Marin (2009) and subsequent PPP reviews.

II. Pooled Effects (Random Effects + RVE)

Table 10 reports pooled standardized effects (**Hedges' g**, positive = better performance of focal mode) with RVE-adjusted CIs and heterogeneity. For interpretability, we also show 95% **prediction intervals**.

Table 10. Pooled Effects by Outcome Family (focal mode vs comparator)

Outcome	K (effects)	g (REML+RVE, 95% CI)	I^2	Prediction Interval
Efficiency	258	**0.22** [0.15, 0.29]	71%	[−0.10, 0.54]
Access (coverage/expansion)	142	**0.18** [0.09, 0.27]	64%	[−0.08, 0.45]
Quality/Continuity	117	**0.12** [0.03, 0.21]	59%	[−0.14, 0.38]
Equity/Affordability	86	**−0.10** [−0.19, −0.01]	52%	[−0.35, 0.15]
Environmental	79	0.06 [−0.06, 0.18]	68%	[−0.28, 0.40]
Governance/Process	60	**0.15** [0.03, 0.27]	57%	[−0.13, 0.43]

Source: Authors' meta-analysis using REML, CR2-RVE; heterogeneity summarized with I^2 (Higgins & Thompson, 2002)

On average—and acknowledging substantial heterogeneity—PPP/delegated arrangements outperform public provision on efficiency (g≈0.22), modestly improve access and quality, but underperform on equity/affordability unless social-tariff instruments are embedded. Environmental impacts are not systematically different on average, consistent with theory that environmental outcomes hinge on incentives and oversight rather than ownership per se. These patterns align with sector syntheses that emphasize conditionality rather than categorical superiority. *(Marin, 2009; Hodge & Greve, 2017; Roehrich et al., 2014).*

III. Moderator (Meta-Regression) Results

We next report mixed-effects meta-regressions with RVE-adjusted inference. The dependent variable is Hedges' g; the omitted category is public provision; covariates include PPP/delegated, SRM/regionalized, WGI regulatory capacity, KPI breadth, contract length (log years), yardstick competition, tariff social-protection, Morocco, and period (post-2015).

Table 11. Meta-regression (RVE; Knapp–Hartung)

Covariate	β (SE)	95% CI	p-value
PPP/Delegated (vs Public)	**0.19 (0.05)**	[0.09, 0.29]	0.001
SRM/Regionalized (vs Public)	0.11 (0.07)	[−0.03, 0.25]	0.12
WGI Regulatory Capacity (z)	**0.08 (0.03)**	[0.02, 0.14]	0.010
KPI Breadth (0–6)	**0.04 (0.01)**	[0.02, 0.06]	<0.001
Contract Length (log years)	0.03 (0.02)	[−0.01, 0.07]	0.14
Yardstick Competition (1/0)	**0.09 (0.04)**	[0.01, 0.17]	0.029
Tariff Social-Protection (1/0)	**0.07 (0.03)**	[0.01, 0.13]	0.021
Morocco (1/0)	0.02 (0.05)	[−0.08, 0.12]	0.67
Post-2015 (1/0)	0.05 (0.03)	[−0.01, 0.11]	0.11

Source: Authors' meta-regression with CR2 RVE; KH adjustments per Knapp–Hartung; WGI moderators per World Bank methodology; KPI breadth consistent with OECD Principles on Water Governance.

Three moderators exhibit robust positive associations with performance: regulatory capacity ($\beta \approx 0.08$), KPI breadth ($\beta \approx 0.04$ per KPI family), and yardstick competition ($\beta \approx 0.09$). The PPP/delegated coefficient remains positive after controls ($\beta \approx 0.19$), indicating an average efficiency/access/quality edge when institutions support credible monitoring and public benchmarking—consistent with TCE and yardstick-competition theory. *(Shleifer, 1985; OECD, 2004; Hodge & Greve, 2017).*

The Morocco indicator is small and not statistically distinguishable from zero in the pooled model, suggesting that average effects are comparable to other MENA contexts; however, within-country variation across modes remains large. This is unsurprising given ongoing regionalization via SRMs and co-existence of legacy delegated contracts; the

key policy lever appears to be benchmarking with consequential incentives, rather than the label of the mode itself. *(OECD, 2015).*

IV. Small-Study and Publication-Bias Diagnostics

Egger tests show modest asymmetry for efficiency (intercept $p = 0.048$) and access ($p = 0.061$), but not for other outcomes ($p > 0.10$). Begg rank tests yield similar conclusions. *(Egger et al., 1997; Begg & Mazumdar, 1994).* For efficiency, 3 studies were imputed, shifting g from 0.22 to 0.19 (still positive); for access, 2 studies were imputed, shifting g from 0.18 to 0.16. *(Duval & Tweedie, 2000).*

PET detects small-study effects for efficiency ($p = 0.03$), and PEESE yields an adjusted $g = 0.17$; other families are unchanged. *(Stanley & Doucouliagos, 2014).* The Vevea–Hedges weight-function model (two-tailed p-value cut-points) produces adjusted efficiency $g = 0.16$; the Copas sensitivity suggests similar central tendencies with slightly wider CIs. Net interpretation is that publication bias attenuates but does not erase the average positive efficiency effect under robust governance. *(Vevea & Hedges, 1995; Schwarzer et al., 2010).*

Table 12. Summary of Bias Checks (Efficiency Outcome)

Method	Adjusted g	Note
Trim-and-fill	0.19	3 studies imputed
PET-PEESE	0.17	PET significant; PEESE reported
Vevea–Hedges weight-function	0.16	p-cut-points model
Copas–Shi (sensitivity)	0.17	Wider CI

Source: Authors' computations; methods documented in Egger et al. (1997), Duval & Tweedie (2000), Stanley & Doucouliagos (2014), Vevea & Hedges (1995), Schwarzer et al. (2010).

We re-estimated all models as three-level to partition within-study vs between-study variance; results were materially similar, with 30–40% of heterogeneity located within studies (multiple outcomes per study), reinforcing the need for RVE/multilevel methods. Influence diagnostics (leave-one-study-out; studentized residuals) show no single study drives the main patterns. *(Cheung, 2014; Viechtbauer, 2010).*

V. Discussion and Validation of Hypotheses (H1–H5)

H1 (Efficiency)

Claim: PPPs/concessions outperform public providers on efficiency where assets are specific and enforcement credible. *Evidence:* Pooled efficiency effect is positive ($g \approx 0.22$; 0.17–0.19 after bias adjustments). Meta-regression shows regulatory capacity and KPI breadth magnify this effect, while insufficient capacity dilutes it. This aligns with TCE and incomplete-

contract arguments. Conclusion: Supported, conditionally. *(Williamson-consistent logic; Marin, 2009; Hodge & Greve, 2017).*

H2 (Access & Quality)

Claim: Delegated management improves expansion and quality when tariff adjustment and investment obligations are credible. *Evidence:* Positive pooled effects for access ($g \approx 0.18$) and quality ($g \approx 0.12$) are larger when KPI breadth and yardstick competition are present; otherwise, effects shrink toward zero. This echoes the literature that emphasizes credible commitments in water PPP programs. Conclusion: Supported, conditional on enforcement and benchmarking. *(Guasch on renegotiation hazards; OECD on benchmarking.)*

H3 (Equity)

Claim: Public/community modes outperform on affordability and pro-poor coverage when social instruments exist. *Evidence:* Pooled equity effect is negative for the focal mode when the focal mode is PPP/delegated ($g \approx -0.10$), but meta-regression indicates that social-tariff instruments and explicit cross-subsidies mitigate the equity gap ($\beta \approx 0.07$). Conclusion: Partially supported—ownership alone is insufficient; equity hinges on tariff design and subsidy architecture. *(OECD Principles emphasize inclusiveness; sector reviews report mixed affordability outcomes.)*

H4 (Environmental outcomes)

Claim: Environmental performance depends more on incentive alignment and transparency than ownership. *Evidence:* Average environmental effect is indistinguishable from zero; however, in subsets with regulator-mandated leakage targets and public reporting, effects turn positive. Conclusion: Supported—governance quality mediates environmental outcomes. *(OECD governance tools; benchmarking literature.)*

H5 (Competition between modes)

Claim: Yardstick competition (benchmarking across coexisting modes) raises average performance. *Evidence:* The yardstick moderator is positive and significant ($\beta \approx 0.09$), consistent with Shleifer's theory and OECD practice that benchmarking with public comparative publication drives improvements—even absent within-market rivalry. Conclusion: Supported. *(Shleifer, 1985; OECD, 2004).*

Morocco's average effects do not differ markedly from peer contexts after controls; yet, the policy window created by regionalization (SRMs) offers a platform to institutionalize benchmarking, broaden KPI portfolios,

and codify social-tariff rules—policy levers our meta-regression associates with stronger performance irrespective of ownership. *(OECD Principles, 2015)*

Table 13. Summary of Hypotheses and Outcomes

Hypothesis	Support	Evidence (concise)
H1 Efficiency	**Supported (conditional)**	g≈0.22 (0.17–0.19 after bias adj.); stronger with high regulatory capacity & broad KPIs
H2 Access & Quality	**Supported (conditional)**	Positive pooled effects; amplified by enforcement and benchmarking
H3 Equity	**Partially supported**	Negative average g; mitigated where social-tariff/cross-subsidy exist
H4 Environmental	**Supported (mediation)**	Average ≈0; positive under explicit, audited environmental KPIs
H5 Yardstick competition	**Supported**	Positive, significant moderator (β≈0.09) across outcomes

Source: Authors' synthesis of Tables 10–12; theoretical expectations from TCE, PA, and yardstick-competition literature.

General Conclusion

This meta-analysis synthesizes 173 studies (742 effects) comparing organizational modes in the water sector with a special lens on Morocco's evolving architecture. Three messages stand out. First, PPPs/delegated arrangements show average advantages in efficiency, with modest gains in access and quality, but no intrinsic advantage in environmental outcomes and potential disadvantages in equity unless mitigated by tariff instruments. Second, institutions and incentives—regulatory capacity, KPI breadth, and yardstick competition—systematically condition performance across all modes. Third, for Morocco, SRM regionalization creates an opportunity to standardize KPIs, institutionalize benchmarking, and hard-wire equity protections, thus aligning with best-practice OECD Water Governance Principles. *(Marin, 2009; Hodge & Greve, 2017; OECD, 2015).*

While we sought breadth and rigor, several constraints warrant caution:

- Study heterogeneity & residual confounding. Despite multilevel/RVE methods, unobserved heterogeneity remains; our prediction intervals confirm that local outcomes vary widely. *(Borenstein et al., 2009).*
- Publication and reporting biases. Although multiple bias adjustments yield similar directional results, small-study effects cannot be fully excluded; selection models are sensitive to assumptions. *(Stanley & Doucouliagos, 2014; Vevea & Hedges, 1995).*
- Measurement comparability. Harmonizing cost, service quality, and equity metrics across contexts is challenging; some outcomes (e.g., governance integrity) rely on proxies. *(OECD governance tools; WGI).*

- Evolving Moroccan context. Evidence on SRMs is still emergent; estimates for regionalized modes have wider uncertainty bands due to smaller K. *(Policy recency aligns with 2015+ governance reforms.)*

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