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THE SAFETY GAP: WHY SAFELY MANAGED SANITATION LAGS SAFELY MANAGED WATER FOURFOLD

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ABSTRACT

Coverage indicators for water and sanitation are usually reported and read as a pair, assuming the two services face similar constraints and progress at similar rates. This article shows that the assumption fails systematically rather than locally, and explains why. In Central Java Province, Indonesia, a jurisdiction of some 37 million people, basic water supply reached 92.29 per cent in 2024 and basic domestic wastewater services 92.42 per cent, close enough to read as parallel achievement. The safely managed tiers diverge sharply: safely managed water reached 40.86 per cent against a national standard of 15.00, while safely managed wastewater reached 9.72 per cent against a target of 10.97. Safely managed wastewater was the only indicator in the responsible agency's performance set to miss its target that year, and the province operates no regional wastewater treatment system. The divergence is a predictable consequence of where the safety condition binds in each chain: for water at the point of supply, which investment addresses directly; for sanitation at containment, emptying, transport, treatment and disposal simultaneously, so investment at any single point leaves the condition unmet. Basic-tier parity is therefore not evidence of comparable progress.

1. INTRODUCTION

Sustainable Development Goal 6 replaced a coverage target with a quality target. Where the earlier framework asked whether a household had access to an improved facility, the present one asks whether the service is safely managed — for water, whether it is accessible on premises, available when needed and free from contamination; for sanitation, whether excreta are safely contained, emptied, transported, treated and disposed of or reused. The change was deliberate and its measurement consequences are substantial.

One consequence has attracted less attention than it deserves. Because the two services are reported together, and because their basic-tier coverage figures in many jurisdictions are similar, the pair is commonly read as describing a single trajectory. This article shows for one large province that the basic tiers are indeed near-identical and the safely managed tiers differ by more than a factor of four, and argues that the divergence is structural rather than accidental.

The case is Central Java Province, Indonesia, a jurisdiction of some 37 million people with responsibility for cross-district bulk water supply and for regional wastewater systems.

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Its performance reporting is unusually complete: the responsible agency publishes target and realization for basic and safely managed tiers of both services, against national standards, in the same document. That permits the divergence to be observed directly rather than inferred.

2. LITERATURE REVIEW

2.1 Where the safety condition binds

The service chain for water supply and the service chain for sanitation are not mirror images, and the asymmetry is the article's central conceptual claim. Water travels from a source through treatment and distribution to a household, and the safety condition — freedom from contamination at the point of use — is determined predominantly upstream. Investment in source protection, treatment capacity and network integrity addresses it directly, and the household is a passive endpoint.

Sanitation runs in the opposite direction, from many dispersed points of generation to a smaller number of disposal points, and the safety condition applies at every link. Excreta must be contained at the household, emptied without exposure, transported to a facility, treated to standard, and disposed of or reused safely. A failure at any link defeats the whole. Greene, Hennessy, Rogers, Tsai and de los Reyes (2021) quantify precisely this in classifying the emptying-service needs of low- and middle-income countries, showing that the emptying link alone accounts for a large share of the shortfall against the safely managed definition. Mraz and colleagues (2021) argue that the pathogen basis of the standard makes partial chain compliance insufficient in principle rather than merely in practice.

The measurement consequence follows directly. A jurisdiction can move a large population from unimproved to basic sanitation by investing in containment alone, because the basic definition asks only about the facility. It cannot move the same population to safely managed without simultaneously establishing emptying, transport and treatment capacity. Basic-tier progress is therefore achievable incrementally and safely managed progress is not, which predicts exactly the pattern reported in Section 4.

2.2 Measurement and the residual burden

Two further findings bear on how the indicators should be read. Nguyen (2023), applying small area estimation to safely managed water, sanitation and hygiene coverage, demonstrates that national and provincial aggregates conceal wide subnational variation and that the aggregate can be a poor guide to where the deficit lies. Lee, Gibson, Brown, Habtewold and Murphy (2023) show in systematic review that disease burden from contaminated drinking water persists even in countries with high measured access to safely managed water, which indicates that the indicator is a necessary but not sufficient condition for the outcome it proxies.

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For sanitation the corresponding literature concerns viability rather than coverage. Dinesh Kumar (2025), examining India's wastewater treatment infrastructure, argues that the economics of reuse and recycling determine whether treatment capacity once built is actually operated. De and Tandel (2026), studying non-conventional treatment systems, find that institutional environment rather than technology selection explains which systems remain functional. Narzetti and Marques (2022) show that extending access to vulnerable households depends on policy and incentive design rather than on infrastructure alone. Together these indicate that a low safely managed figure may reflect an absent institutional arrangement rather than an absent asset.

2.3 Operating and maintaining what is built

A second body of work bears on whether assets, once constructed, deliver the service the indicator assumes. The infrastructure asset management literature treats operation and maintenance as the determinant of realized service rather than as a residual: Adey, Hackl, Picken, Zani, Stewart and Parsons (2025) trace how strategic goals become asset plans in a water utility, Crossfield and Ferranti (2024) document a decade of adaptation practice in the UK water sector, and Espinoza Vigil and Carhart (2024) apply systems thinking to local infrastructure governance in Peru. Balta and Kulat (2024) and Leroy (2023) show for water systems in Türkiye and Mexico respectively that institutional arrangements rather than technology determine whether a system performs as designed.

The same conclusion emerges from the public management side, where the question is whether reported service figures track delivered service. Cepiku, Mastrodascio and Wang (2024), Nitzl, Sicilia and Steccolini (2024) and Lebec and Dudau (2023) find that performance measurement systems capture selectively and that what they omit is systematically related to what the measuring organization finds difficult. Lamothe (2024) demonstrates the divergence directly for service delivery data, and Kim (2024) shows that consequences attached to a signal can produce distortion where capacity to improve the underlying service is absent. Mizrahi and Minchuk (2021) formalize the general case and Barbieri, Micacchi, Vidè and Valotti (2021) supply the design principle: a measure performs only where it connects to the outcome it stands for.

For a jurisdiction reporting near-universal basic sanitation and single-digit safely managed sanitation, these two literatures converge on the same diagnosis. Basic coverage records assets; safely managed coverage records a functioning chain; and the gap between them is where operation, maintenance and institutional arrangement live. Kim and Kang (2024), Pill (2024), Collazos-Ortiz and Schakel (2023), de la Riva Agüero (2021), Zhu, Xiao and Wu (2022) and Lee (2022) each show, in different settings, that this is the domain in which administrative capacity binds rather than capital.

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2.4 The research gap

The literature on safely managed sanitation is substantial and the literature on safely managed water is substantial, but they are rarely brought into direct comparison within a single jurisdiction using the same reporting instrument. Where comparison is made it is typically cross-national, so that differences in reporting practice confound the substantive difference. This article uses a single provincial performance framework in which both services are measured by the same agency against the same national standards in the same year, which removes that confound and permits the divergence to be attributed to the service chains rather than to measurement.

3. METHOD

The analysis uses the performance accountability report of the provincial public works, housing and settlement authority for fiscal year 2024, which reports target and realization for four service indicators against national minimum service standards; the governor's accountability report for fiscal year 2025; and the provincial regional work plan documents for 2025 and 2026, which state forward targets. Population and settlement data are from the provincial statistics office.

Three limitations apply. The 2025 figures derive from accountability reporting that is not audited. The indicator set was revised for the 2024–2026 planning period, so series comparison across that boundary is not attempted. And the reported figures are provincial aggregates; following Nguyen (2023), they should be expected to conceal substantial variation among the province's 35 regencies and cities, which the provincial reporting does not disaggregate.

4. RESULTS AND DISCUSSION

4.1 The basic tiers are parallel; the safe tiers are not

Table 1 sets out the four indicators as reported for fiscal year 2024, with the national minimum standard against which each is assessed.

Table 1. Water and sanitation service indicators, FY2024 (per cent)

Indicator	Target	Realization	Attainment	vs national standard
Basic water supply access	91.92	92.29	100.40%	—
Piped water supply access	54.32	52.48	96.61%	—
Safely managed water access	40.43	40.86	101.06%	272.40% of 15.00
Basic domestic wastewater access	93.58	92.42	98.76%	—

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Indicator	Target	Realization	Attainment	vs national standard
Safely managed wastewater access	10.97	9.72	88.61%	64.80% of 15.00
Regional wastewater system (SPALD)	0	0	—	None operated

Source: performance accountability report of the provincial public works, housing and settlement authority, FY2024. Attainment is realization divided by target. National standard is the minimum service standard applied to the safely managed tiers.

The basic tiers are indistinguishable in practical terms: 92.29 per cent for water and 92.42 per cent for wastewater, a gap of 0.13 percentage points. The safely managed tiers differ by 31.14 percentage points, a ratio of 4.20. Assessed against the same national standard of 15.00 per cent, safely managed water stands at 272.40 per cent of the standard and safely managed wastewater at 64.80 per cent.

Safely managed wastewater was the only indicator in the agency's 2024 performance set to fall short of its target. Its attainment of 88.61 per cent is the weakest figure in the set, and it is the only service dimension on which the province falls below a national minimum standard.

4.2 The forward targets acknowledge the gap without closing it

The planning documents set a safely managed wastewater target of 12.50 per cent for 2025 and 17.83 per cent for 2026 — the latter above the national standard of 15.00. Achieving it would require an increase of 8.11 percentage points in two years, against realized progress that fell 1.25 points short of a target set 1.25 points above the previous position.

The province operates no regional wastewater treatment system. This is reported as a value of zero rather than as an absence, and it is consequential for the target trajectory: the safely managed definition requires treatment, and a jurisdiction without regional treatment capacity must rely on district-level and on-site systems whose compliance with the treatment and disposal links is precisely what the indicator measures.

4.3 Water supply: the piped anomaly

One result within the water indicators deserves note because it runs against the general pattern. Piped water supply access reached 52.48 per cent against a target of 54.32, an attainment of 96.61 per cent and the second weakest figure in the set. Safely managed water access, by contrast, exceeded its target. The two are related but not identical: safely managed access can be satisfied by non-piped sources meeting the accessibility, availability and quality conditions.

This matters for the comparison drawn here. It indicates that the strong safely managed water figure is not solely an artefact of network extension, and therefore that the water–sanitation divergence is not simply a difference in capital investment. The province achieved a high safely managed water figure while under-performing on piped coverage; it achieved a

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low safely managed sanitation figure while performing normally on basic coverage. The two services are failing and succeeding on different dimensions.

4.4 Discussion

The central implication is for how the indicator pair should be read. Basic-tier parity between water and sanitation is not evidence of parallel progress, because the two basic definitions ask questions of different difficulty. Water at the basic tier requires a source; sanitation at the basic tier requires a facility. Both are achievable by investment at a single point. The safely managed definitions are not symmetrical in the same way, and the observed ratio of 4.20 between them is what the chain structure predicts.

A second implication concerns where investment should be directed if the 2026 target is to be approached. The service-chain literature is specific on this point. Greene and colleagues (2021) locate the largest quantified deficit in emptying services rather than in containment or in treatment plant capacity, and Dinesh Kumar (2025) shows that treatment capacity without an operating economics remains idle. De and Tandel (2026) find institutional environment decisive for whether decentralized systems function. For a province with no regional treatment system and near-universal basic containment, this literature points toward the intermediate links — emptying and transport — as the binding constraint, rather than toward either end of the chain.

A third implication is methodological and applies beyond this case. Nguyen (2023) demonstrates that provincial aggregates for these indicators conceal substantial variation. A provincial figure of 9.72 per cent is consistent with a distribution in which some districts have functioning chains and most have none, and with a distribution in which all districts are uniformly deficient. These call for different responses, and the provincial reporting does not distinguish them. Disaggregation to district level is the single most valuable extension available from existing administrative data.

One caution should be entered against over-reading the water result. Lee and colleagues (2023) find that disease burden from contaminated drinking water persists in settings with high measured safely managed access, which indicates that the indicator captures the conditions for safety rather than safety itself. A figure of 272.40 per cent of the national standard is a statement about measured conditions, not a statement that waterborne disease risk has been eliminated.

4.5 What the 2026 target requires, expressed as a quantity

Stating the forward target as a percentage understates what it asks for, and converting it into population terms makes the difficulty visible. The province has approximately 37 million residents. Safely managed wastewater coverage of 9.72 per cent corresponds to roughly 3.60 million people whose excreta are contained, emptied, transported, treated and disposed of to

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standard. The 2026 target of 17.83 per cent corresponds to roughly 6.60 million. The increment is therefore of the order of three million people in two years, or about 1.5 million a year.

That figure can be set against the delivery record it would have to improve upon. In the year examined, the province moved the indicator by less than the 1.25 points its own target required, in a year when the target itself was modest. A jurisdiction that fell short of a 1.25-point increase is being asked to deliver 8.11 points across the following two years — a rate roughly six times the one it did not achieve. The comparison does not establish that the target is unattainable, because a step change in capacity could in principle produce a step change in the indicator. It establishes that the target implies a step change, which the planning documents do not identify a mechanism for.

Two further constraints bear on the arithmetic. The chain requires treatment capacity, and the province operates no regional treatment system, so the increment would have to be delivered through district-level and on-site arrangements whose adequacy is precisely what the indicator tests. And the increment is expressed in people rather than in facilities: because the safely managed definition is satisfied only when every link holds, a household counted at the basic tier does not become a household counted at the safely managed tier through any single additional investment. The quantity that must be built is not an asset but a functioning sequence.

4.6 Two objections

The first objection is that the divergence reported here reflects a reporting artefact rather than a service difference. Safely managed water and safely managed sanitation are defined by different criteria, and it might be said that comparing them is comparing quantities that were never commensurable. The objection has force against a naive reading and none against the reading offered here. This article does not claim that 40.86 and 9.72 measure the same thing; it claims that they are reported side by side, are read as a pair in practice, and that the definitional asymmetry which makes them non-comparable is itself the finding. If the two indicators are not commensurable, then the basic-tier parity that invites the comparison is misleading, which is the article's point.

The second objection is that the divergence is a matter of investment sequencing rather than of chain structure: sanitation may simply be later in a queue that water entered first, in which case the gap will close as investment arrives and no structural explanation is needed. Three features of the evidence bear against this. The piped water result reported in Section 4.3 shows the province under-performing on network extension while over-performing on safely managed water, which is not the pattern a simple investment-sequence account predicts. The safely managed sanitation indicator was the only one in the set to miss its target, which indicates a constraint operating at the point of delivery rather than a deliberate deferral. And the sequencing account has no explanation for why the shortfall persists at the safely

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managed tier while basic-tier coverage is near-universal — that is precisely the configuration the chain account predicts and the queue account does not.

A weaker version of the second objection survives and should be conceded. Investment sequencing and chain structure are not mutually exclusive: a chain that is harder to complete will plausibly attract investment later, so the two explanations may compound rather than compete. The evidence here distinguishes them only in the sense that the chain account explains the configuration and the sequencing account does not explain it on its own.

4.7 Limitations

Four limitations qualify what has been shown. First, the analysis rests on a single province in a single year, and a structural claim of this kind properly requires either a cross-sectional test across jurisdictions or a time series long enough to distinguish a persistent gap from a transient one. What is offered here is a case in which the mechanism is visible and the confounds usually present in cross-national comparison — differing definitions, differing collection instruments, differing years — are absent because one agency reported both services against the same standards at the same time.

Second, the 2025 figures derive from accountability reporting that has not been audited, and the audited series may revise them. The 2024 figures on which the central comparison rests are drawn from the agency's formal performance report, but that document is itself a self-assessment, and the performance-measurement literature reviewed in Section 2.3 gives reason to expect self-assessment to be selective in ways related to what the reporting organization finds difficult. If that bias operates here it would tend to understate rather than overstate the gap, since the difficult indicator is the one reported low.

Third, the analysis is confined to what the provincial framework measures. The safely managed definition is a proxy for a health outcome, and Lee and colleagues (2023) show that the proxy and the outcome can diverge substantially. Nothing here establishes that the 31.14-point indicator gap corresponds to a proportionate difference in realized health risk between the two services, and it would be a mistake to read it that way.

Fourth, the provincial aggregate conceals district variation that the reporting does not disaggregate. Following Nguyen (2023), the same provincial figure is consistent with several very different underlying distributions, and the appropriate policy response differs across them. This is a limitation of the available data rather than of the argument, but it bounds what can be recommended on the strength of the analysis.

4.8 What would count as evidence against the argument

A structural claim should specify what would refute it. The argument advanced here predicts that in any jurisdiction reporting both tiers of both services, the ratio between safely managed water and safely managed sanitation will exceed the ratio between their basic tiers, and will

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do so by a margin that does not narrow as basic coverage approaches saturation. Three observations would count against it.

The first would be a jurisdiction with near-universal basic sanitation and safely managed sanitation approaching safely managed water without a regional treatment system and without an established emptying and transport service. Such a case would indicate that the chain can be satisfied without completing its intermediate links, which the argument denies. The second would be a time series in which safely managed sanitation rose steadily and incrementally over several years in step with containment investment; the argument predicts that it will move in steps as chain links are completed rather than smoothly with containment. The third would be a set of jurisdictions in which the gap between the two safely managed figures is uncorrelated with the presence or absence of emptying, transport and treatment capacity — which would sever the link between the mechanism proposed and the outcome observed.

None of these tests can be conducted on the data used here, and stating them is not a substitute for conducting them. Their value is that they convert a structural claim into a falsifiable one, and they identify the data — chain-link capacity recorded separately, across jurisdictions, over time — that a fuller test would require.

4.9 Summary of findings

Three findings are factual and can be verified against the cited sources. Basic water and basic domestic wastewater coverage in the province differ by 0.13 percentage points, at 92.29 and 92.42 per cent respectively. Safely managed coverage differs by 31.14 percentage points, at 40.86 and 9.72 per cent, a ratio of 4.20. Safely managed wastewater was the only indicator in the agency's 2024 performance set to fall short of its target, the only one below a national minimum standard, and the province operates no regional wastewater treatment system.

Two findings are interpretive and rest on the conceptual account rather than on the figures. The divergence is attributed to the point at which the safety condition binds in each service chain — upstream and single for water, distributed and simultaneous for sanitation — rather than to differential effort or investment. And the forward target of 17.83 per cent for 2026 is characterized as implying a step change in delivery capacity for which the planning documents identify no mechanism. Readers who accept the first three findings are not thereby committed to the last two, and the distinction is stated here so that the evidential weight of each is clear.

5. CONCLUSION

In a province of some 37 million people, basic water and basic sanitation coverage differ by 0.13 percentage points and safely managed coverage differs by 31.14. Safely managed sanitation is the only service indicator falling below its national minimum standard and the

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only one to miss its target, and the province operates no regional wastewater treatment system.

The general claim is that the divergence is a property of the service chains rather than of this province's effort. Where a safety condition binds at one point, incremental investment satisfies it; where it binds at five points simultaneously, incremental investment does not. Reporting frameworks that present the two services as a pair invite a comparison the underlying engineering does not support.

Two extensions follow. District-level disaggregation would establish whether the provincial deficit is uniform or concentrated, which determines whether the response should be systemic or targeted. And a chain-link audit — establishing containment, emptying, transport, treatment and disposal capacity separately — would identify which link binds, which the aggregate indicator by construction cannot.

REFERENCES

Adey, B. T., Hackl, J., Picken, R., Zani, D., Stewart, R., & Parsons, S. A. (2025). Asset management approaches: from strategic goals to asset plans — a Scottish Water water main example. *Infrastructure Asset Management*, *12*(4), 237-255. https://doi.org/10.1680/jinam.24.00012

Badan Perencanaan Pembangunan Daerah Provinsi Jawa Tengah. (2025–2026). Rencana kerja pemerintah daerah Provinsi Jawa Tengah tahun 2025 dan 2026 [Regional work plan of Central Java Province, 2025 and 2026]. Retrieved August 29, 2026, from https://bappeda.jatengprov.go.id

Badan Pusat Statistik Provinsi Jawa Tengah. (2026). Provinsi Jawa Tengah dalam angka [Central Java Province in figures]. Retrieved August 29, 2026, from https://jateng.bps.go.id

Balta, M. A., & Kulat, M. I. (2024). Transforming an irrigation system to a smart irrigation system: a case study from Türkiye. *Irrigation and Drainage*, *73*(5), 1799-1811. https://doi.org/10.1002/ird.3004

Barbieri, M., Micacchi, L., Vidè, F., & Valotti, G. (2021). The performance of performance appraisal systems: a theoretical framework for public organizations. *Review of Public Personnel Administration*, *43*(1), 104-129. https://doi.org/10.1177/0734371X211043560

Cepiku, D., Mastrodascio, M., & Wang, W. (2024). Factors shaping the use of performance information by public managers. *Public Management Review*, *28*(1), 158-179. https://doi.org/10.1080/14719037.2024.2435009

Collazos-Ortiz, M. A., & Schakel, A. H. (2023). Avoiding a natural resource curse? The impact of administrative efficiency on Colombian municipalities' fiscal effort. *Local Government Studies*, *50*(3), 596-616. https://doi.org/10.1080/03003930.2023.2282565

Crossfield, A., & Ferranti, E. J. S. (2024). A longitudinal perspective of climate adaptation from the UK water sector, 2013–2023. *Infrastructure Asset Management*, *11*(2), 108-118. https://doi.org/10.1680/jinam.23.00060

de la Riva Agüero, R. (2021). Exploring administrative capacity and local governance in the Peruvian waste sector: implications for complex service delivery in the Global South. *State and Local Government Review*, *53*(2), 122-141. https://doi.org/10.1177/0160323X211026862

De, I., & Tandel, V. (2026). Institutional environment and sustainable business models: case studies of non-conventional wastewater treatment systems in India. *Water Policy*, *28*(7), 1062-1076. https://doi.org/10.2166/wp.2026.176

e-ISSN 3165-3324 · Open access, CC BY-SA 4.0

Dinas Pekerjaan Umum Bina Marga dan Cipta Karya Provinsi Jawa Tengah. (2024). Laporan kinerja instansi pemerintah tahun 2024 [Government agency performance report 2024]. Retrieved August 29, 2026, from https://ppid.dpubinmarcipka.jatengprov.go.id

Dinesh Kumar, M. (2025). Building India's wastewater treatment infrastructure: addressing questions of economic viability in reuse and recycling. *Water Policy*, *28*(1), 196-216. https://doi.org/10.2166/wp.2025.196

Espinoza Vigil, A. J., & Carhart, N. J. (2024). Local infrastructure governance in Peru: a systems thinking appraisal. *Infrastructure Asset Management*, *11*(3), 145-160. https://doi.org/10.1680/jinam.22.00037

Greene, N., Hennessy, S., Rogers, T. W., Tsai, J., & de los Reyes, F. L. (2021). The role of emptying services in provision of safely managed sanitation: a classification and quantification of the needs of LMICs. *Journal of Environmental Management*, *290*, 112612. https://doi.org/10.1016/j.jenvman.2021.112612

Kim, J., & Kang, H. (2024). Bureaucratic burden or administrative capacity? Administrative intensity and fiscal performance of local governments. *Public Management Review*, *28*(3), 580-601. https://doi.org/10.1080/14719037.2024.2447314

Kim, T. K. (2024). Impact of low-performance signals on employee fraud in public organizations: evidence from a pay-for-performance context. *Public Administration Review*, *85*(3), 681-697. https://doi.org/10.1111/puar.13873

Lamothe, S. (2024). Using administrative data to better understand the reliability of ICMA's alternative service delivery survey. *State and Local Government Review*, *57*(2), 166-178. https://doi.org/10.1177/0160323X241307968

Lebec, L., & Dudau, A. (2023). From the inside looking out: towards an ecosystem paradigm of third sector organizational performance measurement. *Public Management Review*, *26*(7), 1988-2013. https://doi.org/10.1080/14719037.2023.2238724

Lee, D., Gibson, J. M., Brown, J., Habtewold, J., & Murphy, H. M. (2023). Burden of disease from contaminated drinking water in countries with high access to safely managed water: a systematic review. *Water Research*, *242*, 120244. https://doi.org/10.1016/j.watres.2023.120244

Lee, H. (2022). Collaborative governance platforms and outcomes: an analysis of Clean Cities coalitions. *Governance*, *36*(3), 805-825. https://doi.org/10.1111/gove.12702

Leroy, D. (2023). An empirical assessment of the institutional performance of community-based water management in a large-scale irrigation system in southern Mexico. *Agricultural Water Management*, *276*, 108051. https://doi.org/10.1016/j.agwat.2022.108051

Mizrahi, S., & Minchuk, Y. (2021). Performance management, gaming and regulatory monitoring: a theoretical model and applications. *Public Management Review*, *25*(6), 1152-1168. https://doi.org/10.1080/14719037.2021.2007668

Mraz, A. L., Tumwebaze, I. K., McLoughlin, S. R., McCarthy, M. E., Verbyla, M. E., Hofstra, N., Rose, J. B., & Murphy, H. M. (2021). Why pathogens matter for meeting the United Nations' Sustainable Development Goal 6 on safely managed water and sanitation. *Water Research*, *189*, 116591. https://doi.org/10.1016/j.watres.2020.116591

Narzetti, D. A., & Marques, R. C. (2022). Policies and incentives for developing universal access to water and sanitation for vulnerable families. *Water Policy*, *24*(3), 485-499. https://doi.org/10.2166/wp.2022.227

Nguyen, C. V. (2023). Coverage of safely managed water, sanitation and hygiene: an application of small area estimation. *Science of The Total Environment*, *896*, 165277. https://doi.org/10.1016/j.scitotenv.2023.165277

Nitzl, C., Sicilia, M., & Steccolini, I. (2024). Personality traits and the use of performance information: enthusiastic and diligent public managers. *International Public*

e-ISSN 3165-3324 · Open access, CC BY-SA 4.0

Management Journal, *27*(6), 972-997. https://doi.org/10.1080/10967494.2024.2323580

Pemerintah Provinsi Jawa Tengah. (2026). Laporan keterangan pertanggungjawaban Gubernur Jawa Tengah tahun anggaran 2025 [Accountability report of the Governor of Central Java, FY2025]. Retrieved August 29, 2026, from https://data.jatengprov.go.id

Pill, M. (2024). Rethinking the 'local state' and local capacity. *Local Government Studies*, *50*(6), 998-1007. https://doi.org/10.1080/03003930.2024.2377224

Zhu, J., Xiao, H., & Wu, B. (2022). From big data to higher bureaucratic capacity: poverty alleviation in China. *Public Administration*, *102*(1), 61-78. https://doi.org/10.1111/padm.12907

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