Tap-Water Safety in Metropolitan Colombo and the Role of Household Water Treatment

A Critical Narrative Review of Published Monitoring and Laboratory Evidence

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Abstract

Background: Concerns about pollution in the Kelani River, the quality of distributed water, and household storage frequently converge in debates about whether Colombo residents need domestic filtration. These concerns involve different sampling environments and cannot be resolved by treating all water-quality results as equivalent. **Objective:** To critically integrate published evidence on source water, treated supplies, and household treatment relevant to metropolitan Colombo, and to identify conditions under which additional treatment is justified. **Methods:** A targeted narrative review used web-based discovery, exact-title and DOI searches, publisher material, PubMed records, university repositories, and official guidance, with searches completed in October 2026. Evidence was organized by sampling matrix, geographical relevance, analytical scope, and study limitations. A descriptive secondary calculation used published thermotolerant-coliform compliance counts; no new samples or household survey were collected. **Findings:** River studies demonstrate pressures requiring catchment protection and treatment vigilance, but do not measure consumer exposure. A retrospective Colombo Municipal Council analysis reported negative bacterial indicators across 268 treated-water reports, while internal reporting inconsistencies constrain interpretation of some operational results. Western Province household research identifies variation between supply types and treatment practices. Recalculation of published marginal counts gives compliance changes of +44.9 percentage points for boiling, −2.1 for cloth filtration, and +59.1 for heterogeneous commercial filters. These observational comparisons cannot establish comparative device efficacy or the necessity of reverse osmosis. Preliminary microplastic findings warrant better measurement and exposure assessment rather than a direct disease-risk conclusion. **Conclusion:** The literature supports risk-specific household treatment and safe storage alongside verified utility performance. It does not establish a universal requirement for household filtration across Colombo. Stronger inference requires contemporaneous sampling across treatment, distribution, and household stages, with transparent laboratory quality assurance and consistent reporting.

Keywords: Colombo; Kelani River; drinking-water quality; household water treatment; microbial indicators; water safety planning; narrative review.

1. Introduction

An assessment of urban drinking water must connect environmental conditions to the water people actually consume. Pollution in a source river is important because it changes the burden placed on treatment and increases the consequences of treatment failure. Nevertheless, a river sample and a household drinking-water sample answer different questions. Between them lie abstraction, treatment, distribution, building plumbing, storage, and sometimes domestic treatment. A credible evaluation must specify where each observation belongs in that chain.

Metropolitan Colombo presents a useful case because the published literature includes river monitoring, analysis of treated-water reports, and household studies across the wider Western Province. These sources provide complementary perspectives, but their spatial and temporal coverage differs. Colombo Municipal Council findings should not automatically be generalized to the entire metropolitan area. Likewise, Western Province household results include Gampaha and Kalutara as well as Colombo. The present review retains those distinctions rather than manufacturing a single citywide contamination estimate.

The central question is: **What does available published laboratory and monitoring evidence support about tap-water safety and the need for household treatment in metropolitan Colombo?** Three subsidiary questions guide the analysis: which findings concern source hazards rather than consumer exposure; what can published household comparisons establish about treatment performance; and which evidence gaps prevent a confident universal recommendation?

The review contributes a structured interpretation of existing evidence and a reproducible calculation from published counts. Its purpose is to improve the reasoning connecting water-quality findings to household decisions. Greater analytical depth comes from examining denominators, sampling locations, uncertainty, and alternative explanations; adding statistical complexity without suitable data would weaken that reasoning.

2. Review Methods

2.1 Review design and scope

This is a critical narrative review with an explicit evidence-extraction approach. It is not an exhaustive systematic review or a meta-analysis. Sources were selected for their direct relevance to Colombo, the Kelani catchment, or Western Province household water, together with authoritative guidance needed to interpret measurements and treatment claims. Publications available by the October 2026 search were considered; publication dates and access levels were checked where possible.

The evidence base comprises original research articles, an official utility water safety plan reproducing national water-quality requirements, authoritative technical guidance, and a preliminary conference abstract. Their evidential roles are kept distinct. Research studies inform local observations; guidance informs interpretation and risk-management principles. A conference abstract is not treated as having the same methodological detail as a full article.

2.2 Discovery and selection

Web searches combined Colombo, Kelani River, Western Province, drinking water, treated water, household water treatment, bacteriological quality, coliform, and microplastics. Exact titles and DOIs were then searched to locate publisher pages, full PDFs, indexed primary-source text, PubMed records, or institutional repositories. Official WHO, CDC, and NWSDB materials were consulted for standards and treatment interpretation. Commercial product promotion was not used as evidence of local necessity or effectiveness.

Selection favoured a stated sampling location, an identifiable water matrix, a described analytical method, and results that could be traced to a primary publication. Broader Sri Lankan evidence was retained only when its relevance to Colombo could be stated explicitly. Studies of other water sources were not silently reclassified as municipal tap-water studies. Discovery was iterative, so no preregistered search strategy, exhaustive database coverage, independent dual screening, or PRISMA selection counts are claimed.

2.3 Extraction and critical appraisal

For each local source, extraction recorded the citation, access route, study area, sampling matrix, study period or coverage, sample denominator where stated, measured outcome, principal finding, and limits on inference. Full text was distinguished from abstract-only access and publisher text retrieved through search indexing. Direct publisher access restrictions were recorded rather than concealed. The accompanying source register identifies these access levels and useful locators.

Critical appraisal considered selection and geographical coverage, sampling frequency, technical versus independent replicates, laboratory specificity, internal consistency, comparability of endpoints, confounding, and possible reuse of the same dataset. No numerical quality score was assigned: a single score would obscure whether a weakness concerns exposure relevance, measurement validity, or causal interpretation. Reported inconsistencies were retained as limitations instead of being resolved by choosing whichever value supported a preferred conclusion.

2.4 Secondary calculations

Published before-and-after compliance counts from Wijesekara et al. (2026) were recalculated as percentages using each treatment group's reported denominator. The calculation was:

Compliance (%) = 100 × compliant observations / group observations.

Absolute change (percentage points) = 100 × (after-compliant − before-compliant) / group observations.

These are descriptive calculations from marginal counts, not new laboratory observations. The publication describes paired observations, but the counts of individual transitions between compliance and non-compliance were unavailable in the extracted table. Consequently, this review does not calculate a paired confidence interval, perform a McNemar test, or infer individual household transitions. Treatment categories were not pooled or compared as randomized groups.

3. Evidence Architecture: From Catchment to Consumption

Table 1 sets out the different questions addressed by the evidence. The distinction is more than terminology. A contaminant concentration measured before treatment describes an incoming challenge. A concentration measured at a treatment works describes performance at that point. A household result may additionally reflect distribution, plumbing, storage, handling, and domestic treatment. Attribution becomes progressively harder when the intermediate stages have not been sampled.

Sampling stage	What the result can establish	What it cannot establish alone
River or abstraction source	Environmental pressures and incoming treatment challenges	Exposure at a household tap or treatment failure
Treated-water outlet or plant sump	Quality at the sampled treatment stage	Quality throughout the network or after household storage
Distribution or public tap	Local quality at a specified time and location	The cause of contamination or every household's exposure
Household source and stored water	Conditions along part of the domestic water pathway	A technology's causal effect without adequate controls
Standardized device challenge test	Performance under defined test conditions	Real-world adherence, maintenance, or citywide need

Table 1. Interpretive framework used in this review. This is an analytical classification, not an additional dataset.

Two further distinctions are essential. An indicator organism is evidence about a water-quality condition, not a measurement of every pathogen. Similarly, a chemical or particle measurement is not itself a complete risk assessment: exposure frequency, dose, analytical specificity, and relevant toxicological evidence matter. Failure to distinguish detection, exposure, and health outcome can turn a valid analytical result into an unsupported public-health claim.

4. Published Evidence Relevant to Colombo

4.1 Source-water pressures in the Kelani catchment

Narangoda et al. (2023) examined 26 upper- and lower-catchment locations quarterly between May 2019 and May 2020, measuring 14 physicochemical parameters. Reported examples include chemical oxygen demand of 81.10 mg/L at Kolonnawa and ammonia of 0.977 mg/L at Kaduwela. These results identify environmental pressures and spatial differences. They are not measurements of water delivered after treatment. Triplicate laboratory analyses improve analytical repeatability but do not multiply the number of independent field locations or sampling occasions.

Two 2024 studies provide a broader temporal perspective. Wijayaweera et al. (2024a) used monthly CEA observations from 17 stations during 2016–2020 to examine industrial-pollution patterns through indexing and machine learning. Wijayaweera et al. (2024b), available here at abstract level, analysed 17 parameters from the same stated station network and period using latent variables. Their

apparent agreement must be interpreted in light of overlapping monitoring records, rather than counted as independent replication.

Samarasinghe et al. (2026) extended statistical analysis to six parameters at 12 stations from January 2007 to May 2022. Only two directional relationships survived correction across 360 Granger comparisons. The authors distinguish predictive relationships from environmental causation and acknowledge limitations including imputation uncertainty and omitted contaminant groups. This study illustrates why sophisticated modelling can reveal structure while leaving important questions about exposure unanswered.

Together, these sources justify continued attention to catchment protection and treatment resilience. They do not supply a valid prevalence estimate for unsafe household tap water. Their different parameters also prevent a simple numerical ranking: an industrial index, a latent pollution factor, and a measured chemical concentration are distinct outputs. Any comparison should begin with the analytical endpoint and its water matrix, not with which study reports the most alarming number.

4.2 Treated-water monitoring within Colombo Municipal Council

Ayomi et al. (2022) retrospectively examined 268 NWSDB treated-water analysis reports from July–November 2021 in the Colombo Municipal Council area. All reported total-coliform and E. coli results were negative. Reported means were 0.49 NTU for turbidity, 7.33 for pH, and 24.51 mg/L for total dissolved solids. These observations are evidence about the reports and period examined, not a guarantee of current quality at every consumer outlet.

The article contains internal inconsistencies: its abstract and results differ on turbidity deviations, and residual-chlorine frequencies do not reconcile consistently with the stated denominator. This review therefore does not calculate residual-chlorine compliance percentages from that article. The uncertainty limits interpretation of those endpoints without invalidating every reported observation. Reconciliation with the original reports would be necessary before using the disputed frequencies in a formal compliance audit.

4.3 Household water quality and supply type

Wijesekara et al. (2021) assessed 4,508 Western Province households. Its abstract reports the highest bacteriological compliance for NWSDB water, followed by tube wells and other sources, community systems, and dug wells. The abstract does not provide the group-specific counts required to reproduce those comparisons. This review therefore uses the reported ordering as context and does not invent percentages or derive a Colombo-only estimate.

The 2026 household-treatment study sampled every third household from a larger water-quality survey and may be linked to this earlier research programme. Until cohort identifiers and dates are fully reconciled, the two publications should not be interpreted as independent confirmations of the same effect. Multiple publications can add different analyses without adding independent participants.

4.4 Preliminary microplastic evidence

Mahatantila et al. (2024) reported a conference study of three treatment plants associated with Kelani River drinking water, comparing raw intakes and treated sumps during November 2022–April 2023. The abstract reports 3.25–10.25 particles/L in raw water and 0.5–3 particles/L after treatment, with a highest removal of 82%. It describes organic digestion, Nile Red staining, contamination controls, and ATR-FTIR polymer identification.

This is preliminary treatment-stage evidence. The abstract does not provide the full sample denominator or size-detection threshold, and it does not measure household tap exposure. The maximum reported removal must not be represented as a mean across plants. Particle counts alone cannot establish a clinical consequence. WHO's 2019 technical assessment identifies substantial uncertainties in drinking-water microplastic occurrence and health interpretation; it is used here as a methodological reference, not as proof that all subsequent findings have resolved those uncertainties (WHO, 2019).

4.5 Evidence coverage and dependence

Evidence cluster	Primary contribution	Principal boundary
Narangoda et al., 2023	Spatial and seasonal physicochemical river measurements	Untreated source water; limited sampling occasions
Wijayaweera et al., 2024a, 2024b	Multi-year river pattern analysis	Shared station network and period; one article abstract-only here
Samarasinghe et al., 2026	Long-term river dynamics and predictive analysis	Six variables; imputation; exposure not measured
Ayomi et al., 2022	Local retrospective treated-water reports	Selected 2021 period; inconsistent operational frequencies
Wijesekara et al., 2021, 2026	Supply-type context and domestic-treatment observations	Wider province; observational design; possible cohort overlap
Mahatantila et al., 2024	Raw versus treated microplastic observations	Conference abstract; detection and denominator detail incomplete

Table 2. Evidence clusters rather than a count of independent populations. The accompanying source register provides access routes and extraction locators.

5. Household Treatment: A Descriptive Secondary Analysis

5.1 Recalculated compliance

Wijesekara et al. (2026) surveyed 1,502 households in Colombo, Gampaha, and Kalutara. Its published paired laboratory subsets comprise boiling (486), cloth filtration (236), and commercial filters (286). Table 3 recalculates thermotolerant-coliform compliance from the published counts. Values are rounded only after division; the changes are percentage points, not relative percentage increases. The survey total is not the laboratory denominator for each method.

Method	Group n	Before, count (%)	After, count (%)	Change, points
Boiling	486	170 (35.0)	388 (79.8)	+44.9
Cloth filtration	236	85 (36.0)	80 (33.9)	−2.1
Commercial filters	286	106 (37.1)	275 (96.2)	+59.1

Table 3. Author's descriptive recalculation from Table 2 of Wijesekara et al. (2026), DOI: 10.2166/washdev.2026.130. Commercial filters comprise different technologies. Rounded percentages may differ slightly from the source's displayed values.

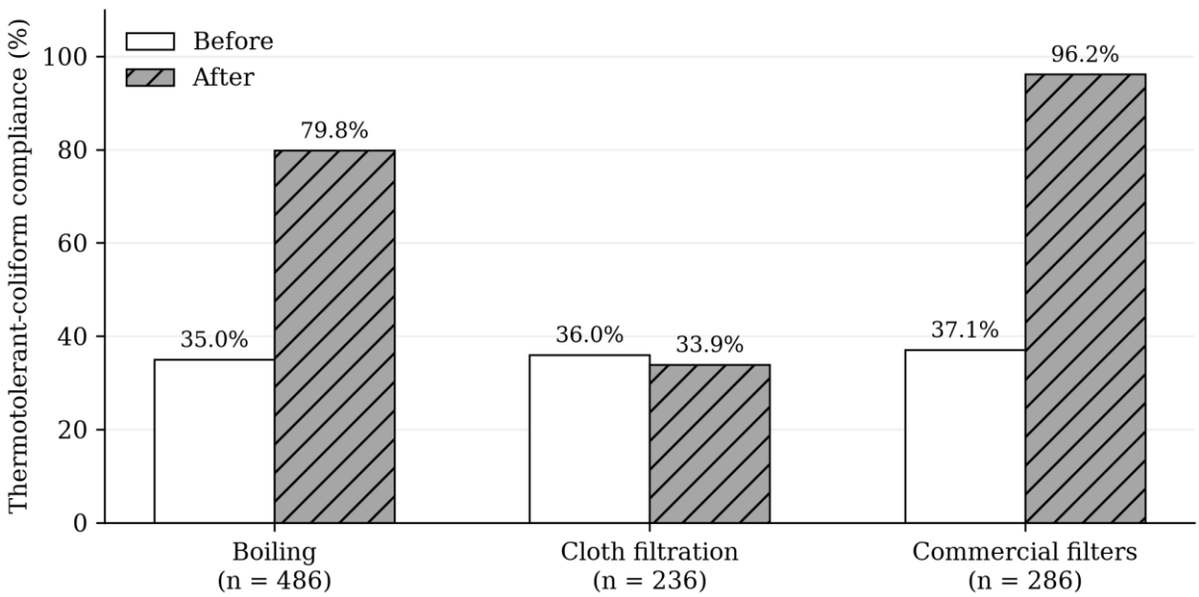


Figure 1. Recalculated percentages from published counts in Table 3. Open and shaded bars distinguish before and after treatment. This is an observational comparison within reported categories, not a randomized comparison between technologies.

5.2 What these comparisons establish

The descriptive pattern is consistent with improved indicator compliance after boiling and commercial filtration, but not after cloth filtration. The commercial category includes different devices and combinations; it does not isolate reverse osmosis. Unequal starting conditions, household practices, and storage can influence observed outcomes. The results support examining actual performance and use rather than assuming that a product category guarantees safety.

An important distinction follows from paired observations. A higher compliant total after treatment shows a net change in group compliance. It does not reveal how many initially compliant samples deteriorated while other samples improved. Those two directions can offset one another in the marginals. A transition table is therefore required for a proper paired uncertainty analysis. Reporting a new significance test from the two totals alone would imply information that the extracted evidence does not contain.

Nor should residual non-compliance be attributed automatically to a single mechanical

failure. Possible explanations include inadequate treatment, contamination during transfer, unsuitable storage, or measurement variability. Distinguishing these mechanisms would require matched observations along the household pathway and information on device condition or treatment practice. This review identifies them as alternative explanations, not as documented causes in individual households.

5.3 Why a pooled effect would mislead

Combining the treatment groups into a single success percentage would blur important differences in method, baseline water, and behaviour. Combining them with the treated-water reports would be even less defensible: the populations, years, sampling points, and indicator definitions differ. A meta-analytic summary needs sufficiently comparable effect measures and information about uncertainty and dependence. The available extracted evidence does not meet those conditions.

The appropriate quantitative contribution is consequently modest but useful: a transparent recalculation, correct denominators, and an explicit interpretation of what is missing for stronger inference. The calculation file supplied with this paper preserves the unrounded values and source counts so that the table can be checked independently.

6. Interpreting Standards and Analytical Results

6.1 Health, operation, and acceptability

Water-quality interpretation requires separating health-based guidance from operational and acceptability criteria. WHO's current guidance emphasizes risk management from catchment to consumer. E. coli or thermotolerant coliforms should not be detectable in a 100 mL drinking-water sample; total coliforms are not interchangeable with a faecal-specific indicator. WHO does not set a health-based guideline value for total dissolved solids. Its 5 mg/L chlorine guideline is a health-based value, not a target residual for routine delivery (WHO, 2026).

The NWSDB Kandana water safety plan reproduces SLS 614:2013 requirements including pH 6.5–8.5, turbidity 2 NTU, and total dissolved solids 500 mg/L. Those values must be identified as reproduced national requirements, rather than relabelled as WHO health thresholds. The plan concerns a Kalu River supply; it is used here as a documentary source for the reproduced table, not as evidence of Colombo treatment-plant performance (NWSDB, 2018, Table 2.3).

Low turbidity is also important to treatment operation and disinfection. A result that meets an aesthetic or national limit does not by itself demonstrate optimized pathogen control. Conversely, an isolated exceedance of an operational or acceptability value does not quantify a clinical disease risk. WHO's turbidity review explains the parameter's role in managing treatment and microbial safety rather than treating it as a universal stand-alone health test (WHO, 2017).

6.2 Concentration, detection, and compliance

An analytical result should be read together with its detection limit, unit, method, and sample location. “Not detected” means below the method's detection capability in the analysed sample. It does not mean that every possible contaminant was absent from the

supply. Compliance is likewise parameter-specific: passing a bacterial indicator test cannot establish the absence of every dissolved chemical, while low total dissolved solids cannot establish microbiological safety.

Microplastic concentrations require particular care because counting depends on the smallest particles included, the volume sampled, contamination control, identification method, and reporting convention. A concentration from one protocol may not be directly comparable to another using a different size window. Before combining results, a reviewer must establish that both methods measure sufficiently similar particle populations. This methodological requirement follows independently of whether the observed concentrations are high or low.

River indices present another comparability problem. A multi-parameter index compresses observations according to its chosen components and weights. Its category is not a direct measure of disease incidence or an individual resident's exposure. A statistically strong association can still be irrelevant to a household-treatment recommendation if it concerns a different water matrix or does not measure the contaminant the proposed treatment removes.

7. A Risk-Based Framework for Household Decisions

7.1 Matching treatment to a defined problem

Household treatment should answer a defined water-quality problem. A defensible decision links a measured or credibly identified hazard to a method with demonstrated capability, followed by proper operation and verification. WHO's household-treatment evaluation framework emphasizes microbiological performance under specified conditions and locally suitable options; it does not imply that every available device achieves the same level of protection (WHO, 2011).

For routine household decisions, the sequence is to establish the supply and storage situation, identify a concern that is analytically meaningful, choose a method suited to that concern, and check whether performance is maintained. This framework avoids converting understandable concern about river pollution into an automatic recommendation to buy the most elaborate filter. It also avoids assuming that reassuring treatment-plant results eliminate every risk introduced farther downstream.

Situation	Proportionate response	Verification needed
Verified acceptable supply; mainly taste or odour concern	Investigate the cause; a suitable carbon device may improve acceptability	Appropriate product claim and maintenance; taste improvement is not proof of pathogen removal
Microbial concern or official incident advice	Follow the relevant authority's instructions; use a suitable microbial barrier where indicated	Correct operation, safe handling and storage, and appropriate follow-up testing
Confirmed dissolved-chemical problem	Select treatment demonstrated for the identified substance	Contaminant-specific certification or testing, and treated-water verification

Situation	Proportionate response	Verification needed
Deterioration after household storage	Inspect, clean and manage tanks, containers, transfer and access	Compare incoming and stored water; assess recurrence
Unspecified concern without recent evidence	Obtain targeted information before choosing a treatment train	Relevant sampling point, analytes, detection limits and interpretation

Table 4. Decision framework synthesized from the evidence and treatment guidance. These are conditional principles, not a diagnosis of any individual household's water.

7.2 Technology boundaries and maintenance

Activated carbon can address some taste and chemical concerns, but ordinary carbon filtration should not be assumed to remove all microorganisms. Removing disinfectant residual throughout a building can also alter downstream microbial conditions. A product's claims must therefore be checked against the concern being addressed, and maintenance is part of treatment performance rather than a secondary convenience (CDC, 2024a).

Ultraviolet treatment depends on suitable water clarity, equipment condition, and operating conditions, and does not remove dissolved chemicals. Reverse osmosis can reduce specified dissolved substances and other contaminants, depending on the system and its verified claims. Neither is a universal substitute for source assessment. A multi-stage unit introduces several components whose performance and replacement requirements must be understood (CDC, 2024b).

Boiling can address microbial hazards when performed correctly, but it does not make water containing harmful dissolved chemicals safe. Handling and storage after treatment remain relevant because successful treatment does not protect water from every subsequent contamination route (CDC, 2024c). These distinctions explain why the present review uses the broader term household water treatment rather than equating all protection with filtration.

7.3 Cost, practicality, and public responsibility

No comparable local lifecycle-cost dataset was extracted, so this review does not present a cost-effectiveness ranking. A meaningful future comparison would include purchase, replacement parts, energy, water losses where relevant, consumables, testing, and the burden of correct daily use. Affordability alone cannot establish adequate protection, and higher purchase cost cannot establish greater relevance to a household's actual problem.

Household measures should complement utility and public-health responsibilities. They cannot substitute for source protection, reliable distribution, incident communication, or transparent surveillance. WHO's water safety planning manual places preventive management across the supply chain at the centre of safe provision (WHO, 2023). The household is one control point within that system, not the sole place at which a city should manage water risk.

8. Integrated Discussion

8.1 Reconciling apparently conflicting findings

Published river pollution findings and reassuring treated-water results are not inherently contradictory. Treatment exists to change incoming water quality. The central question is whether barriers remain effective under the conditions actually encountered. Likewise, deterioration in stored household water can coexist with acceptable incoming water. A review that treats these observations as mutually exclusive would erase the pathway that explains them.

The evidence supports different confidence levels for different propositions. There is a defensible basis for concern about catchment pressures. There is also local evidence of satisfactory treated-water indicator results during a defined historical period. Household findings show that supply type and treatment practice matter, while leaving important causal questions unresolved. The weakest proposition is the strongest blanket claim: that all Colombo households necessarily need a particular filter technology. None of the reviewed evidence establishes that requirement.

The opposite blanket claim would be equally unjustified. Historical negative reports cannot guarantee uninterrupted future safety, and aggregate compliance does not describe every building or storage tank. The most defensible conclusion is conditional: the need for additional treatment depends on current quality, location in the supply chain, the identified hazard, and the household's ability to operate the selected measure correctly.

8.2 Why analytical sophistication does not replace exposure evidence

Machine learning, latent variables, and time-series models can organize complex monitoring records and generate useful hypotheses. Their relevance to domestic water safety still depends on what was measured. No transformation of river variables into a more sophisticated index creates an observed concentration at a household tap. Prediction should also be distinguished from causation, particularly when seasonality, missingness, or shared external influences can create associations.

Similarly, apparent precision can be misleading when the denominator is wrong. A household survey total, a treatment subgroup, a number of monitoring reports, and a set of laboratory replicates are not interchangeable. Reporting a very small p value does not correct an inappropriate unit of analysis. Explicitly preserving each denominator is therefore a substantive part of research quality rather than a presentation detail.

8.3 Priorities for a stronger evidence base

The most informative next study would sample matched stages: raw intake, treated outlet, selected distribution locations, household incoming water, stored water, and water after domestic treatment. Repeated observations should cover different seasons and interruptions where applicable. Sampling locations and schedules should permit assessment of where deterioration occurs, rather than requiring attribution from unrelated studies.

Laboratory documentation should include validated methods, detection limits, field and laboratory blanks, calibration, sample

transport conditions, and the distinction between independent samples and technical repeats. Household assessment should record supply type, treatment technology, maintenance, storage and handling. For paired microbial outcomes, reporting the full transition table would permit an appropriate uncertainty analysis rather than forcing readers to infer from marginal totals.

Advanced analyses would then have a clearer role. Hierarchical models could reflect repeated observations within locations; sensitivity analyses could assess missing-data assumptions; and device comparisons could adjust for measured baseline differences. These are recommendations for an adequately documented future design, not analyses claimed for the present review. Transparent descriptive evidence should precede greater modelling complexity.

9. Limitations

This review used a targeted, iterative search rather than exhaustive bibliographic databases and independent screening. Relevant studies may have been missed, including non-indexed local reports and unpublished utility records. Availability bias is possible because full texts were not equally accessible. One river article and the 2021 household article were available at abstract level, and some publisher text was retrieved through search indexing after direct access restrictions. The source register preserves those access limitations.

The studies differ in geography, period, matrix, analytical method, and outcome. Wider Western Province evidence cannot be reduced to a Colombo-only estimate. Historical monitoring cannot establish current conditions at a named tap. Several publications may draw on overlapping records or cohorts, reducing the number of independent evidence streams. Internal discrepancies in one treated-water report analysis further limit selected endpoint interpretation.

The secondary calculation uses published aggregate counts, without household-level data or paired transition cells. It provides descriptive changes rather than causal estimates or newly tested statistical significance. The commercial-filter category is heterogeneous, and no technology-specific comparison is inferred. No new laboratory work, illness surveillance, exposure model, or economic evaluation was conducted. These boundaries prevent a universal safety certification, contamination prevalence estimate, disease burden estimate, or filtration mandate.

10. Conclusion

The reviewed literature supports a supply-chain interpretation of Colombo's drinking-water safety. Catchment pollution creates treatment challenges; treated-water monitoring evaluates particular stages and periods; household practices can alter the quality ultimately consumed. These findings must remain linked to their actual sampling matrices and denominators.

Additional household treatment is most defensible when it addresses an identified hazard, demonstrable deterioration, or applicable official incident advice. The available evidence does not establish that every Colombo household requires filtration or reverse osmosis. Safe storage, suitable treatment where indicated, maintained equipment, and verifiable utility performance form a more defensible approach than a universal product rec-

ommendation. The priority for deeper research is matched, transparent evidence across the supply chain, with adequate laboratory quality assurance and data sufficient to test the mechanisms being proposed.

Data Availability

This review uses published sources. The accompanying source register and calculation file provide citations, access levels, extraction notes, published input counts, and derived percentages. No original household-response dataset or new laboratory dataset is presented. The underlying study records remain subject to the original authors' availability arrangements.

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