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The Socioeconomic Case for Regenerating Contaminated Water

Return on investment of decentralized, circular-economy water regeneration across Latin America

1–4%

of GDP lost to poor water & sanitation

$4–46

returned per $1 invested in WASH

50.8%

of LAC lacks safe sanitation services

Executive Summary

Water contamination is a structural brake on development and regeneration is a high-return investment

A structural problem

Across Latin America, microbiological, chemical and emerging contaminants degrade watersheds. Rivers and lakes operate as informal waste-disposal infrastructure where treatment is absent or inefficient.

A measurable cost

Poor water, sanitation & hygiene (WASH) costs 1–4% of GDP in developing countries through health spending, lost productivity, premature mortality and degraded natural capital.

A proven return

Every $1 invested in water & sanitation returns $4–46, widening further once time savings, productivity, disease reduction and human-capital gains are counted.

A scalable solution

A system that transforms organic waste into low-cost remediation solutions, easy to deploy in places where centralized infrastructure is not viable.

A persistent structural gap in water management

50.8%

of Latin America & the Caribbean lacks safely managed sanitation

PAHO, 2023

24–69%

non-revenue water lost in distribution networks

Saravia-Matus et al., 2023

~5%

removal efficiency reported in parts of Peru vs >80% international standard

Talledo, 2016

298,000

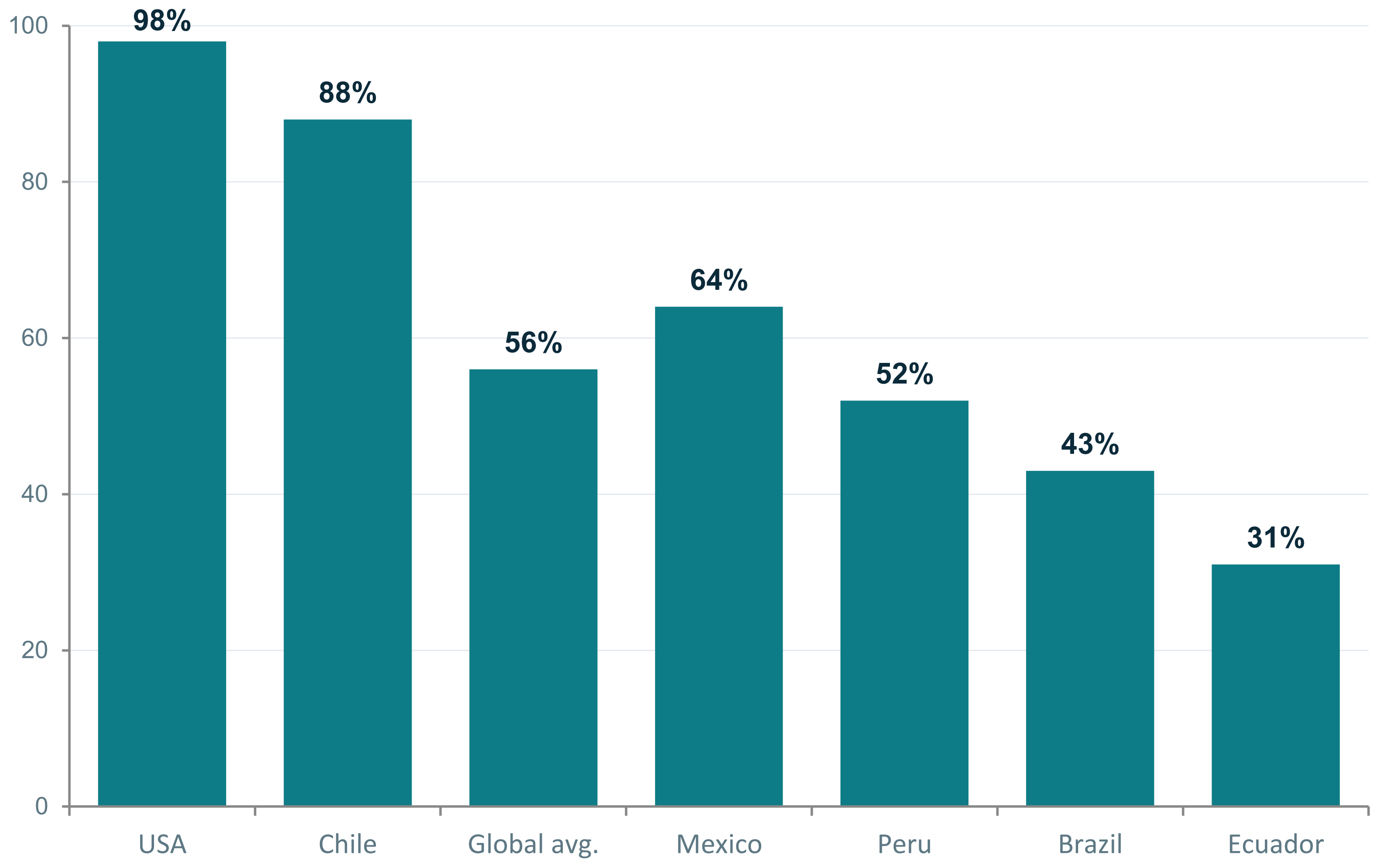
m^3/day of untreated wastewater discharged in evaluated Peruvian localities

Talledo, 2016

Weak institutions, fragmented small-scale providers, underpriced tariffs, and fiscal constraints, together with degraded watersheds, hinder fast, territorially adaptive responses.

Safely treated domestic wastewater

Share of domestic wastewater treated safely before discharge (%): stark gaps across the Americas



Why it matters

- Only 56% of domestic wastewater is treated safely worldwide (2024).
- Chile (88%) shows what high coverage achieves; Ecuador (31%) and Brazil (43%) lag far behind.
- These gaps justify decentralized regeneration to protect public health and natural capital.

Source: WHO (2025). Years vary by country (2020–2024).

Three classes of water contaminants

A multidimensional, structural problem requiring adaptive, technologically diverse solutions

Microbiological

- Fecal coliforms & enteric pathogens (E. coli, Salmonella, Shigella)
- From untreated sewage discharge
- Direct cause of waterborne disease: acute diarrhea, GI infections

Chemical

- Heavy metals: lead, arsenic, cadmium, zinc
- From mining, industry and agriculture
- Cumulative, bioaccumulative effects on health and ecosystems

Emerging

- PFAS / PFOS, hydrocarbons, pharmaceutical residues
- Highly persistent, low biodegradability
- Hard to treat with conventional technology

Empirical evidence across the region

The same structural pattern repeats, from extreme contamination to effective nature-based solutions

Mexico	**Huixtla River (Chiapas)**	Fecal coliforms > 2,419.6 MPN/100 mL , above method limit
Peru	**129 watersheds (ANA)**	89 localities with no treatment; 298,000 m^3/day discharged untreated
Bolivia	**La Paz River**	Total coliforms ~14.7 million CFU/100 mL + antimicrobial resistance
El Salvador	**Lake Coatepeque**	Low coliforms (<1.8–170 MPN/100 mL) , but latent vulnerability
Ecuador	**Phytoremediation trials**	99–100% E. coli removal in ~7 days with aquatic macrophytes

Sources: Escalona-Domenech et al. (2025); Talledo (2016); Estévez et al. (2025); Barraza (2018); León et al. (2018).

Antibiotic resistance & water

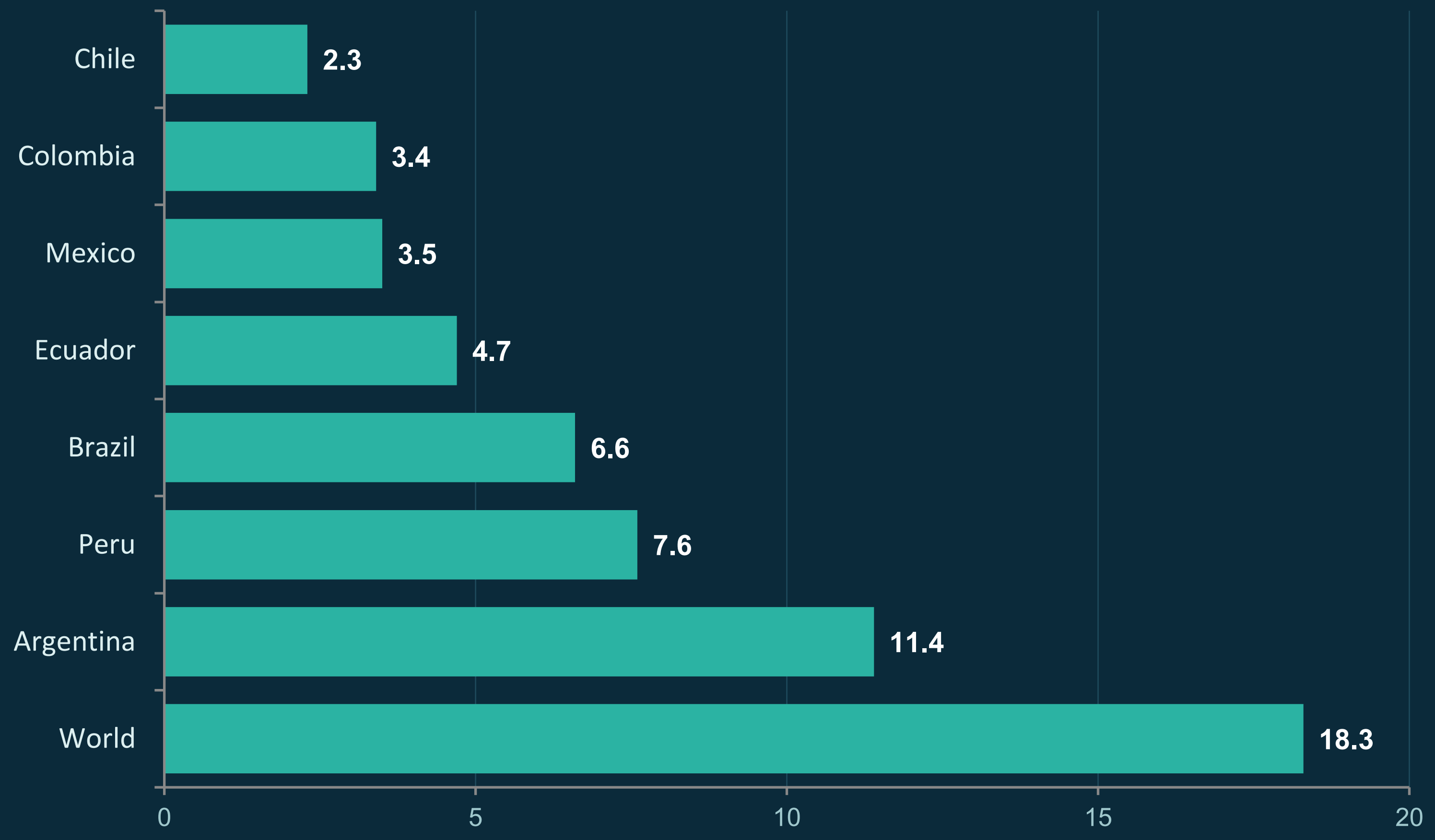
A “One Health” challenge linking human, animal and environmental health

Colombia	River and wastewater contamination spreads resistance genes, raising hard-to-treat infection risk.
Chile	Multidrug-resistant Gram-negative bacteria, incl. Enterobacter cloacae, in southern rivers and basins.
Peru	Rímac irrigation water: 2,400–11,000+ MPN/100 mL fecal coliforms; 24.5% multidrug-resistant strains.
Belize	Urban rivers act as resistance hotspots, threatening tourism and fisheries.
Paraguay	Paraná basin streams are reservoirs of resistant E. coli. Urban (human) vs agricultural (animal) drugs.

Socioeconomic stakes

- Higher medical costs from harder-to-treat infections
- Lost labor productivity from illness
- Eroded trust in farm & fishery products → weaker local markets
- Tourism and agriculture directly compromised
- Water regeneration is a preventive, cost-saving strategy

The human toll of unsafe water



Mortality attributed to unsafe WASH services (per 100,000 people), 2019

443,832

annual deaths in children under 5 from diarrheal disease (global)

11,000–18,000

estimated annual diarrheal deaths in LAC

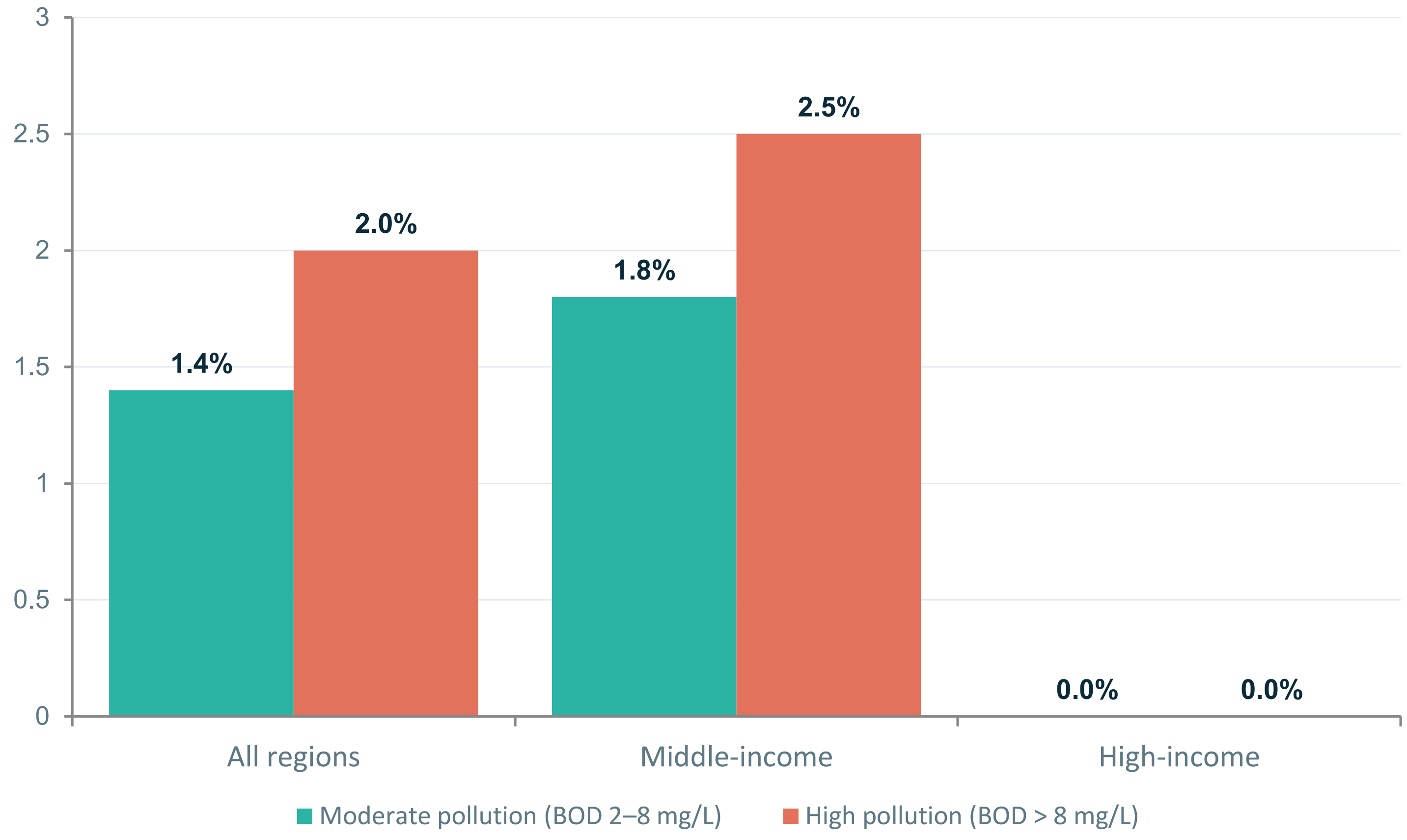
↓63%

global diarrheal deaths fell 1990→2021, yet inequality persists

Sources: WHO (2024); IHME GBD; Qiao et al. (2026).

Water pollution slows economic growth

Downstream regions grow more slowly, and middle-income economies are hit hardest (Desbureaux, Damania et al., 2019)



Percentage-point reduction in annual growth in downstream regions

The opportunity cost

- Average growth in the sample is ~2.33%/year.
- High pollution can erase over a third of regional growth.
- High-income countries show no significant effect (greater resilience via infrastructure & regulation).
- Estimates likely understate the true cost: BOD misses chemical and long-term health effects.

Water & sanitation is a high-return investment

$4 – 46

returned for every $1 invested in water & sanitation

$4.3 — WHO conservative estimate, based mainly on direct health savings

25–45% — reduction in diarrheal disease from WASH interventions

3.7% vs 0.1% — annual growth: countries with vs without improved water access

Sources: Hunter, MacDonald & Carter (2010); WHO (2018, 2025).

What drives the range

Time saved

Hours freed, mostly for women & children, reallocated to work and school

Health savings

Fewer visits, hospitalizations and medications; less pressure on public health

Productivity

Lower absenteeism and reduced unpaid care burden

Human capital

Better nutrition, child development and long-term growth

The Total Value of Water

Beyond traditional ROI: a composite model integrating eight interdependent streams of value

S — **Health**
DALYs/YLL avoided; fewer infectious & chronic diseases

P — **Productivity**
Workdays recovered; higher GDP, farming & fishing output

A — **Environment**
Better water quality, biodiversity, less eutrophication

C — **Carbon**
Avoided emissions × social cost of carbon (\$25.83/t CO_2)

R — **Waste**
Avoided collection, transport & disposal costs (OPEX)

SH — **Water security**
Reuse, drought resilience, less water stress

RE — **Resilience**
Lower climate & health vulnerability

CH — **Human capital**
Preserved IQ, education, less neurological damage

Total Value of Water = Health + Economic + Environmental + Climate + Social value

Chemical contamination can carry a disease burden up to 8× the infectious one; environmental chemicals may exceed 10% of world GDP. Today's models structurally undervalue regeneration.

Conclusions & recommendations

Water regeneration is a systemic, high-return investment: social, fiscal, sanitary and productive

Impact infrastructure

- Better public health and fewer waterborne diseases
- High economic return per dollar invested
- Less fiscal pressure on health systems and municipalities
- Lower waste & water-treatment operating costs
- Climate benefits → access to green bonds & ESG finance
- Long-term productivity and human development gains

Strategic recommendations

1. Deploy decentralized water infrastructure where contamination is high and coverage low
2. Blend public, private and climate finance to scale projects
3. Measure health, climate and productivity impact, not just financial returns
4. Prioritize critical watersheds and peri-urban zones with greatest potential impact
5. Promote circular-economy models linking waste reuse and water treatment
6. Embed water regeneration within sustainable & ESG investment strategies