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Water, Community, and Sustainability

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ABSTRACT

This document analyzes the challenges and solutions related to water and sanitation in Latin America and the Caribbean. It highlights the fundamental role of community-based management through Community Organizations for Water and Sanitation Services in achieving the Sustainable Development Goals (SDGs). It also proposes integrating innovative solutions based on the circular economy. The document concludes that combining community management with these innovations significantly multiplies positive impact across multiple SDGs and offers strategic recommendations at the household, community, and institutional levels, underscoring the importance of a cross-cutting technical–social approach with a gender perspective

Key words: WASH, community management, renewable energies, sustainable development goals, circular economy, sustainability, climate change.

RESUMEN

Este documento analiza los desafíos y soluciones en materia de agua y saneamiento en América Latina y el Caribe. El texto destaca el rol fundamental de la gestión comunitaria a través de las organizaciones comunitarias de servicios de agua y saneamiento (OCSAS) para alcanzar las metas de los Objetivos de Desarrollo Sostenible (ODS). Asimismo, se propone integrar soluciones innovadoras basadas en la economía circular. El documento concluye que la combinación de la gestión comunitaria con estas innovaciones multiplica significativamente el impacto positivo en múltiples ODS y ofrece recomendaciones estratégicas a nivel domiciliario, comunitario e institucional, subrayando la importancia de un enfoque técnico-social transversal con perspectiva de género.

Palabras clave: agua y saneamiento, gestión comunitaria, energías renovables, objetivos de desarrollo sostenible, economía circular, sostenibilidad, cambio climático.
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A world where everyone has a decent place to live.

1. INTRODUCTION

Water and Sanitation in Latin America and the Caribbean (LAC)

The Latin America and the Caribbean region has made progress in basic water and sanitation (WAS) coverage, but significant gaps remain in quality, treatment, and territorial equity. Although 78% of people have access to safely managed water, only 51% use improved sanitation, and only 38% of wastewater is properly treated (JMP, 2025). Achieving the SDG 6 targets by 2030 will require a 14-fold increase in the current rate of progress toward safely managed water and a 7-fold increase toward sanitation (UNICEF/WHO, 2022). In 2022, 65% of people in Latin America and the Caribbean (LAC) without basic access to water and 45% without basic sanitation lived in rural areas (UNICEF/WHO, 2023), highlighting an intersectional issue.

The required investment is substantial, ranging from 0.32% to 0.65% of annual regional GDP (about USD 17,000–36,000 million) for infrastructure alone. Additionally, USD 33,000 million is needed to treat two-thirds of contaminated water by 2030. Operational and maintenance costs for sanitation systems account for the largest share, ranging from 54% to 58% of total investment (Rozenberg and Fay, 2019; Serebrisky et al., 2020; Cavallo, Powell, and Serebrisky, 2020).

> **Achieving the SDG 6 target by 2030 will require a 14-fold increase in the current rate of progress toward safely managed water and a 7-fold increase toward sanitation.**

The water and sanitation gap affects genders differently. In 80% of households in LAC without piped water, women and girls are responsible for collecting water (UNESCO, 2022), limiting their time for education and work. The poorest households may spend up to 2.5 times as much on water as wealthier households because they lack direct connections (ECLAC, 2022a). Climate change worsens water scarcity: LAC has experienced 74 droughts over the past 20 years, resulting in losses exceeding USD 13,000 billion (World Bank, 2023b). Water demand in the region is projected to rise by 43% by 2050, nearly twice the global average (UNDP, 2024b).

40 of diarrhea-related deaths in LAC were linked to inadequate water and sanitation services (CAF, 2023).

Nova Vida Community, Manaus, Brazil © Habitat for Humanity International/Carolina Guerrero.

2. COMMUNITY MANAGEMENT

A Viable Solution

Progress in water and sanitation will require not only expanding coverage but also transforming the management of these services. In this context, strengthening governance frameworks, improving efficiency, and promoting innovative solutions, including climate change adaptation, ecosystem restoration, renewable energy, and a circular economy, are vital (JMP, 2025).

Community-based water management plays a crucial role alongside formal systems, advancing progress toward the SDGs, especially in contexts where public services still cannot fully meet needs (JMP, 2025). In LAC, the most widely recognized form is the Community Organizations for Water and Sanitation Services (OCSAS, the Spanish acronym). These structures are built by local communities in rural, peri-urban, and informal areas, with residents managing and maintaining the systems on a nonprofit basis, in accordance with quality, continuity, and affordability standards (Fundación Avina and CLOCSAS, 2017; Nicolás-Artero, 2016).

> **Community Organizations for Water and Sanitation Services (OCSAS) are groups of neighbors who manage and maintain water and sanitation systems on a nonprofit basis.**

CLOCSAS, the Latin American Confederation of Community Organizations for Water and Sanitation Services, groups over 145,000 Community Organizations for Water and Sanitation Services (OCSAS) across 15 Latin American and Caribbean countries, providing water access to more than 70 million people (Fundación Avina and CLOCSAS, 2017). UNESCO (2022) reports that these figures include more than 180,000 OCSAS and 80 million people living in rural areas. Their democratic structure, with rates tailored to local economic conditions, ensures efficient resource allocation that no formal provider can match at that scale (Nicolás-Artero, 2016).

OCSAS are not limited to rural areas; in Colombia, community aqueducts in cities such as Pereira, Ibagué, and Villavicencio supply up to 20% of drinking water (Moncada Mesa, Pérez Muñoz, and Valencia Agudelo, 2013). These organizations strengthen local autonomy, reduce reliance on external solutions, enable rapid emergency responses, and reinforce the social fabric through collaboration and accountability within communities (Fundación Avina and CLOCSAS, 2017).

3. THE RELATIONSHIP BETWEEN WATER, SANITATION, AND SUSTAINABILITY

Managing water and sanitation sustainably affects the economic, social, and environmental aspects of development simultaneously. According to UNESCO

(2015), water resources and the services they provide are essential to both economic growth and environmental sustainability.

3.1 Economic Aspect

Providing universal access yields returns that far exceed the initial investment. In LAC, each dollar spent on sanitation yields a return of $7.30, while each dollar invested in drinking water yields $2.40 (WHO, 2012, cited in IDB Invest, 2020; CAF, 2023). Achieving basic universal coverage could yield benefits 3 to 4 times higher than the costs. In impoverished rural areas, these benefits can reach up to 10 times the water costs and 8 times the sanitation costs. (CAF, 2023).

> **In LAC, each dollar spent on sanitation yields $7.30 in return, while each dollar invested in drinking water yields $2.40.**

The lack of investment leads to a 1.5% loss in GDP, driven by healthcare costs, reduced work hours, and resource depletion (CAF, 2023). Implementing community-based water management models with nonprofit rates, tailored to customers' ability to pay, reduces out-of-pocket costs for rural households and eliminates intermediaries' markups. These community operations generate local cash flow, strengthening the financial sustainability of both the service and the community organization (Fundación Avina and CLOCSAS, 2017).

3.2 Social Aspect

In 2016, nearly 40% of diarrhea-related deaths in LAC were attributable to inadequate water and sanitation services. Water and sanitation interventions reduce the risk of childhood diarrhea by 40% and improve nutrition and development (CAF, 2023). Access to nearby water sources reduces travel time and promotes school attendance and labor force participation, especially among women (CAF, 2023; UNICEF, 2016).

In several rural areas across LAC, many organizations have been led by women, thereby strengthening their technical and leadership capacities in a historically male-dominated field and promoting their individual and collective empowerment (IDB, 2024a).

3.3 Environmental Aspect

Sustainable water management protects ecosystems and builds resilience to climate change. Integrated water management must incorporate watershed protection, wastewater treatment, and water reuse within a circular-economy framework (UNESCO, 2015). Community organizations support reforestation, spring cleanup, and environmental education to maintain water flows and reduce stress on local water sources (AECID, 2022; Moreno and Günther, 2013).

In Guatemala, with support from ADIMAM, more than 70 water systems were built, and 70 hectares were reforested, benefiting more than 75,000 people (AECID, 2022).

4. CHALLENGES IN COMMUNITY WATER AND SANITATION MANAGEMENT

The OCSAS face significant challenges, primarily due to limited resources for system operation and maintenance, stemming from insufficient public investment in rural and peri-urban infrastructure (UNESCO, 2022). In practice, families need to dedicate time, volunteer, and allocate resources to carry out functions traditionally assigned to the state (UNESCO, 2022).

Río Negro, Manaus, Brazil. © Habitat for Humanity International/Carolina Guerrero.

4.1. Financial and Operational Challenges

1. Insufficient collection: In Mexico, fee collection rates range from 30% in the worst case to 70% in the best, with historical debts of up to 15 years for certain households (UNESCO, 2022).
2. When OCSAS cannot cover operation and maintenance costs, they are forced to rely on extraordinary fees or uncertain, conditional state support, leading to increased tensions among households (UNESCO, 2022).
3. In systems that rely on conventional pumping, electricity can account for up to 75% of monthly operating costs (Sánchez, 2020).

4.2. Organizational and Social Challenges

1. Exhausted leaders, gender inequality in participation, and limited engagement among younger generations undermine collective efforts; the burden is especially borne by women (UNESCO, 2022).
2. For long-term sustainability, communities must recognize the service's value and agree to pay a fair fee to ensure its continued operation (UNESCO, 2022).

In practice, families need to dedicate time, volunteer, and allocate resources to carry out functions traditionally assigned to the state (UNESCO, 2022).

4.3 Technical and Institutional Challenges

1. In many countries, OCSAS lack legal and regulatory backing, which hinders their official registration and access to formal support systems (UNESCO, 2022; Fundación Avina and CLOCSAS, 2017).
2. Territorial fragmentation and the limited capacity of local actors obstruct institutional sustainability; communities need accessible, legitimate institutions that can coordinate and ensure the continuity of these processes (OECD, 2012).
3. Technology must be culturally appropriate and manageable by the community; post-construction technical support is crucial to prevent infrastructure abandonment (IDB, 2019a).

Alpacoma, La Paz, Bolivia. © Habitat for Humanity Bolivia

5. CIRCULAR ECONOMY AND RENEWABLE ENERGY IN WATER AND SANITATION MANAGEMENT

The major economic, environmental, and social problems outlined above require innovative, comprehensive solutions. The following paragraphs present two main strategies that could help close these gaps.

5.1 Circular Economy Applied to Wastewater Treatment

In LAC, 30% to 40% of collected wastewater is treated (FAO, 2017; World Bank, 2020). However, municipal wastewater is 99.8% water and contains recoverable resources, including clean water, energy, and nutrients (World Bank, 2020). The circular economy provides a framework for transforming wastewater treatment into a process that delivers economic, environmental, and social benefits (ECLAC, 2022b). LAC documents three main and most effective processes for implementing this approach.

Reuse of treated water: It includes irrigation, industrial processes, aquifer recharge, and secondary domestic uses. This reduces supply uncertainty, increases availability, and delivers energy savings (ECLAC, 2022b). In San Luis Potosí, Mexico, a power plant replaced its groundwater supply with treated wastewater, achieving a 33% cost reduction and total savings of USD 18 million over six years (World Bank, 2020).

Biogas production: Through anaerobic digestion of organic waste, biogas can meet part of the plant's energy needs or generate revenue through sales. The La Farfana plant in Santiago, Chile, invested USD 2.7 million and earns about USD 1 million annually by selling biogas as a

renewable energy source (World Bank, 2020). In Costa Rica, the Los Tajos plant uses biogas to generate electricity for on-site use (AyA, 2023).

Nutrient recovery (biosolids): Using nitrogen and phosphorus from biosolids as agricultural fertilizers reduces reliance on mineral inputs. In Brazil, the company CAESB applied biosolids to corn crops, achieving a 21% higher yield than with conventional mineral fertilizers. In Cusco, Peru, a partnership with a local compost producer results in annual savings of USD 230,000 in waste disposal costs (World Bank, 2020).

> **Through innovation, wastewater treatment shifts from a sunk cost to a source of revenue, inputs, and ecosystem services.**
>
> ECLAC (2022b); World Bank (2020)

5.2 The Water-Energy Value Cycle

Water and energy are closely connected; water is vital at every stage of energy production and use, and energy is essential for water treatment and transport (Zakariazadeh et al., 2024; Perrone, Murphy, and Hornberger, 2011).

In LAC, the sector consumed 120 million tons of oil (Mtoe) in 2014 – equivalent to Australia's total energy demand – of which 42% was used for wastewater treatment (ECLAC, 2022c). Electricity accounts for 20% to 30% of the operating and maintenance budget for water services (World Bank, 2015); in conventional community pumping systems, this figure can reach 75% (Sánchez, 2020).

Solar photovoltaic pumping is the best-documented approach to permanently reducing this expense. With an estimated lifespan of about 25 years, minimal maintenance, and panel prices dropping by up to 80%, solar panels reduce ongoing fuel expenses and enhance resilience to climate change (World Bank, 2017; Sánchez, 2020). Furthermore, it strengthens community autonomy, improves access equity, and reduces greenhouse gas emissions by eliminating diesel use (Sánchez, 2020).

6. The Role of Integrated Water and Sanitation Management in Achieving the Sustainable Development Goals

The water and sanitation gaps in LAC extend beyond technical and infrastructure issues; they encompass governance, operational models, maintenance, community and institutional capacities, financing, scale, and quality. These challenges are further shaped by overarching issues, including inequality and climate change.

Given the complexity of these interrelated factors, a comprehensive approach to water and sanitation – and to comprehensive solutions – is necessary. These solutions must incorporate community-based management because areas with the greatest shortages pose challenges that large-scale government systems cannot sustainably address. Community-based water management itself presents specific challenges that require attention. A circular economy approach, combined with renewable energy, could help mitigate some of these challenges in an innovative and comprehensive way.

The table on the next page summarizes how integrated water and sanitation management can contribute to the SDGs. It examines each approach or area listed above, one by one, and outlines each one's specific contributions.

Overview of the Relationship Between the SDGs and Water Supply and Sanitation (WSS) Interventions

SDG	If water supply and sanitation (WSS) infrastructure interventions are implemented	If, in addition, interventions are implemented in partnership with OCSAS	If, in addition, a circular economy approach and the use of renewable energy are incorporated
6 CLEAN WATER AND SANITATION	6.1. About serving underserved populations.	6.b. Promotes community participation. 6.a. Enhances local technical capacity.	Its impact is enhanced by preventing the discharge of untreated wastewater into the environment.
11 SUSTAINABLE CITIES AND COMMUNITIES	11.1. Ensures access to basic services in rural and peri-urban communities.	11a. Strengthens links among rural, peri-urban, and urban areas through territorial management. 11.3. Encourages participatory management.	Contributes to a cleaner living environment.
1 NO POVERTY	Aids to achieving extreme poverty eradication goals by helping to break poverty cycles.	Reduces poverty by providing a nonprofit service with fees tailored to local communities' realities.	Reduces operating costs associated with energy use and treatment processes, freeing up resources for system maintenance or expansion and generating revenue.
3 GOOD HEALTH AND WELL-BEING	Contributes specifically to child health goals and to efforts to reduce mortality.	Water quality monitoring, maintenance, and preventive community oversight help prevent disease outbreaks and promote hygiene in vulnerable settings.	Aids to a cleaner living environment by reducing soil and ecosystem pollution.
10 REDUCED INEQUALITIES		10.2. Drives the social, economic, and political inclusion of vulnerable territories.	
5 GENDER EQUALITY	5.4. Lowers the burden of water collection, which disproportionately falls on women and girls, creating opportunities for their education and economic empowerment.		
13 CLIMATE ACTION	Climate resilience and adaptation: sustainably managed infrastructure serves as an effective adaptation strategy for droughts, floods, and extreme weather events.		Cuts greenhouse gas emissions by replacing fossil fuels and supports climate adaptation by recharging aquifers and providing alternative, reliable water sources during drought.
7 AFFORDABLE AND CLEAN ENERGY			Directly contributes by integrating clean technologies into a sector with high electricity demand.

Promoting community management, a circular economy, and a renewable-energy approach in water and sanitation projects will double the impact on SDGs 6, 11, 1, and 3 and expand the number of SDGs from 6 to 8.

In summary, actions that primarily support infrastructure address six SDGs. These include SDG *6: Clean Water and Sanitation*, by bringing services closer to marginalized populations; SDG *11: Sustainable Cities and Communities*, by providing basic services in rural and peri-urban areas; SDG *1: No Poverty*, by helping break the cycle of poverty; SDG *3: Good Health and Well-being*, through its direct impact on child health and mortality reduction; SDG *5: Gender Equality,* because the lack of water and sanitation disproportionately affects women; and SDG *13: Climate Action*, by enhancing community resilience and climate adaptation.

Integrating community-based water management as a core component would improve outcomes for four of these six SDGs (6, 11, 1, and 3) and support SDG *10: Reduced Inequalities*, as deliberate community efforts foster social, economic, and political inclusion in vulnerable regions.

Finally, integrating circular economy and renewable energy solutions into water and sanitation management can advance progress on five SDGs (6, 11, 2, 3, and 13) and support an additional goal: *7, Affordable and Clean Energy*. This is achieved by integrating clean technologies into a sector with substantial electricity demand.

7. GUIDELINES FOR MANAGING WATER AND SANITATION PROJECTS

7.1 Household Level

Encourage culturally appropriate sanitation options, such as adapted dry toilets in indigenous communities in Bolivia (AECID, 2022), and affordable household filtration and chlorination systems for homes without centralized treatment (Galeano Botero et al., 2023). In areas where boiling water is a common cultural practice, introduce improved cookstoves that reduce indoor smoke exposure while respecting local customs, as in Romatambo, Peru (IDB, 2019a). All home interventions must begin with an understanding of local practices because no technology is neutral.

7.2 Community Level: Comprehensive Strengthening of OCSAS

7.2.1 Building Capacity in Technical, Administrative, and Management Areas

Develop comprehensive capabilities within the OCSAS, including technical operations and maintenance of systems; chlorination and water quality monitoring; administrative and financial management; designing appropriate rates and efficient collection mechanisms; managing reserve funds for maintenance and emergencies; establishing operational models; providing customer service; and basic organizational management (IDB, 2019a; Fundación Avina and CLOCSAS, 2017).

Training should specifically include women in technical and leadership roles, as highlighted by the CAPyS committee in Villa Mercedes, Bolivia (UNESCO, 2022).

7.2.2. Leveraging Information Technologies, Data Analysis, and AI to Improve Management Efficiency

Supporting OCSAS, local providers, and governments in adopting digital tools for efficient water monitoring and management – such as sensors for water quality and flow, telemetry, AI, and big data analytics – to detect leaks, optimize supply, and enhance decision-making (World Bank, 2025). Currently, less than 10% of water utilities in low- and middle-income countries use these tools (World Bank, 2025). However, gradually adopting these measures, tailored to each OCSAS's size and capabilities, can significantly improve operational efficiency in service delivery.

7.2.3. Improving the Implementation and Ongoing Support of Technical Solutions. Post-Construction

Establish ongoing technical and social support after construction, including preventive maintenance plans, training on the proper use of technology, and mechanisms for intercommunity collaboration to share knowledge and resources (IDB, 2019a; IDB, 2022c). The IDB reports that restoring unused hand pumps has proven more sustainable in impoverished rural areas than installing complex systems that depend on external resources. It also recommends providing post-construction technical support to prevent infrastructure abandonment (IDB, 2019a).

7.2.4. A Cross-Cutting Socio-Technical Framework Emphasizing Women's Role

Implement a socio-technical approach across all interventions, spanning technological design to system management, to ensure cultural relevance, community ownership, and social sustainability (CAF, 2016). Explicitly acknowledge women's roles in diagnosis, design, implementation, and evaluation by recognizing and reducing their disproportionate burden in water management. Promote their participation in decision-making and emphasize their leadership within OCSAS (IDB, 2019a; IDB, 2024a). This principle applies to all other suggestions in this section.

7.2.5. Renewable Energy for Energy Autonomy and Sustainability

Promote the shift from traditional pumping systems to solar photovoltaic pumping by emphasizing community maintenance training, ensuring local ownership, and supporting long-term sustainability. In community systems, electricity can account for up to 75% of monthly operating costs (Sánchez, 2020). Solar pumping, with an approximate lifespan of 25 years and benefiting from an 80% decrease in panel prices, offers a way to permanently lower this expense and enhance independence from unstable power grids (World Bank, 2017; Sánchez, 2020). Community maintenance training is essential to success, as shown by the Wayúu

communities in La Guajira, Colombia (La Nota Económica, 2023).

7.3. Advocacy Level: Partnering with Local Governments

7.3.1. Developing and Promoting Legal Frameworks for OCSAS Governance

Advocate for nationally and locally established regulations that formally recognize OCSAS as legitimate water and sanitation service providers. Without legal support, these organizations cannot obtain official registration or protect the rights of the communities they serve (UNESCO, 2022; Fundación Avina and CLOCSAS, 2017). Assist in developing governance models that clearly define rights, responsibilities, and accountability among OCSAS, user communities, and local governments.

7.3.2. Capacity Building for Local Governments to Support OCSAS

Enhance local governments' ability to streamline processes, simplify administrative procedures, and support OCSAS's daily operations (IDB, 2019a). Ongoing local support, such as Bolivia's SENASBA model, which provides technical assistance, training, and conflict resolution with departmental and municipal authorities (UNESCO, 2022), is crucial for sustaining these processes and preventing community management from becoming solely reliant on volunteers without formal institutional backing. According to OECD (2012), the primary risks to the sustainability of these systems are territorial fragmentation and limited local capacity.

7.3.3. Generating Evidence and Diagnoses to Support Advocacy

Promote the systematic registration of OCSAS across the territory to build a robust evidence base to advocate to governments. Allocate resources to participatory water risk diagnostics that inform mitigation investments, using methodologies accessible at the local level (IDB, 2019a). Thoroughly document intervention outcomes – including coverage, water quality, gender impact, and financial sustainability – to generate replicable lessons and strengthen the OCSAS's bargaining power with authorities.

8. GUIDING QUESTIONS FOR DESIGNING COMPLETE WATER AND SANITATION PROJECTS

This instrument is a set of open-ended questions, not a checklist of requirements, designed to guide the development of a water and sanitation intervention from its earliest phases. Each question encourages you to identify opportunities and anticipate potential challenges.

Technical Design and Sustainability

- What is the most appropriate technology for this context? Can the community operate and maintain it without external support?

- Which circular economy elements might be integrated (such as reuse of treated water, biogas, and nutrient recovery)?
- What are the opportunities to reduce dependence on the system's energy (solar pumping and other renewable sources)?
- How can infrastructure be planned to withstand extreme weather and adapt to climate change?

Social, Cultural, and Institutional Sustainability

- In what ways can the community be actively involved in designing, managing, and holding the system accountable?
- What technical, administrative, and management skills must OCSAS strengthen to ensure the system's long-term sustainability (in operations, fees, and customer support)?
- How are women's roles in water management acknowledged, their burdens alleviated, and their leadership enhanced?
- What types of technical and social support are required after construction is complete?
- Which community-level cooperation mechanisms could enhance mutual learning and strengthen system resilience?

Institutional and Regulatory Framework

- Are OCSAS legally recognized? What measures can be taken to formalize their status and improve their governance?
- What capabilities does the local government need to support, facilitate, and ensure continuity of OCSAS's work?
- What types of evidence will be collected, and how will it be documented to support advocacy with governments and funding agencies?

Technology, Data, and Operational Efficiency

- What digital tools could improve the monitoring and efficient management of the system (sensors, telemetry, data analysis, and AI)?
- How will the intervention's effects on coverage, water quality, gender, and the financial sustainability of the OCSAS be assessed?

9. Conclusions

Water and sanitation in Latin America and the Caribbean (LAC) face many challenges and require solutions, with notable disparities in quality and territorial equity that primarily affect women and rural communities.

Achieving the Sustainable Development Goals (SDGs) requires the essential role of Community Organizations for Water and Sanitation Services (OCSAS), which serve millions of people yet face major challenges in securing financial, technical, and legal support.

To address these challenges sustainably, it is essential to adopt innovative circular-economy strategies, such as wastewater reuse, biogas production, and nutrient recovery, alongside renewable energy sources, particularly solar-powered pumping, to substantially reduce electricity costs. In summary, integrating community management with these innovations significantly amplifies the positive effects on various

SDGs. We trust that the strategic suggestions for households, communities, and institutions will enable us to maintain a focus on a comprehensive technical-social approach that incorporates a gender perspective.

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