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# **SCOPING STUDY: IMPLEMENTATION AND EXPANSION OF CIRCUIT RIDER SUPPORTED PASSIVE CHLORINATION IN PIPED DISTRIBUTION SYSTEMS IN EL SALVADOR**

June 2025

**DISCLAIMER:** This report builds on research initiated under the Rural Evidence and Learning for Water (REAL-Water) project, which was supported by a cooperative agreement between the United States Agency for International Development (USAID) and The Aquaya Institute. The research was completed in collaboration with Cova. The contents of this report are the sole responsibility of The Aquaya Institute and Cova and do not necessarily reflect the views of USAID or the United States Government.

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### ABOUT REAL-WATER:

Rural Evidence and Learning for Water (REAL-Water) was a USAID-funded applied research program that studied how to achieve safer and more sustainable rural water supply in low- and middle-income countries. Designed and originally executed as a five-year program (September 2021–September 2026) led by Aquaya, REAL-Water was terminated in February 2025 along with the vast majority of USAID's overseas development assistance programs. For further information about this and other aspects of the project, as well as to access our knowledge products, please visit <https://aquaya.org/real-water-resource-hub/>.

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## EXECUTIVE SUMMARY

Cova Agua (covaagua.org) is an international non-profit organization that supports community-based management of rural water systems in Central America. Cova's Circuit Rider support model for community-based management of passive chlorination is currently deployed across rural communities in Nicaragua and Honduras. Cova partners with community water boards to install simple passive chlorinators into existing piped networks and then provides ongoing support through routine water quality monitoring, technical assistance, and capacity building focused on operation and maintenance for chlorinators, financial management, watershed protection, and other relevant themes.

## OBJECTIVES

The goal of this scoping study was to determine if it is feasible to expand Cova's Circuit Rider-supported passive chlorination program within rural El Salvador. For additional background and motivation, see Appendix I. Through this study we aim:

1. To compile and analyze information regarding relevant agencies, laws, and regulations supporting community-operated water systems, rural water utilities, and water treatment.
2. To evaluate the enabling factors for and barriers to implementation of Circuit Rider-supported passive chlorination in rural communities.
3. To estimate the costs associated with implementation of Circuit Rider-supported passive chlorination.
4. To assess the existing chlorine supply chain (availability, quality, cost).
5. To explore opportunities for collaboration with USAID funded and other rural water programs.
6. To identify opportunities for implementation research on circuit-rider supported passive chlorination.

## METHODS

Between June and August 2024, Cova conducted a scoping study to evaluate the feasibility of expanding Circuit Rider-supported passive chlorination programs in El Salvador, including virtual and in-person interviews with Water, Sanitation, and Hygiene (WASH) specialists in El Salvador. We met with three non-profit implementing organizations, the El Salvador Water Authority (ASA), two local commercial entities, and four rural communities to conduct site visits and 57 key informant interviews. Our scoping study also evaluated opportunities for collaboration and implementation research with USAID-funded water development programs. Through site visits, desk research, and key informant interviews, we found opportunities for collaboration that are favored by the changing institutional environment in El Salvador. The establishment of the El Salvador Water Authority (ASA) and the simultaneous (but unrelated) consolidation of municipalities mean that the regulatory and funding environments around water are changing rapidly, and municipal governments will likely have more funding but less personnel capacity to focus on the water sector. Therefore, we see possibilities for collaborating with both ASA and municipal governments to support and expand ongoing efforts to provide access to safely managed drinking water.

## FINDINGS

We determined that the first two questions are well-suited for testing in a new Cova context, such as El Salvador, as expansion is considered. Questions 3 and 4, while relevant in both new and existing Cova service delivery areas, are better suited for a planned randomized controlled trial in Honduras.

We noted a clearly communicated need from rural communities for expert guidance and technical assistance in the face of evolving regulations and administrative roles. We also identified arguments that many community water boards lack the technical capacity necessary to carry out operation and maintenance plans for existing water systems.

Concerning chlorination, community feedback indicates that water boards generally support chlorination as required by regulations, with only minor (and not necessarily representative) concerns; however, rural communities may need more technical support to ensure adequate chlorination. This mirrors Cova's experience in Honduras and Nicaragua. Of possible concern is the variable and uncertain nature of the chlorine tablet supply chain in El Salvador, but one that could be mitigated through Cova's supply chain support efforts in Honduras.

Preliminary findings from our scoping study suggest that community water boards may have a greater capacity to pay for chlorine than Honduras and Nicaragua, indicating an opportunity to manage water quality more formally than was already being done at the time of our interviews.

Finally, we highlight several research questions that could be explored through the expansion of Cova's Circuit Rider-supported passive in-line chlorination system into El Salvador:

1. What is the effectiveness of Cova's Circuit Rider-supported in-line chlorination model in a new context?
2. What are the possible costs of the Circuit Rider model in El Salvador and how much of the costs can be supported by community water boards and their customers?
3. How can we incentivize water boards to improve chlorination rates in communities served by Cova's Circuit Rider model?
4. How do chlorine taste/odor detection and acceptability thresholds differ for users with prior exposure to chlorinated water versus those not consuming chlorinated water?

## FULL REPORT

### I. COMPILE AND ANALYZE INFORMATION ON RELEVANT AGENCIES, LAWS, AND REGULATIONS SUPPORTING COMMUNITY-OPERATED WATER SYSTEMS, RURAL WATER UTILITIES, AND CHLORINATION IN EL SALVADOR

#### I.1 LAWS AND REGULATIONS

Signed into law in the beginning of 2022, the Ley Nacional General de Recursos Hidricos, or the National Water Resources Law, informally referred to as the National Water Law, establishes, first and foremost, the human right to water in El Salvador.<sup>2</sup> In addition, this law sets forth a series of regulations that govern water resources usage, including a series of canons, or fees, for private water use for commercial purposes (i.e., the filling of large water jugs or containers for sale). According to key informants, this law is not applied consistently, with some believing it applies to community water boards while others indicate that it only applies to community water boards that are selling water beyond the community. Per the letter of the law, community water boards should not have to pay a canon for water use, though some think it may still ultimately be applied to rural community water boards regardless of the way the law is written. The National Water Law also established ASA as the entity responsible for water resources and therefore responsible for the canon fees.

At the community level, two regulations indicate the necessary water quality targets that community water boards must meet, and the frequency with which they are responsible for monitoring and reporting. The *Reglamento Tecnico Salvadoreno: Agua. Agua de Consumo Humano. Requisitos de Calidad E Inocuidad* sets forth the schedule upon which the water quality parameters established in the *Norma Salvadorena Agua. Agua Potable* must be tested. Rural community water boards are required to chlorinate and measure free chlorine residual daily. They must also test water samples for fecal contamination indicators, *Escherichia coli* (*E. coli*), total coliform and fecal coliform, along with a selection of physical-chemical parameters, on a monthly basis. Annual testing is required for physical chemical parameters, such as arsenic, that are more challenging to measure accurately. A complete analysis of all water quality parameters must be completed every three years, and when a new water source is developed. Although these requirements are in place, the actual completion rate of water testing is quite low, with 36% of water boards not completing any testing, 12% completing one of the three aforementioned forms of testing, 23% completing two out of three forms of testing, and only 29% completing all testing required. Regulation across these requirements is patchy, with fines being imposed very rarely.<sup>1</sup>

#### I.2 RELEVANT GOVERNMENT AGENCIES

*Juntas Administrativas de Agua Potable* are community water boards that manage rural water supplies in El Salvador (referred to herein as water boards). Water boards typically consist of 8-10 elected individuals, including the president, vice president, secretary, treasurer, and members at large. Each water board position is elected every two years, and members are not allowed to serve consecutive terms in the same position. The plumber, who plays a crucial role in operating the water system, is not considered a board member and therefore is not subject to the two-year transition requirement that applies to water board members. The water boards are responsible for the day-to-day management, operation, and maintenance of the community water system, including the costs associated with those responsibilities. They are also responsible for holding routine assemblies of the community at large for the purpose of

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voting on significant changes. Finally, the water boards are responsible for tariff rate setting and collection. There is a legal process through which water boards are formalized and licensed, allowing them access to municipal funding, the ability to maintain a bank account and other administrative capacities. In Honduras and Nicaragua, the licensing process is often seen as unnecessary or quite challenging and, therefore, many community water boards are not licensed. But in El Salvador, 76% of water boards are already licensed.<sup>1</sup>

Administratively, community development associations, *Asociaciones de Desarrollo Comunal* (ADESCO), oversee development projects within a community and sometimes also oversee water boards. ADESCOs typically focus on the development of infrastructure, such as roads or construction, but may also be involved in social development programs. In some cases, the water board is a part of the ADESCO, and in other cases, the ADESCO manages the water system without a separate water board. These roles and responsibilities levels are highly variable from community to community. ADESCOs are usually well connected to municipal governments, thus providing the water board with opportunities for obtaining funding from municipalities.

Municipalities directly manage 12% of rural water systems.<sup>1</sup> In other cases, municipalities are responsible for providing support to rural water boards, though actual implementation is variable. The effects of the recent consolidation, from 262 municipalities to 44, on support for rural water boards is uncertain. Key informants suggested that this consolidation may increase funds available from municipalities to support safe water initiatives. But conversely, it may also decrease personnel resources. Time will tell the results.

Multiple interviewees noted that water sector governance in El Salvador is evolving, and oversight is often unclear. For example, one community water board member called attention to a recent visit from MINSAL (Ministry of Health) employees who indicated that the community could expect frequent upcoming audits of the water board's chlorine monitoring registry. MINSAL is the entity responsible for oversight of water safety, but the community board was learning of this oversight and the possibility of audits for the first time. Overall, there was a clearly communicated need from rural communities for expert guidance and technical assistance in the face of evolving regulations and administrative roles.

## 2. EVALUATE THE ENABLING FACTORS FOR AND BARRIERS TO IMPLEMENTATION OF CIRCUIT RIDER SUPPORTED PASSIVE CHLORINATION IN EL SALVADOR'S RURAL COMMUNITIES

### 2.1 PHYSICAL WATER SYSTEMS & WATER QUALITY

A report by the Spanish Agency for International Development Cooperative (AECID) published in 2016 indicated that there were more than 2,325 rural drinking water systems managed by water boards in El Salvador, which serve 25% of the population.<sup>1</sup> However, unlike in Honduras and parts of Nicaragua, most of these systems rely upon pumps instead of being gravity-fed. Over half (57%) of community water systems, including all of the communities interviewed for this scoping study, had pressurized piped systems using solar or grid-electricity pumps to connect the groundwater sources to piped distribution networks.<sup>1</sup> Cova has installed chlorinators in pressurized systems, which typically require some engineering adjustments to ensure proper dosing. Therefore, installing chlorinators in pressurized systems in large numbers will require some additional consideration for components and sustained

effectiveness. However, due to Cova's experience implementing chlorinators in pressurized systems, particularly in Nicaragua, Cova does not identify this as a considerable risk for future expansion.

Community water boards are required to chlorinate and submit water samples for routine fecal bacteria analysis. However, the AECID report indicates that less than 2% of rural community water boards meet chlorination standards: 40% attempt to chlorinate but do not achieve free chlorine levels within the required range, and 59% don't chlorinate at all.<sup>1</sup> Sixty-four percent of water boards indicated that they do submit routine water quality samples for fecal bacteria analysis, but the results of those analyses were not described in the study.<sup>2</sup> MINSAL reported that diarrheal disease is one of the top ten reasons people in El Salvador visit local community health centers.<sup>1</sup> Improved chlorination may address this public health concern.

## 2.2 COMMUNITY TECHNICAL CAPACITY & SYSTEM AGE

The AECID report also found that many community water boards lacked the technical capacity necessary to carry out operation and maintenance plans for existing water systems.<sup>1</sup> These gaps are compounded by two factors: the age of water systems and the electro-mechanical components of water systems. Over 65% of rural piped water systems in El Salvador are 10 years old or older, and half of those have been functioning for more than 20 years.<sup>1</sup> Nevertheless, most water boards have not carried out age-required maintenance or repairs in that time. Since many of these systems are pump-fed, they also require electricity, which requires additional technical capacity on the part of the water board.

## 2.3 CHLORINATION

Key pieces of legislation require chlorination of any water systems (either publicly or privately owned) that provide drinking water in rural and urban areas. Further, chlorine appears to be widely available, though of uncertain quality, and two of the four rural communities visited were already chlorinating. Compared to Cova's experience in Honduras and Nicaragua, where fewer than 3% of communities were chlorinating prior to Cova's Circuit Rider model intervention, these are indicators that the enabling environment for chlorination in El Salvador is stronger.

Communities expressed mixed perceptions regarding drinking water chlorination. Two water boards out of four noted that chlorination and best practices for water treatment were priorities for water board members. Only a single community water board member interviewed indicated resistance to chlorination, citing negative perceptions of taste and misconceptions about the health impacts. Some community water board members reported they were unsure if they were chlorinating correctly or sufficiently for disinfection.

Community feedback indicates that community water boards generally supported chlorination as required by regulations, with only minor (not necessarily representative) concerns, but that rural communities may need more technical support to ensure adequate chlorination. This mirrors Cova's experience in Honduras and Nicaragua, where water boards are leveraged as advocates for chlorination amongst community members.

## 3. IDENTIFY THE POTENTIAL COSTS ASSOCIATED WITH IMPLEMENTATION OF CIRCUIT RIDER-SUPPORTED PASSIVE CHLORINATION

### 3.1 CIRCUIT RIDER MODEL COSTS & WILLINGNESS-TO-PAY

Our scoping study indicates that the costs associated with implementing the Circuit Rider-supported passive chlorination model in El Salvador may be lower than in Honduras and Nicaragua. The less mountainous terrain of El Salvador facilitates easier travel by motorcycle, enabling Circuit Riders to access more communities within a given period and reducing transportation costs per Circuit Rider per community. Additionally, the rural communities in El Salvador are more densely populated, with an estimated average population of 1,153 individuals per rural community, compared to an average of 546 individuals in the rural communities Cova serves in Honduras and Nicaragua. Consequently, each community visit in El Salvador has the potential to impact a greater number of people.

Operational expenses for Cova's established Circuit Rider model in Honduras and Nicaragua amount to approximately \$650 per community per year, or around \$1.19 per person per year during the first two years of implementation. We anticipate that the more navigable terrain in El Salvador could reduce operational costs by 3-4%. More significantly, due to the higher population density, the cost per person is estimated at \$0.56, as the population density in El Salvador is less than half that of our community averages in Honduras and Nicaragua.

During our study, we observed that different tariff structures were used by water boards in El Salvador when compared to Honduras and Nicaragua. These included block tariffs for a designated volume per month (e.g., \$4.25 for the first 15 cubic meters), a cubic meter rate (e.g., \$0.65 per cubic meter), or a fixed monthly rate (e.g., \$6.00 per month). Most water boards implemented volumetric block tariffs, indicating that these communities utilize household water metering.

Preliminary findings from this scoping study suggest that community water boards may have a greater capacity to pay for chlorine compared to Honduras and Nicaragua. This hypothesis is supported by the observation of higher water tariffs and larger community populations. For pumped water systems, the average water tariff was found to be \$0.228 per person per year in El Salvador, compared to \$0.144 per person per year in Nicaragua. Although not a comprehensive sample, these results indicate that individuals in El Salvador are subject to slightly higher water tariffs than those in Nicaragua.

During interviews, members of included water boards also explicitly noted their willingness to pay for additional services, like chlorination training and chlorine testing supplies such as digital comparators and reagents. A local water services business owner suggested to Cova that this was representative of the willingness to invest in water safety efforts. In addition, water boards communicated that they had the necessary means to purchase supplies and services related to elevating access to safe water, but lacked information on who could support those services. Though these water boards are unlikely to be representative of all water boards, these interviews suggest a financial capacity and desire to manage water quality more formally than was already being done at the time of the interview.

## 4. ASSESS THE EXISTING CHLORINE SUPPLY CHAIN (AVAILABILITY, QUALITY, COST) IN EL SALVADOR

Cova relies on the NSF 60 standard for selecting chlorine tablets for drinking water treatment. However, NSF 60 compliant tablets are not manufactured in Central America. In two independent interviews, water board members identified the quality of chlorine tablets as a point of concern, specifically the variable performance of tablets purchased from the same source. A local water services business owner noted that due to the variability of supply quality and pricing, his company has begun using granular calcium hypochlorite to fabricate their own chlorine tablets. Although this method produced tablets of known quality, which the community viewed as reasonably priced, there are inherent downsides to this approach, including the risks to staff handling chlorine and increased staff time. This example further illustrates the variable and uncertain nature of the chlorine supply chain in El Salvador.

## 5. ESTABLISH THE POTENTIAL OPPORTUNITIES FOR COLLABORATION UNDER EXISTING OTHER RURAL WATER PROGRAMS

Catholic Relief Services (CRS) Azure Initiative: CRS Azure provides loans to communities to support water system construction and improvement efforts. During the period of the loan, CRS also offers technical assistance to support the design, operations, and maintenance (O&M) needs of new and improved systems. Cova has started collaborations with CRS to combine resources and connections to better support rural communities.

Azure S.A. (originally started as a spinout from CRS Azure, above, but now an independent entity) is a for-profit technical assistance provider based in San Salvador. They provide technical services to rural communities. There is an opportunity for Azure S.A. and Cova to collaborate on chlorination and capacity building services.

ASA: Agency officials showed considerable interest in the Cova Circuit Rider model and would like to be informed of any pilot activities. In addition, they have identified several communities and institutions like primary schools that require better drinking water treatment. ASA requested that Cova consider expansion of the Circuit Rider model to include these communities and primary schools.

## 6. IDENTIFY AND DEVELOP OPPORTUNITIES FOR POSSIBLE IMPLEMENTATION RESEARCH ON CIRCUIT-RIDER SUPPORTED PASSIVE CHLORINATION IN EL SALVADOR

Based on the scoping study, interviews with potential partners and collaborators, and discussions with USAID, we have compiled a list of research topics and related questions that could help guide the development of a Circuit Rider program in El Salvador. These are presented in Table I, including priorities for a Cova expansion pilot.

**TABLE 1: RESEARCH TOPICS RELEVANT FOR ESTABLISHING SUSTAINABLE CIRCUIT RIDER SUPPORT FOR WATER SAFETY MANAGEMENT AT RURAL WATER SYSTEMS IN EL SALVADOR. QUESTIONS MARKED WITH AN ASTERISK (\*) ARE SUGGESTED PRIORITIES FOR A PILOT CIRCUIT RIDER PROGRAM.**

TOPIC	QUESTION	OTHER DETAILS
<b>Model Effectiveness in a Novel Context</b>	<ul style="list-style-type: none"> <li>How frequently can community-managed drinking water systems equipped with passive chlorinators, supported by Cova circuit riders, meet free chlorine residual targets at the point of consumption, in new communities in rural El Salvador? *</li> <li>Does passive chlorination, supported by a Circuit Rider model, reduce the prevalence of diarrheal disease-causing pathogens in drinking water?</li> <li>What kinds of socialization or incentivization are required to ensure chlorination rates? And to whom? I.e., the water board, community members, others?</li> </ul>	Pilot study of 1 circuit rider, in rural El Salvador (region to be determined)
<b>Costs</b>	<ul style="list-style-type: none"> <li>What are the costs of expanding the Circuit Rider model into new contexts?</li> <li>What is the effective demand for passive chlorination supported by circuit riders? *</li> <li>What is the effective demand for chlorine tablets, purchased by community water boards in rural El Salvador? *</li> <li>What kinds of subsidies are required for chlorine or programmatic efforts to maintain positive outcomes?</li> <li>How much and what kinds of community-level factors influence effective demand for chlorination: for example, tariff setting, system type, population, etc.*</li> </ul>	<p>Pilot study of 1 circuit rider expansion, rural El Salvador</p> <p>Can be measured through direct measurement of operating costs by Cova</p>
<b>Chlorine Acceptance</b>	<ul style="list-style-type: none"> <li>What are the taste &amp; odor thresholds for chlorine acceptance in rural El Salvador?</li> <li>How can we optimize taste &amp; odor acceptability across an entire distribution system?</li> <li>How long does it take for people to acclimate to the taste/odor of chlorinated water?</li> <li>What kinds of community engagement and sensitization activities influence acceptability? *</li> </ul>	
<b>Climate Resilience &amp; Source Switching</b>	<ul style="list-style-type: none"> <li>To what extent is source switching, secondary source usage, and water storage taking place?</li> <li>To what extent is chlorination affecting the above?</li> <li>To what extent is climate variability, overuse, or seasonal variability impacting the above?</li> <li>To what extent is permanent source switching, i.e., connecting to a different, often groundwater source, due to surface water variability, occurring?</li> </ul>	

## APPENDIX

### BACKGROUND AND MOTIVATION

#### I.1 WASH CONTEXT IN EL SALVADOR

El Salvador has experienced strong improvement in drinking water services over the last several decades, owing primarily to investment in urban water supply, which serves approximately 75% of the population. The remaining rural population remains largely without safely managed drinking water, with 94% of the rural population only receiving basic services.<sup>3,4</sup> However, in the last two years, there has been renewed interest from the Government of El Salvador to invest in the WASH sector and rural water supply. Created in 2022, the ASA is leading efforts to regulate the supply and treatment of water supply across El Salvador with a focus on rural communities.<sup>2</sup>

Unlike much of the rest of Central America, most water supply options in El Salvador require pumping rather than relying on gravity. These individual water systems are managed by community water boards (Juntas de Agua), which are also sometimes supported by municipal level entities. However, recent consolidation of municipalities from 262 to 44<sup>5</sup> leaves many municipalities over-burdened and under-funded, and therefore potentially open to collaborative efforts around rural water supply.

#### I.2 COMMUNITY-BASED MANAGEMENT

There is a growing research priority to identify and amplify the service delivery models that result in access to safely managed drinking water. Specifically, as the WASH sector continues to evolve in its perspectives on community-based management (CBM) to understand that external support or “community-based management +” arrangements are necessary additions to typical community-based management, interest in understanding what those arrangements look like has grown.<sup>6</sup> Further, a critical remaining question is how external support organizations, such as NGOs and professionalized utility entities, can expand their reach to communities not otherwise part of an external support network currently using a CBM strategy. Important implementation-level questions for the rural water sector include:

- How do communities join existing external support networks?
- How do water treatment service providers support communities as they move along the spectrum from non-networked to fully integrated into service provision and support?
- What is an effective balance of water user payments and public and/or philanthropic subsidy to financially sustain external support services?

In Central America, many rural communities have existing water supplies that meet “at least basic” access levels but are not served by any kind of maintenance or external support entity. There is an opportunity to develop research and resources around how these communities can be elevated to safely managed supply through external support provision, governmental support, and water treatment.

## I.3 CHLORINATION

Passive chlorinators are a relatively simple and affordable class of water treatment technology that dose chlorine into existing water supply infrastructure without requiring electricity, machinery, or burdensome input and behavior change from water users.<sup>7</sup> A large variety of passive chlorinators exist that are compatible with many kinds of water provision infrastructure, but they are particularly compatible with gravity-fed systems. A growing number of NGOs and service providers are developing passive chlorination programs, and they have been implemented in at least 16 countries to date.

However, passive chlorinators require sustained operation and maintenance from trained individuals to maintain consistent dosing at concentrations necessary for disinfection.<sup>7-9</sup> Therefore, evaluating the kinds of service delivery models compatible with chlorination has been identified as a priority research area necessary to scale passive chlorination.<sup>8</sup> This is particularly critical, given that an estimated 2.32 billion people in need of safely managed drinking water supply have systems compatible with passive chlorination.<sup>10</sup>

## I.4 COVA AGUA

Cova Agua (Cova) is an NGO working in Honduras, El Salvador, and Nicaragua that provides sustained, external technical support to rural community drinking water systems through its Circuit Rider model, including the implementation and ongoing maintenance of passive chlorinators. Multiple peer-reviewed and internal reports indicate the effectiveness of the Cova Circuit Rider program on chlorination and disease outcomes,<sup>8</sup> in Nicaragua and Honduras, where Cova has operated since 2008. A recent study indicated a chlorination rate across operational data collected between 2013 and 2021 of 77% at the point of collection<sup>8</sup> across the two countries, Cova has worked in 2,109 rural communities, each with an in-line chlorinator served by Cova's Circuit Rider model. In 2023, Cova (EOS International) began testing the market in El Salvador, where they collaborated with the partner Grupo Inversiones Melendez (GIM) to test aspects of the Circuit Rider model in 63 communities. Through GIM, Cova hired a Circuit Rider to begin Circuit Rider activities, including partner mapping, water quality monitoring, and chlorinator installations. This has facilitated an initial footprint and opportunity for learning for Cova. Beginning in late 2024, Oscar Melendez, the owner of GIM, transitioned into country director of Cova El Salvador and will permanently integrate GIM under Cova's operations.

With an on-the-ground staff in Nicaragua, Honduras, and El Salvador, Cova is a locally managed organization dedicated to comprehensively implementing drinking water solutions that ensure a long-term, positive impact. Strong partnerships with ministries of health, local communities, private entities, universities, NGOs, and governmental organizations have helped expand Cova's reach and effectiveness.

All solutions are locally operated and require co-financing from rural community clients. Cova's program explicitly targets rural communities in Nicaragua, Honduras, and El Salvador, where most residents are subsistence farmers earning \$3-6 per day and lack access to safe drinking water. The goal of Cova's Circuit Rider model is to empower rural communities with access to safe drinking water, resulting in an improved standard of living, poverty reduction, and increased educational and economic opportunities.

## 1.5.1 THE CIRCUIT RIDER MODEL

Cova Agua's model follows three distinct phases. Prior to entering any new communities, our Circuit Riders meet with municipal leaders and local government health offices to identify communities and travel "circuits" to explore expansion into. Once explicit agreements have been reached, Circuit Riders begin delivering Phase I.

### **Phase I: Implement**

The Circuit Rider model aims to build the capacity of rural community water boards by equipping them with the necessary skills, knowledge, and resources to provide safe drinking water for their community and to operate their water utilities efficiently and effectively. Activities of Circuit Rider include baseline water quality analysis to assess contamination in the community water source, installation of passive chlorinators, water board capacity building, routine free chlorine residual monitoring at the tank and households, and ongoing chlorine tablet distribution. During Phase I, a Circuit Rider typically works in 40-50 communities. At this stage, communities sign agreements specifically outlining the responsibilities of the water board and the responsibilities of the Circuit Rider. At this stage, community water boards begin to purchase chlorine tablets for the chlorinators using funds available through water tariffs paid by each household connected to the piped scheme. Water tariffs are legally mandated structural components within water board governance; however, Circuit Riders also include financial capacity building in the early phases of their engagement to support water boards without tariffs or without sufficient tariffs.

### **Phase II: Transition**

In Phase II, monthly water quality monitoring activities are transitioned to community leaders and other professional entities. Cova identifies and trains community leaders, such as municipal WASH technicians and government public health promoters to monitor and report free chlorine residual monthly, eventually eliminating the dependency on Cova to identify water quality issues. Cova provides the communities with tools and equipment to report monthly water quality metrics, which can be shared with the Ministry of Health or other local partners. This transfer of monitoring responsibilities can only begin after the community meets key sustainability metrics, especially sustained high rates of chlorination.

### **Phase III: Scale**

With the training provided in Phase I and Phase II, communities and government entities can troubleshoot and respond to most water quality issues identified (i.e., through preventative maintenance, repair, and/or chlorinator calibration). This allows a Cova Circuit Rider to transition from supporting 50 communities to supporting up to 150 rural communities, continuing to act as a technical resource on an as-needed basis and chlorine distributor, providing technical assistance, and laboratory-level analyses for the community. At this stage, communities remain responsible for the purchase of chlorine, and if the chlorinator (or other system components) requires replacement or repairs, the water board is responsible for paying for those repairs.

Cova has found that with two years of community investment, year three can be sustained entirely with the communities' support (see chlorine sales below), providing a financially viable and sustainable model. This program investment requires multiple years to build up the capacity of the communities and the local institutions and an operational plan to achieve sustainability without outside funding. Cova also

maintains recognition that there is some feedback between phases, particularly as new water boards are elected, communities that have otherwise moved on to Phase III may require additional capacity building to rebuild knowledge lost during the transition of power. However, this emphasizes the importance of Cova working at both the water board level and at the municipality and secretary of health levels.

## I.5.2 FINANCIAL MODEL

To cover a portion of the costs of these services and ensure that communities have access to chlorine necessary for the operation of the chlorinator, Cova Circuit Riders sell chlorine tablets to the water boards. Cova also leverages philanthropic support and results-based funding to cover the remaining costs of the circuit rider model. The cost of the circuit rider program shifts over time depending on the length of time they have worked in a community, the frequency of community visits, and the capacity of the water board. In Phases I & II, Cova's operational cost to support 50 communities in Honduras and Nicaragua is approximately \$1.19/person/year on average. However, as Circuit Riders continue to build the capacity of the community and the visit frequency is reduced, allowing the Circuit Rider to support more than one district, our operational costs are reduced to approximately \$0.54/person/year or less, depending on the number of districts served.

## I.5.3. EXPANSION

As Cova seeks to expand across Central America, both into new countries and new regions in Honduras, El Salvador, and Nicaragua, there is an opportunity to study the factors that enable the expansion of these services. Exploring expansion in El Salvador will allow for future comparison and generation of research questions, as well as a determination of where future implementation research should focus between new and already established country programs (El Salvador, Guatemala, and Honduras).

## REFERENCES

1. Gregori, C.; Gomez, P.; Forte, B.; Gisbert, L.; Alcover, M.; Pedro, V.; Nobell, R.; Troyano, C. Elaboracion de Diagnóstico y Catastro Georreferenciado de Sistemas de Agua Potable y Saneamiento Rurales No Administrados Por ANDA; AECID, 2015.
2. Ley General de Recursos Hidricos. 2023.
3. World Bank Open Data. <https://data.worldbank.org/>.
4. Progress on Household Drinking Water, Sanitation, and Hygiene 2000-2020: Five Years into the SDGs; Geneva: World Health Organization (WHO) and the United Nations Children’s Fund (UNICEF), 2021.
5. Renteria, N.; Morland, S.; Gregorio, D. El Salvador Consolidates Local Governments, Opposition Warns of Power Grab. Reuters. June 14, 2023. <https://www.reuters.com/world/americas/el-salvador-consolidates-local-governments-opposition-warns-power-grab-2023-06-14/>.
6. Kayser, G. L.; Moomaw, W.; Portillo, J. M. O.; Griffiths, J. K. Circuit Rider Post-Construction Support: Improvements in Domestic Water Quality and System Sustainability in El Salvador. *J Water Sanit Hyg Dev* 2014, 4 (3), 460–470. <https://doi.org/10.2166/washdev.2014.136>.
7. Lindmark, M.; Cherukumilli, K.; Crider, Y. S.; Marcenac, P.; Lozier, M.; Voth-Gaeddert, L.; Lantagne, D. S.; Mihelcic, J. R.; Zhang, Q. M.; Just, C.; Pickering, A. J. Passive In-Line Chlorination for Drinking Water Disinfection: A Critical Review. *Env. Sci Technol* 2022, 56 (13), 9164–9181. <https://doi.org/10.1021/acs.est.1c08580>.
8. Lindmark, M.; Meier, W.; Calix, D.; Just, C. Performance of Community Water Board-Managed Passive In-Line Chlorinators Supported by a Circuit Rider Program in Rural Honduras. *ACS ES T Water* 2023, 3 (12), 4011–4019. <https://doi.org/10.1021/acsestwater.3c00425>.
9. Lauuwen, M. Implementing Decentralized Rural Water Treatment: Passive Chlorination and UV Disinfection, University of Oxford, 2022, Vol. Master of Science in Water Science, Policy and Management.
10. Cherukumilli, K.; Bain, R.; Chen, Y.; Pickering, A. J. Estimating the Global Target Market for Passive Chlorination. *Env. Sci Technol Lett* 2023, 10 (1), 105–110. <https://doi.org/10.1021/acs.estlett.2c00781>.