

damages from hurricanes in 2016 alone.⁸ These included Hurricane Matthew, which struck during the design phase of the USAID Water and Sanitation Project and significantly damaged water and sanitation infrastructure.⁹ As 2016 was also the year USAID’s CRM policy took effect, USAID Haiti conducted a climate risk assessment and incorporated findings in the project’s design (see annex to the project’s Initial Environmental Examination).¹⁰

Consideration of climate impacts is particularly important for managing and maintaining natural and built systems that provide crucial community services. Acknowledging the public health and safety implications of Haiti’s high climate risk, the project works in 10 areas, which are either cholera “hot spots” or that were affected by Hurricane Matthew. The project initially focused on five areas: three hard hit by the cholera outbreak (Cap-Haïtien, Mirebalais, and Canaan) and two hard hit by Hurricane Mathew (Les Cayes and Jérémie). During its fourth year, the project added five more areas hard hit by the cholera outbreak (Ouanaminthe, Hinche, Pignon, Lascahobas, and Belladère).

The project incorporates CRM to protect infrastructure, reduce the risk of cholera, and safeguard lives and property during and after a disaster. CRM is helping sustain project benefits and protect USAID investments from climate-related impacts.

Climate Risks to Haiti’s Water and Sanitation Systems

Climate stressors like heavy rains, flooding and drought threaten the availability and quality of Haiti’s water sources, which include surface water and groundwater via springs and pumps. Storms and landslides can damage water delivery via distribution and transmission lines, as well as sanitation infrastructure; damaged and overflowing latrines introduce contamination and risk of waterborne diseases.

Although the Caribbean is most often associated with hurricanes, heavy rains, and flooding, drought has also been a serious problem in Haiti. “There is not enough focus on drought. In the past three to four years, we have had a lot of droughts. People have lost cattle... We need to distribute water to communities [during droughts],” reflected USAID Haiti Mission Environmental Officer Abdel Abellard. Droughts affect both quantity and quality of water,

CLIMATE RISKS TO HAITI’S WATER AND SANITATION INFRASTRUCTURE

Heavy rains, flooding, and landslides damage water and sewage infrastructure, disrupting service and introducing contamination through broken pipes and overflowing latrines

Hurricanes significantly damage water and sanitation infrastructure, disrupting services and increasing risk of cholera

Drought causes water shortages and public health risks as contaminants and pathogens concentrate in depleted water sources and people have inadequate clean water for sanitation

⁸ EM-DAT. 2021. International Disaster Database. Brussels, Belgium: Centre for Research on the Epidemiology of Disasters. Available at: <https://www.emdat.be/>

⁹ Khan, R., R. Anwar, S. Akanda, M.D. McDonald, A. Hug, A. Jutla, and R. Colwell. 2017. Assessment of Risk of Cholera in Haiti following Hurricane Matthew. *The American Journal of Tropical Medicine and Hygiene*, 97:896-903.

¹⁰ USAID. 2017. Initial Environmental Examination: Haiti Water, Sanitation and Hygiene (WASH) Project [50023.pdf \(usaid.gov\)](#)

raising risks of water shortages and public health concerns due to contaminated water and inadequate supply for sanitation.

In interviews, water and sanitation system managers in Jérémie and Les Cayes described more intense, frequent droughts and more intense rainfall. One objective of the project is to gather more information about water in spring-fed systems and pumped systems, as well as information about how changes in climate affect water availability in these systems. This information will help the project team and local water managers improve their understanding of vulnerabilities of specific sources and identify technical solutions to sustainably manage short-term and long-term risks to water availability and quality. Because Haiti faces problems associated with too much water and too little water, the project must design and construct water and sanitation infrastructure that can withstand and operate reliably under both types of extreme conditions.

USAID Haiti Mission WASH Lead Marcia Urquhart Glenn described how the country's water and sanitation infrastructure failed repeatedly in the aftermath of three hurricanes in five years—Isaac (2012), Matthew (2016), and Irma (2017)—underscoring the need for the project to strengthen utilities' capacity for operational resilience. In Les Cayes, Tamara Thomas, CTE Les Cayes Commercial Director reported that storms have destroyed pipes in the water utility, known in Haiti as the Centre Technique d'Exploitation (CTE) system, which limits availability of water and pollutes water in the system..

Latrines damaged by extreme precipitation, floods, and landslides release human waste, exacerbating public health and environmental hazards during and after an extreme weather event. Jean Edens of the latrine service provider PME in Jérémie explained that frequent and timely maintenance can help prevent some overflow incidents (“When it rains, I get more contracts because the pits are filled with water”). However, during and immediately following extreme precipitation, it often is not feasible to access and maintain latrines in vulnerable areas. Latrine service providers can select sites and construction techniques to protect latrines from some impacts, but “for landslides, I don't have a prevention formula,” said James Bellefleur, director of latrine service provider ASTIAS in Les Cayes.

Climate Change as a Threat Multiplier

Climate change exacerbates other underlying conditions that affect the quantity and quality of water that enters the system and the vulnerability of water and sanitation infrastructure. Jocelyn Laurent, technical director of CTE Jérémie, and Engineer Jean Macson Duverseau, director of CTE Jérémie, explained that deforestation upstream of water sources and infrastructure contributes to runoff and increases risk of flooding and landslides. Storms like Hurricane Matthew damage and degrade forests further, creating a feedback cycle that leaves damaged forests more vulnerable to future climate risks.

Aging and degraded infrastructure also intensifies the impacts of climate-related events. Much of Haiti's water and sanitation infrastructure is in disrepair and highly vulnerable to damage. Jérémie's water system was built in 1901, and the last major system-wide repairs were completed in 1956 and 1982, said Ms. Laurent. In Les Cayes, CTE Engineer Oswald Hyppolite said that though the system has been strengthened since it was built in 1881, it needs significant improvements to reduce vulnerability to climate and non-climate risks and improve its water storage capacity.



Tamara Thomas, CTE Les Cayes Commercial Director and Eng. Jean Macson Duverseau, director of CTE Jérémie. *Credit: Abt Associates for USAID (2021)*

The project team recognized that designing and constructing water and sanitation infrastructure without accounting for climate risks would result in future damages and losses and would waste valuable resources. To help protect USAID’s investments in Haiti’s water and sanitation systems, the project team designed a suite of CRM actions, which the next section details.

Climate Risk Management in Action

To build the foundation for long-term, climate-resilient water and sanitation management plans, USAID Haiti conducted a climate risk assessment during the project design phase.¹¹ This enabled the eventual USAID Water and Sanitation Project team to identify the most important vulnerabilities in these systems and devise actions to manage both short-term and long-term climate risks. These actions include building the awareness of multiple stakeholders about climate vulnerabilities and CRM so they can integrate CRM principles into long-term planning and management of water and sanitation systems.

The project incorporated CRM into its activities in three main ways.^{12, 13, 14}

- **Designing and implementing interventions for areas with high climate risk.** The project prioritizes areas where water and sanitation systems have experienced severe climate impacts and cholera outbreaks. This case study focuses on two project areas—the coastal towns of Les Cayes and Jérémie—that experienced especially severe impacts from Hurricane Matthew, a Category 5 storm that struck Haiti in 2016. To address climate risk in these

¹¹ Ibid

¹² DAI Global. USAID Water and Sanitation Project: Annual Work Plan - 2018

¹³ Climatelinks blog post. “Haiti Water and Sanitation Prepare for Climate Events.” July 11, 2018. Available: <https://www.climatelinks.org/blog/haiti-water-and-sanitation-programs-prepare-climate-events>

¹⁴ DAI Global. USAID Water and Sanitation Project. Year 2 Work Plan. October 1, 2018 – September 30, 2019

vulnerable locations, the project works to improve existing water and sanitation infrastructure and services and develop new infrastructure in these communities.

- **Protecting water infrastructure in anticipation of changes in water levels and land degradation from extreme weather events.** The project uses USAID's [climate risk screening and management tool](#) to identify where climate impacts could affect proposed activities and then designs appropriate protection for infrastructure and services through work plans and in quality assurance and quality control plans. For example, project staff and other stakeholders use the tool to identify areas prone to landslides, which helps stakeholders determine whether any planned water delivery infrastructure should be relocated or buried at a depth that will be safe from damage during an extreme precipitation or landslide event.

- **Building stakeholder capacity to manage potential climate-related damages to water and sanitation infrastructure and services.** The project provides technical assistance with climate-resilient design and construction to individuals and households, the Government of Haiti, fecal sludge management (FSM) entrepreneurs, small and medium enterprises (SMEs), communes, subnational institutions, civil society, and the private sector. The project offers technical assistance and training to water service providers who lead water supply planning processes, trains latrine providers to manage flood risk, trains households in siting latrines, and delivers



Repairing water pipes in Les Cayes. Credit: DAI Global for USAID (2021)

technical assistance to regional sanitation units to standardize FSM protocols in response to flooding and erosion concerns. The project also helped decision makers manage budgets to meet longer-term goals for financial sustainability in the face of climate risk. “It was important to build operational resilience into the project’s utility management turnaround framework,” said USAID’s Marcia Urquhart Glenn. “Simply put, both revenue generation and maintaining an [operations and maintenance] budget for emergency repairs and emergency services became important.”



Manual sewage emptyers in Fonfred, near Les Cayes. Credit: Mark Lee Steed (2021)

This CRM action contributes to the project’s indicator that tracks the number of national and subnational water and sanitation institutions trained to support sector planning, investment, monitoring, and/or regulation. By 2020, the project trained nine CTEs to shift from focusing on just day-to-day operations and

crisis response to developing short- and long-term system management plans.¹⁵ Abdel Abellard of USAID Haiti explained that helping stakeholders at all levels expand their planning horizon and anticipate climate impacts was an important step in building long-term climate resilience in water and sanitation systems. “If you’re working on a day-to-day basis, then you’re not thinking about [climate] risk,” he said. “But when working on a longer time frame, it matters.”

CRM Outcomes and Benefits

The USAID Water and Sanitation Project demonstrates how CRM contributes to project success by helping protect outcomes from climate-related impacts. Integrating CRM into the project’s main activities has contributed to meaningful benefits: sustained water savings, avoided damages to water and sanitation infrastructure, basic access to water and avoided travel costs, increased revenue for water service providers, and prevention of waterborne illnesses. (Some CRM actions deliver benefits that are difficult to quantify or monetize—for example, strengthening water utility managers’ capacity to manage climate risk in their operations. Other CRM benefits may not yet be apparent because the timeframes associated with climate variability and change are much longer than the period of active USAID support.)

Sustained Water Savings

One of the project’s main interventions is repairing leaks in water infrastructure, which in some communities can significantly reduce non-revenue water losses by up to 90 percent.¹⁶ Repairs also reduce future climate-related damage and leaks, increasing system resilience during droughts and water shortages.

“We are abating massive water wastage at a time where water security is becoming increasingly critical,” said USAID’s Marcia Urquhart Glenn.

Leak repairs create and sustain meaningful benefits to a community. For example, the Les Cayes water system produces approximately 100,000 cubic meters of water per month for approximately 3,400 people. But individuals only receive about 14 cubic meters of water each month—for a total monthly consumption of 47,600 cubic meters. The rest of the water—more than half the water produced each month—never reaches consumers; other systems are losing even more water.¹⁷ Eliminating leaks could prevent the loss of approximately 50,000 cubic meters of water per month in Les Cayes, for a total monthly value of \$15,000 per month.¹⁸ If this water were retained and sold to additional subscribers, the Les Cayes water system could double its monthly income.

¹⁵ DAI Global. USAID Water and Sanitation Project. Monitoring, Evaluation, and Learning Plan, FY2020 Update.

¹⁶ Interview with Marcia Urquhart Glenn, USAID Haiti WASH Lead.

¹⁷ Interview with Dan O’Neil. USAID Water and Sanitation Project Chief of Party.

¹⁸ Cost of water is 30 Haitian gourdes per cubic meter; 1 Haitian gourde = 0.010 USD

Avoided Damages to Water and Sanitation Infrastructure

Relocating, strengthening, and burying water and sanitation infrastructure increases its resilience to extreme weather events, including stronger storms associated with a changing climate. As a Small Island Developing State (SIDS) in the Caribbean, Haiti is highly vulnerable to tropical storms and hurricanes that damage water infrastructure and contaminate water supplies, creating serious threats to water security and health.¹⁹ One historic estimate projected the cost of inaction on climate change in Haiti will be more than 60 percent of 2004 GDP by 2050, and another estimated the long-term effects of climate change as 75 percent of GDP by 2100 in several SIDS, including Haiti.^{20,21}

It is difficult to estimate future avoided damages from a particular event or hurricane season, though past storms could be indicative. In 2004, Hurricane Jeanne's damage to water infrastructure accounted for 31 percent of total infrastructure damage in Haiti.²² Within the Caribbean region between 1990 and 2008, damage and loss to water infrastructure from natural disasters was greatest in Guyana and Haiti: "approximately 43 percent of the total national cost in infrastructure in both countries."²³ Project work to design and construct climate-resilient water and sanitation infrastructure could substantially reduce costs of damages.

Basic Access to Water and Avoided Travel Costs

By the end of its fourth year (September 2021), the project had provided at least basic access to water for 13,240 people. Although the project did not collect data on total travel time community members spent before its interventions, one member of a community where the project works explained he regularly traveled two kilometers to access water.²⁴ If poor water service requires traveling up to one hour per day round trip (including



Water kiosk in Les Cayes. Credit: Mark Lee Steed (2021)

¹⁹ Mycoo, Michelle. 2017. [Beyond 1.5 °C: vulnerabilities and adaptation strategies for Caribbean Small Island Developing States | SpringerLink](#)

²⁰ Ibid

²¹ Stephenson, T.S. and J.J. Jones. 2017. Impacts of Climate Change on Extreme Events in Coastal and Marine Environments of Caribbean Small Island Developing States (SIDS). Caribbean Climate Change Report Card: Science Review 2017, pp. 10-12.

²² ECLAC (Economic Commission for Latin America and the Caribbean). 2010. Analysis of Extreme Events in the Caribbean 1990-2008. Port of Spain, Trinidad and Tobago. Available at: https://www.cepal.org/sites/default/files/publication/files/38660/LCCARL254_en.pdf

²³ Ibid

²⁴ <https://www.youtube.com/watch?v=LF6RkM3yhPY>; note Haiti's National Directorate of Potable Water and Sanitation (DINEPA) is the national partner of the USAID Water and Sanitation Project.

queuing) to access clean water, then eliminating this travel time could produce benefits of approximately \$64 per person per year (because time spent walking is time not spent working).²⁵ If all 13,240 community members who gained basic access to water from the project had similar benefits, the total value of these avoided travel costs would be up to approximately \$850,000 per year.²⁶ Even if the project’s interventions cut walking travel time in half by providing access to water within 30 minutes round-trip (based on the definition of providing “basic access to water”), avoided travel costs could total about \$425,000 per year.

These avoided costs are likely underestimated, as the project also improved water service quality for 191,900 people in 2021. Though data are not available on specific improvements for all people and communities, improved water service quality would inherently prevent the need to travel for water due to a service interruption.

Integrating CRM into project interventions helps sustain these benefits across project areas and over time. For example, when the project manages construction of new, climate-resilient infrastructure to provide basic access to water, it helps ensure continuous water delivery even if a community experiences a climate-related extreme event.

Increased Revenues for Water Service Providers

Protecting infrastructure from climate-related damages also increases revenues for local water service providers who provide more reliable service that attracts new subscribers. Engineer Oswald Hyppolite of CTE Les Cayes explained that better understanding of climate risks has made CTE staff take more preventative measures to protect the system and avoid damages, for example by improving emergency response preparedness. Suzie Moise, who manages subscriber payments at CTE Jérémie, said that subscriptions rose from 1,500 to 2,022 during the project period. Jocelyn Laurent of CTE Jérémie said the utility has increased revenue by 400,000 – 600,000



Customer paying invoice in Les Cayes CTE. Credit: Mark Lee Steed (2021)

gourdes—or approximately \$4,000-\$6,000—because of project interventions. Although these increases are not directly attributable to CRM, Ms. Laurent said learning about climate risk has helped CTE Jérémie better prepare for future risks, which should sustain revenue gains.

Avoiding travel costs by providing basic water access and improving water service quality also benefits local water service providers. Easy access to reliable sources incentivizes people to

²⁵ Value of travel time based on Haiti’s gross national income per capita of \$2,930 (World Bank. 2021. GNI per capita, PPP. Available at: <https://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD?locations=HT>)

²⁶ Ibid.

subscribe to local water services. “If people can afford a connection, they’ll pay for it because it’s so much more convenient to have a faucet in your house than to walk even 20 meters down the street to get water,” Dan O’Neil pointed out.²⁷

Avoided Costs of Waterborne Illness

Incidence of waterborne illnesses is directly linked to climate impacts. After an extreme precipitation or flood event, people may not be able to avoid contact with standing water and floodwaters, which can harbor pathogens. Similarly, drought reduces availability and access to clean water and can concentrate contaminants and pathogens in depleted water sources.

The project’s CRM actions contribute to its efforts to prevent waterborne illness in project areas. Repairing leaks with more climate-resilient materials reduces the likelihood that pathogens can enter water systems through broken pipelines. Appropriate siting of latrines and more effective and responsive FSM systems reduce the likelihood and extent of waste contamination of water sources during extreme precipitation. On-premises, climate-resilient drinking water systems protect community water sources from climate-related damages and safeguard people from exposure to floodwaters by having to travel for clean water.

“We know that clean drinking water prevents illness...Prevention is what we are good at,” shared Marcia Urquhart Glenn.

Preventing cholera through climate-resilient clean water solutions can significantly benefit individuals, households, governments, and the global community. The 2010 cholera outbreak killed nearly 10,000 people in Haiti by 2017.²⁸ The global community responded in the first 18 months with \$230 million for rapid response, cholera health care services, surveillance, education and outreach, vaccination, and water and sanitation activities.²⁹

Preventing a single cholera outbreak in Haiti has the potential to avoid substantial costs, in addition to saving thousands of lives. Analyses from around the globe indicate that water and sanitation investments can provide cost-effective solutions to public health and economic development challenges, delivering a US \$4.30 return for every dollar spent, and that benefits of these investments are significantly underestimated.³⁰ Climate-resilient water and sanitation systems can further increase the value of these benefits.

Lessons Learned

During the 2017 climate risk assessment, USAID determined it needed to integrate CRM concepts into its trainings for water and sanitation system managers.³¹ Yet the project team

²⁷ USAID Global Waters. “Creating a Roadmap for Sustainable Water Service Delivery in Haiti.” February 24, 2020. Available: <https://medium.com/usaid-global-waters/creating-a-roadmap-for-sustainable-water-service-delivery-in-haiti-e67128d7ac98>

²⁸ Zarocostas, J. Cholera outbreak in Haiti – from 2010 to today. *The Lancet*, 389(2274-2275). June 10, 2017. Available: <https://www.thelancet.com/action/showPdf?pii=S0140-6736%2817%2931581-7>

²⁹ Sontag, D. In Haiti, Global Failures on a Cholera Epidemic. *The New York Times*. March 31, 2012. Available: <https://www.nytimes.com/2012/04/01/world/americas/haitis-cholera-outraced-the-experts-and-tainted-the-un.html>

³⁰ Global Task Force on Cholera Control. 2017. Ending Cholera, A Global Roadmap to 2030. Available: <https://www.who.int/cholera/publications/global-roadmap.pdf>

³¹ Interview with Marcia Urquhart Glenn, USAID Haiti Mission WASH Lead.

recognizes that CRM concepts must be introduced in a way that is meaningful to practitioners who likely have never heard the term “climate risk management” and may not understand how the concept is relevant to water and sanitation systems in which the primary challenge is maintaining services on a day-to-day basis.³² “[Trainees] weren’t in a position where they could think about [CRM],” observed Dan O’Neil.

“It became clear that while we have been integrating disaster risk reduction capability in our training, we have not been integrating CRM language and rationale in the training, nor awareness training to citizens through our messaging campaigns,” commented USAID’s Marcia Urquhart Glenn. “It has been included in our infrastructure repair work that we meet certain building codes that are pertinent to the region, such as burying transmission mains to mitigate vulnerability to flooding or hurricane events and criminal sabotage, but we have not shared this in terms of CRM per se.”

Therefore, the project has worked to build stakeholders’ capacity for CRM incrementally, working with managers to expand their planning timelines, first by developing annual water system management plans and then building awareness and skills for longer-term planning.

“We focus on messaging the importance of designing infrastructure to withstand expected future conditions, including the impact of climate change, rather than just focusing on historical events,” said O’Neil. “What used to be considered a 50-year flood now is a 10-year flood. Designs need to be based on this reality.”

Summary

The USAID Water and Sanitation Project in Haiti demonstrates that meaningfully integrating CRM into the design and implementation of water and sanitation development activities can help achieve and sustain project benefits and provide significant value to USAID and its beneficiaries. Despite the complexity of managing climate risks to Haiti’s water and sanitation systems, the project team said fundamental good practices lead to successful CRM outcomes. “A lot of CRM is about good engineering,” said Dan O’Neil.

Though difficult to quantify, one of the most important benefits of the project’s CRM actions is stronger local capacity to manage climate risks to water and sanitation systems. Engineer Oswald Hyppolite of CTE Les Cayes explained that in addition to increased revenue and improved water quality and water service, CTE staff now have more awareness of natural resources management, the importance of reforestation for water supply management, and other measures that build resilience to climate change impacts on water



Eng. Jonel Francois, Director of l'OREPA Sud (the Regional Office for Drinking Water and Sanitation). *Credit: Abt Associates for USAID (2021)*

³² Interview with Dan O’Neil. USAID Water and Sanitation Chief of Party.

systems. His team is better prepared to quickly mobilize before, during, and after climate-related events to make quick repairs to infrastructure, and to better manage natural disaster spending.

Engineer Jonel Francois, Director of l'OREPA Sud (the Regional Office for Drinking Water and Sanitation), remarked that the project's training and capacity building taught him the importance of considering climate risk in decision making. "Climate change must be taken into account."

For more information about USAID Water and Sanitation Project

- [Haiti | U.S. Agency for International Development](#)
- Marcia Urquhart Glenn, USAID Haiti Mission WASH Lead / Senior Water, Sanitation & Hygiene Advisor
- Abdel Abellard, USAID Haiti Mission Environmental Officer
- Dan O'Neil, USAID Water and Sanitation Project Chief of Party
- Fritz Alemagne Yzema, USAID Haiti Senior Engineer

For more information about CRM

- Geoffrey Blate, Ph.D., Senior Policy Advisor, Climate and Cross-Sectoral Strategies, USAID/DDI Environment, Energy, and Infrastructure Bureau, gblate@usaid.gov
- Alexandra Giese, Ph.D., Science and Technology Policy Fellow (of the American Association for the Advancement of Science), Climate and Cross-Sectoral Strategies, USAID/DDI Environment, Energy, and Infrastructure Bureau, agiese@usaid.gov

The [Climate Integration Support Facility \(CISF\)](#) blanket purchase agreement supports USAID to conduct climate risk management across all USAID programming. [Climate risk management](#) is the process of assessing, addressing, and adaptively managing climate risks that may impact the ability of USAID programs to achieve development objectives. This worldwide support mechanism can assist USAID missions, bureaus, and offices with climate risk management by providing analysis, facilitation, training, evaluation, learning opportunities, and related services. The agreement may also support focused adaptation, clean energy, and sustainable landscapes programming with such services.

Case study authors

Lorine Giangola, Leah Quin, David Cooley, [Abt Associates](#). Abt Associates developed this case study and "[The Benefits of Climate Risk Management](#)," an accompanying blog series on Climatelinks.

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