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**Toward a Sustainable Approach to Water Service Delivery Methods
in a Rural Context**

by

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14. ABSTRACT According to the World Health Organization (WHO), over two billion people lack access to safely managed drinking water services, accounting for over one million deaths worldwide each year. To focus needed attention on this crisis, the United Nations' Sustainable Development Goals call for universal, equitable, safe, and affordable water service. This global challenge has proved to be particularly difficult in a rural context. Governments in developing regions often lack the resources, capital, and capabilities to provide and manage public services, to include drinking water. Many have turned to the private sector, foreign donors, and aid organizations to supply safe water. Historically, these programs have struggled to do so sustainably, over-prioritizing short-term infrastructure development at the expense of the long-term operation of the systems. Many water providers and their donors have focused on the number of facilities built and the number of people with access, driving the performance of the Water, Sanitation, and Hygiene (WASH) sector by these metrics alone. Sustainability; however, cannot be described by system functionality or population coverage exclusively. The definition of the term should be expanded to include a wider variety of metrics that describe the long term operation and resiliency of the system, from the perspective of both the water suppliers and the communities they serve. A more nuanced view of sustainability is especially needed in rural communities where weak governance, low per capita resources, and high per capita costs of obtaining water access combine to present a substantial barrier to water service delivery. In recent years there has been recognition in the development sector that in order to improve sustainability, water providers should shift from a paradigm that relies on external support yet operates independently from other WASH actors, to one that combines grants and a strong enough revenue base to recover operational and maintenance costs in collaboration with WASH actors. Water providers must achieve a difficult balance that increases impact (increasing the amount of impoverished communities using safe water) with a model that will continue to perform. A broad, systematic review of WASH programs was conducted to develop a comprehensive summary of considerations for rural communities in developing regions to proactively develop their own water provision. The primary recommendations for community authorities seeking water service delivery are applied to a case study on the island of Île-à-Vache, Haiti.					
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**TOWARD A SUSTAINABLE APPROACH TO WATER SERVICE DELIVERY
METHODS IN A RURAL CONTEXT**

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Abstract:

According to the World Health Organization (WHO), over two billion people lack access to safely managed drinking water services, accounting for over one million deaths worldwide each year. To focus needed attention on this crisis, the United Nations' Sustainable Development Goals call for universal, equitable, safe, and affordable water service. This global challenge has proved to be particularly difficult in a rural context.

Governments in developing regions often lack the resources, capital, and capabilities to provide and manage public services, to include drinking water. Many have turned to the private sector, foreign donors, and aid organizations to supply safe water. Historically, these programs have struggled to do so sustainably, over-prioritizing short-term infrastructure development at the expense of the long-term operation of the systems. Many water providers and their donors have focused on the number of facilities built and the number of people with access, driving the performance of the Water, Sanitation, and Hygiene (WASH) sector by these metrics alone. Sustainability; however, cannot be described by system functionality or population coverage exclusively. The definition of the term should be expanded to include a wider variety of metrics that describe the long term operation and resiliency of the system, from the perspective of both the water suppliers and the communities they serve.

A more nuanced view of sustainability is especially needed in rural communities where weak governance, low per capita resources, and high per capita costs of obtaining water access combine to present a substantial barrier to water service delivery. In recent years there has been recognition in the development sector that in order to improve sustainability, water providers should shift from a paradigm that relies on external support yet operates independently from other WASH actors, to one that combines grants and a strong enough revenue base to recover operational and maintenance costs in collaboration with WASH actors. Water providers must achieve a difficult balance that increases impact (increasing the amount of impoverished communities using safe water) with a model that will continue to perform.

A broad, systematic review of WASH programs was conducted to develop a comprehensive summary of considerations for rural communities in developing regions to proactively develop their own water provision. The primary recommendations for community authorities seeking water service delivery are to:

- Favor an approach that builds more on community strengths and collaboration than a one size fits all model. Water providers should enter the WASH sector with an understanding of the efforts of the other actors (water users, government, funders, aid organizations, community leadership).
- Improve governance by actively studying the challenges, concerns, and priorities of the other WASH actors.

- Drive performance by monitoring sustainability and prioritize long-term investments in business models and contracts.

These recommendations are applied to a case study on the island of Île-à-Vache, Haiti.

Keywords: Water service delivery, sustainability, systems-based approach, collective action, business model, global water crisis.

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Section 1: Introduction and context to global clean water access

Section 1.1: Access to Water is a Key Development Challenge

Providing access to basic services lies at the heart of community development. Unfortunately, essential human needs are still not being met in developing regions around the world today. Water is at the core of this problem. According to the World Health Organization (WHO), 40% of the world faces water scarcity, and conditions are not improving. Over two billion people lack access to safely managed drinking water services, accounting for over one million deaths worldwide each year.¹ Access to clean drinking water is critical to human health and sanitation. Ensuring people have access to safely managed drinking water is a top priority for the United Nations (UN), outlined in the UN Sustainable Development Goals, and those affected by this global water crisis.

The United Nations has defined 17 global Sustainable Development Goals (SDGs) and water, sanitation and hygiene (WASH) is the sixth goal, known as SDG-6. Clean water is a requirement for human flourishing and provides a foundation for community development. Clean drinking water results in improved health due to reduction in water-related illness, safer food, more opportunities for education, and even reduced gender inequalities. There are a variety of technical, economic, political, social, and cultural factors that shape what solutions are most likely to be effective, and these must be considered in the development of a specific solution for a particular community.

Section 1.2: Tension Between Water as a Right and a Commodity

Water was formally declared a human right by the United Nations General Assembly in 2010, underscoring the need for every person in the world to have the ability to consume safe drinking water to survive. Even in 2002, the UN Committee on Economic, Social and Cultural Rights declared water “indispensable for leading a life in human dignity. It is a prerequisite for the realization of other human rights.”² The right to water is derived from the right to an adequate standard of living, and is also linked to the right to health and even the right to life.³

The United Nations required water services to be:

- 1) Sufficient in volume to meet WHO standards for personal and domestic use
- 2) Safe according to WHO quality guidelines

¹ WHO, “2.1 Billion People Lack Safe Drinking Water at Home, More than Twice as Many Lack Safe Sanitation.”

² United Nations Department of Economic and Social Affairs, “The Human Right to Water and Sanitation.”

³ Roaf, de Albuquerque, and Heller, “The Human Rights to Water and Sanitation.”

- 3) Acceptable in terms of the cultural context
- 4) Physically accessible based on time and distance required to fetch water

And perhaps most notably,

5) Affordable

Though water was declared a human right that did not indicate the service to water was free. The inherent implication is that not every person in the world will be able to pay, thus intentionally excluding some of the most underserved communities from the right to water. A tension thus develops between defining water as a right versus defining it as a commodity. If the United Nations never meant to ensure every person, regardless of income, had access to water, what was the purpose?

Formally acknowledging water as a human right, and expressing the willingness to give content and effect to this right, may be a way of encouraging the international community and governments to enhance their efforts to satisfy basic human needs and to meet the Millennium Development Goals.⁴

The intent was to establish water as an international priority and demand greater attention for providing a water service. Taking water purification and delivery as a right that must be free is shortsighted and falls short of achieving true sustainability. Charity work is not enough in this field. Too often, well-intentioned organizations, politicians, mission groups, etc. design and build a functional system and hand it over to a community only to find that in a short time, the system has become non-functional. This reality is why a business model is necessary and why water must be treated as a right *and* a commodity. Organizations must account for ongoing expenses to continue to operate and maintain a technical system over the long term. This was one of the first concepts the CEO of a water provider, *Water4*, addressed to people just entering the field. Though water itself is a right, in the organization's view, the purification and delivery of it is not.

The ethical desire to provide a human need as important as safe water at no cost to communities is very well-intentioned, but not feasible. Water has been politicized to the point that it may seem at first inappropriate to describe a basic human need as a *commodity* with *customers* paying a price defined by a *business model*. Arguments that deny the need for revenue are not recognizing that grants and governments cannot cover the cost of operation and maintenance forever, and so a service delivery model based solely on donations and charity is not sustainable. Some even call for the complete ban of privatization,⁵ yet do not account for communities where there is no public service in place to provide basic services and private

⁴ Scanlon, Cassar, and Nemes, *Water as a Human Right?*

⁵ Castro, "Universal Access to Water Is about Democracy."

organizations are the only option. Ignoring the potential for private organizations promotes overlooking the “promising and scalable models for safe water provision.”⁶

A significant challenge in this field is the disconnect between the price of water and its true value. The *Dalberg Report* presents this “value asymmetry” as a challenge for private water providers, which must charge for the service of providing quality water and delivery. Due to the pressing crisis surrounding the lack of universal access to water worldwide, the view that water is a “social good,” which is “something that benefits the largest number of people in the largest possible way”⁷ as opposed to an “economic good,” which is a “product or service which can command a price when sold”⁸ has driven down the perceived value of water. The two definitions are not at odds; water was even listed as an example for both definitions. But that tension and overlap has created a disparity in the perceived and true value to the point that water is charged in rural communities at a price below the needed quantity to maintain the system. By addressing the need to ensure water can be accessible to everyone eventually with the recognition that to do so requires a charge, the water sector can be successful.

Section 1.3: Providing Water to Rural Communities

According to the World Bank, only about 70% of the world used safely managed water in 2015; however, only 55% of rural communities were.⁹ Generally, public services (such as water and sanitation) are delivered by public service actors (i.e. the government), though that is largely not the case in rural communities where a central government does not have the capacity to provide these services.¹⁰ Though there is debate regarding the privatization of water services that aim to profit from water, private organizations are stepping in to provide basic needs where governments have not been able to. Because water is a right; however, the government still has an obligation to oversee the implementation. Prominent WASH sector consultants have argued that:

*Whether services are provided through public, private, community or self-managed models, or a combination of any of the above, the State has a strong role to play in regulating service provision, and ultimately has the legal obligation to and is accountable for ensuring that services meet human rights principles and standards.*¹¹

There is a significant disparity between water coverage in rural and urban communities, with a lot of differences stemming from the lack of a centralized WASH sector as noted above.

⁶ Shepard and Allison, “How Can a Trickle Become a Torrent ?”

⁷ Kenton, “Social Good.”

⁸ Stevenson, *Oxford Dictionary of English*.

⁹ World Bank, “People Using Safely Managed Drinking Water Services, Rural (% of Rural Population).”

¹⁰ Roaf, de Albuquerque, and Heller, “The Human Rights to Water and Sanitation.”

¹¹ Ibid.

Several key challenges remain prominent in rural communities, namely affordability for a typically lower income population and less education on the relationship between water and sanitation. Typically, this is accompanied by insufficient governance unable to provide the resources, management, regulation, and leadership necessary to maintaining a sustainable water service. The WASH sector itself is not a highly profitable one on its own either. Water providers must sell high volumes of water just to break even, yet many have struggled to reach or exceed 50% of coverage capacity.¹² Once breakeven is reached; however, the linearly increasing economy of scale suggests there is great potential for providers to thrive as coverage capacity expands.

Currently, many communities rely on a variety of water sources, though not all are considered safe according to accepted standards. Unlike municipal water systems which are often available in urban or peri-urban settings, safe water in rural areas is generally accessed through protected wells, protected rainwater collection, purchased bottles or sachets (bags), public taps or standpipes, protected springs, and in a very limited number of cases by the government.¹³ However, often out of necessity, continuing to use water that may not be safe, such as surface water (i.e. ponds, lakes, rivers, etc.), unprotected well water, or untreated rainwater collection.¹⁴ Given the benefits and need for safe water, the fact that access is not universal is a significant focus for many international organizations. Particularly for rural areas, governments in developing regions do not have the resources to provide access. Non-government organizations (NGOs) have helped to address this need, known in the water sector as water providers. These organizations extract, treat, and sell clean drinking water to communities, often with the altruistic aim of increasing the number of people and communities with access and not necessarily to maximize profits. These organizations are often supported heavily by donations from both the public and private sector.

Even with a desire to provide access to rural communities, providing safe water is, and will continue to be, a substantial challenge. The heart of the problem is a lack of sustainability, which has historically not been the primary focus of water service delivery. The term *sustainability* can have a number of different definitions, depending on the context. For the purposes of this study, sustainability does not mean mitigating environmental damage, maximizing profit, or even maximizing access. Instead, the term, sustainability will be used here to refer to the long-term operation of a water system within the local economic, political, social, and cultural context without reliance on long term external intervention and financial support. A *systems-based approach* is how to operationalize sustainability by recognizing the interconnected framework each actor of the WASH sector is responsible for.

¹² Bhatnagar et al., “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market.”

¹³ Onda, Lobuglio, and Bartram, “Global Access to Safe Water : Accounting for Water Quality and the Resulting Impact on MDG Progress.”

¹⁴ Ibid.

A *market-based approach* indicates that the driving force behind the long-term sustainability of the system is the consumers, and not an external funder. This is key for organizations aiming to provide basic services in a rural context: to provide a service and prioritize pleasing customers over pleasing donors. A purely market-based approach has shown to be successful in urban, peri-urban, and otherwise densely-populated areas. However, the economic inefficiency of relatively low population density has prevented the spread of such systems to rural areas leaving the people who live in these areas often without options for improved water access. The problem of economies of scale greatly limits the profitability of the water sector and thus provides little incentive to increase access to rural communities based on the promise of profits alone.

Section 1.4: Report objectives and applications

Historically, many NGOs have addressed humanitarian crises with a universal approach, assuming that because a solution works in one community it can be applied anywhere. Without taking into account the differences between these peoples, organizations have failed to achieve successful implementation in providing water. Realizing this mistake, professionals in the WASH sector have devoted significant research to understanding the uniqueness of communities that should be considered in adapting new solutions. Perhaps the pendulum has swung too far in the opposite direction now though, where organizations today struggle to get started, lacking a more systematic approach to addressing crises. In regards to providing water around the world, literature repeatedly endorses the idea that there is no “one size fits all” or “universal” solution.¹⁵ Similarly, the literature advocates for abandoning the idea of a “cookie cutter” approach or some “ultimate” model, as every market presents different challenges.¹⁶

While it is widely recognized that there is not a *one size fits all* or *universal* methodology to implement water service delivery, many argue that there is a weakness in the lack of a systematic approach.^{17,18,19} Several reports point to the lack of transparent, clear methodologies as a significant challenge for service water providers.^{20,21} Current data measurements collected on the sustainability of water points, which are services established providing water, are

¹⁵ OECD, *Sustainable Business Models for Water Supply and Sanitation in Small Towns and Rural Settlements in Kazakhstan*.

¹⁶ Shepard and Allison, “How Can a Trickle Become a Torrent ?”

¹⁷ Lockwood and Smits, *Supporting Rural Water Supply*.

¹⁸ Moriarty et al., “Trends in Rural Water Supply: Towards a Service Delivery Approach.”

¹⁹ Bain et al., “Establishing Sustainable Development Goal Baselines for Household Drinking Water, Sanitation and Hygiene Services.”

²⁰ Lockwood and Butterworth, “Global Study On Sustainable Service Delivery Models For Rural Water: Country Brief Haiti.”

²¹ World Health Organization, *Guidelines for Drinking-Water Quality*.

estimates and should be “treated with caution.”^{22,23} Ultimately, this presents a paradigm that every water provider is unique and faces completely different circumstances with the idea that every provider can use the same methodology. Both are ineffective methods, and thus the model proposed here is intended to be one in the middle: one that recognizes the nuances across every culture yet considering the variety of methods. The purpose of this report is to provide a model that highlights the key challenges and concepts to consider that is not too broad to be useful, but not too specific to lack applicability.

There are similarities among water providers that could be identified to facilitate more effective water project development. This report aims to identify a model in the middle - one that recognizes the nuances across cultures and communities yet still identifies the common features of successful providers. The utility in this is that the paper provides a starting place for any organization entering this field, a summary of key factors and challenges that should be considered, and a central hub directing organizations to more detailed surveys on the concepts. This paper serves to describe current efforts at implementing private, market-based water service delivery schemes, identify best practices, and demonstrate application with a specific case study on the island of Île-à-Vache, Haiti. The island provides a unique opportunity to consider a geographically isolated case with minimal external influences. The objectives of the report are thus to:

- 1) Identify the primary challenges faced in the water sector and provide recommendations to overcome each.
- 2) Develop an approach for water service delivery in rural communities.
- 3) Apply the approach to a case study of Île-à-Vache to demonstrate how to customize a model for specific recommendations.

The objectives are accomplished through the following sections. Section 2 below describes the methodology used to research water service delivery in a rural context and the sources used. Section 3 provides a background on global efforts to provide sustainable water services through a literature review. In Section 4, the model for the theoretical framework is discussed to introduce the different business model approaches in the sector. The results of the literature and theoretical analysis are presented in Section 5 to highlight the most prominent challenges in WASH and how to overcome them. Finally, Section 6 applies this study’s model for approaching water services to a case study for Île-à-Vache, Haiti.

²² Tincani et al., “Improving Value for Money and Sustainability in WASH Programmes (VFM-WASH) Regional Assessment of the Operational Sustainability of Water and Sanitation Services in Sub-Saharan Africa.”

²³ Harvey and Reed, *Rural Water Supply in Africa: Building Blocks for Hand Pump Sustainability*.

Section 2: Methodology

The literature review conducted for this study was unique in the sense that it was inclusive of both the traditional academic sources as well as professional sources from organizations active in the WASH sector. The sources of information for this field are much more disparate than perhaps a more traditional scholarly field, and include a wide variety ranging from the expected peer-reviewed, published journal articles to working papers, studies, reports, and internal records from organizations involved in WASH. These sources were augmented with field work and interviews.

Gathering information for this study began with gaining local context and experience firsthand. A site visit to Île-à-Vache, Haiti was made to gain familiarity with the island and determine the priorities of both the governing authority and local communities. This provided a sense of the social and political atmosphere of the island and helped to develop personal connections with the people who the water service is meant to serve. Additionally, the geography and current safe water sources available were surveyed to facilitate follow-on analysis.

The next step was to gather information on what organizations are currently doing to address water needs in rural communities. A site visit was arranged with one of the leaders in safe water provision, an NGO called *Water4*, which is based in Oklahoma City, Oklahoma and provides water services around the world. Prior to the visit, a review of the technical aspect of water services was undertaken to establish a foundational understanding of the technical aspects of well drilling and water distribution systems. Key literature included a 2008 technical report by the U.S. military titled “Water-Well Drilling Operations.”²⁴ This detailed report explained important considerations of the different drilling methods. This prompted a key question for this research project: If the technology to drill wells and extract water is well-established, why is clean water not even close to being a universal service? The field work with *Water4* helped place the technology component of water service delivery in perspective: The technology of water delivery, while certainly important, is balanced by other, equally important aspects of a water project including the economics, social, and political implications. In this way, this field work with *Water4* showed the need for a multidisciplinary, holistic approach in the water sector. The work began with an overview of the organization and mission in Oklahoma City, including an in-person interview with the CEO, Matt Hangen. This visit was followed by a week of site surveys in the Wassa East District of Ghana in West Africa. This experience provided a detailed, practical understanding the core challenges, practices, and objectives of rural water service provision and provided critical context for the academic and professional literature review that followed.

²⁴ Navy, Army, and Force, “Water-Well Drilling Operations.”

Due to the multidisciplinary nature of water service delivery, it was important to consider sources from the perspective of many different actors in the WASH sector. The literature search began with recommendations from Water4, and then continued to expand in many different directions. The Joint Monitoring Programme (JMP), which is a WHO/UNICEF effort, has monitored the progress of the WASH sector in regards to SDG-6 and provided many updates on the targets. Some other very prominent studies in the field include reports referenced in this paper as the *Triple-S Report*, *Value for Money Report*, and *Dalberg Report*. Each of these were written reports documented by professionals from various WASH backgrounds. Triple-S, referring to Sustainable Services at Scale, was a 6 year initiative starting in 2009 led by a non-profit organization called the International Water and Sanitation Centre (IRC). The objective was to strengthen water services specifically for rural communities and make recommendations for how to improve the sustainability.

Value for Money (VFM) is a combined effort of five organizations (consultants, researchers, and charities) to study how to make sustainability more operational and effective. Finally, another report referenced here as the *Dalberg Report* (with full title “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale: The State of the Safe Water Enterprises Market”) documented progress of NGO approaches to water provision as of 2017. The Dalberg Group is an international firm consisting of partners such as entrepreneurs, researchers, and innovators focused on development, one area in particular being the WASH sector. The report assessed the capabilities of small-scale private water providers to implement service delivery when the government cannot. It included an overview of the effectiveness of 14 ventures in their ability to provide services sustainably and recommendations for how to overcome challenges in the field.

Each of the above three reports provided an extensive review of the efforts being made globally to address water challenges. The next step was to better understand what specific organizations were doing to address these challenges. Some of the prominent actors researched included the United States Agency for International Development (USAID), a department invested in ending poverty and supporting resilient democracies worldwide; the WHO for statistics and safety guidelines; and *Untapped*, a water provider based in Port-au-Prince, Haiti. Numerous water providers, such as *Safe Water Network*, *Water Mission*, and *Save The Water* were searched for information to better understand their missions and methods.

Another important perspective to consider was the funders. The loan plans of Inter-American Development Bank and World Bank were reviewed to understand funding practices and the allocation of grants. Investigation of loan plans for Haiti, the 2008 “Port-au-Prince Water and Sanitation Project-II” documented leading efforts in Haiti to provide WASH services and the focuses for the system. Reports from the World Bank also documented efforts to finance services at an international scale. Speeches and presentations by the Key Biscayne Rotary Club provided

insight to other priorities by funders as well. During the earlier trip to Île-à-Vache, two funders were also present and expressed their hopes for their investments.

Journal articles from published researchers provided very specific research on a particular aspect of WASH. Luke Whaley and Frances Cleaver published an article in 2017 titled “Can ‘functionality’ save the community management model of rural water supply.” Monitoring techniques have been analyzed in Patrick Thomson and Johanna Koehler’s “Performance-oriented monitoring for the water SDG – challenges, tensions and opportunities.” Several books on the topic were identified, such as Harold Lockwood and Stef Smits’s “Moving Towards a Service Delivery Approach,” Oliver Cumming and Tom Slaymaker’s “Equality in Water and Sanitation Services,” the Organization for Economic Cooperation and Development’s “Sustainable Business Models for Water Supply and Sanitation in Small Towns and Rural Settlements in Kazakhstan.” These academic sources provided in-depth discussions of water service delivery and well-documented methods for improvement.

Another useful source included interviews with the professionals engaged in WASH. The interviews came in the form of phone calls with Jim Chu, CEO of Untapped, personal conversations with Alexis Bonnell of USAID, presentations and feedback reviews with the Biscayne Keys Rotary Club of Florida, and discussions with Patrick Lucien of the EDEM Foundation based in Île-à-Vache. Interviews were also conducted with WASH experts working at the U.S. Embassy in Port-au-Prince Haiti to comment on the local status and national efforts.

Finally, literature specific to Haiti’s history in WASH and context for Île-à-Vache were investigated. A journal article describing the history of WASH in Haiti, titled “Water, Sanitation and Hygiene in Haiti: Past, Present, and Future” presented an overview of notable actors still prominent today in Haiti’s efforts, most significantly DINEPA, the central government’s National Water and Sanitation Agency. Dionissi Aliprantis’s “What Is the Equity-Efficiency Tradeoff when Maintaining Wells in Rural Haiti?” presented advantages to different management models and recommendations specifically for Haiti. A study of the island was recorded in a working paper titled “Île à Vache Technical and Participatory Diagnostic Architecture,” providing insight on the current water points, economic structure, and demographics of the island. Most importantly, interviews with the mayor of the island himself, Jean-Yvres Amazan, along with owner of the non-profit EDEM Foundation, Patrick Lucien, shed light on the most important aspect of this research--the people of Île-à-Vache the water service is to serve. Documents regarding the country’s strategy for addressing development were studied, namely the Action Plan for National Recovery and Development of Haiti and the Strategic Plan for the Development of Haiti.

Information on water sector development in rural communities has been studied by disparate sources. For example, two of the most important documents of this study, the

Architecture for Humanity Technical Report as well as the Strategic Development Plan for the Development of Haiti were only offered in French and had to be translated page by page. The Architecture for Humanity Report was never published and only a final draft could be acquired through Patrick Lucien.

Through the lens of many different perspectives, an overview of the literature review is provided below in Section 3. This serves to summarize the practices and doctrine currently applied to address water challenges, which will then be used as a basis to make recommendations moving forward. The objective of the literature review is to understand the extent of WASH practices to develop solutions that can balance the intricate relationship between the technical, economic, social and political factors and between the water providers, authorities, and users. Water services are complex, and through a nuanced understanding progress towards sustainability can be accomplished.

Section 3: Background and Literature Review

Section 3.1: Sustainable Development Goal Focuses for Water

The SDG primary target is defined as: “By 2030, achieve universal and equitable access to safe and affordable drinking water for all.” This goal addressed many key concepts and challenges crucial to water service delivery. The difficulty is for water providers to implement a service that is 1) universal, 2) equitable, 3) safe and 4) affordable. These four qualities are amplified in the context of this study below:

- 1) **Universal:** Everyone in the world should have access to safe water. Currently 30% of the world’s population does not have access to safe water according to WHO (2.1 billion people).
- 2) **Equitable:** Water provision should be fair and actively seek to incorporate underserved communities in achieving access.
- 3) **Safe:** The water provided should meet nationally recognized health standards in regards to quality. Specifically, water should be free of microbial, chemical, and radiological effects harmful to the long term health of the consumer. The specific WHO guidelines provide further description.
- 4) **Affordable:** The objective of water service delivery should not be organizational profit, but sustainability. Water providers should seek to ensure the most underserved communities can pay for water and design business models that can account for low incomes.

With the ultimate goal of SDG-6 to provide universal, equitable, safe, and affordable water to as many people as possible, each term has a significant role in the success of the water sector. A key factor for successful implementation of this SDG is recognizing the multifaceted nature of the water sector. Organizations have to account for not only the technical system, but the economic model funding it and the social context supporting it. The literature repeatedly addresses concerns of overlooking the many, nuanced factors contributing to the multifaceted model for water service delivery. The lack of understanding of the “local socio-economic milieu, and the plural institutional landscape in which they are embedded” results in functioning, yet underutilized, water points.²⁵ Without a broad understanding of these various aspects of SDG-6, water services are unlikely to thrive.

Section 3.2: Objectives for the Water Sector

A common theme that will develop throughout this report is the tendency for oversimplification in the WASH sector. Typically, metrics used in the WASH sector are oversimplified and/or used in a way to improperly indicate success without properly addressing critical aspects of water delivery. An important transition occurred in 2000 when the JMP transitioned from a monitoring system that incorporated user-based data as opposed to solely provider-based.²⁶ Throughout the 21st century, efforts have been made to better incorporate the perspectives of the *water users* (community members who are provided access to safe water), the *water providers* (organizations enabling access to safe water), and the *water authority* (the governing body regulating the safe water provided).^{27, 28} The *Value for Money Report* highlighted the concept that water indicators for success should reflect data from both the supply and demand perspective. Even the understanding of universal, equitable, safe and affordable have been challenged for their lack of nuance, and are some of the most current focuses WASH sector experts have attempted to elaborate on and better define.

Consider the first of these four success indicators: *universal*. The term emphasizes the need for safe water to ultimately be accessible to everyone everywhere. This requires recognizing discrepancies between groups that do not have access and those that do, and also discrepancies where services are accessible. The literature has reinforced that these challenges look different at the household level and at the level of public institutions. Furthermore, according to JMP, as of 2015, 80% of the global population still without access to improved drinking water sources live in rural areas. The combined challenges faced by the community, government, and water providers consolidates into a difficult balance of low per capita resources

²⁵ Whaley and Cleaver, “Can ‘functionality’ Save the Community Management Model of Rural Water Supply?”

²⁶ Bartram et al., “Global Monitoring of Water Supply and Sanitation : History, Methods and Future Challenges.”

²⁷ Lockwood and Le Gouais, “Service Delivery Indicators and Monitoring to Improve Sustainability of Rural Water Supplies.”

²⁸ Tincani et al., “Improving Value for Money and Sustainability in WASH Programmes (VFM-WASH) Regional Assessment of the Operational Sustainability of Water and Sanitation Services in Sub-Saharan Africa.”

and high per capita costs without a strong monitoring authority. *The Dalberg Report* has summed these arguments as “low margins, low penetration rates, and [high] competition.”²⁹

Additionally, *equitable* is a vague term that is distinct from *equal*. The lack of specificity this term allows for flexibility within the local context without requiring a specific solution. While *equality* carries a more precise legal weight, equity is a “rather imprecise and plastic concept, which can be interpreted differently according to one’s culture, academic discipline and political preferences.”³⁰ For example, a safe water system in one country may consist of a water network with direct household connections while another may rely on an independent well to provide safe water. These services may not be equal but can be considered equitable in the sense that both are appropriate for the expectations and feasibility of that community. This definition, while providing greater potential for applicability for different communities, lacks a clear meaning or means to achieve it.³¹ It has presented challenges to monitoring progress in the water sector because there are not internationally agreed upon standards applicable for every context, making it difficult to compare water systems around the world. There is thus an inherent tension when terms must be broad enough to be relevant to every community yet specific enough to present a standard and a means of monitoring progress.

The final indicator, *safe*, also has presented an open-ended concept with multiple considerations. Fortunately, the WHO has described standards for consumption that address contamination types and treatments available. Despite this, the means of categorizing safe sources has presented more of a challenge than might perhaps be expected. Prior to the 21st century, definitions varied from region to region which made it difficult to compare progress internationally. The Joint Monitoring Programme (JMP) proposed a technical-based definition to safe water by categorizing facilities as either “improved” or “unimproved.” Improved sources refer to water facilities protected from outside contamination while unimproved facilities are at risk of exposure. Using this approach taken by JMP, safe can be operationalized by the grouped examples of improved and unimproved sources as shown below in Table 1.

²⁹ Bhatnagar et al., “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market.”

³⁰ Roaf, de Albuquerque, and Heller, “The Human Rights to Water and Sanitation.”

³¹ Ibid.

Table 1: Graph comparing improved versus unimproved sources according to the JMP.³²

Drinking water source	
Improved • Piped water into dwelling, plot or yard • Public tap/standpipe • Tubewell/borehole • Protected dug well • Protected spring • Rainwater	Unimproved • Unprotected dug well • Unprotected spring • Small cart with tank/drum • Tanker truck • Surface water (river, dam, lake, pond, stream, channel, irrigation channel) • Bottled water *

* Bottled water is considered to be improved only when the household uses water from another improved source for cooking and personal hygiene; where this information is not available, bottled water is classified on a case-by-case basis

This definition; however, while providing the benefit of simplicity and ease in communication, has been criticized for lacking complexity and nuance.³³ The definition has evolved to better address complaints that the standard was too high for low-income countries and too low for high-income countries by expanding the examples to include alternative sources for both improved and unimproved sources (such as bottled water, piped water into a dwelling, plot or yard, and tanker trucks). Another important aspect of the definition is that it describes the *potential* of water sources to provide safe water (i.e. protected sources are much less likely to be contaminated), but neglects the actual and varying experiences of the water users. The threshold was thus too simple in the sense that it presents a single benchmark unable to adequately capture progress above and below it.³⁴

The definition of *affordability* is also difficult to pin down. If some degree of funding is required to ensure a system can last, how should organizations decide on price, especially in the context of providing water to communities typically previously underserved and lacking significant means to afford the service? Could a set price maximum apply to everyone across the world? Is it a function of national GDP, household income, or the generosity of external funders? Or perhaps is it an even more complex system of tariffs and subsidies? A very common practice today is setting a price cap to a maximum of 3-5% of household income, though more rural and/or impoverished communities would fall closer to the 3% end.^{35,36} Yet this definition only considers the perspective of the water user and not the financial needs of the water provider. Investors must find the balance in charging “to generate returns from a social impact as well as a financial perspective.”³⁷ Affordability, in fact, is a topic still being heavily research today. Guy Hutton, senior advisor in the UNICEF WASH Section, is currently researching the most up-to-

³² Moriarty et al., “Ladders for Assessing and Costing Water Service Delivery.”

³³ Bain and Slaymaker, “Progress in Tracking Inequalities.”

³⁴ Ibid.

³⁵ Hutton, “Monitoring ‘Affordability’ of Water and Sanitation Services after 2015: Review of Global Indicator Options.”

³⁶ Bhatnagar et al., “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market.”

³⁷ Shepard and Allison, “How Can a Trickle Become a Torrent ?”

date methods of defining affordability so that the methods can appropriately capture both the supply and demand perspective.

While SDG-6 advocates for water delivery services that are universal, equitable, safe and affordable, there exists inherent tensions between these qualities.³⁸ Increased quality in terms of safety requires higher prices to account for the technological advancements, counter to affordability. Universal services that are equitable are challenging when communities range so widely in their current levels of practice. The objective of universality is to increase coverage, yet incorporating very low-income communities is in some cases at odds with maintaining affordability.

There is no question that water services favor the wealthier and the concern for equity is a significant problem linked directly into affordability. The 2017 JMP report found that, unsurprisingly, the rural, poorest communities are underserved, falling 10% behind the global average of basic sanitation services users as indicated below in Figure 1.³⁹

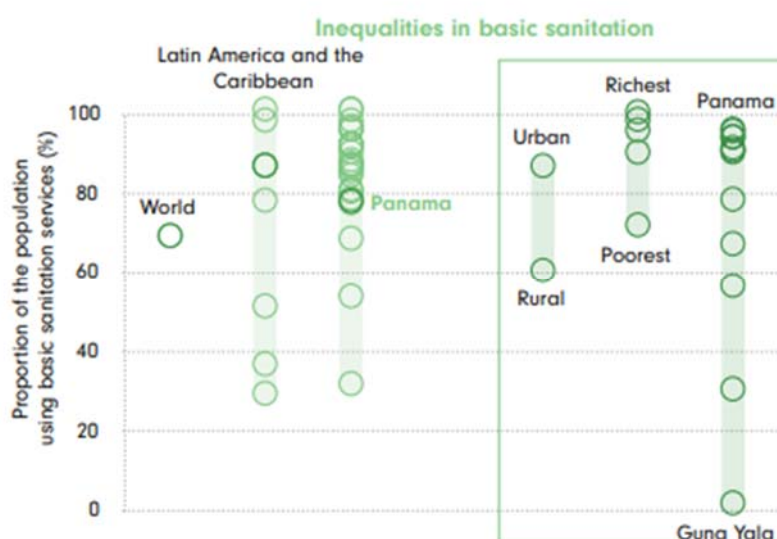


Figure 1: Inequalities in basic sanitation between urban and rural areas.⁴⁰

These terms are not only difficult to measure on their own, but they can also at times seem at odds with each other. A thoughtful approach is needed to develop the water sector. This is being accomplished by redefining the way the sector approaches water. The most promising solutions do not rely on technological innovation or money alone. Instead, there is a need for a

³⁸ Thomson and Koehler, "Performance-Oriented Monitoring for the Water SDG – Challenges, Tensions and Opportunities."

³⁹ JMP, "2017 Annual JMP Report."

⁴⁰ Ibid.

framework that can capture the wide variety of important aspects of providing water. The framework with the potential to capture this is known as *water service delivery*.

Section 3.3: Reframing Water as a Service

Historically, there has existed an over-emphasis on infrastructure as the most important solution to the water crisis. Talk of *innovation* and *gadgets* dominated the conversation surrounding WASH.⁴¹ Susan Davis, Global Coordinator of *Agenda for Change*, has addressed this desire for organizations to pursue development of the newest technical system to address water access worldwide. There are incentives in this regard to pour funds into the latest new innovation that claims to be the “silver bullet” solution the sector has been missing all along.⁴² Instead of focusing on how to improve solutions already in place or learn from other organizations’ efforts, engineers have designed without local context in mind and funders have supported it. Infrastructure is developed, yet fails to fit into the systems already in place within a community.

Connecting this directly to the push to define water as a right *and* a commodity, the definition of water could now expand to *a right and a commodity that should appeal to water users’ aspirations and desire for convenience*. This is the foundation upon which water service delivery is developed.

The shift in mentality of approaching water as a service, more formally known as *water service delivery*, has grown in popularity throughout the sector. An important distinction has been made between an *implementation approach*, which is solely access oriented, and a *service delivery approach*, which incorporates sustainability factors. An implementation approach focuses primarily on the initial capital investments in the physical infrastructure of the system as opposed to the more holistic service delivery approach, accounting for the full life-time of a system and the need to sustain it.⁴³ Studies have shown that platforms that prioritize a service-oriented model tend to be the most profitable.^{44,45} Solutions are most successful when the objective is to provide long-term benefit of the community.

The term *service* at first became a simple binary term indicating whether a service was adequately universal, equitable, safe and affordable. As a benchmark it failed to adequately describe progress at all levels of service delivery. The need for different categories of service levels to have different focuses for how to improve was expanded into a *Service Ladder*. The

⁴¹ Cheney, “Why You Should Care about ‘Systems’ in WASH.”

⁴² Ibid.

⁴³ Lockwood and Smits, *Supporting Rural Water Supply*.

⁴⁴ Lockwood and Le Gouais, “Triple-S.”

⁴⁵ Ibid.

Service Ladder concept has been adopted widely by the JMP, WASHCost, and IRC. A basic overview of the progression through the five identified service levels can be found in Figure 2. The first level starts with the lowest level *no service*, which is when a community does not have access to an improved source. The next level is *sub-standard*, which is the introduction of a water service, but one that fails to meet basic criteria in accessibility, functionality, and reliability. WASHCost still classifies sub-standard service as unimproved. Moving to the next ladder rung is *basic service*, which just barely manages to reach an improved status. Improvements to this level result in *intermediate service* which describes a system capable of better serving the people, ultimately aiming to achieve the final rung of *high service*. High service can sustain water demand and meet the expectations of both the water users and providers.

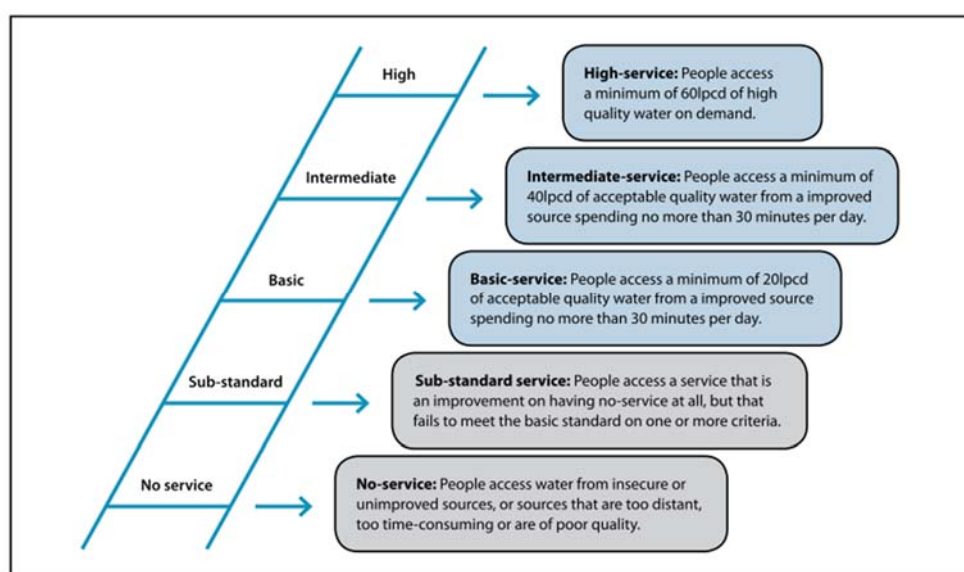


Figure 2: WASHCost descriptions of the five service levels.⁴⁶

Table 2: JMP requirements for improved status of service level. provides a breakdown of the status of each service level in accordance with the JMP requirements in quantity, quality, accessibility, and reliability.

⁴⁶ Moriarty et al., “Ladders for Assessing and Costing Water Service Delivery.”

Table 2: JMP requirements for improved status of service level.⁴⁷

Service level	Quantity (litres per person per day)	Quality	Accessibility (minutes/capita/ day)	Reliability	Status (JMP)
High	>= 60	Good	Less than 10	Very reliable	Improved
Intermediate	Greater than 40	Acceptable	Less than 30	Reliable/Secure	
Basic (normative)	Greater than 20				
Sub-standard	Greater than 5	Problematic	Less than 60	Problematic	Unimproved
No service	Less than 5	Unacceptable	Greater than 60	Unreliable/ insecure	

Notice that the Service Ladder not only provides nuance to what an acceptable service is and what is not, but also to improved versus unimproved sources. The Service Ladder is a more realistic representation of the various levels of services provided today, and recognizes the growing intermediate levels that have not yet achieved the status of an improved source. The benefit is that policy, recommendations and strategies can be more clear and specific for the levels of service. Additionally, the Service Ladder addresses the “non-linear” nature of improving from one level to the next.⁴⁸ This shifts the focus from moving from no service to high service to a more realistic and achievable goal of moving from no or a sub-standard service to a basic service, etc. This recognizes the fact that price increases to the next level of service are significant but also different, and require different implementation strategies. The ladder adds a more complete picture to the process for improving services by “monitor[ing] progress up different rungs of this ladder, rather than drawing a binary distinction between those who have reached the top and those who have not.”⁴⁹ This study captures the intent of recognizing that universal, equitable, safe, affordable water is the ultimate goal, it is not a “simple binary indicator” that has the potential to discount progress up the lower ladder rungs.⁵⁰ A positive shift is now being made towards tracking progress at the lower rungs and defining these indicators.

Section 3.4: Description of Current Approaches

Who are the organizations that have attempted to meet this global demand for water? Water is typically provided as a public good in high-income countries, but there are other options when a government is not able to provide this good, as is common in lower-income countries. NGOs, charities, and private actors have sought to pick up where governments leave off. *Safe*

⁴⁷ Moriarty et al., “Ladders for Assessing and Costing Water Service Delivery.”

⁴⁸ Ibid.

⁴⁹ Thomson and Koehler, “Performance-Oriented Monitoring for the Water SDG – Challenges, Tensions and Opportunities.”

⁵⁰ Ibid.

Water Enterprises (SWEs), a term in the literature typically used to describe organizations which deliver water on a small scale, have the potential to be extremely successful given the immense freedom they provide in how they service different communities. These decentralized systems provide the opportunity to customize technical models for the given population size, geology, and funding available to the community.

How are these organizations doing in terms of providing water as a service?

Organizations have struggled to find the balance of improving access through infrastructure while having a foundation for sustainability upon which to build. Though the service delivery approach is the ultimate objective for all water providers, the implementation approach is a necessary starting point for the countries with low income and coverage.⁵¹ Countries focused on increasing access to water with limited financial means should thus begin by adopting an implementation approach with the objective of increasing coverage. However, as financial resources expand through successful implementation and increased funding, countries can shift to focus on building a foundation of management and sustainability. The next increment towards achieving a service delivery approach is to incorporate quality and performance. The goal is to be able to incorporate centralized management as much as possible from the start, while recognizing this may take a less pressing role in countries where there is extremely limited access to clean drinking water.

In order to ensure that water prices can be “equitable, affordable, and efficient,”⁵² the price must reflect both the supply and demand perspective. When the demand perspective is the only focus, the result is a tariff and subsidy system that are “not the direct product of market forces.”⁵³ The expenses for continual operations must be covered by some means, yet because water is such an important human need it is widely accepted that “full cost recovery is not an appropriate objective in the case of water services.”⁵⁴ This has significant implications for a water service delivery business model, especially in terms of providing a sustainable service. The strong drive for “fair” tariffs aims to ensure the majority of the population can access these services.⁵⁵

How then are organizations funding ongoing operations? A study conducted by the Dalberg group surveyed ten SWEs to determine the percentage of funding coming from grants versus revenue, as shown in Figure 3. The plot provided by the *Dalberg Report* shows the degree of philanthropic support that ten different SWEs rely on for initial funding. The purple bars represent Safe Water Enterprise reliance on grants, the lightest blue represents debt, and the

⁵¹ Lockwood and Le Gouais, “Service Delivery Indicators and Monitoring to Improve Sustainability of Rural Water Supplies.”

⁵² Pharr, “She Who Pays the Plumber : Costs of Drinking Water and Sanitation.”

⁵³ Le Blanc, “Providing Water to the Urban Poor in Developing Countries: The Role of Tariffs and Subsidies.”

⁵⁴ Ibid.

⁵⁵ Ibid.

darker blue represents equity from impact investors or company founders. The significance of this finding is that philanthropic support has a huge role in financing with 50% relying entirely (or near entirely in the case of Venture F) on grants. The remaining ventures are forced into debt to cover the initial costs and must hope to break even through the revenues collected through service delivery.

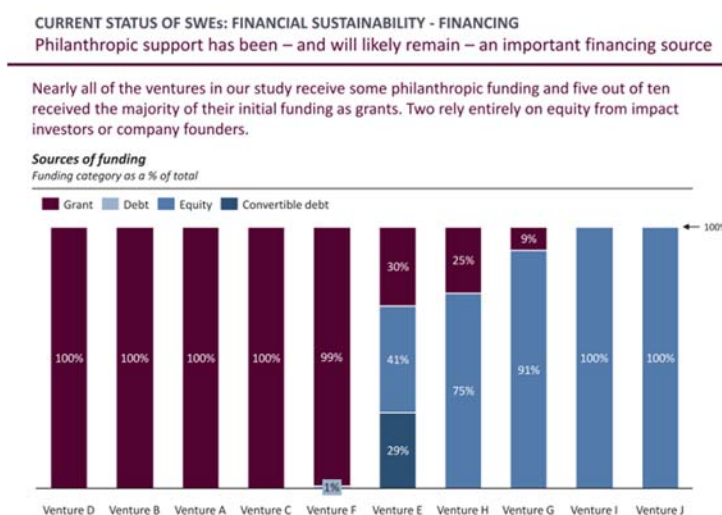


Figure 3: Evaluation of philanthropic support (purple) across various SWE.⁵⁶

The *Dalberg Report* concluded that for the near future, this reliance on philanthropic support will be an important component of any water provision business model. Philanthropic support, and any external intervention and assistance, does not indicate that an organization cannot be sustainable. For most rural cases, philanthropic support will be key to creating a strong foundation of sustainability by covering *initial* costs so all revenue can be focused on maintaining operational and maintenance costs. Thus, philanthropic support should be actively sought out by the communities seeking water and the organizations providing.

The *Dalberg Report* analyzed how well the ventures were covering the operational costs, referred to in Figure 4 as *opex* (operating expenses). The ability to recover *opex* through revenue has much greater implications on sustainability than the funding source for initial costs. Maintaining funds for operating expenses shows that the business model has accounted for the repairs, maintenance, and ongoing expenses that span the lifecycle of the infrastructure. The dark bar represents SWEs with the capacity to recover *opex* and overheads (which are all other ongoing expenses), the ideal capacity for a fully sustainable model. The medium pink represents ventures recovering only *opex*, which is a good stepping stone working towards becoming fully sustainable. Finally the lightest pink represents ventures operating at a loss, which would

⁵⁶ Bhatnagar et al., “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market.”

implicate an unsustainable model progressing towards infrastructure failure and collapse upon the demand for overheads.

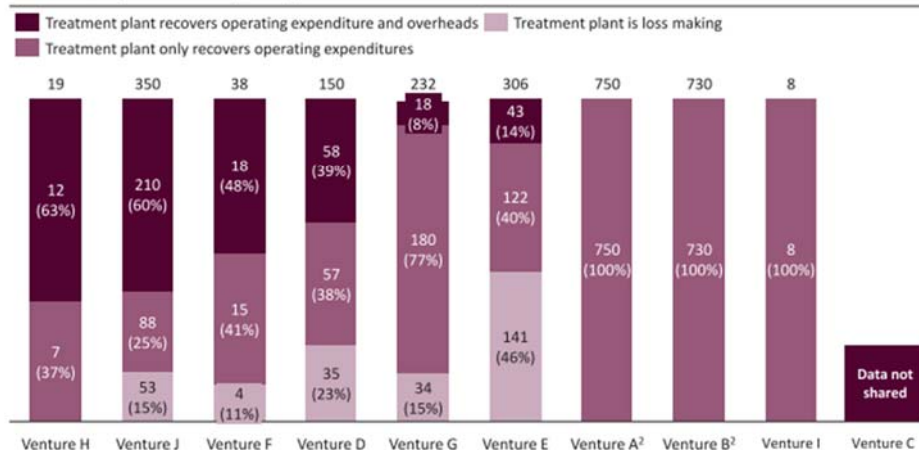
CURRENT STATUS OF SWES: FINANCIAL SUSTAINABILITY - TREATMENT PLANT ECONOMICS

Most SWEs have a portfolio of high-performing and under-performing plants

Only two SWEs in our study have the majority of their water treatment plants covering operating expenditures and overhead¹.

Mix of treatment plants by recovery of opex, opex + overheads and neither

Number and % of total treatment plants of SWEs



Note: (1) Overheads refer to existing all venture operating costs exclusive of direct production & distribution costs (e.g., salary of operation, energy costs, delivery costs etc.) -- for most ventures this refers to corporate or HQ costs (e.g., salaries of management, travel allowances etc.); (2) SWEs recover overheads through grant funding and do not account for it in enterprise costs
Source: SWE financials, Dalberg analysis

Figure 4: Comparison of revenue recovery across various SWE.⁵⁷

No organization surveyed was fully capable of recovering both operating expenditures and overheads, but 62% were capable of recovering operating expenditures.⁵⁸ All SWEs had some number of water projects that operated at a loss, but many water projects were able to recover at least opex, if not both opex and overhead costs. The balance between increasing coverage while maintaining affordability can be achieved by making operational returns the objective and seeking external funding to cover initial costs. The remaining, ongoing costs will require support from the water users if organizations hope to provide a service that will last for the long-term. This leads to the question of what methods organizations are currently using to charge water users.

How much are organizations charging water users and why that amount? This has been a difficult question to answer and something with which organizations have struggled. Many organizations have charged too little. Because affordability has previously only been viewed as a function of consumer income without regard for financial viability, services have failed. This ties directly back to the misconception that providing safe drinking water should or could be free. By setting water commodity prices too low for long-term sustainability, communities are forced to

⁵⁷ Bhatnagar et al.

⁵⁸ Ibid.

rely on charity, which ultimately runs out. Ongoing expenses must be accounted for to ensure functionality over time, which is an ongoing problem for many organizations. Figure 5 shows that water point functionality declines significantly as the system ages, a concern echoed widely across water sector literature.^{59,60,61,62}

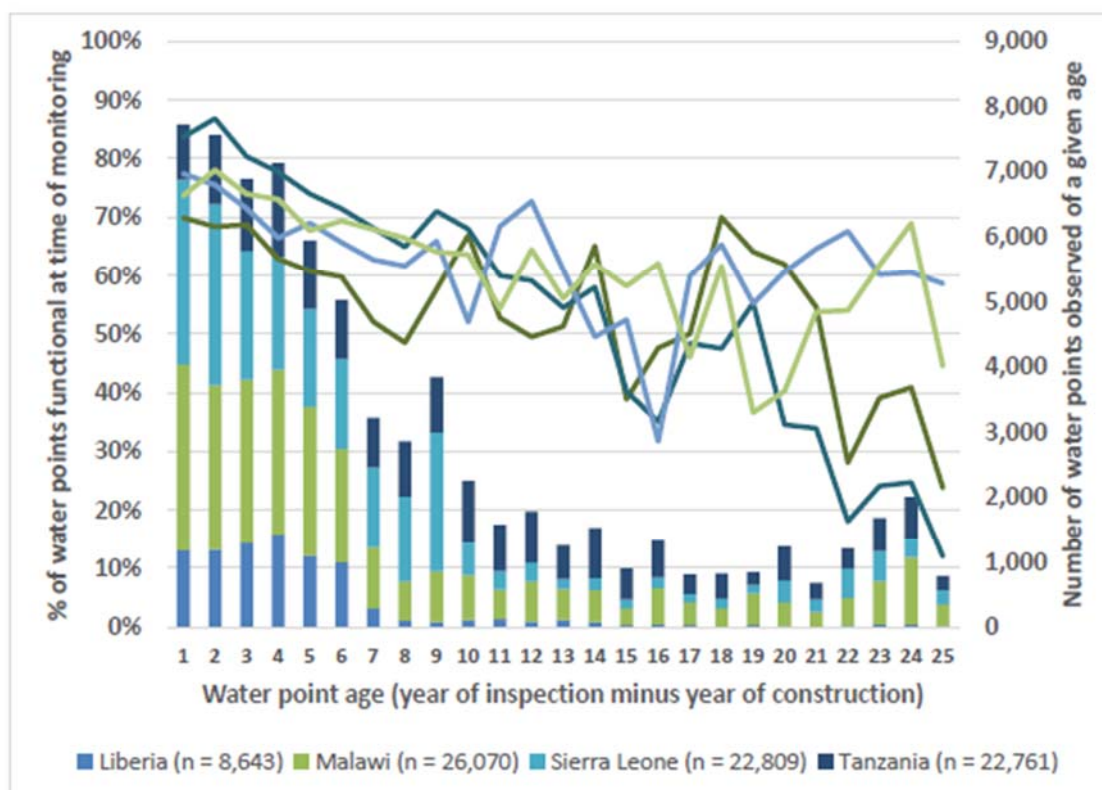


Figure 5: Trend of quantity of water points by age (bars) and functionality percentage by age (lines).⁶³

Water users can be charged with a variety of schemes such as by paying per a visit or paying a monthly rate. The literature advocates for a flexible tariff system that allows for various subsidy schemes, linking operational needs with water usage and its associated tariff/subsidy system.⁶⁴ Another study identified the challenge of balancing cost recovery with affordability, especially given water is a human need and access can be limited by income.⁶⁵ Other challenges include connecting the poorer households to the water piping grid and enforcing the appropriate

⁵⁹ RWSN, "Rural Water Supply Network Report 2016."

⁶⁰ Whaley and Cleaver, "Can 'functionality' Save the Community Management Model of Rural Water Supply?"

⁶¹ Koehler et al., "Pump-Priming Payments for Sustainable Water Services in Rural Africa."

⁶² Walters and Javernick-Will, "Long-Term Functionality of Rural Water Services in Developing Countries: A System Dynamics Approach to Understanding the Dynamic Interaction of Factors."

⁶³ Tincani et al., "Improving Value for Money and Sustainability in WASH Programmes (VFM-WASH) Regional Assessment of the Operational Sustainability of Water and Sanitation Services in Sub-Saharan Africa."

⁶⁴ Thomson and Koehler, "Performance-Oriented Monitoring for the Water SDG – Challenges, Tensions and Opportunities."

⁶⁵ Le Blanc, "Providing Water to the Urban Poor in Developing Countries: The Role of Tariffs and Subsidies."

water tariff.⁶⁶ Subsidies are generally needed for the lower income households currently underserved due to prices.⁶⁷ Schemes may be provided based on 1) an income subsidy, though it is difficult to accurately gauge this in rural communities on a household basis, 2) a connection subsidy, addressing the initial obstacle of affording the upfront costs to connect to the water grid, 3) a quality subsidy, recognizing that incremental steps can be taken in providing at least improved water sources to the options, or 4) consumption subsidies, which help discourage overconsumption in areas with strained water sources.⁶⁸ Often, the most appropriate approach is a combination of subsidies that cater to the specific goals and needs of the region.

What then is a reasonable expectation for the subsidization amount to achieve universal access to all? The *Dalberg Report* identified 3.8 billion people lacking access to an improved source in 2017, yet determined that SWEs could be the “cost-effective, wide-scale” solution.⁶⁹ The report calculated that the remaining underserved population could be charged at 3% of their income, with 2.16 billion people paying the full amount and the 1.7 billion people remaining at the lowest income levels subsidized with \$8.50 per person per year by government, development agencies, and/or charitable support.⁷⁰ While this presents a promising role of SWEs in providing water services, this assumes SWEs operating on a global, universal scale. Even with access rates on the rise, this is not a realistic near-term goal, but certainly indicates the importance of NGOs in providing services.

Even if the business model is focused on long-term sustainability, what ensures that the system continues to operating successfully? Not only is there a financial aspect to ensuring the sustainability of the service, but components that can adequately capture all of the diverse factors that determine the long term success of a service. The idea of sustainability, and limitations of current definitions of sustainability in the literature, are discussed below in the following section.

Section 3.5: Tools to Measure Sustainability

The term *sustainability* and its derivatives are so frequently used in this area of study it has lost some specificity. *How does it relate and encompass the SDG-6.1 target to create a universal, equitable, safe, and affordable water service delivery model?* Sustainability, or the lack thereof, has been identified as a major problem in water service delivery widely across WASH literature. Data describing sustainability is weak and is “based on a limited number of

⁶⁶ Pharr, “She Who Pays the Plumber : Costs of Drinking Water and Sanitation.”

⁶⁷ Le Blanc, “Providing Water to the Urban Poor in Developing Countries: The Role of Tariffs and Subsidies.”

⁶⁸ Ibid.

⁶⁹ Bhatnagar et al., “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market.”

⁷⁰ Dalberg Group, “The Untapped Potential of Decentralised Safe Drinking Water Enterprises Highlights From a Study on the State of the Safe Water Enterprises Market Highlights.”

programme-specific studies utilising diverse methodologies.”⁷¹ The United Kingdom’s Department for International Development has called for more information on sustainability to apply “rigorous and transparent methodologies to establish up to date benchmarks against which the sector can assess comparative performance.”⁷² The lack of data on sustainability has ultimately limited the ability to benchmark performance. It is not enough to select and deploy technology that is field-tested and robust or to develop a business model that provides for operation and maintenance costs. A service characterized as sustainable encompasses a wide range of components and considerations that have been discussed in the literature and expanded on to reflect their distinctness.

The establishment of the Sustainable Development Goals in 2016 in place of the Millennium Development Goals (MDGs) showed a significant shift in how sustainability was measured. The United Nations had originally defined eight MDGs with targets to be met by 2015 regarding international development before expanding to the 17 SDGs with new targets for 2030. Water sustainability was originally grouped under MDG-7 to ensure environmental sustainability before being given its own, more explicit goal as SDG-6 for Clean Water and Sanitation. MDG-7c and MDG-7d focused primarily on improved water services to include piped water, protected dug wells, boreholes, and public taps, ignoring alternative providers such as water tankers and vendors as of 2005.⁷³ The MDGs proved disappointing in both their ability to fully measure progress or drive it forward.⁷⁴ The MDGs pushed for a near-term solutions as opposed to advocating for sustainable services in the long-term to deliver safe water.⁷⁵ The SDGs now incorporate more basic services and alternative providers through a tiered approach to provide insight on how to progress no matter where a country fell on the spectrum of service quality.⁷⁶

What exactly is sustainability? Sustainability has lacked a definition that fully encompasses its multidimensional nature. Time however, is an integral component. The joint definition for sustainability provided by international non-profit *WaterAid* and the United Kingdom *Department for International Development* (DFID) requires the water service to “continue to work and deliver benefits over time.”⁷⁷ Though there is no agreed upon time limit or even required outcomes of the system, the service must be lasting and continuous.⁷⁸ This is referred to as a “permanent service,” and measures performance daily, monthly, and across

⁷¹ Tincani et al., “Improving Value for Money and Sustainability in WASH Programmes (VFM-WASH) Regional Assessment of the Operational Sustainability of Water and Sanitation Services in Sub-Saharan Africa.”

⁷² Tincani et al., “Improving Value for Money and Sustainability in WASH Programmes (VFM-WASH) Regional Assessment of the Operational Sustainability of Water and Sanitation Services in Sub-Saharan Africa.”

⁷³ Pharr, “She Who Pays the Plumber : Costs of Drinking Water and Sanitation.”

⁷⁴ Whaley and Cleaver, “Can ‘functionality’ Save the Community Management Model of Rural Water Supply?”

⁷⁵ Bhatnagar et al., “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market.”

⁷⁶ Pharr, “She Who Pays the Plumber : Costs of Drinking Water and Sanitation.”

⁷⁷ Tincani et al., “Improving Value for Money and Sustainability in WASH Programmes (VFM-WASH) Regional Assessment of the Operational Sustainability of Water and Sanitation Services in Sub-Saharan Africa.”

⁷⁸ DFID, *Annual Report and Accounts 2010-2011*.

multiple years along with the quality of service at each level.⁷⁹ This does not indicate that the system will not need to be maintained and replaced, but that this is accounted for so that the service can remain.

How has sustainability been measured? Sustainability of water systems has historically mainly focused on coverage; however, this is a very elementary step.⁸⁰ When coverage (i.e. the number of people served) is the focus for measuring success, there is usually a lack of focus on support for ongoing operations and maintenance. Often this value may be misleading, as it does not incorporate functionality of systems and can overestimate the number of people actually benefiting from a system. Sustainability is *not* “simply overall levels of coverage or access,”⁸¹ meaning that just because a technical system has the capacity to serve a given number of people does not mean that they will use it.

If coverage lacks the capacity to fully capture sustainability, has functionality been able to achieve that goal? Unfortunately, functionality is another common, but insufficient attempt to capture the concept of sustainability. In the literature as recently as 2011, sustainability and functionality seemed to be interchangeable. One report pointed out that functionality “often serves as a proxy for sustainability”⁸² and an IRC report on Uganda referred to them as synonyms: “Sustainability (functionality) is rising on the agenda, reflected in the sector policies (in the golden indicators) and the current undertaking to improve it.”⁸³ The literature argued that sustainability and functionality are “not the same thing” and described confusing these concepts as worrying.⁸⁴ Measuring functionality is certainly important, and captures aspects of sustainability, but it does not capture the full extent of sustainability. Functionality itself is often poorly operationalized and suffers from many, potentially conflicting methods of measurement.

Functionality is a broad term, and has shown to lack a rigid definition and requires further explanation.⁸⁵ The literature has well established that functionality is complex and encompasses a multifaceted picture.^{86,87,88,89} Functionality ties directly into the operational sustainability of the model, but this has been recognized as only “one dimension” of overall

⁷⁹ Ibid.

⁸⁰ Lockwood and Smits, *Supporting Rural Water Supply*.

⁸¹ Whaley and Cleaver, “Can ‘functionality’ Save the Community Management Model of Rural Water Supply?”

⁸² Ibid.

⁸³ Nimanya et al., *Uganda: Lessons for Rural Water Supply*.

⁸⁴ Carter and Ross, “Beyond ‘Functionality’ of Handpump-Supplied Rural Water Services in Developing Countries.”

⁸⁵ Fisher et al., “Understanding Handpump Sustainability: Determinants of Rural Water Source Functionality in the Greater Afram Plains Region of Ghana.”

⁸⁶ Whaley and Cleaver, “Can ‘functionality’ Save the Community Management Model of Rural Water Supply?”

⁸⁷ Foster, “Predictors of Sustainability for Community-Managed Handpumps in Sub-Saharan Africa: Evidence from Liberia, Sierra Leone, and Uganda.”

⁸⁸ Lockwood and Smits, *Supporting Rural Water Supply*.

⁸⁹ Welle and Williams, “Monitoring and Addressing Governance Factors Affecting Rural Water Supply Sustainability.”

sustainability.⁹⁰ One definition offered in the literature is “the percentage of water points working at any given time,” yet there still seems to be more to the picture.⁹¹ Functionality captures not only the physical infrastructure of the pump and pipes, but also the ability to manage it.^{92,93,94,95,96} Studies have noted key factors to measuring the functionality of the water point management include frequency of management meetings and finance-generating ability.^{97,98,99}

It is difficult to gain an accurate gauge of functionality with so many different means of defining it, many of which are too simple. The *Value for Money Report* estimates that most Sub-Saharan countries report functionality levels between 60-75%, but there is overall an absence of data for many countries and “inherent uncertainties in estimating mean functionality.” An updated survey conducted across 20 countries in Sub-Saharan Africa by the Rural Water Supply Network in 2016 estimated functionality has increased since 2009 ranging from 70-90%,¹⁰⁰ with Tanzania as an outlier. Figure 6 below shows the spread of the percentage of functional water points.

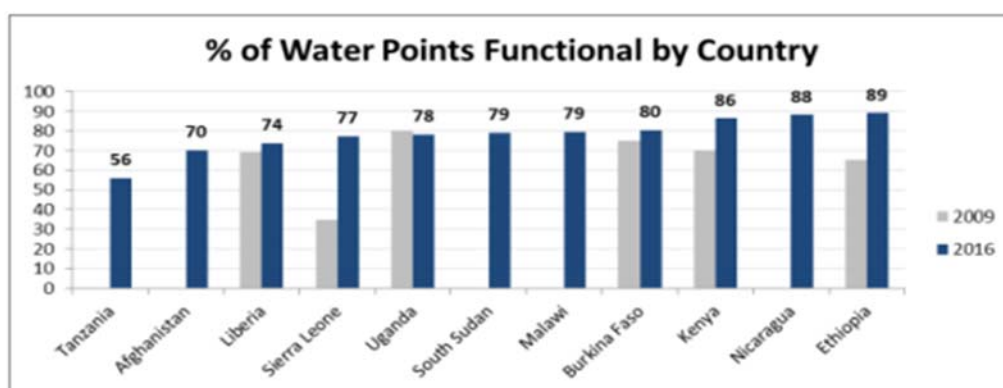


Figure 6: Percentage of functional water points across various countries between 2009 and 2016.¹⁰¹

⁹⁰ Tincani et al., “Improving Value for Money and Sustainability in WASH Programmes (VFM-WASH) Regional Assessment of the Operational Sustainability of Water and Sanitation Services in Sub-Saharan Africa.”

⁹¹ Lockwood and Smits, *Supporting Rural Water Supply*.

⁹² Whaley and Cleaver, “Can ‘functionality’ Save the Community Management Model of Rural Water Supply?”

⁹³ Bey, Magara, and Abisa, “Assessment of the Performance of the Service Delivery Model for Point Sources in Uganda.”

⁹⁴ “Business Models for Rural Water Sustainability.”

⁹⁵ Welle and Williams, “Monitoring and Addressing Governance Factors Affecting Rural Water Supply Sustainability.”

⁹⁶ Whittington et al., “How Well Is the Demand-Driven, Community Management Model for Rural Water Supply Systems Doing?”

⁹⁷ Foster, “Predictors of Sustainability for Community-Managed Handpumps in Sub-Saharan Africa: Evidence from Liberia, Sierra Leone, and Uganda.”

⁹⁸ Chowns, “The Political Economy of Community Management: A Study of Factors Influencing Sustainability in Malawi’s Rural Water Supply Sector.”

⁹⁹ Chowns, “Water Point Sustainability and the Unintended Impacts of Community Management in Malawi.”

¹⁰⁰ RWSN, “Rural Water Supply Network Report 2016.”

¹⁰¹ Ibid.

As the non-binary nature of functionality became well established, the term became more descriptive in terms of “partial functionality,” encompassing a wide array of in-between states, such as cracks, leaks, low quality, and low discharge.¹⁰² Functionality was measured by various methods such as by meeting a certain number of pumps required to prime the pump or fill a bucket, by the number of hours the water point is operational, by repair-time, or similar metrics. The *Value for Money Report* assessed the functionality of public improved water points through 1) a community survey, 2) water point inspections if water was available, and 3) a cross-comparison of household perceptions. Community surveys identified water points as “usually functional,” “sometimes functional,” and “not functional.”¹⁰³ Functionality had gained a much more comprehensive definition, yet still was lacking. One very important deficit in the definition was the ability of the system to function *over time*.

Functionality has largely been viewed until only recently as the status of a water point; reliability on the other hand is the long-term trends of functionality. Studies have repeatedly shown that consumers are willing to pay higher, even “significantly higher” for a guarantee of improved reliability.¹⁰⁴ The importance of reliability, or the predictability of service, has proven critical.¹⁰⁵ For example, studies in Kenya found that the speed of repair was the number one most important quality of service through surveying the water users.¹⁰⁶ Yet this is still an area of research that is currently underway, specifically in regards to unmanned water points or breaks in the supply of electricity.¹⁰⁷ Challenges associated with functionality include: the neglect of the local institutional and socio-economic landscape, broader governance processes and power dynamics, and socio-technical interface (ensuring the technology is applicable to the cultural expectations).¹⁰⁸ There is still significant work to ensure the consistent functionality of systems to establish longer-term reliability.

Coverage, functionality, and reliability all fail to fully describe the sustainability of a water service. Sustainability metrics require a variety of factors that can depict the full picture in the local context. The *Value for Money Report* concluded that indicators must incorporate other indicators of water services, noting quality and accessibility. Functionality alone cannot save rural service water delivery.¹⁰⁹ More factors are needed to capture sustainability beyond whether or not a system is working at a certain point in time.

¹⁰² Carter and Ross, “Beyond ‘Functionality’ of Handpump-Supplied Rural Water Services in Developing Countries.”

¹⁰³ Tincani et al., “Improving Value for Money and Sustainability in WASH Programmes (VFM-WASH) Regional Assessment of the Operational Sustainability of Water and Sanitation Services in Sub-Saharan Africa.”

¹⁰⁴ Le Blanc, “Providing Water to the Urban Poor in Developing Countries: The Role of Tariffs and Subsidies.”

¹⁰⁵ Arlosoroff et al., “Community Water Supply: The Handpump Option.”

¹⁰⁶ Thomson and Koehler, “Performance-Oriented Monitoring for the Water SDG – Challenges, Tensions and Opportunities.”

¹⁰⁷ Tincani et al., “Improving Value for Money and Sustainability in WASH Programmes (VFM-WASH) Regional Assessment of the Operational Sustainability of Water and Sanitation Services in Sub-Saharan Africa.”

¹⁰⁸ Whaley and Cleaver, “Can ‘functionality’ Save the Community Management Model of Rural Water Supply?”

¹⁰⁹ Ibid.

The *Triple-S Report* encouraged improvements by governments, NGOs, and funders to promote improvement in sustainability indicators. The services received by users indicates measuring the quantity, quality, accessibility and reliability over time to better understand how to promote further customer engagement and accurately capture the utility of the system. Likewise, the other consideration is to hold the service provider accountable and measure their ability to fulfill basic technical, financial, management and organization functions necessary to deliver a sustainable service. Furthermore, the service authority has a role in fulfilment of planning, coordination, regulatory and support functions necessary to ensure the service provider can be formally established and perform in the community.

What then are all of the components of sustainability? Sustainability does not need to be defined by one metric alone, but instead can be described by numerous indicators that can be customized for different communities. As discussed above, one important component is the operational capacity. The term “operational sustainability” has been used to describe the functionality and performance over time of the service.¹¹⁰ The report did acknowledge the limitations of its term for operation sustainability in recognizing it was just one component of a fully sustainable model. The term was meant to fit into the broader context of sustainability to include all “financial, institutional, environmental, technical and social dimensions of a water or sanitation service.”¹¹¹ Thus on top of the operational component, other important aspects of sustainability include the technological resiliency, business model component, social support, and political framework. Additionally, just as other terms in the sector had to expand to reflect both the supply and demand perspective, sustainability depends on this recognition as well.

The tools needed to measure sustainability must capture a wide array of system characteristics. There is no one metric that can fully capture the long term potential of a system. The Ladders for Accessibility report identified four key indicators: quantity, quality, accessibility, and reliability, as well as brought attention to a fifth piece—customer satisfaction. These indicators are a solid baseline and commonly adopted, each with their own sub-indicators. The report defined the metrics as:

- **Quantity:** Capacity to serve measured in liters per capita per day (lpcd).
- **Quality:** The microbial and chemical quality of the water, including a number of different sub-indicators (i.e. biological contamination and several physical parameters).
- **Accessibility:** The ease with which people can get water, normally expressed in some regard to time. Common sub-indicators include time per day spent fetching

¹¹⁰ Tincani et al., “Improving Value for Money and Sustainability in WASH Programmes (VFM-WASH) Regional Assessment of the Operational Sustainability of Water and Sanitation Services in Sub-Saharan Africa.”

¹¹¹ Ibid.

water (minutes per day), maximum walking distance, maximum crowding (people sharing a common water point), frequency and duration that water is supplied.

- **Reliability:** The extent to which the service meets expectations, commonly expressed as the percentage of time that the service is not fully functional. This does not indicate water services are available 24/7, but instead might consistently be available 4 hours a day, context specific.
- **Customer satisfaction:** Another factor more implied in the report, but which deserves its own category, captures the water user's opinion on the system's performance.

The list of indicators can and arguably should be even more expansive. For example, the Ministry of Water and Environment in Uganda has expanded on the definition of sustainability with eleven “golden indicators” to include 1) access, 2) functionality, 3) per capita investment cost, 4) sanitation, 5) water quality, 6) quantity of water, 7) equity, 8) handwashing, 9) management, 10) gender, and 11) water resources management compliance. These indicators expand on what it means to be successful and much more holistically capture the impact water sustainability has on the community.¹¹²

Water users' satisfaction should be more than implicitly referenced within another indicator, even more than an indicator on its own, but fused into every measure of sustainability along with the supply perspective. Community satisfaction is a “key factor” to operation and maintenance, directly contributing to sustainability.¹¹³ Anecdotally, stories of water services that do not collaborate with communities result in underused services due to factors ranging from a poorly placed site location to the color of the kiosk.

In one case, a Safe Water Enterprise placed chlorination kiosks near water sources that enabled residents to add chlorine easily to gathered surface water. A follow-up study showed that the kiosks were severely underutilized, and consultants were hired to figure out why. The conclusion reached was that the color of the kiosks - brown - was hindering people from using them. Residents were uneasy about putting something from a brown container into their water. When the kiosks were painted blue, usage went up significantly.¹¹⁴

New indicators are being adopted to better incorporate water users. For example, one traditional economic indicator is called *returns on invested capital* (ROIC).¹¹⁵ This tool has necessary value for sustainability monitoring by signaling the potential for operations to continue

¹¹² Lockwood and Smits, *Supporting Rural Water Supply*.

¹¹³ Welle and Williams, “Monitoring and Addressing Governance Factors Affecting Rural Water Supply Sustainability.”

¹¹⁴ Bonnell, Interview by Wesdyk, Feb 2019.

¹¹⁵ Shepard and Allison, “How Can a Trickle Become a Torrent ?”

based on revenue earned. Yet this proves insufficient in failing to account for the “purposeful trade-offs” SWEs make in improving affordability by reducing revenues.¹¹⁶ Instead, new indicators are being developed such as *impact return on capital* (IROC), meaning the “number of people capable of subsisting each day from the water production achieved by each SWE,” measured in daily water consumers per thousand dollars of invested capital.¹¹⁷ The indicator is calculated by dividing the water quantity that could be delivered by daily water consumption requirements per capital costs. Both have utility and work well together, as this concept underscores the balance between sustaining the business and sustaining people's' livelihood, wellbeing, and health. Sustainability is about impact.

After another week of work providing water services through the communities of the Wassa East District of Ghana, Mike Barbee, Chief of Staff for *Water4*, commented that “Technology is but a small piece of this problem. The biggest challenge is behavioral change.” *In a field where the behavioral change of water users is crucial to achieve buy-in to water services, how is success achieved?* It is well documented that tools used to measure success on a cultural level have significant influence on the resultant behavior of those involved, regardless of the context. In regards to water service delivery, the literature continues to support the theory that metrics influence behavior.^{118,119} Andy Narracott, WASH sector consultant and founder of *Finding Impact* called for continuous monitoring as opposed to a “one time exercise” or “an asset inventory.”¹²⁰ Abdul Hafiz Koroma (WASH Sector Coordinator for the National Water Sanitation and Hygiene Promotion Committee within the Ministry of Public Works in Liberia) explained that evaluation through continuous monitoring ensures quality and impact of services.¹²¹

Data monitoring not only measures performance—it drives performance. Other reports have referred to this as monitoring for “purpose:”

*Water, sanitation, and hygiene programs often monitor expenditures and outputs, but many lack evidence adequate to increase efficiency and impact. Without robust data on functionality, quality, sustainability and service delivery, programs are hindered in their ability to take preventative and corrective action.*¹²²

¹¹⁶ Shepard and Allison, “How Can a Trickle Become a Torrent?”

¹¹⁷ Ibid.

¹¹⁸ Hauser and Katz, “Metrics: You Are What You Measure!”

¹¹⁹ Thomson and Koehler, “Performance-Oriented Monitoring for the Water SDG – Challenges, Tensions and Opportunities.”

¹²⁰ Narracott, “WASH Talk Podcast on National Monitoring Systems EP12”.

¹²¹ Ibid.

¹²² The Water Institute at UNC, “Six Year Review.”

The literature has advocated for transitioning from “monitoring and evaluation leading to lessons learned response paradigm” to a “surveillance paradigm.”¹²³ This transition has been referred to as a “fast feedback loop” allowing for organizations to improve service on a more day-to-day scale with quick adjustments as opposed to slowly identifying trending problems and having to make larger changes in direction.¹²⁴ The ability to quickly adopt based on feedback presents a means of improving functionality and reliability through untapped remote monitoring.¹²⁵ Installing mobile-enabled transmitters in hand pumps has the potential to provide “unprecedented information...that can be harnessed for developing a business model guaranteeing fast repairs and offering flexible tariffs built on user demand.”¹²⁶ Automated data alone can successfully monitor the SDG water indicators, but new automated technologies can complement additional data collection through surveys.¹²⁷ Current systems lack the ability to effectively track progress and a combined approach to cross-validate each other would provide greater depth.¹²⁸

Providing recommendation for achieving a *sustainable water service* is the ultimate objective of this report. However, even a sustainable operation will struggle without support of its structure. A sustainable service calls for *understanding* of the context, but the next level is to actively work *within* the context and partner with both the water authority and users. This structure is crucial to the success of providing water, and will be explored further in the following section.

Section 3.6: Providing Governance Structure

The literature points to the importance of legitimizing water providers as a significant challenge to the water sector currently. The *Dalberg Report* found that organizations typically operate in an environment that does not promote growth, describing an:

*Uncertain regulatory climate where they are not recognized as part of the broader water provision ecosystem and face threats from centralized networks extending into their service areas at subsidized prices, low-cost local competitors that may not be selling safe water and ‘free’ water from local sources.*¹²⁹

¹²³ Thomson, Hope, and Foster, “Is Silence Golden ? Of Mobiles , Monitoring , and Rural Water Supplies.”

¹²⁴ Thomson and Koehler, “Performance-Oriented Monitoring for the Water SDG – Challenges, Tensions and Opportunities.”

¹²⁵ Ibid.

¹²⁶ Ibid.

¹²⁷ UN-Water, “Tackling the Challenges of SDG Monitoring : A Roadmap Outlining the Costs and Value of a Water Sector Monitoring System July 2015.”

¹²⁸ Ibid.

¹²⁹ Bhatnagar et al., “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market.”

Koehler found that organizations can support reliability of functionality through “professionalized, supra-communal management options” which recognize the interface between the local community and the water providers.^{130,131} The literature also demands incorporating good governance into water service delivery to assist in supporting the credibility, structure, and professionalism of private operators.¹³² Experts in the field have recommended, if not already, that governments recognize, regulate and support private organizations.¹³³ *If governance is such an important facet of water service delivery, how can water providers be successful in contexts where support and backing from the central government is lacking? What is necessary for organizations to survive if government funding and legal recognition are not forthcoming?*

The social-political dynamics within the community have a significant role and can be central to achieving an equitable and universal service. The Global Study On Sustainable Service Delivery Models For Rural Water: Country Brief Ethiopia criticized the idea that techno-managerial concepts can be divorced from power relations, and concluded that studies thus far have fallen short in addressing the need to understand broader governance processes. Management models are only sustainable with a strong local institution to support it.¹³⁴ There are undoubtedly positive benefits to direct support, regulation and structure provided by local governments.¹³⁵ The Second World Water Forum in 2000 even declared “the world water crisis is mainly a crisis of governance.”¹³⁶ Yet in many cases and typically in rural communities where populations have typically been underserved, the government does not have the full capability to meet the water demands. Governments, such as the water sector in India, have increasingly encouraged the private sector to advance in filling gaps where the government has been unable to resolve water issues.¹³⁷

While governance plays a critical role in legitimizing, leading, and managing the success of service delivery models, the only source of governance perhaps does not need to come from a central government itself. While that would be the ideal case, and the lack of a strong central government is perhaps one of the primary differentiators between a rural and urban WASH context, this is just not always feasible. Good governance can perhaps come also from a different source in rural settings. Patrick Moriarty, CEO of IRC, advocated that the building blocks for sustainability “start with the ability of government to give strong leadership to the [WASH]

¹³⁰ Blaikie, “Is Small Really Beautiful? Community-Based Natural Resource Management in Malawi and Botswana.”

¹³¹ Thomson and Koehler, “Performance-Oriented Monitoring for the Water SDG – Challenges, Tensions and Opportunities.”

¹³² The Water Institute at UNC, “Six Year Review.”

¹³³ Le Blanc, “Providing Water to the Urban Poor in Developing Countries: The Role of Tariffs and Subsidies.”

¹³⁴ Harvey and Reed, “Community-Managed Water Supplies in Africa: Sustainable or Dispensable?”

¹³⁵ McIntyre and Smits, “Direct Support Post-Construction to Rural Water Service Providers Central Government , NGOs , or Associations Of.”

¹³⁶ Scanlon, Cassar, and Nemes, *Water as a Human Right?*

¹³⁷ Fund, “Water at the BoP: India and East Africa.”

sector as a whole,”¹³⁸ but perhaps that leadership can come in many forms. That foundation of leadership can be instilled through more localized leaders at a district level, from a Council of Elders, from the leadership of collective between private water providers and NGOs.

This decentralization of governance is the reality of current rural WASH developments. Moriarty made a point of highlighting that specifically *rural* WASH (not necessarily the entire sector such as in urban areas) struggles with sustainable service delivery. He noted that while other sectors, namely health and education, have traditionally been viewed worldwide “as large integrated sectors under one ministry,” the WASH sector in comparison has seldom been under one ministry or department and has instead often been the responsibility of more municipal level councils.¹³⁹ The problem with decentralized governance is fragmentation, which when considered in the context of poor financing, a lack of clarity, and weak government institutions, puts a lot of pressure on water providers. Moriarty explained the result is “well-meaning external interventions, NGOs and donors coming in often with rather demanding people funding them and wanting quick questions.”¹⁴⁰ Water providers are pressured to point to quick, tangible fixes:

*It’s an awful lot easier to say we provided a borehole to this village and it’s your 20£ that you donated that has given water to the village then to explain that you spent a lot of time trying to strengthen a WASH system.*¹⁴¹

The concerns with more localized leaders can be combated through collective behavior, meaning the collaboration between water providers, water users, the private sector, governments, and researchers. Moriarty gives water providers the advice to not “pretend you can do it all yourself. If there is one thing that I think undermines that work of many great actors is [trying to] do it alone.”¹⁴² Ultimately, the end goal for universal service would be for a more centralized government authority to be the provider, but decentralized governance figures provide the necessary transition for rural contexts. Moriarty coined his own term for this transition as “utilization.” Andy Narracott of *Finding Impact* elaborated on the idea that utilities are well established and understood in urban WASH, but questions why this is lacking rurally. He asked why utilities are so difficult to translate to a rural setting and question if “we need something like a rural utility?” Moriarty responded that in the long-term yes, but the first step towards utilization are municipalities taking on the provision of water services before the eventual transition to utilities.¹⁴³

¹³⁸ Narracott, podcast “Achieving Systems as Usual in the WASH Sector.”

¹³⁹ Ibid.

¹⁴⁰ Ibid.

¹⁴¹ Ibid.

¹⁴² Ibid.

¹⁴³ Ibid.

Andy Narracott added that governments need to rebuild their vocabularies in the WASH sector to better reflect reality. He asserted that until now, the “sector has been led by people who only do infrastructure...Everybody cannot be doing everything.”¹⁴⁴ In other words, there is a need for more expertise and specialization in the specific components of the system as opposed to a general approach. Just as in other sectors such as health or education, there would be people from all backgrounds to focus on managing that technological, financial, managerial, and customer service aspect of their respective hospitals and schools. This same diversity of backgrounds, approaches, and terminology is required for the WASH sector as well.

The following section summarizes the theoretical framework used to analyze water delivery from a technical, economic, political, and social perspective.

Section 4: Synthesis of Literature Review

The multidisciplinary nature of water service delivery requires understanding from the technical, economic, political and social perspectives. The purpose of Section 4 is to analyze the literature review and through the lenses of each of the four perspective

Section 4.1: Technical Analysis

The technology to extract, purify, and distribute water is well-documented.^{145,146,147,148} There are established methods to construct wells, robust pumps (such as the Indian Mark II), sturdy pipes, and high-capacity storage tanks, as well as methods that define clear standards and methods to purify water.¹⁴⁹ Over the short-term, the majority of water systems operate as intended. Without ready access to maintenance personnel and spare parts, however, the systems degrade—a physical testament to the unsustainable nature of foreign aid. Over the long-term, the systems begin to break down rapidly and many fall into disrepair. Central to the effort to ensure sustainability are the qualities of *robustness*, the ability of a system to continue to operate in a variety of conditions, and *resiliency*, the ability of a system to be returned to operation quickly in the event of a system failure. These two qualities are imperative to the longevity of the physical infrastructure because often times the problem is not the technology itself, but the ability to continually operate and maintain it.

¹⁴⁴ Narracott, podcast “Achieving Systems as Usual in the WASH Sector.”

¹⁴⁵ Vita, “Manual Drilling Techniques.”

¹⁴⁶ Navy, Army, and Force, “Water-Well Drilling Operations.”

¹⁴⁷ Bowman, “Well-Drilling Methods.”

¹⁴⁸ World Health Organization, *Guidelines for Drinking-Water Quality*.

¹⁴⁹ Ibid.

Studies have found that ensuring the long-term functionality of the technology is extremely challenging. In some cases, such as in Tanzania, pump functionality fell to 75% after just one year of installation.¹⁵⁰ Furthermore, after 30 years, in service, functionality falls drastically to around 25%.¹⁵¹ Figure 7 depicts this trend and the need for efforts directed towards keeping implemented technology in operation. Other studies in various rural communities throughout Africa have shown similar trends, indicating a similar drop of one quarter of infrastructure functionality after just one year. These studies found inadequacies in siting and poor design and construction, exacerbated by inadequate construction supervision as the primary causes.¹⁵² Commonly cited figures for non-functionality in rural communities around the world often range between 30-40% of all systems at any one time.¹⁵³

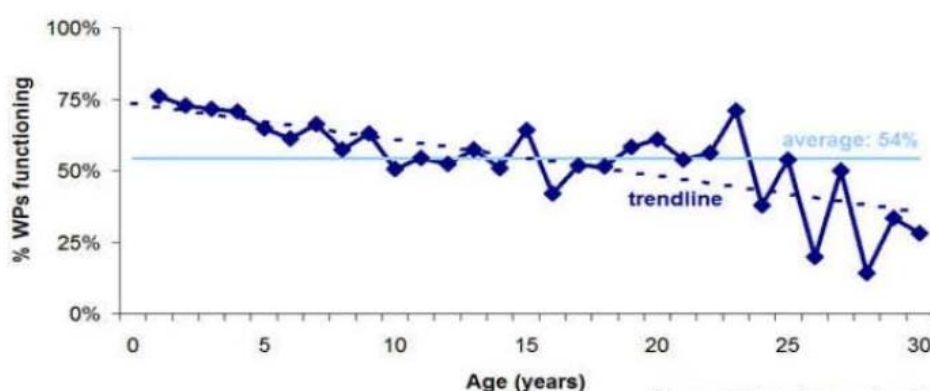


Figure 7: Functionality of rural water points by age in Tanzania.¹⁵⁴

To guarantee functionality over the long term, there has to be a system in place for addressing necessary maintenance, repairs, malfunctions, and replacements. Some organizations have attempted to address this challenge by developing *better* technology, but no matter how developed the technology is there will *always* be a need for maintenance, repairs, and replacements. Few, if any, outside organizations are capable of providing persistent technical support over the span of years. Therefore, a group of local people must be trained and equipped to conduct this maintenance.

Extraction, distribution, and monitoring technology must be matched to the education level, skill, and logistics access of the members of the community. If the technology is too advanced, it will likely be too complex for community members to maintain. Additionally, if there are too many complex parts, the system is unlikely to be robust. Robustness ensures the technology works effectively yet is also simple enough to understand without a high degree of training.

¹⁵⁰ Carter, "Optimising Community Management of Rural Water Services."

¹⁵¹ Ibid.

¹⁵² Carter and Ross, "Beyond 'Functionality' of Handpump-Supplied Rural Water Services in Developing Countries."

¹⁵³ Lockwood and Smits, *Supporting Rural Water Supply*.

¹⁵⁴ Carter, "Optimising Community Management of Rural Water Services."

Technology that is too advanced may also not be suitable for the rugged environment in the developing world. For example, technology may be exposed to greater weather hazards or to a lower standard of electrical power quality in rural communities. Advanced technology can also be too expensive for the community to replace, further reinforcing a cycle of dependency with the donor organization.

Figure 8 shows volunteers from a community in Nigeria receive training on maintenance and repairs at the Rahoss Primary School.



Figure 8: Nigerian community members learn to repair and maintain the pump newly installed at the Rahoss Primary School in 2012.¹⁵⁵

Another image of a team of community members trained in Kenya is shown below in Figure 9. The mechanics being trained wear uniforms from The Water Project as they demonstrate their professional skills servicing a hand pump installed in 2015 and still functional as of February of 2019.

¹⁵⁵ ICRC, "Icrc Audiovisual Archives Reference: V-P-NG-E-00539."



Figure 9: Kenyan community members effectively maintain and repair this hand pump that has remained functional since 2015.¹⁵⁶

From a technological perspective, the maximization of availability and the minimization of system downtime are amongst the top priorities for community satisfaction.^{157,158,159} System failure in the ability to deliver sufficient quantity or quality can erode community faith in the system and can have significant deleterious effects on the social support required for long-term sustainability. When a community member identifies a failure of the system and does not know who to contact or cannot expect immediate remediation for whatever reason (technical, logistical, etc.), this too reduces community support for the system.¹⁶⁰ On the other hand, resilient systems can adapt. When failures are identified, communicated, and remedied quickly and in a professional manner, this gives the community confidence in the system, increases the aspirational quality of the system in the eyes of community members, and ultimately increases the likelihood that the system will be sustainable over the long term. Resiliency is facilitated through formal trainings, technical manuals detailing maintenance, contacts for whom to obtain new parts from, mechanisms for water users to report failures, and better monitoring systems in place to track functionality.

On a larger scale, robustness and resilience combine for the network of water points. Especially for rural communities, it is much more preferred to minimize the type of models of wells, pumps, and pipes in place as opposed to having many independent ones. Organizations

¹⁵⁶ The Water Project, “Emutsiliba Community Well Rehabilitation Project.”

¹⁵⁷ Whaley and Cleaver, “Can ‘functionality’ Save the Community Management Model of Rural Water Supply?”

¹⁵⁸ Walters and Javernick-Will, “Long-Term Functionality of Rural Water Services in Developing Countries: A System Dynamics Approach to Understanding the Dynamic Interaction of Factors.”

¹⁵⁹ Thomson and Koehler, “Performance-Oriented Monitoring for the Water SDG – Challenges, Tensions and Opportunities.”

¹⁶⁰ Ibid.

have historically not collaborated thus leaving behind many different technical models that no one knows how to maintain. Having one or a few different types allows for the mechanics to exchange parts and knowledge as they become increasingly familiar and specialized with the pumps, wells, and piping in place. There are fewer suppliers needed to provide new parts as well which makes the entire maintenance process more stream-lined and centralized. The community gains greatly from a technical system that is robust in terms of simplicity (less systems) and resilient in terms of overcoming failures (more fixable).

Section 4.3: Economic Analysis

Water services are not a highly profitable business anywhere, but are especially financially constrained in rural communities. Profit for this study is discussed not in terms of benefitting some external provider and making entrepreneurs rich, but instead in terms of obtaining financial reserves to account for the ongoing expenses and paying the people providing the water service, from the mechanics to the managers and everyone in between. The financial reserves are so imperative because regardless of the technology used, funds are needed to keep technology in operation.

A very basic overview of the expected costs that will incur over time is depicted below in Figure 10. The initial design and construction phase will be the most expensive phase of the service, but does not encompass the *full* costs. As time goes on, *periodic* inspections and maintenance are to be expected *regardless of the technology installed*. It is also expected that there will be major maintenance needed at times, which may result from anything from natural disasters, usage damage, to part failures. As the system ages, maintenance will be needed at an increasing rate as the system approaches end of life. But all of these costs are a natural pattern for infrastructure and can be expected and accounted for. It is up to the water provider and water authority to incorporate financial reserves into the business model.

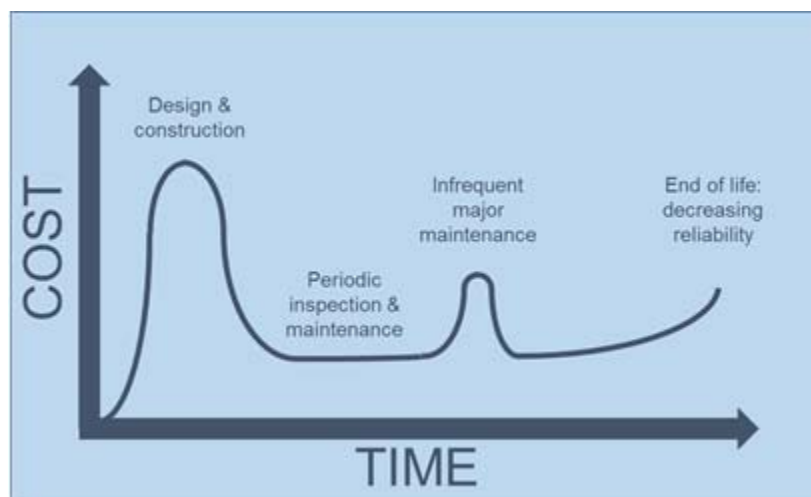


Figure 10: Overview of expected costs over time of a technical system.¹⁶¹

When water providers and authorities do not account for these costs, not only does the service fail to continue but the cycle of dependency discussed above as a technical challenge now becomes an economic challenge. Well-intentioned organizations that do not collect revenue at all or at a substantial level cannot pay for repairs and the service ends. But even worse, these organizations undercut others that try to operate in communities because they are charging less. Communities hesitate to pay for services provided by organizations charging at a sustainable price because there is an ongoing cycle of reliance on the whims of the next organization providing water below its cost. *Profit is necessary to provide a permanent service.* Water given out as charity has not worked to this day and prevents sustainable water providers from successful operation.

For rural communities, it is important to drive down the costs to an affordable level based on both their income needs but also the supplier's needs. One obstacle rural communities specifically face is the lack of population concentrations. Compared to urban communities, rural populations are spread much more widely which makes it difficult to service efficiently. More infrastructure is needed to account for limitations on distance between homes and water points, driving up costs of an already financially pressed population.

These financial constraints are another extremely limiting factor to the economics of water services. Water services have associated costs but must be kept to a bare minimum because the objective is to provide water as a right. Organizations have adapted to this by incorporating philanthropic support into their business models. The literature review indicated that many ventures face trouble just to break even on operational and maintenance costs, let alone account for overheads and the initial capital investments needed to build the infrastructure. However, this results in a degree of reliance on external aid. External assistance must be contacted and willing

¹⁶¹ Blue-Green Team, "Life Cycle Costs of Blue-Green Infrastructure."

to cover the costs. Typically, these organizations will not agree to an indefinite and ongoing amount, and instead agree to cover the initial design and construction costs, also known as the initial capital investments. These can be calculated and accounted for over a defined time period and are also needed before revenue is collected. The initial capital costs are a substantial hurdle to entering a rural water sector, signifying philanthropic support will continue to be a significant portion of rural business models for the near future.

Water services are provided commonly through four different sector approaches, which each pose their own advantages and challenges. These sector approaches, identified in Table 3, range from a completely private model independent of the government to a public model provided by the government. The most effective models for rural communities tend to fall in the intermediate levels based on community management and/or external aid.^{162,163,164}

Table 3: Sector models and descriptions.¹⁶⁵

Sector Model	Description
Private	For-profit, market-based provision with no subsidies.
NGO Community-based	NGO provision, with subsidized capital/installation costs, but fee-based, community-ownership/operation that covers operation and maintenance expenses.
NGO Aid-based	NGO provision at zero effective cost to water users.
Public	Public provision by a central government.

Public models are often not effective in rural communities because the governments lack the means and capacity to provide the service. For the case of this study, it is thus assumed that the government cannot provide water services self-sustainably and must rely on some degree of external assistance. Purely private models are often not economically feasible for low-income countries due to challenges in collecting sufficient revenue. Affordability is still such a major barrier to safe water consumption that private models cannot thrive nor are incentivized to participate in the rural water sector. Thus NGOs are commonly relied on to provide basic services when public models are ineffective and private models unprofitable. NGOs that have relied solely on aid tend to lack ongoing funds to cover the needs of a permanent service, and thus community-based models that utilize some degree of aid tend to be most effective.¹⁶⁶ Thus

¹⁶² Aliprantis, “What Is the Equity-Efficiency Tradeoff When Maintaining Wells in Rural Haiti?”

¹⁶³ Lockwood and Butterworth, “Global Study On Sustainable Service Delivery Models For Rural Water: Country Brief Haiti.”

¹⁶⁴ Check and Deal, “Improving Access and Sustainability: Success Indicators and Barriers to Access : A Study of Community-Based Water Management in Uganda.”

¹⁶⁵ Aliprantis, “What Is the Equity-Efficiency Tradeoff When Maintaining Wells in Rural Haiti?”

¹⁶⁶ Ibid.

for this report, a hybrid sector model will be adopted combining the NGO community-based model with aid support.

Section 4.3: Political Analysis

This section presents the political theory relevant to water provision and delves specifically into reasons why governments may struggle to adequately provide water as a public good. The means of supplying safe drinking water can be broadly categorized as centralized, decentralized, or self-supply.¹⁶⁷ These delivery methods are defined in Table 4:

Table 4: General means of drinking water supply.

Delivery Model	Description
Centralized	Large scale delivery, typically state-run, with a central technical system branching off to connected smaller systems.
Decentralized	Small scale delivery, with several separate technical systems.
Self-Supply	Delivery acquired through individuals accessing bore, surface, or rain water.

Ideally, basic services are provided by governments. But centralized providers must have the means to implement, monitor, and manage the services they provide, which is often not feasible for countries that lack an organized governing body with these capacities. Governments in a rural context in particular experience governance challenges to implement basic services to include water delivery. Five major constraints to centralized implementation have been identified below in Table 5.¹⁶⁸

Table 5: Government failure theories.

Government Failure	Description
Categorical	Pressure to provide goods and services on a uniform and universal basis.
Majoritarian	The majority conception of public good met and minority concepts underserved.
Time Horizon	The short time frame of officeholders promotes addressing problems with short-term fixes.

¹⁶⁷ Bhatnagar et al., “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market.”

¹⁶⁸ Young, “Government Failure Theory.”

Knowledge	Bureaucracies are not organized enough to handle all information, ideas, research necessary to respond to complex problems.
Size	Bureaucracy can be too large to be approachable for ordinary citizens or too small to fulfill duties.

In the context of water service delivery, these government failure theories each have the potential to prevent a public model from succeeding. The categorical failure prevents governments from being able to select and focus on communities with the greatest potential to succeed, and instead push a central body to serve evenly. NGOs have a unique advantage in that they can choose to work in a particular community without any pressure to serve the entire country at one time, focusing resources more narrowly instead of spreading them thinly across many programs. The majoritarian failure raises concern over pricing water to the majority population that can afford water and overlooking the most impoverished and underserved population that needs water accessibility just as much. The time horizon failure is experienced through government officials and even charities overemphasizing short term accomplishments at the expense of long term investment. Politicians with reelection on their minds are pressured to provide evidence quickly of their goodwill, which can result in inexpensive investments that do not account for costs associated with the continual operation of a system.

The potential for knowledge failure may result from a central body not having the capabilities to manage the resources and data required to monitor and develop a functioning system. Without a firm grasp of the demographics and water inventory, it is difficult for a government to provide the best model design tailored to the community's needs. Finally, the size failure is based on a bureaucracy that is too small or large to connect with a population. A bureaucracy too large may be intimidating to local citizens and inefficient, while a bureaucracy too small is incapable of carrying out its most basic tasks. All five of these failure theories are only exacerbated in a rural context. Centralized providers must have the capacity to overcome these potential failures, which is not feasible for most developing countries that lack such an organized governing body.

While centralized provision is often not logistically feasible, self-supply is not necessarily safe. Self-supply presents health concerns due to lack of reliable access and quality control. People may acquire drinking water from unimproved sources for a variety of reasons ranging from insufficient education on sanitation, to a lack of funding, to no alternative access to an improved water source. Even rain water may be contaminated in unclean storage bins, and bore and surface water can be easily contaminated by run-off of nearby sites. Decentralized systems have consistently proven to be the most successful delivery method in rural countries that lack strong central service provision, as seen in countries such as Indonesia, the Philippines, India,

Haiti, Bangladesh, Nigeria, and Kenya.¹⁶⁹ Decentralized systems may lack the resources and direction of well-supported and organized centralized systems, but have shown promise when able to overcome these barriers.¹⁷⁰

While governments, especially in rural communities, may face considerable challenges in the provision of services and goods, decentralized organizations should not work around them. This has been a common mistake; providers recognize a need, such as water, is not being met by a government and then attempt to provide it themselves independently. The United Nations has declared water provision a responsibility of governments, and thus even if they lack the full capacity to do it alone, the governments are the ones who will ultimately be charged with the ownership and accountability of the service. After all, it is the governments who will be managing the service once the external aid and water provider exit the country.

Thus organizations seeking to work in a country must work *through* that country. Water providers must work through *all* levels of government in order to implement water service delivery successfully. Eventually, the objective is for the central government to have the capability to provide a basic service entirely on its own in the future. But until then, help is needed by a water provider who recognizes the government is the ultimate water authority. Organizations working around the central government undercut the government's ability to monitor the water sector actors, regulate who is working in country and implement their authority over the service. A sustainable approach recognizes that the central government is the final authority and is the one who must be spearheading water provision with the *support* of interested water providers.

The national government, though it provides the greatest authority over water provision, does not provide the *only* authority. Local governments, too, have a significant role in overseeing successful water provision as they are much closer and aware of the local context. They will be able to provide the status of current water provision and best assist with implementation on the ground. Furthermore, local more informal leaders must be engaged as they hold significant sway and credibility within their communities. Organizations have increasingly worked to interact with local chiefs, councils of elders, female leaders, and those with the respect and best interests of their community members.

The literature review indicated that water is largely a problem of governance, and that has been one of the most substantial focuses of the water sector today. Overall, the literature has shown that the technical challenges can be overcome and the economics can be accounted for properly. Political models that ensure the country and local leadership are identified as the true

¹⁶⁹ USAID, "Report of Water Sector Activities."

¹⁷⁰ Bhatnagar et al., "The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market."

leaders (as opposed to external providers) can be achieved through collaboration and cooperation. But even still, a water service will fail when *all* of the factors are not considered. And one factor that may often be neglected or undervalued is the people themselves. No matter how well the government and provider design and fund a system, it is useless without community buy-in.

Section 4.4: Social Analysis

Just because a water service is available does not mean the people will use it. Mike Barbee of *Water4* asserted that behavior change, convincing people to purchase a new service, has been the greatest challenge his organization has faced in successful implementation. Many others have failed to realize just how important that consideration is, and have had to learn through experience the importance of community buy-in. Shannon Evanchec, People's Choice Award Winner and co-founder of start-up *TruePani*, described the challenge of a lack of buy-in to her organization's systems in India: "While our device worked, it was a lot harder to get people to use it and have that behavior change, than we had originally thought."¹⁷¹ The product she designed did not fit well into the cultural expectations nor the current market for water services, and thus *TruePani* turned towards a domestic market in the United States instead. Likewise, Matt Hangen, CEO of *Water4*, described his organization's first attempts at entering the rural water sector as delivering a product no one wanted.¹⁷² He designed water-filtering hand pumps from cheap scraps, and though the product was functional and very affordable, it lacked the professionalism and assurance of quality to sway customers to pay for it. A graduate student reviewed the product and reported back that despite the functionality, it had no value to the community.¹⁷³ These demonstrate the ongoing challenge engineers have in placing technology in context. Development of a functional product alone—which seems to fit the end-user requirements—is not a reliable measure of actual success and adoption in the field.

In another example, USAID did not ask a local community where to install their water systems. Community buy in was lacking and USAID sought to understand why the percentage of community members using their service was so low. After receiving suggestions to move locations closer to the river near where customers typically access water, they experienced a greater than two-fold increase in customer base.¹⁷⁴ Input from communities in India shed light on the community's view of water as a premium for health insurance. This community, like many other low-income populations, preferred to spend little or nothing on safe water and instead risk the need for loans to cover medical bills.¹⁷⁵ In other communities, the health risks associated

¹⁷¹ Evanchec et al., "How This Water Quality Startup Pivoted To Address the Domestic Market."

¹⁷² Hangen, Interview conducted by Wesdyk, Aug 2018.

¹⁷³ Ibid.

¹⁷⁴ Bonnell, Interview conducted by Wesdyk, Feb 2019.

¹⁷⁵ Bhatnagar et al., "The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market."

with waterborne diseases are not fully realized. Without understanding what community members value in terms of water and sanitation, water providers miss key opportunities to tailor to their priorities.

*The importance of the relationship between the water leadership and the community at large cannot be understated in the long-term success and sustainability of the water system, regardless of the model in place. For example, in Walumbe researchers witnessed a community-led boycott which was likely the result of a lack of transparency between the community and the Water Committee over an abrupt two-fold price increase for the treated water. In interviews, Walumbe residents repeatedly expressed sentiments of general distrust in the Water Committee and their ability to manage the water system.*¹⁷⁶

The social considerations vary widely from each culture, so it is imperative that water providers actively seek to understand what the communities they hope to serve care about. Anywhere in the world people develop social norms that may not be healthy, anything from smoking, to not exercising, to eating unhealthy, and changes to these behaviors do not come easily even when people are fully aware of the health implications. Water providers should expect no different from people who have drank water from a certain source for all of their lives and are no suddenly told they were wrong to do so.

Because behavioral change is so hard, organizations must understand what the current social norms are before they do anything to change them. Water providers hoping to enter a sector should take action to study what the current WASH practices are and how much the community members would value a safer water source. Numerous examples of failure from the literature indicate that more than just the supply side must be considered; a good understanding of the demand side (the water users) and their culture is critically important. But what do the end users actually *want*? The CEO of *Water4* asserted that people pay for two things: “aspiration and convenience.”¹⁷⁷ Community members will want to pay for water if it is sold as a desirable product that appeals to their sense of wholeness and connectedness to the world or if it makes their life easier. Literature has identified the three most important social considerations as price, convenience, and taste preferences.^{178,179} Thus in order to provide an aspirational, convenient water service, the product should meet (or change) their expectations on its value, the effort required to retrieve it, and the desired taste.

¹⁷⁶ Check and Deal, “Improving Access and Sustainability: Success Indicators and Barriers to Access: A Study of Community-Based Water Management in Uganda.”

¹⁷⁷ Hangen, Interview by Wesdyk, August 2018.

¹⁷⁸ Bhatnagar et al., “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market.”

¹⁷⁹ Lockwood and Smits, *Supporting Rural Water Supply*.

From the economic perspective, the service must charge enough to cover the costs of providing the service. From the social demand perspective, the price must not exceed the cost communities are willing to pay. The WHO recommends water costs account for no more than 3-5% of annual income, and only 3% for low-income communities.^{180,181} Profit is necessary, and can be viewed as the foundation, for a long-term ability to continue to fund the service—this message must be effectively communicated to the water users. The social perspective requires the value of the service to meet expectations based on the current practices and recognize the increase in personal expenses being asked.

By incorporating local context to infrastructure designs, solutions have shown to be much more successful. Stephen Honan of the *Institute of Electrical and Electronics Engineers* demonstrated an example of working within the local context in his analysis of water filtration systems in Bangladesh.¹⁸² Previously, the practice was to use electrically powered, highly technical metal vats to filter arsenic out of water for drinking. Honan explained in his TEDx Talk that “Over time if the money dries up or the skilled labor doesn’t know how to maintain the system, eventually those big, metal vats become rusted and useless. Time and time again these projects failed.”¹⁸³ He introduced a new system based on phytoremediation (the use of a plant to collect heavy metal toxins), specifically using the *Pteris mayii* fern to absorb and store arsenic. This system came at minimal cost to the community and even had the potential for profit through the collection of the arsenic for application in electronics. The technology was also well within the ability of the community members to manage, unlike the complex vats.

Convenience in rural communities is perhaps most obviously measured by the walking distance to the water points. Today, the average walking distance covered to fetch water in rural communities is over 3.5 miles.¹⁸⁴ The WHO demands water points are “sufficiently close to the households,” limiting walking distances to no more than 1000 meters, or 0.62 miles, depending on elevation changes.^{185,186,187} Additionally, the way people fetch water varies across the world and must be considered. Water providers commonly offer water from taps and pumps. Some communities even preferred pumps because they enjoyed the physical connection to fetching the water.¹⁸⁸ People may fetch water with various sources, from buckets to jerry cans to gallon

¹⁸⁰ Hutton, “Monitoring ‘Affordability’ of Water and Sanitation Services after 2015: Review of Global Indicator Options.”

¹⁸¹ Bhatnagar et al., “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market.”

¹⁸² Flaherty, “Do-Gooder Turns Ferns Into Arsenic-Filtering Super System.”

¹⁸³ TEDx Talks, *Unexpected Innovation: Stephen Honan at TEDxOxbridge*.

¹⁸⁴ World Vision, “Walk for Water : Your 6K vs . Theirs The Walk for Water in Sub-Saharan Africa.”

¹⁸⁵ World Health Organization, *Guidelines for Drinking-Water Quality*.

¹⁸⁶ Chown, “The Political Economy of Community Management: A Study of Factors Influencing Sustainability in Malawi’s Rural Water Supply Sector.”

¹⁸⁷ Tincani et al., “Improving Value for Money and Sustainability in WASH Programmes (VFM-WASH) Regional Assessment of the Operational Sustainability of Water and Sanitation Services in Sub-Saharan Africa.”

¹⁸⁸ Key Biscayne Rotary Club, Interview by Wesdyk, Apr 2019.

buckets, so water providers should pinpoint what that norm is to set their prices in familiar metrics. The taste of the water, too, can be highly influential in the decision for people to purchase from a water provider. *Water4* recalled communities turning away their services because they preferred the taste of their current water source, others because they disliked the taste of the chlorination treatment, and others because they have come to like the taste of minerals because of the misconception that they are nutritious. Treatment can be adjusted to meet different preferences, such as by reducing chlorination levels and relying on additional UV treatment. If chlorination is preferred, perhaps even becoming an indication of high quality water, chlorination can be used predominantly as a more affordable option.

The literature was reviewed through the lenses of each of the technical, economic, social and political factors, and synthesized below for recommendations on how to approach the water sector. No factor can be neglected; it is only with an understanding of all factors that an organization can thrive in the water sector.

Section 5: Results

Section 5.1: Defining the Challenges and Recommendations

Indicated by recent published material and interviews, it appears that many approaches to water provision are in need of reframing. Chris W. Williams, Executive Director of the Water Supply and Sanitation Collaborative Council described current approaches as obsolete: “Development as we know it is no longer relevant, or desirable...the system is broken and it is time to redo development, building from the ground up.”¹⁸⁹ Leading organizations in the water sector, to include the *Caterpillar Foundation*, *Water.org*, and *Opportunity International* have agreed that “the clean water challenge is not a technology challenge.”¹⁹⁰ *If people in the water sector want to help and if the technology exists to provide clean water, why are so many people still struggling to access water?* In this very multidisciplinary sector, the primary obstacles lie in the approach. The three leading challenges observed in the water sector are as follows:

- 1) Well-intentioned approaches that have sought to improve access have often sought to achieve success through **infrastructure** and **gadgets**. There is a lack of understanding of the other critical components of water service delivery.
- 2) There are many temptations to prioritize **short-term** goals when basic human needs are at risk. But without a long-term approach, solutions are **unsustainable**, will likely soon fail, and promote a cycle of dependency on short-term projects.

¹⁸⁹ Williams, “Can We Finance Sustainable Development ?”

¹⁹⁰ Cheney, “Why You Should Care about ‘ Systems ’ in WASH.”

- 3) Water sector actors often fail to collaborate and work within the local context. Termed **system blindness**, water actors have ignored pre-existing frameworks and have tried to act independently to the detriment of cooperative action.

The answers to these challenges do not lie in some new technology, but rather require a careful analysis of past mistakes. Unfortunately, the solutions are hard. Susan Davis of *Agenda for Change* does not deny that this is difficult and even “scary” for organizations because it “threatens their mindsets.”¹⁹¹ What does a new approach look like that might address these challenges? Three recommendations for this new approach are offered as follows:

- 1) Water is not only a right, but it is also recognized as a commodity with value, which together makes it a service. Successful **water service delivery** requires more than just a focus on the infrastructure and technology.
- 2) Clearly prioritize **sustainability** as the foundation of any water service delivery approach. Sustainability requires water authorities, providers, and users to value long-term approaches that will protect against short-term failure.
- 3) A **systems-based approach** demands collective action with established systems in place. By recognizing the local technical, economic, political, and social contexts and actively working to cooperate as a *part* of this system, efforts will be much more effective over the long-term.

These are broad recommendations that demand elaboration and actionable objectives. In section 5.2, thirteen components of successful *water service delivery* are identified and explained. Section 5.3 expands on how to measure the success of this service in terms of *sustainability*. Finally, Section 5.4 elaborates on what a *system-based approach* means and how to achieve it. By adopting this new philosophy towards development in the water sector, SDG-6 can be achieved more effectively and water can be the universal, safe, affordable, and equitable service that everyone is working towards.

Section 5.2: Implementation Considerations for Water Service Delivery

Water service delivery has previously been reduced to the physical systems that deliver water: pumps, filters, pipes, etc. Because the service aspect of water was ignored, the solutions were incomplete. Often, solutions focused only on better or more innovative technology. This oversight was detrimental to the communities who suffered as a consequence of an incomplete

¹⁹¹ Davis, comment on “Paying the piper: why the things that donors are prepared to fund in WASH need to change.”

solution, to the charitable organizations who failed in their efforts, and the funders who neglected to raise sufficient funds for all of the other components of the service, gaining little from their investment.

To identify a new path forward, a new definition for *service* as it pertains to water is proposed by this study:

A service is defined as the provision of a public good that is wanted or needed and has value. This definition captures both aspects of water as a right and a commodity.

Water service delivery approaches were studied across the sector to identify the main components of water provision. Technology and infrastructure are important, but are only a part of a larger system. Based on synthesis of approaches across the sector, a list of thirteen major service components were identified and are listed below and then elaborated on to show the major considerations for provision:

Components of a Water Service

- | | |
|--|--|
| 1. Hydrology Study | A hydrological report of the region to estimate best locations for wells and required water treatment. |
| 2. Feasibility Study | An initial estimation of the economic feasibility of implementing a system based on customer demand, willingness to pay, and system cost. |
| 3. Technology Selection | Identifying which technology is most appropriate for the setting. |
| 4. Community Selection and Engagement | Communities are selected based on optimizing local support and interest, hydrological considerations, and economic potential. |
| 5. Business Model | Develop an economic model that estimates the expected costs and revenues for the organization, highlighting operational and maintenance costs recovery. |
| 6. Secure Funding | Acquire funds to cover expenses through formal agreements with funders. Contracts should identify which funds are grants and which are loans and a plan to pay back loans. |
| 7. Formalized Community Partnership | Form a contract with communities presenting expectations for the community and what can be expected of the provider. |
| 8. Inventory Assessment | Using funds, invest in a more thorough water inventory that identifies if sources are functional, reliable, and clean. |
| 9. Community | Give the community the tools to successfully implement the |

Management Training	construction and maintenance of the service.
10. Construction/ Rehabilitation	Wells, pumps, and kiosks are built for water extraction.
11. Marketing	Water service delivery is presented and branded as a product.
12. Implementation of Service Delivery	The model is implemented beginning from water extraction, to treatment, transportation, delivery and payment.
13. Monitor and Improve	Organizations should seek feedback and implement data monitoring mechanisms in order to track trends and address areas of improvement.

Section 5.2.1: Hydrology Study

A hydrology study is the assessment of the quantity, quality, and availability of water in the water cycle. A hydrological report documents the conditions of the available water resources as the supply component of the service. The report provides insight on how to approach the technical solution within the economic means of a community. A hydrologist requires formal training, typically a bachelor's degree, provide the skill set necessary to collect, interpret, analyze, and synthesize the data. The report characterizes the available water resources so that a sustainable system can be designed and built upon it.

Potable water may come from a variety of sources to include rainwater, surface water, or groundwater.¹⁹² The means to extract, store, treat, and transport water from each source will vary. Rainwater may be collected on an individual basis in storage containers, but likely requires treatment and protection to ensure there is no contamination. Surface water is likely to be the easiest to access but also the most contaminated, while groundwater is least likely to be contaminated but will require drilling to access. Organizations hoping to provide water on a large scale to communities, especially for rural communities will rely primarily on surface water. This ensures that the technical solution can be managed by the community and does not require training beyond the capacity of local labor source.

A hydrology report is also important in helping to determine the type of rock and sediment that will be necessary to drill through to access a potential aquifer. Lack of detailed understanding of the hydrography has been shown to increase costs significantly in some cases, specifically when well drilling requirements were much more technical than anticipated. Machine drilling requires more technical equipment and in some cases specialized training as compared to manual drilling, which can greatly increase the overall capital costs of the project.

¹⁹² USGS, "What Is Hydrology?"

The report should record:

- Water quantity: Volumetric flow rate
- Water quality: Contaminants and presence of waterborne diseases, salinity, pH
- Technology recommendation: Purification treatment required/preferred
- Seasonal effects: changes in water availability expected throughout a typical year
- Water points: Record of current wells and pumps in existence
- Geology: Additional pertinent information regarding terrain and elevation

The hydrologist should also estimate water distribution requirements for residents, schools, and commercial needs (agriculture, husbandry, tourism, etc.). After the initial hydrology data is analyzed, a map of the distribution (supply side) with the water requirements distribution (demand side). The water requirements should consider both population density (residential) and the presence of large institutions where demand will be high. All of this information is optimized then to determine the most suitable placement of well heads and delivery infrastructure aligned with:

- The long-term health of the well and aquifer
- Ensured year-round access to the maximum number of customers, prioritizing residents
- Potential shortfalls in access (situations where demand exceeds availability)
- The number of personnel required to staff the points of sale

A hydrology report is the first step to understanding the current status of water resources available to a community. It provides information on how much water is available, what treatment will be required, and what access points are available. It is a driving factor for the technical approaches that will be needed to address water extraction, treatment, and delivery.

Section 5.2.2: Feasibility Study

The purpose of the feasibility study is to define the market potential and consumer willingness to pay for a service, in this case for water delivery. The survey objective is to provide data on the demographics, where communities currently procure water, water-related practices and usage, community health perspectives, household expenditures, and wealth index scores in order to present a picture of how household currently access water and their willingness and ability to pay for water service delivery. This information encapsulates the demand perspective affecting water provision. The results shape the service methods chosen that are within the means of the community and aligned with their needs and wants

To gauge the capacity of the community to participate in the service, several tools can be used to measure income available for water. Understanding of the sources, levels, and variance

in incomes provide insight as to the communities' ability to pay and what would be considered affordable. Figure 11 shows a plot of income distribution for the world in terms of millions of people as current as 2013 (blue) and predicted for 2035 (green).

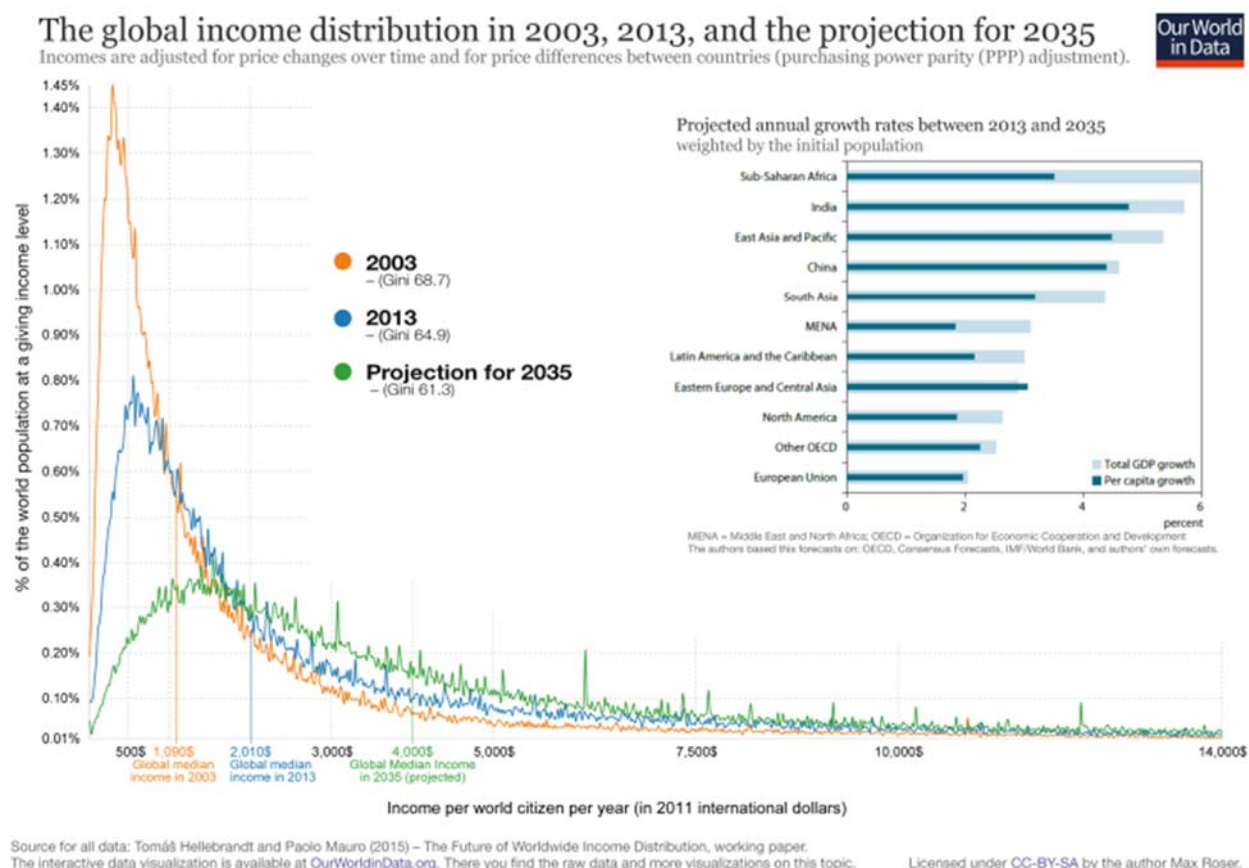


Figure 11: Chart showing current and predicted global income distribution.¹⁹³

In order to increase coverage, some households may require subsidies, as previously described. An assessment parameter that is used to identify which households would qualify is the Gini coefficient, which measures economic equality based on wealth distribution.¹⁹⁴ The statistic measures inequality ranging from 0 to 100%, where 0% represents perfect equality and 100% perfect inequality. This influences subsidization schemes in terms of income if there is substantial variance since opinions of affordability will vary widely. Other useful tools measured through survey include directly asking what the population is willing to pay and how much they currently pay (if at all) for water.

A feasibility study also provides insight as to what services and products communities *want* to pay for. Willingness to pay for water is often driven by health education and a concomitant desire to change current drinking water habits. While some communities may have

¹⁹³ Roser, "Global Economic Inequality."

¹⁹⁴ Chappelow, "Gini Index."

a better understanding of the health risks of unsafe water and have limited or no alternatives, they may be very willing to pay even a high price to ensure quality drinking water. On the other hand, communities with access to a range of water sources of adequate quality, such as rainwater catchment or uncontaminated freshwater sources, may have less incentive to pay for a source that guarantees higher quality.

Section 5.2.3: Technology Selection

During technology selection the service delivery provider develops a technical system that takes into account regional hydrology, population distribution, available energy sources, material availability, local literacy, and community needs. The physical system includes the wells, pumps, taps, pipes, and infrastructure that are most typically associated with the water sector. It may be a system completely tailored to one specific community or may become a generic model that is applied and customized for communities across different regions and countries. Robustness and resiliency are important attributes because they tie directly into sustainability. They ensure the system is understandable, simple, functional, maintainable, and replaceable.

Robustness emphasizes the need for local labor to have the capacity to manage and operate the water systems. Resiliency calls for the system to withstand usage, weather, and repairs. Technical experts will have to train community members on drilling, treatment methods, piping, facility construction, and repairs in addition to how to operate the system. The community must have the capacity to not only run the systems but also be able to handle repairs and replacements.

For rural communities, manual drilling is preferred to reduce expertise needed and reduce prices, but machine drilling may be required given the geology. The treatment method selected also has implications on the costs, complexity, and energy requirements for the system, as described below in Table 6.

Table 6: Contaminant sources and methods of treatment.

Technical Treatment	Description
Distillation	Heating and cooling water to remove particles, though the process is energy intensive.
Filtration	Removing small particles through a medium to separate solids from the liquid.
Ultraviolet	Non-chemical disinfectant to treat for bacteria, though is more technical and energy intensive compared to chlorination.

Chlorination	Chemical disinfectant to treat for bacteria that is affordable but alters the water's taste, odor, and appearance.
Reverse Osmosis	Forced process to push liquid through a membrane to remove salt particles, but is energy intensive.

Treatment is most simple when a freshwater source requires only filtration to remove non-harmful minerals. Treatment becomes increasingly expensive and requires more advanced technology when harmful chemicals or biological contaminants are present. Particularly in communities where organic waste management is lacking, treatment must include anti-biological methods such as UV treatment and/or chlorination. Salt infiltration also increases difficulty and costs to water purification since reverse osmosis filtration is required. Reverse osmosis is a process which forces the contaminated or brackish water through a membrane using high pressure. Reverse osmosis has a high capital and maintenance cost, and because it is also an energy intensive process, increases operating costs by increasing energy required for operation.

Section 5.2.4: Community Selection and Engagement

Community selection and engagement are often insufficient or overlooked. Community buy-in is perhaps the single most important contributor to sustainability. No matter how well the technology works or how much donor funding there is, without community engagement, a water system will fail. Successful enterprises must engage on every level of government, from the national to the neighborhood, even when the central government does not have the resources to contribute. Community engagement actually begins before the hydrology study and is built upon the feasibility study. Engagement must be paired with education and that education should come from community leaders, not outside partners.

Collective action has shown to be most successful when all levels of leadership have been incorporated, from the central government through localized government down to community leadership and even unofficial leaders. The local leadership may come in the form of a village elders, community councils, religious and social leadership support is critical to the successful implementation of any water service plan.¹⁹⁵ However, support from unofficial leadership should be incorporated as well. Women and young persons have been increasingly incorporated into community engagement outreach programs as well as they are primarily responsible for fetching water. Partnering with the community is essential to developing a working relationship with future customers and the local leaders that will support the water service delivery provider over time. Engagement and education should address a variety of factors including health effects and benefits, economic and educational benefits, and social and safety benefits, but must be sensitive

¹⁹⁵ Jesse, "Participation without Representation: Chiefs, Councils and Forestry Law in the West African Sahel."

to community history and cultural norms. The market-based approach demands a relationship with the community to fully integrate the system with the local wants and needs.

In addition to community interest, there are other more practical factors that help determine the most promising potential sites for selection. The hydrology and feasibility reports should be used to match compatible organizations and communities. The population size of the local community is an important consideration for a successful water project. Sufficient population is required to provide enough revenue to support the business model. Typically, sites for water services are selected based on the proximity to a dense population, served by a more centralized model, or around small clusters of settlements, served by a hub-and-spoke configuration.¹⁹⁶ This factor explains why rural communities have often been neglected; profit is easier to ensure in an urban area.

Site location has been identified as a “decisive factor influencing sales and sustainability,” and should be carefully analyzed before implementing.¹⁹⁷ Some of the primary considerations are financial sustainability, potential for social impact, and water conditions.¹⁹⁸ Financial sustainability requires the site to have a sufficient population to provide the minimum sales required to maintain operations, measured by the number of households that would consume the water. But this must be balanced with the social impact aspect of the model, where organizations seek opportunities to reach previously underserved communities.

The hydrology and feasibility reports help organizations match water projects with communities. The hydrological factors drive the required treatment and associated costs with providing improved water sources. The ability and willingness for the community to pay as described in the hydrology report indicates if an organization can operate in that community. Donors can have significant input in the site as well.¹⁹⁹ Since the majority of SWEs depend on some degree of philanthropic support, these inputs are important to consider. Donors may have partnerships established with certain communities and choose sites that may not be sufficient in terms of accessibility and population density, resulting in unsustainable locations.

A *district approach* has been shown to promote successful water projects in areas that have proved historically challenging for sustainable, long-term water projects.²⁰⁰ A district approach, or any approach referring to an entire boundary, refers to a commitment to fully service a geographic region as opposed to picking and choosing only the most profitable small-scale locations throughout a country. The later approach often neglects rural areas and has left

¹⁹⁶ Shepard and Allison, “How Can a Trickle Become a Torrent?”

¹⁹⁷ Ibid.

¹⁹⁸ Bhatnagar et al., “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market.”

¹⁹⁹ Ibid.

²⁰⁰ Hagen, Interview by Wesdyk, Aug 2018.

communities lagging behind compared to urban areas. A district approach ensures that everyone is served. Because rural communities typically are not dense and may lack sufficient income to afford water, organizations tend to ignore these populations. Water providers have little potential to make sufficient revenue if operating in only the most rural communities, so it is important to incorporate them into a provision approach alongside urban communities. Despite the challenges of serving rural communities, approaches that encompass both the rural and urban have advantages for the long-term objective to service everyone universally. More affluent communities may pay slightly more to offset slightly lower costs in rural areas with an income subsidization as mentioned in Section 3. If a water provider becomes prominent in the geographic region, behavioral change may become easier as people see their neighbors become water users for a certain water provider. Additionally, community training, engagement, and marketing become more consolidated. The district approach allows for communities that might not be profitable on their own to become incorporated into a larger provision approach that can offset potential losses from lower-income rural communities with the higher-income urban communities.

Section 5.2.5: Business Model

Once a technical system has been identified that meets the economic needs of a community, the business model should be developed to support the ongoing lifespan of the service. Two fundamentally different models for viewing the timeline of the service are a *project-* versus *product-*based approach.

With the project-approach, there is a start and end point, resulting in a finite lifetime. The project ends once the system fails to operate. This philosophy is detrimental to development projects as it fails to emphasize the maintenance and operational costs needed to continue the system. Unfortunately, this mentality is sometimes promoted by short-term thinking organizations such as governments and charities. Government officials face pressure to show results quickly and at a low cost to ensure their re-election. Even charities may implement a project but fail to prepare for the investments required to keep the system operational.

In contrast, the product-approach treats water systems as investments that must be maintained to continue indefinitely. Unlike the project-approach, which focuses on the initial capital costs, the product-approach focuses on the operational and maintenance costs to keep the system running. This philosophy has been also called Life Cycle Costing (LCC) (Fonseca, Mohan) and is essential to any solution designed for long-term sustainability.

Comparison of an Implementation Approach versus a Service Delivery Approach highlighted the difference in emphasis on construction as opposed to long-term investments.²⁰¹ A

²⁰¹ Lockwood and Smits, *Supporting Rural Water Supply*.

study of SWEs in Benin, Burkina Faso, Colombia, Ethiopia, Ghana, Honduras, India, Mozambique, South Africa, Sri Lanka, India, Thailand, Uganda, and the USA revealed that favoring service delivery allowed for the SWEs to better achieve business models.

It is imperative then to adopt a business model that looks to the future. The product- as opposed to project-approach model views systems as investments that must be maintained to continue indefinitely. Unlike the project model which focuses on the initial capital costs, the product model focuses on the operational and maintenance costs to keep the system running in addition to the capital cost. This philosophy has been codified as Life Cycle Costing (LCC) and is essential to any solution designed for long-term sustainability.

LCC accounts for six forms of costs: 1) capital expenditures (CapEx), 2) costs of capital (CoC), 3) operation expenditures (OpEx), 4) capital maintenance (CapManEx), 5) direct support costs (ExpDs), 6) indirect support costs (ExpIDS). Table 7 shows the six categories and examples of each below.

Table 7: Life Cycle Costing categories.²⁰²

Expense	Description
CapEx	Drilling, construction, community engagement.
CoC	Loan interest, bank fees.
OpEx	Overhead, labor, fuel, materials, minor repairs.
CapManEx	Asset renewal and depreciation.
ExpDS	Monitoring and evaluation, employee training.
ExpIDS	Supporting government regulation, taxes.

Once organizations can better organize and account for each of these costs, they can plan for them. The diagram below in Figure 12: **Plot of life-cycle costs over time**, provides a framework for accounting for the large initial capital expenditures, maintenance and operating costs both large and small, repayment costs of capital, and ongoing supporting costs. The graph adds the dimension of time, plotting the expected costs across the lifespan of the service.

²⁰² Moriarty et al., “Ladders for Assessing and Costing Water Service Delivery.”

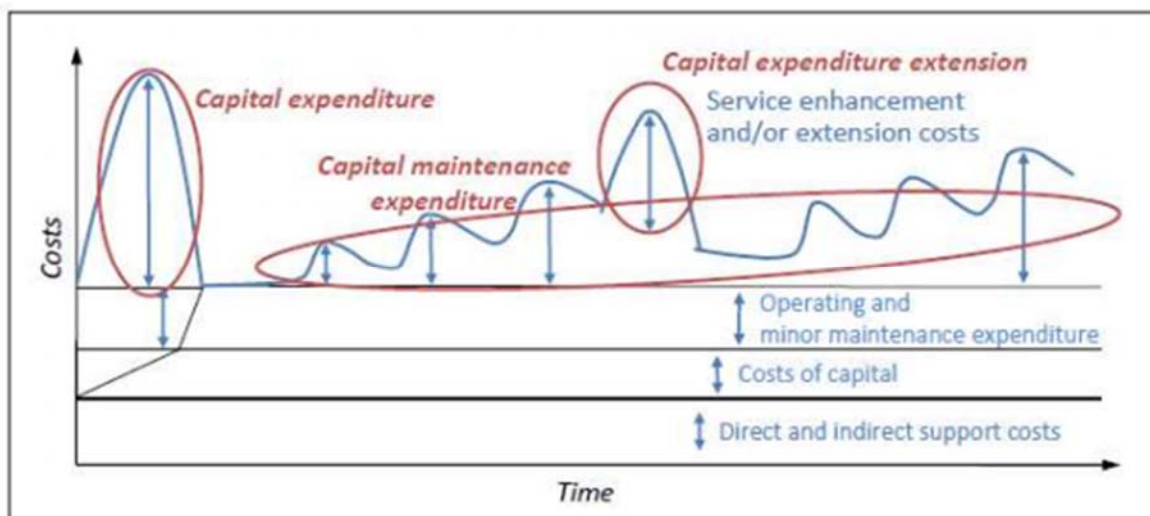


Figure 12: Plot of life-cycle costs over time.²⁰³

As shown above, the first costs expected are the initial capital expenditures when the system is first purchased and developed. As the water system is used, operational and maintenance costs will arise. These costs are shown as the small periodic dips above in the blue line, and they should be anticipated by the business model. Even more, *large* capital expenditure *extensions* should be accounted for in budgets as systems require replacements. That is one of the most important differences between the project- and product-approaches. When a system in a project-approach eventually fails and requires replacement, there are no funds allocated to do this replacement and the project comes to a close. In contrast, a proper business model would have anticipated assets to fund service continuation. Expenses that may be less obvious are the costs of capital, and direct and indirect support costs. These expenses, which account for working through banks, monitoring systems, and supporting regulations, respectively, are also ongoing throughout the full system lifespan.

Section 5.2.6: Secure Funding

To account for these various expenses which all have different timelines, organizations tend to cover these costs through different funding sources. Once a thorough business model is developed and appropriate sector model selected, plans can be presented to external entities and banks to secure funding. There are several sources to raise funding to include government funding, grants, loans and revenue. For rural communities, it will be assumed for this study that government funding is either unavailable or negligible. The business model then will be based off of a combination of grants, loans and revenue to account for the initial and ongoing expenditures. Most organizations today in a rural context do rely on some degree of philanthropic support from organizations, which may be insufficient in quantity or timespan

²⁰³ Moriarty et al., “Ladders for Assessing and Costing Water Service Delivery.”

available. Funding ideally is invested in *all* components of the service over a significant span of *years*. Limited funds that only cover infrastructure (neglecting hydrology and feasibility reports, training local labor, monitoring, branding, etc.) and end abruptly disrupt water service delivery. Even if grants can sufficiently cover initial investment costs, a significant degree of the ongoing expenses must come from revenue. Revenue goes towards the expenses that last for the permanent service. Profit from the service goes towards paying back loans and other costs of capital, as well as the direct and indirect expenses. Once a long-term budget with the funding source(s) has been formalized, a partnership can be forged with the local community.

Section 5.2.7: Community Partnership Formalized

The partnership developed and cultivated with the community is the cornerstone of a successful implementation strategy. Even if every other aspect of the service water delivery model is conducted well, community acceptance, demand, and leadership is required for success. Historically, many services have failed in the past due to the disconnect between what the water providers and authorities perceive as the customer's top priorities and what the customers truly value. For example, strong community relationships have allowed for water providers headed in the wrong direction to adjust course for a better outcome. Other SWEs that have failed to engage with the community have struggled to understand why their work hasn't succeeded as expected. SWEs that have failed have tended to lose the trust of the communities through a lack of transparency and collaboration.²⁰⁴

Thus it is imperative to devise a formal plan to present to the community in the hopes of reaching agreement for water service delivery. The agreement should outline the water price, profit for the community, and management relationship agreed upon between the provider and community leadership. This allows for the community and water providers to understand their own expectations from both perspectives and to reach an agreement that is mutually beneficial and favorable to all sides.

Section 5.2.8: Inventory Assessment

With funding and the approval of the community, a thorough inventory of the water point resources can be conducted. This allows for analysis of the quality, accessibility, and functionality of the water points already existing. The quality of water must be tested to ensure the water meets typically internationally agreed upon standards laid out by the WHO and ensures that harmful bacteria are not contaminating the water source. Common tests include detection for Coliform and E-coli bacteria, which are serious waterborne diseases with the potential to kill those who consume them. Another important quality is the accessibility of the pumps: noting the

²⁰⁴ Bhatnagar et al., "The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market."

frequency wells or pumps are operational. Functionality may take on various definitions in different scenarios, from as simple as broken or operational to more sophisticated measures such as a set number of pumps required to fill a quantity of water.

The primary sources of potential drinking water currently include wells, pumps, water holes, rainwater, and the ocean. The data on these sources collected in the inventory reveals where water systems already in place can be repaired and incorporated into a new project, where previous projects have provided sufficient service, or if an entirely new water system is required. It would be most convenient to create an entirely new network of pumps and wells from a few, select primary providers which would promote better maintenance and replacement of systems. However, current systems that can be salvaged, are deemed functional, and have a means in place to ensure continual operation may be incorporated into the developing network.

- If well already in place, determine necessary refurbishment costs
- For new well heads, determine type and construction costs
- Size pumps, as required
- Determine ground pump power requirements, as required
- Design distribution network
- Identify power source for each node in the distribution network
- Determine the number of personnel required to maintain the pumping and distribution infrastructure

An expert with significant experience in the WASH sector should be contacted externally to perform the inventory assessment. This ensures credibility in the data collected (as opposed to a potentially more biased view from the organizations managing the systems themselves) and a nuanced definition of functionality. Functionality is an extensive term that in this case should be defined by i) whether the current pumps extract water, ii) the number of pumps required to prime a bucket, iii) the number of hours operational each day, and iv) downtime between repairs. As customer and provider demands and expectations are surveyed and better gauged, additional factors can be incorporated into this multidimensional term as well.

Section 5.2.9: Community Management Training

Water stability is not only important for the health and wellbeing of communities, but it is also the foundation for all other aspects of development. Service delivery approaches should aim to *empower* communities and engage members as leaders in the solution. Community development is not merely a secondary benefit, but the core reason for providing water in the first place. Opportunities to hire, train, and educate the community are a crucial part of the water provision plan. While technical and business expertise may be needed to provide the initial

oversight of the local teams, the objective is to incorporate the community in all of the benefits service water delivery provides beyond clean water.

Even more practically, training local teams to perform the drilling, system operation, and management are essential to ensuring the service is permanent. The community then has the capabilities and skill sets to become self-sufficient regardless of the presence of external aid. Funding then must be allocated for the local teams to be hired and trained in the technical and business skills required. Community members must become specialized in well construction, business practices, and collaboration with water authorities and fellow community members. Education is key to the empowerment of the community and ensures the longevity of the program. There must be a local workforce that can manage the water supply as it transitions to full community-based operation and control.

Section 5.2.10: Construction/Rehabilitation

The water system hardware must be procured and installed, and any well must be drilled. The infrastructure is built with an understanding of the many other factors that have been addressed above to ensure that resources are not wasted on construction based on insufficient planning. This is finally the step in the service implementation where pumps, wells, taps, piping, and facilities are built. This component is something many organizations understand well since the technology is well established and documented. Water providers should ensure proper training to prevent unnecessary repairs and maintenance caused from poor installation.^{205,206} Generally though, water infrastructure installation is an organization's "bread and butter."²⁰⁷

Section 5.2.11: Marketing

Just because a physical water system is in place does not necessarily mean people will use and buy the water. Because water is properly viewed as a product that comes at some cost, there exists a real need to explain the cost, and convince individuals to purchase the water. Like any product, effective marketing and branding is important. Branding is at times an overlooked step in the process of developing a water service. It is likely often overlooked because implicitly or explicitly, water is not viewed as a product. While water itself is a right and worldwide need, the treatment and delivery of water comes with a cost. There is a disparity between the value of

²⁰⁵ Lockwood, "Scaling Up Community Management of Rural Water Supply."

²⁰⁶ Chowns, "The Political Economy of Community Management: A Study of Factors Influencing Sustainability in Malawi's Rural Water Supply Sector."

²⁰⁷ Davis, comment on "Paying the piper: why the things that donors are prepared to fund in WASH need to change."

water, accounting for all of the costs that go into employing a team to extract, treat and deliver water, and the actual cost of water. Therefore in order to overcome this perception that delivered drinking water should have little or no cost, water must be treated as a product. The outward professionalism of an organization shapes how the public views the water product, thus steps taken to develop a brand, organizational uniforms, symbols, and advertisements all have a significant role in the success of the water service delivery model.

The “value asymmetry,” which is the disparity between the high price of water and the low perceived value of water, is a significant barrier to the profitability of the WASH sector in terms of achieving the necessary water users to break even. Organizations aim to promote the quality of their water and the health benefits as a selling point yet are faced with a population in rural communities that typically values convenience over quality.²⁰⁸ Rural communities do not, however, value convenience when it exceeds their willingness to pay. For example, despite being more convenient, installed connections within homes are often not yet feasible in rural communities because connections cost a substantially higher price. While in-home connections continue to remain out of reach for the majority of low-income communities, the current focus for improving buy-in to water provision is by promoting the salience of clean water. This can be accomplished by increasing market demand through improved customer awareness. Typical marketing techniques include campaigns from a mass media level down to the community led interpersonal level. Advertisements through billboards, signs, the kiosks themselves, television ads, radio announcements, jingles, lessons in school, community WASH meetings, and family conversations can greatly drive up the demand for the water service.²⁰⁹

Section 5.2.12: Implementation of Service Delivery

The implementation of water service delivery consists of five primary steps: extraction, to treatment, transportation, delivery, and payment.²¹⁰ Each step is governed by the research conducted on the resources and demographics of the community. Some of the most prominent options within each step are shown below in Figure 13.

²⁰⁸ Bhatnagar et al., “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market.”

²⁰⁹ Ibid.

²¹⁰ Bhatnagar et al., “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market.”

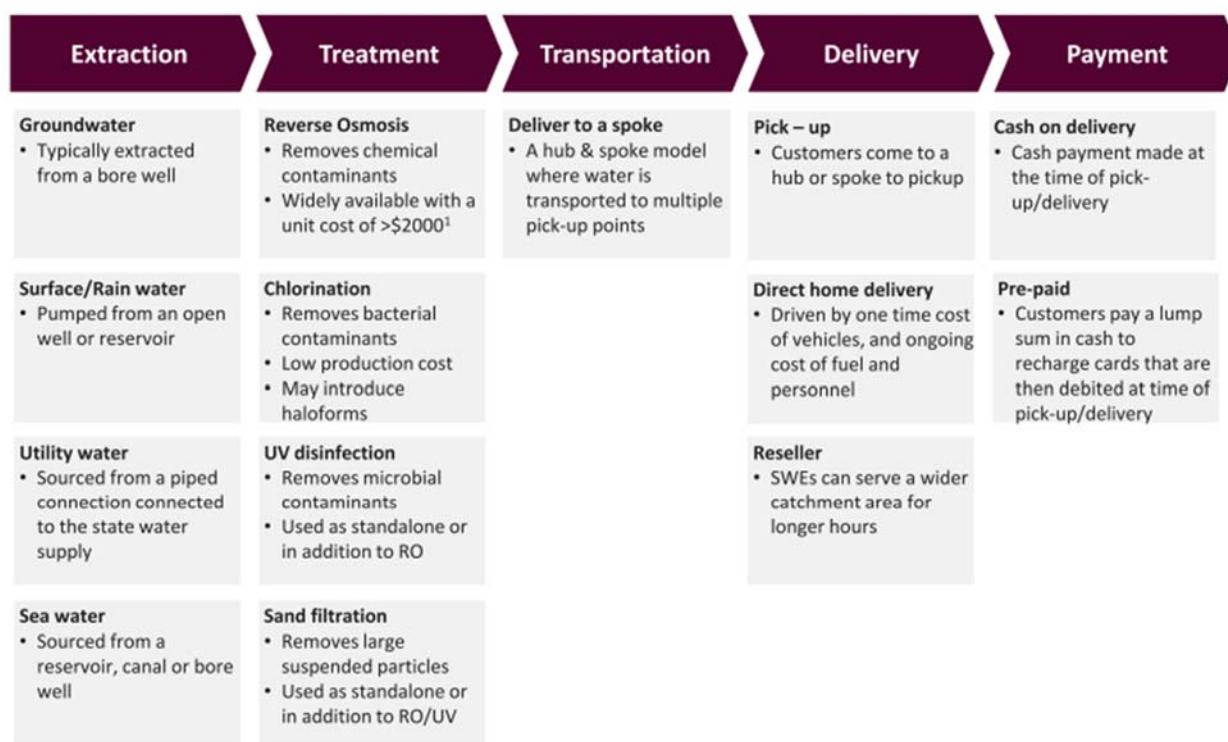


Figure 13: Drinking water value chain for service delivery.²¹¹

Water sources to extract have been identified and evaluated by the hydrology report. Wells must be drilled and constructed after property rights are secured and various methods can be implemented based on the geography.²¹² Treatment selection is based on the contamination type, complexity of technology appropriate, and taste preference.

In regards to transportation, the advantage of decentralized Safe Water Enterprises are that they allow for independent systems to operate and spread out water on a small scale with connections. Organizations should consider whether to treat the water at the source or at pickup point. Treating at the source may be more centralized and lower cost but presents the opportunity for contamination along route. In the delivery of water, the proximity to water hubs largely effects the scale. The locations should be selected based on finding the appropriate scale at the community level, because it is not economically feasible to have a system connected to every household (difficult to maintain and houses would have to pay for individual costs). But it is also not economically feasible to have one centralized unit because transportation costs would go up significantly. It is important to consider the capacity of a community to transport goods as well: taking into road quality and means of travel (cars, trucks, motorcycles, foot).

²¹¹ Bhatnagar et al., “The Untapped Potential of Decentralized Solutions to Provide Safe, Sustainable Drinking Water at Large Scale The State of the Safe Water Enterprises Market.”

²¹² Navy, Army, and Force, “Water-Well Drilling Operations.”

The final step is payment, which can either incorporate a pre-pay model or pay-as-you-go model. This is the payment between the system managers and the water service delivery provider. Often water providers prefer to set up a pre-paid meter in which the manager pays for the water to sell and then gets to keep the profit made selling to customers. The alternative is to give the managers the water and request back a percentage of the profit made, which may cause problems with improper accounting. Pre-paid models have been successful because they allow full accountability of profit and the managers can simply take home all of the profit they make.

Implementation of the service itself is a multi-step process that incorporates all of the other components above. Without forethought and collaboration from the other components, implementation is much less likely to gain traction and thrive in communities.

Section 5.2.13: Monitor and Improve

Improving the system can be thought of the “customer service” component of water provision. Data monitoring is not only important in the sense that it provides feedback and insight on trends, but that it *drives* the progression of the service. To drive the service progress forward, constant adjustments should be made to best adapt to supply restrictions and consumer preferences. *Water4* recognized the importance of this ability to monitor services, track trends, and identify areas that are lagging. The water provider partnered with *mWater* to develop an app capable of managing their NUMA systems in 15 countries around the world. Ultimately, the local organization gains the skill set and capabilities to manage service water delivery themselves. Once a service is established, a market assessment survey should be implemented to determine customer satisfaction. Supply metrics must be considered as well to ensure the service is feasible within the means of the water provider. These metrics that most essential to a lasting system are discussed in greater detail in the following section.

Section 5.3: Measuring Success in Terms of Sustainability

An unsustainable service is worse than no service at all. Susan Davis of *Agenda for Change* made the bold statement that “Poor implementation actually causes harm to those we are seeking to help.”²¹³ In other words, it is more harmful to implement a water project that is destined to fail than it is to not help in the first place. It suggests external collaborators do not care enough to follow through on projects, delegitimizes organizations attempting a sustainable model that charges, and continues the cycle of dependency. No matter how well intentioned, poorly planned projects provide at most, water for a short period of time, but without fail leave behind communities unable to manage it. These projects prevent organizations that charge fees for water from thriving, portraying these sustainable providers as profit-seeking. Communities

²¹³ Improve International, “Redefining the Problem.”

continually are left to rely on the fickle support of outside assistance instead of gaining the skillset to manage water services on their own. Sustainability *must* be established as a priority to achieve long-term success.

*According to this study, **sustainability** is defined as the long-term feasibility of providing water as a permanent service within the technical, economic, political, and social context. Sustainability indicates that the service delivery model remains functional, reliable, and resilient indefinitely through a self-supportable business model.*

This is such a difficult concept to address especially in rural communities where so many are suffering without safe water services. An example of general indicators that would be required to meet the SDG indicators that consider both the supply perspective and the demand perspective is demonstrated in Table 8.

Table 8: Sustainability indicators framed by SDG Target 1.

Indicator	Supply metrics	Demand metrics
Universal	● Coverage ● Accessibility ● Physical functionality ● Quantity ● Capital investments	● Desire to improve sources ● Reliability ● Managerial functionality
Equitable	● Walking distance ● Management system ● Demographics served ● Urban versus rural coverage	● Time spent to collect ● Community engagement
Safe	● Bacterial measurements ● Chemical measurements ● Treatment options	● Taste, odor, and appearance ● Presence of particles ● Salinity
Affordable	● Revenue returns for ongoing operations ● Means of charging ● Subsidies/tariff systems	● Coverage ● Household income ● Competition options ● Expectations

While these indicators are important at any stage of water service delivery development, the service ladder provides a framework for how to focus an organization's efforts. The ladder is useful in the sense that service delivery is a balancing act of many metrics, and each rung can provide useful and realistic guidance for where to prioritize. At the most basic levels, coverage

will be the primary driving factor while more intermediary levels will work to incorporate improved performance and quality.

This table is a primary example of the importance of viewing water as *both* a right and a product. It allows for more meaningful conversation surrounding how to measure performance and empowers water users to expressing their expectations. The concept of a market-based approach indicates that the consumers are the drivers of the water market. Water providers are not primarily aiming to serve the desires of external funders but instead set the communities' demands as the utmost goal to obtain success. The term does not suggest that profit is the objective, as explained by the CEO of *Untapped*, who defined market-based approaches as “focusing on value proposition versus directive needs of an outside funder.” In order to facilitate affordability for consumers with lower prices, NGOs “often intentionally run as close to breakeven as possible.”²¹⁴ Instead of profit, the goal is to prove the value added to the lives of the consumer's by participating in water service delivery.

Section 5.4: A Systems-Based Approach with Collective Action

Patrick Moriarty of IRC, described the source of many WASH sector struggles as stemming from *system blindness*, a problem that calls for “strong WASH systems.”²¹⁵ *But what exactly are these “systems” and how does it fit into the larger picture of providing a universal, equitable, safe and affordable water service?* Andy Narracott, WASH sector consultant and founder of *Finding Impact*, described today's WASH sector as “cursed with the systems blindness” and investigates this through a series of podcasts.²¹⁶ The systems-based approach is the focus popular in the water sector today. Yet, there does not seem to be a clear definition or means to accomplish it currently outlined in the literature.

Systems blindness then is when organizations do not realize that they are collaborating within a framework and act independently.

A systems-based approach has been defined by this study as a recognition of the interconnected relationships existing between the established technical, economic, political and social frameworks. It is both working within and supporting this framework to operationalize a sustainable water service delivery.

A *systems-based approach* is the solution to *systems blindness*. It may seem natural to refer to the health and education sectors as ‘health systems’ and ‘education systems,’ but it is much less common to refer to the water sector as a system. Juste Nansi, Country Director for

²¹⁴ Shepard and Allison, “How Can a Trickle Become a Torrent?”

²¹⁵ Narracott, podcast “Achieving Systems as Usual in the WASH Sector.”

²¹⁶ Ibid.

IRC in Bakina Faso, discussed challenges he has seen when the WASH sector is not described in terms of a system. Nansi compared the Prime Minister of Bakina Faso's update on the assessment of the WASH sector's performance to the health and education sectors, which have been more successful in adopting a systems-based approach.²¹⁷ As the Prime Minister discussed the WASH sector, he spoke in terms of the number of hand pumps built and the number of networks installed—only discussing how many facilities had been built in the past year. The difference in his description of the health and education sectors was drastic. He spoke to much more diverse factors to include the number of hospital buildings (i.e. infrastructure), but also the number of doctors recruited, funds invested to improve how medicine could be reached in more remote locations in country, the success of vaccines, and improved access to basic medicine for everyone. Similarly, the education system consists of a wide range of factors such as school buildings, specialized teaching departments, supplies like books and computers, and principals and institutions to measure progress. Many speak of improving “health systems” and “education systems” but then only of improving “WASH facilities.”²¹⁸

Angela Huston, Programme Officer in the International and Innovation Programme of IRC, described a system-based approach in WASH as somewhere “between a philosophy and a science.”²¹⁹ She compared the sector to an ecosystem to highlight the interconnectedness between the sector actors. Essentially, the *systems-based approach* places water in the context of a system with many moving parts; water is more than just the fluid that comes out of a tap. Harold Lockwood added to this definition by describing service delivery approach as a response to the linear business-as-usual approach that has preceded over the years. He defined the approach as a reaction to what has not worked, which is when water providers assume they can “make a simple intervention, invest in infrastructure, train some people, and then the problems are solved. Years and decades have shown that a more linear approach has not resulted in sustained impact on service delivery.”²²⁰ The linear approach describes a checklist-oriented mentality where organizations come and go so quickly that they do not have time to discover their own shortcomings.

Leaders in the field have called for organizations to seek a greater understanding of what is useful at each level (water user, provider, and authority). Organizations should actively ask the stakeholders about their incentives, motives, and the challenges they face so everyone can progress forward based on common interests. When NGOs attempt to work autonomously and not within the systems approach, progress is slow and unproductive. Andy Narracott of *Finding Impact* pointed out that “no one actor can do this on its own” and a significant barrier to the WASH sector today is overcoming the “challenge to get people to work together.”²²¹ Lockwood

²¹⁷ Narracott, podcast “Achieving Systems as Usual in the WASH Sector.”

²¹⁸ Ibid.

²¹⁹ Narracott, podcast “Adopting a Systems Approach to Deliver the SDGs.”

²²⁰ Ibid.

²²¹ Ibid.

echoed this same concern when NGOs do “parallel things with not only themselves but also with governments around monitoring and planning.”²²²

If a systems-based approach is improving the relationships by looking inward to the systems, *collective action* is improving those same relationships by looking outward. IRC-WASH has defined collective action as “a facilitated approach to strengthening the coordination, trust and cooperation among a diverse set of stakeholders toward achieving a shared outcome.”²²³ Collaboration is such a challenge because the water user, provider and authority do have different priorities and expectations to meet, which at times seem to collide. Harold Lockwood, the director of the consulting firm *AguaConsult* in the United Kingdom, recognized that it is very difficult to balance this:

*NGOs work under an awful lot of external pressure. They have incentives, they have pressure to deliver certain targets, they have branding and profile issues, and the need for fundraising--which are very, very powerful. A lot of these NGOs really survive on being able to showcase what they have done, them specifically. So to give up your identity and to work in a common framework and cause runs counter to a lot of things that make NGOs keep going.*²²⁴

But he continues to say that not being able to overcome those pressures can prove harmful to the organization's ability to implement their model successfully. He refers to the lack of cooperation with all of the actors playing a role in the WASH sector as developing into “a danger that NGOs don’t realize that they are part of the system itself...they are affecting that system. Sometimes there is that lack of objectivity.”²²⁵ To prevent this danger then, organizations investing in the sector must be willing to bring a transparency and collaborative nature to the forefront. Water authorities can initiate and oversee the exchanging of ideas between groups and help monitor agreements that prioritize what is best for the water users ultimately being served.

The WASH sector has a multidimensional nature that spills into the WASH system itself. A WASH system is more than the pumps, a tap, or toilet. Moriarty describes the infrastructure as “part of a WASH system, but arguably only a small part of it.”²²⁶ He defines WASH systems as:

The people, the management, the money, the institution, the rules and practices that are all required to make that infrastructure work to deliver a service. A WASH systems approach means focusing on the service (how much water, what quality, how effectively

²²² Narracott, podcast “Adopting a Systems Approach to Deliver the SDGs.”

²²³ Annis, “Collective Action: A Change in Business as Usual.”

²²⁴ Narracott, podcast “Adopting a Systems Approach to Deliver the SDGs.”

²²⁵ Ibid.

²²⁶ Narracott, podcast “Achieving Systems as Usual in the WASH Sector.”

*is the fecal matter dealt with) and it means looking at all the different aspects of that service that are required to make that service work indefinitely.*²²⁷

Moriarty raised the critical point of how to get all of the WASH sector actors to “buy into” the concept that water service delivery revolves around more than just facilities.²²⁸ He suggests that governments, development agencies, program officers and specialists have a difficult time getting on board to advocate for this mindset and “prefer not to hear.” *Why?* Because it's much easier to point to success with quick fixes surrounding infrastructure such as building more hand pumps, wells, and facilities. Moriarty explains that the WASH sector is not used to hearing the message that organizations must invest as much into capacity building as they do the infrastructure.²²⁹

Additionally, Huston called for the need for ‘complexity thinking’ in WASH as a way of understanding the actors, factors and functions of the moving parts of a system.²³⁰ A *systems-based approach* is the means of operationalizing the service delivery approach through monitoring finance, information exchange, and the different institutions and there way of thinking. This is a difficult multi-faceted concept that demands collaboration.

Section 6: Case Study Supplying Clean Water to Île-à-Vache, Haiti

Section 6.1: An Overview of WASH History in Haiti

The government of Haiti has historically struggled and continues to struggle to meet the basic needs of its people. Challenges specific to Haiti that have made provision of goods and services difficult include drought, food insecurity/malnutrition, cholera, and lack of understanding of water sources, to name but a few.²³¹ Additionally, natural disasters have presented significant setbacks to Haiti’s development as the community is continually forced to rebuild after hurricanes and earthquakes. Droughts caused by climate change and El Niño have placed enormous pressure on resources including drinking water and agriculture. The *World Food Programme* characterized over half of the 11 million population as chronically food insecure and 22% of children chronically malnourished.²³² Food, like water, is essential to life and the development of strong communities. Haiti is ranked 168 out of 189 countries by the

²²⁷ Narracott, podcast “Achieving Systems as Usual in the WASH Sector.”

²²⁸ Ibid.

²²⁹ Ibid.

²³⁰ Narracott, podcast “Adopting a Systems Approach to Deliver the SDGs.”

²³¹ Lockwood and Le Gouais, “Service Delivery Indicators and Monitoring to Improve Sustainability of Rural Water Supplies.”

²³² World Food Programme, “WFP Haiti Country Brief.”

United Nation's Human Development Index; without access to people's most basic needs, all other advancements stagnate.²³³

Having the financial resources and ability to manage those resources over the long term is one of the greatest barriers to successful implementation of water service delivery. Haiti's gross domestic product (GDP) today represents 0.01% of the world's wealth with a total value of \$8.41 billion according to the World Bank (the Dominican Republic, which shares the island of Hispaniola, has a GDP of \$75.93 billion for comparison).²³⁴ Haiti has the lowest GDP in Latin America and the Caribbean region and one of the lowest in the world, with a GDP falling 0.7% a year from 1971 through 2013.²³⁵ In 2012, 58.5% of the population was considered to be in poverty, meaning they could not meet their basic needs, and 23.8% of the population were considered to be in extreme poverty, indicating they could not meet their food needs.²³⁶ The country struggles to collect sufficient tax revenues, but the revenues it does collect are independent of income level. Government provided water supply and sanitation services were inadequate in quantity and quality, with infrastructure assets equivalent to only 0.8% of the national GDP. Instead, the portion of the population relying on private sector water services has risen from 10.9 to 25.8% between 2006 and 2012.²³⁷

The country's low GDP and history of national disasters has sparked the interest of non-governmental organizations (NGO) to supplement the government in providing services to the country. As the central government does not have the funding or means to provide basic services, the country mainly relies on the private sector to fill the gap. Haiti has primarily adopted the NGO aid-based model as described previously in Section 4. The country has been described as a "Republic of NGOs" with nearly 80% of basic services provided by the private sector through NGOs.²³⁸ Thus, Haitians find themselves in a perilous position, relying on the continuing goodwill of NGOs to meet their basic needs. This can have detrimental effects on communities, especially when the NGOs are not accountable to the local inhabitants.

Water coverage inequality is a prominent concern in Haiti. Economic inequality, as measured by a Gini coefficient, was recorded as 60% (unequal) for Haiti, ranking the country as the highest in inequality in the region and among the most unequal in the world.²³⁹ The disparity between rural and urban coverage is staggering: as of 2010, while 85% of the urban population

²³³ World Food Programme, "WFP Haiti Country Brief."

²³⁴ "GDP." <https://tradingeconomics.com/haiti/gdp>.

²³⁵ Gelting et al., "Water, Sanitation and Hygiene in Haiti: Past, Present, and Future."

²³⁶ World Bank, "Looking Beyond Government-Led Delivery of Water Supply and Sanitation Services The Market Choices and Practices of Haiti's Most Vulnerable People."

²³⁷ Ibid.

²³⁸ Edmonds, "NGOs and the Business of Poverty in Haiti."

²³⁹ World Bank, "Looking Beyond Government-Led Delivery of Water Supply and Sanitation Services The Market Choices and Practices of Haiti's Most Vulnerable People."

had access, only 51% of the rural population did.²⁴⁰ Likewise, while 24% of the urban population had access to improved sanitation, only 10% of the rural population did.²⁴¹ Basic services lag behind for the country and the MDG to half the population without access to improved water and sanitation facilities by 2015 fell short. Reaching this goal for Haiti would require 74% coverage for improved water and 63% for improved sanitation.

Haiti has invested in improving access to clean water as far back as the 1900s. The government recognized the many challenges the country faced and invited researchers to provide assistance addressing these challenges. Poor water quality has been directly tied to almost all aspects of Haitian development, or the lack thereof, with an early report in 1900 connecting “poverty, the use of impure water, constipation, overwork, bad alimentation, the total absence of hygiene, and meteorological conditions” in Nippes, Haiti.²⁴² The “total absence of hygiene” reflected the severity of the WASH status in Haiti at this time, as deadly waterborne diseases plagued the country.²⁴³ Improved water sources were essentially nonexistent prior to initiative starting in the 1900s by the United States military.²⁴⁴ The initiatives throughout the next century unfortunately were “unsustainable infrastructure projects sponsored by foreign entities,” which has been a recurrent theme in many rural communities and is still a challenge today.²⁴⁵

Economically, Haiti has never recovered from the lasting effects of declaring independence from France in 1804 and has since struggled to thrive. Crippling debts paid back to the French (who demanded approximately \$25 billion from a country with an annual GDP less than half the amount) and sanctions imposed by the United States took Haiti 143 years to pay off, which was finally accomplished in 1947. The United States occupied Haiti from 1915-1934 which was the start of municipal water and sanitation infrastructure projects. However, the *Economist* referred to this occupation as “using virtual slave labor during a brutal military occupation.”²⁴⁶ These projects failed miserably and President Dumarsais found little to no progress had been made in the WASH sector by the late 1940s.²⁴⁷ The President invited the United Nations to observe the conditions and make recommendations for the country in 1948. The UN suggested seeking loans from the Inter-American Development Bank to facilitate growth of water services.

Progress towards providing these basic services stagnated under the rule of cruel Haitian dictators François Duvalier and his son Jean-Claude Duvalier from 1957 through 1986. The central government and their brutal enforcers controlled water access and overcharged the people

²⁴⁰ Gelting et al., “Water, Sanitation and Hygiene in Haiti: Past, Present, and Future.”

²⁴¹ Ibid.

²⁴² Behrmann, et al, "Haiti: Dysentery Prevalent in Nippes."

²⁴³ Ibid.

²⁴⁴ Gelting et al., “Water, Sanitation and Hygiene in Haiti: Past, Present, and Future.”

²⁴⁵ Ibid.

²⁴⁶ “*The Economist*. First, Do No Harm.”

²⁴⁷ Gelting et al., “Water, Sanitation and Hygiene in Haiti: Past, Present, and Future.”

for poor quality water.²⁴⁸ However, some notable developments occurred during the second half of the century through the introduction of key players still active today to include:

- Autonomous Metropolitan Potable Water Facility (CAMEP) in 1964 to provide water to Port-au-Prince.
- Pan American Health Organization (PAHO), the regional arm of the WHO Organization, provided technical assistance focused on enhancing governance and community planning related to water from 1974-1980.
- National Drinking Water Service (SNEP) provided water in urban areas from 1977.
- US Agency for International Development in 1985 funded the NGO CARE in 1985 to provide water supply systems.

The end of the 20th century still saw little improvement for the WASH sector in Haiti. The chaos and turmoil that plagued the transition from dictatorship to democracy resulted in instability and the withdrawal of foreign donor support. The efforts made by the US Agency for International Development (USAID) ultimately failed during the violence and destruction. As the country stabilized in the 2000s and the human immunodeficiency virus (HIV) began ravaging the country (most prevalent in Haiti of all the Americas), foreign assistance began to trickle back into the country. Nonetheless, Haiti still struggled to make progress in the WASH sector even past 1995, assessed to be the sole country of 161 with available sanitation data shown to have a decrease in the proportion of the population with access to improved sanitation facilities for reasons other than a population decrease.²⁴⁹ Sanitation coverage had been decreasing from the 1900 level of 26% to 17% in 2008.²⁵⁰

Change was needed, and in 2009 the Haitian parliament unanimously voted for reform of the sector. The result was the establishment of the National Service for Potable Water and Sanitation (DINEPA), which was to act as the central regulating authority for all WASH programs. DINEPA integrated the previously-established initiatives of CAMEP and SNEP and sought to manage the development of the sector. Previously, the government agencies had been over-spending their budgets and providing water of questionable quality, which DINEPA aimed to address by adding oversight of sanitation to its responsibilities. The directorate is part of the national Ministry of Public Works, Transport and Communications, which as of 2015 accounted for less than 1.5% of the annual budget.²⁵¹ During DINEPA's first three years of establishment, the agency secured nearly \$300 million for an action plan focused on overcoming institutional reform, more sustainable operations, and obtaining investment in further infrastructure. DINEPA

²⁴⁸ Gelting et al., "Water, Sanitation and Hygiene in Haiti: Past, Present, and Future."

²⁴⁹ Ibid.

²⁵⁰ Ibid.

²⁵¹ The World Bank Group, "Open Budgets Portal."

had a promising start but did not have the funds or the capabilities of meeting the MDG targets in achieving greater coverage by 2015.²⁵²

DINEPA's organizational structure outlined in the Framework Law of 2009 decentralized water provision to OREPAs and CAEPAs. Municipal water systems are overseen by one of four Regional Offices for Drinking Water and Sanitation (OREPAs), which are the national water service providers. Each OREPA is responsible for one of four major sections of the country, labeled in Figure 14 as the Nord (North) in blue, Centre (Center) in orange, Ouest (West) in green, Sud (South) in pink. Unfortunately, the OREPAs barely can cover operating costs and there are insufficient reserves saved for maintenance. On a more local level, hundreds of Drinking Water Supply and Sanitation Committees (CAEPAs) registered by DINEPA provide services by collecting revenue, hiring plumbers for maintenance, monitor bank accounts, interact with the community, and meet regularly. But these water committees have fallen short in meeting these expectations.²⁵³

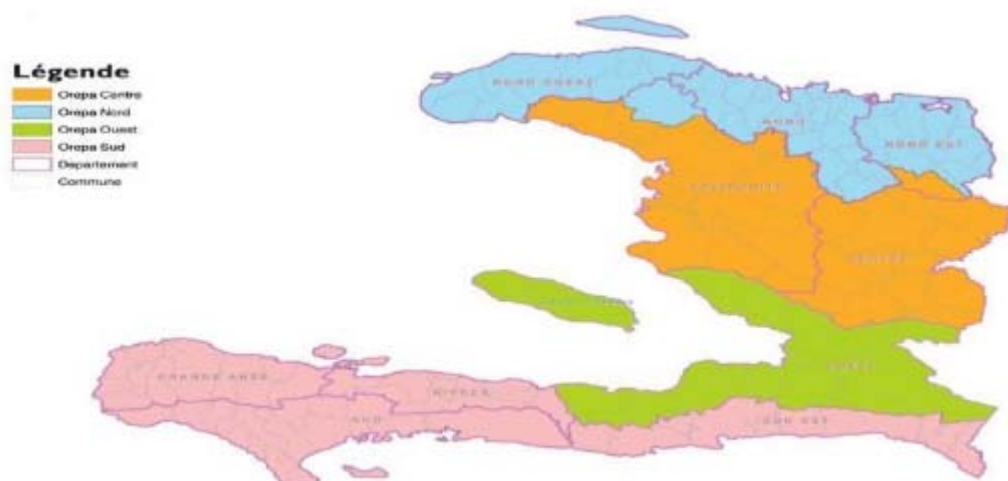


Figure 14: Four OREPAs of the country: the North (center), Center (orange), West (green), and South (pink).²⁵⁴

DINEPA as a whole has not succeeded in providing water as a public good. A largely unfunded mandate, to this day the central government lacks the capacity to provide water as a public service and is seeking assistance from local leaders and external collaborators to help provide oversight.^{255,256} DINEPA created a comprehensive technical guide to assist operation and maintenance of infrastructure (le Référentiel Technique), but did not translate it in Creole for local level training. DINEPA created a performance monitoring system yet does not remediate reported problems, lacks the funds to properly monitor water quality through the SIS-KLOR

²⁵² Gelting et al., “Water, Sanitation and Hygiene in Haiti: Past, Present, and Future.”

²⁵³ Widmer et al., “VisiEAU A Vision for Water in Haiti.”

²⁵⁴ Cathala, “Water and Sanitation in Haiti.”

²⁵⁵ Gelting et al., “Water, Sanitation and Hygiene in Haiti: Past, Present, and Future.”

²⁵⁶ *Haiti: Country Study Guide*.

system, and rarely reaches rural areas.²⁵⁷ Services charge tariffs are flat rates that vary widely throughout Haiti depending on location and provider, which have varied from \$1 per person per month in small towns to \$7.30 per person per month as of 2008.²⁵⁸ Metering is available in Port-au-Prince but largely absent outside the capital. Since there are no legal enforcements established to enforce payment, water is sometimes cut off but water users often reconnect illegally.²⁵⁹

There are no national, departmental, or municipal water committees. Many NGOs have sought to assist with water provision and meet the need for water services, including Haitian Association for the Control of Water and Soils (ASSODLO) (Haitian), World Vision (US), Water Project for Haiti (Canada), CARE (US), Sustainable Organic Integrated Livelihoods (SOIL) (US), Helvetas (Swiss), Inter Aide (French), and many more.²⁶⁰ There are over 50 NGOs and 8 ministries, shown in Table 9, presently active in the WASH sector.²⁶¹ However, there appears to be little coordination of these many organizations at the government level and even less among the organizations themselves.

Table 9: Institutions Participating in Water Governance in Haiti.²⁶²

National Government Department	Description
Ministry of Public Works, Transportation and Communications (MTPTC)	Ensures the study, planning, execution, maintenance, control, supervision and evaluation of all physical infrastructure related to drinking water services.
National Service for Potable Water and Sanitation (DINEPA)	A directorate of MTPTC, DINEPA serves as the main entity responsible for potable water and sanitation, oversees implementation of regulation of public service providers.
Ministry of Planning and External Cooperation (MPCE)	Responsible for development and implementation of a national planning policy, which includes the water sector.
Ministry of Commerce (MCI)	Regulates the quality of treated and packaged water for sale on the market to protect consumers.
Ministry of the Environment (MDE)	Provides coordination, support, supervision, and legislation for quality control of water; also administers educational training programs.

²⁵⁷ Lockwood and Butterworth, “Global Study On Sustainable Service Delivery Models For Rural Water: Country Brief Haiti.”

²⁵⁸ *Haiti: Country Study Guide*.

²⁵⁹ *Ibid.*

²⁶⁰ *Ibid.*

²⁶¹ Widmer et al., “VisiEAU A Vision for Water in Haiti.”

²⁶² Casey, “Community Management for Improved Sustainability: Case Studies of Three Rural Community Water Supply and Sanitation Projects in Honduras.”

Ministry of Agriculture, Natural Resources, and Rural Development (MARNDR)	Responsible for irrigation infrastructure, flood and drought-alert systems, weather forecasts, and management of hydro-meteorological data.
Ministry of Public Health and Population (MSPP)	Administers the quality of water and health-related diseases caused by water; responsible for basic sanitation.
Ministry of National Education (MENFP)	Responsible for promoting quality water for human consumption.
Ministry of Interior and Territorial Communities (MICT)	Provides guidance to mayors responsible for sanitation and road works.

Many of these Ministries; however, fall short in their responsibilities over the WASH sector. The Ministry of Environment has not fulfilled its obligations in maintaining information on water resources nor regulating water abstraction.²⁶³ The Ministry of Health is not monitoring drinking water quality despite the cholera epidemic.²⁶⁴ No ministry is managing land tenure, which has presented “one of the biggest roadblocks to investing and rebuilding in Haiti.”²⁶⁵ Public policy regarding land is only weakly managed by the Office of National Cadastre, the General Tax Office, and the Ministry of Justice, all which lack the resources and capacity to ensure land security. The ministries themselves are not collaborating nor have any incentives to cooperate, instead competing for donor funding.²⁶⁶

The relevance of this history to the WASH sector in Haiti is hugely important to understanding the contextual challenges of the island. Sustainability is at the heart of the problem in Haiti and demands that significant improvements be made to developing infrastructure and business models that can last in the long term. DINEPA as a regulating authority lacks the capacity to provide resources and support and instead often acts as a barrier to accomplishing action.²⁶⁷ Haiti is also highly reliant on donor financing, which makes the WASH sector highly vulnerable to the demands and resources of these funders. There is a reoccurring trend in Haiti that as time goes on functionality quickly declines until the next donation comes in, depicted in Figure 15. Given the longstanding history of insufficient and misguided foreign aid in Haiti, it is perhaps not surprising then that Haitians are hesitant to welcome foreign intervention.

²⁶³ Lockwood and Butterworth, “Global Study On Sustainable Service Delivery Models For Rural Water: Country Brief Haiti.”

²⁶⁴ Ibid.

²⁶⁵ Haiti Property Law Working Group, “A How-to Guide for the Legal Sale of Property in Haiti.”

²⁶⁶ Lockwood and Butterworth, “Global Study On Sustainable Service Delivery Models For Rural Water: Country Brief Haiti.”

²⁶⁷ Gelting et al., “Water, Sanitation and Hygiene in Haiti: Past, Present, and Future.”

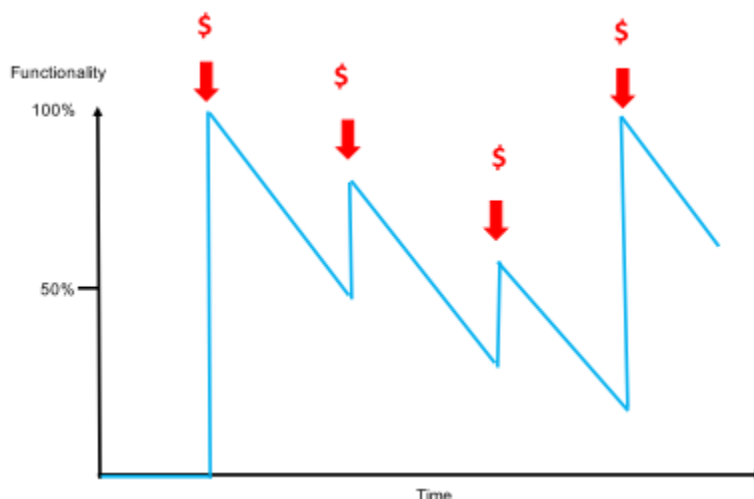


Figure 15: Functionality in Haiti over time, demonstrating reliance on external aid.²⁶⁸

Just a year after the establishment of DINEPA, the 2010 earthquake struck Haiti which quickly transformed all development efforts into emergency response efforts. Unfortunately, the United Nations unintentionally introduced cholera to Haiti during the recovery period after the earthquake. The cholera strain was discovered to have originated from the Nepalese peace keepers.²⁶⁹ The United Nations was sued for billions of dollars by the Haitian government for the devastation resulting in over 650,000 cases and nearly 9,000 deaths, yet the lawsuit was largely dismissed in court and the United Nations was given immunity.

In response to the devastation caused by the earthquake, Haiti has several significant documents governing the country's path forward towards development in line with the UN Sustainable Development Goals. Haiti devised the national Action Plan for the Recovery and Development of Haiti (PARDH). This document outlined Haiti's needs from the international community. Specifically for water, Haiti called for an "inter-sectoral approach" for the water sector to be "safe and productive in a sustainable way." The government recognized the need for progress to be made through increased hygienic practices, better waste disposal, affordable services, socially adapted technology, and strengthening of financial autonomy. The budget requested for the 18 months after the earthquake reflected the need for sustainable measures as opposed to short-term emergency procedures. Specifically, the budget allotted for \$80 million towards providing potable water, with half saved for budging support and another \$50 million for disposal sites, of which \$10 million were saved for budgeting support. Furthermore, \$30 million were allotted to strengthening institutions.²⁷⁰ This document marks significant change in the funding mechanisms of the country as compared to the 20th century. The national tragedy

²⁶⁸ Lockwood and Butterworth, "Global Study On Sustainable Service Delivery Models For Rural Water: Country Brief Haiti."

²⁶⁹ Katz, "U.N. Admits Role in Cholera Epidemic in Haiti."

²⁷⁰ Government of the Republic of Haiti, "Action Plan for National Recovery and Development of Haiti."

caused by the 2010 earthquake demanded the need for “structural changes” so the country could gain the independence needed to provide the quality of life and prosperity of its people.²⁷¹

That same year, the Haiti Reconstruction Fund (HRF) was established to manage the international support and contributions flowing to the government of Haiti. The primary donors leading the contributions included the Inter-American Development Bank, the United Nations and the World Bank. The Haitian government requested the International Development Association (IDA) of the World Bank Group serve as Trustee for the Fund and manage the donations in accordance with the PARDH. The multi-donor approach provides collaboration, reduces transaction costs for the government and donors by working through a single funding facility, and allows better exchange of lessons learned.²⁷² The Steering Committee oversees all activities of the trust funds and includes two representatives from the Haitian government, a representative of each donor member (which requires a minimum contribution of \$30 million to be a member represented on the Steering Committee), a representative of each partner entity and a representative of the Trustee.²⁷³ The Haitian Reconstruction Fund unfortunately had a five year lifespan and dissolved in 2017. There are still donors active in Haiti but no known international efforts on the level of the Haitian Reconstruction Fund to manage the flow of aid.

The Ministry of Planning and Cooperation External (MPCE) led the initiative for Haiti’s Strategic Development Plan (PSDH) released in 2012, which has the purpose of establishing Haiti as an emerging country and economy by 2030. It provides guidance meant for all scales of development from the local to regional level and calls for “strong and sustainable” economic growth through well-developed, decentralized management. There is one single information system used meant to manage and evaluate actions undertaken and monitor progress, known as BOOST, which helps to streamline data collection. By 2015, the World Bank and Inter-American Bank had dedicated a total of \$31.58 million in funding to the water sector, but this was not enough.²⁷⁴ It has been estimated that the investment required to meet the country’s water needs will amount to approximately \$580 million.²⁷⁵ In 2016, disaster struck again with Hurricane Matthew, resulting in a death toll of over 500 people. Further damage was done to already vulnerable infrastructure and the country was forced to rebuild once again. The country needed renewed efforts on resilient infrastructure.

The first private venture to sell water for profit in Haiti was *dloHaiti*, the sister company of CEO Jim Chu’s *Untapped*. The firm raised \$3.4 million to invest in solar-power high-tech water purification systems for urban areas around Port-au-Prince. The firm has been successful thus far and interviews with Jim Chu indicated that their market based approach was sustainable

²⁷¹ Government of the Republic of Haiti, “Action Plan for National Recovery and Development of Haiti.”

²⁷² Haiti Reconstruction Fund, “About the HRF.”

²⁷³ Haiti Reconstruction Fund, “Governance Document for Haiti Reconstruction Fund.”

²⁷⁴ The World Bank Group, “Haiti Reconstruction Fund.”

²⁷⁵ Cathala, “Water and Sanitation in Haiti.”

for the country. Chu even indicated that there is potential for similar private ventures on the island of Île-à-Vache at the primary market, Madame Bernard. For the entire island to be serviced; however, an NGO community-based approach with aid support has greater potential to meet the needs of *all* inhabitants, and is thus assumed as the approach that will be adopted on Île-à-Vache.

Several major donors have aimed to provide this philanthropy in Haiti within the framework of the country's Strategic Plan for the Development of Haiti 2012-2030. All donors directly involved in WASH have been listed in Table 10 along with their annual budgets.

Table 10: List of major donors active in Haiti WASH development.²⁷⁶AI

Donor	Budget
Inter-American Development Bank (IDB)	\$300 million (2017), \$1 billion (2017-2022)
World Bank	\$736 million (2016-2019)
European Union	\$448 million (2016-2020)
Spanish Agency for International Development Cooperation (AECID)	\$137 million (2013-2019)
Swiss Agency for Cooperation (SDC)	\$18 million 2017, \$70-100 million (2018-2023)
Japan International Cooperation Agency (JICA)	\$18 million annually

The primary funding sources for national-scale water projects specifically in rural Haiti have come from the Inter-American Development Bank and the Spanish Agency for International Development Cooperation. Rotary International has recently undertaken a huge initiative to provide water to all of Haiti, adopting an ambitious and country-wide approach. It will rely on two, already established programs to achieve this goal: Haiti Outreach, spearheaded by Rotary International, and Haiti National Clean Water, Sanitation and Health Strategy (HANWASH) initiated by Rotary District 7020 in the Cayman Islands. Both advocate strongly for working through DINEPA as well as with all other partners active in the sector. They refer to water services as being much more than infrastructure and speak to other service components such as hydrology reports and business models. Their strategies are also long term and intentionally aligned with SDG timeline for 2030. There are no short-term or independent programs being pursued. And thirdly, all are determined to make this a community-led initiative that is in collaboration with other sector actors. There is certainly great potential in these strategies, which will be elaborated below in Section 6.3 for the specific recommendations.

The Haitian government has prioritized many of the same concepts discussed in Section 5, yet many are not the reality in the country to this day. The *United Nations* and Haiti declared the five priorities for Haiti as governance, resilience, poverty reduction, social services, and gender quality and protection in the Development Assistance Framework 2017-2021 (UNDAF)

²⁷⁶ USAID, "Usaid/Haiti Stategic Framework 2018-2020."

under the umbrella of Haiti’s Strategic Development Plan. The 2018-2010 *USAID*-backed strategic framework for Haiti identified the four greatest priorities for the country’s development as governance, resilience, economic growth, and local solutions. Governance was declared currently an “impediment to growth” needing improvement as a “key driver of future scenarios.”²⁷⁷ But external assistance provided to Haiti has fallen short in enhancing these priorities and they remain ongoing obstacles for the national government to overcome. Section 6.3 delivers recommendations for how to address these challenges. But first, the current conditions in Île-à-Vache will be explored in Section 6.2 to develop the background for the recommendations.

Section 6.2: Current WASH conditions in Île-à-Vache

During an interview with the island magistrate, Amazan Jean-Yves identified water security as his top priority. Clean water and access is critical to nearly all of the other aspects of community development. A healthier community is more productive--there is more time for education, employment, and community growth. As communities have more time for education and pursuing professional development, their capacity and willingness to support a water service can increase as well. The best, publicly-available information on Île-à-Vache is contained in a 2013 report produced by an organization called *Architecture for Humanity*, funded by a grant from the Kellogg Foundation. The report is the product of a rigorous, two-year study of the island and includes a comprehensive description of the island, including its geography, hydrology, demography, economy, and political structure, as well as a variety of other topic areas. Pertinent details are summarized here, with the intent of informing the recommendations that follow.

Île-à-Vache is a small island located south of the main island of Haiti, about 6.5 miles from the port of Les Cayes. The island, labeled in Figure 16, is accessed primarily by boat from several ports on the main island and in very limited instances by air.

²⁷⁷ USAID, “Usaid/Haiti Stategic Framework 2018-2020.”



Figure 16: Île-à-Vache is the small island off the southern coast circled in red. ²⁷⁸

The island is approximately 8 miles long and 2 miles wide with a total area of 4601 hectares, equivalent to 17.8 square miles. The island lacks basic services and infrastructure to include electricity, water, sanitation, waste management or improved roads. The terrain is hilly with the highest point on the island reaching 492 feet (150 m) above sea level in the western end of the island. The northeastern portion of the island is covered by uninhabitable mangrove swamps and the central portion by soil used for agriculture ²⁷⁹. The first known land map of the terrain was conducted in 2013 and is depicted in Figure 17.

²⁷⁸ Wikipedia, “Île-à-Vache.”

²⁷⁹ Good Samaritan, “Ile a Vache.”

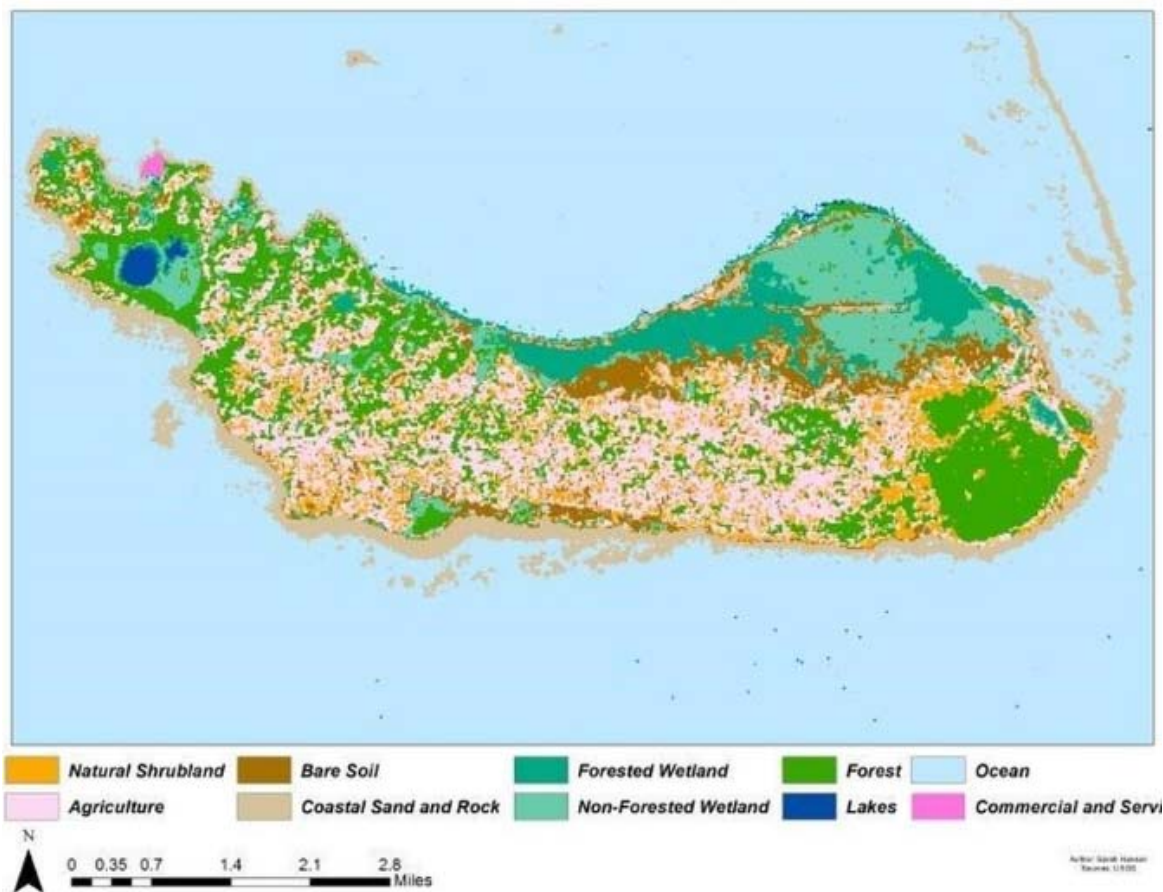


Figure 17: Land terrain map of Île-à-Vache.²⁸⁰

The topography has been mapped and is shown in Figure 18, depicting the flat northeastern portion of the island and hilly northwestern portion.

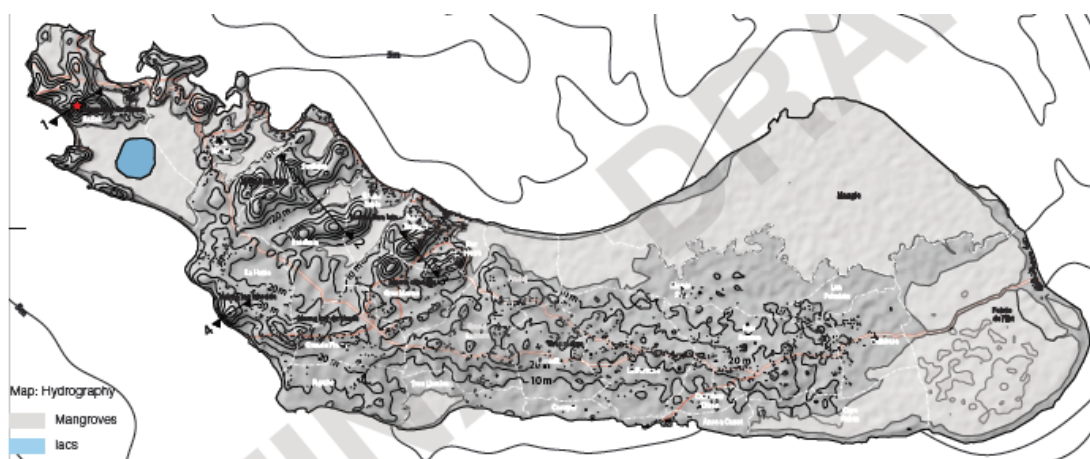


Figure 18: Topography of the island.²⁸¹

²⁸⁰ Serra et al., “Île à Vache Technical and Participatory Diagnostic Architecture (Final Draft).”

²⁸¹ Ibid.

The steepness of the hills will affect the walking distance range from households to the water points. More water points will be needed in the steepest areas to account for the added difficulty in walking, indicating ranges should be limited closer to the lower end of the WHO recommended range for 0.25 miles. Figure 19 maps the steepness of the hills below in terms of the percentage of the slope.

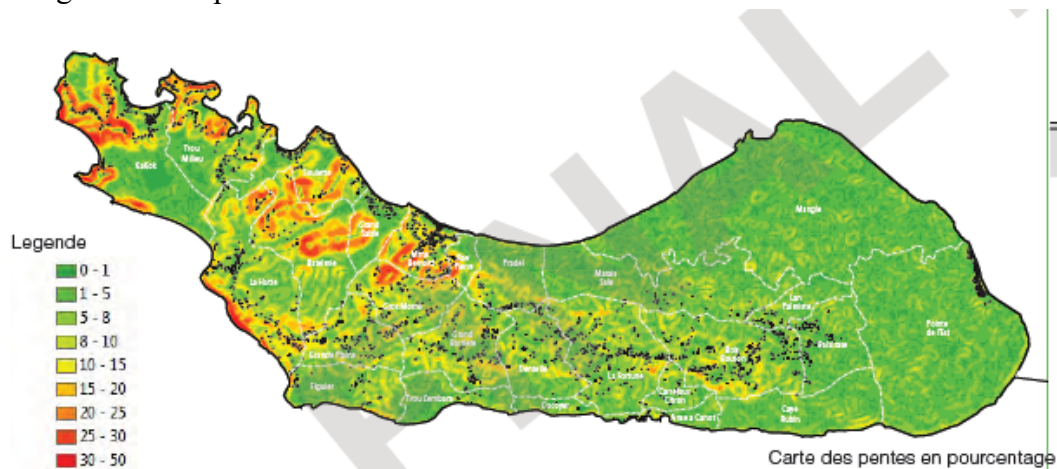


Figure 19: Map of the slope percentage of hills.²⁸²

The Office of Mines and Energy of the Republic of Haiti determined the soil of the island is formed mainly by sedimentary rock. Environmental hazards primarily include the risk of droughts, erosion, and fires. Sedimentary rocks can be drilled through using manual techniques, which include hand auger, sludging, percussion, and jetting drilling methods that are well documented.^{283,284,285}

According to a 2012 census, Île-à-Vache houses 14,695 residents on the island year round, but that number may swell by 1,000 people during certain times of the year. Families are distributed among 2,683 households, with an average number of 5.47 people per household.²⁸⁶ Unfortunately, land assets are not formally documented and have caused disputes over ownership rights even amongst households.

Figure 20 depicts the population distribution in persons per hectares below, indicating the effects of the terrain below.

²⁸² Serra et al., “Île à Vache Technical and Participatory Diagnostic Architecture (Final Draft).”

²⁸³ Vita, “Manual Drilling Techniques.”

²⁸⁴ Bowman, “Well-Drilling Methods.”

²⁸⁵ Navy, Army, and Force, “Water-Well Drilling Operations.”

²⁸⁶ Serra et al., “Île à Vache Technical and Participatory Diagnostic Architecture (Final Draft).”

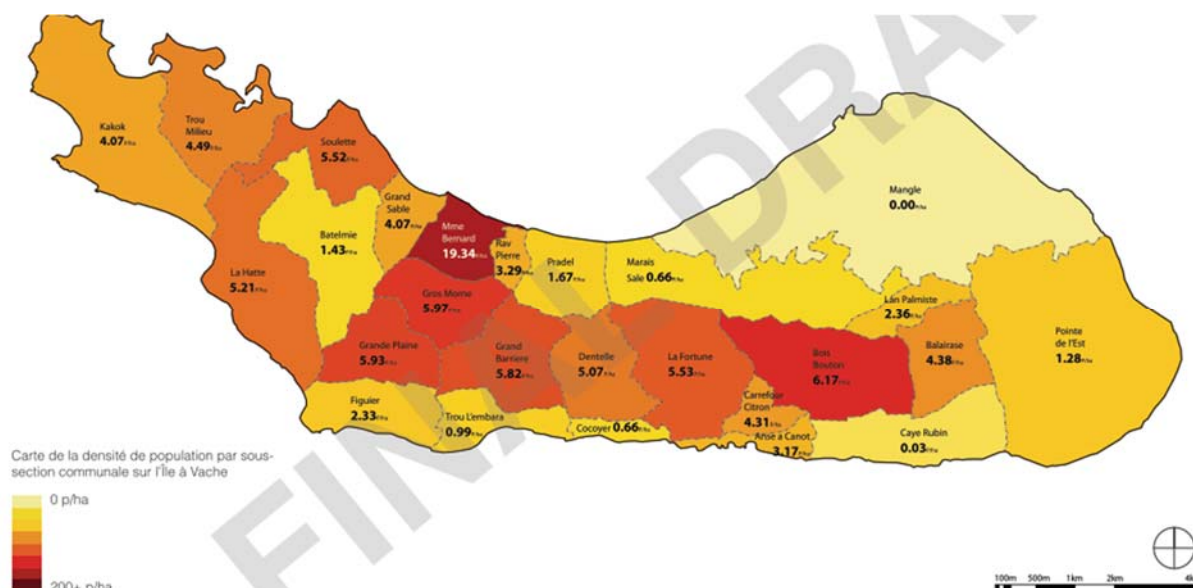


Figure 20: Image of population distribution on the island.²⁸⁷

Populations are denser in the hilly west and southeast portion of the island, and also near the main port of the island, Madame Bernard. The ten most populated communities and their densities are recorded in Table 11.

Table 11: Population densities of the largest communities.²⁸⁸

Community	Households	People	% of Population	Area (hectares)	Density (population/hectares)
Madame Bernard	300	1644	10.4%	85	1934
Bois Bouton	260	1425	9.0%	231	617
La Hatté	229	1255	7.9%	241	521
Kakok	227	1244	7.8%	306	407
La Fortune	226	1238	7.8%	224	553
Trou Milieu	154	844	5.3%	188	4.49
Pointe de l'Est	133	729	4.6%	568	128
Grand Plaine	133	729	4.6%	123	593
Soulette	129	707	4.5%	128	552
Gros Morne	122	669	4.2%	112	597

The houses tend to cluster around areas that are easily accessible from routes on the island and in flatter areas, as shown in Figure 21.

²⁸⁷ Serra et al., "Île à Vache Technical and Participatory Diagnostic Architecture (Final Draft)."

²⁸⁸ Ibid.

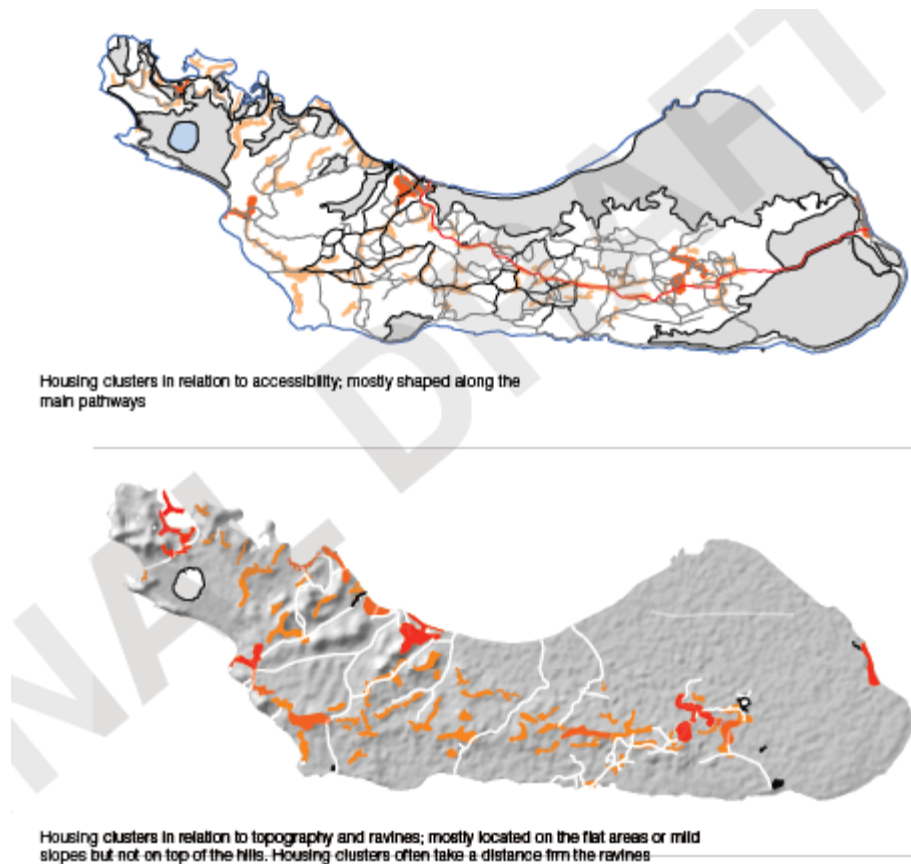


Figure 21: Housing clusters around the most accessible, flattest areas.²⁸⁹

Madame Bernard is the most densely populated community with nearly 3,000 residents. Residents outside of Madame Bernard still regularly travel to the port for the island's main market. The market, shown in Figure 22, opens twice a week and provides the primary means for goods to be bought and sold. Food, clothes, electronics, cosmetics, alcohol, and miscellaneous household goods are sold in the market.



Figure 22: Image of the Madame Bernard market.²⁹⁰

²⁸⁹ Serra et al., "Île à Vache Technical and Participatory Diagnostic Architecture (Final Draft)."

²⁹⁰ Ibid.

The shops are set up densely along the coast line as shown in Figure 233 and are directly next to the mayor's office. As the market expands, there is potential for water providers to set up and sell to large masses of the population.

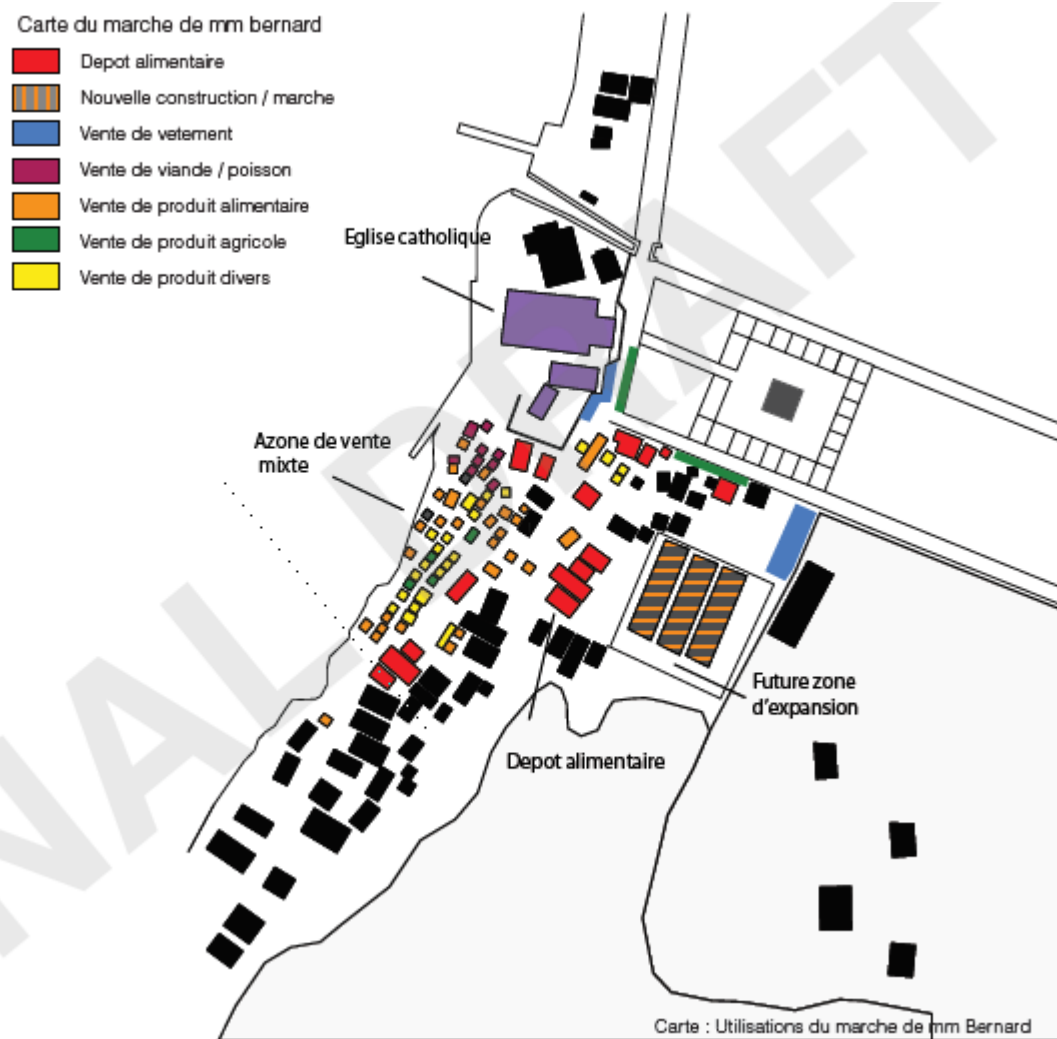


Figure 23: Shops line the coast of Madame Bernard to sell goods.²⁹¹

The main modes of transportation around the island are on foot, motorbikes, donkeys and horses, and boats, shown in Figure 24. Travel is regularly conducted on foot and on motorbikes to Madame Bernard and is no further than 4 miles from any community, resulting in approximate one-way travel times of 2 hours. Traversing the island on foot takes the majority of the day, even for adults in good health. This is the main avenue for exports to reach the island from boats from the mainland. On the island, goods can be transported via donkey or horse as well as boats around the island. The majority of roads on the islands are widened foot paths, though there is a

²⁹¹ Serra et al., "Île à Vache Technical and Participatory Diagnostic Architecture (Final Draft)."

future, tourism is increasingly becoming a focus for economic development for the island. The rise of tourist hotels and plans for an airstrip show the commitment to attracting and accommodating tourists. Ensuring there is a reliable guarantee of clean water is a critical factor the success of that plan.

The political structure of the island consists of the municipal council, the consultative committee, the Community Platform, and stakeholders, shown below in Figure 26. The central government has limited influence on the island, but DINEPA has been present. The municipal council is comprised of the mayor and his two deputy mayors, which serve as the executive officials of the island. They rotate with four year terms. The Advisory Committee was established in 2012 and is comprised of nine advisors representative of territorial communities, executive committee of the Community Platform, representatives of local organizations active on the island, representatives of international actors hoping to invest, and deconcentrated state services. They incorporate input from a diverse group of sources from religious organizations, female led groups, and NGOs dedicated to developing the island.

The Community Platform was also established in 2012 and is comprised of 26 members representing larger localities, democratically elected. The Community Platform serves as the interface between the Town Hall and Advisory Committee to help bridge communication between the local population, elected officials, and stakeholders. The success of this platform is essential to the cohesion of community development and buy in, and can provide all parties a voice. The Stakeholders include resort hotels, namely Abaca Bay and Port Morgan, tourism associations such as the Ministry of Tourism, and actors engaged in water services such as the Ministry of Public Works, Ministry of Planning and External Cooperation (MPCE), Society of Planning Development (SODADE), and Haven.

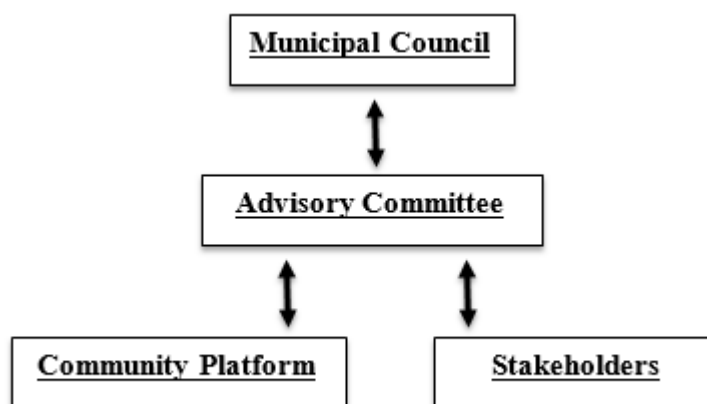


Figure 26: Community governance relationships.

The Community Resource Center, located on Madame Bernard, was established in 2013 as a meeting place for all above to gather. Community members, elected officials, and national and international organizations are meant to gather here to exchange information and raise greater awareness of development actions occurring on the island.

The most current hydrology study is limited. It found no permanent rivers on the island, with the only permanent source being the large lake located on the western portion of the island covering just over 1% of the territory. There are also small streams from the sea that are relatively small and vary based on tides and rainfall. The streams are brackish, which makes the purification process more technologically and economically advanced since there are greater energy requirements to remove the salt. These streams also make the coast of the island very vulnerable to flooding, such as near Madame Bernard at its low elevation.

The people currently living on the island have limited access to wells, but many are contaminated and/or require maintenance, leaving an estimated 15% of the population with a reliable, safe drinking water source. Wells are largely managed by the community but without strong regulation, raising concerns over quality assurance for safe water. An estimated 30% are functioning and none would be considered of quality for drinking according to accepted global health standards.²⁹⁶ WHO standards recommend walking distances do not exceed 1000 meters (varying with topography) to water points to meet customer expectations. However, the topography in Île-à-Vache is particularly difficult with steep hills, especially in the western, more populated area of the island.²⁹⁷ Currently, people are expected to walk between 20 to 40 minutes to reach a water point, which can be improved upon with a well-planned network of sites selected.²⁹⁸ Pictured in Figure 27 is the water demand based on population density for the island.

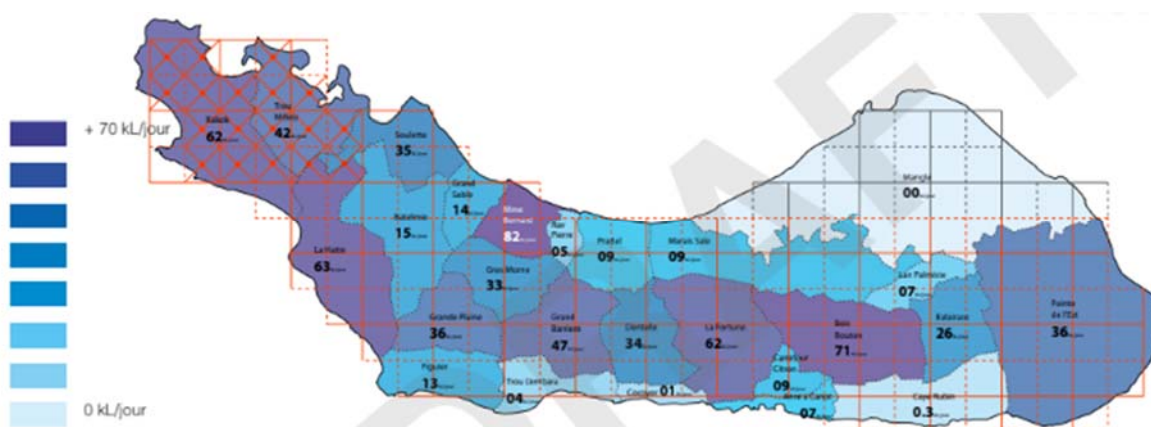


Figure 27: Image of water demand across the island.²⁹⁹

²⁹⁶ Serra et al., “Île à Vache Technical and Participatory Diagnostic Architecture (Final Draft).”

297 Ibid.

298 Ibid.

299 Ibid.

There are wells and pumps in place across the island helping to meet some of these needs. Table 12 below identifies the primary sources used for water consumption and their current statuses on the island:

Table 12: Water inventory of the island.³⁰⁰

Water Point	Description
Wells	Primary source, built from rock and mortar, contaminated
Pumps	Installed above well to prevent contamination
Naturally occurring water holes	Too brackish
Reinforced water holes	Can be used for laundry/household work
Hard ground dug well	Low quality, low-density areas for breeding
Reservoirs and cisterns	Collect and store rainwater

Images of wells, pumps and waterholes found on the island are shown in Figure 28.



Figure 28: Images of water points used on the island.³⁰¹

³⁰⁰ Serra et al., “Île à Vache Technical and Participatory Diagnostic Architecture (Final Draft).”

³⁰¹ Ibid.

Wells and pumps are the most promising sources for water to ensure quality and minimize potential for contamination. Naturally occurring water holes on the island are not a safe source of water because they are too brackish. The reinforced water holes lack the quality necessary for drinking, but have utility for laundry and household work. Hard ground dug wells also have a low quality and are typically only used in low-density areas for breeding.

Many people currently rely on a self-supply water source for their drinking water. Rain water is collected and stored in reservoirs and cisterns, but they too, are at risk of contamination going uncleaned and holding stagnant water. An image of wells and pumps established across the island are shown in Figure 29.

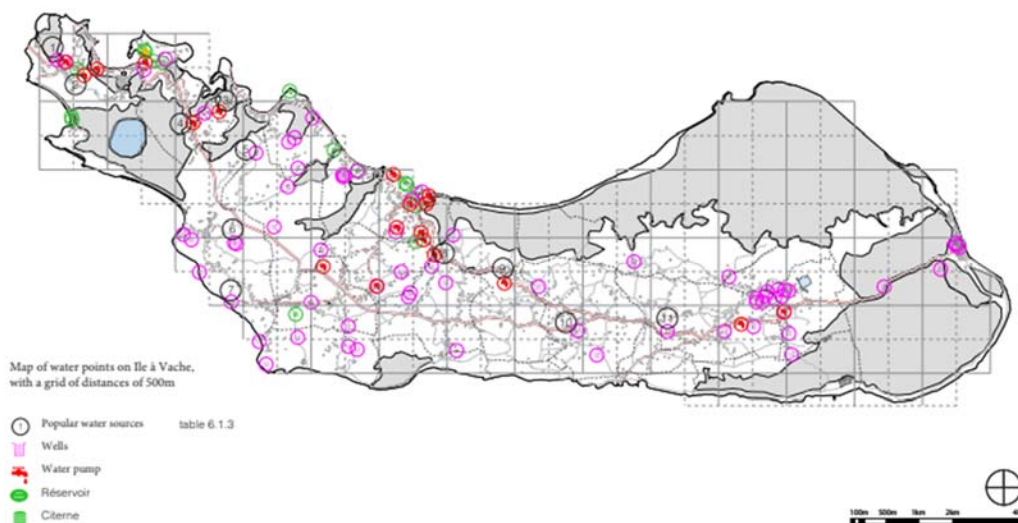


Figure 29: Wells and pumps established on the island.³⁰²

Unfortunately, even with attempts to provide quality with pumps and wells, basic standards are still not being met. The quality of all of the wells and pumps fail to meet basic health requirements: of the seven tested, five tested positive for either Coliform or E-coli or both. The inventory assessment is shown in Table 33.

³⁰² Serra et al., “Île à Vache Technical and Participatory Diagnostic Architecture (Final Draft).”

Table 33: Inventory assessment of eleven pumps and wells on the island.³⁰³

No	Place	GPS N degree	Decimal minute	GPS W degree	Decimal minute	Active	Status	Description	Ph	Salinity	Coliform	E. Coli	Observed use
01	Kakok well	18	6.181	73	42.235	Active	Broken pump	At base of a hill, exposed to water runoff	7	0	Positive	Negative	Drinking, cooking, bathing and washing
02	Kakok pump	18	6.052	73	42.012	Active	Recently repaired pump	On a path sloping downhill. Exposed to runoff.	7	0	Positive	Positive	Primarily drinking
03	Trou Millieu Pump	18	5.746	73	40.893	Active	Plans for erosion control	Exposed to runoff and erosion.	7	0	Negative	Negative	Drinking, cooking, bathing and washing
04	Trou Millieu "Broken" Pump	18	5.602	73	41.058	Active	Broken or dry. Recently fixed.	Located on farmland.	7	0	Negative	Negative	Washing
05	Camila Well	18	5.432	73	40.571	Active	Large open well near broken pump	Remote location near pathways. Used by Camila, Soulet, Trou Millieu, Grande Sable and other small villages.	7	0	Positive	Negative	Drinking, cooking, bathing and washing
06	La Hatte Well	18	4.704	73	40.751	Inactive	Out of use	Located near School National. Water dark color with trash.	N/a	N/a	N/a	N/a	N/a
07	La Seoce Well	18	4.239	73	40.795	Active	Open well	Located around farms and sloping hills from the south.	N/a	N/a	N/a	N/a	N/a
08	Pradel Pump 1	N/a	N/a	N/a	N/a	Active	Hand pump	Near main road from Mme. Bernard and Pradel. Low lying, flood hazard.	7	0	Positive	Positive	Drinking, bathing and washing clothes
09	Pradel Pump 2	18	4.372	73	38.515	Active	Hand pump	Remote Pradel.	N/a	N/a	N/a	N/a	N/a
10	La Fortune Well	18	3.990	73	37.907	Active	Large open well near broken pump	Cleaned with chlorine.	N/a	N/a	Positive	Positive	Drinking, cooking, bathing and washing
11	K-Fou Citron Well	18	3.979	73	37.159	Active	N/a	N/a	N/a	N/a	N/a	N/a	N/a

Information taken from: Massachusetts Maritime Academy, Emergency Management Program, (2011-2012), Emergency Management Assessment Île-à-Vache, Haiti.

In addition to the threat of bacterial contaminants, the descriptions also note risk of water runoff and erosion from hills, waste from proximity to farmlands, flooding threats, and trash compiling. More specifically in regards to the understanding of water availability is the lack of understanding in how to manage the water resources. Without a waste management system, contamination from human and household waste is a significant concern. It would be necessary to place restrictions on the proximity of potential contamination sites to the water sources. Education on protecting water sources is limited, thus there is a notable gap linking the health hazards of unimproved water sources to waterborne diseases. Hundreds of thousands have died in Haiti especially following natural disasters as dehydration worsens the treatability of the waterborne disease. The country is not well equipped to handle the aftermath of natural disasters in devising emergency action plans to maintain access to drinking water. Île-à-Vache, with only 15% of the population currently with access, has even greater difficulty maintaining as the mayor still fights to provide a reliable source on an everyday basis.

The status of the wells and pumps indicate there is significant challenges to the maintenance of these systems. The wells and pumps often were implemented with more short-term focuses in mind, and hence like any foundation of sustainability. More often, the functionality is so poor that organizations find it more economical to rebuild wells rather than fix the ones already in place. This highlights an opportunity for an entirely reinvigorated business model to operate in which a new network of wells and pumps can be built with sustainability in mind from the start.

Section 6.3: Specific Recommendations

These considerations and observations have been compiled into recommendations for the mayor of the island of Île-à-Vache. Many organizations active in Haiti today look for community

³⁰³ Serra et al., "Île à Vache Technical and Participatory Diagnostic Architecture (Final Draft)."

initiative, and thus it is recommended that the mayor both spearhead the service provision and direct collaboration amongst partners. The general recommendations synthesized in the results of Section 5 called for a service that is sustainable and in collaboration with the local context. The recommendations below are addressed within the format of the service components discussed in the first results section, Section 5.2, and infuse principals of sustainability (Section 5.3) and systems-based approaches (Section 5.4) throughout.

Section 6.3.1: Hydrology Report

A skilled hydrologist should be hired to conduct a survey for the entire island, analyze the data, and synthesize information on the water supply available. The most current hydrology report from *Architecture of Humanity* provided a general overview of the watersheds but lacks sufficient detail on the water quantity, quality, and seasonal changes. There are already records of the geology (sediments) and the water points available will be discussed in the inventory assessment. Water conservation has been a concern throughout the country of Haiti and so it is important to know the supply available on the island. As tourism expands, measures will likely need to be taken to protect the local water supply for the inhabitants. The mayor may request that foreign enterprises seeking engaged in tourism on the island provide their own water externally. This may be through desalination of the ocean water or importing water from the mainland, so long as it does not threaten the local supply. The quality is also important to assess much more thoroughly since the inventory assessment conducted in 2012 indicated high prevalence of water contaminants. To provide a high quality service, these contaminants must be closely monitored to provide guarantee on the purification process. Any seasonal changes, including weather patterns and tidal changes, are important to be aware of to ensure systems are adequately designed for the environment.

Having a cohesive system for the entire country would be useful for enhancing DINEPAs capabilities to monitor and regulate the sector. One organization, *mWater*, hopes to do just that. *mWater* has already begun recording water services in Haiti as shown in Figure 30. The organization plans to implement a full country approach so would be an ideal partner to map out Île-à-Vache. The Terms of Service are listed as a reference and can be consulted for future partnership.³⁰⁴

³⁰⁴ mWater, “mWater Terms of Service.”

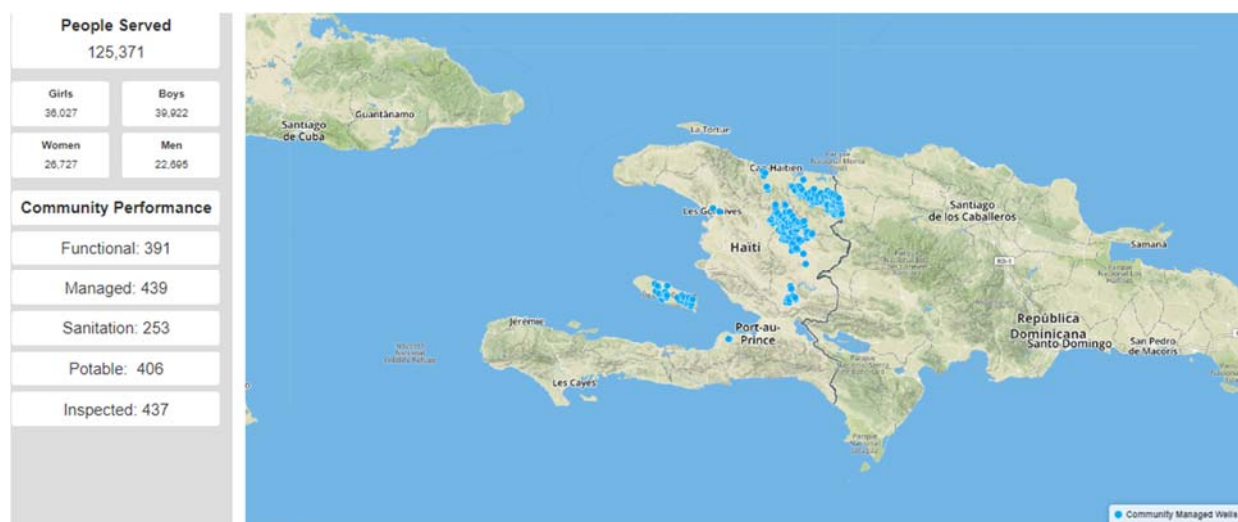


Figure 30: mWater progress in mapping of water services in Haiti.³⁰⁵

Section 6.3.2: Feasibility Study

Community buy in will be imperative to the successful implementation of the water provision. The *Architecture of Humanity Report* indicated that measures are in place through the Community Platform and Town Hall to engage community members. This ensures that the inhabitants are aware and in agreement with development plans for the island, can express their preferences and concerns, and become a part of the solution. The feasibility study is the opportunity to let the community members' voices be heard and synthesized into future recommendations for the progression of service delivery.

The study should be an externally led initiative implemented by a local team. External organization devised a survey to measure basic demographics, current income levels, whether income is steady, current water source, satisfaction with water source, and the perceived value of water. It is necessary that respectable, creditable leaders of the community (perhaps members of the mayor's office, the Advisor Committee, Community Platform, or Town Hall) are the ones engaging with the community to ensure the community's views are most accurately represented. The external organization can then gather and analyze the information to determine how to set the final price. A report should be delivered addressing the primary means of current water collection amongst the demographics and whom are most likely willing to be involved in water service delivery.

³⁰⁵ Haiti Outreach, "Where We Work."

Section 6.3.3: Technology Selection

The technology selected for the island should be both robust and resilient by choosing a single system for the whole island, or if not possible, then by minimizing the number of different systems. The pump and well types should be a standard model all made from common components that are interchangeable and easily replaceable. Previous efforts have been sporadic and incohesive to the point where each system's uniqueness prevented repairs. By standardizing the technology, it can be more easily managed, replaced, and regulated. This helps to simplify supply chain and ease in troubleshooting.

Two different systems *are* recommended for the power source of the pumps. The island should adopt both manual and solar-powered pumps to meet the different water demands as well as price differences throughout the island. High-density locations, such as a potential spot in Madame Bernard, will require substantially more power to operate and could afford to cover the additional costs of solar power. Solar power is one of the most affordable energy sources and has been used on the island before. However, the community has not yet been sufficiently trained on how to manage the solar panels and most on the island are not functioning. The community can and should be trained though to monitor this form of technology. In the most rural parts of the island where populations are more spread out and income is lower, manual pumps would be preferred. Manual pumps would be easier to maintain and have the potential for greater sustainability in parts of the island less likely to have large consumer bases.

Based on the known hydrology reports, the primary water point sources would come from ground water as opposed to surface water near the swamplands or ocean due to high salinity concerns. The geology of the island is based on sedimentary rock which can be manually drilled through, indicating that machine drilling, which is more expensive and training-intensive, will not be necessary. The inventory assessment of wells done indicated that wells and pumps would require reinforcements to prevent contamination from erosion, runoff, trash, and waste. It showed that wells maintained a neutral pH when using ground water and there was negligible salinity. However, most of the water points did not ensure quality and tested positive for bacterial diseases.

Chlorination is the recommended treatment procedure for ensuring the water is free of bacterial contaminants. Chlorination has been used effectively throughout Haiti before, and unless objections arise in the taste preferences of the feasibility study, is preferred for its low cost and ease in operations (does not require an energy source). As shown on the water inventory, even when treated with chlorine, the water sources tested positive for Coliform and E-Coli. This does not indicate that chlorine cannot be effective, but proper training on the procedures to treat the water must be better explained.

There should be clear manuals in Creole detailing procedures for all technical systems installed and for the purification procedures. Any opportunity for automation when affordable should be utilized to prevent human lapses in training from failing to properly purify water.

Section 6.3.4: Community Engagement and Selection

Community engagement from the start will provide guidance on how to implement the service. The Community Resource Center located in Madame Bernard would be an ideal meeting place to engage with community members. Community leadership will be necessary to promote the water services and encourage interest in the service. The *Architecture for Humanity Report* indicated that a lack of means to communicate led to poor turnout at workshops and meetings, and recommended investing in better radio communications. Radios would enhance water providers and authorities in spreading awareness of the actions being implemented on the island. Many inhabitants also have phones would provide additional means of gathering people and communicating progress. Ultimately, community engagement should be initiated as soon as possible and continued throughout every stage of service implementation.

There are two aspects to choosing the community. The first is the general region and the second is the specific coordinates of each water point. For the case of Île-à-Vache, the first part is already answered and a whole island approach has already been selected. The mayor aims to ensure water security for every inhabitant of the island. This does not; however, indicate that all of the wells and pumps must be constructed at once. The whole island approach, which will effect several of the components discussed in Section 6.3, indicates that communities can be serviced in modules. The mayor and water provider may choose to start with the most densely populated regions of the island as listed in Table 11 or more geographically based.

Madame Bernard has significant potential as both the most densely populated area and ideal location geographically centered on the island. There is already a market well established where clean water could develop a consumer base and the mayor's office is in close proximity for better ease in monitoring. The central region also has great potential since there are high population densities, lower risks of flooding, and less elevation changes. The east is less populated and faced with low basic service provision, which indicates there is a high need but greater challenges in starting. The west has substantial elevation changes which means more water points will be required as walking distances should be shorter to account for the topography. The west is also the predominant tourist base of the island and thus there is the potential for external water provision from private enterprises involved in tourism.

The specific coordinates selected for each water point site are a matter of optimization, considering both the water supply and demand. The hydrology, topography, population distribution, and locations of public institutions (such as schools and orphanages) should be

overlaid to generate a network of sites that can best serve the inhabitants. It will be important to identify key local leaders that will manage the systems for this area. They should compromise a water council and can become part of the mayor's office. The skill set recommended for the council includes literacy, a basic economic understanding of service provision, and a desire for safer water. The business model can be explained but there must be a genuine understanding of why charging people enough is a necessary component of sustainable water provision.

Section 6.3.5: Business Model

The business model most likely to succeed in Île-à-Vache is a community based model. NGO provision will be necessary to run the organization externally while the government builds its capacity to manage water as a public service. Given the desire to ensure water is eventually universal and build in a foundation of sustainability, a subsidy system based on a combination of both water usage and income is recommended. This would promote preserving the serviced water for drinking/cooking needs and continuing current water usage practices for nonessential tasks such as laundry or cleaning.

The recommended tariff system would be to provide water users the option of per visit payments or monthly payments depending on what better meets their needs. There is thus low commitment required and allows for flexibility and convenience based on individual needs. The price must be optimized to balance sustainability with affordability. The literature indicated that Haitians in small towns were paying approximately \$1/person-month for water, or about \$0.03/person-day. Inhabitants in Île-à-Vache currently can expect to pay for water exported from the mainland a price of \$0.45 for five gallons. According to an interview with Patrick Lucien, islanders would expect a locally sourced permanent water source to cost less, approximately \$0.30 for five gallon as a reasonable price. WHO recommends a half gallon of water consumption per person per day, which aligns with previous affordability estimations based on income for a cost of \$0.03/person-day.³⁰⁶ Metering is also highly recommended due to the automation. Metering allows for a more accountable system where people pay for their water prior to receiving it, which would help ease some of the challenges the country has faced with residents illegally taking water.

Affordability will likely be particularly challenging based on the varying sources and amounts of income for the islanders. The potentially limited water supply on the island may also prove to be a driving factor in the business model. Subsidies will be necessary to ensure that underserved communities can overcome cost barriers to accessing services and the water sources themselves are not overused. The subsidy system should also be simplified for the island-Haiti has faced complications with systems comprised of hundreds of different subsidizes that have only confused water users and authorities alike. A combined subsidy system based on both

³⁰⁶ World Health Organization, *Guidelines for Drinking-Water Quality*.

income levels and usage is recommended, which favors the residents aiming to provide safe water for household consumption. Subsidies should be higher for communities of the island with greater employment challenges offset by lower subsidies for more economically stable communities. Given the emphasis of tourism on the island to develop the economy, these larger companies looking to come to the island should be required to provide desalinated water from the ocean. This ensures the local water supply is ensured for the islanders and those who most need it. Businesses have greater capacity to afford the higher costs of desalination units.

Section 6.3.6: Secure Initial Funding

Given the pressing need to supply water to Île-à-Vache at a price the people can afford, the business model will rely fully on philanthropic support to cover the initial capital costs. The primary potential funding sources identified include Inter-American Development Bank, the United Nations, the World Bank, and the Spanish Agency for International Development Cooperation, and Rotary Clubs. Based on previous loan reports, each has shown to emphasize key sustainability factors and proves a promising avenue. Each also are increasingly realizing the important of community initiation, and so it is recommended that the mayor reach out directly to these organizations and indicate his resolve for water provision.

If the mayor receives interest from potential funders, that do not indicate an understanding of sustainable, community-led water services, he can help redirect them towards the island's needs. A significant challenge NGOs can face when partnering with funders is pressure to deliver based on facilities alone. Instead, the mayor should facilitate agreements that prioritizes the long term capabilities of the systems. The NGO should agree to improve access/coverage but also prove means to maintain and operate systems, manage loans, ensure locals are trained and educated on how to replace systems. If well intentioned organizations hope to provide water as charity, the mayor can request that they partner with a funding provider to facilitate collection of revenue. By understanding the negative implications of free water services, the mayor can ensure free short-term projects do not undercut attempts at sustainable services.

The mayor may offer his own vision to these organizations outlining his priorities for water services and offer recommended readings to organizations that are unaware of the unique circumstances to Haiti. Offering the hydrology report and feasibility studies will allow organizations to make more informed decisions. If possible, it would be very useful to secure published, English versions of the Architecture for Humanity Technical Report as well as the Strategic Development Plan for the Development of Haiti so that organizations can understand the framework they are to work in.

The mayor can also develop his own budget needs so that when organizations arrive with funding, the mayor can indicate where the need is. Instead of accepting grants focused solely on infrastructure, the mayor can offer alternative strategies that invest in training community members, inventory assessments, automated monitoring systems, metering, savings for maintenance and repairs, WASH education, marketing strategies, and all other needs identified. The mayor can utilize his best judgement of what the island needs to guide funders in the right direction.

Another important consideration is the implication of a full island approach. The mayor should not feel pressured to provide water to the island all at once, but can instead progress in modules. If funds secured are spread too thin primarily on infrastructure throughout the island, only short-term projects will be implemented and a permanent service will not be feasible. As funding is collected, the mayor should establish percentages necessary to be allotted to all components of the service, which will vary based on different circumstances throughout the island such as income, density, elevation, hydrology, etc. Instead of viewing funds as how many wells and pumps can be built, the strategy instead is how much of the island can be covered with the current funds available.

Section 6.3.7: Formalize community partnership

It must be clear from the onset that serviced water is about improving the welfare of the community. In order to do so, the mayor should initiate opportunities for the community to be involved in agreeing to the arrangement. A formal contract should be signed with the communities outlining the price they pay, the profit those who are employed receive, and the expectations of community management (i.e. reasonable replacement times, ensured quality, etc.). The local water council members should be the one to deliver the message and contract presenting opportunities for input, questions, and feedback from the people. These meetings should explain why serviced water is so important and why it must have a price. WASH education tends to be lacking in rural communities and incorporating this into the community engagement allows relevant progress forward on this front.

The contract developed between the water provider, water authority, water user and funder should reflect the priorities of all members. This is a prime opportunity for the mayor to spearhead the identification of these priorities such that community members feel represented and providers and funders can have confidence that their service will be successful. The contract should reflect an emphasis on sustainability, systems strengthening, and collective action. It is important for organizations interested in assisting the island recognize that there are mechanisms in place to engage with the community through this platform. The Community Platform is the crux to collective action at the most local level and organizations should actively seek to work through them. The purpose is to gain insights on what the community prioritizes as well as build

support and trust through these representatives who will in turn bring community members on board with the organizations intentions. The formal, official contract represents investment from all sides (the NGO, the government and the people) to bringing water service delivery to the island.

Section 6.3.8: Water Inventory Assessment

The water inventory is a more thorough assessment then the hydrology report that should be initiated just before construction plans begin. The hydrology report is more stable and does not need to be updated as regularly, but the inventory is meant to provide the most up to date statuses of all water service infrastructure currently established now that there is an agreed upon partnership between the water provider, authority and user. The inventory assessment conducted in 2012 shown in Table 13 would now be obsolete. The data collected by the Massachusetts Maritime Academy collected valuable information on the infrastructure functionality and water quality, but further details, such as information on the reinforcements, treatments used, people served, price (if any) of the water, and repair history, would be useful.

From this previous assessment, it was determined that while salinity and pH were well managed, the functionality of the wells and pumps and contamination of the water were not. Most wells and pumps were either not functioning or recently fixed, indicating that functionality and repair time will be very important quantities to measure and monitor regularly. The assessment also showed the need for greater protection of the water points through reinforcements and treatment of even ground water that may have been assumed safe.

While it is more cost effective at least in the short term to incorporate already established infrastructure and potentially repair currently nonfunctional systems, there is a long-term trade off. Substantial revenue may be poured into broken systems that may not be repairable if not thoroughly assessed beforehand. Old infrastructure that does not combine well with new technical systems being implemented will be difficult to maintain and operate as training is focused on the new systems. Older systems will also require greater maintenance and repairs, which may result in greater accumulated costs then having replaced the infrastructure with a more robust and resilient system from the start. The inventory assessment thus should be carefully analyzed to reflect the most efficient and long-term cost effective way to provide a water service.

Section 6.3.9: Train local water team

At every instance possible, the islanders (as opposed to external sources) should be the ones employed to manage the system. Everyone involved within the service delivery model must be trained. At the highest leadership levels, the water council must be trained on the business

model, the management required, and how to market the service. These trainings can be led by the NGO with the experience in the field. Local inhabitants should be hired and trained to drill wells, build infrastructure, and replace infrastructure. The NGO provides the technical expertise to teach the locals how to run their own systems.

Water providers have often failed to provide a permanent service because they left the water systems behind without anyone trained on how to continue to maintain it. The technical manuals developed for each system can help answer questions, but water providers should also provide further contact information for unexpected problems that arise that the community may not be experienced in fixing. Community members should be formally trained and provided the management skills necessary to oversee the service. Students in schools or community members who have demonstrated skills in business or maintenance should be identified and provided the additional education needed to ensure the service can become self-sufficient.

Employees of the water provider should be trained as professionals, with a sufficient paycheck, a uniform appearance, and strong regard for the organizations they represent. The water team should be paid in terms of what would be most equivalent to their skill set. The well drillers should be paid similarly to construction workers on the island, covered by the initial capital donations, those directly managing the wells and pumps on a percentage of revenue basis, and the leadership managers similar to a member of the mayor's office. This helps develop the water sector on the island and promote water as a desirable good that people want. Training and professionalism are also essential to mitigate business failures due to lack of understanding. The employees not only provide the water service, but with their buy in, promote it within the communities as well.

Section 6.3.10: Construction/rehabilitation

The infrastructure and facilities of the system can now be constructed. This is commonly the service component water providing organizations excel in, their “bread and butter.”³⁰⁷ Local labor hired by the water provider along with local leaders must be identified to manage the building of these structures prioritizing robustness, and resiliency. The wells and pumps should be installed professionally to ensure reliability. As systems are installed, they should be formally registered and mapped with the mayor's office. *mWater* allows sites to be uploaded and described which can be done as each is built, laying the groundwork for future monitoring. The technical takeaways from the literature; however, indicated the problems often do not lie in installation but in maintaining. Every effort should be made to ensure that the systems installed will last.

³⁰⁷ Davis, “Blog.”

Section 6.3.11: Market

Water is a public service because it is purified and delivered to communities-however, the gap between the value of water and price of water can be significant. It is important to advertise serviced water as its dual role as a right and a commodity. To improve the perceived value of water and better align the value with the price, water should be advertised to highlight its importance. Signs might be posted to direct people to water, the water council may lead community seminars explaining the health repercussions of WASH, the medical facility can teach people when they come in sick, and schools can teach children about the benefits as well. Radio stations may advertise different NGOs and the wells themselves should be maintained in a respectable manner to ensure user satisfaction. Jingles, advertisements, and a visible filtration system help promote water delivery services as a desirable product. Water providers often develop a brand to advertise their product. Hygiene practices that encourage safe water consumption are a significant tool to reinforcing the importance of safe water. The social priorities identified in the literature were price, taste and convenience, and each factor should be advertised in alignment with the feasibility study recommended in Section 6.3.2. The service should be advertised as an affordable commodity that tastes appealing and is easily accessible.

Section 6.3.12: Implement Service Delivery Model

After this significant investment into the model, the values, and the people involved, water service delivery can begin. Community members may now have access to an improved water source that is close to their homes and they know they can rely on for quality water at a price they can afford. Water users pay, water managers pay for their way on a meter basis and take home the profit, and revenue is collected to ensure the ongoing operation and maintenance. Water coverage not only improves, but also community participation and satisfaction improve as well.

Section 6.3.13: Monitor and Improve

In order to ensure ongoing sustainability, the system must be monitored to drive performance. The metrics used to measure and define the systems must be selected to incorporate both the perspective of the water providers and water users. The inventory assessment indicated that functionality and quality will need to be carefully monitored. The feasibility study can determine what is most important to the community members which can be aligned with the water provider's needs. Whenever feasible within the business model, automation should be incorporated as much as possible. Live updates drastically improve the ability of water authorities to monitor and provide quick responses.

The mayor has significant opportunities to leverage his position in governance to direct water service provision in an impactful and lasting way. These recommendations provide guidance for how to lead the initiative and make significant progress even within the challenges of a rural community. The mayor has committed to prioritizing water services, and these recommendations can hopefully serve as the basis for the governing strategy of Île-à-Vache.

Section 7: Conclusions

Safe water is recognized as not only an essential human need, but has also been recognized by the United Nations as a *right* through the Sustainable Development Goals (SDG-6.1). Despite mature water delivery technology, many people still lack access to clean drinking water, particularly in rural poor communities. The water sector has come to increasingly recognize that water projects that focus on simple application of technology alone tend to fail. Gizmos and gadgets aren't sufficient to get water to the world's rural poor over the long term. Instead, a multidisciplinary approach is required to address the economic, technological, social, and political factors that drive water provision. Water provision requires a more complete understanding of each of these various perspectives.

The first objective of this research was to identify the primary challenges faced in the water sector and provide recommendations to overcome each. Based on interviews, field studies, and a detailed review of the academic and professional literature, this report has made three primary recommendations:

- 1) A shift in perspective is necessary from defining water as just a right to defining water as a service. By itself, technology is usually an effective long-term solution.**

Water is a right, but water *provision* is a service that comes at a value and is part of a larger sector. *Water service delivery* requires more than a physical system, but also a business model that engages the water users and collaboration with water authorities to account for the full service.

- 2) This service must be sustainable for the long-term. Short-term incentives result in no progress forward and may do more harm than good.**

A service is not enough to solve the water crisis if there is no thought for the long-term feasibility of the system. The water sector requires *sustainable* water service delivery to ensure a *permanent service* is in place. This breaks the cycle of dependency that so many rural communities struggle to overcome.

3) To operationalize sustainability, a systems-based approach paired with collective action is required to allow for the sector to flourish within the established framework.

Even more, a sustainable water service delivery that does not work as a part of the larger system in place, too, has historically not been enough. A *systems-based approach* highlights the necessity to work within established sector frameworks and engage with other sector actors through *collective actions*. Developing a unique, fully customized solution to any humanitarian problem is essential, but there are certainly universal themes that can be applied to communities aiming to provide a sustainable, systems-based water service delivery.

The second objective of this report was to develop an approach for sustainable water service delivery in rural communities within local context. In Section 5.2, thirteen specific considerations were made as important components of a water service project. These considerations are not meant to be a one-size-fits-all template for all rural water projects, but each of the listed components was extracted from the literature and should likely play some role in a successful, well-designed, rural water project. In Section 5.3, recommendations were made on how to balance sustainable goals with the temptation to prioritize short-term, tangible, and easy to measure targets. Data monitoring of *many* key metrics will drive performance forward. In Section 5.4, the methods to strengthen systems and collaborate with others were explored. Through this approach, water users, providers and authorities alike can benefit from the integrated permanent service established.

Finally, the third objective was to apply this approach to a case study on the Haitian island of Île-à-Vache to demonstrate how to customize a model for specific recommendations. These recommendations described how a community seeking water service can incorporate these principles and demonstrate good governance. For Île-à-Vache, it will be important to gather significantly more data through hydrology and feasibility studies within the context of a complete service. There are many organizations already deeply invested in universal access to water for all in Haiti and outreach programs should be initiated where not already.

The approach recommended above was customized for a case study in Île-à-Vache, Haiti to demonstrate the utility in applying universal themes to a specific community. Each recommendation was tailored to reflect the priorities, resource capacity, and limitations of the island in order to provide a model useful to the Île-à-Vache but with applicability to other communities through customization. The water sector continues to improve its approach to fully understanding both the supply and demand perspectives of a sustainable, system-based approach to water service delivery. This more complete picture is being defined more clearly, and water users, providers and authorities are better defining their respective roles in the sector. Successful

water provision has the potential to thrive in rural communities through these efforts, greatly impacting the communities it services.

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