WATER, SANITATION, & HYGIENE

IN CENTRAL AMERICA AND THE CARIBBEAN:

DEPTH OVER BREADTH FOR SUSTAINABLE INTERVENTIONS

by

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ABSTRACT

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Depth Over Breadth for Sustainable Interventions

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Water, Sanitation, and Hygiene (WASH) resources are often scarce in developing communities around the world. Although countless organizations from small non-profits to large international government agencies are working to improve conditions, their actions, known as interventions, often do not lead to lasting results. Interventions are limited by the tendency in the WASH sector toward a practical approach, without a sufficient theoretical base of knowledge for effective planning and design. There is a need for theoretical tools that can guide organizations through designing interventions that are sustainable. This study is a comparative analysis of twelve WASH interventions throughout one of the regions with the least access to WASH – Central America and the Caribbean. For this study, I use two frameworks from the limited WASH literature to identify key strategies for sustainable interventions. The analysis also sheds light on the utility of the limited WASH literature by evaluating the two frameworks for designing and evaluating WASH interventions. Through the analysis, I determined the two frameworks are effective for design and evaluation, however, they are both limited by redundancies and unclear definitions. The most effective strategies for sustainable interventions fell into two general categories – taking a Holistic Approach to intervention and establishing strong External Support systems. Both strategies transcend simply providing a technology or inciting behavior change by transcending the direct service of the intervention by enhancing systems that are connected to WASH.

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Introduction

Background

Within the global population, one group of people, the global north, rarely consider where their drinking water comes from or where their human waste goes. Technological capability in the global north is so great that water and sanitation are a non-issue for most of the population. Meanwhile, billions of people in another group, the global south or "the developing world," do not have access to basic human needs in terms of water and sanitation (UNICEF & WHO, 2015). Despite safe water and sanitation being designated as basic human rights by the United Nations General Assembly in 2010 and other global movements like the Millennium Development Goals, an imbalance of resource-access remains between the global north and south (UNICEF & WHO, 2015).

In terms of access to safe drinking water, 9% of the global population (663 million people) do not have access to an improved water source – meaning that the source is protected by a barrier from fecal contamination (UNICEF & WHO, 2015). Access to adequate sanitation is much less widespread with 32% (2.4 billion people) of the global population without access to improved sanitation – meaning that excreta is hygienically separated from human contact (UNICEF & WHO, 2015). Perhaps the statistic with the worst result in terms of human and environmental health is that 13% of the global population resorting to open defecation – meaning they do not use any designated toilet and excreta is not contained from the environment (UNICEF & WHO, 2015). A global movement called, "Water, Sanitation, & Hygiene (WASH)" initiated by UNICEF promotes the enhancement of local systems to "improve water supplies and

sanitation facilities in schools and communities." UNICEF recognizes that each field requires its own independent work, however, WASH was grouped to highlight the interdependent nature of the three fields and the importance of collaboration for progress (UNICEF, 2016).

Many developing nations are locked into systems where basic human needs like WASH are limiting factors to upward mobility. Inadequate safe water and sanitation permeates nearly all aspects of daily life in rural areas and severely limits achievement of other development activities like "adequate nutrition, gender equality, education and the eradication of poverty" (UNICEF & WHO, 2015). Since women in developing communities tend to hold the water management responsibilities, inadequate water and sanitation conditions disproportionally affect women and severely limits their upward mobility in terms of alleviating poverty for themselves and their families (UNICEF & WHO, 2015). Collecting water is time consuming and the responsibility limits time for things like educating themselves or their children – not to mention that collecting water can be dangerous and often leads to women frequently placing themselves in vulnerable positions (Water and Sanitation Programme, 2010). The disproportionate burden felt by women is just one example of how inadequate WASH conditions limits many aspects of life in developing communities.

Inadequate WASH conditions restricts economic opportunity in the developing world because most resources must be spent on surviving through the results of poor health. I repeatedly witnessed the economic restriction scenario while managing a household WASH survey project in rural Nicaragua in 2015. The purpose of the survey was to inform a non-profit organization, El Porvenir, on the performance of its aid

programs as well as on the health and WASH conditions of the local communities. Most of the households I visited were on small dairy farms that depend on the sale of a few jugs of milk per day for income. The households report frequent visits to health posts which require an average four hours of travel and if the medication they seek is available, it is often too expensive for the farming households to afford (Burgess, 2015). Frequent illness is also reported which is most likely due to residents using the same surface water points for washing clothes, washing dishes, and personal hygiene. Since 22% of the households in the region resort to open defecation, many of these water points are contaminated vectors for water-borne disease transmission (Burgess, 2015). The rural families in this area of Nicaragua are locked into a system; the households are forced to spend their income on medicine that does not treat the underlying problem – inadequate water and sanitation.

Although subject to varying conditions of poverty, I also witnessed similar mechanisms in the Dominican Republic that keep rural communities locked in the same perpetual state of immobility due to the foundational problem of inadequate access to safe water and sanitation. In a rural area of the country I worked with a non-profit organization, Project Hearts, gathering baseline data on the needs of the community and piloting a program that provides access to safe water storage, filtration treatment, and incites behavior change. Globally, there are countless organizations and agencies doing work like El Porvenir and Project Hearts, attempting to assist communities with WASH development. These organizations include local and international non-profits like El Porvenir or Water for People, governmental agencies like the United States Agency for International Development (USAID), and international agencies like the World Health

Organization (WHO). The aid activities are in the form of "interventions" that occur at household, community, municipal, regional, or national levels. Interventions have highly varied approaches, scopes, and goals – resulting in a sector with no standard of practice.

Significance

Countless organizations and agencies worldwide spend an average of US $220 billion annually on investments and human resources for WASH interventions (Hutton, 2012). However, their efforts are often limited by strategies that do not lead to lasting improvements on WASH conditions. For example, the Caribbean coastal region of Central America has been host to many humanitarian efforts to improve WASH systems, but the approaches of international non-profits and government agencies have been largely unsuccessful due to cultural differences that go unacknowledged by intervening organizations. In an article from 2014, Tinoco et al. cite "quick fix solutions" as one of the major contributions to the failures of interventions. Quick fix solutions fail because they do not assess the capabilities of the communities in which they are implemented, they clash with cultural preferences, they ignore relevant local knowledge, or the installations often remain incomplete due to incapacity to control or monitor them after implementation (Tinoco, Cortobius, Grajales, & Kjellénd, 2014). Another downfall of the quick fix solution is that interventions do not include sufficient user training or WASH education.
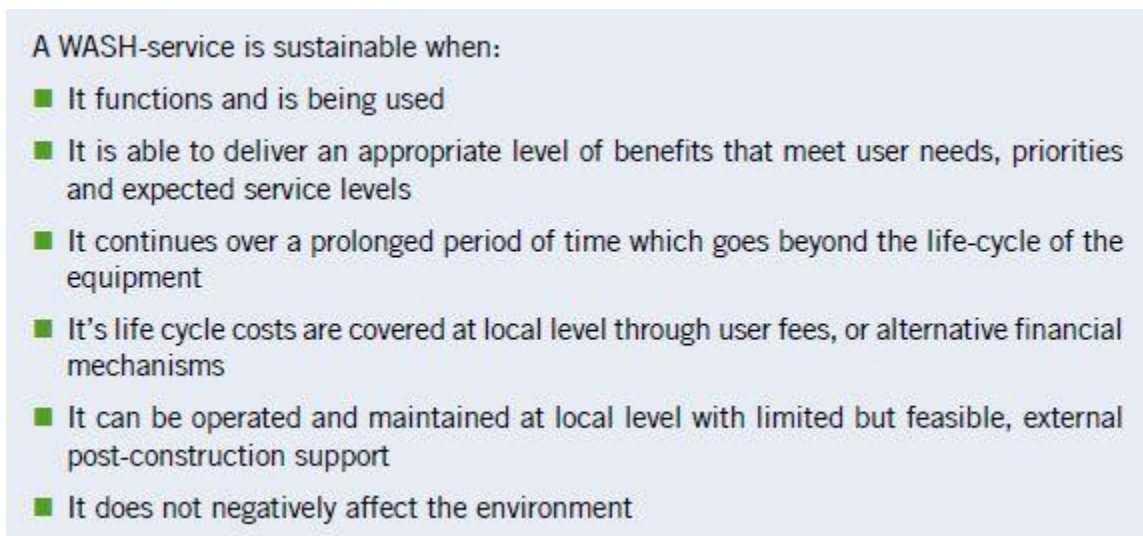
While there are plenty of studies on the efficacy or limitations of interventions, there are not sufficient resources on identifying the most effective and sustainable approaches to WASH intervention in specific regions (Aiken, Stauber, Ortiz, & Sobsey,

2011). Community WASH access depends on countless variables that are beyond control such as regional climate, proximity to centralized cities or towns, economic stability, and geography which make a uniform approach to designing interventions problematic. However, honing in on the most effective strategies for improving WASH conditions will make efforts more efficient and will make investments into WASH programming more worthwhile. Further, honing in on the most sustainable strategies for improving WASH conditions will enable beneficiaries of the intervention to use the system in longevity and potentially achieve upward mobilization through meeting basic needs.

The notion of "sustainability" is highly debated in terms of a definition, so for this study I use the definition set by the German humanitarian aid organization, Welt Hunger Hilfe. To be considered sustainable in this study, the service had to fit the criteria outlined in Table 1.

TABLE 1: Definition of sustainability by German NGO Welt Hunger Hilfe

A WASH-service is sustainable when:
- It functions and is being used
- It is able to deliver an appropriate level of benefits that meet user needs, priorities and expected service levels
- It continues over a prolonged period of time which goes beyond the life-cycle of the equipment
- It's life cycle costs are covered at local level through user fees, or alternative financial mechanisms
- It can be operated and maintained at local level with limited but feasible, external post-construction support
- It does not negatively affect the environment

Sub-Saharan Africa, South and East Asia, and Latin America are identified as having the least WASH coverage in the world (UNICEF & WHO, 2015). My experience

in the WASH sector has been focused in Central America and the Caribbean which are host to some of the poorest nations in Latin America – Haiti, Honduras, and Nicaragua. Many other nations in Central America and the Caribbean are plagued by political unrest such as El Salvador and Honduras. Central America and the Caribbean have a tropical climate pattern with two main seasons – wet and drought. The region also experiences frequent extreme storm events. Climate change will intensify pressure on rural access to WASH in Central America and the Caribbean in two primary ways, which are connected and influence one another: altered precipitation patterns and increased intensity/frequency of natural disasters (Mendoza & Barmen, 2006; Hidalgo, Amador, Alfar, & Quesada, 2013; Rivera & Wamsler, 2014). Altered precipitation patterns are already seen in the Caribbean through extended drought periods (Intergovernmental Panel on Climate Change, 2014). The current economic conditions, expected climate pressures, and my participatory experience are what led to my focusing on Central America and the Caribbean region in this study.

Practical & Theoretical Approaches in WASH

Currently, a main issue in global WASH aid is that organizations often implement practical approaches that initially seem impactful such as, "We installed 234 bio-sand filters in the Posoltega community." (Vanderzwaag, Atwater, Bartlett, & Baker, 2009). However, the question of the community's knowledge about microbes and how water-borne diseases are transmitted is often overlooked. Posoltega residents may not have seen the need for bio-sand filters and decide not to use them, as seen in the under 10% rate of continued use (Vanderzwaag, 2009). The focus on practicality in WASH partly stems

from most organization's evaluation structures being results-based. To ensure continued funding organizations must regularly show funders results, so most organizations consider interventions "finished" at given stage. Organizations then proceed to the next community in need to produce more results and receive continued funding – which is the mechanism that leads to unsustainable "quick-fix" approaches (Easterley, 2006; Tinoco et al. 2014).

While working the in the Dominican Republic with Project Hearts, I piloted a program that is designed to provide affordable ceramic water filters and rain catchment systems with storage tanks to households. During the planning stage, I collected baseline data through household surveys, discussions with Community Health Leaders, and local medical records from hospitals, clinics, and health-posts in the area. The data shows that about 40% of the population was consuming untreated water on a daily basis as well as a high prevalence of water borne diseases, especially in children under five years of age (Machado, 2015). With these data, it was clear to the organization and I that the best course of action was to prioritize dispersing ceramic filters and training the households on their proper usage, with the hope of supplying a few families with rain catchment systems and storage tanks. However, at the end of the first quarter of the program I found that the number of filters provided was far below our goal and the number of rain catchment systems with storage tanks provided exceeded 300% of the target (Adea, 2016). Our baseline data collection and analysis missed a vital aspect – the community's priority on reliable water storage. Community members prioritized being able to store water reliably and safely before considering the content or quality of the water itself. Although the baseline data shows problematic statistics related to health, the most

problematic statistic to the community itself was not shown. The program was then altered to reflect the community's priority on storage and to increase education on transmitting water borne diseases and health related to WASH.

Errors in intervention design are not uncommon in the WASH sector. The "quick-fix" focus stems from a practical approach taken by WASH organizations that hinders the sustainability of interventions. The WASH literature does not have a sufficient theoretical base of knowledge that organizations can rely on during the design stage of WASH interventions, as there are few frameworks that guide organizations on how to approach interventions sustainably. In this thesis I first explore the threshold between practical and theoretical strategies by examining WASH interventions through two available WASH frameworks. The research questions addressed are:

"Are the WASHplus Improvement Framework and the WaterAid Sustainability Framework effective for designing sustainable WASH interventions in Central America & the Caribbean?"

and from these two frameworks,

"What are they key strategies that lead to more sustainable interventions?"

The need for increased investment in planning strategies stems from the nature of the WASH sector being directed by outsiders of the communities being intervened (Tinoco et al., 2014). As seen in my story of error in the Dominican Republic, an organization can have the most benevolent intentions but the position in the community as outsiders can severely limit their affect. The outsider position is key to keep in mind

not only for reading this thesis but also for understanding the foreign aid sector in general. Building a strong theoretical knowledge base can reduce the limitations of the outsider position and lead to more effective and sustainable WASH interventions.

Study Design

This section includes an explanation of the criteria for the case studies included, followed by an exploration of each case study and the methods used to evaluate the interventions. Two frameworks were selected for analyzing interventions, the WASH Plus Improvement Framework created by USAID and the WASH Sustainability Framework created by WaterAid. I explain both frameworks' structures as well as the specific characteristics that led me to use them in this study. Finally, the methods used to discuss the interventions through the two frameworks are explained. Figure 1 shows the study design.
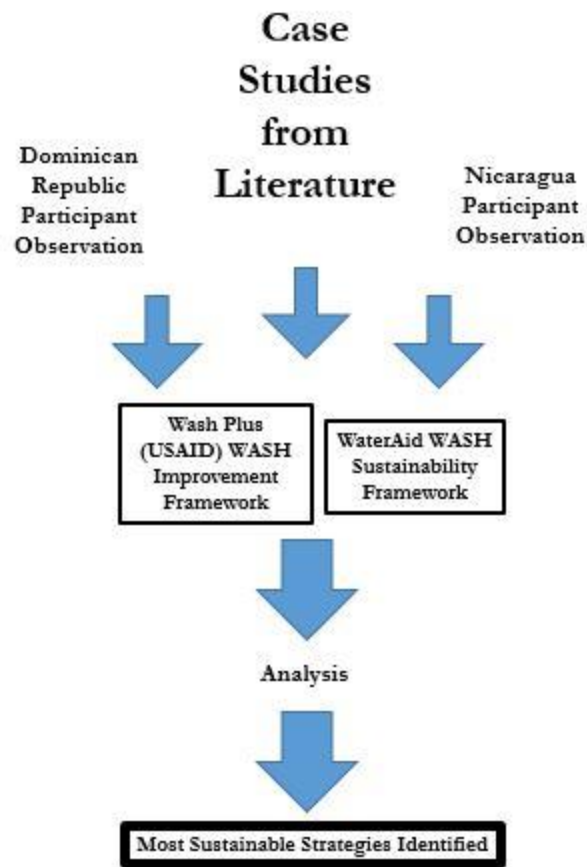
FIGURE 1: Schematic of study design

I use the frameworks to analyze the interventions to highlight the need for a stronger theoretical base of knowledge in the WASH sector. The WSF and the WIF are examples drawn from a limited pool of theoretical frameworks, and their ability to measure performance and ensure sustainability of WASH interventions is assessed through the analysis.

Criteria for Including Interventions

Interventions included in this study needed to fit a set of pre-established criteria. First, the intervention had to take place in either Central America or the Caribbean region because of the relative continuity of climate and economic conditions throughout the region. Confining the study to Central America and the Caribbean also contributes to filling a current gap in the WASH literature — an analysis specific to a region (Burgess, 2015).

Next, the intervention had to provide a technology or incite behavior change concerning water supply, treatment, sanitation systems, handwashing stations, soap/storage containers/consumables, or fecal sludge management (as according to the WASH Plus framework). For example, the intervention could include the provision of bio-sand filters, or a hand-washing education campaign, or both. The intervention also fits the criteria if it is focused on managing latrines that have filled, or building new latrines. In addition, the intervention had to have measurable outcomes reported in the literature or reference materials that would enable comparative analysis. Often, organizations will report what they do, which are Outputs, instead of reporting the results that are produced by what they do, which are Outcomes (Poister, 2003). For example, an output is constructing 50 latrines for a community; the outcome is that rates of diarrhea in children under five years old decreased by 20% due to cleaner water from less open defecation. Outcomes are always measurable; otherwise results of interventions can be reported ambiguously or incomparably. To see how the interventions included in this study met the criteria, see Table 2.

TABLE 2: Measurable outcomes of interventions included in the study.

Intervention	WASH Technology or Behavior Change	Measurable Outcome Reported
Mesita Azul Ultraviolet Treatment - Mexico	Both	Reduced % of households with contaminated water by a risk difference (RD) of -19%
Caritas & Catholic Relief Services - Guatemala	Behavior	12% more households self reported treating water than control households (risk difference)
American Red Cross - El Salvador, Guatemala, Honduras, Nicaragua	Both	No difference in access to improved sanitation facility; Found 15% decrease in use & maintenance of latrines
Bio-Sand Filters - Nicaragua	Technology	24/234 BSFs still in use (10% rate of sustained use)
USAID PROSALUD - El Salvador	Both	40% reduction of childhood diarrhea under 5 years old
USAID - Dominican Republic	Both	33% water systems still functioning
FEMSA - Mexico	Technology	160 individuals "benefited with access to quality water"
FEMSA - Nicaragua	Technology	60 families gained access to improved sanitation
Water for People - Honduras	Both	97% households have access to sanitation facility
Water for People - Guatemala	Both	61% people over five years old use sanitation facility
El Porvenir - Nicaragua	Both	540 people have adequate sanitation resources
Project Hearts - Dominican Republic	Both	% reduction in monthly income spent on potable water

Frameworks Used for Comparative Analysis

The two frameworks chosen for analyzing WASH Interventions are USAID's WASH Plus Improvement Framework (WIF) and WaterAid's WASH Sustainability Framework (WSF). Both frameworks focus on the sustainability of interventions and although there is overlapping information between them, thee frameworks were created by organizations with highly varying capacities and different strategies for intervention.

Each framework is composed of three dominant fields that are sub-divided by individual categories which are explained in detail in the following sections. The frameworks were not chosen purely for analysis, but also to identify and evaluate the potential for their application in designing other interventions and measuring performance.

USAID – WASHplus Improvement Framework (WIF)

The WASHplus Improvement Framework (WIF) was created to support a project that started in 2010 and finished mid-2016. The primary goal of the WASHplus project was, "creating and delivering interventions that lead to significant improvements in access, practices, and health outcomes related to water supply, sanitation, and hygiene (WASH) and household air pollution" (USAID, 2014). All interventions performed during the WASHplus project used evidence-based approaches aiming to reduce rates of diarrhea and respiratory infections, particularly in children. The organization also placed a priority on "promoting and exploring innovation" in WASH strategies and technologies (USAID, 2014). The WASHplus model was designed to integrate into existing HIV/AIDS prevention programs, as well as those addressing neglected tropical diseases, nutrition, and related education. Partnerships for the project included large scale international organizations such as CARE and Winrock International as well as a large network of on-the-ground NGOs, universities, and private sector agents (USAID, 2014).

WASHplus focused its efforts on six countries: Bangladesh, Benin, Burkina Faso, Mali, Nepal, and Zambia. This geographic restriction provided the opportunity to assess the applicability of a framework created for the eastern hemisphere in Central America and the Caribbean. The WASHplus framework is structured on three dominant fields that

are related to, "improvement for reduced diarrhea and improved health." (USAID, 2014).
The three fields are:

"Access to Hardware and Services": involving the direct provision of technologies and behavior change aspects connected to water supply, sanitation systems, and handwashing stations. This component is the direct service component of the intervention; it does not include training, education, monitoring, or external support system. For this study, I have collapsed one category, "Fecal Sludge Management" into another, "Sanitation Systems" to avoid redundant scoring. Likewise, "Soap, containers, water treatment, and other consumables for household water treatment, menstrual hygiene management, and anal cleansing" was changed to exclude "water treatment."

"Promotions": catalyzing the acceptance and continued use of the intervention by the beneficiaries. Education and training are critical for success of this component, but promotions also involves household outreach, various types of media use including social media and radio, Community Led Total Sanitation (CLTS), and School Led Total Sanitation (SLTS). For this study, I merged collapsed "Social Marketing" into "Mass Media" to avoid redundant scoring. I also changed SLTS to "School Involved" due to the limited implementation of the SLTS strategy in Central America and the Caribbean. Likewise, CLTS was excluded from the study because it is also not implemented widely in the study region and essentially the same data is encompassed in another category, "Community Participation."

"Enabling Environment": implementing strategies that allow the beneficiaries to fully

support the intervention to ensure positive outcomes and longevity. These strategies

include a supportive policy and tariff structure, institutional strengthening, capacity

building, and partnerships. Figure 2 displays the WIF in its entirety.

Access to Hardware & Services

- Water supply
- Sanitation systems
- Handwashing stations/tippy taps
- Soap, containers, water treatment, and other consumables for HWS, MHM, and anal cleansing
- Fecal sludge management/pit emptying

Promotion

- Household outreach/promotion
- Community participation
- Community mobilization/CLTS
- School-led total sanitation
- Theater and folk media
- Mass media, including radio
- Social marketing
- Training

Sustainable WASH Improvement for reduced diarrhea and improved health

Enabling Environment

- Supportive policy, tariffs, and regulations
- Institutional strengthening
- Capacity building
- Coordinated planning and budgeting
- Financing and cost-recovery
- Cross-sectoral coordination
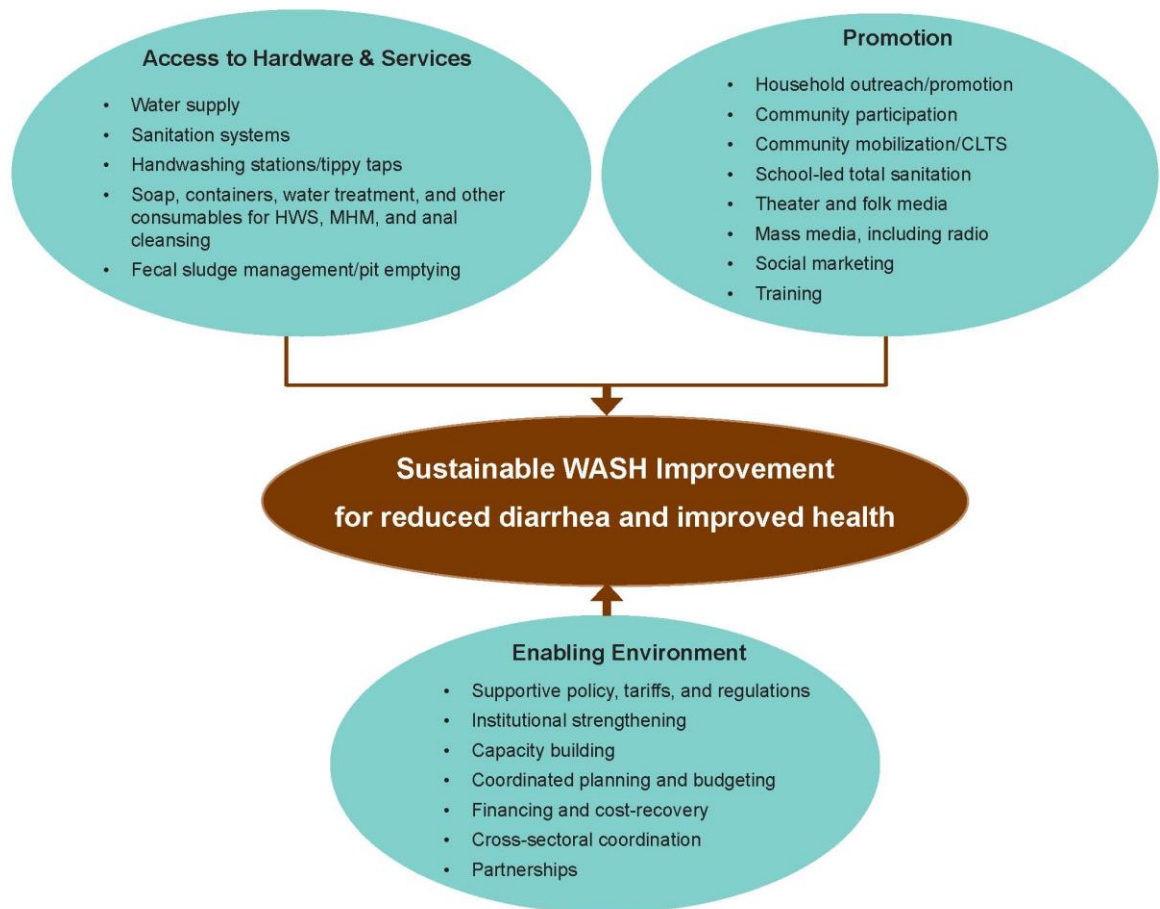- Partnerships

FIGURE 2: USAID's WASHplus Improvement Framework (WIF)

I chose the WIF because it was created by a governmental aid organization — the

United States Agency for International Development (USAID). USAID operates on a

$27.2 billion USD annual budget and performs large scale global interventions to support

"Global Health, Education, and Economic Growth & Trade" (USAID, 2015). Since USAID is a U.S. government agency, using this framework for analyzing interventions will be valuable to determine if extensive resources and a "two-fold purpose of furthering America's interests while improving lives in the developing world" yields an effective measure of intervention performance (USAID, 2015). Although the other framework used in this study was produced by an organization with extensive resources available, it differs from USAID because it is an international charity and does not nearly have the reach of a governmental organization – providing ideal conditions for comparison.

WaterAid – Wash Sustainability Framework (WSF)

WaterAid was established in 1981 and by 1986 the organization had programs in Ethiopia, Tanzania, Nepal, and India (WaterAid, 2017). Starting with basic WASH interventions, the organization has evolved and is now involved in local and international advocacy and policy change based on "WASH's vital role in reducing poverty" (WaterAid, 2017). The WaterAid model mandates hygiene education with every intervention because the organization believes that interventions are ineffective in its absence (WaterAid, 2017). As a charity, WaterAid depends on funding from both public and private sectors. Increasingly larger scale donors (including USAID) have enabled the organization to expand its capacity greatly. For example, in 2003 the United Kingdom Department for International Development gave WaterAid £15.5 million for its Bangladesh project (WaterAid, 2017). Although these large allocations enhance the potential capability and scale of interventions, it also makes WaterAid subject to the

United Kingdom Department for International Development's oversight throughout the use of the funding.

WaterAid works in thirty-two developing countries across the Central America, South America, Asia & Pacific Islands, and East, West, & South Africa. The programs are solely focused on WASH; however, WaterAid also incorporates issues the organization considers connected to WASH such as time poverty (meaning that women devote significant hours to collecting water, and thus have less time to spend on other things like education), menstrual health, violence, social exclusion, and urbanization (WaterAid, 2017). The framework is structured around three dominant fields. The outer fields "Design and Implementation" and "External Support" are key elements that flank the central field, "Community based, externally supported Operation & Maintenance (O&M) system in place" — which supports the entire intervention (Carter, Casey, & Harvey, 2011). One section outside of the three fields precedes the intervention itself: "Establish need, demand and service level" (WaterAid, 2017). For this study, due the difficulty of obtaining data on "relevant service levels" I consider need, demand, and relevant service level as established prior to implementation and did not use this category for scoring.

"Design and Implementation": crafting a plan that covers aspects that could limit effectiveness of interventions. These aspects appear in the initiation phase of the project and include full beneficiary participation, capital contribution by beneficiary, environmental aspects addressed, and a monitoring system in place (Carter et al., 2011). For this study, I issue requirements for one category, "High Quality Implementation" for

which if the intervention meets at least one, it receives a positive score. These requirements are derived from the WaterAid Framework definition document that explains criteria for each category (Carter et al., 2011). The intervention meets "high quality" by scaling-up from previous interventions, having systems in place to correct for malfunctioned or broken technologies, or using enduring materials that can be sourced and constructed locally (Carter et al., 2011, pp. 13-19).

"Community based, externally supported O&M system in place": creating systems that ensure the required operations and maintenance of the technologies and behavior changes occur post-intervention. According to the framework, a sustainable O&M system has its water use committee still functioning, maintenance tasks undertaken, strong links between beneficiary and support systems, and environmental monitoring (Carter et al., 2011).

"External Support": the intervening organization continuing dialogue and actions with the beneficiary after the intervention takes place. According to WaterAid, key aspects of external support are technical assistance to beneficiaries and committees (if established), recurrent cost sharing, and support to supply chains and service providers (Carter et al., 2011). Figure 3 displays the WSF in its entirety.
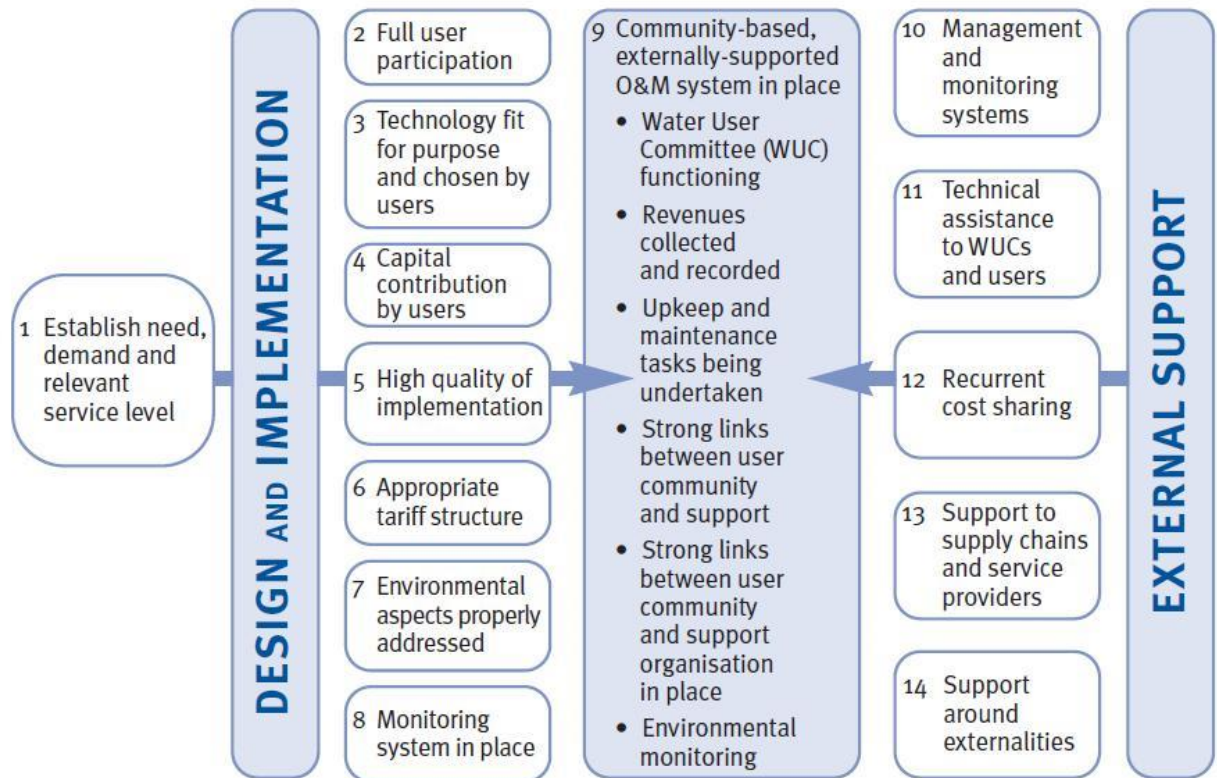
FIGURE 3: WaterAid's WASH Sustainability Framework

The primary reason I use the WSF is because it is highly detailed in defining each section, therefore it provides the ability to assess if rigidity is a limiting factor in determining if a framework is proficient at measuring intervention performance. I also chose the WSF because it was created by an international NGO that is widely mentioned in WASH literature and current publications This provides an ideal opportunity to compare a framework created by an NGO against a governmental organization's framework and find out which is a stronger theoretical framework for WASH interventions in Central America and the Caribbean.

Analysis

Once the data from each case study is in the two frameworks, the interventions are scored in terms of five different scoring groups. The scoring groups and the criteria for earning high scores are explained in Table 3.

TABLE 3: Criteria for scoring high in each scoring group

Scoring Group	Criteria for High Score
Achieved Outcomes	Highest scoring interventions achieved outcomes with highest rates of success
Most Effective Measurable Outcome	Highest scoring interventions are assessed as reporting outcomes that are both measurable and comparable
Highest WASHplus (WIF) Score	Highest scoring interventions have the most positive entries in the WIF.
Highest WaterAid (WSF) Score	Highest scoring interventions have the most positive entries in the WSF.
Highest Combined Framework Score	Highest Scoring interventions have the most positive entries in both frameworks combined.

The four highest scores in each scoring group are then compared in terms of commonalities that emerge from analyzing the two frameworks. The common characteristics will emerge as categories or themes that are shared amongst the highest scoring interventions. After the highest scoring interventions for each scoring group are identified, they are also analyzed in terms of associations. For an association to exist, the following criteria is met:

1) The four interventions with the most entries in the given field are represented by at least one of the five scoring groups

   OR

2) The four overall highest scoring interventions (USAID – Dominican Republic, Water for People – Honduras, Water for People – Guatemala, El Porvenir - Nicaragua) are represented with the highest number of entries in that field.

The results of the "Scores" and "Associations" analyses are the main data sources for identifying the most sustainable strategies, which provides the opportunity to assess if these frameworks are useful for designing future interventions and measuring performance. The categories and themes of WASH strategies that emerge as the most sustainable are also supported by field notes taken during participant observation. Merging these categories results in a recommended framework that adds to the theoretical WASH knowledge base.

Findings

In the next few pages, I explain the findings from the analysis of twelve interventions under two WASH sustainability frameworks. The categories for the final recommended framework are composed of these results because they point to the most sustainable intervention strategies. In the "Standards" section, I explain the categories that are incorporated by at least 75% of the entire group of interventions. Since these categories are so prolific, they are considered "Standard" practice for WASH intervention and are not discussed in detail beyond this section.

In the second section, "Commonalities Amongst High Scores," I discuss the findings from analyzing the common characteristics of interventions with high scores in each of the five scoring groups. Finally, I conclude the "Findings" section with the results of the "Associations" analysis.

Standards

The following categories are incorporated by nearly all interventions and are therefore considered standards for sustainable WASH interventions – which means they are placed on the recommended framework in some form. To be considered standard, at least 83.3% of the interventions must be incorporated.

The first categories to be considered standard are "Full user participation" from WASHplus and "Community participation" by WaterAid. They are incorporated by 88% of the entire group and represent the same strategy – including beneficiary input in the intervention. With this high percentage, it is safe to assume that community buy-in is crucial for the sustainability of WASH interventions.

The next category that is considered standard is the "Training" category found in the WASHplus framework. It is safe to assume that there is some element of training necessary for all interventions, which is reflected in 96% of intervention incorporating training (the remaining 4% is due to a report of "insufficient training") (Vanderzwaag, 2009).

The final category that is considered standard is WaterAid's "Established need, demand, and relevant service level." Although establishing need, demand, and service

level is vital, for this study I have assumed that each organization made this step before intervening in the communities. There is strong evidence that all interventions included in this study established need, demand and relevant service level, however two interventions, "Caritas & Catholic Relief Services – Guatemala" and "USAID PROSALUD – El Salvador" do not provide a concrete explanation of a need or demand recognized prior to intervention. Due to this constraint, I am unable to score this category with validity and therefore chose to consider "Established need, demand, and relevant service level" as a standard approach in the WASH sector.

Commonalities Amongst High Scores

Each table displays the percentage of highest scoring interventions that incorporate the category in each of the five scoring groups as well as the score for the entire group of twelve interventions. The tables below are explanations of each finding as well as supportive participant observation when available.

TABLE 4: Combined Interventions

Scoring Group	Combined Intervention (Technology, Behavior Change, Community Development)
Achieved Outcomes	75.0%
Most Effective Measured Outcome	75.0%
WASHplus Framework High Score	100.0%
WaterAid Framework High Score	100.0%
Overall Framework High Score	100.0%
Entire Group	50.0%

A dominant theme that emerges from the data is that the highest scoring interventions implemented a combination of providing technology, inciting behavior change (training and education), and community development in the intervention approach. Community development is defined by starting or supporting WUCs, collaboration with government entities, creating networks, or other cross-sectoral coordination. There were three associations with high scores and implementing the combination of technology, inciting behavior change, and community development:

1. WASHplus framework high score
2. WaterAid framework high scores
3. Combined framework high scores

TABLE 5. Results – Capacity Building

Scoring Group	Capacity Building
Achieved Outcomes	100.0%
Most Effective Measured Outcome	100.0%
WASHplus Framework High Score	100.0%
WaterAid Framework High Score	100.0%
Overall Framework High Score	100.0%
Entire Group	66.7%

Capacity building is a key factor for effective interventions; all highest scoring interventions incorporate capacity building in some form, compared to 66.7% of the entire group of interventions. For these interventions, capacity building takes the form of establishing WUCs, creating training and promotions programs, as well as involving local and national governments in WASH activities. For Project Hearts, the organization I worked with in the Dominican Republic, the WASH Days program depends on

incorporating and expanding another program, the Community Health Leader program. Since most of the communities are small, the Community Health Leaders are well known women who are known as a resource for basic health and first aid knowledge and are frequently used resources for basic health and first aid. Most of the participants in the WASH Days program attribute their participation in the program to Community Health Leaders who encourage them to participate (Burgess, 2015). Without the capacity building aspect of the WASH Days program, the program scope is severely limited.

TABLE 6. Results – Technology chosen by user

Scoring Group	Technology Chosen by User
Achieved Outcomes	25.0%
Most Effective Measured Outcome	25.0%
WASHplus Framework High Score	50.0%
WaterAid Framework High Score	83.0%
Overall Framework High Score	50.0%
Entire Group	29.0%

In three out of five of the scoring criteria, the highest scoring interventions do not incorporate a "technology chosen by user." This result is counterintuitive, as user participation being a key factor (see "Standards" section above) implies that increased beneficiary decision-power leads to a more sustainable intervention. Also, the fact that WaterAid includes "Technology fit for purpose & chosen by user" in the framework implies that beneficiary choosing power is important for the sustainability of interventions. However, the analysis of these twelve interventions through these two frameworks yields the opposite effect, as seen in Table 6, most of the highest scoring interventions do not supply technologies that are chosen by the beneficiary. This does not

mean that the beneficiaries were not involved in deciding the direction of the intervention, but it does mean that there is some influence that comes from the intervening organization regarding which specific technology is most appropriate.

TABLE 7. Results – Environmental Aspects

Scoring Group	Environmental Aspects Addressed Properly
Achieved Outcomes	100.0%
Most Effective Measured Outcome	75.0%
WASHplus Framework High Score	75.0%
WaterAid Framework High Score	100.0%
Overall Framework High Score	100.0%
Entire Group	66.7%

Addressing environmental aspects properly was a factor for all scoring criteria. Although only 67% of the interventions in this study address environmental aspects properly, it is addressed by most of the highest scoring interventions. WaterAid defines "properly addressed" as focusing on both the security of the water source and enhancing the concept of sanitation for the beneficiary (Carter et al., 2011). In rural Nicaragua, working with El Porvenir, I saw in the evaluation results that WASH education based on watersheds and promoting the separation of washing locations, drinking water collection, and sanitation was highly effective (Burgess, 2015). Households that we visited were often eager to show us their reforestation projects, promoted by El Porvenir for water retention on the rural landscape that has mostly been turned to farm and pastureland with little concern for the environment.

TABLE 8. Results – Both Water & Sanitation

Scoring Group	Incorporated Both Water & Sanitation Technology
Achieved Outcomes	50.0%
Most Effective Measured Outcome	100.0%
WASHplus Framework High Score	75.0%
WaterAid Framework High Score	100.0%
Overall Framework High Score	100.0%
Entire Group	50.0%

Incorporating sanitation technology with water supply technology leads to more sustainable interventions than either one independently. Coupling the two seems to strengthen the beneficiary's investment into the intervention in my experience, especially in rural Nicaragua where water supply, sanitation, and the health of the watershed are tightly intertwined. Most households that are without latrines get their drinking water and do their washing (personal, dishes, clothing) in the same place while defecating in the open – creating many vectors for transmitting water borne diseases. The low (50%) rate of including both sanitation and potable water technologies in the entire study group of interventions shows that this approach is still novel – and the tendency to focus on one aspect of WASH may be a symptom of the common "quick-fix" approach.

TABLE 9. Results – Water Use Committees (WUCs)

Scoring Group	Created or Supported Water Use Committees (WUCs)
Achieved Outcomes	50.0%
Most Effective Measured Outcome	100.0%
WASHplus Framework High Score	100.0%
WaterAid Framework High Score	100.0%
Overall Framework High Score	100.0%
Entire Group	50.0%

Although not a specific category on either framework, "Creating or Supporting Water Use Committees (WUCs)" emerges as a critical component of a sustainable intervention. As seen in Table 9 only two of the highest scoring interventions did not create or support WUCs, leaving the remaining four scores with 100% coverage of this parameter. The low (50%) rate of including both sanitation and potable water technologies in the entire study group of interventions shows that this approach is still novel – acting outside of the direct service of the intervention may be considered beyond scope for some organizations.

TABLE 10. Results – Capital Contribution

Scoring Group	Capital Contribution from Beneficiary (in kind or fee)
Achieved Outcomes	75.0%
Most Effective Measured Outcome	100.0%
WASHplus Framework High Score	100.0%
WaterAid Framework High Score	100.0%
Overall Framework High Score	100.0%
Entire Group	66.7%

Capital contribution from the beneficiary is an important component to a sustainable intervention. WaterAid's definition of capital contribution includes in-kind (materials or labor) or fee-based contributions. Fee-based contributions can be a singular payment for a technology or an ongoing payment for a service (Carter et al, 2011). Research shows that beneficiaries are more invested and likely to care for the technologies if they contribute, which leads to further longevity and sustainability of the intervention (Carter, Casey, & Harvey, 2011). Before launching the WASH Days program in the Dominican Republic, the organization Project Hearts received free water

filters that were donated by another organization and indiscriminately gave them out to families in need. During the baseline WASH assessment for the community, we found that a fraction of these filters were still in use, which was the reason for instituting a finance system for the beneficiaries (Machado, 2015). There had been no system to keep track of the filters or for training the beneficiary on maintenance and proper use. If the system is set up correctly, all the money collected from beneficiaries goes directly back into the program, and the amounts collected are usually less than the cost of the technology itself (Carter et al., 2011).

TABLE 11. Results – Monitoring System

Scoring Group	Monitoring System in Place
Achieved Outcomes	75.0%
Most Effective Measured Outcome	75.0%
WASHplus Framework High Score	87.5%
WaterAid Framework High Score	83.0%
Overall Framework High Score	87.5%
Entire Group	54.0%

Monitoring systems prove to play a critical role in the sustainability of interventions. The importance of monitoring and evaluation is increasingly recognized in the WASH sector, but can only be part of interventions in which the organization plans to be available for extended amounts of time after implementation (Sobsey, Stauber, Casanova, Brown, & Elliott, 2008; Ogunyoku, Nover, McKenzie, Joshi, & Fleenor, 2011). Commitments to ongoing consultation and dialogue between intervening organization and beneficiary are sparse in the interventions analyzed in this study which is reflected in the low score for "Monitoring System in Place" for the entire group – 54%.

TABLE 12. Results – Support System for Local Management

Scoring Group	Support System for Local Management (post-intervention)
Achieved Outcomes	75.0%
Most Effective Measured Outcome	75.0%
WASHplus Framework High Score	100.0%
WaterAid Framework High Score	100.0%
Overall Framework High Score	100.0%
Entire Group	62.5%

Creating "Support systems for local management post-intervention" is a key strategy for ensuring the sustainability of interventions. According to the WaterAid framework, support can be "light", however there needs to be a resource in the event that local management experiences challenges in "skills and knowledge, material resources, relationships and trust, and power." (Carter et al., 2009, pp. 19-20). In the entire study group, only 62.5% of interventions have support systems for local management in place. Like establishing "monitoring systems" and "creating or supporting WUCs", the category of "Support systems for local management post-intervention" requires an organization to commit to an ongoing relationship with the community.

TABLE 12. Results – Cross-Sectoral Coordination

Scoring Group	Cross-Sectoral Coordination
Achieved Outcomes	50.0%
Most Effective Measured Outcome	75.0%
WASHplus Framework High Score	75.0%
WaterAid Framework High Score	66.7%
Overall Framework High Score	75.0%
Entire Group	33.3%

The implementation of "Cross-Sectoral Coordination," meaning the organization breaches the boundary of working solely in the WASH sector, is rare in this study as seen in the 33.3% rate of incorporation. However, the highest scoring interventions incorporate cross-sectoral coordination at an average rate of 68.3%. Although the ability to involve multiple sectors could be partly indicative of a larger-scale organization with a higher investment ability, the highest scoring interventions in this study are from highly varying scales of investment and capacity is not an influential factor for success of interventions in this analysis.

Involving schools is an efficient and effective way to build the community's capacity for WASH infrastructure and knowledge sharing. For the WASHplus category, the highest scoring interventions all involve local schools in the program As mentioned in the "Study Design" section, I altered the category from School-led Total Sanitation (SLTS) to "School Involved", as the SLTS category limited the scope of involvement to an entire movement, which is not currently implemented in Central America and the Caribbean widely enough to assess accurately (Adhikari & Shrestha, 2008). In rural Nicaragua, El Porvenir uses schools as community water points due to their centralized locations, schools are not owned by a single family in the community, schools can be accessed by everyone in the community, schools are generally respected as a safe zone, and signage with directions for use and hygiene education are more available and protected by the school's structures and mutual respect for the space amongst community members.

The category, "Support to Supply Chains" is important as evident in the high number of entries in the "WASHplus Framework High Scores" scoring group. Only 38% of the entire group of interventions in this study provide support to supply chains, which is repeatedly identified in WASH literature as crucial for sustainability of interventions (Sobsey et al., 2008).

Associations

As explained in the "Study Design" section, for an association to exist between a given framework-field and high scores in one of the five scoring groups, the association must fit one of two criteria:

1) The four interventions with the most entries in the given field are represented by at least one of the five scoring groups

   OR

2) The four overall highest scoring interventions (USAID – Dominican Republic, Water for People – Honduras, Water for People – Guatemala, El Porvenir - Nicaragua) are represented with the highest number of entries in that field.

An association exists between high scores in the WASHplus framework and the interventions with the highest number of entries in the "Promotions" field – meaning that promotions is a key element to the sustainability of interventions. All the interventions with the most entries under the "Promotions" field are represented in the WASHplus framework high scores (the highest overall framework score represents 67% of the highest "Promotions" scores and the remaining scoring categories represent 33%). In my

experience in Nicaragua working with El Porvenir, it was surprising to see how effective promotions can be for WASH interventions. Every week El Porvenir hosts an hour-long radio show that promotes not only El Porvenir's current activities but also includes WASH education and training delivered in an entertaining way. Upon performing the program evaluation for El Porvenir, I found that radio is the primary form of media entertainment in the rural communities and that the show is listened to regularly and is highly esteemed in most communities (Burgess, 2015). Even more interesting, the data shows a higher frequency of beneficiaries sanitizing latrines and washing stations properly when the beneficiary listens to the show on a regular basis. (Burgess, 2015).

An association exists between high scores in the WASHplus framework and the number of entries in the "Enabling Environment" field – meaning that creating a supportive environment for the intervention to function is a key element to the sustainability of interventions. All the interventions with the most entries under the "Enabling Environment" field are represented in the WASHplus framework high scores. The "Outcomes Achieved" score only represents 25% of "Enabling Environment" scores, however the most "Effective Measurable Outcome" and the WaterAid framework high score represent 50% while the highest overall framework score represents 75%. "Enabling Environment" means many things, but the core function is an enduring relationship and ongoing dialogue between intervening organization and community. In my experience in both the Dominican Republic and Nicaragua, one crucial component of creating an enduring relationship with the community is having a central office that is open for consultation with community members. For crisis situations, supply chain

issues, or general guidance on WASH related inquiries, the central office plays a crucial role in enabling the community to develop sustainably.

An association between establishing a "Community-based, externally supported Operation & Maintenance (O&M) system" and all four highest scoring interventions (USAID – Dominican Republic, Water for People - Honduras, Water for People - Guatemala and El Porvenir – Nicaragua) – meaning O&M systems are key elements to sustainable interventions. In addition, both the "Highest WIF Framework" and the "Highest WSF Framework" as well as the "Highest Combined Framework" scores meet the criteria for the category. The association indicates that the Community-based, externally supported O&M system is important for the sustainability of interventions as supported by WASH literature (Ogunyoku et al., 2011; Sobsey et al., 2008). As found repeatedly throughout this analysis, incorporating a "Community-based, externally supported O&M system" is another example of a strategy that requires an organization to commit to post-intervention involvement.

Discussion & Recommendations

First I discuss the dominant themes that emerged throughout the analysis. Then, I discuss the functionality and dynamics of using the two frameworks to evaluate WASH interventions broken down into advantages and limitations of each. Expanding on the limitations of the frameworks, I then explain the current limitations to collecting and analyzing WASH intervention data. To address the limitations and to act on the results of this study, I conclude the section with a recommended framework for sustainably approaching WASH interventions in Central America & the Caribbean.

Dominant Themes

Two main themes emerge from the analysis. The first theme is the highest scoring interventions tend to take a holistic approach – employing strategies that expand on the direct WASH service to address things that may affect the sustainability of interventions. The other main theme that emerges is external involvement – creating systems that enable organizational support post-intervention. Both themes represent interventions that move outside of direct service and cultivate aspects that support WASH in a wider sense.

Holistic Approach

The highest scoring interventions in each scoring group tended to implement strategies that incorporate more than the intervention itself; these strategies expand on the direct service of the intervention to enhance other related factors. For example, all highest scoring interventions implemented a combination of technology, behavior, and community development, as well as incorporated both water and sanitation technology. This means that for the intervention to be high scoring, it must focus on more than simply providing a technology or conducting behavior change education. It also means that each independent technology is more effective in an intervention if it is provided alongside the other technology. For an intervention to provide leverage and catalyze further community development, it needs to transcend providing either a service or a technology and rather provide a functioning system.

Interventions that use a holistic approach consistently appear in the categories of "Creating or Supporting WUCs" and "Capacity Building." Constructing institutions and encouraging partnerships that support WASH activities leads to more sustainable

interventions in this study group, and this is reflected in my experience as well. The WASH Days program in the Dominican Republic would not exist without the partnership of at least four other organizations. Partnerships can expand to "Cross-Sectoral Coordination" which is not prevalent in this study group, although most of the highest scoring interventions coordinate with entities beyond the WASH field.

Other holistic approaches represented by the highest scoring interventions in the analysis include "Addressing Environmental Aspects Properly" and "Involving Schools." The holistic approaches discussed in this section are like the next theme, external involvement, which also emerges as a theme representing action beyond direct service from the intervening organization.

External Involvement

Like the holistic approaches theme, the other dominant theme involves interventions that incorporate more than direct service – they incorporate aspects that keep the intervening organization involved after implementation. For example, the entire field, "Enabling Environment" in the WASHplus framework proves to be associated with high scores. An "Enabling Environment" consists of the following categories: Supportive Policy, Tariffs, Regulations; Institutional Strengthening; Capacity Building; Coordinated Planning/Budgeting; Financing/Cost Recovery; and Cross-Sectoral Coordination.

Aside from the WASHplus framework, categories that rely on external involvement that emerge from the WaterAid framework include "Support to Supply Chains" and "Support Systems for Local Management." These aspects ensure that the intervention's effects will continue after implementation with some degree of

involvement from the intervening organization. The framework definition states that external support can be "light" and still effective (WaterAid, 2017). It is also important to have a "Monitoring System in Place" that the organization can refer to ensure correct, continuous, and consistent use of the technology or behavior change after initial implementation. The monitoring data can be used to secure future funding or to redirect efforts that are not producing desired effects.

As seen in the WASHplus framework, one entire field in the WaterAid framework was found to be associated to high scoring interventions – "Community-Based, Externally Supported O&M System in Place." Although this category may encompass aspects like supply chains and support systems for local management, it stands alone because O&M is crucial for transcending direct service. Without a system for troubleshooting that is supported by the intervening organization, the beneficiary community is left to themselves to handle any externality without a knowledge base.

The final result that highlights the External Involvement theme is counter-intuitive. From the outside, it would make sense that an intervention would be more effective if the "Technology was Chosen by User." However, this study showed the opposite effect. The highest scoring interventions did not mention allowing the beneficiaries to choose the technologies. This result points to the notion that some level of expertise is necessary to effectively guide WASH development – which further emphasizes the demand for effective WASH sustainability frameworks.

Advantages

The uncomplicated design of the WASHplus framework makes it intuitive; program initiation and implementation stages are clearly delineated as the fields "Access to Hardware & Services" and "Promotions." These stages are kept separate from the program execution stage where an "Enabling Environment" is conceptually created by the intervening organization. This workflow is widely used in Project Management and is applicable to conceptualizing global WASH programs (Cooke & Tate, 2010). Although simple in design, WASHplus is non-linear. This is advantageous because it does not depict an end to the intervention; rather, it depicts an ongoing relationship between organization and beneficiary.

The WASHplus framework is progressive because it incorporates Menstrual Hygiene Management (MHM), which is relatively novel in the WASH field. Gender issues are not often recognized in WASH interventions and since women in Central America & the Caribbean are largely responsible for WASH activities, the concept of "gender mainstreaming" is crucial for sustainable interventions (Water and Sanitation Programme, 2010). Gender mainstreaming is defined by the World Bank's Water and Sanitation Program as, "the process of assessing the implications for women and men of any planned action, including legislation, policies or programs, in all areas and at all levels." (Water and Sanitation Programme, 2010). Although MHM is not grouped optimally within the framework (see below), its presence shows that the thinkers at USAID incorporate progressive strategies.

Another progressive strategy within the framework (although also not presented optimally) that is not often considered is school involvement in the intervention. In rural communities, schools often serve doubly as community centers and can provide a neutral access point for community water interventions (Burgess, 2015). Since schools are not owned by any individual family, no power dynamics are created when using schools as water access points. El Porvenir in Nicaragua uses this strategy when prospecting for locations for rural community wells, and they are even able to post education materials about water treatment at the well, as seen in Figure 4.

FIGURE 4: Space for educational material at well-site at a local school in Camoapa, Nicaragua

However, the way in which USAID presented school involvement in the framework is limiting for evaluating WASH interventions.

Limitations

As mentioned in the "Study Design" section, there are redundant categories in the WASHplus framework that were collapsed into other categories. The framework represents interventions in Central America & the Caribbean more effectively with these edits. The limiting categories and the changes are listed below in Table 14.

TABLE 14: Limiting Categories & Proposed Changes

Limiting Category	Change to Framework
"Soap, Containers, Water Treatment, Consumables, Menstrual Hygiene Management, and Anal Cleansing"	1. Water Treatment Removed (collapsed to "Water Supply") 2. Menstrual hygiene management becomes own category
"Fecal Sludge Management"	Collapsed to "Sanitation Systems"
"Social Marketing"	Collapsed to "Mass Media"
"Financing/Cost Recovery"	Collapsed to "Coordinated Planning/Budgeting"
"School-Led Total Sanitation (SLTS)"	Changed to "School Involvement"

Reiterated above, MHM is so rare in interventions in Central America & the Caribbean that I recommend that it should be its own category. Isolating and highlighting

MHM could catalyze more action in this area, which has been shown to strengthen attendance in schools as it can be a culturally sensitive issue (Sommer & Sahin, 2013).

WASHplus includes the category "School-led Total Sanitation (SLTS)." SLTS is a model with proven success in Nepal that focuses sanitation efforts at the school level with the goal of proper WASH habits permeating into their communities (Adhikari & Shrestha, 2008). The model has also been implemented in Sierra Leone & India (Institute of Development Studies, 2011). However, SLTS has not been implemented in Central America & the Caribbean, and the specificity of the category limits the framework by only including activities in schools that are central to the intervention. Excluding periphery activities like WASH curricula or school events from the framework does not lead to an accurate portrayal of WASH in schools in Central America & the Caribbean. Instead, I recommend the category title, "School Involvement" which encompasses a holistic approach to interventions that still includes schools as a pivotal institution that can lead to a more sustainable intervention.

Finally, the WASHplus framework does not have an accompanying definition-document. A supporting document that explicitly defines the parameters of each category would have greatly enhanced the usability of the framework. This limitation was particularly highlighted by the fact that the WaterAid framework has a definition-document as described.

Advantages

The WaterAid framework is structured with more priority on certain categories which gives it a highly dynamic nature. "Community-based, externally supported O&M system in place" is the center of the framework, and is included as a category but also given the weight of an entire field. This extra emphasis solidifies that O&M systems are keystones for sustainable interventions. Like the WASHplus framework, the layout of the WaterAid framework is non-linear, therefore an ongoing relationship between intervening organization and beneficiary is displayed. Prioritizing the ongoing relationship is prevalent in other parts of the framework as well – for example, in the categories that call for creating systems.

WaterAid has a focus on creating systems; the framework includes a minimum of three systems that make a sustainable intervention: 1) Monitoring system in place 2) Community-based, externally supported O&M system in place 3) Management systems. Since there is a current need for effective conceptual strategies for WASH, a focus on systems is advantageous for the WaterAid framework. Creating systems also enables intervening organizations to take a step back and let the community take more control by operating the system, reaching the outcomes themselves. Donelle H. Meadows discusses the connection between systems thinking and sustainability further in *Thinking Systems: A Primer*.

One specific category that WaterAid includes in the framework that is advantageous to sustainable interventions is, "Environmental aspects addressed

properly." Environmental factors are intrinsically linked to sustainability, so it is vital for

sustainable development. This strengthens the framework as a model for Central America

& the Caribbean because of the drought periods that are expected to increase due to

climate change (Intergovernmental Panel on Climate Change, 2014). One of the

interventions in this study located in Hato Mayor in the Dominican Republic is an

example of ignoring environmental factors. Although the intervention was a large-scale

program implemented by USAID with a large budget, the interveners did not sufficiently

address drought when designing the community water systems and it was reported as a

"critical undersight." (Miranda & Zelaya, 2006). The other specific category that is

advantageous for the framework is "Support to Supply Chains." As mentioned many

times in this paper, supply chains are often a limiting factor to success of interventions

(Sobsey et al., 2008).

Finally, perhaps the greatest advantage of the WaterAid framework is the

supporting document that explains the criteria for each category exhaustively (Carter et

al., 2011). This document truly makes the framework a worthy tool.

Limitations

Although not based in redundancy like the WASHplus framework, the WaterAid

framework is also limited by the design of certain categories.

The category "Technology fit for purpose & chosen by users" should be

separated, as they reflect different things. A technology being fit for its purpose is a

scope-based concern, while the technology being chosen by the beneficiary is a concern

about the autonomy of the community. Although these aspects of the provision of

technologies are connected to one another and related to the sustainability of interventions, the data can become skewed from one or the other not being part of the intervention. Further, in this study the beneficiary choosing the technology was not associated with high scores; rather, the effect was the opposite (see "Findings"). This is a complicated and delicate aspect of interventions to navigate because an intervening organization may have pre-existing interest in the provision of a certain technology due to factors like funding sources or business opportunities. These interests are beyond the intervention itself and they have the potential make decisions about technologies complicated both politically and bureaucratically. In the following example that occurred during my time at Project Hearts in the Dominican Republic, the complicated nature of choosing technologies is shown: Catalyzed by a partnership, we were presented the opportunity to get receive all the ceramic filters for the program subsidized on the condition that we sourced them from a local factory. In this case, control over the choice of technology was not based in outside profit, however, these conditions can still limit maneuverability in an intervention. My recommendation is to eliminate the "technology chosen by users" portion of the category altogether as it does not seem to be related to the sustainability of an intervention. However, it is important for the beneficiary to be part of the decision, and this is encompassed under the category "Full user participation."

Another limiting aspect of the framework is the parameters of the field, "Community-based, externally supported O&M system in place." I recommend the field be replaced with, "Creating or Supporting WUCs" because this would capture more beneficial information than an ambiguously defined O&M system. WUCs are established institutions that can efficiently liaison with outside organizations for guidance on all

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aspects of the intervention, encompassing all aspects of O&M and eliminating the need for its own category.

Finally, the "High Quality Implementation" category is too arbitrary. In this study, I required a justification for an intervention to receive a score in this category (see "Study Design"). I recommend discarding this category altogether to keep the framework succinct and conceptually relevant.

Current Limitations to Collecting/Analyzing WASH Data

Throughout this study the analysis shed light on the limitations to collecting, analyzing, and comparing WASH data. The following section explains two themes regarding these limitations. The first section is, "Hard to Compare" followed by, "Hard to Measure." The section ends with an explanation of potential approaches to addressing these limitations.

Hard to Compare

The WASH field needs a more standardized method for reporting outcomes; currently the terminology and metrics used are not fluid and the ability to compare outcomes is complicated. Many outcomes are ambiguous or worded in a way that makes them impossible to compare to other organizations' outcomes even when they are essentially equivalent in effect. Table 15 highlights some examples from the interventions included in this study.

TABLE 15: Problems with outcomes

Intervention	Outcome	Reason Incomparable
American Red Cross (ARC) Post-Hurricane Mitch	% of households with appropriate handwashing behavior	Terminology
USAID - Dominican Republic	6 promoted macrobehaviors observed	
FEMSA - Nicaragua	increased number of community members trained in healthy living	Ambiguous
FEMSA - Mexico	increased number of trained individuals on health & hygiene	

Examples of outcomes that are widely used in the WASH field currently include:

- Increased access to improved water source
- Increased access to improved sanitation
- % reduction in childhood diarrhea under age 5
- % reduction in monthly income spent on drinking water

Although these outcomes are reported frequently in WASH, they are often reported with varying terminology that renders them incomparable. It is difficult to identify trends in various regions around the world when a researcher is unable to make assertions without validity.

Hard to Measure

Effects of interventions are difficult to measure for many reasons including availability of rural health data, long durations needed to gather data regarding health aspects like diarrhea (change is observed over years), and ensuring the correct, consistent and continuous use of technology or behavior change provided. It can be difficult to measure important attributes of WASH interventions other than in qualitative studies like this one because of criteria like, "training", "capacity building" or "level of support."

Measuring these criteria takes considerable resources and time to ensure validity. The inability to measure vital attributes of interventions is a steep barrier to overcome. However, there is an approach that is used widely across many sectors that could address the limitation as well as enhance other areas of WASH reporting.

Addressing Limitations

One way for the WASH sector to improve on both the incomparability and difficulty of measuring program outcomes is to adopt "Shared Management Systems" that are a main component of the "Collective Impact" approach to collaboration. Collective impact is a "structured approach to making collaboration work across government, business, philanthropy, non-profit organizations and citizens to achieve significant and lasting social change" (Kania & Kramer, 2011). A key component of collective impact is standardized metrics amongst organizations that work in the same sector – known as "Shared Measurement Systems." Organizations create and share reports under the same protocols for increased availability of data, comparability, and collaboration. In the WASH field, the Millennium Water Alliance (MWA) has implemented collective impact by becoming a "partnership broker" for WASH organizations in Ethiopia; they established a coalition and encouraged a standardized approach for reporting and sharing data (Davis & Dundon, 2013). Although MWA is active in Latin America, the collective impact model has not been implemented widely in Central America & the Caribbean (Millenium Water Alliance, 2017).

To further address these limitations and to act on the results of this research, I conclude the "Findings" section with a recommended framework for sustainably approaching WASH interventions in Central America & the Caribbean.

Recommended Framework

The framework displayed in Figure 5 is an amalgam of the most important categories that emerged from each framework and categories that I recommend based on participatory experience and the current WASH literature. The categories chosen as most important met the following criteria:

- Category is incorporated by at least 83% of interventions
- Category is represented by the highest scoring interventions in the five different scoring groups (see "Findings")
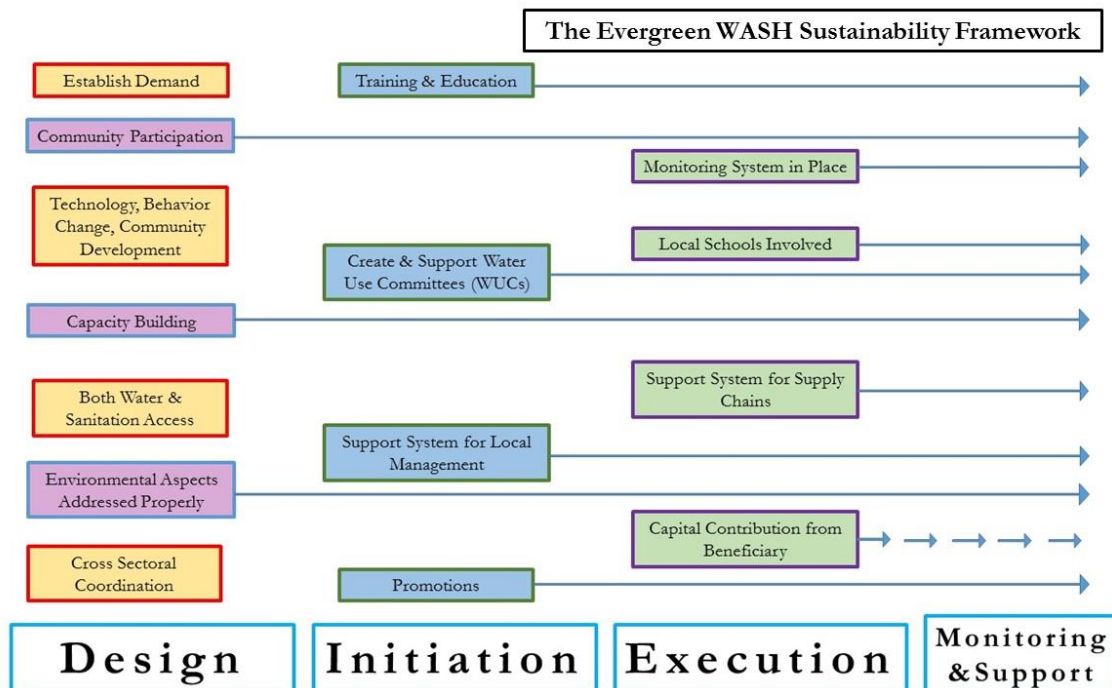

FIGURE 5: New Framework - The Evergreen WASH Sustainability Framework

The title, "The Evergreen WASH Sustainability Framework" provides credit to the institution where the author of this thesis performed the research. The framework follows the stages of a modified Project Management plan, from "Design" to "Monitoring & Support" (Cooke & Tate, 2010). Each component begins at a given stage and continues through the following stages as the intervention progresses. The arrow for "Capital Contribution by Beneficiary" is dotted because if the intervention is a service, there may be an ongoing fee required. As depicted in both the WASHplus and WaterAid frameworks, there is no endpoint shown due to the expectation of an ongoing relationship between organization and beneficiary.

Conclusion

USAID's WASHplus Improvement Framework and WaterAid's WASH Sustainability framework proved to be effective for designing and evaluating interventions in Central America and the Caribbean but not without limitations. To shed more light on these frameworks' utilities, this study should be replicated for another region with high demand for WASH improvement like Southeast Asia or Sub-Saharan Africa (UNICEF & WHO, 2015). Further, this study could be altered to focus on emerging sub-sectors of WASH like Community Led Total Sanitation or School Led Total Sanitation.

The key strategies that lead to sustainable interventions in Central America and the Caribbean are taking a holistic approach and implementing systems of strong external support after the intervention takes place. Both strategies involve the intervening

organization investing more time into interventions whether the additional effort is expanding on direct service or keeping systems functioning externally. Future research should explore the specific systems that organizations can lightly support after intervention that lead to the longest lasting and most effective efforts.

It is crucial to build a stronger theoretical base for the WASH sector to make the $220 billion annual efforts justifiable and to eliminate the remaining gap between the global north and south that leaves a huge portion of the world without basic human needs.

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