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A Case Study of Operation & Maintenance of School WaSH Facilities

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Introduction

Safe drinking water, improved sanitation, and hygiene (WaSH) in schools is globally recognized as a pre-requisite for the right to a basic education[1,2]. Academic research suggests that if school children have access to sufficient and safe drinking water, clean and appropriate toilets, and functioning handwashing facilities with soap, they will be healthier and perform better in school[2]. In particular, all-inclusive access to improved water and sanitation has been estimated to result in 1.9 billion school days gained due to a reduction of diarrheal diseases among students globally[3].

Despite the potential contribution of improved WaSH in schools to students' education and health, evidence shows that these benefits can be extremely heterogeneous over the long-term as they depend on sustained operation & maintenance (O&M) [4,5,6,7]. Hundreds of projects around the world demonstrate how newly built WaSH infrastructure deteriorates quickly after they are built if proper O&M is neglected[4,8]. Sustaining successful O&M is intimately linked to the presence of an enabling environment that includes government oversight and commitments, provision of adequate funding, school leadership and management, clear roles and responsibilities, monitoring and accountability, and adequate technical support[9].

1 Adams, J., Simms, J., Chartier, Y., Bartram, J. & Organization, W. H. Water, Sanitation and Hygiene Standards for Schools in Low-Cost Settings. World Health Organization, Geneva, Switzerland, 2009
2 Jasper, C., Le, T.-T. & Bartram, J. Water and sanitation in schools: a systematic review of the health and educational outcomes. International Journal of Environmental Research and Public Health 9, 2772–2787.2012.
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4 WHO (2012) Towards Sustainable O&M : Module 3. Geneva. World Health Organization
5 Castro, V. Msuya, N. Makoye, C. (2009) Sustainable Community Management of Urban Water and Sanitation Schemes (A Training Manual). Nairobi: Water and Sanitation Program-Africa, World Bank
6 Harvey, B. (2015) Chapter 9: Operation and Maintenance Consideration. UNHCR WASH Manual. Geneva
7 WASHplus. 2015. School WASH Facilities Operation and Maintenance Guidelines. Washington DC: USAID/WASHplus Project
8 Arab, N. Hilal, M. Montell, L. (2015): Empowering for dignity: Best Practices of Community WASH Committees in North Lebanon. Water, Sanitation and Hygiene beyond 2015. Loughborough: Loughborough University
9 Freeman. M.C., Saboori, S., Porter, S., Rheingans, R. (2010) Assessing the sustainability and effectiveness of school WASH projects: a toolkit. Atlanta, GA, USA. Centre for Global Safe Water at Emory University

The Cántaro Azul Foundation (FCA), with support from UNICEF Mexico, collected information on current and historical WaSH O&M practices, WaSH O&M financing, and factors related to the enabling environment in 21 schools in Chiapas, Mexico. This effort was combined with a multi-armed intervention aimed at improving WaSH environments and hygiene practices in schools that were affected by the September 2017 earthquake. This case study characterizes our findings concerning the WaSH O&M system and WaSH enabling environment for the included schools.

Approach

Setting and selection: Two lists of schools damaged by the 2017 earthquake were compiled independently by UNICEF and Cántaro Azul. The lists were compared and schools located in Chiapas were visited to conduct a needs survey and corroborate damages. Of the schools visited, 21 were chosen to intervene directly. Schools included ranged in size, level (e.g. pre-school, etc.), geographical region and pre-existing condition of water, sanitation, and hygiene infrastructure.

Table 1. Summary of selected schools

Total number of schools surveyed	21
Avg. student enrollment (min, max)	229 (53, 875)
Avg. male student enrollment (min, max)	116 (20, 460)
Avg. female student enrollment (min, max)	113 (19, 415)
Total number of schools with at least 1 student/staff with limited mobility	7

Key informant interviews were conducted with 1) the school director, 2) president of the parent's committee, 3) the treasurer of the parent's committee, and 4) the school janitor. Questions concerning the WaSH O&M system and the WaSH enabling environment were asked. These included,

the range of WaSH related issues/expenses in the school over the past 5 years, other major or reoccurring issues/expenses in the school, financial resources, technical resources, and about the organizational/decision-making structures. FCA conducted the first round of interviews in September 2018. They assessed the information collected and found gaps with the interview format so they conducted 2 rounds of follow-up interviews from November 2018 to January 2019. All interviews were semi-structured to allow for follow-up questions, were conducted in-person, and the audio was recorded to allow for future reference and analysis.

School visits, to conduct direct observation of the state of school WaSH infrastructure prior to Cántaro Azul Foundation's intervention, took place in all 21 schools from July 2018 to August 2018. Structured surveys were used by trained staff to assess the school WaSH infrastructure. Space for contextualizing comments was available to the enumerator.

Condition of WaSH facilities in schools

The following description of WaSH facilities in schools was captured prior to Cántaro Azul's intensive multi-arm intervention that took place from September 2018 to January 2019.

Water. Drinking water and non-drinking water access was high amongst schools included in the case study. Twenty out of the 21 schools (95%) included in the case study were observed to provide drinking water to their students [see Table 2]. Water quality tests were performed and all drinking water sources were found to microbiologically safe (<1 MPN E. coli). Of the 20 out of 21 schools that provided safe drinking water, all provided purchased bottled water as their main source of drinking water. All schools (100%) had access to a non-drinking water source on-plot.

Table 2. Summary of school WaSH conditions (n = 21)

Variable	N (%)
WATER	
Access	
Drinking water available	20 (95.2%)
Available water supply (non-drinking)	21 (100%)
Drinking water source type	
Purchased bottled water	20 (95.2%)
No drinking water source available	1 (4.8%)
Drinking water quality	
Safe drinking water available (<1 MPN E. coli)	20 (95.2%)
SANITATION	
Sanitation facility type	
Flush toilet	17 (81.0%)
Improved pit latrine	1 (4.8%)
Unimproved pit latrine	1 (4.8%)
No sanitation facility available	2 (9.5%)
Sanitation facility quality	
At least 1 usable toilet available per sex	18 (85.7%)
All available toilets were usable	0 (0%)
Avg. number of available toilets that were usable and clean (for females)	<1
Avg. number of available toilets that were usable and clean (for males)	<1
HYGIENE	
Access	
Hand hygiene facility available	18 (85.7%)
Hygiene facility quality	
At least 1 functional hand hygiene facility w. water available	18 (85.7%)
At least 1 functional hand hygiene facility w. water and soap available	10 (47.6%)

Figure 1

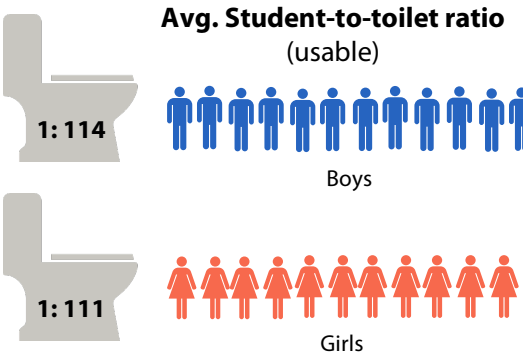
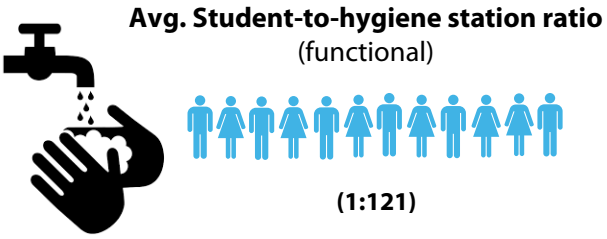


Figure 2



Sanitation. Nineteen out of the 21 schools (90%) were observed to have access to a sanitation facility [see Table 2]. The most commonly used type of sanitation facility was flush toilets (17 schools; 81%). One school had access to improved pit latrines (4.8%) and in another school the students only had access to unimproved pit latrines (4.8%).

Eighteen schools (86%) had at least one usable toilet available for girls and at least one usable toilet for boys. "Usable" here refers to a toilet that is single-sex, functional, and protects the privacy of the user [26]. All usable toilets were also observed to be improved sanitation facilities, or a flush/pour flush toilet or a pit latrine with slab[10]. While on average, there was one toilet per every 22 female students available and one toilet per every 24 male students available, there was only one *usable* toilet per every 111 female students and one *usable* toilet per every 114 male students [see Figure 1]. Even fewer sanitation facilities were both usable and clean. Across schools on average, there was less than one toilet that was both usable and clean (no smell, no flies, no feces on wall/floor) available for girls at a school [see Table 2]. Similarly, on average, there was less than one toilet that was both usable and clean available for boys at a school.

Hygiene. The majority of schools had a designated handwashing facility available (18 schools; 86%) [see Table 2]. Of the schools that had a designated handwashing facility, all had at least one functional facility with water available (18 schools; 86%). While 18 schools had at least one functional handwashing facility that provided water available, on average there was only one functional handwashing facility for every 121 students [see Figure 2]. Additionally, not all schools with functional handwashing facility had soap available. Only 10 schools (48%) had a handwashing facility with both running water and soap available [see Table 2].

School WaSH O&M systems and expenses

Resources & systems for O&M of WaSH facilities

Overall, schools surveyed, faced challenges in maintaining functional and clean WaSH facilities and all 21 schools reported limited financial resources as a major barrier to proper maintenance. To better understand the available systems for WaSH O&M, semi-structured interviews were conducted with key informants – 1) the school director, 2) president of the parent's committee, 3) the treasurer of the parent's committee, and 4) the school janitor. Trained staff from the Cántaro Azul Foundation spoke to these 4 key informants (where available) in all 21 schools.

All schools acknowledged that the responsibilities for the O&M of water, sanitation, and hygiene largely rested on the shoulders of the school director and the parent's committee. No formal budget of any kind existed in any school, and as a result no formal budget existed specifically for WaSH. The school director and parent's committee were typically jointly in charge of identifying problems within the school. A vote would take place amongst the parents and this was reportedly how decisions were

10 Joint Monitoring Programme. "Global Baseline Status of Targets and Indicators." SDG 6 Synthesis Report 2018 on Water and Sanitation, 2018, pp. 29–102

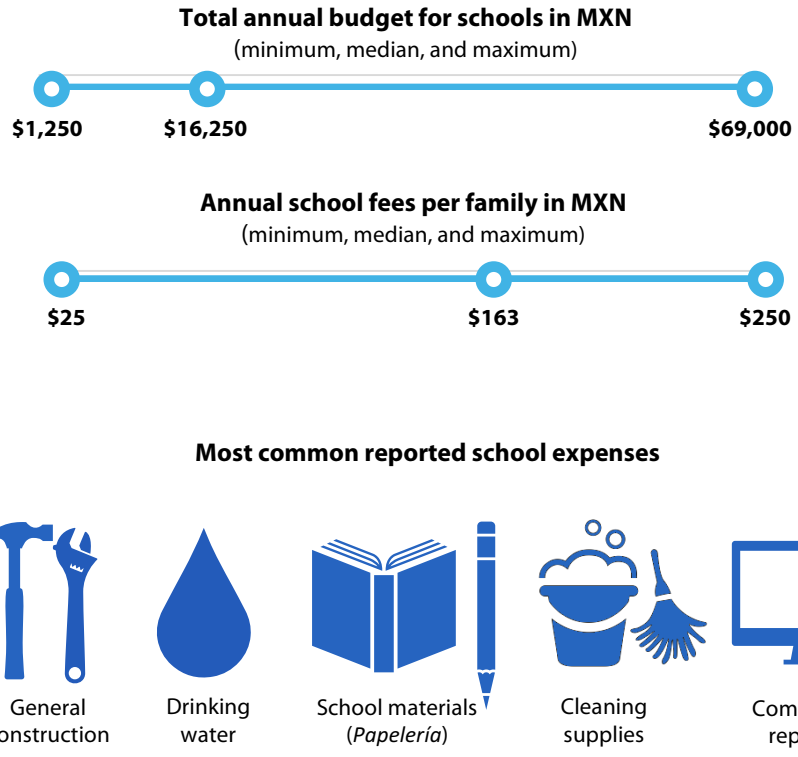
made concerning all school expenses and school repairs. This method for decision-making appeared to be consistent across all schools.

The parent's committee was in charge of collecting fees from each family every year. These fees made up the total annual school budget for all expenses outside of staff salaries, electricity, and the provision of non-drinking water sources, which were covered by the Ministry of Education (MoE). These expenses included all school materials used by the children, cleaning supplies, maintenance and repairs, bus fares for school staff to attend required meetings in the capital of Chiapas, and all WASH expenses including the purchase of drinking water. In a few schools, they also had a store that would provide snacks and sodas to the students during breaks and this money would help supplement the school budget provided by the parent's committee.

In most schools (86%) there was a janitor or cleaning lady present. They were often in charge of cleaning the school, which included the bathroom facilities. Traditionally the janitors were also in charge of doing minor repairs around the school and doing informal monitoring of the facilities, including sanitary/ hygiene facilities, and reporting damages to the school director. While these were the stated responsibilities FCA enumerators often found through their interviews that the cleaning of the bathroom facilities was often inadequate and the janitors were not typically trained in repairs, and usually a professional needed to be hired, even for minor repairs.

Total annual budgets varied widely but in all cases, were reportedly inadequate to cover all required expenses [see Figure 3]. The smallest annual budget reported was just $1,250 ($64.90 USD)[1] and the just $69,000 ($3,582.55 USD). From these budgets, the most commonly reported school expenses included, general construction, drinking water, school materials (e.g. paper, books, pencils), cleaning supplies, and computer repairs. WaSH expenditures

Figure 3



were not explicitly stated besides drinking water provision. However when probing follow-up questions were asked, we found other WaSH expenditures generally fell under cleaning supplies and general construction[11].

Fees were collected per family rather than per student, giving families with multiple students in the same school a little financial relief. The smallest annual fees per family were $25 MXN ($1.30 USD) [see Figure 3][12], the median annual fees were $163 MXN ($8.46 USD), and the largest annual fees were $250 MXN ($12.98 USD). While fees were relatively low, still parent's committees reported that not all families could afford to pay, reducing the annual budget that was available.

Historical WaSH O&M expenses/issues

FCA conducted three rounds of interviews with key school informants about WaSH O&M costs. During the first round of interviews, they discovered that no formal annual WaSH budget, besides drinking water, existed. Schools did report sporadic WaSH-related expenditures but they varied wildy from year-to-year. FCA enumerators found their original format did not accurately capture sporadic expenses and the range of WaSH expenses that might be incurred. They revised their design and returned for follow-up visits.

In their second round of interviews they asked about the range of WaSH-related issues/expenses that occurred in the school over the previous 5 years [see Table 3]. While FCA enumerators asked about specific amounts or estimates of costs, they often found that due to inadequate record keeping in most cases the respondent could not provide an actual quantity in pesos. Typically the respondent could provide details of the issue that occurred and if it was resolved or not. In a few cases respondents were able to provide estimates, but they seemed very uncertain. As a result, FCA provides ranges where information was provided by the respondent. However to provide context, they also provided the range of costs for WaSH repairs the Cantaro Azul Foundation incurred in Figure 4.

The range of WaSH-related expenses are organized into 4 categories adapted from "Sustainable Community Management of Water and Sanitation Schemes" from the World Bank's Water & Sanitation Programme[5].

- *Operation* includes activities that refer to the direct access to the system by the user (e.g. operating the hand pump) and the activities of any operational staff (e.g. operators of motorized pumps) or organizational bodies that manage the systems.
- *Preventative maintenance* includes work that is planned and carried out on a regular basis to maintain and keep the infrastructure in good condition, such as network inspection, flushing of the well, cleaning and greasing of mechanical parts and replacement of items with a limited lifespan. It sometimes also includes minor repairs and replacement as dictated by the routine examinations.
- *Corrective maintenance* includes replacing or repairing something that was done incorrectly or that needs to be changed; an example is the reallocation of a pipe route or replacement of a faulty pump.
- *Reactive maintenance* includes a reaction to a crisis or public complaint; it normally occurs as a result of failures and the malfunctioning or breakdown of equipment.

Operation & daily (recurring) activities were practiced in more schools than the other types of WaSH O&M practices [see Table 3]. Typically "operation & daily"

Photo credit: Carlos Alberto Cordero Contreras

5 Castro, et al. *Sustainable community management of urban water and sanitation schemes.*
11 More details concerning WaSH expenditures are detailed in the following sub-section.
12 Conversion rate used in this study was 19.26 MXN to 1 USD (Bloomberg).

Table 3. Summary of school WaSH costs and repairs reported from previous 5 years

Operation & daily (recurring) costs

Description of WaSH-related O&M activity (n = 21)	Activity practiced # (%)	Activity not practiced # (%)	Cost range reported/year+ MXN (USD)
Toilet paper purchased	15 (71%)	6 (29%)	--
Soap for handwashing purchased	12 (57%)	9 (43%)	$18 to $810 ($0.93 to $42.06)
Cleaning supplies purchased	20 (95%)	1 (5%)	$900 to $2,000 ($46.72 to $103.84)
Drinking water purchased	20 (95%)	1 (5%)	$960 to $7,700 ($49.84 to $399.79)
Water for non-drinking purposes purchased	0 (0%)	---	All schools were freely provided non-drinking water sources

Preventative maintenance

Description of WaSH-related O&M activity (n = 21)	Activity practiced # (%)	Activity not practiced # (%)	Cost range reported/year+ MXN (USD)
Regular inspection of pipes	2 (10%)	19 (90%)	--
Regular cleaning of the cistern	9 (43%)	12 (57%)	$500 ($25.96)
Regular repainting of bathrooms	9 (43%)	12 (57%)	--
Regular maintenance of wells (n = 9)	6 (43%)	3 (33%)	$250 to $800 ($12.98 to $41.54)
Fix small leaks in sinks, water systems, or toilets	5 (24%)	16 (76%)	$200 to $900 ($10.38 to $46.72)

Corrective maintenance - None reported.

Reactive maintenance

Description of WaSH-related O&M issue (# applicable)*	Issue resolved # (%)	Issue unresolved # (%)	Cost range reported++ MXN (USD)
Pipes – broken, clogged, or replace old (n = 17)	12 (71%)	5 (29%)	$300 to $9,000 ($15.58 to $467.29)
Toilets – clogged, overflowing, or non-functioning (n = 19)	6 (32%)	13 (68%)	$900 to $15,000 ($46.73 to $778.82)
Handwashing facility - cracked or broken (n = 17)	7 (41%)	10 (59%)	$500 to $2500 ($25.96 to $129.80)
Broken doors (n = 11)	2 (18%)	9 (82%)	---
Water pumps – fix or replace non-functioning (n = 18)	8 (44%)	10 (56%)	$600 to $2,500 ($31.15 to $129.80)
Septic tank or pit – overflowing, cracked, or new (n = 12)	1 (8%)	11 (92%)	--
Broken cistern (n=5)	1 (20%)	4 (80%)	--
Major rehabilitation of well (n = 4)	3 (75%)	1 (25%)	$4,000 to $25,000 ($207.68 to $1298.03)
Electricity not functioning (e.g. broken transformer) (n = 16)	11(69%)	5 (31%)	Paid by MoE/INIFECH
Damage to buildings (n = 21)	16 (76%)	5 (24%)	Paid by MoE/INIFECH

+ Adjusted to annual costs || ++ Cost per occurrence, many schools reported >1 occurrence || *Number of schools that reported this type of issue

Photo credit: Lisa Fleming

activities may be thought of as salaries for operational staff, however MoE covers all salaries. The school typically incurs recurring expenses in the form of repurchase of consumables including toilet paper, soap, cleaning supplies, and drinking water. The majority of schools reported repurchasing each of these items weekly – toilet paper (71%), soap for handwashing (57%), cleaning supplies (95%), and drinking water (95%). Reported annual costs for these expenses range from $18 MXN to $7700 (<$1 to $400 USD). While majority of schools purchase these consumables, we were still surprised that a marked number of schools do not purchase toilet paper (6, 29%) and do not purchase soap for handwashing (9, 43%). This often occurred in the largest schools which were typically secondary schools. The students were required to bring toilet paper from home and soap was unavailable for handwashing.

Preventative maintenance activities are essential to keep the infrastructure in good condition. Despite their importance for ensuring the health of WaSH systems, they were not practiced in the majority of schools [see Table 3]. Preventative maintenance activities that were reportedly practiced in schools included, inspection of pipes (10%), cleaning of the cistern (43%), repainting of bathrooms (43%), maintenance of wells (43% of the schools with wells), and fixing small leaks in WaSH systems (24%). Of particular concern is the neglect for regular inspection of pipes and fixing small leaks in hygiene stations, water systems, and/or toilets. Schools often cited that the loss of water was a large problem due to leaks, and one of the primary reasons they shut off water to hygiene stations and toilets rendering these WaSH facilities non-functional. Schools often reported, due to limited budgets, they typically did not respond to a problem until they viewed it as a an emergency. Surprisingly though, preventative maintenance activities tended to be the cheapest O&M activities ranging from $200 to $900 ($10.38 to $46.72 USD), underlining their cost-effectiveness and importance as a preventative measure.

Corrective maintenance activities, or replacing/ repairing something that was done incorrectly or that needs to be changed, were not reported at any school.

Reactive maintenance repairs were practiced sporadically in most schools. However, issues related to reactive maintenance, were frequently reported but remained unresolved at the time of the interview [see Table 3]. It should be noted that the WaSH-related issues described here/listed in Table 3, and in particular whether or not they remained unresolved, are reflective of the answers provided by the key-informants. The Cántaro Azul Foundation, after conducting a technical diagnostic for the multi-armed intervention, found more WaSH-related issues that were not reported and/or found issues that persisted despite being reportedly resolved. Despite observing a greater number of WaSH-related issues, the results presented in Table 3 remain unaltered, in order to reflect the perceptions of and past efforts made by the school communities to maintain their WaSH facilities.

All schools had at least one WaSH-related issue that required reactive maintenance that remained unresolved at the time of the interview. The most commonly reported issue was damage to buildings (n = 21), typically from the earthquake. In the majority of schools the damage was repaired (16 out 21; 76%) and paid for by INIFED. However, five schools still report after 15 months there is significant damage to buildings and they were still waiting for funds from the government. The most commonly reported WaSH-infrastructure issue was related to

toilets – clogged, overflowing, or non-functioning – and the issue was reported in all schools that had sanitation facilities (n = 19). Only 6 out of 19 schools (32%) reported their issues related to their sanitation facilities had been resolved while the majority (13 out of 19; 68%) reported these issues remain unresolved. Repairs for toilets were fairly high ranging from $900 to $15,000 ($46.72 to $778.82 USD). In the majority of schools, issues with water pumps (n = 18), pipes (n = 17), cracked or broken handwashing facilities (n = 17), and major issues with electricity (n = 16) were reported in the previous 5 years. Only issues related to pipes (71%) and electricity (69%) were resolved in the majority of schools. While the issues, more directly related to access to WaSH infrastructure, cracked or broken handwashing facilities and broken water pumps, remain unresolved in more than half the schools (59% and 56% respectively). More infrequently reported issues include, issues with septic tanks/pits (n = 12), broken bathroom stall doors (n = 11), broken water cistern (n = 5), and major rehabilitation of wells (n = 4). In over 80% of the schools that cited these less frequently reported issues, the issues still remain unresolved at the time of the survey and cost estimates were unknown by respondents, except for major rehabilitation of wells (3 out of 4 schools resolved the issue; 75%). Reactive maintenance issues were the most commonly reported, this may be due to the fact that they are more easily noticed than other type of maintenance activities/issues because they are typically signaled by a crisis or a public complaint.

Difficulties with cost data collection

Like many WaSH case studies, the data we report here is based on structured interviews with key informants[9,14,15]. However, unlike several case studies focused on WaSH O&M we had three rounds of interviews with each key informant and we performed a multi-armed intervention aimed at improving school WaSH environments in each school which included intensive WaSH infrastructure diagnostics. These added interactions with key informants and the extensive time focused on WaSH in each school, revealed that the data provided on WaSH O&M is incomplete (i.e. may not accurately reflect all WaSH-related issues from the past 5 years) and for some responses could be of poor quality. Likely because most key informants had only been in their current position (i.e. school director, president of parent's committee, treasurer of parent's committee, and janitor) for only 1 to 2 years. Additionally, due to the lack of a formal budget and poor record keeping all of our information was provided from memory [these issues will be discussed in the next section: Enabling Environment]. In some cases, the respondent seemed confident with their answers and for other answers they appear to struggle with their memory. As a result, some care should be taken when reading the results provided in Table 3. Please see our report on Improving School WaSH Environments to see a more detailed description of the WaSH issues we identified and repaired.

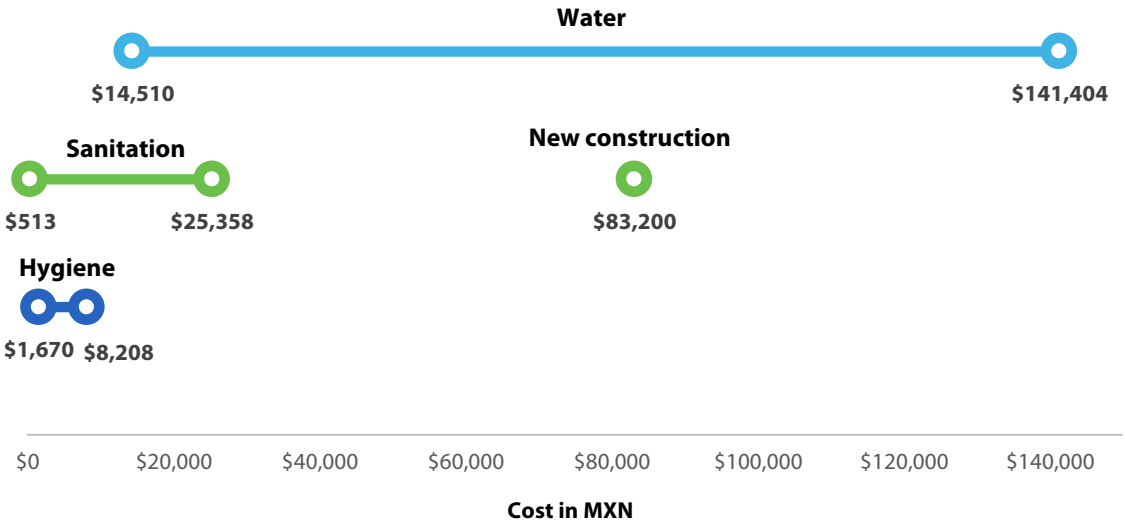
Context for school WaSH maintenance expenses

The costs reported for different WaSH O&M activities was particularly difficult for interviewees to remember. To provide context, we provided the range of costs the Cantaro Azul Foundation incurred during our intervention [see Figure 4]. All costs provided in Figure 4 reflect reactive maintenance and therefore should only be used to frame these activities. Costs are broken up by categories of WaSH infrastructure (i.e. water, sanitation, and hygiene) and they reflect the cost of all materials and the cost of labor. Due to the large range and variability only minimum and maximum costs are provided. For hygiene and sanitation, the costs reported in Figure 4 are per handwashing facility and per toilet. The costs of WaSH improvements/reactive maintenance repair implemented by FCA, spanned a wide range - $513 to $141,404 ($26.64 to $7, 341 USD).

Photo credit: Lisa Fleming

9 Freeman, et al. *Assessing the sustainability and effectiveness of school WASH projects*
14 Harnmeijer, J. and Sutton, S. (1993) 'Measuring sustainability in the water sector', Waterlines 12: 28–30
15 Saboori, S., Mwaki, A., Porter, S., Okech, B., Freeman, M. & Rheingans, R. 2011 Sustaining school hand washing and water treatment programmes: lessons learned and to be learned. Waterlines 30, 298–311

Figure 4 **The cost to rehabilitate school WaSH infrastructure by FCA spans a wide range**
(minimum and maximum)



The lowest cost range was for hygiene, $1,670 to $8,208 ($86.70 to $426.17 USD) [see Figure 4]. The most inexpensive repair was for the replacement of the sink faucet and its corresponding hardware, including some of the connectors that link the faucets to the main water supply. Many sink faucets we found were old and the cause of significant leaks. The most expensive hygiene repair was for the construction of a new handwashing facility. The cost reported in Figure 4 reflects the labor and materials to construct a base and hardware components.

Sanitation maintenance repairs spanned a wide cost range $513 to $83,200 ($26.64 to $4,319.83 USD) [see Figure 4]. The least expensive repair was for replacing the toilet flushing components (i.e. the flapper and float ball). The most expensive involved the construction of new dry bathroom facilities ($83,200). This included the materials and labor for the construction of the physical structure of the sanitation facilities and for the hardware. Outside of the construction of new facilities, the most expensive sanitation repair involved connecting a school to the local sewerage network. This was performed in one school because their septic tank had filled, was severely damaged, and they had easy access to a sewerage network whereas as most other schools did not. A failing or full septic tank was a fairly common problem we encountered (see Table 3). In schools where we repaired or replaced septic tanks, it cost about $19,500 ($1,012 USD), still a significant cost for a school.

Water-related costs for our multi-armed intervention were by the far the most expensive [see Figure 4]. However, these costs reflect the price of on-plot water treatment systems, and would not be a common expense incurred by a school. The two prices reported reflect the range in costs for a small treatment system fit for a small school to a medium/large treatment system. The marked difference stems from the construction of a structure to house the medium/large treatment system and the filling/cleaning station needed to handle the large volume of water treated per day.

The most common reactive maintenance repairs we encountered were related to sanitation. These included replacement of flushing components ($513; $26.24 USD) and replacement of a cracked toilet base/pedestal ($2,172; $122.77 USD). However, while inexpensive, if a school had to replace the flushing components or a cracked pedestal for multiple toilets, this could quickly consume the majority of their annual budget, which ranged from only $1250 to $69,000 ($64.90 to $3,582.55 USD) with a median budget of only $16,250 ($843.72 USD) [see Figure 3]. With such a limited annual budget, if the schools attempted to tackle even a quarter of the WaSH-related repairs they required, they would quickly be without money for any other resources they require for the school. The results of this case study highlight the difficult situation these schools face and underlines the extent that finances significantly constrain O&M of WaSH facilities.

WaSH enabling environment

While limited finances were a substantial barrier to the sustainable operation and maintenance of school WaSH facilities, financing was not the only issue identified. Through our interviews with key informants we noted many difficulties arose from failures unrelated to finances, including but not limited to poor planning, poor management, lack of accountability, and poorly defined roles and responsibilities. These failures led to breakdowns in the school's 'enabling environment'. An enabling environment, can take many forms depending on the context but in general for WaSH, a proper enabling environment sets out the institutional, regulatory, infrastructure, and cultural conditions that ensure adequate sustainable provision of WaSH services[9,14,15,16,17,18]. Breakdowns in the enabling environment constrain the school's ability to consistently provide key WaSH services.

In the third round of semi-structured interviews FCA enumerators explored each school's enabling environment. This included the school's administration and the parent's committee. In particular FCA enumerators asked questions concerning how decisions were made, the school's access to financial and technical resources, management, the different roles and who fulfilled these roles, technical support, and in their opinion what were main issues/grievances related to the school. The responses were recorded, analyzed, and sorted. In Table 4 breakdowns and successes common across most schools are reported. In the following section a more detailed background from the literature on what factors are necessary for a proper enabling environment for WaSH in schools is provided.

Background: Key enabling environment factors for sustainable WaSH in schools

There are many factors necessary for fostering an environment in which schools continue key WaSH activities. While each new intervention will encompass a slightly different set of necessary components to ensure the continuation of benefits beyond the timeline of the intervention itself, studies and experts in the field of WaSH have identified the following aspects that are vital to almost all projects in the school WaSH sector [9,14,15,16,17,18].

Financial capacity. A system of school funding that allows for establishment, maintenance, repair, and repurchase of needed inputs is essential for the long-term success of any WaSH project. In an ideal situation, the government would provide a significant portion of school funding, however given that inadequate government funding is often a reality in resource-poor settings, program implementers and beneficiaries need to anticipate recurrent costs and establish funding processes to support WaSH activities and access.

Accountability. There are three components of accountability: how government officials, such as the Minister of Education, are held accountable by their constituents to provide adequate funding and oversight for WaSH activities in schools; how the school administration is held accountable for provision of WaSH activities; and how school

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9. Freeman et al. *Assessing the sustainability and effectiveness of school WASH projects.*
14 Harnmeijer et al. *Measuring sustainability in the water sector.*
15 Saboori et al., *Sustaining school hand washing and water treatment programmes*
16 IRC and UNICEF (2005) Water, Sanitation and Hygiene Education for Schools Roundtable Meeting, Oxford.
17 IRC and UNICEF (2007) Towards Effective Programming for WASH in Schools: A Manual on Scaling Up Programmes for Water, Sanitation and Hygiene in Schools, TP series, IRC International Water and Sanitation Centre, Delft, the Netherlands
18 Mathew, K., Zachariah, S., Shordt, K., Snel, M., Cairncross, S., Biran, A., Schmidt, W. (2009) 'The sustainability and impact of school sanitation, water and hygiene education in southern India', Waterlines 28: 275–92

Table 4. Breakdowns and successes encountered in the school WaSH enabling environments

Enabling environment component	Breakdowns encountered	Successes encountered
Financial capacity	▪ Government financial support is limited to salaries, electricity, non-drinking water, and uneven funds for damage from earthquake. ▪ Source of school budgets are restricted to annual fees contributed by parents, and in a few cases school stores. ▪ Parents from schools located in poorer regions, are often unable to pay fees, reinforcing poor WaSH services in these schools. ▪ Insufficient funds for repairs and repurchase of consumables. ▪ Many other significant demands on school budgets beyond WaSH expenses exist.	▪ 20 out of 21 schools were able to provide safe drinking water. ▪ Local communities provided free non-drinking water sources to all schools. ▪ All schools collected fees and a budget existed. ▪ Most schools receive free electricity from municipality.
Accountability	▪ While national standards for schools exist concerning WaSH, none of the schools were aware of any mechanism to hold INIFED accountable for provision of minimum WaSH services, including drinking water. ▪ Often funds promised for repairs post-earthquake were reportedly not received or schools were still waiting, over 15 months later. ▪ Lack of government support, often reportedly led to feelings of helplessness or distrust. ▪ No formal school budgets existed to ensure school had basic resources. ▪ Particularly for toilet infrastructure, there was a lack of accountability to ensure regular maintenance. ▪ Decisions for WaSH repairs and all school expenses were subjective and based on the perceived need of the school director and parent's committee. There was no system in place to ensure basic WaSH needs were met.	▪ Established roles and decision-making structures shared between school administration and the parent's committee, made accountability between these bodies more feasible. However, the efficiency and effectiveness of these school bodies was highly variable between schools.
Technical feasibility & adequate support	▪ While all schools had ready access to skilled labor and materials, the cost for these was prohibitive in many cases because of small school budgets. ▪ Frequent leakage of hygiene facility taps and toilet hardware. ▪ Reported loss of water due to leaks in hygiene facilities and toilets. ▪ Theft of soap.	▪ All schools had access to local skilled labor and locally available materials required to repair infrastructure and the repurchase of consumables.
School leadership & management	▪ Lack of prioritization and motivation for WaSH maintenance by school administration and parent's committee. They only prioritize if it is an emergency and requires immediate attention. ▪ Directors and teachers often switch schools every 1 to 2 years. This constant change in leadership and management made proper budgeting, maintenance, and smooth daily operations difficult to implement on a continuous basis.	▪ In all schools, parent's committees were present and functioning.
Clear roles & responsibilities	▪ Positions among members of parent's committee change every year. This high turnover rate often led to: a) poorly trained committee members; 2) lack of institutional knowledge; and 3) poorly defined responsibilities for each role. These issues were particularly apparent for the treasurer position and handling school finances. ▪ Positions in parent's committees, while democratically elected, we sensed often the members did not want the role they were given. This attitude may negatively impact their ability to be effective. ▪ In the absence of a janitor, the position to maintain and clean WaSH infrastructure was voluntary and taken up by teachers or students, which often meant these activities were neglected or poorly executed.	▪ Roles in school administration and parent's committees were clearly defined but the responsibilities were not.
Community support & student engagement	▪ Poor student engagement. Schools often complained that students were destructive with school infrastructure and their vandalism was the main cause of breakdowns. ▪ Staff often originate from other villages and a divide between staff and the community/students can create barriers for adequate community and student support.	▪ In some schools, parent's committees were effective and highly engaged. This often correlated with schools where the director or a highly engaged teacher had been stationed at the school for several years and had developed a strong relationship with the community.

stakeholders (children, teachers, parents) are held responsible for WASH access at school. Schools and their director are often accountable to communities and government authorities for school metrics relating to condition of classrooms, pupil attendance, and educational performance. However, school administration is often not held accountable for provision of safe drinking water, hand-washing facilities and soap, or adequate and clean sanitation facilities. At the school level and government level, systems of accountability for supporting WaSH practices are crucial to sustaining WaSH activities and access.

Adequate technical feasibility and support. Access to skilled technicians (or training) and affordable replacement parts are essential for on-going repairs, but sometimes it is beyond the control of the school. The technical specifics of WaSH technologies are often varied across a particular geographic region. Hardware components should be selected with attention to ease and cost of repair and replacement. The implementing organization may also help to establish a linkage between manufacturers, local vendors, local skilled labor, and the schools to ensure there is local access to project inputs and adequate technical support.

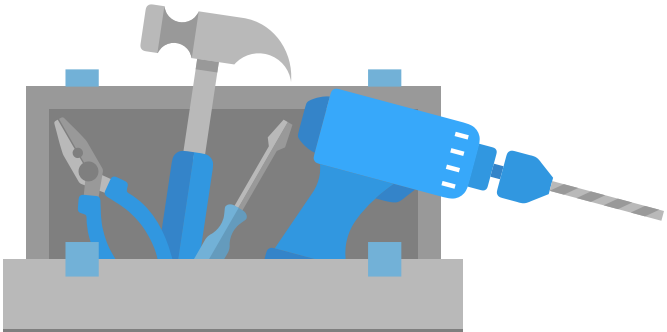
School leadership and management. The level of involvement and support in WaSH activities by the director of the school can affect the level of commitment by teachers and community stakeholders. Strong management will involve budgeting properly for WaSH activities and maintenance, developing a defined daily system surrounding WaSH activities for teachers and students to perform, ensuring this system is being followed, and working to involve the school and community in WaSH activities.

Clear roles and responsibilities. To ensure sustainability at scale, creation of standardized roles and responsibilities for school staff surrounding WaSH activities, should be incorporated into school management guidelines and training. Weak coordination between school administration and school staff or school administration and the community can negatively impact the management and effectiveness of WaSH activities in schools. Ensuring these roles and responsibilities are carried out relies on strong accountability, leadership, and management.

Community support and student engagement. The community and students play a crucial role in sustaining WaSH projects. When communities have a stake in the continuing function of WaSH in schools, the pressure to sustain the WaSH components may encourage the school director and staff to ensure the systems function continuously. Students are often the key stakeholders who have the most contact with WaSH infrastructure. As a result, they are key in creating the demand and expectations for the condition of the WaSH infrastructure and also for maintaining it on a daily basis.

Summary of findings

The results of the interviews with key informants revealed a number of common breakdowns and common successes in the enabling environment. Most notably, it was surprising to find all schools reported having access to local technical support and technical knowledge for WaSH maintenance [see Table 4]. However, this coupled with the fact that nearly all schools had physical access to sufficient WaSH infrastructure, but many of the facilities were not functional at the time of school visits, suggests that construction of new facilities and increasing technical capacity may not improve WaSH services in schools.



Interesting finding: all schools report having access to local technical support and technical knowledge.

Several breakdowns were noted in each enabling environmental component [see Table 4]. Breakdowns in financial capacity and accountability were significant. Breakdowns in these components were present at the government, school administration, and at the parent committee level. A common concern that was voiced was about limited and uneven financial support from the government and a feeling of helplessness because school administration did not know of a system that existed to hold the government accountable for provision of services. Of particular concern, is the high turnover rate of school staff and of parent committee members. This has far-reaching impacts on accountability, school leadership & management, and clear roles & responsibilities. In particular, results from the interviews suggested that high turnover rate may be one root cause of poor provision of basic WaSH resources, lack of prioritization and motivation for WaSH maintenance, issues encountered with proper follow-through on roles due to poorly defined responsibilities, disorganized budgeting, improper documentation of budgets, and their poor ability to organize and conduct routine preventative maintenance.

9. Freeman et al. *Assessing the sustainability and effectiveness of school WASH projects.*
14 Harnmeijer et al. *Measuring sustainability in the water sector.*
15 Saboori et al., *Sustaining school hand washing and water treatment programmes*

Conclusion

Proper operation and maintenance and true sustainability of school WaSH services involves a complex system of inputs and relationships across multiple levels, extending from decisions made at an individual level upwards toward policy created at the government level[9, 14,15]. Schools included in our case study already posses several core components required to ensure sustainable operation and maintenance of WaSH services, including access to local technical support and technical knowledge. However from interviews with key informants and school visits, we identified several barriers to consistent WaSH provision. Failure to deliver sustained WaSH services can be caused by weakness in one or more of the enabling environment domains we discussed. While limited finances was most often cited, we identified breakdowns in all domains. However not all aspects of the enabling environment are under the school administration's control, thus without the coordination of the parent's committee, the community, and importantly the government sustained provision and maintenance of quality WaSH services will remain elusive.

Recommendations for future work

Hopefully future school WaSH programs can use the lessons learned from this case study to inform the development of interventions that schools are able to sustain. The following are recommendations for future WaSH interventions in schools in Mexico.

Define clear roles and responsibilities to ensure proper O&M of WaSH facilities with parent's committee and school staff. This will also create a stronger system of accountability. Develop training and a method to ensure training is effectively passed on to future committee members and school staff.

Develop an educational and behavior change intervention aimed at parents and school staff concerning the importance and cost-effectiveness of routine preventative maintenance.

Develop an educational and behavior change intervention aimed at parents and school staff concerning the importance of repurchasing soap for handwashing. Demonstrate financial feasibility of purchasing this product even with limited finances.

Train the parent committee treasurer in budgeting techniques and help develop a system for record keeping to help better manage limited school finances and ensure institutional knowledge of school expenses is retained.

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