IDENTIFYING PATHWAYS TO WELL-MANAGED SCHOOL SANITATION SERVICES IN LOW-INCOME COUNTRIES

by

CHRISTIE CHATTERLEY

B.S., Idaho State University, 2003

M.S., University of Colorado, 2009

A thesis submitted to the

Graduate School of the University of Colorado

in partial fulfillment of the requirement of the degree of

Doctor of Philosophy

Department of Civil, Environmental and Architectural Engineering

2013

This thesis entitled:
Identifying Pathways to Well-Managed School Sanitation Services in Low-Income Countries
written by Christie Chatterley
has been approved for the Department of Civil, Environmental and Architectural Engineering

_____
Dr. Karl G. Linden

_____
Dr. Amy Javernick-Will

_____
Dr. JoAnn Silverstein

_____
Dr. Rita Klees

_____
Ned Breslin, CEO

Date 15 April 2013

The final copy of this thesis has been examined by the signatories, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

IRB protocol # 0110.37

ABSTRACT

Chatterley, Christie (Ph.D. Civil, Environmental and Architectural Engineering)

Identifying Pathways to Well-Managed School Sanitation Services in Low-Income Countries

Thesis directed by Professor Karl G. Linden

The continued maintenance of sanitation services post-implementation is a persistent challenge in less-developed countries that can often negate the anticipated health and economic impacts of sanitation investments. The school setting, in particular, may present an even greater test of service longevity due to the greater number and rapid turnover of stakeholders. In response, a number of drivers of well-maintained services have been posited in white and grey literature. However, there is a surfeit of factors and we lack evidence of which conditions are *necessary* and *sufficient* for continued service provision over time. This dissertation analyzes case schools in Peru, Belize, and Bangladesh to identify causal pathways to continued (and discontinued) maintenance of school sanitation services post-intervention. A novel method, Qualitative Comparative Analysis, facilitates the evaluation of collective influences and offers multiple models or a "roadmap" of conditions that provide high likelihood for continued maintenance of school sanitation.

Barriers and pathways to well-managed school sanitation are discussed for each study location specifically, followed by a multi-country cross-case fuzzy-set qualitative comparative analysis to provide more generalizable results. Based on case data from Peru, Belize and Bangladesh, two sufficient pathways to well-maintained school sanitation are identified as well as three pathways to poorly maintained services. Both pathways to well-maintained sanitation include high quality

construction and local involvement in planning and construction, in combination with a local champion in one pathway and with financial support from the government and community in the second. All sufficient pathways to poorly maintained services include the absence of financial support from either the government, community or both, indicating the significance of reliable financial access to on-going maintenance and the negative impact that the absence of support for *recurrent* costs can have on capital investment.

This dissertation provides empirical evidence for multiple sufficient pathways to well-managed (and poorly managed) school sanitation in Peru, Belize and Bangladesh. The research methods and findings may have widespread implications for improving the reliability of sanitation and hygiene service provision in low-income schools, increasing potential for positive health and education impacts, as well as more effective resource utilization.

ACKNOWLEDGEMENTS

The research presented in this dissertation would not have been possible without the financial support, encouragement and mentoring from a number of people who I am greatly indebted to. My words are inadequate to express my gratitude and I hope I will have the opportunity to repay or pay forward their support.

I am grateful for the financial support from a National Water Research Institute Fellowship and a Mortenson Graduate Fellowship, without which this research would not have been possible. I would also like to thank CONAPAC in Peru, the Ministry of Education and UNICEF in Belize, and Save the Children in Bangladesh for support of the studies that comprise this dissertation. Also to the principals, teachers and students that participated in the studies for their time and honest responses.

I thank the members of my PhD committee who have guided my research over the past three and half years: Karl Linden, Amy Javernick-Will, JoAnn Silverstein, Rita Klees and Ned Breslin. Their advice has been invaluable in the development of this dissertation. I am indebted to my advisor, Karl Linden, for over six years of mentorship in research and life decisions, and his patience through my often unconventional research interests and desire to live abroad for almost the entirety of my PhD research.

Much gratitude is also due to mentors, both directly and by example: Ned Breslin (Water For People), Jesus Trelles (UNICEF), Murat Sahin (UNICEF) Mark Duey (Water For People), Kate Fogelberg (Water For People), David Silver (University of Colorado), and Mohini Venkatesh

(Save the Children International). I would also like to thank Ikhtiar Khandaker, Kawser Alam and Laure Bottinelli for their field support in Bangaldesh; Nelson Longsworth, Joan Palma, Marshall Mejia, Pamela Scott, Debbie Sabal, Moses Palma, Fabien Cayetano, and Alden Chavez for field support in Belize; and Sintia Snyder, James Pasmino Escobedo, Victoria Espinoza Zavaleta, Gianncarlo Valdivia Zavaleta, Giorly Muchuca Espinar, and Marjorie Raquel Donayre for field support in Peru.

I'm also extremely grateful for the support of wonderful friends who encouraged me before and during this research.

I owe the opportunities I have had in life to my parents, Jamie and Bud Chatterley, who have guided me through my good decisions, stuck by me through my not so good decisions and encouraged me to experience life and continue learning with unfaltering love and support. I will never be able to repay the impact they continue to have on my life. My brother, Brent Chatterley, has been a greater influence than I think he realizes as I'm constantly reminded of the good and compassion that exists in the world through his personal actions and beliefs toward others on a daily basis, not as part of his job, but as part of who he is as a person.

I dedicate this thesis to my partner in crime, David Sparkman. This research would not have been possible without his mentorship, support and love. I kept my sanity throughout this work because of his guidance, encouragement to put the computer down and enjoy life, and his wit. He continues to surprise and inspire me. I wish I had his gift of words to adequately express my gratitude to him here, but fortunately have the rest of my life to find them.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

AEO	Assistant education officer (district-level, Bangladesh)
AUEO	Assistant upazila education officer (sub-district level, Bangladesh)
CFU	Colony forming units
CONAPAC	Civil association for conservation of the Peruvian Amazon environment
csQCA	Crisp-set qualitative comparative analysis
EFA	Exploratory factor analysis
EMIS	Education Management Information System
FLOW	Field-Level Operations Watch
fsQCA	Fuzzy-set qualitative comparative analysis
GPS	Government primary school (Bangladesh)
HFLE	Health and family life education (MoE Belize)
JMP	Joint Monitoring Program
MoE	Ministry of Education
MoH	Ministry of Health
MoW	Ministry of Works
NGO	Non-government organization
O&M	Operation and maintenance
PCA	Principal component analysis
PSM	Propensity-score matching
PTA	Parent teacher association
QCA	Qualitative comparative analysis

QCI	Quantitative composite index
RNGPS	Registered non-government primary school (Bangladesh)
SHN	School health and nutrition
SLIP	School level improvement plan (maintenance fund in Bangladesh)
SMC	School management committee (Bangladesh)
STH	Soil transmitted helminthes
TC	Total coliforms
UNICEF	United Nations Children's Fund
UN	United Nations
VIP	Ventilated improved pit (latrine)
WASH	Water, sanitation and hygiene
WHO	World Health Organization
WinS	WASH in schools

CHAPTER 1

INTRODUCTION

BACKGROUND

Globally, UNICEF estimates that only 51% and 45% of schools in low-income countries have access to adequate water and sanitation, respectively (UNICEF et al., 2012).[1] This restricts the positive hygiene behaviors such as handwashing and safe sanitation practices that are known to improve health (Cairncross, 1990; Ejemot, 2008; Cairncross, 2010). In response, non-governmental organizations (NGOs) and government agencies have recently increased efforts toward addressing these inequities through water, sanitation and hygiene (WASH) in schools, or "WinS", interventions. This is exemplified by the global call to action for WinS, "Raising Clean Hands", jointly published by a number of leading agencies (UNICEF et al., 2010) and re-published with updated information and additional partners (UNICEF et al., 2012).

Although school-aged children are at lower risk of death from diarrheal and respiratory illnesses than children under five years of age, interventions targeted at schoolchildren have many advantages and could complement other efforts to reduce under-five mortality. There are a number of logical rationales behind these efforts, which can typically fit into one of the following seven categories: (1) the rights motive, (2) the health motive, (3) the learning motive, (4) the gender motive, (5) the child motive, (6) the household impact motive, and (7) the economic motive. Each of these is discussed subsequently in further detail to provide context for

[1] Unfortunately, "adequate" is not defined and interpretation of what constitutes adequate services varies between countries and these data should be considered accordingly.

the importance of WinS. A summary of the WinS impact studies discussed is also provided in Table 1.

Table 1. Summary of WinS impact studies including evidence (or no evidence) for health (H), learning (L), gender (G) and community impact (CI)[†]

Study	Site	Intervention	Impact	H	L	G	CI
Abrahams et al. (2006)	South Africa	none	Girls reported staying home during their first two days of menstruation due to inadequate school toilets and unaffordable sanitary materials			Y	
Blanton et al. (2010)	Kenya	Drinking water and handwashing infrastructure and hygiene training	Household water treatment increased (1% to 7% for use of flocculent-disinfectant and from 6% to 13% for hypochlorite) and student absenteeism decreased by 26% from baseline to 13 month follow-up.		Y		Y
Bowen et al. (2007)	China	1: hygiene education 2: hygiene education, soap, peer hygiene monitors	Intervention 1: decrease, but not significant Intervention 2: 54% decreased absenteeism due to illness, 71% fewer in-class illnesses. Over 50% decrease in upper respiratory tract infections.	Y	Y		
Devnarain & Matthias (2011)	South Africa	none	Identified challenges faced by girl learners included the burden of carrying water and lack of facilities for menstrual management			Y	
Dreibelbis et al. (2012)	Kenya	none	School latrine cleanliness associated with reduced odds of student absence.		Y		
Freeman & Clasen (2011)	Southern India	Classroom water purifiers, hygiene education	No evidence of increased awareness or water treatment practices in surrounding households				N
Freeman et al. (2011)	Kenya	1: water treatment + hygiene promotion 2: 1 + latrines	Intervention 1: 58% reduction in the odds of absence for girls compared to control schools. Intervention 2: similar reduction. No effect on boys' absenteeism.		Y	Y	
Freeman et al. (2012)	Kenya	School-based WASH intervention	56% reduction in Ascaris worm infection	Y			
Guinan et al. (2002)	USA	hygiene education and hand sanitizer	51% lower absenteeism in intervention schools compared to control		Y		
Koopman (1978)	Columbia	none	44% lower rate of diarrhea in schools with hygienic toilets compared to those with unhygienic facilities.	Y			
Lopez-Quintero et al. (2009)	Columbia	none	Students who reported proper handwashing were 20% less likely to be absent due to gastrointestinal or respiratory conditions.	Y	Y		
Mbatha (2011)	Swaziland	none	A correlation between poor access to water and sanitation and girls' attendance was identified. Challenges also included fetching water at school.		Y	Y	

Study	Site	Intervention	Impact	H	L	G	CI
Melghem (2003)	Honduras	Construction of WinS facilities, hygiene education, student sanitation clubs, sanitation committee	household hygiene practices were much higher in communities that received hygiene education, including 49% improvement in personal hygiene, 39% improvement in water treatment practices, and 30% improvement in latrine use & maintenance				Y
Njuguna et al. (2008)	Kenya	Varied, but included infrastructure and hygiene training	Girls were absent less in schools where there was more handwashing ($p<0.043$) and very high toilet use ($p<0.048$). No significant effect for boys'.		Y	Y	
O'Reilly et al. (2008)	Kenya	Social marketing of water treatment, hygiene education	Increased household drinking water treatment from 6% to 14% in 9 months. Absenteeism decreased by 40% compared to control schools.		Y		Y
Onyango-Ouma et al. (2005)	Kenya	Child-to-Child and Child-to-Family health education	Increased toilet cleaning and handwashing at households as well as construction of new latrines in a few homes. Behavioral changes were more evident among the children than among the adults.				Y
Oster & Thornton (2010)	Nepal	none	Menstruation had little impact on attendance, but attendance in participating schools was already very high			N	
Patel et al. 2012	Kenya	Social marketing, drinking water and handwashing facilities	Decrease in the median percentage of students with acute respiratory illness among those exposed to the program; no decrease in acute diarrhea was seen.	Y			
Rosen et al. (2006)	Israel	Hygiene education, liquid soap, paper towels	No significant change in rates of communicable illness or absenteeism despite sustained handwashing behavior after six months	N	N		
Sommer (2010b)	Tanzania	none	Girls identified lack of water taps in the toilets and unclean toilets as challenges during menstruation			Y	
Talaat et al. (2011)	Egypt	Hygiene education	Statistically significant declines in absences caused by illnesses such as diarrhea, conjunctivitis, & influenza	Y	Y		

[†]Y = yes, the study provides evidence of the impact in the associated column; N = no, results from the study do not show a significant relationship between WinS and the impact in the associated column

The rights motive

Education is a human right (UN, 1948) and a child's right (UN, 1959). It is argued that within this framework, improving water, sanitation and hygiene education is an intervention aimed at ensuring the rights of children (Betancourt et al., 2010). This is also highlighted in "Raising Clean Hands" which promotes WinS *"because every child deserves to be in a school that offers safe water, healthful sanitation and hygiene education"* (UNICEF et al., 2010). The United Nations (UN) underscores the importance and urgency of adequate water supply in schools

specifically in Comment No. 15 under the International Covenant of Economic, Social and Cultural Rights which says:

> *"State parties should take steps to ensure that children are not prevented from enjoying their human rights due to the lack of water in educational institutions and household or through the burden of collecting water. Provision of adequate water to education institutions currently without adequate drinking water should be addressed as matter of urgency"*. (UN, 2002)

The UN took further steps toward promoting water and sanitation in July 2010, when it directly recognized access to clean water and sanitation as a human right and called for "*the provision of financial resources, capacity building and technology transfer, particularly to developing countries, in scaling up efforts to provide safe, clean, accessible and affordable drinking water and sanitation for all"* (UN, 2010). In this light, school-based WASH services are cross-cutting as they address both the human right to education and to water and sanitation specifically.

The health motive

More children die every year from diarrheal illnesses than from AIDS, malaria and measles combined (UNICEF/WHO, 2009). Each episode of diarrhea contributes to malnutrition, reduced resistance to infections and when prolonged, to impaired growth and development (Ejemot et al., 2008). Additionally, soil-transmitted helminthes (STH), such as hookworm and whipworm, infect 47% of children in the developing world ages 5-9 (Bhutta et al., 2008). Beyond the direct effects of STH infection, such as malnutrition and the associated consequences including decreased cognitive and spatial memory performance, intestinal worms also increase

children's susceptibility to other illnesses such as malaria, tuberculosis, and HIV (Fincham, Markus, & Adams, 2003; Le Hesran et al., 2004). In addition to gastrointestinal illnesses, acute respiratory illnesses are a leading cause of death among children, with approximately two million children dying annually from pneumonia (UNICEF, 2008).

These illnesses have a direct link to inadequate WASH access and associated poor hygiene practices. For example, the World Health Organization (WHO) estimates that 88% of diarrheal disease is caused by unsafe water supply, and inadequate sanitation and hygiene (WHO, 2004), and Rabie and Curtis (2006) estimate that handwashing alone could decrease the risk of respiratory infections by 16%. Specific to the school environment, a study in Columbia showed a positive correlation between diarrheal disease and unhygienic school toilet conditions, suggesting that diarrheal disease in participating school children could be reduced by 44% with hygienic sanitation facilities in the school alone (Koopman, 1978). They speculate that more diarrhea is attributed to school transmissions rather than from the home despite more chances of contact with feces in the home, due to the greater range of enteropathogens children are exposed to in school toilets and the greater likelihood of transmission of an agent that the child is susceptible to. This may in turn be a source of infection for children under-five with school-aged siblings which may expose them to new infectious agents (Hodges et al., 1956; Koopman, 2001; Luby, 2004). Handwashing practices among school children have also been associated with decreased diarrhea (Lopez-Quintero, 2009; Talaat et al., 2011), and acute respiratory infections (Bowen, 2007; Patel et al., 2012).

Specific to STH, a school-based WASH intervention in Kenya saw a 56% reduction in Ascaris worm infection (Freeman, Clasen, Brooker, Akoko, & Rheingans, 2012). Due to the lower cost of deworming interventions in comparison to WinS (e.g. in Meherpur, Bangladesh, the cost of deworming is estimated at $0.33/child/year, while WinS is $5.84/child/year including infrastructure and hygiene education (Save the Children, 2012)), worms are often dealt with post-infection and not at the source. However, despite the efforts of de-worming campaigns, re-infection of intestinal worms will occur after de-worming if sources, such as feces in water, food or on fingers, are not removed, especially in school-age children as they are typically more exposed to worm eggs than adults (Hall, Hewitt, Tuffrey, & Silva, 2008). Further, frequent use of de-worming medications, necessitated by the continued presence of the source of fecal contamination, could also lead to drug resistance (Albonico, Engels, & Savioli, 2004). Accordingly, drug therapy for STH alone is insufficient and improved sanitation and hygiene is crucial to prevent re-infection (Luong, 2003).

In addition to diarrhea, acute respiratory illness and STH infections, students that hold back bathroom needs until they reach home, due to the absence or inadequacy of school toilets, can suffer short- and long-term health problems (Kistner, 2009). Further, a lack of drinking water at school and/or unacceptable toilets that students are afraid to use and hence do not drink fluids at school can lead to dehydration (WHO, 2003).

The learning motive

Health and learning are strongly coupled. WHO (2005) estimates that over 200 million years of schooling have been lost due to worm associated absenteeism, and an average of 3 school days

are missed per episode of diarrhea suggesting that 443 million schooldays would be gained around the world if everyone had access to improved water and sanitation (Hutton & Haller, 2004). Country-level research also suggests the effect of STH on absenteeism: a study in Kenya found that worm infections attributed 25% of the overall absenteeism rates (Miguel & Kremer, 2004) and in Jamaica, Nokes and Bundy (1993) found an association between absenteeism and STH infections to the extent that some infected children attended school half as frequently as their uninfected peers. Beyond the educational ramifications of absenteeism, STH reduce cognitive potential and indirectly undermine educational efforts through attention deficits and early dropout (Bethony et al., 2006). In Mali, de Clerq (1998) identified a significant decline in academic performance with increasing infection intensity, and a study in Turkey found an adverse relationship between *Giardia* infection and school success (Çelİksöz et al. 2005). Additionally, WHO estimates an average IQ loss of 3.75 points per worm infection; a total global IQ loss of 633 million points for developing countries (WHO, 2005).

WinS interventions have the potential to substantially increase student attendance, particularly for girls. In rural Kenya, school-based safe water and hygiene programs have led to a 35% drop in school absenteeism one year after implementation, compared to an increase of 5% at surrounding control schools (O'Reilly et al., 2008), a decrease in student absenteeism by 26% from baseline to 13 month follow-up (Blanton, 2010), and school latrine cleanliness has been associated with reduced odds of student absence (Dreiblis et al., 2012). However other studies from rural Kenya have found similar relationships only for girl learners and not boys (Njuguna et al., 2008; Freeman et al. 2011). Specific to school-based handwashing programs, numerous studies have shown a connection between handwashing practices among school children and

lower rates of absenteeism (Guinan, McGuckin, & Ali, 2002; Bowen, 2007; Lopez-Quintero, 2009; Talaat et al., 2011), with one study from Isreal observing no significant improvement in absenteeism despite sustained handwashing behavior after six months of program implementation (Rosen et al., 2006), suggesting that there may be other factors in addition to WinS that need to be addressed in order to improve attendance in some schools.

In addition to decreased absenteeism, improved WASH services have been shown to decrease the worm burden associated with decreased student performance (Bethony, 2006; Bleakley, 2007). And it has also been shown that children holding back their need to use the bathroom and feeling the negative effects of dehydration while at school are not able to take full advantage of educational opportunities (Bar-David, Urkin, & Kozminsky, 2005). As a result, school WASH services that are acceptable to children may encourage them to use the toilet when needed and to drink water throughout the day, increasing their focus and academic performance.

The gender motive

The Former UN Secretary General, Kofi Annan, said in April 2003 that *"there is no tool for development more effective than the education of girls"*. Educated women have a greater say in their own development, contribute to national economic growth, and are likely to have fewer children allowing families to invest more in each child, raising productivity of future generations. WinS has the potential to promote girls' education and gender equality by providing safe and hygienic facilities for female students during their menses and the presence of a water source on school grounds may alleviate girls from the common "female" chore of fetching water. Studies in South Africa (Abrahams et al., 2006; Devnarain & Matthias, 2011) and Swaziland

(Mbatha, 2011) identified inadequate access to water and sanitation as a barrier to girls' attendance and learning, highlighting the chore of carrying water that is imposed on girls and not boys, and inadequate facilities to manage menstrual hygiene needs. A World Bank study in Ghana suggests that a fifteen minute reduction in time hauling water would increase girls' school attendance by 8-12% (Nauges & Strand, 2011). Specific to sanitation and hygiene, Njuguna et al. (2008) found significantly decreased girls' absenteeism from schools in Kenya where there was more handwashing and toilet use reported. The authors further suggest that because similar results were not observed for boys, this might imply that in schools where toilets are not available, convenient, private and hygienic and where handwashing facilities are not provided, it is more likely that girls will stay home during menstruation. In contrast, a study in Nepal found that menstruation had a very small impact on school attendance (Oster & Thornton, 2010). However, attendance rates in participating schools were already very high and Sommer (2010a) cautions the sector in generalizing findings from the Nepal study to other socio-cultural contexts. In discussions around menstruation and schooling, Tanzanian school girls have specifically suggested "*to build toilets which have water taps; to build a place to burn pads which is far from the boys' areas; to buy tools for cleaning in toilets…*", indicating the important part that water and sanitation play in meeting girls' needs during their menstrual cycle (Sommer, 2010b).

The child motive

Children are generally more receptive to new ideas and behavior change, making school-years crucial for learning healthy hygiene practices (Burgers, 2000; UNICEF et al., 2010). As an example of the decreased receptivity to change with age, a study in Cambodia found that after the introduction of a 100% condom policy for professional sex workers, the drop in HIV-

prevalence among participants under 20 years old was double that of those 20 years or older (Wong et al., 2003). The CDC (2007) also states that promoting and establishing healthy behaviors for younger people are more effective, and often easier, than efforts to change unhealthy behaviors already established in adult populations, and sustained hygiene behavior changes have been observed in children in a number of studies (Uhari, 1999; Greenberg, 2003; Rosen, 2006). Cairncross and Shordt (2004) also identified the need to focus on children, stating *"the earlier behavior is changed in life, the longer the lifespan of the change"*.

The household impact motive

School-based WASH programs have been promoted as a means to influence household WASH practices. However, available data on the impact of WinS programs on the knowledge and practices of the surrounding community have been contradictory. Two WinS interventions in rural Kenya resulted in increased household uptake of hygiene practices including drinking water treatment (O'Reilly, et al., 2008), and regular toilet cleaning and handwashing, as well as construction of new latrines in a few homes (Onyango-Ouma, Aagaard-Hansen, & Jensen, 2005). In Honduras, household hygiene practices markedly improved following a school-based hygiene education program focused on promoting children as agents of change (Melghem, 2003). However, in an assessment of a school-based safe water program in India, no evidence of household impact was found, including awareness or behavior change (Freeman & Clasen, 2011). Accordingly, as Onyango-Ouma et al. (2005) point out in their study in Kenya, a number of contextual factors influence the ability of children's agency in the community and results may differ in environments where children are unable to act or the school-community link is poor.

The economic motive

The lack of clean and reliable water, safe sanitation, and soap for handwashing has the potential to compromise educational opportunities in the world's poorest populations, limiting job opportunities and economic growth (Ozturk, 2001; Bleakley, 2007; Permani, 2009). As an example, considering the costs of improved water and sanitation, the annual economic impact of poor sanitation in Bangladesh has been estimated at 6.3% of the Gross Domestic Product due to health-related losses resulting in negative social impacts, including less educated children (WSP, 2012). In the school-setting specifically, the study estimates an economic impact of approximately 11.5 million USD from inadequate school sanitation for girls ages 10-19 alone. Based on 2,236,448 girls estimated to be without access to a girls-specific school toilet in Bangladesh (WSP, 2012) and an estimated cost of school toilet construction and maintenance of $3.97/child/year (Save the Children, 2012), improved school sanitation for girls would likely result in an economic gain of 2.6 million USD annually. Despite the strong arguments from the other motives, the negative economic impact of inadequate WASH services at schools and communities may be the most effective argument to increase local buy-in and government funding for intervention.

OBSERVED PROBLEM

Unfortunately, despite increasing efforts to improve WinS services in low-income countries, management of services over time remains a persistent challenge that can negate anticipated impacts of investment (Dreibelbis et al., 2012; Greene et al., 2012). Infrequent soap provision, poorly maintained toilets, and inadequate water treatment post-intervention are often cited (Saboori et al. 2011). For example, in Kenya, one study found that only 30% of toilets were in

use and a quarter of handwashing facilities were functioning just two to four years post-implementation (Njuguna, et al., 2008), and a second study revealed that 27% and 8% of schools continued treating water and providing soap, respectively, three years after program implementation (SWASH+, 2010).

The positive impacts linked with handwashing are unlikely without *reliable* access to soap as a critical first step to behavior change (Bowen, 2007; Curtis et al., 2011; Saboori, Mwaki, & Rheingans, 2010). Similarly, dirty or poorly maintained toilets are unlikely to be used by students and are a potential health hazard if they are used (Koopman, 1978; Mathew et al., 2009; Xuan, Hoat, Rheinlander, Dalsgaard, & Konradsen, 2012). Therefore, understanding what conditions promote continued management of quality WinS services is needed to improve effective resource utilization and likelihood for positive impact.

RESEARCH OBJECTIVES

This dissertation examines the key drivers of sustainable WASH in schools, with continued toilet maintenance as an indicator of sustainability. This case study research focuses on WASH service provision in schools in three geographic areas: the Peruvian Amazon near Iquitos, Belize with additional focus on the southern districts of Toledo and Stann Creek districts, and Western Bangladesh in Meherpur district (Figure 1). In all cases, research is conducted in partnership with a local partner to support local program improvements, but findings from the three locations may have broader, global impacts, particularly when brought together.

Figure 1. Maps of research locations in Peru, Belize, and Bangladesh

DISSERTATION FORMAT AND SCOPE

The chapters comprising this dissertation follow the stages of the research with some chapters building upon data and findings from earlier ones. Chapter 2 provides a literature review of sustainability drivers for WASH and more specifically, WASH in schools. This discussion of postulated factors of sustainable WinS provides a basis for the following chapters, however Chapters 3, 4, 5, 6 and 7 have been written to stand alone, with Chapters 6, 7 and 8 comprising the heart of this dissertation.

Chapter 3 describes local perspectives and challenges for WASH in schools in the Peruvian Amazon, based on eight rural schools and surrounding communities. Findings provide insights into student, teacher, and parent priorities surrounding the importance of WASH in comparison with other school services, as well as challenges whose solutions may likely need to precede WASH intervention.

Chapter 4 presents a national WASH in schools assessment in Belize that identifies the key challenges for WinS using a Qualitative Composite Index to support rural/urban and inter-district comparison. Elements of school WASH management that are associated with better maintained services are identified based on statistical methods at the national level.

Chapter 5 builds on Chapter 4 by evaluating a government-led WASH in schools program in the two southern districts of Belize. The condition of facilities and continuation of hygiene practices are assessed two to three years post-intervention to investigate the longevity and sustainability of the school WASH intervention.

Chapter 6 takes findings from Chapter 5 further to identify combinations of causal conditions that led to both well-maintained and poorly-maintained school toilets identified during the evaluation, as an indicator of sustainability. Implication of findings for policies and programming in Belize are also discussed.

Chapter 7 provides validation and comparison for the findings from Chapter 6 in a different geographical, cultural, and policy context: Meherpur District in Bangladesh. This analysis also provides the opportunity to include possible causal conditions that were held constant in Belize.

Chapter 8 discusses the generalizability and implications of findings for the WASH in schools sub-sector based on cross-case comparative analysis of case schools from all three study locations.

METHODS OVERVIEW

This dissertation incorporates both quantitative and qualitative research, with a greater focus on qualitative analysis, particularly in Chapters six, seven and eight, as a means to understand the causal factors behind the sustainability of WinS services. The rationale behind the use of qualitative data (over statistical methods) is presented here.

Methods to identify causal models

Logistic Regression is used to predict the probability of occurrence of an event by fitting data to a LOGIT function logistic curve. Using LOGIT, the influence of each variable on the outcome of interest can be quantitatively measured. Examples of this in WASH sector research include Mimi Jenkins' (1999) civil engineering PhD dissertation where she used LOGIT regression to identify the most important factors that determine latrine adoption in Benin. Sara Marks (2010) also used LOGIT regression to identify the effect of household-level financial contributions on water system sustainability in Kenya. LOGIT regression is appropriate to identify the influence of various factors in a single causal model at the household-level, however it is limited for the identification of influential variables for WinS sustainability for the following reasons: (1) LOGIT requires intermediate to large N ($\geq$100) that is often logistically and financially unreasonable for school-level studies, and (2) it offers limited insights based on the inherit assumption of regression to evaluate a single causal model (Long, 1997; Rihoux & Ragin, 2009). For these reasons, Qualitative Comparative Analysis (QCA) is employed in this research.

The QCA method is based on a systematic matching and contrasting of cases to identify common causal relationships, specifically allowing for "conjunctural causation", meaning that different

constellations of conditions may lead to the same result (e.g. AB or CD lead to Y) (Rihoux & Ragin, 2009). QCA is typically utilized for small- to intermediate-N (i.e. 10-100 cases) and lies between pure quantitative approaches such as statistical techniques and pure qualitative such as case studies, though is considered to be more qualitative or case-oriented in nature. The QCA method is suitable to this research as it allows for greater flexibility than statistical methods such as LOGIT regression and is applicable to small-N research, a desired attribute for school-level research where it is resources rarely permit large-N studies. The goal of QCA is not to specify a single causal model that best fits the data as in statistical techniques, but to determine the number and character of the different causal models that exist (Rihoux & Ragin, 2009).

CHAPTER 2

REVIEW OF POSTULATED DRIVERS OF WELL-MANAGED SCHOOL WASH

INTRODUCTION

This chapter serves to familiarize readers with the available literature and sub-sector theories on conditions that promote the continued management of quality water, sanitation, and hygiene (WASH) in schools. The posited conditions presented are not meant to be exhaustive and further exploratory research is encouraged.

DEFINING THE OUTCOME

There is significant evidence that health benefits stem from the behavior changes water and sanitation make possible (Cairncross et al., 2010; deWilde, Milman, Flores, Salmerón, & Ray, 2008; Strina, Cairncross, Barreto, Larrea, & Prado, 2003; Waddington, Snilstveit, White, & Fewtrell, 2009; Zwane & Kremer, 2007). As Cairncross and Shordt (2004) point out, the measurement of behavior changes facilitated by continued access to WASH infrastructure, is likely to be easier, more reliable and more useful as an operational evaluation tool than attempts to measure health benefits directly. Health impact studies are rarely conclusive due to the challenge of adequately controlling for the large number of social, political, economic, environmental and educational variables which affect health (Blum & Feachem, 1983; Cairncross, 1990; Curtis, 2001; DFID, 1998; World Bank, 1976). Moreover, the extent to which impact studies engage with the question of why an intervention is effective or not is often very

limited and hence not useful for informing intervention improvements (Cairncross and Shordt 2004; Waddington 2009).

Therefore, to better inform policy decisions and programming design and implementation, this dissertation will focus on the continued management of WASH in schools (WinS) services as a necessary condition for behavior change and associated impacts. Specific indicators of well-managed services will be defined in subsequent chapters including reliably functional and clean toilets and the consistent provision of soap and water.

DRIVERS OF WELL-MANAGED SCHOOL WASH

Conditions that promote well-managed WinS services have been posited in prescriptive literature (IRC, 2007; Mooijman, Snel, Ganguly, & Shordt, 2010; Snel, 2004). However, we lack evidence of their collective effects and the sufficiency of their aggregated presence to promote continued maintenance (Snel 2004; Saboori et al. 2011). Due to resource limitations, establishing all the conditions suggested in the literature may not be feasible and there is a need to identify which combinations of conditions are *sufficient* for a high likelihood of continued maintenance in order to improve effective resource allocation. Further, the pathway (i.e. combination of conditions) most appropriate in each country, district, or even school, may differ due to local management dynamics or economic condition. In these cases, if multiple sufficient pathways are identified, there can be flexibility and adaptability of which conditions are targeted based upon the specific needs and capacities.

As an indicator of WinS maintenance, clean toilets have been associated with water availability and teachers' involvement with the school management committee (SMC) to address O&M needs in Kenya (Njuguna et al. 2008), and with active student health clubs in India, though the authors note the link between student engagement and active teachers and parents, which may be of greater influence (Mathew et al. 2009). Expanding upon this work, Saboori et al. (2011) highlighted the aforementioned studies as the only school WASH sustainability literature available and contributed further evidence from 55 schools in Kenya identifying common characteristics of the two most successful schools (based on the presence of handwashing water and treated drinking water). These included the presence of at least one teacher who had been trained during implementation, an active SMC involved in WASH activities, the inclusion of WASH in the school budget, and teachers' observation of health benefits resulting from the intervention. However, the authors identified nine other schools that shared these traits and yet did not meet the majority of their success criteria, suggesting that these conditions are insufficient to enable sustainability and further research is needed to identify sufficient conditions to foster well-managed WinS.

Conceptual Framework

Despite limited empirical evidence to support conditions that promote continued service management, common themes from fundamental WinS guideline documents and available literature are reviewed and discussed here to provide a preliminary framework and background for subsequent chapters. Due to the limited empirical data specific to the school setting, supporting data from community- and household-level research are also included.

Financial capacity for maintenance

In order to support sustainable and successful WinS, the IRC (2007) suggest allocating and securing finances for the operation and maintenance (O&M) of school WASH facilities, as opposed to construction only. More specifically, a system of school funding that allows for establishment, maintenance, repair, and repurchase of needed inputs was considered essential for the long-term success of a WinS program in Kenya where insufficient funds were often mentioned by schools as the reason for the cessation of WASH-related activities (Saboori, et al., 2011). These sentiments are echoed by Nagpal (2010), who states that "one of the goals of WinS programs should be to ensure that budgets account for O&M of all water and sanitation infrastructure, and that school management, whether it is teachers, the principal, or parents, know where to find these resources and allocate them appropriately". However, there is limited evidence as to the most effective source of funding for continued O&M, though Saboori et al. (2011) suggest at least a portion of O&M funding to come from the surrounding community with the hypothesis that when the community has a stake in WinS activities, the pressure to sustain WASH components may encourage the head teacher and staff to ensure services function continuously.

Accessible spare parts and services

A study of 55 schools in Kenya identified access to affordable repairs, replacement parts and consumables as essential to on-going service management; schools often reported not knowing where to find repair services or replacement parts, or that the items needed were too expensive (Saboori, et al., 2011). Similarly, Obure (2009) recommended ensuring a clear supply chain of soft goods such as soap, brooms, and cleaner as a way to improve the Kenya Education Sector

Support Program. In Central America, monitoring of WinS revealed the need for equipment, spare parts and technical skills to be available when needed for all maintenance processes (Chatterley, Gray, & Leslie, 2010), and Nagpal (2010) also highlights the importance of product and parts availability in the market.

Local involvement in planning and construction

In Kenya, Obure (2009) identified a lack of community involvement in the construction process as a major threat to the sustainability of a WinS program. Similarly, Abraham et al. (2011) includes the creation of demand through stakeholder involvement in decision making and planning in their list of five guiding principles for successful and sustainable school sanitation, and Saboori et al. (2011) suggests that programs should receive buy-in from the school leadership before project implementation under the assumption that this will foster continued service management. This assumption is supported by community water service studies. For example, in South-West Uganda, cash contributions upfront were identified as a crucial condition to continued functionality (Carter & Rwamwanja 2006) and in Bolivia, Marks and Davis (2012) found that user participation in decision-making and substantial cash contributions upfront had the greatest impact on sense of ownership for community water services, thought to be linked to continued service management.

Hygiene promotion

IRC (2007) suggests monitoring classroom hygiene education to ensure it is participatory and life-skills based highlighting the importance of hygiene promotion in school sanitation programming. Beyond the classroom, Abraham et al. (2011) also promotes the use of many

channels and different media for sanitation and hygiene advocacy beyond health benefits only, including working with local institutions, as one of their five guiding principles to successful and sustainable school sanitation. Njuguna et al. (2008) did not find a correlation between WASH education for children and cleaner toilets, but suggested that there may have been issues with their data collection methods as children reported limited training that incorporated how to use the facilities.

Student engagement

Students play a crucial role in sustaining school WASH and efforts to identify, promote, and institutionalize vibrant student participation through health clubs or additional child-centered activities may strengthen participation (Sidibe and Curtis, 2007). Educational campaigns around WASH behaviors are more successful when pupils are engaged in a structured and participatory manner (Onyango-Ouma et al., 2005; Bowen et al., 2007). In a study in Kenya, WASH clubs were not associated with better WASH in the school, but the relevance of club training and content were questioned (Njuguna, et al., 2008). A study in India, however, identified a positive association between active health clubs and cleaner toilets, better maintained handpumps, and open wells. (Mathew et al., 2009). *"In our school we have students who formed a group and they volunteered to clean the toilets. They have been doing so well and now many more are joining the group. Even when they finally finish their studies they have already recruited their predecessors."* (Teacher) (MoES Uganda, 2006). Saboori et al. (2011) point out that while student engagement has to happen at the school level, institutional and policy changes may be needed to make active health clubs the norm.

Quality construction

IRC (2007) includes that "the constructed water and sanitation facilities follow minimum specifications for design and quality of construction" in their criteria for sustainable and successful WASH in schools. This is highlighted in a study of 100 schools in Kenya where students and teachers mentioned weak toilet construction as a reason for frequent breakdown (Njuguna, et al., 2008). Evidence from the community-level also suggests the importance of construction quality: WaterAid (2011) suggests that quality construction may increase service life despite weaknesses in other aspects of O&M, while poor quality construction can undermine even the best efforts to maintain services over time. However, there is limited empirical evidence of the influence that quality construction may have on WinS service longevity.

Students per toilet ratios

Mathew et al. (2009) found that the number of children per toilet cubicle (which averaged 116–294 boys per cubicle) was unrelated to the cleanliness and maintenance of facilities (Mathew, et al., 2009). However, the possible importance of this factor is highlighted by the frequency that students per toilet ratios are included in government standards and monitoring, and this condition deserves further investigation. An example of this is found in a report from the Ministry of Education and Sports in Uganda which says *"there was an outcry for improving on current pupil: stance ratio by pupils, school management and district managers alike"* (MoES Uganda, 2006).

Vandalism

Obure (2009) identified theft and vandalism by some community members, including stealing taps, handwashing containers, latrine doors and cement for construction, as a threat to the sustainability of WinS. Similarly, McMahon (2010) suggests encouraging the community to stop using school facilities after hours as a means to improve facilities and avoid cleanliness issues in the mornings, indicating a negative impact on school toilet conditions from community use. Beyond anecdotal information, however, there is limited evidence of the impact of vandalism on the continued maintenance of WinS services.

Parent participation in WinS activities

In a study in Kenya, Njuguna (2008) found that outreach activities in the community were not associated with cleaner toilets, more water, or better handwashing practices, but the extent that the activities focused on WASH was unknown. Despite a lack of empirical evidence, creating a family hygiene day where parents are encouraged to come to the school and try the new facilities or other similar way to involve the community in WASH at the school is recommended as a way to improve WinS services (McMahon, 2010). This is exemplified by a teacher in Uganda who says, *"Once parents are involved they demand for good sanitation and hygiene and it has to be done. Some parents have offered to rectify sanitation and hygiene problems in the school and they go ahead and mobilize funds of behalf of schools"* (MoES Uganda, 2006).

School maintenance and monitoring plan

McMahon (2010) suggests encouraging teachers to create and enforce a maintenance system as a means to improve the condition of WASH facilities and Njuguna et al. (2008) state that teacher

planning and school organization for keeping toilets clean deserves high priority. More specifically, Saboori et al. (2011) describe a defined daily system surrounding WASH activities for teachers and students to perform with a way to ensure the system is being followed and the IRC (2007) suggests that WinS monitoring should include mechanisms which make it possible to act on problems that may arise.

WASH Champions

UNICEF Nepal (2006) attributed one school's successful continuation of a WinS program to "a dynamic and committed headmaster". Saboori et al. (2011) point out the impact that a champion head teacher can have in a schools, saying that "the level of involvement and support in the WinS activities by the head teacher of the school can affect the level of commitment by teachers and community stakeholders" and suggest identifying the motivators and barriers for head teacher involvement in WASH activities. Nagpal (2010) suggests that champions from local up to national level can have a big impact, including a village elder, local government official, or an official at the national level.

External monitoring and incentives

Njuguna et al. (2008) suggest that systematic, in-school supervision or inspection post-construction by government officials may support WinS sustainability, stating that this was mentioned by teachers and district personnel as an area that deserved further attention. IRC (2007) discuss the creation of a monitoring system at national, regional, district and school levels to safeguard the sustainability of WinS programs, including mechanisms which make it possible to act on problems that may arise. Accordingly, the Ministry of Education and Sports in Uganda

recommends that districts allocate funds and regularly inspect sanitation and hygiene in all schools (MoES Uganda, 2006), and Abraham et al. (2011) list monitoring of impacts, processes and facility usage as one of five guiding principles for successful and sustainable school sanitation.

O&M training

O&M training for school staff and/or community members is recommended in a number of prescriptive reports: Obure (2009) recommends training for school leadership on forecasting annual maintenance costs; in a six-country pilot project, teacher capacity building was recommended including exchange visits by teachers to health both visiting and visited teachers learn more about how other schools implement WinS (Bolt, 2006); an assessment of WinS in Peru, suggested O&M training for school maintenance personnel as a way to improve sustainability (WSP, 2001); and the IRC (2007) stresses the importance of refresher training for teachers and creative training ideas such as teacher visits to a school or district that has been active in WASH. However, there is limited evidence to substantiate the positive impact that O&M training may have and more evidence is needed. For example, in a study of WinS in Kenya, training of teachers or children was not associated with cleaner facilities or more handwashing, but training was typically a long time ago, very short duration, and/or not relevant (Njuguna, et al., 2008).

CHAPTER 3

IDENTIFYING BARRIERS TO WASH IN SCHOOLS IN THE PERUVIAN AMAZON

Christie Chatterley[1], Karl G. Linden[1], Victoria Espinoza Zavaleta[2], and Gianncarlo Valdivia Zavaleta[2]

[1] *Civil, Environmental and Architectural Engineering, University of Colorado at Boulder*
[2] *Environmental Management Engineering, Universidad Nacional de la Amazonia Peruana*

ABSTRACT

We conducted a study of the water, sanitation and hygiene (WASH) services at eight rural schools in the Peruvian Amazon to assess current conditions, understand local priorities, and identify barriers to providing and sustaining school-based services. Results set the stage for subsequent chapters by investigating local perspectives around WASH services in schools and barriers that may require addressing before school WASH intervention can be successful or is even needed. Though the geographic region is different from subsequent studies presented in this dissertation and the precise challenges will differ in each, results serve as background information to complement the sustainability challenges that arise in later chapters.

INTRODUCTION

In Peru, 84% and 72% of households have access to improved water and sanitation, respectively (WHO/UNICEF, 2008). However, less than 65% of Peruvian schools have access to potable water and approximately 50% have access to adequate sanitation (UNESCO, 2008). A World Bank study in Junín, Peru, conducted to identify opportunities to improve the quality of education, found the most deficient areas negatively impacting education pertain to the water, sanitation and hygiene (WASH) infrastructure in schools (Cotlear, 2007). In the Loreto Region

specifically, data on school WASH coverage is unavailable, however data on community and household services show an extreme lag behind the rest of the country: only 3.9% of the rural population have access to safe drinking water and even fewer have access to safe sanitation (Guevarra, 2008). The sustainability of existing water and sanitation infrastructure is especially troublesome in Loreto: 33% of water systems in the region are not operational and 58% produce non-potable water; 46% of toilets are collapsed or in a severe state of deterioration (Calderon, 2004).

A local non-profit organization, called the Civil Association for Conservation of the Peruvian Amazon Environment (CONAPAC), is attempting to improve water and sanitation services in communities and schools along the Amazon and Napo Rivers in the Loreto Region. Their Adopt-A-School program has been providing supplies and environmental conservation education to students in rural Amazon schools for over 20 years. In 2007, CONAPAC began implementing community-scale water treatment plants. The systems were funded and constructed by CONAPAC with labor donated by community members. Additionally, intervention included a two-day water workshop teaching the importance of clean water and facilitating discussion on household fee collection, as well as free household and classroom water collection buckets with a lid and tap. Water from the treatment plants is meant to be collected daily by bucket with schools receiving the water for free and households paying S./3 (app. $1.20) per month, though payment compliance varies in each community. At the time of the study, seven communities had participated in the safe water program with plans to include an eighth.

Objectives

This study aims to (1) assess the state of water, sanitation and hygiene (WASH) services in rural schools in the Peruvian Amazon, including usage and quality of the water provided by the community plants and stored at the schools; (2) determine the importance of school WASH services to students, teachers and mothers; (3) identify the barriers to sustaining adequate WASH services; and (4) test the hypothesis that better school toilets would improve teacher attendance (as requested by CONAPAC).

METHODS

Over two weeks in June 2010, we visited eight rural primary schools twice each in the municipalities of Indiana, Mazan and Amazonas in the Loreto region of Peru. The school year in Peru begins March 1 and schools were well into their first semester. Each school was part of CONAPAC's Adopt-A-School program and seven of the eight also participated in CONAPAC´s community water program within the previous two years. The community of the eighth school was next in line to participate in the water program. We were only able to conduct interviews and observations at seven schools, as one of the schools was closed during both visits for unknown reasons, and community members reported that their water treatment plant had been locked for months.

We interviewed seven school principals (or teachers when the principal was unavailable), nine mothers, and the rural district education officer[2]. Additionally, hands-on activities were carried out with students in grades 4-6 (ages 8-12) at three schools: two that participated in

[2] Survey tools are found in Appendix A

CONAPAC's water program and one that had not yet received a water plant (45 students participated in 17 groups total). Students were unaware of our objectives to learn more about the water and sanitation services at the school and the activities were presented to them as a fun activity. Consent was obtained from their teacher after description of the overall research, activities and what the information would be used for in accordance with IRB protocol 0110.37. During the classroom activities, students' drinking water usage was also observed. The objective of the first activity was to learn if students considered WASH facilities as part of a healthy school environment and their representation of ideal WASH services. Generality was purposely maintained in the activity directions to understand students own interpretation of "una escuela saludable" (a healthy school). Students were asked to draw a picture of a healthy, beautiful, ideal school in groups of two to four. In a second activity, called the "papelitos" (little slips of paper) activity, students, individually and in groups of up to four, were given 10 small pieces of paper with a picture and word for a school service (clean water, computer, electricity, furniture and materials, good bathrooms, library, music, sinks with soap, sports, and telephone) and asked to put them in order of what is most important to them to have at school. The objective of the "papelitos" activity was to identify how important school WASH facilities are to students in comparison with other school services. We also conducted the "papelitos" activity with six teachers, four mothers, the district education officer and the mayor of Mazan to learn their priorities for school services.

We observed the WASH facilities at all schools. Latrines were inspected for structural condition based on a three-point scale (1=functioning well, 2=functioning, but repairs needed, 3=not functioning/pit full), and hygienic condition based on existence of feces outside of the hole. We

analyzed water quality based on the presence of total coliforms and *E. Coli* using 3M Petrifilm (St. Paul, MN, #6404) for quantitative results in 1 mL samples and IDEXX Colilert (Westbrook, Maine, #WP020I) for presence/absence in 100 mL. All tests were conducted in duplicate to evaluate result accuracy. Free and total chlorine residual were tested with HACH 5-in-1 test strips (Loveland, CO).

RESULTS

Situational Analysis

Drinking water

Despite the schools' participation in the CONAPAC community water program, only three of the seven schools visited had treated water available on school grounds; three had no drinking water at the school and one had untreated drinking water. Three of the seven community treatment plants were functioning properly, while an additional three were functioning but in need of repair and one was completely broken down and locked (Oroche, Torres, & Sigmon, 2010). The school without a treatment plant collects water from the small creek that runs through the community or a rainwater collection system at the school when rainwater is available. Reasons given by principals and teachers for the absence of drinking water include that the community water system is too far from the school (at one school the plant is 25 minutes away "if walking fast" according to the teacher) or is closed during planned hours of operation, the school's water buckets were stolen or taken home by other teachers, and that students go home for water and it is not needed on school grounds.

Chlorine residual was not identified in any school drinking water sources. The CONAPAC treatment plant utilizes activated carbon to remove chlorine from the water prior to collection, but schools and households are encouraged to add a small amount of chlorine after the water is collected. Limited training is offered and there is a greater focus on education regarding the importance of using chlorine, but most household bleach sold in the region has directions for chlorinating drinking water on the bottle. Of the schools with drinking water from the community treatment plant, none had safe water at point-of-use based on microbiological testing. In samples collected from classroom water buckets, total coliform counts ranged from 30 to >150 CFU/mL (the detection limit of 3M Petrifilm TC/EC tests) and *E. coli* was present in 100 mL samples based on Colilert presence/absence testing. Regarding usage, students were observed drinking water from the classroom buckets with treated water in all schools where they were available, indicating student acceptability of water from the treatment plant. However, at some schools students were seen taking the lid off the bucket to fill their cup from the top instead of using the tap, a likely source of recontamination even if source water was clean.

Sanitation

Five of the seven schools have traditional pit latrines, while two have piped flush toilets that empty into a septic tank. Only two schools have toilets that are functioning well with little to no repair needs; three have toilets that are functioning but in need of repair and the toilets at two schools are completely unusable, due to full or collapsed pits. Teachers also report that latrines become unusable during the flooding season when the pits fill up and smell terrible. Besides this, maintenance needs include missing or broken doors, unbearable odor, and/or filthy conditions (including feces on the floor and seat). Flies can enter and exit the toilet chamber at five schools

and none have sanitary cleansing material, such as toilet paper, available. There are gender segregated toilets at two schools and four schools meet international recommended standards for toilet quantities of no more than 25 girls per toilet and 25 boys per toilet or urinal (WHO/UNICEF, 2009). Reasons given by principals and teachers for the poor sanitation conditions at the school include a lack of funding, improper use by students (*"kids fear sitting on the toilets because they don't want to fall in and sometimes they will just go in front of the toilet"* (Principal)), and that students go to their nearby home to use the toilet during breaks and the school toilet isn't necessary. Common complaints from students include that toilets are dirty and dark. Schools with toilets in good condition tended to be in communities that also had well-maintained toilets at the household level.

Handwashing and hygiene education

Only one school has handwashing facilities and none of the schools provide soap. Hygiene promotion is prevalent at one school including paintings with reminders of key times to wash hands, but there were no facilities to practice the messages. Reasons given by teachers and principals for the lack of handwashing facilities include insufficient funding for soap, kids taking the soap or animals eating it. They also mention that students go home to wash their hands.

Student perspectives on school WASH

Student depictions of a healthy school

Most groups included a bucket of clean water in the classroom of their drawing of an ideal/healthy school and a few groups included a toilet. No groups included soap or sinks for handwashing in their drawings. The groups that included sanitation facilities, drew two

characteristics that differed from their current toilets: bathrooms attached to the school building (most are behind the school at one end of the school yard) and bathrooms equipped with a light (most current toilets are very dark when the door is closed), indicating that these features would be desirable to students and may improve school toilet usage.

Student priorities

Based on average rankings from the "papelitos" activity, most students consider WASH services relatively unimportant, ranking sixth, seventh and ninth for clean water, good bathrooms and sinks with soap, respectively (Table 2). The top three services were library, computer and music, in that order. There were no significant differences between male and female group results. It is interesting to note that clean water ranked the highest of the three WASH components since this is the main focus of the CONAPAC program, including educational and promotional messages around safe drinking water. If the reason for the higher ranking of clean water was due to this promotional activity, it may be possible to increase sanitation and handwashing in the list of priorities through similar means, such as Global Handwashing Day.

Mother perspectives on school WASH

Mothers tend to link handwashing with improved health slightly more frequently than clean water or sanitation: four mothers mentioned handwashing as a critical component of WASH for improved health, compared to two that said sanitation, and two who said water. Despite this connection, on average, mothers ranked handwashing facilities as their lowest priority in comparison with water and sanitation, ranking sixth compared to first and fourth for water and sanitation, respectively in the "papelitos" activity (Table 2). Based on these results, promotional

messages beyond health benefits may be more effective for encouraging handwashing; echoing current thoughts in the sector on marketing WASH (Jenkins & Scott, 2010; Sidibe & Curtis, 2007). With respect to the importance placed on school WASH facilities by mothers, five of the nine mothers interviewed feel that WASH facilities are most important at home, compared to three that consider school and household facilities as equally important and one that didn't have an opinion. The main rationale mothers give for the importance of having facilities at home is that *"students will follow habits at home and if they don't have services at home, they can't learn these habits"* (Mother and Teacher); and *"they are only at the school a short time"* (Mother). This is particularly true in the rural Peruvian Amazon where teacher absenteeism is startlingly high and students are often at home during school hours because there is no teacher present.

Principal and teacher perspectives on school WASH

School principals recognize that access to WASH at their school is inadequate, and three of six principals asked consider handwashing to be the most important component of WASH, followed by sanitation (mentioned by one) and both safe water and sanitation equally (mentioned by two). Despite the importance placed on handwashing by half the principals interviewed, there was no evidence of handwashing practice at any of the schools. Average teacher results from the "papelitos" activity indicate a strong importance placed on water (ranking first), followed by good bathrooms (ranking fourth) and lastly handwashing facilities with soap (ranking sixth) (Table 2). However knowing that we were connected with CONAPAC who provided the water treatment plants, teachers may have been bias toward water in the prioritization based on that knowledge. Having a library, furniture and teaching materials, and electricity all ranked higher than handwashing.

Rural authority perspectives on school WASH

The district education officer based in the small town of Indiana that is surrounded by the smaller communities included in the study, ranked telephone services as the most important for the rural schools in the "papelitos" activity (Table 2). This makes sense from the perspective of a district officer as transportation between communities can be very time consuming and costly. He ranked handwashing facilities with soap as number two and says *"almost no one practices handwashing in the rural schools"*. He ranked having a library fifth saying that *"books are as important at a school and discs at a discotech"*, but this level of importance is not placed on water or sanitation which he ranked eighth and ninth, respectively. He does acknowledge that water services in the schools and communities are poor and told us *"there is no potable water in the rural schools and even when there is a treatment plant it is not used correctly"*. The mayor of the municipality of Mazan (one of the three municipalities included in the study) ranked music as his first priority followed by computers and telephones. He placed the least importance on WASH services ranking handwashing facilities with soap, good toilets, and clean water as eighth, ninth and tenth, respectively (Table 2). He says there is insufficient funding for school WASH services in general and there are still schools without classroom walls or desks.

Table 2. Local priorities for school services (in order of high to low)

Group / Rank	Students (n=17)	Teachers (n=6)	Mothers (n=4)	District Education Officer	Mayor of Mazan
1	Library	**Clean water**	Library	Telephone	Music
2	Computer	Library	**Good toilets**	**Sinks with soap**	Computer
3	Music	Furniture	**Clean water**	Music	Telephone
4	Furniture	**Good toilets**	Computer	Furniture	Electricity
5	Sports	Electricity	**Sinks with soap**	Library	Furniture
6	**Clean water**	**Sinks with soap**	Sports	Computer	Library
7	**Good toilets**	Computer	Electricity	Sports	Sports
8	Electricity	Telephone	Music	**Good toilets**	**Sinks with soap**
9	**Sinks with soap**	Sports	Furniture	**Clean water**	**Good toilets**
10	Telephone	Music	Telephone	Electricity	**Clean water**

Challenges and barriers to adequate WASH in rural Amazon schools

A common urban (Iquitos) perception of the rural Amazon is that communities don't need toilets because they can relieve themselves in the jungle and collect water from the river. According to the Loreto rural education officer, because of this misperception, most rural schools are constructed without WASH facilities. However, according to the district education officer, the mayor can have a big impact on school WASH and says that the municipality of Amazonas built their schools with hygiene services because of the mayor they had at the time. We observed this during school visits as the school in Amazonas was the only building with attached toilets including a rainwater system for toilet flushing and sinks. Funding for rural schools in general is inadequate – one school didn't have walls or desks for a number of their classrooms and the director expressed embarrassment with the level of infrastructure provided for their students. Local authorities expressed frustration with the level of local support saying that *"the parents don't contribute to the education either"* (District Education Officer).

Many of the teachers in rural Amazon schools are from the city and teacher absenteeism is a major challenge to student education: the education officer says this is in part because of mandatory monthly teacher trainings in Iquitos, but says that *"after they are gone for training and stay an extra day or two each weekend to visit their families and then add in the holidays, the students are only in school for two to five days every month and most leave sixth grade still illiterate"*. In addition to teacher absenteeism which often renders school WASH facilities unnecessary, there is also a lack of local interest in WASH: handwashing was reported of most interest from a health perspective, but ranked lowest for student, teacher and mother priorities in comparison with water and sanitation, and WASH in general is a low priority for most students

and mothers. Teachers, school directors and government officials expressed the importance of WASH but said more funding and a specific program including hygiene education would be needed, as expressed by one school principal who said *"the main issue is changing habits since most habits are formed in the home…this [change] can come from the school, but it takes a program and time and work"*.

Potential impact from improved WASH in schools

School attendance records were unavailable or considered unreliable due to high rates of teacher absenteeism that didn't coincide with records. However, based on the fact that school is rarely in session and many students live nearby, attendance is likely not directly linked to school WASH. Health records were obtained from health posts, but illnesses were so infrequently reported to the health post that statistically significant data was not available. Increasing student performance in school will also likely take more than just WASH improvements. Beyond the clear link between educational performance and teachers, a number of schools also reported that students were often hungry at school, likely decreasing their ability to focus. There was no evidence of household impact, such as improved hygiene practices (e.g. treating water or handwashing with soap) or construction of improved infrastructure at homes, motivated by school-based activities. As with other impact limitations, the infrequency with which schools are open, limit the opportunities for schools to serve as a platform for students to learn about WASH and bring messages home.

Would better school toilets improve teacher attendance?

Based on teacher interviews, better school toilets would not influence teacher attendance. Teachers typically return to the nearby teacher housing provided to teachers that are not from the

community (where they are expected to stay during the week) to use the toilet, and main reasons for preferring to be in the city include: time with family and mandatory teacher training.

CONCLUSION

None of the eight schools included in the study provide adequate WASH services to students. Water was often unavailable or unsafe, almost all toilets were in terrible condition, and no schools provided soap and water for handwashing. Despite the poor WASH conditions in these schools, there are additional challenges that may preclude potential benefits of WASH intervention. These include very high rates of teacher absenteeism and a low level of priority placed on hygiene services, which implies that on-going maintenance may be unlikely and suggests other issues in these schools that may need to be addressed before, or in parallel with, WASH. Unfortunately, we found no evidence to support CONAPAC's hypothesis that teacher absenteeism could be diminished by improving school toilets, as teachers typically use their home toilet and their main reasons for absence include teacher training and visiting family in the city.

Based on findings, we conclude that successful school WASH intervention in rural Loreto will likely need to be coupled with community WASH marketing strategies based on local motivations beyond health to create demand for school WASH, and greatly reduced teacher absenteeism, perhaps through restructured training so teachers don't have to go into the city every month, increased monitoring, and programs to encourage local teachers. Further investigation is needed to explain the cause of school WASH conditions, particularly the

identification of schools with facilities in good condition in order to identify the drivers behind well-managed service provision.

CHAPTER 4

NATIONAL ASSESSMENT OF WASH IN SCHOOLS IN BELIZE

This chapter is published online as a report at dbzchild.org

ABSTRACT

Data from the 2009 Ministry of Education national assessment of water, sanitation and hygiene (WASH) in Belizean schools are analyzed and presented with regard to the state of WASH facilities, practices and education. The principal challenges for WASH in Belizean schools and elements of effective school WASH administration are also discussed. Based on quantitative composite indices developed for access to and management of school WASH, the most common challenges, on a national level, include sanitation access relating to sufficient quantity and accessibility of toilets, and the provision of soap and handwashing promotion in schools. Surprisingly, based on indices calculations for each district, there is no statistically significant difference in WASH access and management between districts; on average, schools with poor WASH access and management tend to be spread throughout the country. The rural schools typically lag behind urban schools with respect to access to WASH infrastructure, but the condition of WASH facilities and hygiene education indicate that WASH management, on average, is similar between rural and urban schools.

Elements of successful school WASH are identified based on association with quality service provision. Higher frequency of cleaning and monitoring of facilities, and regularly following the hygiene education curriculum, are associated with cleaner, better maintained and more properly used facilities. The presence of a PTA alone does not correlate with better WASH conditions at

the schools, however, active participation of PTAs and management[3] support for maintenance of school WASH correlate with better service conditions (r_{pb} = 0.181, p = 0.006 for PTA participation and r_{pb} = 0.141, p = 0.014 for management support).

Recommended national standards for WASH in schools are provided along with a short monitoring tool intended for use in the Education Management Information System (EMIS) annual data collection. Roles and responsibilities for WASH is schools stakeholders are also suggested including students, school staff, parents, and local and national government officials. Implications and recommendations for WASH in Schools programming in Belize are discussed.

INTRODUCTION

A study of school WASH services in Latin America showed that 75% of schools have access to potable water and 65% have adequate[4] sanitation facilities (UNESCO, 2008). These statistics are averaged over seventeen countries, with the worst situation lying in Nicaragua where less than half the schools have access to clean water and less than one-third have sufficient bathrooms. Belize was not included in the study and there was no official data on WASH in Belizean schools prior to the 2009 assessment presented here. The assessment aims to inform the Ministry of Education's mission of "ensuring that all Belizeans are given the opportunity to acquire the knowledge, skills and attitude required for full and active participation in the development of the nation and for their own personal development". The results presented are not meant to assess any specific person or group, but to provide a baseline for addressing WASH in schools in a

[3] There is district-level management usually by religious affiliation
[4] "adequate" is not defined in the report

strategic and sustainable manner so that the WASH situation may be improved for the children of Belize.

Objectives

The main objectives of this study are to (1) conduct a situational analysis of the physical state of WASH facilities in Belizean schools; (2) identify the principal challenges to providing adequate facilities in a sustainable manner; (3) conduct a situational analysis of WASH practices and education in schools including the available capacities for delivering WASH education, challenges and existing gaps; and (4) identify elements that facilitate successful school WASH in Belize. Objectives of the study were guided by the Ministry of Education (MoE) and UNICEF Belize.

METHODS

The MoE and UNICEF Belize conducted an in-depth nationwide survey of WASH in schools, including all six districts of Belize (Figure 2). They developed a questionnaire which was administered in March and April, 2009 in 264 schools, representing almost 90% of schools nationwide. Surveys were distributed to school principals and the MoE's Health and Family Life Education (HFLE) officers supervised and validated responses as well as took photos of the school toilet facilities. In addition to the 2009 assessment data, the author visited Belize in December 2010 to conduct interviews and focus groups with MoE and MoH officials, HFLE officers, school principals and teachers, school management, representatives from local development organizations, and a local contractor.

Figure 2. Political map of Belize

The author was provided data in hard copy questionnaires as well as an SPSS[5] file by the MoE. Data entry was double-checked based on the hard copy questionnaires, data were re-coded into numerical format to facilitate analysis, and missing values were assigned to account for missing data. SPSS was used to compute frequency data and descriptive statistics (mean, maximum, minimum) for each variable collected in the assessment and to compute new variables based on such as ratios of students per toilet, percentage of schools that meet international recommended standards, and quantitative composite indices developed to facilitate comparison between urban and rural schools and between districts. Association between variables was evaluated in SPSS. Statistical tests were selected based on the characteristics of the data, inlcuding variable data type[6] and behavior of the information. Tests included Phi, Cramer´s V, Kendall´s Tau Beta, Point biserial, Spearman´s rho, and Pearson´s r. The structural and sanitary condition of school toilets were evaluated based on the criteria in Table 3 and Table 4, respectively.

Table 3. Criteria for the structural condition of toilets

Condition	Criteria
All in Good Condition *no improvement necessary*	No visible damage No report of malfunctioning
Fair Condition *minor repairs necessary*	Visible damages or report of malfunctioning Functions, but not properly because of this damage
Poor Condition *major repairs required*	Visible damages and report of malfunctioning Functions with difficulty, use is not continued
Very Poor Condition	Complete (re)construction required

[5] SPSS is a common statistical software package developed by IBM.
[6] Scale data are numeric values on an interval or ratio scale (e.g. age, number of students); ordinal data represent categories with some intrinsic order (e.g. low, medium, high); nominal data represent categories with no intrinsic order (e.g. teachers, principals, PTA)

Table 4. Criteria used to evaluate the sanitary conditions of the school toilets

Criteria / Category	Good: Demonstrates proper use	Fair/Poor: Demonstrates improper use	Very Poor: Requires urgent intervention
Cleanliness of toilet seat	Absence of dirt, urine or fecal matter	Some presence of dirt, urine or fecal matter	Major presence of dirt, urine or fecal matter
Coverage of toilet hole	Fully covered	Presence of cover material, but uncovered	No hole covering available
Cleanliness of floor	Absence of trash, urine or fecal matter	Some presence of trash, urine or fecal matter	Major presence of trash, urine or fecal matter
Cleanliness of wall	Absence of graffiti, urine, fecal matter	Some presence of graffiti, urine, fecal matter	Major presence of graffiti, urine, fecal matter
Smell of the facility	Clean smell: no foul odor	Slightly intolerable odor	Highly intolerable odor
Cleanliness of urinals	No urine on floor or beyond receptacles	Small presence of urine on floor or wall	Major amount & smell of urine on floor or wall
Type of cleansing material in toilet	Appropriate (toilet paper, sanitary tissues)	Inappropriate (leaves, newspaper, corncob, etc)	None

RESULTS

Situational Analysis

WASH in schools coverage, including access to water supply, sanitation and handwashing facilities, as well as their condition and management, are presented on a national level and disaggregated by classification (urban/rural) and the six districts of Belize.

Water supply

64% of Belizean schools have access to an adequate water supply, defined as an improved[7] and reliable source of safe water (Figure 3). Adequate water supply is less common in rural schools (56%) and the districts of Stann Creek (53%) and Toledo (47%). Water is piped to the premises of 79% of schools and 13% have access to another form of improved water source such as tube wells or rainwater catchment. 5% collect their water from an unimproved water source such as

[7] By Joint Monitoring Program definition, improved water sources include piped water to the premises, tube well or borehole, protected dug well, or rainwater collection.

tanker trucks, surface water, unprotected wells or springs, or bottled water, and 2% do not have any water access on school grounds.

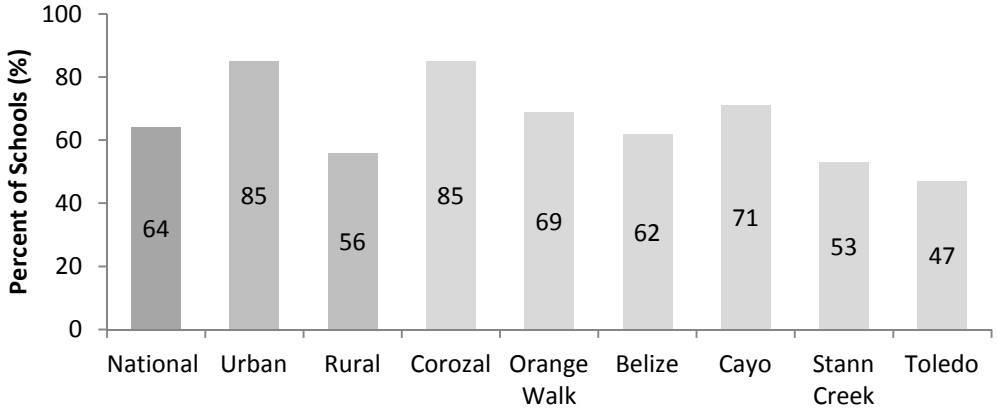


Figure 3. Percent of schools with adequate water services

Despite the high percentage of schools with piped water access, many of these sources are not potable. 75% of schools report that their main water source is treated, but this figure is based on school responses not water quality analysis and is likely a very high estimate of actual treatment. Additionally, only 43% of schools report treating water on school grounds if it is not treated at the source, with the majority chlorinating the water (90%), followed by filtering (6%), boiling (3%), and distilling (1%). Based on school visits and interviews with HFLE and MoH officers however, these self-reported data are likely a high estimate of actual water treatment practices in schools with unsafe source water: treated water was not observed at any of the 10 schools visited in December 2010 and HFLE and MoH officers reported that many people have an aversion to chlorine.

Similar to water treatment reporting, the reliability of school water supplies may be overestimated. Water supply is considered reliable throughout the year by head teachers at 78% of schools, but the questionnaire did not address daily continuity or water quantity and fewer schools may have sufficient water sources when these are taken into consideration. To help alleviate the effect of unreliable water service, 37% of schools have alternative water storage. At most of these schools (88%) the water storage facilities are kept clean. The remaining 12% with dirty water storage tanks are all in the rural areas, spread throughout the six districts.

In addition to potential contamination from dirty water storage tanks, water delivery at the point-of-use can also be a source of contamination. At the majority of schools (61%), students have access to drinking water in the classroom stored in water buckets or water coolers. Other water collection points include piped water fountains (16%) and directly from the hand pump or storage vat (6%). Students bring their own water at 12% of schools. At most schools (88%), children use their own cup for drinking water, but at 9% children use a shared cup and 5% of schools do not properly cover their drinking water containers, including both rural and urban schools.

Considering service equitability, water facilities cater to small children and children with physical disabilities at 70% of schools nationwide. In the district of Corozal, 90% of schools provide accessible water facilities, but in other areas the percentage is much lower such as Belize district where only 62% of schools provide adequately accessible water facilities.

Drainage is an often forgotten aspect of water service provision with potential negative health impacts as stagnant water can serve as a breeding ground for disease vectors such as mosquitoes. Almost 30% of schools have stagnant water on the premises and 19% have heard complaints of mosquitoes from students, teachers and other school staff. Complaints of mosquitoes are more common in the rural areas (23% versus 11% in urban schools), and the district of Toledo has the greatest percentage of schools with stagnant water (37%) and complaints of mosquitoes (27%). Based on general reporting by principals of WASH-related illness issues at their school in the previous year, the presence of stagnant water on school premises is associated with reports of malaria ($\varphi = 0.149$, $p < 0.05$).

Sanitation

Only 21% of schools have adequate sanitation, defined as access to improved[8] toilets where the number of students per facility meet international standards for schools in low-cost settings: 25 girls per toilet and 50 boys per toilet and urinal (WHO/UNICEF, 2009) (Figure 4). Flush toilets are the most common sanitation technology found in Belizean schools and constitute 77% of school bathrooms nationwide: 96% in the urban areas and 69% in the rural areas. 20% of schools have another type of improved sanitation technology, including pit latrines (12%), ventilated improved pit (VIP) latrines (7%), and composting toilets (1%). 3% have unimproved sanitation such as a pit latrine without a slab – all in rural areas. Urinals are provided at 62% of schools. Nationwide, 30% of schools meet the standard for girls' toilets and 33% meet the standard for boys' facilities (toilets and urinals). The urban areas struggle the most to provide sufficient quantities for their typically larger student population and smaller land area. The national

[8] Improved sanitation includes flush toilet to piped sewer system or septic tank, ventilated improved pit (VIP) latrine, pit latrine with slab, or composting toilet

averages for the number of students per toilet/urinal are found in Table 5. 39% of school toilets have been constructed within the past five years, while 11% of toilets were constructed over twenty years ago. Surprisingly, toilet age does not significantly correlate with structural condition however indicating that promoting improved facilities management may support better coverage in parallel with construction of new facilities.

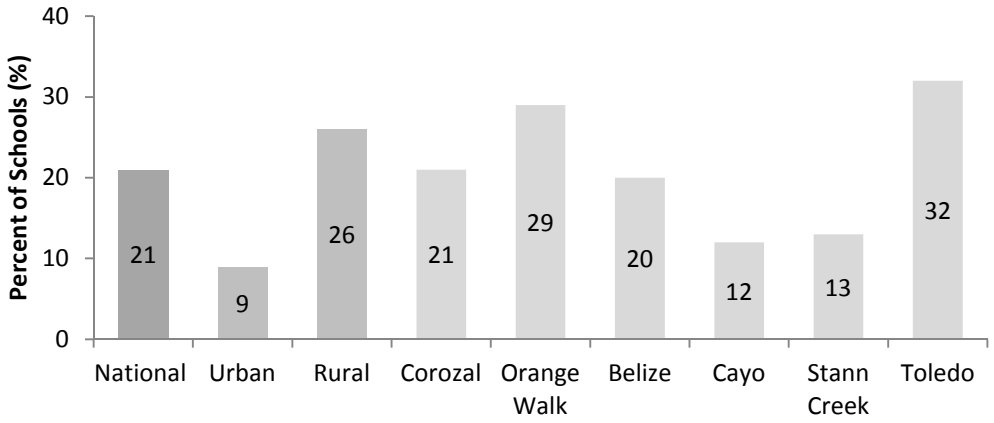


Figure 4. Percent of schools with adequate sanitation services

Table 5. Average number (and range) of students and teachers per toilet/urinal

	Total	Urban	Rural	Corozal	Orange Walk	Belize	Cayo	Stann Creek	Toledo
Average girls per toilet ratio (range)	43 (0-206)	53 (6-145)	39 (0-206)	42 (6-134)	47 (10-206)	40 (7-121)	53 (0-145)	49 (9-143)	33 (3-125)
Average boys per toilet ratio (range)	52 (5-282)	67 (6-194)	46 (5-282)	49 (9-147)	51 (13-141)	54 (5-194)	59 (7-133)	58 (13-151)	41 (6-282)
Average boys per urinal ratio (range)	68 (2-285)	89 (10-285)	55 (2-191)	59 (12-145)	52 (11-178)	77 (4-230)	78 (2-285)	82 (20-191)	45 (6-141)

Toilets are in poor structural condition in many schools. Based on the criteria in Table 3, toilets are in good structural condition (including doors, seats, bowls, floor and septic tank all in

working order) in 33% of schools for both the boys' and girls' facilities and 42% for teachers' toilets (Table 6). Less than half the schools have boys' urinals in good condition. At many schools, the toilets doors are broken or non-existent and the toilet bowls/seats and urinals are often in need of repair.

Table 6. Structural condition of student toilets (% of schools)

Component	Good	Fair	Poor	Very Poor
Internal doors	53	33	10	4
External doors	53	34	8	5
Toilet seats	56	29	10	5
Toilet bowls	51	29	15	5
Toilet floor	66	23	9	3
Septic tank	62	21	9	8
Urinals	47	38	9	7
All toilet components are in good condition				boys 33% girls 33% teachers 42%

The sanitary condition of toilets is poor in many schools based on the criteria listed in Table 4. Similar to the structural quality of school toilets, the teachers' facilities tend to be in better sanitary condition than the student toilets, but there is no significant difference between girls' and boys' facilities. Proper use is demonstrated in all categories (cleanliness of seat, floor and walls, coverage of toilet hole, and smell) for 31% of boys' toilets, 33% of girls' toilets and 53% of teachers' toilets (Table 7). At just over half the schools, appropriate sanitary cleansing material, such as toilet paper or sanitary tissues, was found in the toilet hole/bin. A small percentage of schools had evidence of inappropriate materials such as leaves, newspapers or corncobs, but 35% and 36% of schools did not have evidence that any sanitary cleansing material was used at all for the boys and girls toilets, respectively. These findings likely overestimate the

reliable provision of toilet paper based on school visits in December 2010, where only one of 10 schools had toilet paper available in the student toilets.

Table 7. Sanitary conditions of student toilets (% of schools)

Component	Good	Fair/Poor	Very Poor
Cleanliness of toilet seat	75	22	3
Cleanliness of toilet floor	71	27	2
Cleanliness of toilet walls	61	37	2
Smell of facilities	55	38	7
Coverage of toilet hole	52	36	12
Cleanliness of urinals	57	38	5
Type of cleansing material in toilet	59	5	36
All toilet components are in good sanitary condition			Boys 31% Girls 33% Teachers 53%

Interestingly, toilets located within the school building are associated with better structural condition (r_{pb}=0.241, p<0.001) and cleanliness (r_{pb}=0.189, p<0.001). Toilets are located within the school building at 36% and 38% of schools for boys' and girls' facilities, respectively. Having an indoor toilet is especially important if the school is also used as a hurricane shelter, but only 53% of schools that are designated hurricane shelters have at least one toilet within the building.

The majority of schools (94%) provide separate toilets for girls and boys and there is no significant difference in the existence of gender separated facilities between the urban and rural areas. Teachers and students share toilets at 5.4% of schools. Although these schools do not comply with recommended standards for teachers to have a separate facility (WHO/UNICEF, 2009), some schools report that toilets that are shared between teachers and students remain

cleaner and better maintained and the lack of separate facilities for teachers may not be of concern in some cases.[9]

School toilets are rarely constructed to accommodate special needs: nationwide, only 13% of schools have toilet facilities that are accessible to children with physical disabilities. Accessible facilities are rare in both urban and rural schools, with Cayo and Orange Walk districts having the lowest percentages of schools (2% and 3% respectively) and Stann Creek and Toledo with the highest percentages (26% and 25% respectively). There is at least one physically disabled student at 29% of schools. In schools without proper facilities, these children have to rely on their peers to help them when they need to use the toilet, greatly decreasing their independence and privacy.

Handwashing and hygiene education

Nationwide, 70% of schools have handwashing basins equipped with running water, a service more common in the urban areas (93%) than rural (60%). One-quarter (25%) of schools, have wash basins with bucket water and 3% have no access to handwashing facilities, mostly in the rural areas. Handwashing facilities are typically located inside the toilets (52%), immediately outside the toilets (19%), or inside the classroom (18%). Handwashing facilities that are outside of the toilet stall can be beneficial for monitoring of student handwashing practices and ensuring that students properly use the facilities, but a method to close and lock them should be considered for security as many external wash basins were reported to have been vandalized after school hours.[10]

[9] Based on interviews and school visits in December 2010 and March 2011
[10] Based on interviews and school visits conducted by the author in December 2010.

There is no standard for the number of students per handwashing point recommended by the World Health Organization for schools in low-cost settings (WHO/UNICEF, 2009) and at the time of analysis there was no standard in Belize. In Colombia, the standard is 25-35 students per device (toilet and handwashing point) (García, 2006), and in Peru and El Salvador it is 30 and 40 students per handwashing point, respectively (Ministerio de Salud de El Salvador, 2007; Ministerio de Vivienda del Peru, 2006). Based on the 2009 assessment data, 48% of Belizean schools would meet a standard of 30 students per handwashing point and 55% would meet a standard of 40. Similar to toilet and urinal facilities, the urban areas are more prone to crowded handwashing facilities: only 32% of urban schools would meet a standard of 40 students per handwashing point compared to 66% of rural schools.

Reliable soap provision is integral to student handwashing practices. According to school principals, soap is available to students at 72% of schools. However, this is likely a high estimate based on school visits and HFLE officer feedback. Further, soap is often kept in the classroom which offers greater supervision by teachers, but may not encourage its use by students.[11] In addition to soap provision, the importance of proper hand drying materials was shown by Snelling et al. (2011) who report that "damp hands are actually more likely to attract new bacteria" and students should have access to hygienic hand drying material (paper or clean cloth towels). Almost half (45%) of the schools in Belize do not provide material for drying hands after handwashing with urban schools less likely than rural schools to provide hand drying material: 38% and 61%, respectively. The most common type of drying material provided are

[11] Based on interviews with principals and HFLE officers by the consultant in December 2010

towels (39%) followed by disposable sanitary paper (15%). There are a handful of schools that do not have soap, water, or reminders for children to wash their hands; all in the rural areas.

Hygiene promotion in combination with the provision soap, water and drying materials, has the potential to reinforce positive hygiene behaviors. Over 25% of schools nationwide have posters, stickers or other signs that encourage good hygiene visible in the toilets. The Stann Creek and Toledo districts have the largest percentage of schools with hygiene education material in the toilets and this may be in part due to the school WASH intervention conducted in 36 schools within these two districts starting in 2007. Hygiene promotion in the toilets is associated with cleaner, properly used facilities (r_{pb}=0.207, $p<0.001$), though it is unclear if the underlying cause is the promotional material itself or active teachers that may be more likely to post these materials.

Beyond posters and other promotional materials, hygiene messages integrated into the student curriculum and routine school activities may further encourage health-boosting behaviors. Health and Family Life Education (HFLE) curriculum is part of the national curriculum in Belize and being implemented in the majority of schools. In the urban and rural schools of the Belize, Toledo and Stann Creek districts, the HFLE curriculum is not being implemented by any teachers in 8%, 7% and 3% of the schools respectively. All schools in the other three districts are implementing the HFLE curriculum to some extent. Good use of the HFLE curriculum, where it is regularly taught by all teachers, is associated with reported treatment of unsafe water (□=0.275, $p<0.05$) and the teaching of proper handwashing outside of the hygiene curriculum (□=0.338, $p<0.001$). Most schools (93%) report teaching students the proper way to wash their

hands, with a slightly higher percentage in the rural areas (94%) compared to urban (89%). Less than half of schools nationwide designate a time for all students to wash hands before and after eating or monitor students in the feeding program to ensure hands are washed before and after eating. The Corozal, Stann Creek and Toledo districts have substantially more schools with a designated handwashing time and handwashing monitoring than the Orange Walk, Belize and Cayo districts.

Composite indices for WASH access and management

A quantitative composite index (QCI) was developed to facilitate communication of results to individual districts and school managements based on (1) access to WASH facilities and (2) WASH management (measured by the condition of WASH infrastructure and presence of hygiene promotion) as described in Table 8. Each variable score is normalized from zero to one, where zero indicates that intervention is needed and one indicates that standards and expectations for a healthy school environment are being met. Variable weighting is based on areas of key importance from interviews with WASH in schools actors in Belize and school visits. Missing data were excluded pair-wise from the calculation of the QCI for districts, classification (urban/rural) and school management type. These data are meant to provide a rough idea and a starting place but each school's situation may be unique and considered on a case-by-case basis.

Table 8. Composite indices for WASH access and management

Composite Index	Level 2 Variable	Indicator	Normalized Responses	Weight
WASH Access	Water	1.Improved water source	1=improved[12]; 0=unimproved/none	2
		2.Water reliability	1=constant throughout the year 0.5=not constant some months 0=not constant all months	2
		3.Water treatment at source	1=treated; 0=untreated	1
		4.Child-friendly water facilities	1=yes; 0=no	1
	Sanitation	5.Improved toilets	1=improved[13]; 0=unimproved/ none	2
		6.Number of girls per toilet	1= ≤ 25; 0.5= ≤ 50; 0= >50	1
		7. Number of boys per toilet/urinal	1= ≤ 25; 0.5= ≤ 50; 0= >50	1
		8.Accessible to students with physical disabilities	1=yes; 0=no	1
	Hygiene	9.Handwashing facility type	1=running water; 0.5=collected; 0=none	2
		10.Number of students per handwashing facility	1=meets standard of 35 0.5=meets twice standard (70) 0=more than 70 students per sink	1
WASH Management	Water	11.Treated by school if not at source	1=yes; 0=no	2
		12.Containers properly covered	1=yes; 0=no	1
		13.Type of cup used by students	1=unshared; 0=shared	1
		14.Standing water on premises	1=no; 0=yes	1
	Sanitation	15.Average structural condition	1=good; 0.5=fair; 0=poor/very poor	2
		16.Average cleanliness	1=good; 0.5=fair; 0=poor/very poor	2
		17.Sanitary cleansing materials	1=appropriate; 0.5=inapp.; 0=none	1
		18.Maintenance of area around toilet	1=good; 0.5=poor; 0=very poor	1
	Hygiene	19.Soap provision	1=yes; 0=no	2
		20.Use of HFLE curriculum	1=good; 0.5=poor; 0=very poor	1
		21.Hygiene promotion in toilets	1=yes; 0=no	1
		22.Designated time allotted for washing hands before & after eating	1=yes; 0=no	1

Surprisingly, the differences in composite indices between districts are not statistically significant and schools challenged by WASH access and management tend to be spread throughout the country (Table 9, Figure 5). The most common challenges, on a national level, include: Sanitation Access (sufficient quantity; toilets accessible to students with physical disabilities), and Hygiene Management (hygiene promotion; designated handwashing time; soap

[12] Improved water sources include piped water to the premises, tube well or borehole, protected dug well, rainwater collection. Unimproved sources include unprotected wells/springs, tanker truck, bottled water, surface water.
[13] Improved sanitation includes flush toilet to piped sewer system or septic tank, ventilated improved pit (VIP) latrine, pit latrine with slab, or composting toilet. Unimproved sanitation include pit latrine without slab and bucket toilet.

provision). Though averages are similar between districts, some districts are challenges by different areas more than others and specific issues disaggregated by district are presented in Table 10.

Table 9. Composite indices for school WASH disaggregated by district

	Corozal	Orange Walk	Belize	Cayo	Stann Creek	Toledo	National Average
WASH Access	**0.715**	**0.653**	**0.694**	**0.657**	**0.672**	**0.673**	**0.675**
Water Access	0.939	0.867	0.810	0.861	0.812	0.760	0.838
Sanitation Access	0.562	0.558	0.533	0.491	0.602	0.610	0.546
Handwashing Access	0.642	0.533	0.739	0.619	0.601	0.648	0.641
WASH Management	**0.621**	**0.611**	**0.608**	**0.600**	**0.603**	**0.766**	**0.632**
Water Management	0.651	0.573	0.574	0.581	0.414	0.660	0.602
Sanitation Management	0.632	0.709	0.729	0.714	0.754	0.925	0.719
Hygiene Management	0.578	0.552	0.519	0.506	0.641	0.714	0.577
N (# of cases)	42	35	63	43	35	45	262

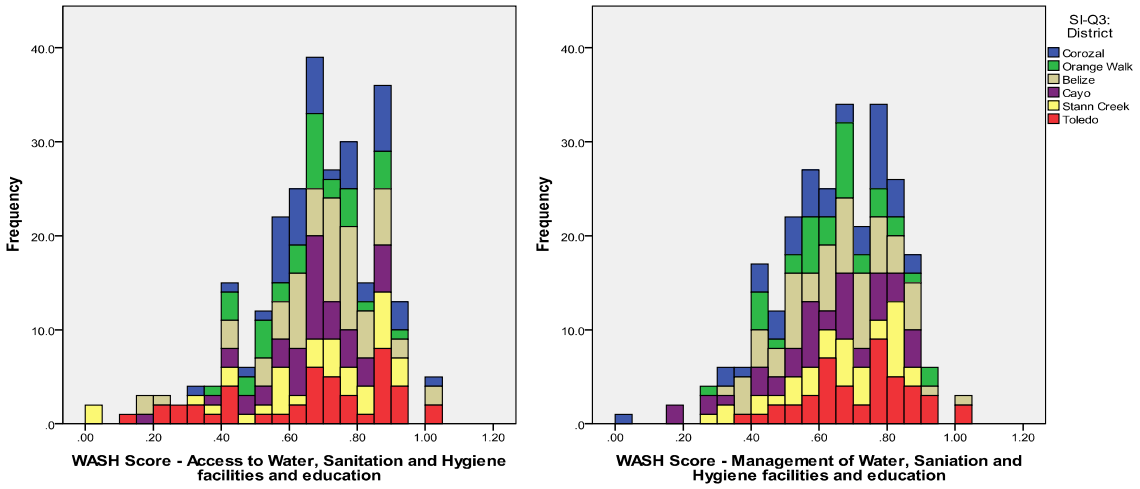


Figure 5. Histogram of WASH access and conditions among schools in each of the six districts

Table 10. Components of the composite indices where disricts fall below national averages

District	Category	
	WASH Access	**WASH Management**
Corozal		Sanitation Management • Toilet cleanliness • Provision of toilet paper
Orange Walk	Handwashing Access • Access to running water handwashing facilities • Quantity of handwashing facilities	Hygiene Management & Education • Soap provision • Designated time allotted to wash hands
Belize	Sanitation Access • Quantity of toilets • Toilets accessible to students with disabilities	Hygiene Management & Education • Use of HFLE Curriculum • Handwashing promotion • Designated time allotted to wash hands
Cayo	Sanitation Access • Access to improved toilets • Quantity of toilets • Toilets accessible to students with disabilities	Hygiene Management & Education • Soap provision • Handwashing promotion • Designated time allotted to wash hands
Stann Creek	Handwashing Access • Quantity of facilities	Water Management • Treatment of water if not at source • Use of shared cups • Standing water
Toledo	Sanitation Access • Access to improved toilets • Toilets accessible to students with disabilities	Water Management • Treatment of water if not at source • Standing water

Rural schools tend to lag behind urban schools with respect to WASH access, but the condition of WASH facilities and hygiene education indicate that WASH management, on average, is similar between rural and urban schools (Table 11, Figure 6).

Table 11. Composite indices for WASH in rural and urban schools

	Urban	Rural
WASH Access	**0.710**	**0.659**
Water Access	0.917	0.805
Sanitation Access	0.494	0.565
HW Access	0.718	0.608
WASH Management	**0.662**	**0.636**
Water Management	0.756	0.586
Sanitation Management	0.720	0.716
Hygiene Management & Education	0.512	0.607
N (# of cases)	76	180

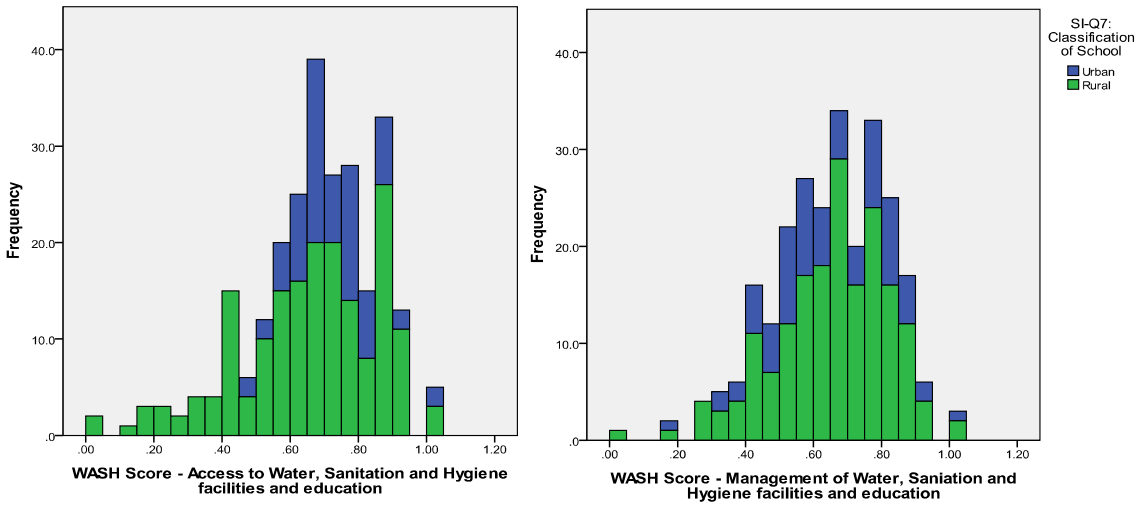


Figure 6. Histogram of access and management of school WASH in the rural and urban areas

WASH management structures linked to higher quality services

Though further investigation is needed to gather a more complete picture of the reasons why some schools have better maintained services than others, statistical correlation between higher quality service provision and characteristics of various management structures provides initial insight into what may promote improved service provision. Each managerial factor associated with better-maintained services are discussed below.

Involvement of the PTA: Three-quarters of schools have a parent teacher association (PTA), but only 20% and 30% participate in the maintenance of WASH facilities at urban and rural schools, respectively. There is no correlation between better WASH conditions and the presence of a PTA. However, improved WASH conditions are associated with active participation of the PTA in WASH maintenance (r_{pb} = 0.181, $p < 0.01$). Specific to water service provision, at 31% of schools the PTA is involved in monitoring and maintenance of the school water supply (more

commonly in the rural areas: 34% versus 22% in the urban schools) which is also associated with better managed water services ($r_{pb} = 0.187$, $p < 0.01$).

School management support: School management typically does not support the maintenance of WASH facilities: only 27% of schools receive management support for WASH maintenance (20% of rural schools). In most schools, principals have to fundraise within the community to collect these funds from parents and local businesses which are often unreliable sources as they are solicited for funds for other school and community needs as well.[14] However, schools that do receive management support for WASH maintenance tend to have better WASH conditions ($r_{pb} = 0.141$, $p < 0.05$).

Water supply maintenance plan: Nationwide, 37% of schools have a maintenance plan for water facilities. However, the presence of a maintenance plan does not significantly correlate with better water management.

Who is responsible for toilet maintenance: Students and hired cleaners are most frequently responsible for cleaning the toilets: 50% and 38% of schools, respectively. Teachers clean student toilets at 4% of schools. At the majority of schools (64%), the principal is responsible for ensuring that toilet facilities are inspected for misuse and damages, followed by teachers (18%) and school management (9%). The PTA is responsible for ensuring inspection of toilet facilities at 5% of the schools. The school administration is responsible for ensuring that repairs are made in the toilet facilities when necessary at 68% of the schools, followed by school management

[14] Based on interviews with school principals by the consultant in December 2010 and March 2011

(18%), teachers (8%) and the PTA (6%). Surprisingly, there is no significant correlation between who is in charge of cleaning and ensuring toilet inspection with toilet condition.

Frequency of toilet maintenance: 79% of schools inspect their toilet facilities at least once per week, while 3% report never inspecting the facilities. Toilets are cleaned at the majority of schools at least every other day, though 31% clean the toilets once a week or less frequently. Cleaning frequency correlates with toilet cleanliness ($\rho = 0.211$, $p < 0.001$), but inspection frequency is not statistically correlated with structural condition.

Toilet paper provision: Toilet paper is supplied by school management or the principal at 71% of schools. It is supplied by the class teacher at 22% and personally supplied by students at 8%. Not surprisingly, the use of proper sanitary cleansing material, such as toilet paper, correlates with toilet paper provision at the school ($\phi = 0.338$, $p < 0.001$) and relying on students to bring it from home may not encourage proper hygiene. Frequently, toilet paper is collected from parents at the start of the year and provided to the students by the principal or teachers as needed.[15]

Table 12 provides a summary of the statistically significant associations between the administration of school WASH services and the impact on reliable access and hygienic behaviors based on data collected such as maintenance, physical condition, proper usage of toilets, and treatment of water. Factors identified in the previous section, such as the presence of hygiene promotional materials and the location of toilets, are also included. The association between variables is presented as the correlation coefficient and p-value, where the correlation

[15] Based on school visits and interviews in December 2010 and March 2011

coefficient is a measure of the strength of the association and the p-value is a measure of the strength of statistical significance. This information demonstrates that some elements of WASH administration may lead to improved hygienic conditions for the students.[16] Based on these data, elements of effective WASH administration may include high frequency of cleaning and monitoring of facilities (which can be facilitated by facility location), teaching hygiene education such as the HFLE curriculum, and the involvement of the PTA and school management in the maintenance of WASH facilities. Based on interviews, PTA and management support is most beneficial when the principal is a good leader and has taken a strong interest themselves in ensuring that WASH facilities are acceptable and have given the community a voice in the issue.

Table 12. Summary of significant correlations identified in the study

Input	Output	Sample Size	Strength of Association[17]	Statistical Significance
Presence of a PTA	WASH Management Score	N = 253	No significant correlation	
PTA actively participates in maintenance of WASH facilities	WASH Management Score	N = 195	r_{pb} = 0.181 (weak)	p < 0.01 (strong)
PTA is involved in the monitoring and maintenance of water facilities	Water Management Score	N = 232	r_{pb} = 0.187 (weak)	p < 0.01 (strong)
Management supports maintenance of WASH facilities	WASH Management Score	N = 247	r_{pb} = 0.141 (weak)	p < 0.05 (associated)
Water supply maintenance plan	Water Management Score	N = 260	No significant correlation	
Who is responsible for ensuring maintenance of WASH facilities	Structural condition of facilities	N = 260	No significant correlation with any group	
Frequency of toilet cleaning	Cleanliness of student toilets	N = 257	□ = 0.211 (weak)	p < 0.001 (very strong)
Location of toilets (in main building)	Structural condition of student toilets	N = 243	r_{pb} = 0.241 (weak)	p < 0.001 (very strong)
	Cleanliness of student toilets	N = 254	r_{pb} = 0.189 (weak)	p < 0.001 (very strong)
Good use of the HFLE curriculum	Water treatment is reported	N = 92	□ = 0.275 (weak)	p < 0.05 (associated)
	School teaches proper handwashing	N = 245	□ = 0.338 (moderate)	p < 0.001 (very strong)
Posters, stickers, or other hygiene promotion are present in the toilets	Cleanliness of toilets	N = 249	r_{pb} = 0.207 (weak)	p < 0.001 (very strong)

[16] Other elements of WASH administration may be associated with improved conditions, but are not presented in the table if their association was not statistically significant.
[17] Interpretation of the strength of the correlation are based on (Cohen, 1988)

WASH-Related Illnesses

Head lice, diarrhea and conjunctivitis are the three most common WASH-related student illnesses reported by principals. Over half of schools nationwide report having issues with head lice in the past year, 40% report diarrhea and 35% report conjunctivitis. WASH-related illnesses tend to be slightly more common in the rural areas and in the Toledo and Corozal districts. Unfortunately, these data are only meant to provide a general idea of the common WASH-related illnesses and are not used to determine the impact of WASH facilities due to the long recall time (one year) and general nature of the question that are not recommended for impact studies (Blum & Feachem, 1983). Associations between illness data and school WASH facilities were analyzed, though the reliability of the illness data collected should be considered in the interpretation: the presence of stagnant water on school premises is weakly associated with reports of malaria ($\varphi = 0.149$, $p < 0.05$) and the data suggest that students at schools with running water are less likely to have scabies ($\varphi = 0.235$, $p < 0.001$).

It has been shown conclusively in previous studies that health improvements result from the behavior changes facilitated by reliable access to WASH services, and the measurement of these changes is likely to be easier, more reliable, and more useful as a diagnostic tool than attempts to measure health impacts directly (Cairncross, 1990). In this context, the data on hygiene practices, including maintenance and cleanliness of facilities, that were collected in the 2009 assessment provide insight into the hygienic conditions that facilitate improvements in children's health.

CONCLUSIONS

Based on data collected from almost 90% of schools in Belize, 64% have access to an adequate water supply and 21% have adequate sanitation facilities. Maintenance of facilities is often poor, echoing challenges common to the WASH sector. However, there are a number of schools with well-managed WASH services and associated factors are identified, including active PTA participation and school management support for WASH maintenance and high frequency toilet cleaning. Hygiene education and promotion are also associated with quality service provision.

Recommendations to improve WASH in schools nationally

Results provide a baseline for future programming and policy recommendations. Recommendations for future WinS programming based on results from the 2009 national assessment are briefly discussed followed by policy level recommendations.

Based on the 2009 data and school visits, WinS interventions may have higher success if PTAs and the school management are involved. This could include upfront financial contribution from school management, and design-decisions and the drafting of maintenance plans including a budget and sources of funding for on-going maintenance needs by the PTA. According to results from the national assessment, school facilities should be cleaned at least once per day and regularly monitored. Quick and simple checklists with daily sign-off may be helpful to ensure adequate cleaning, as well as monitoring from within the school (by the principal, teachers, students) and externally such as MoE HFLE officers or MoH health educators.

The establishment of a clear set of standards for school WASH and corresponding regular monitoring can increase accountability for schools and responsible agencies to provide quality services. Suggested standards for WinS in Belize can be found in Appendix B. The existing Education Management Information System (EMIS) is often a prudent option for annual WinS monitoring at the national level; WASH specific questions can often be added for very little additional government resources. A recommended WASH-specific EMIS questionnaire for Belize is found in Appendix C). To be effective, these data must be processed in a timely fashion and acted upon. Clearly defined roles and responsibilities for school WASH stakeholders can also increase accountability. Key actors with associated roles and responsibilities are suggested for Belize in Appendix D, based on interviews and school visits. Roles should be agreed upon by all government bodies involved and responsibilities should be clear and publicized. A position or board to ensure each groups compliance with their agreed upon responsibilities may help improve accountability.

CHAPTER 5

EVALUATION OF A WASH IN SCHOOLS PROGRAM IN SOUTHERN BELIZE

This chapter was submitted as a separate report to the Ministry of Education and UNICEF Belize

ABSTRACT

A WASH in Schools program (called "the WASH Project") led by the Belize Ministry of Education in 2007 and 2008 is evaluated to learn from successes and challenges observed at the schools, so that success can be built upon and challenges addressed in future programming for greater impact. Data are presented based on interviews with principals, teachers and students, inspection of facilities, and observation of student handwashing practices.

Program Successes – What went well: Where the WASH Project infrastructure was completed, children have access to safer water (water from the installed drinking fountains tend to be less contaminated than water from classroom buckets), less crowded toilet facilities that are typically an improvement over pre-existing facilities with better lighting, ventilation, privacy and smell, and increased access to running water handwashing facilities. Based on case studies where the WASH Project was successful, key elements that facilitate success include completion of infrastructure, involvement of the school and PTA/community in the planning and implementation, and proactive principals who show concern for WASH at their school.

Program Challenges – Where things fell short, but can be learned from: Infrastructure was not completed at many schools and schools/communities were rarely consulted or involved in the decision-making process. This has resulted in some disappointment and frustration at the local

level. This lack of consultation up front may have left a perception at some schools that an outside agency would also be doing the repairs and many WASH Project facilities are not currently functioning due to lack of completion or lack of maintenance: 75% of drinking fountains, 35% of toilets, and 19% of sinks are not functioning.

Key Findings: School and community involvement upfront correlate strongly with the structural condition of WASH Project toilets three to four years later. Based on observation, 76% of students use soap when it is available at the sink compared to 0% when it is kept in the classroom. 68% of schools report poor quality materials/construction as a major cause of damage to WASH facilities followed by vandalism, mentioned by 53% of schools. Implications for improving the WASH project are discussed.

INTRODUCTION

Water, sanitation and hygiene (WASH) services are integral to providing a school environment that is conducive to student learning. In Belize, 64% and 21% of schools have adequate[18] water services and sanitation, respectively (Chatterley, 2011). In response to the WASH challenges in Belizean schools, the Ministry of Education implemented a WASH in Schools program, called "the WASH project", with financial support and guidance from UNICEF. It was implemented in 61 schools over three years (2007-2010) in the two southern districts of Belize: Toledo and Stann Creek (Figure 7).

Figure 7. Map of southern Belize

[18] Adequate water services are defined here as an "improved" (by JMP definition) and reliable source of treated water. Adequate sanitation services are defined here as reliable access to "improved" toilets (by JMP definition) where the number of students per facility meet international standards for schools in low-cost settings: 25 girls per toilet and 50 boys per toilet and urinal (WHO 2009)

Schools were selected based on critical needs (toilets, water facilities or both are in a critical state and in dire need of repair, replacement or do not exist at all) identified in a baseline assessment (Enedu, 2007). The program included community sensitization meetings conducted by district-level Ministry of Education (MoE) and Ministry of Health (MoH) officers, a maintenance training workshop attended by a representative from each community, a maintenance manual and kit, a community education program and infrastructure varying by school needs, such as drinking water fountains and toilet facilities.

Maintenance training was held in the capital of each district and one representative from each community was invited to attend. The maintenance training and manual addressed recommended inspection and maintenance frequency including checklists, and detailed steps and images describing how to repair WASH infrastructure such as flush toilets. The accompanying maintenance kit included basic tools and an array of common spare parts. A community education program was also attempted as part of the program where young adults in the communities were trained to visit households to conduct surveys and promote WASH, but the program was very short-lived (a few weeks). WASH infrastructure was constructed by hired contractors selected by and reporting to the MoE.

The program was completed in three phases including 36 schools in the first phase. Phase one in Toledo was from December 2007 to July 2008 and in Stann Creek from November 2008 to May 2009. Phase 2 included additional schools in Toledo and was from November 2008 to May 2009 with Phase 3 following in both districts from March to July 2010.

Objectives

The objectives of the study are to (1) understand the current state of the intervention facilities (2-3 years later), (2) understand children's hygiene knowledge and practices, and (3) determine the effect of management structures and intervention strategies on sustainability.

METHODS

Over two weeks, the author and HFLE officers visited 20 schools, randomly selected from the 36 schools included in the first phase of the intervention. The highest randomly generated schools in each district and the schools along their routes were included, up to 12 (of 24) schools in Toledo district and 8 (of 12) schools in Stann Creek district. This provides 95% confidence that results are accurate to within 7.5% based on the sample size equation for finite populations.

At each school, the evaluation included water quality analysis, interviews with principals and/or teachers who had been at the school for at least three years where possible, inspection of water and sanitation facilities (Table 13), blind observation of student handwashing practices after toilet use (118 students total) and interviews with students (21 girls and 20 boys total) from standard six (age 10-15)[19]. Water quality analysis included free and total chlorine residual using HACH (Loveland, CO USA) 5-in-1 test strips, and total coliform and *E. coli* detection in 5 mL samples using the Quantitube method developed by Micrology Laboratories (Goshen, IN USA). All microbiological tests were conducted in duplicate to evaluate accuracy. Survey tools are found in Annex 4.

[19] Survey tools used are found in Appendix E

Table 13. Definitions used for facilities inspection scoring

Category	Good	Fair	Poor
Toilet Structural Condition	all function well, no repairs needed	all or most function, but repairs are needed	Most toilets are not functioning
Toilet Cleanliness	Absence of trash, dirt, urine or feces	Some presence of urine, dirt, trash	Presence of feces outside of toilet or major presence of urine, dirt, or trash
Toilet Privacy	Private and secure	Others could see in through gaps/cracks and/or the lock doesn't function	Others can easily see in due to missing walls/doors
Sink Condition	All function well, no repairs needed	All or some function but repairs are needed	None are functioning
Water System Condition	All function well, no repairs needed	All or some function but repairs are needed	None are functioning

Evaluations were conducted with the Health and Family Life Education (HFLE) officers for the two districts. Data were collected electronically using Field-Level Operations Watch (FLOW)[20] for the principal/teacher interview, facilities inspection and student interview, with additional notes taken manually. Student handwashing observations were recorded on paper throughout the school visit. A focus group comprised of community leaders, teachers and mothers was also held in Toledo district to identify explanations for survey responses and capture nuances and details from open questions.

Data were coded and imported to SPSS for statistical analysis, including descriptive statistics (mean, maximum, minimum), frequencies, and correlations. Statistical tests to measure the association between variables were selected based on the characteristics of the data, inlcuding variable data type[21] and behavior of the information. Tests included: Phi, Cramer´s V, Kendall´s

[20] http://www.waterforpeople.org/programs/field-level-operations-watch.html
[21] Scale data are numeric values on an interval or ratio scale (e.g. age, number of students); ordinal data represent categories with some intrinsic order (e.g. low, medium, high); nominal data represent categories with no intrinsic order (e.g. teachers, principals, PTA)

Tau Beta, Point biserial, Spearman´s rho, and Pearson´s r. Normality was evaluated visually using Q-Q plots and confirmed numerically with the Shapiro-Wilks test, assuming normality if the significance is greater than 0.05. Missing values were excluded pairwise, meaning that only the variable missing is dropped from the analysis, not the entire case. Where disaggregated data is desired, data was split by the characteristic of interest (e.g. gender, classification (urban/rural), district) and frequency and descriptive analysis were conducted for each disaggregation. New variables were also computed in SPSS based on the collected data such as ratios of students per toilet and percentage of schools that meet standards.

RESULTS

Condition of WASH services post-intervention

Water supply

Water was available the day of the visit at 95% of the schools, with 85% of water systems functioning properly and 15% functioning but with unaddressed repair needs. The main water source at three schools was constructed as part of the WASH Project; all rainwater catchment systems. One had empty water storage tanks and two were functioning with water available. All the project schools were meant to receive drinking water fountains: 25% of these are still in use; the other 75% are incomplete or the faucets were broken off by students or the outside community. Of the 25% that are in use: 100% had water available from the fountains the day of the visit, but half of them are in poor structural condition with repairs needed and 75% have standing water nearby providing a breeding ground for mosquitoes and associated illnesses.

Despite access to "improved" water supply at all the schools, 90% of schools' water is untreated and there is evidence that at least 27% of the water sources are unfit for human consumption. Chlorination at the water source is reported by 58% of schools, but total chlorine residual was found at only 10%; in urban schools only. Free chlorine (chlorine available for pathogen disinfection) was not found at any[22]. Of the schools without chlorine residual, total coliform bacteria were identified in all samples, ranging from 10 to over 4000 CFU/100 mL.[23] Total coliform bacteria are a group of closely related, mostly harmless bacteria that are naturally present in the environment, but their presence gives an idea of the general quality of the water, and for treated water indicates a problem with the treatment or distribution. *E. coli*, a specific type of total coliform bacteria that indicates fecal contamination, was identified in 5 mL samples at 27% of schools, ranging from 10 to 50 CFU/100mL (Figure 8).[24] Chemical and metals testing was not conducted.

Schools with multiple water sources typically had one source that was considerably safer than the other. Of particular concern is the contamination of classroom water buckets in comparison to the main water source from which the water was collected (Figure 8). 55% of schools evaluated have classroom buckets. These are typically covered but students collect water by dipping their cups into the bucket, likely contaminating the stored water in the process. At almost half the schools (45%), students drink water from classroom buckets and the presence of *functioning* drinking water fountains or the addition of taps on existing buckets may limit the increased contamination observed in the stored drinking water.

[22] The World Health Organization recommends a minimum residual concentration of free chlorine of 0.2 mg/L at the point of delivery (WHO, 2008)
[23] There is no guideline for total coliforms recommended by the World Health Organization.
[24] The World Health Organization guideline for *E. coli* is 0 CFU/100 mL.

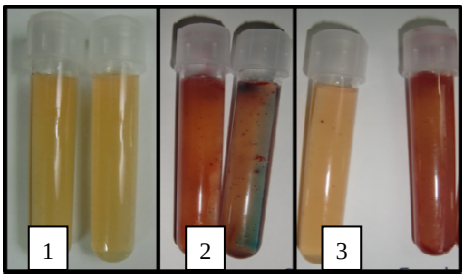


Figure 8. Example of water analysis results: (1) uncontaminated, (2) total coliform bacteria (red) & *E. coli* (blue), (3) water collected from source (left) & from classroom water bucket (right)

All of the schools' drinking water is provided to students from the school's main water source without further treatment. Even in schools where the principal was aware that the main water source was not treated, chlorine was not used due to cultural reasons and an aversion to the taste/odor. Most students interviewed say they like the water at school because it doesn't taste like chlorine, though one student doesn't drink the water at school because it is not chlorinated and she brings her own chlorinated water from home, indicating that there may be potential for increased chlorine use through promotion strategies based on why these families decided to use chlorine.

Regarding water quantity and reliability, principals feel they have insufficient water to meet the needs of their students and encourage good hygiene, including water for drinking, handwashing and cleaning at 37% of schools, and 42% of school water sources are not reliable throughout the year or day. Of the schools with an inconsistent water source, 29% report seasonal changes as the cause, 57% attribute the water shortages to operational challenges such as breakdown of the community system, insufficient water pumped to the community tank and cuts during refurbishing work after an earthquake in 2009, and 14% say the main reason is cultural such as the community not wanting to pay for the water to support the pump costs or water being wasted

and draining the community tank. None of the reasons behind water shortages were a direct cause of school water management by the school and the school-community link may have a large influence on water supply at the school.

Sanitation

Despite intervention, only 15% of project schools have adequate access to sanitation defined as access to improved[25], functioning toilets where the number of students per facility meet international standards for schools in low-cost settings: 25 girls per toilet and 50 boys per toilet and urinal (Adams, 2009). Due to the low prevalence of urinals, schools with 25 boys or less per toilet were considered to have sufficient quantities of toilets for boys. Student per toilet ratios range from 22 to 84 students per toilet.

Toilets were constructed or repaired at all project schools, including mostly flush toilets to septic tank, with pit latrines at three schools. Most schools had additional toilets from before the WASH Project that could still be used, but the intervention was intended to increase the quantity of toilets available at the schools. Two to three years post-intervention, 65% and 29% of WASH Project toilets are functioning and clean, respectively. The most common maintenance issues observed are broken flush levers and toilet tanks, warped or fallen doors and malfunctioning or broken locks (Table 14). The WASH Project toilets specifically, had frequently broken toilet tanks and flush levers which may be due to the high percentage of flush toilets installed by the WASH Project instead of pit latrines. Pre-existing toilets, more commonly pit latrines, had more challenges with the building structure and broken or missing toilet seats (Table 14). Due to the

[25] Improved sanitation includes flush toilet to piped sewer system or septic tank, ventilated improved pit (VIP) latrine, pit latrine with slab, or composting toilet

nature of pit latrine design, most pit latrines are still usable despite the repairs needed, whereas flush toilets are often unusable when the flush lever or tank is broken. This may be a reason for the increased percentage in both the "good" and "poor" categories in comparison to pre-existing toilets. When the flush toilets work, they are a good option, but when something breaks, they can easily become completely unusable. Building structure challenges identified in many pre-existing toilets could be due to the older age of the majority of pre-existing facilities. The age of the facilities does not correlate with the overall functionality of the toilets however.

Table 14. Common maintenance issues for WASH Project and pre-existing toilets

Component	WASH Project toilets	Pre-existing toilets
doors, doorknob/lock	42%	47%
toilet fixture, tank, flush lever	92%	53%
toilet seat	17%	33%
building structure	8%	40%
sewage pipe/septic tank	8%	0%

Breakdown of school toilets has a substantial impact on sanitation access: if all toilets at the school were functioning and in use, 30% of schools evaluated would be considered to have access to adequate sanitation, doubling the current value of 15%. Only 73% of usable[26] school toilets are functioning and in use, reducing the percentage of schools that meet international standards[27] for the number of students per toilet from 80% and 40% (if all usable toilets were functioning and used) to 45% and 20% (currently functioning and used toilets) for boys and girls, respectively (Figure 9). These findings indicate that solutions to low school sanitation coverage

[26] These calculations do not include unimproved toilets or pit latrines that are out of use due to full pits, unsafe slabs, and/or irreversible weather damage to the building structure.
[27] International standards are based on WHO/UNICEF (2009)

rates will likely include more than just new construction, but a focus on maintenance and acceptability of current and future services.

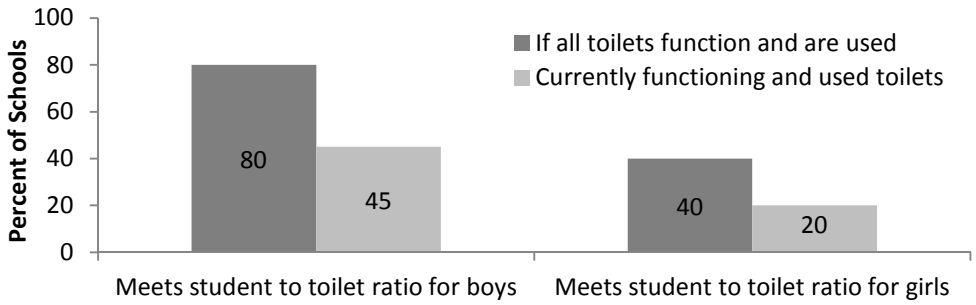


Figure 9. Percent of schools that meet standards for the number of students per toilet, currently and if all usable toilets were functioning and in use

Toilets were considered acceptably clean (ranking "good") at 26% of schools. The WASH Project-funded toilets tend to be dirtier than pre-existing toilets, but this could be due to the students' preference for the WASH Project toilets (as reported by many principals and students) and therefore higher usage rates (Table 15). Students preferences are likely linked to the more child-friendly facilities implemented: the WASH Project-funded toilets (both new construction and rehabilitated toilets) on average have better lighting, ventilation, privacy and smell than the pre-existing toilets (Table 4, Table 15). Despite improvement over previous sanitation services, the provision of toilet paper remains a challenge and may diminish the positive influence that school toilet use may have as feces were frequently found smeared on the toilet walls in the absence of toilet paper. The majority of schools (58%) keep toilet paper in the classroom for students to bring with them to the toilet, 16% keep toilet paper at the toilet facilities, and 26% do not provide any toilet paper and students are expected to bring their own.

Table 15. Condition of WASH Project-funded and pre-existing toilets

Category	Source	Good (%)	Fair (%)	Poor (%)
Structural Condition	WASH Project	29	35	35
	Pre-existing	17	72	11
Cleanliness	WASH Project	22	39	39
	Pre-existing	33	50	17
Lighting	WASH Project	56	44	0
	Pre-existing	28	39	33
Ventilation	WASH Project	44	56	0
	Pre-existing	22	67	11
Privacy	WASH Project	83	11	6
	Pre-existing	56	33	11
Smell	WASH Project	56	39	6
	Pre-existing	33	50	17

Hygiene

Handwashing was a focus of the WASH Project and running water sinks were installed at a number of project schools. Two to three years later, 66% of these sinks function. However, WASH-Project sinks tend to be in better structural condition than pre-existing facilities (Table 16). Sink taps are the most commonly broken component; faucet knobs are often broken off or the tap is loose from the sink structure (Table 17). Despite intervention, only 33% of schools have adequate handwashing facilities, defined as a sufficient quantity (at most 40 students per handwashing point[28]) of *functioning* running water or bucket-collected facilities with soap and water available.

[28] A ratio of 40 students per handwashing facility is based on the common standards in the region of 30-40 students per handwashing point.

Table 16. Condition of WASH Project and pre-existing sinks

		Good (%)	Fair (%)	Poor (%)
Structural Condition	WASH Project	44	38	19
	Pre-existing	29	14	57

Table 17. Common maintenance issues for WASH Project and pre-existing sinks

	WASH Project sinks	Pre-existing sinks
tap	100%	67%
sink structure	13%	17%
drain/drain pipe	25%	0%

Soap is available to students at 95% of schools based on principal response, but was observed at only 45%. Both soap and water were available for handwashing at 40% of schools the day of the visit. Principals at 40% of schools report providing hand-drying materials, but towels were observed at only 15% of schools and were seen being used at 5% (one school).

Equity considerations

Drinking water facilities that cater to small children and students with physical disabilities are provided at 58% of schools, but none of the schools have toilet facilities accessible to students with physical disabilities, including one school that houses a special education program which includes multiple students with physical disabilities. At 80% of schools, separate toilet facilities are provided for all boys and girls; 5% provide separate facilities for the older students only. The remaining 15% divide toilets by class instead of gender. Students interviewed did not express concern over sharing facilities however and reported that they liked having a toilet specifically for their class with a key kept in the classroom so that others couldn't use it and "mess it up".

Infrastructure improvements from 2007 to 2011

Compared to the 2007 assessment (Enedu 2007), many schools have seen improvements through the WASH Project[29]. None of the schools had drinking water fountains previously and their installation provided students a safer option than classroom buckets. The average number of students per toilet improved slightly from 53 to 51 for boys and 44 to 42 for girls; this includes a 7% population growth at the schools between 2007 and 2011 and only considers functioning toilets. Some schools abandoned their old toilets after the WASH Project implementation as many were in a very poor state, having less of an effect on toilet quantities but offering a safer and preferred option to students compared to the previous sanitation option. At one school, the male students did not have any sanitation facilities and the WASH Project provided a remedy to this situation through facility construction and sanitation promotion. In 2007, there were no toilets accessible to students with physical disabilities and this was not remedied by 2011. The greatest improvement between 2007 and 2011 was access to running water handwashing facilities which increased from 32% of schools to 80% based on access to functioning sinks.

Student knowledge and practices post-intervention

Hygiene knowledge

Most (85%) students interviewed listed both times promoted in WASH Project posters and educational materials, "before eating" and "after using the toilet", as important times to wash hands, and 83% reported the reduction of illness as a reason that handwashing is important. When asked for how many seconds they think people should wash their hands, 13% said 20 seconds (the time recommended in hygiene education materials used in the WASH Project).

[29] Further structural improvements and design changes based on the evaluation are provided in Appendix F.

About half (51%) of students interviewed were not able to list a correct method of water treatment saying they didn't know, the water would have to be thrown away because there is no way to make dirty water safe again, or listing an ineffective water treatment method such as adding protein to the water. The other 49% of students were able to list at least one method of water treatment, including boiling (46% of responses), filtration (29%) and chlorination (25%).

When asked what they would include on a poster reminding other students how to properly use the toilet, 98% of students were able to list at least one reminder relative to proper toilet use. The most common reminders included keeping the toilet clean, flushing the toilet, not throwing toilet paper or garbage on the floor, and not going to the toilet on the seat or floor (Table 18).

Table 18. Most common ideas from students of reminders of how to properly use the toilets

	Total (%)	Girls (%)	Boys (%)
Keep clean	51	52	50
Flush toilet	42	62	20
No TP/garbage on floor	42	52	30
Don't go to the bathroom on floor/seat	37	38	35
Don't play/respect toilets	22	14	30
Don't write on walls	20	14	25

Hygiene practices

During school visits, no student was observed using the classroom handwashing basins or bringing soap or toilet paper from the classrooms to the toilets. It was not possible to observe the handwashing basin in every classroom and handwashing may have occurred that was not

recorded, but evidence of handwashing in the classroom basins was not seen, including schools where classroom basins were the only option for handwashing.

Of the students observed, 20% scrubbed their hands with soap and water after using the toilet facilities (Figure 10). Soap was available to 70% of the students observed (observations were only conducted at schools with functioning handwashing facilities of some type); either at the sink (37%), in the classroom (54%) or in the toilet stall (9%). 28% of students that had soap available to them used it; 76% when soap was available at the handwashing facilities and 0% when soap was available in the classroom (Figure 10). 63% of the students who had soap available to them in the classroom but not at the sink, washed their hands with water; encouraging evidence that if soap had been readily available to them, they likely would have used it. On average, girls were more likely than boys to wash their hands after using the toilet (Figure 10).

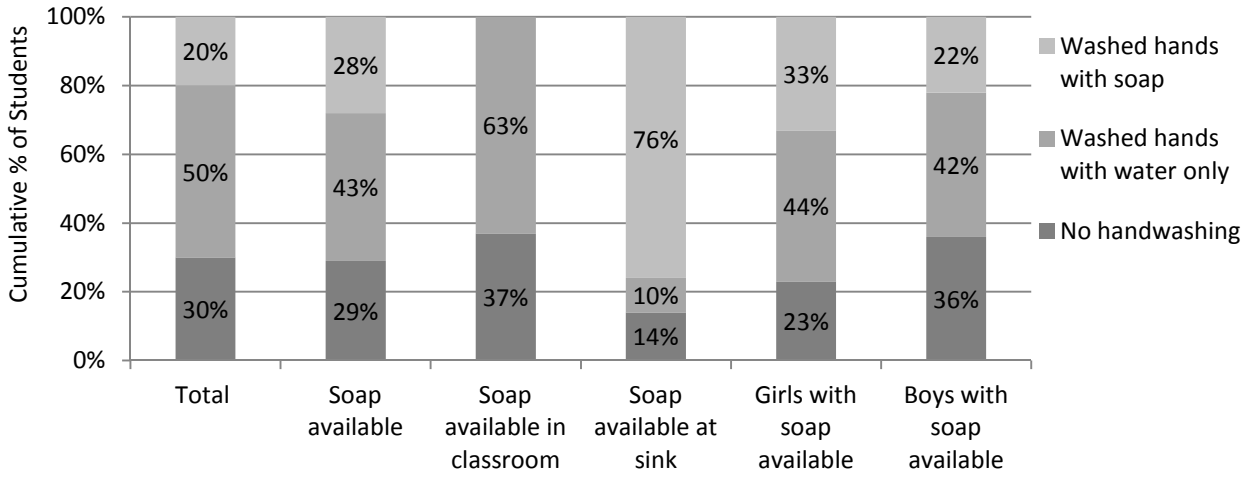


Figure 10. Percent of observed students that washed their hands after using the toilet

Based on observation, 74% of student toilets showed improper use including graffiti on the walls, feces on the wall/seat/floor, garbage and toilet paper thrown on the floor, leaving the toilet unflushed and putting items other than toilet paper in the toilet, despite most students listing these things as improper use of the toilet. Only older students were interviewed however and these issues could be coming from the younger students.

Student satisfaction as an indicator of water and toilet use

Student satisfaction with the water and sanitation services are discussed as an indicator of water and toilet use. Student likes and dislikes about current services provide insights into what may encourage higher usage rates. Despite the poor water quality at most schools, 90% of students interviewed said they drink the water available at school and 75% report satisfaction with the water. The most common reasons that students like/dislike the water are presented in Table 19. There is a common dislike of chlorine reported by students and teachers, but due to the low use of chlorine in the schools this does not appear as frequently in Table 19 as it might if chlorine were used. When the students who said they like the water because it's "clean" were asked how they know it's clean, 44% said because it looks clear, 33% said because the community water board adds chlorine, and 22% said because the water board cleans the tank.

Table 19. Reasons why students like and dislike the school water

Reasons Don't Like Water	% of Students	Reasons Like Water	% of Students
Bad taste/smell	10	Clean	19
Looks dirty	6	Cold	19
Unsafe	4	Tastes good	8
Too much chlorine	2	Makes me not thirsty	6
Don't know where it's from	2	Gives strength	6
		Similar to bottled water	2

Most (95%) students say they like the school toilets. The most common reasons students report for why they like or dislike the toilets are listed in Table 20. Other aspects of the WASH Project toilets that students mentioned they like (not listed in the table) include tile, windows, close proximity to the school building, that they are new, and that they don't smell. Many students like the flush toilets, but if water is not always available, they may not be appropriate and students report lack of satisfaction with the toilets when they could not flush them due to a lack of water.

Table 20. Reasons why students like and dislike the school toilets

Reasons Don't Like Toilets	% of Students	Reasons Like Toilets	% of Students
Afraid someone can open door	5	Flushes/Sewerage	31
Smell bad	3	Clean	21
Can't flush when no water	3	Has sink to wash hands	10
People wait outside	3	Nice paint/color	10
Dirty	3	Good toilets	8
		Built well	5

The influence of management structures and intervention strategies on sustainability

Examination of management and implementation serves to elucidate possible reasons behind schools with WASH services in good and poor condition. Management structures for school WASH, including maintenance responsibilities and planning, are discussed, followed by a brief look at local perspectives on WASH Project success. Lastly, factors statistically associated with well-maintained facilities are presented.

School WASH management

According to school principals, damage to WASH facilities is typically caused by poor quality materials or construction (mentioned by 68% of schools), vandalism (53%) or improper use by

students (37%). Despite frequent repair needs due to these causes, none of the schools have a written maintenance plan for the water and sanitation facilities at the school. One principal thought having a written maintenance plan would be a good idea, but many don't feel they need a written plan suggesting they have an adequate verbal system in place. At some schools, usually where the principal has been there for some time, a non-written maintenance system seems to be working well while at others there is no clear system for maintenance, written or otherwise, and the facilities are in poor condition. The WASH Project maintenance training was intended to support on-going maintenance, but only 10% of schools are still in contact with the community representative that attended the training. Those that attended felt it could be more practical and with more people from the community: *"I would have liked to have more practical workshops where parents and teachers could practice how to fix the plumbing. The ITVET workshop was all theory"* (Principal). Where the school is still benefitting from the WASH Project maintenance training, the representative is a teacher or principal at the school, not a community member. 15% still have the maintenance kit and manual provided during the training and these principals expressed their utility: *"We have used about 80% of what was provided in the maintenance kit and the manual and kit complement each other well"*; *"The manual has been useful in order to find part names"*.

In the absence of the community representative trained through the WASH Project, facilities are frequently repaired by school staff with occasional support from parents and/or hired labor (Figure 11). Repairs are usually paid for out of the school budget depending on the extent of repair needs and the PTA/parents and/or school management provide assistance at some schools (Figure 11). The community water board or municipal water managers are responsible for the

main water source for the school at 85% of schools. The other 15% of schools manage their own rainwater catchment or well. Based on these management responsibilities, both the school and community should be involved from the beginning as they are ultimately responsible for upkeep over time.

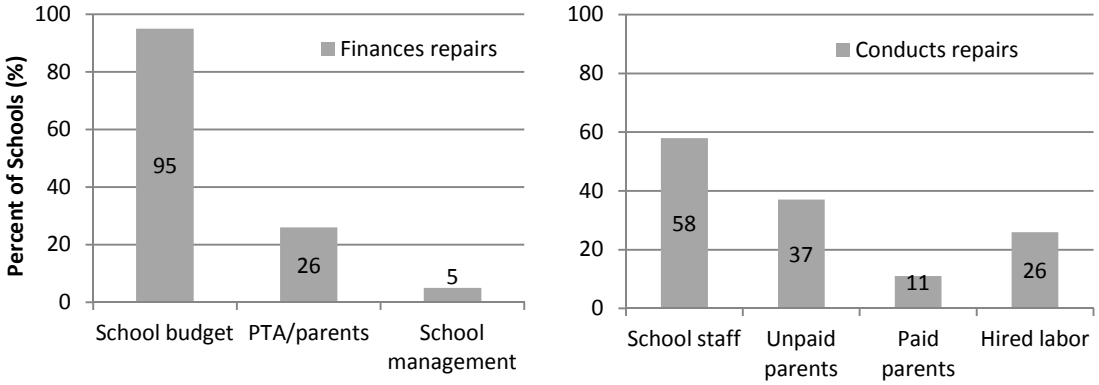


Figure 11. Who conducts and pays for repairs to WASH facilities

The school provides their own cleaning supplies at 100% of the schools with occasional assistance from the PTA or donations (both mentioned by 5% of schools). Soap is purchased from the school budget at 80% of the schools. Principals also mentioned support from PTA/parents (15% of schools) and donations (15%) for soap. Teachers are responsible for purchasing soap for their class using their personal funds at 5% of schools. If toilet paper is supplied at all, it is provided by the school at 58%, parents at 26%, teachers at 11% and donations at 5%. Students are involved in toilet cleaning at 90% of schools, sometimes with the help of teachers (Table 21). At one school, toilet cleaning was considered a form of punishment for students when they misbehave, however.

Table 21. Who cleans the toilet?

Group	Percent
Students	58%
Students & Teachers	26%
Teachers	5%
Hired Cleaners	5%
Group of Paid Students	5%

Local perspectives on WASH Project success

Principals at 20% of the schools say they are happy with the WASH Project, specifically that *"They are very good toilets. I am very pleased and I applaud them"*; *"we are grateful for the assistance we received. It made a tremendous impact on our lives"*; and *"I said 'wow!' when I saw the WASH Project toilets because most schools around here don't normally have nice toilets like that"*. Another 25% reported that they were somewhat happy: *"I don't like where the washbasins are located because of vandalism"; "I would be happy if it met full needs (more toilets & urinals), but I'm satisfied"; "The site is good, but they keep breaking"; "I'm 75% happy with the project because it's also our fault. If we push, [the facilities] will work"*. The 55% of principals that were unhappy with the project were mostly frustrated with a lack of consultation prior and during implementation as well as the lack of completion of some facilities: *"At first I was happy with the WASH Project, but then started to notice the poor quality as things began to break and leak after only five months"; "[the facilities] are incomplete and poor quality"; "I wanted a consultation before the start of construction. It is poor and inappropriate construction and unfinished work"; "I don't like where they put the drinking fountains. It is unhygienic"*.

The infrastructure listed in the Ministry of Education WASH Project Accomplishment report was fully completed in 45% of the schools; 5% did not know if everything was completed because none of the current teachers were there during implementation. The other 50% of schools were missing something ranging from small finishings such as drinking fountain faucets, to the gutters and tanks for a rainwater catchment system, to full toilet building structures that were not completed: *"The toilets were incomplete: the sewage pipe was not functioning and we were given a key that did not work. We had to break in and complete things and buy new locks"* (Principal); *"Things were completed but I had to push [the contractor] to finish it and I worked with the Alcalde (Mayor) and Village Chairperson"* (Principal). One principal pointed out the duplicity in teaching hygiene education without adequate facilities to practice behaviors, saying *"what will I show kids if the facilities are incomplete"*.

Of the schools visited with staff that were present during the WASH Project implementation, 25% of schools report that the school itself was involved in the planning and implementation stages: *"We chose the location"; "located a spot for toilets and asked for fountains to be away from bathrooms"; "there was a meeting and we gave input"*. 25% say they were somewhat involved: *"[our] desired location was not listened to"*; *"I attended meetings and gave input"*, and half of the schools state that they were not involved in the planning and execution of the WASH Project at their school.

There is a Parent Teacher Association (PTA) at 94% of schools. Based on those schools with a staff member who was there during project implementation, the PTA or surround community was involved in planning and implementation at 17% of schools: *"they helped to go through the*

town board for septic issues and some fundraised or volunteered"; "assisted with painting and replaced tile for free". 25% say they were somewhat involved: *"One parent went to maintenance training"; "a parent came to WASH Project meeting"; "initially, but the contractor just proceeded"*, and 58% say the PTA or community was not involved in the planning and execution of the WASH Project.

Factors associated with the condition of school WASH services

School and community involvement in planning and implementation correlate strongly with principal and school staff satisfaction with the outputs of the WASH Project (T_β=0.689, p<0.001 for school involvement and T_β=0.745, p<0.001 for PTA/community involvement). Even more promising, school and community involvement upfront also correlate strongly with the structural condition of the WASH Project toilets two to three years later (T_β=0.762, p<0.001 for school involvement and T_β=0.532, p<0.001 for PTA/community involvement). Community support, financial or in-kind, is also associated with well-maintained toilets (=0.537, p=0.009). Based on the evaluation results, facility age, students per toilet ratios, and toilet type are not associated with the structural condition and functionality of the toilet and may be more influenced by staff interest and financial capacities at the school for maintenance.

WASH Project impacts

Potential health and attendance impacts

Health, attendance and national exam score data was not accessible disaggregated by individual schools and health/attendance impacts are not evaluated. In any case, these impacts are difficult to measure conclusively due to the multiple factors that can influence health, attendance and

school success. It has been shown conclusively in previous studies, that health improvements result from the behavior changes facilitated by reliable access to WASH services, and the measurement of these changes is likely to be easier, more reliable, and more useful as a diagnostic tool than attempts to measure health impacts directly (Cairncross, 1990; Cairncross & Shordt, 2004). In this context, the data on hygiene practices (including handwashing practices), structural condition and cleanliness of facilities, and reliability of access that were collected in the evaluation provide insight into the hygienic conditions that facilitate improvements in children's health. However, principals' opinions of WASH Project impacts and thoughts on absenteeism, as well as student-reported health and attendance at WASH Project schools for the previous two weeks are presented subsequently to provide a general idea of the illness and absenteeism rates at the schools. Due to time constraints, ethical concerns, and lack of nearby control schools due to how WASH Project schools were selected, control schools were not included in the evaluation.

Almost half (47%) of principals interviewed say they have noticed a difference because of the WASH Project, providing examples specific to children's hygiene behavior, such as *"Children are learning how to use [flush] toilets and wash hands";"students seem healthier and I don't think the kids go in their pants anymore";"The students choose the WASH toilet over the old toilet. Some students would hold it because they did not want to use the old toilets";"The students wash hands quite a bit now*". Though anecdotal these examples, offer insight into benefits as seen by school principals. Most principals said that absenteeism was not a concern at their school, particularly at schools that charged parents money for student absenses. However,

according to principals the most common reasons that girls and boys are absent are identified in Table 22, along with the common reasons students report for being absent in the past.

Table 22. Most common reasons for absenteeism reported by principals and students

Principal Response*			Student Response*		
	Girls (%)	Boys (%)		Girls (%)	Boys (%)
Illness	78	89	Never absent	44	30
Helping at home	61	5	Illness	28	55
Working in the fields	0	50	Family emergencies	11	10
Menstrual cramps	22	0	Helping at home	6	10
Don't want to come	0	11	Injured	0	15
Working	0	5	Don't want to come	11	5
Gang activity	0	6	Suspension	6	5
			Working in the field	0	10
			Hunger	6	0

** Some of these reasons may be underrepresented, such as hunger, menstrual cramps or not wanting to come to school, due to the private nature of the question and embarrassment.*

Student interviews during the evaluation (dry season) show that 24% of students had been sick in the previous two weeks with various illnesses (Table 23)[30]. 60% of these students were absent because of their illness, resulting in 15% of all students interviewed being absent due to an illness in the previous two weeks. 10% of students were absent for a reason other than illness, including helping at home, healing injuries, headache and feeling weak (possibly hunger), and appointments or errands scheduled by their parents.

Table 23. Student illnesses from the previous two weeks

Illness reported	% of students
Fever	30
Vomiting/stomach ache	20
Cold/flu	20
Cough	10
Dehydration	10
Long-term/genetic illness	10
Chicken pox	10

[30] A recall time for illness/absence of two weeks was used; the maximum recall time recommended (Blum and Feachem 1983).

Based on these data, WASH in Schools programs should consider a holistic view to provide a safe and welcoming school environment that includes but is not limited to WASH facility construction. Motivations beyond health and attendance, such as promoting healthy practices as part of a well-rounded education, ensuring a child's right to education which includes WASH facilities and hygiene education and providing an example of health infrastructure for the surrounding community, should also enter into programming rationale.

Holistic programming such as integrating WASH with school nutrition and deworming programs may increase the potential for health, attendance and school performance impacts. Based on feedback from the schools, incorporating WASH with feeding programs may have a positive impact on student focus, performance, and behavior in school, as one teacher expressed that *"they tend to be much more interactive and less aggressive"*. The positive effects of proper nutrition can be supported by school WASH but nutrition during the school day is not addressed in many schools. Teachers at one school recommended *"a government assisted program where parents were still required to pay a portion of the meal cost and teachers could be more discreet about making sure that those students in need, get the food for free and the program is not taken advantage of"*. Currently, 26% of schools evaluated have a feeding program that offers food for free or at a reduced cost to low-income students.

Community involvement and impact

Most schools report that they do not have a strong link to the surrounding community: 6% of schools say they have a strong link to the community, 56% say moderate, 22% say weak, and 17% say there is no link at all. With respect to WASH specifically, 42% of schools report that

the community is involved in hygiene related activities at the school including community cleanup campaigns and parents in the health care sector coming to speak to students. Regarding "Personal Sellers", the community outreach arm of the WASH-Project, 20% of school principals remember the program where young adults in the community were trained to go to homes and conduct questionnaires and promote WASH, and suggest that though the program had potential, it needed additional support and follow-through: *"I remember the Personal Sellers program but it didn't last – maybe a week or two"; "I remember the program, but I don't know much about it"; "The stipends were not given out to the students and there was no follow-through. One training was not enough. But, the idea is a good one. It just needs more support to motivate students"* (Principals).

In schools where the facilities are complete and well-maintained, the WASH Project facilities serve as a positive example and may impact WASH uptake in the community through children, though the extent of these impacts deserve further investigation: *"Most of the community does not have toilets – I would say there are about five pit latrines for 40 families, and the rest use the bush. The students are exposed to toilets at school and they definitely ask parents to get them, especially in the rainy season"* (Principal); *"I told my parents to put gas inside the toilets to prevent mosquitoes. They did it and it helped"* (male student); *"Sometimes I tell [my parents] about health, I tell them about handwashing before eating and now they do"* (female student).

CONCLUSIONS

The Ministry of Education in Belize has risen to the challenge of evaluating previous programs to learn from successes and challenges and improve future programming, an important step

commonly ignored in the WASH sector (Breslin 2009). Many organizations are working in the schools of Belize, but very few organizations return to evaluate the interventions they supported (as reported by school principals). One reason organizations rarely seek objective evaluation of their programs is because this typically exposes program weaknesses, as the WASH sector is extremely challenging. However, returning years later to investigate long-term outcomes can serve to improve policy and programming, and therefore increase the likelihood for impact on those supported by WASH in School programs – children. It is a commendable step in the right direction and serves as an example for other lead ministries responsible for WinS.

The fact that the WASH Project is led by the Ministry of Education increases potential for program accountability, sustainability over time, and scalability to the national level. This is a challenge for WASH in Schools programs in many countries and is an admirable feat for Belize. In schools where facilities were complete and are maintained, there is a noticeable improvement in WASH at the school. Where drinking fountains are functioning, students have access to a much safer drinking water option than the classroom buckets which are rarely cleaned sufficiently or have proper lids and taps, creating a breeding ground for microbes from students' hands and cups used for dipping. Many schools had very poor sanitation facilities before the WASH Project implementation and the new toilets provided these students with a positive example of safe sanitation in communities where toilets are often regarded as a dirty practice to have near your home and a breeding ground for mosquitoes. Previous examples of toilets in the school/community were often less than delightful to be near, let alone use. The ratio of number of students per toilet is high in most schools, but crowding could be greatly alleviated if schools used and maintained all the useable toilets available at their school. Toilets in good condition

were seen unused for multiple reasons that do not warrant the construction of new facilities to decrease the ratio of students per toilet. Despite great improvement in school sanitation as a result of the WASH Project, there were no toilets accessible to students with physical disabilities, including a school with a special education program. These inequities deserve further attention at the national policy level. Though there are still a number of schools that do not regularly provide soap for student handwashing, there is promising evidence that students are likely to wash their hands (76% of students observed) when soap and running water are available near the toilets.

Incomplete facilities and lack of local involvement in project planning and construction were expressed with disappointment by principals at a number of schools. Schools that were left with incomplete infrastructure report greater levels of frustration and at times mistrust which could hinder future intervention and government monitoring. At some schools, the projects were completed initially, but have not been maintained. Poorly-maintained services were associated with a lack of involvement of the school and PTA/community in project planning and execution. Some schools reported that they were not able keep up with the high levels of vandalism and others were waiting for the Ministry of Education to conduct repairs. The fact that some schools are waiting for outside assistance for maintenance needs highlights the lack of ownership felt by schools and communities that should be addressed from the beginning of the program.

A number of principals noticed a positive difference in student hygiene behavior after the WASH Project, specifically that they are using the toilet (instead of holding back their bathroom needs) and washing their hands more frequently. Though health and attendance impact data are limited, these positive behavior changes are promising. Additionally, at schools with well-maintained

services, there is potential for students to act as agents of change in their families as revealed by teacher and student examples of bringing WASH messages home.

CHAPTER 6

IDENTIFYING PATHWAYS TO CONTINUED MAINTENANCE OF SCHOOL SANITATION IN BELIZE

Christie Chatterley, Karl G. Linden, and Amy Javernick-Will

This chapter has been accepted for publication in the Journal of Water, Sanitation and Hygiene for Development

ABSTRACT

Despite an increasing focus on school-based water, sanitation and hygiene (WASH) interventions in less-developed countries, we lack an understanding of what combinations of conditions are sufficient for their continued maintenance post-implementation. We use a novel method, qualitative comparative analysis, to determine what pathways lead to well-maintained school toilets, as an indicator of continued maintenance of WASH services. Results from 15 case schools in Belize reveal five pathways to well-maintained school sanitation, and three pathways to poorly maintained services. Common conditions in the pathways to well-maintained toilets include local involvement upfront, quality construction, and the presence of a local champion; while conditions common in the pathways to poorly maintained toilets include the absence of the aforementioned conditions, in addition to vandalism and a lack of community support for maintenance. The familiarity of the technology is as common in the pathways to well-maintained toilets as poorly maintained toilets, suggesting that though technology choice is important, quality construction and social conditions may have a stronger influence on maintenance. Qualitative information is presented to support further discussion of the six conditions, including factors linked to their presence that may support improvements in Belize and have implications for school WASH services in other low-income settings.

INTRODUCTION

School-based water, sanitation and hygiene (WASH) interventions have the potential to improve student health and attendance; boosting children's ability to take full advantage of educational opportunities (Bowen et al. 2007; Freeman et al. 2011). Unfortunately, despite increased efforts to improve school WASH in less-developed countries, services are often poorly maintained over time (e.g. Njuguna et al. 2008; SWASH+ 2010). Poor maintenance resulting in broken down and/or unhygienic facilities can have multiple repercussions. One, the behavior change necessary to realize the potential benefits of WASH is unlikely if services are unreliable or unhygienic (Cairncross 1990; Cairncross & Shordt 2004); a situation that may even present a health hazard (Koopman 1978; Hunter, Zmirou-Navier, & Hartemann 2009). Further, facilities that are not maintained leave children with an exiguous understanding of the importance of WASH, jeopardizing the potential capacity for positive impact at the household-level where behavior change is also desired. Additionally, if facilities break down before their expected lifetime, the effective annualized cost of service provision increases rapidly (Hutton 2012; IRC 2012).

For these reasons, on-going maintenance of school WASH facilities is a crucial first step to behavior change and anticipated health impacts, as well as to effective resource utilization in school WASH interventions. Therefore, it is imperative from both a humanitarian and economic perspective to understand what conditions foster the continued maintenance of school WASH services post-intervention.

Conditions that promote continued maintenance of school WASH services have been posited in prescriptive literature (e.g. IRC 2007; Mooijman et al. 2010; Abraham et al. 2011). However, we

lack evidence of their collective effects and the sufficiency of their aggregated presence to promote continued maintenance (Snel 2004; Saboori et al. 2011). Due to resource limitations, establishing all the conditions suggested in the literature may not be feasible and there is a need to identify which combinations of conditions are *sufficient* for a high likelihood of continued maintenance in order to improve effective resource allocation. Further, the pathway (i.e. combination of conditions) most appropriate in each country, district, or even school, may differ due to local management dynamics or economic condition. In these cases, if multiple sufficient pathways are identified, there can be flexibility and adaptability of which conditions are targeted based upon the specific needs and capacities.

As a result, this research investigates the collective effects of conditions that are postulated to influence the maintenance of school WASH services through systematic comparison of pathways to well-maintained facilities that are absent in cases of service neglect. Specifically, we analyze empirical case data from a school WASH intervention in Belize, using functionality and cleanliness of school toilets as an indicator of WASH maintenance. We hypothesize that all sufficient pathways to well-maintained toilets will include both social and technological conditions, with community support for operations and maintenance (O&M) as a necessary condition, particularly since schools in Belize do not receive government support for school operation, leaving schools to rely on often inadequate school fees (e.g. school fees range from 0 USD to 7.50 USD/student/year at case schools) (Ministry of Education Belize 2012). However, beyond these hypotheses, this exploratory research allows conditions to emerge from the empirical cases. Results may inform Ministry of Education (MoE) policy and programming

improvements in Belize and provide further insight for school WASH programming on a global level.

Conceptual framework: social & technological drivers of continued WASH maintenance

Due to the limited empirical literature specific to the school setting, we discuss the available evidence from school WASH studies, followed by supporting data from community- and household-level research. As an indicator of school WASH maintenance, clean toilets have been associated with water availability and teachers' involvement with the school management committee (SMC) to address O&M needs in Kenya (Njuguna et al. 2008), and with active student health clubs in India, though the authors note the link between student engagement and active teachers and parents, which may be of greater influence (Mathew et al. 2009). Expanding upon this work, Saboori et al. (2011) highlighted the aforementioned studies as the only school WASH sustainability literature available and contributed further evidence from 55 schools in Kenya identifying common characteristics of the two most successful schools (based on the presence of handwashing water and treated drinking water). These included the presence of at least one teacher who had been trained during implementation, an active SMC involved in WASH activities, the inclusion of WASH in the school budget, and teachers' observation of health benefits resulting from the intervention. However, the authors identified nine other schools that shared these traits and yet did not meet the majority of their success criteria, suggesting that these conditions are insufficient to enable sustainability. In response, the authors highlight potential drivers such as the suitability of the technology and financial capacity for O&M, including community support. The influence of technology is also suggested by Njuguna et al. (2008), where students and teachers identified weak construction of school flush toilets as a

reason for frequent breakdown, and the need for community support and associated local participation in planning and construction is posited in a number of school WASH reports (e.g. IRC 2007, Moojiman et al. 2010).

Evidence from community and household WASH studies echo this intertwined relationship between social and technological conditions and the need to investigate their collective effects. Marks and Davis (2012) found a strong association between user participation in water projects, including decision-making and substantial capital contribution (i.e. the equivalent of a typical household's monthly income), on sense of ownership, which is thought to be linked to service longevity. However, a study in rural Ghana found that despite high participation upfront, including cash contributions beyond the typical household's monthly income, only 60% of latrines were in operation post-intervention (Rodgers et al. 2007). As a result, local participation and sense of ownership alone may be insufficient for continued maintenance of WASH infrastructure, with the authors suggesting that inappropriate technology and poor quality construction may lead to breakdown. This interdependency is further highlighted by WaterAid (2011) who suggests that appropriate technology and quality construction may increase service life despite weaknesses in other aspects of O&M, while poor quality construction can undermine even the best efforts to maintain services over time.

Thus, this study investigates the *collective* influence of social and technological conditions that lead to well-maintained school sanitation as an indicator of likelihood of sustainable school WASH programs. We analyzed six conditions that emerged from theory as well as case knowledge, including four social factors of: (1) local involvement upfront, (2) community

support for O&M, (3) the absence of community vandalism of facilities, (4) the presence of a local champion at the school who promotes WASH; and two technological factors of: (5) high quality construction, and (6) implementation of a technology that is familiar in the community suggesting that spare parts and technical know-how are readily available.

METHODS

In order to maintain contextual richness and consideration of multiple conditions, we analyzed empirical data from 15 case schools using qualitative comparative analysis (QCA). We first discuss the research setting, then describe the analytical approach and finally define and describe the conditions and cases analyzed.

Study setting

From 2007 to 2009, the MoE in Belize, with support from UNICEF, implemented phase I of a school WASH program in 36 primary schools in the districts of Toledo and Stann Creek. Program schools were selected based on needs identified in a baseline assessment (Enedu 2007). Program implementation included community sensitization meetings conducted by MoE health and family life education (HFLE) officers, maintenance training attended by a representative from each community, a maintenance manual and kit, and infrastructure varying by school needs, including toilets. Of the 15 case schools, flush toilets to septic tank were constructed at 14, while pit latrines were constructed in one school due to insufficient water supply. The number of stalls constructed at each school ranged from two to four. All facilities were constructed by hired contractors selected by and reporting to the MoE. Despite the high levels of

district and national government involvement and sensitization and training sessions, many schools have struggled to continue maintaining the sanitation intervention.

Analytical approach

To date, the majority of sustainability studies in the WASH sector have been based in quantitative analysis methods (e.g. Njuguna et al. 2008; Mathew et al. 2009; Marks & Davis 2012). Statistical approaches offer concise and systematic analysis, but trade the contextual richness of qualitative approaches (e.g. case studies). However, while case studies allow richness, they lack breadth and generalizability (Yin 2003; Flyvbjerg 2006). In order to identify generalizable determinants of continued maintenance that are also based on in-depth case knowledge, we employ QCA – an analytical method that bridges quantitative and qualitative methods by providing a systematic inferential approach to analyze information collected from a small enough number of cases to maintain data richness and context (Ragin 1987; Berg-Schlosser et al. 2009). Because QCA evaluates both the influence of individual conditions, and combinations of conditions, a further advantage is that QCA can link multiple pathways to an outcome. Additionally, QCA uses Boolean minimization logic to reduce conditions to the most logically succinct combinations of conditions that produce the outcome of interest. For these reasons, QCA has been used in a number of sectors to identify pathways linked to outcomes ranging from conflict in developing country pipeline and water infrastructure projects (Boudet, Jayasundera, & Davis 2011) to progress in addressing health inequalities in England (Blackman, Wistow, & Byrne 2011). We are not aware of the use of QCA in WASH sector research, but feel this method is well-suited to study the conditions that promote continued maintenance of WASH services because (1) there are likely multiple pathways to well-maintained WASH facilities,

particularly in the school-setting due to the large number and variety of stakeholders; (2) a number of conditions posited in WASH literature may be difficult to measure using traditional quantitative methods, such as the influence of a WASH champion; and (3) a smaller data set allowing for more rich and contextual data provides an opportunity to identify conditions that may be lost in large-N quantitative studies.

In QCA, cases are coded for having membership in a set of conditions. Because we are interested in analyzing a dichotomous outcome (i.e. we are interested in the sufficient pathways that explain schools with well-maintained toilets that do not explain schools with poorly maintained toilets), we employ the crisp-set variant of QCA (csQCA). CsQCA uses a binary coding scheme where the outcome and each condition in the analysis are assigned a value of 0 (non-membership) or 1 (full-membership) based on in-depth case knowledge. In order to identify sufficient pathways, we used the crisp-set analysis function in the fs/QCA 2.5 software, which summarizes the information in a table of coded conditions (termed a "truth table") and uses Boolean logic, rather than correlation methods, to reduce the table to sufficient pathways. We used the recommended approach to present the intermediate solution whereby assumptions are made based on empirical case knowledge and existing theory to simplify the solutions (Ragin 2008). Individual conditions can be further analyzed to evaluate necessity, where necessary conditions are those which must be present to yield a particular outcome, but alone may not be sufficient (Berg-Schlosser et al. 2009; Jordan et al. 2011). The necessity of conditions and sufficiency of pathways are calculated through "consistency" measures, which evaluate the frequency with which conditions are present when the desired outcome is achieved. Conditions with a consistency score of at least 0.9 are considered necessary, while pathways with a

consistency score of at least 0.8 are considered sufficient (Ragin 2008). A second measure of "goodness-of-fit" used in QCA is "coverage" which indicates how well the conditions or pathways are represented by the empirical cases (Rihoux & De Meur 2009).

Defining outcomes of interest

Because maintenance is a necessary step to produce health impacts, but is often neglected, we focus on the outcome of continued maintenance of school toilets. Specifically, we define an outcome of continued maintenance where all the program toilets function properly with no repair needs (including secure doors and locks) and are free of visible feces. on the floor, wall or seat. Conversely, schools where all the toilets are in need of repair (ranging from broken doors and flush mechanisms to complete breakdown) and have visible feces outside of the toilet bowl are defined as poorly maintained. These schools are considered to have toilets in such poor condition that students do not have access to a functioning, private and clean toilet; a situation known to inhibit use of the facilities (Njuguna et al. 2008; Mathew et al. 2009; Xuan et al. 2012).

Case selection and data collection

Each school is treated as a case. The 36 schools that participated in the first phase of the school WASH program were eligible for inclusion in the study, allowing for the greatest time lapse since implementation, which had occurred two to three years previously. In order to achieve maximum heterogeneity over a minimum number of cases, we purposively selected cases, as opposed to random selection, as recommended by QCA scholars when exploration of pathways to a specific outcome is desired (Berg-Schlosser & DeMeur 2009; Glaesser & Cooper 2011). As such, the results presented cannot be viewed as representative of the larger population though

they do provide evidence of sufficient pathways to well-maintained school toilets, which may have broader implications. We selected 17 schools based on the following criteria: (1) all the toilets are either well-maintained or poorly maintained; (2) there is someone available who was present during construction of the toilets; and (3) students are permitted to use the toilets when needed. We excluded schools where some of the two to four program toilets were well-maintained and some were poorly maintained, because we are interested in comparing the extreme cases of schools with well-maintained versus poorly maintained toilets, and using the dichotomous variant of QCA. Ultimately, we analyzed data from 15 schools: 13 in rural areas and two in small towns (schools 8 and 14). Facilities at schools 16 and 17 were never completed, making continued maintenance irrelevant; these were removed from the QCA, but quotes and lessons-learned from the planning and construction process are included to provide further insight.

With assistance from the district HFLE officers, we conducted unannounced school visits over three weeks during the dry season (March), which is usually the most challenging time to maintain WASH services in southern Belize. Data were collected through systematic inspection of facilities including a checklist of repair needs, functionality and cleanliness; photographs; and interviews with principals and teachers. Additionally, to support triangulation of qualitative data, we interviewed students from standards five and six (age 10-15) at five of the schools where information gathered from other stakeholders was unclear or contradictory. At each of these schools, students were selected at random from the class roster for individual interviews. We continued to interview students until we reached theoretical saturation with a clear pattern of the data needed. As a result, the number of students interviewed ranged between two and 10 at each

school. Two focus groups were also held at the district level with community leaders, women's group representatives, and teachers to discuss program implementation at the local-level including planning and construction, community involvement, support and satisfaction, as well as challenges for on-going maintenance. Questions were specific, based on school WASH sustainability themes promoted in the literature, as well as open-ended allowing for the emergence of additional conditions.

Free and informed consent of the participants was obtained through a signed waiver by school principals and verbal consent of students and community members. The study protocol, including consent waivers and transcripts, was approved by the Institutional Review Board of the University of Colorado, USA, protocol # 0110.37 (approved 10 June 2010).

Selection of conditions

We chose to focus specifically on social and technological factors to promote coordination between these often-divided areas in the development sector. Based on iterative analysis of possible conditions identified in WASH and school WASH literature as well as during data collection, six conditions that promote well-maintained school toilets were included in the analysis (Table 24). Though only anecdotally discussed in school WASH literature, the conditions of a WASH champion and the absence of vandalism were included based on a focus group we held with HFLE officers in 2010 and case knowledge. Because QCA requires sufficient variance in conditions between cases to analyze the influence of a condition on the outcome (as in statistical methods), we eliminated some conditions that have limited variation between program schools (Rihoux & De Meur 2009). These included (1) students per toilet

ratios, which ranged between 22 and 84 with no measurable influence on toilet condition based on correlation analysis (r_b=0.125, p=0.329), which corroborates with findings from similar studies (Njuguna et al. 2008; Mathew et al. 2009; Chatterley 2011); (2) the presence of a specific WASH maintenance plan and budget, because no schools had either; (3) O&M training, since the trained representatives had relocated with the exception of one school; (4) monitoring, as no schools had a WASH monitoring plan; and (5) children's health clubs, which were not present at any school. We recognize that these and many other factors may be at play in promoting the continued maintenance of school WASH and encourage future work to expand the analysis to include additional factors.

Table 24. Coding scheme for outcome and conditions included in the csQCA

Outcome	csQCA Code	Data Source
Well-maintained toilets	1: All toilets function including doors and locks (only minor repairs needed, if any) and are free of visible feces. 0: All toilets are in need of repair (e.g. broken doors or flush mechanisms) and have visible feces on the floor, wall or seat	Observation Teachers Students
Conditions		
	Social Conditions	
Local involvement upfront	1: School/community was involved in planning and construction and their input was incorporated 0: School/community was not involved in planning and construction and their input was not incorporated or they felt disrespected	Principal Teachers
Community supports O&M	1: Community/parents provide financial support or unpaid labor to help maintain the school toilets 0: Community/parents do not provide any support (financial or in-kind) for school toilet maintenance	Principal Teachers
Local champion	1: Presence of a WASH champion (person who voluntarily takes extraordinary interest in WASH at the school) 0: Absence of a WASH champion at the school and limited pro-activity toward WASH issues	Observation
No vandalism	1: Vandalism of toilet facilities by the community was not reported as a common reason for toilet repair needs 0: Vandalism is reported as a common reason for toilet repair needs	Principal Teachers Observation
	Technological Conditions	
Quality Construction	1: Poor quality construction was not reported as a common reason for toilet repair needs and quality is confirmed through observation 0: Poor quality construction is reported as a common reason for toilet repair needs and poor quality is confirmed through observation	Principal Teachers Observation
Familiar Technology	1: The type of toilet is common in households in the community 0: The type of toilet is not common in households in the community	Teachers Students

Operationalizing the outcome and conditions

The coded outcome and conditions are listed for each school in Table 25 based on the definitions and data sources presented in Table 24**Error! Reference source not found.**. When possible, we used multiple data sources as recommended in QCA literature (Basurto & Speer 2012). Additionally, the first author and HFLE officer conducted observations separately to limit subjectivity and enhance construct validity. Further description of the coding process, including examples from the case schools, follows.

Table 25. Truth table for well-maintained school toilets

School	Local Involvement	Community Support O&M	Local Champion	No Vandalism	Quality Construction	Familiar Technology	Outcome
1	1	0	1	1	1	0	1
2	1	1	0	1	1	0	1
3	1	1	1	1	0	1	1
4	1	1	1	1	1	0	1
5	1	1	1	0	1	0	1
6	1	1	1	0	1	1	1
7	1	0	1	0	1	1	1
8	1	0	1	1	1	1	1
9	0	0	0	0	0	1	0
10	0	0	1	0	0	0	0
11	0	0	0	1	0	0	0
12	1	0	0	0	0	0	0
13	0	1	0	0	0	1	0
14	0	0	1	0	0	1	0
15	0	1	0	1	0	1	0

Outcome of interest

Eight schools had toilets that were well-maintained and seven had toilets in poor condition. Repair needs observed included broken flush levers and seats, clogged or leaking pipes, and broken or missing doors to the toilet stalls. Not surprisingly, all schools with poorly functioning

toilets were also the most unsanitary. Cleanliness was not observed in non-functional toilets since they were not in use by students at the time.

Local involvement upfront

The school and/or community were involved in program implementation at nine schools, including selecting the location of facilities: *"the contractor did a good job of consulting with us; we chose the location – he was very flexible"* (Principal, school 7), and in-kind support from parents: *"parents helped to go through the town board for installing the septic tank and some fundraised or volunteered"* (Teacher, school 8). Schools also reported *feeling* more involved when they felt respected by the contractor regarding work hours and consideration of their suggestions. A principal at an Adventist school, where Saturday is considered the day of rest, reported: *"we had quite a bit of consultation throughout the project. The contractor wanted to work on a Saturday, but they respected us and didn't"* (Principal, school 6). In contrast, six schools described frustration that there was no local consultation during implementation: *"by the time it gets here, it's already planned"* (Parent, school 15). In addition, some felt their input was ignored: *"I asked the contractor to put the drinking fountains in a different location where they would be less prone to vandalism but they didn't listen"* (Principal, school 14).

Community support for maintenance

The community supports O&M of WASH services financially or in-kind at seven schools. Parents volunteer their time to assist with repairs at six schools (schools 2, 3, 5, 6, 13 and 15), as explained by the principal at school 6 who said, *"We have reliable [parents] we can call if repairs are needed. They usually do the work for free, but the school gives them a small stipend*

when they can". Three schools receive financial support from the community for repairs (schools 4, 5 and 6), where all three had toilets in good condition. The story is less inspiring at another school where each student was asked to contribute BZ$0.25 (US$0.125) per week to a WASH fund. Unfortunately, *"the students didn't bring the money in"* (Teacher, school 12). Eight schools reported very limited to no community involvement in the school and no in-kind or financial support for O&M.

Local WASH champions

The HFLE officer and first author made separate observations during the school visits to determine if there was a champion present. In each case, it was surprisingly clear when a champion was present and consensus was easily reached between observers. Champions were identified at nine schools. These were principals or teachers who were creative and pro-active in solving challenges that other schools did not address. For instance, at school 1, the principal replaced the drinking water drainage pipe himself because it was frequently clogging. Conversely, one school without a champion said they didn't have trash bins in the toilets because they were not available in the market, while schools with a champion used buckets and empty soda bottle bins as trash receptacles. Despite their obvious positive influence, even schools with a champion sometimes faced challenges they could not resolve, and the presence of a champion did not guarantee continued maintenance in all cases. For example, the champion principal at school 14 hired older students to clean the toilets (with parent permission and her supervision) when hiring a janitor became prohibitively expensive, and pro-actively addressed repair needs. However, she has been unable to tackle the vandalism issues that leave her students without

reliable access to services: *"people in the community will tear down the door to use the bathroom or break the pipe to drink water"*.

Construction quality

Principals at eight schools reported having to frequently replace parts due to poor quality construction: *"At first I was happy with [the program], but then started to notice the poor quality as things began to break and leak after only five months"* (Principal, school 10). However, seven schools reported that they have had no repair needs due to poor quality. We further confirmed construction quality through inspection. In cases with poor quality construction, we noted issues such as the use of inexpensive light-duty anchor sleeves to attach wooden door frames to concrete, and concrete "scaling" usually due to poor finishing.

Vandalism

Vandalism from the surrounding community was observed as a major challenge to maintaining the toilets at eight schools. Multiple principals and teachers reported stories of vandalism: *"the bathroom locks were broken off and the toilets were messed up"* (Teacher, school 12) and *"there is a problem with vandalism here – they can break the locks to the toilets"* (Principal, school 13). In the remaining seven schools, staff reported that they have had no repair needs due to vandalism. Six of these schools were fortunate to be located in communities where vandalism was not a challenge, and school 8 had a high fence around the back of the schoolyard for security after school hours.

Familiar technology implemented

The pit latrines constructed at school 9 are common in the community, and in seven of the 14 schools with flush toilets, flush toilet technology is common locally: *"Most households in [the community] have flush toilets and the rest have pit latrines"* (Principal, school 6). At the other seven schools, flush toilets are not common in the surrounding community: *"Most of the community does not have a toilet…about five pit latrines for 40 families and the rest use the bush"* (Principal, school 10). Spare parts can be found in the capital of each district and in some communities where flush toilets are common, but in other communities schools mentioned that spare parts were challenging to acquire quickly or they had to purchase an entire kit just to get one part.

RESULTS AND DISCUSSION

Pathways to well-maintained school toilets

One necessary condition was identified from the csQCA: local involvement in planning and construction, with a consistency of 1.0, meaning that all cases with a successful outcome had local participation upfront (Figure 12). Because we were interested not only in individual conditions, but their potential collective effects, we also evaluated the pathways of combined conditions that produced the outcome of interest. Five sufficient pathways for well-maintained school toilets were identified, as shown in Figure 12, where each series of lines between conditions indicates a pathway. For instance, in addition to local involvement, pathway 2 also includes quality construction, no vandalism and community support for repairs (financial or in-kind). It is interesting to note that the three schools explained by pathway 3 all received *financial* support from the community, and this pathway is likely only sufficient with monetary

community contribution. Quality construction and the presence of a local champion are common among the pathways. The first pathway is the only combination of conditions that does not include quality construction, suggesting that if quality is poor, the presence of both a local champion and community support for O&M, in addition to the absence of vandalism are needed. Similarly, pathway 2 is the only option that does not include a champion. Familiar technology is less common in the pathways, indicating that technology did not have a strong connection with continued maintenance. Though appropriate design should be considered, results suggest that social factors and construction quality may play a bigger role than the technology itself.

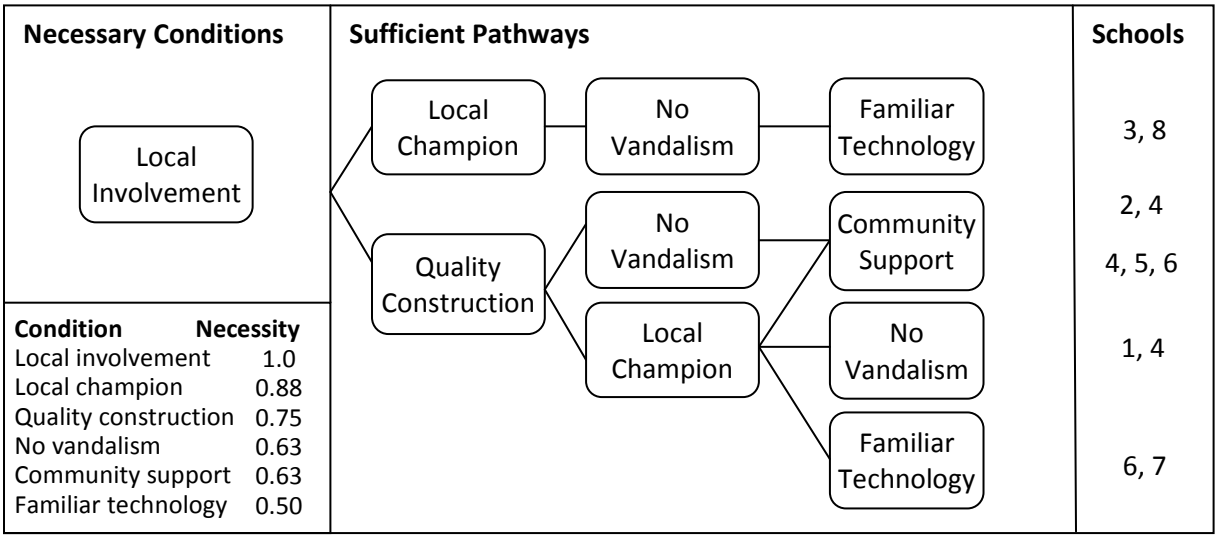


Figure 12. Pathways to well-maintained school sanitation in Belize (intermediate solution)

Each solution pathway has a consistency of 1.0 and coverage ranges from 0.25 to 0.38, meaning that all schools with well-maintained toilets are explained by at least one of the pathways, and each pathway explains two to three cases. Because csQCA is a case-oriented method (as opposed

to a statistical method), each case matters, and even pathways that explain a single case may be retained in results (Rihoux & DeMeur, 2009).

Pathways to poorly-maintained school toilets

We also analyzed the pathways to poorly maintained toilets by negating the outcome in the fs/QCA software. This produces the logical inverse of each outcome score (1s become 0s and vice versa). Analysis of the negative outcome revealed three sufficient pathways to service neglect (Figure 13). Poor quality construction is common to all pathways, with a consistency score of 1.0, indicating that poor quality construction is very likely to lead to facility breakdown over time. In corroboration with results from the positive analysis, familiar technology is only found in one of the pathways. Indeed, roughly half of the schools had familiar technology in both the well-maintained and poorly maintained cases.

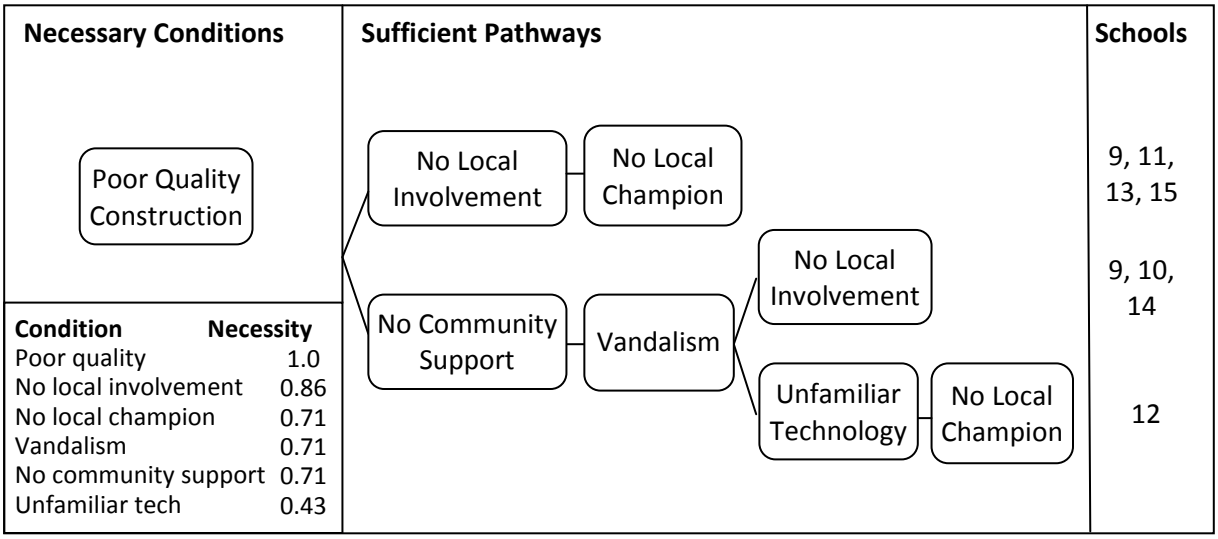


Figure 13. Pathways to poorly-maintained school sanitation in Belize (intermediate solution)

Policy and programming implications

The resulting pathways provide alternative solutions depending on local context and program capacities. The frequency of each condition within the pathways may also suggest their level of influence on continued maintenance. Based on stakeholder feedback and case knowledge, a discussion of how these conditions may be encouraged by policy and programming follows.

Encouraging local involvement

Financial contributions and/or local financial management upfront may increase local participation and hence local buy-in and ownership: *"the PTA should manage the funds so that it is the way we want it, not the way they want it"* (Principal, school 5). An example of local financial management for school WASH implementation is the "direct transfer" method explained by Breslin, Mukherjee and Duey (2009) where "communities are in control of the finances and thus in charge of the project", including contracting out construction services. Though authors note that the method is not necessarily simple, they forecast that the strategy will have a greater impact in the long-term as community members will have the skills to manage projects in the future, a real sense of infrastructure cost, and a relationship with service providers that they'll likely need for future repairs. Many PTAs in Belize are already managing school operation funds and this could be attached to the existing framework, with the additional training and monitoring necessary. The use of local contractors may also facilitate greater local involvement as one principal explains: *"I would like to see [a contractor] from the community. Someone closer to home will get more involvement from the community…"* (Principal, school 7). However, the use of local contractors, as well as the appropriateness of the "direct transfer" method, may vary case by case, and training needs and potential local corruption should be

considered. The inclusion of a school WASH construction protocol, which incorporates local consultation and input, in national guidelines may also help promote local involvement whether the contractor is local or not.

Ensuring quality construction

It should be noted that "high quality" construction does not necessarily mean "high tech" or expensive and there may be simple and locally appropriate approaches to ensuring that whatever technology is constructed, it is of high quality. Principals interviewed suggested hiring local contractors and increasing external monitoring: *"[local contractors] have a vested interest [and] it would be easier to contact them if something didn't go well"* (Principal, school 7), and *"the [work] was not monitored […] so we ended up with poor quality work"* (Principal, school 17). Coordination with the Ministry of Works (MoW) to ensure proper design and siting for school WASH infrastructure would support quality construction within the current national construction framework. Additionally, construction monitoring that is coordinated with the community may improve construction quality while encouraging local involvement and reducing the demand on government resources. The inclusion of guidelines and training for local construction monitoring in policies and associated district-level support may also encourage more effective decentralized monitoring.

Promoting local WASH champions

Based on the case schools, champion principals and teachers tend to be from the community, long-term (four to 18 years) and/or are satisfied with the school WASH intervention and have observed benefits. Promoting local school staff and low turnover rates by prioritizing local

teachers during placements and reducing teacher transfers will likely have a positive effect, but reliance on local champions may be beyond realistic expectations of teachers and easing their responsibilities by enhancing the conditions found in the pathway that does not include a champion (pathway 2) may give teachers more time to improve other aspects of quality education.

Encouraging community support for maintenance

Responsibilities for on-going O&M were unclear at a number of schools and some were expecting continued external support: *"[The MoE] should come back to see it and make repairs"* (Teacher, school 3). On-going O&M needs are typically beyond the available resources of government ministries and may be more effectively managed at the local-level. To aid in the clarification of maintenance roles, one principal recommends *"speak[ing] with the community upfront and mak[ing] an agreement"* (Principal, school 16). Publicizing national policies for local O&M responsibilities and agreements pre-intervention may help avoid misunderstandings and could even motivate greater local involvement in design and construction, which may dispel the lack of ownership felt in many communities that hinders on-going financial support. Champions can also raise community support, as in school 5 where the principal shares expense records and plans spending with parents, who now contribute the majority of the BZ$700-800 (US$350-400) per year the school spends on WASH.

Protecting against vandalism

Surprisingly, based on the data, community involvement upfront and support for O&M are not subsets of lower vandalism rates. Most teachers referred to only a few people, not the community

as a whole, as responsible for the vandalism and suggested more secure designs, including fencing around the bathrooms and washbasins, so that facilities are protected after hours but handwashing can still be observed from outside the toilets during the school day. At one school, the toilet block is kept behind a metal gate after school hours and is safe from vandalism, which the principal says is common in the area. The inclusion of secure toilet designs in national school building guidelines may bring this lesson to scale. Outside of physical protection, the principal at school 5 was able to reduce vandalism through community meetings. However, though less frequent, he was still faced with incidence of vandalism to the school facilities.

Study Limitations

The study setting must be considered when evaluating the generalizability of findings. There are other conditions posited to influence the continued maintenance of school WASH programs that could not be studied due to a lack of variation between cases or practical limitations on data collection capacities. For example, the fact that school WASH is a government priority in Belize, including district HFLE officers who regularly visit schools, may play a large part in the success of many of the program schools and this and other constants from the study should be considered in the generalization of findings and warrant further investigation. An additional limitation is that data were collected from one point in time and expanding on the methods to include multiple data collection periods would increase the validity of results. Future research that includes schools with toilets in “moderate” condition, using fuzzy-set QCA, which permits ordinal or scale coding, may also provide further insight.

CONCLUSION

Based on empirical evidence from case schools in Belize, csQCA reveals that local involvement in planning and implementation is *necessary* for continued maintenance of school toilets years after completion. Though necessary, local participation is not sufficient for continued maintenance and must be combined with other conditions in one of five pathways.

Results confirm the hypothesis that both social and technological factors are important in the continued maintenance of school toilets and quality construction or the implementation of a familiar technology is included in each of the five pathways. However, the familiarity of the technology is not as influential as construction quality: in all four case schools with a high quality flush toilet in a community with only basic pit latrines, the outcome was well-maintained facilities. This does not mean that technology choice is not important, but suggests that infrastructure quality and social factors may have a stronger influence than the specific technology selected.

The hypothesis that on-going support from the community for O&M is a necessary condition is not confirmed, but the absence of support from the community must be compensated by having a local champion, which may not be a reasonable expectation for already time-strapped school staff. Without a local champion, community support for O&M may become necessary. Further, this study is based on infrastructure that is only two to three years old and as time goes on and even high quality construction degrades, community support for maintenance may be needed. Results provide multiple pathways and in-depth qualitative information to support decision-making in the implementation and management of WASH in Belizean schools, and may have implications for improving school WASH in other low-income countries

CHAPTER 7

A QUALITATIVE COMPARATIVE ANALYSIS OF WELL-MANAGED SCHOOL SANITATION IN BANGLADESH

Christie Chatterley[1], Amy Javernick-Will[1], Karl G. Linden[1], Kawser Alam[2], Laure Bottinelli[2], Mohini Venkatesh[3]

[1] *Department of Civil, Environmental and Architectural Engineering, University of Colorado at Boulder*
[2] *Independent*
[3] *Save the Children International*

This chapter will be submitted separately for publication

ABSTRACT

Background. Echoing similar challenges for school-based sanitation and hygiene programs globally, discontinued management of services post-intervention has been observed at a number of schools in Meherpur, Bangladesh. In order to improve programming and policies, we seek to understand how and why some schools have well-managed services over time while others do not.

Methods. Based on in-depth qualitative data from 16 case schools, we employ fuzzy-set qualitative comparative analysis to identify the necessary and sufficient conditions, or combination of conditions (i.e. pathways), to well-managed school sanitation. And, vice-versa, the conditions that support poor management over time.

Results. We identified three distinct pathways that lead to well-managed services. We find that financial access from government or community sources is a necessary, or very common, condition among schools with well-managed sanitation that is absent in many schools with poorly managed sanitation. This effect is particularly strong when the funding source is the community. However, we find that financial access is insufficient for continued service

management and other motivating conditions, such as an active school management committee, a sanitation champion, high quality construction, or a dedicated teacher responsible for toilet maintenance, are needed in conjunction with financial access.

Conclusions. Findings corroborate with those from a similar study in Belize and comparison suggests the need for community support and the possibly tenuous reliance on local champions in the absence of government support. Findings from this study further suggest that schools with government support still require quality infrastructure and a source of motivation to maintain services as observed in the pathways. These findings may have broader implications for school sanitation in other low-income countries and policy and programming implications are discussed based on in-depth case data.

BACKGROUND

As a component of quality education, school-based sanitation and hygiene interventions have the potential to boost student health and attendance (Bowen, 2007; Freeman et al., 2011). Unfortunately, despite increasing efforts to improve school sanitation and hygiene services in low-income countries, management of services over time remains a persistent challenge that can negate anticipated impacts of investment (Dreibelbis et al., 2012; Greene et al., 2012). Infrequent soap provision and poorly maintained toilets post-intervention are often cited (e.g. Njuguna et al. 2008; Mathew et al. 2009; Lopez-Quintero 2009; Saboori et al. 2011). The positive impacts linked with handwashing are unlikely without *reliable* access to soap as a critical first step to behavior change (Bowen, 2007; Curtis et al., 2011; Saboori, Mwaki, & Rheingans, 2010). Similarly, dirty or poorly maintained toilets are unlikely to be used by students and are a potential health hazard if they are used (Koopman, 1978; Mathew et al., 2009; Xuan, Hoat,

Rheinlander, Dalsgaard, & Konradsen, 2012). Therefore, understanding what conditions promote continued management of quality school sanitation and hygiene services is needed to improve effective resource utilization and likelihood for positive impact.

Drivers of well-managed school sanitation and hygiene services (i.e. regular maintenance including toilet repair, cleaning, provision of soap and drinking water treatment) have been posited in sector reports and manuals (IRC, 2007; Mooijman, Snel, Ganguly, & Shordt, 2010; Snel, 2004). However, there is limited empirical evidence regarding how these conditions influence service management, particularly considering their collective effects (e.g. Mathew, et al., 2009; Njuguna et al., 2008). Saboori et al. (2011) identified four conditions common to the two study schools deemed to have continued water and hygiene activities, but found the same conditions in a number of schools with discontinued service provision, suggesting their insufficiency to promote well-managed services. In order to support more effective policy and programming improvements, there is a need to reduce the surfeit of posited conditions by identifying *sufficient* pathways (i.e. combinations of conditions) that consider the collective effects of conditions and are based on empirical data. Further, multiple solution pathways would enable more flexible, practical and economically viable options to respond to local needs and limitations. In response, a study of schools in Belize, used crisp-set Qualitative Comparative Analysis (csQCA) to evaluate the collective effects of social and technological conditions on continued toilet maintenance (Chatterley, Linden, & Javernick-Will, 2012). The authors identified five pathways to well-maintained school sanitation, with local involvement upfront considered a necessary condition. However, the singular study site and exclusion of schools with

"moderate" sanitation services may limit the generalizability of findings, and a similar study in a different geographical location that includes moderate cases is needed to expand upon findings.

As a result, this research analyzes comparative cases of a school-based sanitation and hygiene intervention in rural Bangladesh to identify sufficient pathways to effective management of services over time. We define well-managed sanitation services as a combination of reliability functioning and clean toilets that have soap and water available. After removing conditions found in prescriptive literature that were constant between cases (i.e. "domain conditions") and allowing for emergent themes during data collection, we analyze six conditions including: (1) high quality construction, (2) community support for maintenance, (3) government support for maintenance, (4) an active school management committee (SMC), (5) the presence of a maintenance plan for sanitation, and (6) the presence of a sanitation champion. As an additional and timely research objective, we investigated the different pathways to well-managed sanitation services in government primary schools (GPS) versus registered non-government primary schools (RNGPS) which may have implications to support the continuity of well-managed services through the nationalization of RNGPS which began in January 2013 (OneWorld South Asia, 2013).

Research setting

The annual economic impact of poor sanitation in Bangladesh has been estimated at 6.3% of the Gross Domestic Product due to health-related losses that result in negative social impacts, including less educated children (WSP, 2012). According to the World Bank (2008), improving the quality of education in Bangladesh is a pressing task in order to substantially raise enrollment

and help more children complete primary school. The World Bank report cites school infrastructure, including toilets, as one of the reasons for low levels of student achievement in Bangladesh. In the small western district of Meherpur, educational outcomes and access to sanitation and hygiene in schools are some of the lowest in the country. A baseline study found an adult literacy rate of 37% in Meherpur district (compared to the national average of 53%), a high dropout rate with 58% of students regularly attending primary school, and functioning sanitation and handwashing facilities at only 36% and 47% of schools, respectively (Save the Children 2009).

In response to the educational challenges in Meherpur, Save the Children has been implementing a multi-sector, child-focused program called *Shishuder Jonno,* ("For Children") since 2007. One component of the holistic intervention includes the construction of sanitation and hygiene facilities at schools and very low-income homes, as well as hygiene education training for teachers, parents and children. Save the Children and government departments also provide health-related training and guidance to the SMC; a group of 12 community members and teachers that meet monthly to manage school activities according to government mandate. In 2012, student health clubs were also formed and trained under the title of "Little Doctors" with responsibilities including sharing hygiene messages from training sessions with Save the Children, and cleaning the school toilets. Another central component of the program is the continuous support provided to schools through Save the Children field officers. Each field officer is responsible for five to seven schools which they visit multiple times per week to monitor and support the weekly health class and sanitation, hygiene and health services at the school. The program has invested substantial resources to improve school sanitation, but on-

going service management is a challenge, as expressed by one teacher from a participating school, who says *"When Save the Children gave us the toilet, it was very easy to receive but to sustain it is so tough; like, it is harder to protect freedom than to achieve freedom"*.

METHODS

We use the fuzzy-set variant of Qualitative Comparative Analysis (fsQCA) to evaluate the conditions present in schools with sanitation and hygiene services ranging from well- to poorly-managed. Due to the nascent usage of QCA in sanitation and hygiene research, we first provide a brief background of the method, followed by a description of the case schools and calibration of outcome and conditions coding.

Fuzzy-set Qualitative Comparative Analysis

QCA is a case-comparative analytical method that combines the in-depth knowledge of case studies with the inferential power of "large-N" studies. Based in Boolean logic, QCA allows for the generalization of findings from a relatively small number of cases and offers the ability to identify different pathways of condition combinations that lead to a similar outcome (Berg-Schlosser, Meur, Rihoux, & Ragin, 2009; Ragin, 1987). Contrary to statistical methods which measure the average effect of independent variables on a dependent variable, QCA compares empirical evidence with all theoretically possible combinations that could produce an outcome and considers the collective effects of those conditions.

FsQCA is the most flexible of the three variants of QCA, allowing for ordinal or scale scoring of conditions and outcomes, as opposed to the binary limitations of crisp-set QCA. In contrast to

statistical methods, fsQCA scoring is based on set membership, where conditions and outcomes are coded based on the extent of membership in a set of cases sharing a particular characteristic. Fuzzy sets permit partial membership scores in the interval from 1 ("fully in" the set of cases with a given characteristic) to 0 ("fully out" of the set of cases with a given characteristic), with 0.5 indicating the point of maximum ambiguity where a case is neither more "in" nor "out" of the set (Ragin, 2009).

We feel fsQCA is well-suited for research on the drivers of effectively managed school-based sanitation and hygiene programs due to (1) the likelihood that there are multiple pathways to well-managed services owing to the complexities of sanitation and hygiene programs and the multiple stakeholders involved; (2) the challenge of operationalizing qualitative concepts such as community support within traditional quantitative measures; and (3) the difficulty in obtaining a full picture of the situation in each school for a large data set.

In order to identify pathways that are sufficient to produce an outcome we used fs/QCA 2.5 software. The software summarizes the information in a table of coded conditions (termed a "truth table") and uses Boolean logic, rather than correlation methods, to reduce the table to a few statements including the necessity and sufficiency of conditions by making assumptions about pathways without empirical evidence. These assumptions, termed simplifying solutions, are based on the empirical cases included in the analysis and can also be informed by the researcher based on theory. As recommended in QCA literature, we present the intermediate solution where only logical simplifying solutions are included based on theory and case knowledge (Ragin, 2008b; Ragin & Sonnett, 2004).

Defining the outcome of interest

We define an outcome of well-managed sanitation services as reliably functioning (including secure doors and locks to provide privacy) and clean, with water and soap available in the toilet. These criteria are based on factors that influence student toilet use from the literature: well-maintained, clean and private toilets have been associated with higher student toilet use in both developed and developing nations (Mathew, et al., 2009; Njuguna, et al., 2008; Vernon, Lundblad, & Hellstrom, 2003; Xuan, et al., 2012). Additionally, we included the presence of soap and water in the outcome definition based on recent findings from Kenya which found that the addition of new latrines to intervention schools significantly increased health risk among girls, likely due to unreliable provision of soap and water, and anal cleansing materials (Greene, et al., 2012). The presence of water inside the toilet is of particular importance in Bangladesh where water is culturally the primary anal cleansing material.

Case selection and data sources

Schools were selected purposively, based on Save the Children monitoring data, rather than randomly to ensure variation of the outcome between cases, as suggested in QCA literature (Berg-Schlosser & De Meur, 2009; Glaesser & Cooper, 2011). All schools were located in Meherpur Sadar sub-district with student populations between 72 and 287 per shift. Sixteen case schools were included in the fsQCA based on the following criteria: (1) participated in the *Shishuder Jonno* program, (2) someone that was present during toilet construction is still at the school who can answer questions about the construction process, and (3) the program toilet has needed repair since construction. Any schools that had not faced repair needs for the toilet were removed from the analysis. This was due to the research goal of evaluating a schools ability to

recover from breakdown, which serves as an indicator of long-term resilience and continued maintenance. The age of the toilet facilities ranged from eight to 32 months, but there was no association between toilet age and condition (T=-0.079, p=0.335).

With permission from the local government, we visited the schools unannounced over five weeks in June and July 2012. Qualitative information was gathered for each school through interviews with teachers and the field officer assigned to the school (separately), a focus group discussion with four boys and another with four girls from grade four or five (app. age 9-11), a focus group discussion with four Little Doctors, and systematic inspection and photos of the student toilets. Semi-structured interviews and focus group discussions incorporated specific questions related to postulated sustainability factors including the planning and construction process, maintenance procedures, supply chain of materials for toilet operations and maintenance, community support, SMC activeness, government involvement and support, on-going non-governmental organization (NGO) support, the presence of a champion, children's engagement, and hygiene education/promotion. Additionally, open-ended questions allowed conditions to emerge from the data collection process.

Identification of conditions

Based on iterative analysis of potential conditions, we included six conditions of well-managed sanitation services (Table 26). Conditions with less than 30% variation among the case schools were not included in the analysis as recommended in QCA literature (Berg-Schlosser & De Meur, 2009; Rihoux & De Meur, 2009 p. 45). These included the policy environment, appropriateness of the technology, vandalism, external monitoring, student engagement, local

involvement upfront, access to parts and services, access to water source, parent participation, and advocacy and promotion. The number of students per toilet was also excluded based on literature that does not support association with cleaner, better maintained or more frequently used toilets (Mathew, et al., 2009; Njuguna, et al., 2008) and the empirical cases, where ratios ranged from 18 to 95 students per facility (toilet or urinal) with no significant correlation with facility condition (T=0.085, p=0.322).

Table 26. Coding rubric for outcome and conditions

Condition	fsQCA coding scheme	Source
OUTCOME Well-managed sanitation services	Minimum of the following two measures: *Reliably functional toilets*[a]*:* 1: students have reliable access to functional services; repairs timely addressed 0.67: all toilets usually function, but repair needs are not always timely addressed 0.33: some toilets are frequently unusable; repairs are not timely addressed 0: students do not have reliable access; repairs are rarely addressed	Students Observation Teachers Field officer
	and *Reliably clean toilets*[b]*:* 1: all toilets are almost always clean and quickly cleaned when dirty 0.67: usually more or less clean, with some instances where they remain dirty 0.33: frequently unclean and are usually considered unclean by students 0: rarely clean and students label them as dirty	
Quality construction	1: high quality materials and construction observed; no repair needs due to poor quality 0.67: mostly high quality observed; very minor repair needs due to poor quality 0.33: poor quality observed, but so far there have been no repair needs because of this 0: poor quality observed and have had major repair needs because of this	Observation Teachers Field officer
Community support	1: community has contributed financially to toilet O&M when needed 0.67: community contributes financially, but not every time the school requests help 0.33: community members provide limited support, such as providing a few bars of soap 0: community does not contribute at all to O&M of the toilets	Teachers Field officer
Government support	1: currently has SLIP fund (app. 240-370 USD/yr) and contingency fund (app. 9 USD/mth) 0.67: currently has SLIP fund, but not contingency fund 0.33: currently has contingency fund, but not SLIP fund 0: the school does not receive any government funding	Teachers Field officer
Active SMC	1: Members check the school toilets or talk with students at least once per month, and manage repairs if needed 0.67: Members visit the school but not regularly (less than once per month) or limited in scope, but have or would manage repairs 0.33: Members rarely visit the school and are minimally involved in sanitation 0: Members don't ever visit the school or manage repair needs	Students Teachers Field officer

Condition	fsQCA coding scheme	Source
Maintenance plan	1: a specific teacher is responsible for toilet maintenance and has a cleaning schedule which is followed/monitored 0.7: cleaning schedule usually followed but no specific teacher responsible 0: no specific teacher responsible for sanitation; no cleaning schedule or rarely followed	Students Teachers Field officer
Sanitation champion	1: someone voluntarily takes extraordinary interest in school sanitation & is recognized by others (without whom hygiene activities would likely diminish or discontinue) 0.67: someone leads sanitation activities but doesn't include all aspects of maintenance and hygiene practices or others are identified who may continue their role 0.33: someone takes interest in sanitation at the school, but they don't always take action or others would likely continue their role in their absence 0: There is no one identified as taking interest in sanitation at the school	Observation Students Teachers Field officer

[a] "Functional" = waste is easily flushed with water, the building structure, doors & locks are in working condition providing privacy, water is available for flushing and anal cleansing, and soap is available in or near the toilet "Repairs timely addressed" = minor critical repairs (needed for use) such as a door lock or clogged toilet are repaired within 24 hours, major critical repairs such as a broken pan or door are repaired within 1 week, minor non-critical repairs (not necessary for use) such as a broken tap are repaired within 1 week, and major non-critical repairs such as a broken water pump are repaired within 1 month

[b] "Clean" = no visible feces on the floor/walls/seat, no flies, and no foul smell

Calibration of outcome and conditions

Following guidelines in QCA literature, we developed a rubric (Table 26) to assign codes for the outcome and conditions at each school based on triangulation of interview, focus group and observational data (Basurto & Speer, 2012). The calibration criteria for SMC activity and the presence of a maintenance plan emerged from the cases. Specifically, the importance of SMC involvement in sanitation and hygiene emerged as a stronger indicator than meeting frequency and attendance. In addition, having a single, dedicated teacher responsible for toilet maintenance appeared to be very important.

Inter-rater reliability tests were conducted by having two of the authors independently code the data and then discuss and compare the calibrations to improve the clarity and reliability of the rubric and ensure that the conditions and calibrations accurately reflected the cases studied

(Harry, Sturges, & Klingner, 2005; Jordan, Gross, Javernick-Will, & Garvin, 2011). Final coding and rubric definitions were then reviewed by a third author.

A summary of the coded data for each case is presented in Table 27. In the sections that follow, we provide further details and examples of high and low scoring cases for each condition to provide context of the range of conditions at the schools beyond the definitions listed in Table 26.

Table 27. Data matrix of outcome and conditions for well-managed school sanitation

School	Quality construction	Community support	Active SMC	Government support	Maintenance plan	Champion	Outcome
1 (GPS)	0	0	0.33	1	0	0	0
3 (GPS)	1	0	0.33	1	0	0	0
6 (GPS)	0	0	0.33	0.33	0.7	0	0
17 (RNGPS)	0.67	0.33	1	0.33	0	0	0
12 (GPS)	1	0.67	0	1	0	0	0.33
13 (GPS)	1	0	0.67	0.33	0.7	0.33	0.33
15 (RNGPS)	1	0	0	0	1	0.67	0.33
16 (RNGPS)	0.33	0.33	0.67	0	0.7	0.33	0.33
20 (GPS)	1	0	0.67	0.33	0	0	0.33
2 (RNGPS)	0.67	1	0	0	0	0.67	0.67
4 (RNGPS)	1	0.67	1	0.33	1	0.67	0.67
8 (RNGPS)	0.33	0	0.33	0.33	0.7	1	0.67
10 (RNGPS)	1	0.33	1	0.67	1	0.33	0.67
14 (GPS)	0.67	1	1	0.33	0.7	1	0.67
18 (RNGPS)	0.33	1	1	0.33	1	0.67	1
19 (GPS)	1	1	1	1	1	0.33	1

Outcome

We operationalized the outcome of well-managed school sanitation services based on the minimum of two measures: (1) reliably functional toilets, and (2) reliably clean toilets, where a value of 1 was assigned for positive cases, a value of 0 for negative cases and 0.67 or 0.33 for

cases falling in-between (Table 26). Scores were based on student responses and facility inspection, with supplemental information from teachers and the assigned field officer. The minimum value of the two measures was used based on the assumption that if toilets are not reliably functional, students are unable to regularly use them, and if they are not reliably clean, it is unlikely that students will regularly use them (e.g. Mathew, et al., 2009; Njuguna et al., 2008). Not surprisingly, there were no cases that scored high for functionality, but low for cleanliness, or vice-versa.

Two schools were assigned a score of 1 for both measures. These schools have reliably functioning and clean toilets, with maintenance needs conducted in a timely manner: *"Our toilet is always kept clean. Once a month, the younger students may make the toilet dirty, but students clean it when they see it"* (focus group, boys, school 19), and *"When the soap becomes empty we ask the teacher for soap and the teacher gives it to us. One bar of soap is enough for 15 days"* (focus group, girls, school 18). Conversely, four schools had very poorly managed sanitation with a score of 0, such as schools 6 and 17 where, respectively, boys in the focus group discussions explained that *"When they open the toilet, the next day it becomes clogged and closes again for two weeks"*, and *"When the soap runs out the teachers don't replace it for a month"*.

Quality construction

Schools 1 and 6 have had extensive repair needs due to poor quality construction and assigned a code of 0, as elucidated by a teacher at school 6 who says, *"We think it is because of the faulty toilet pan because all the toilets in this region which were constructed by the same contractor are having the same problem of clogging"* and the field officer for school 1 who describes the

cause of clogging as *"…probably due to bad construction. This is not the only school where it has happened"*. Three schools, coded as 0.33, also felt the quality was poor but did not cite this as a frequent cause of breakdown, as explained by a teacher at school 8, "*we found that the pipe was poor quality, so we think that the other materials were poor quality too"*. Construction quality was confirmed through observation of the toilet facilities. The majority of toilets were well-constructed with quality materials, however in the schools coded as 0 or 0.33, we observed problems such as pipes not buried deep enough in the soil, improperly spaced roof support rods, and poor plaster finishing.

Community support

The community contributes financially to toilet maintenance when needed at four schools, coded as 1: *"When we needed to repair the motor, the local community…contributed 20% of the total cost"* (Teacher, school 14); and *"The local community helps us whenever we need. If we have a problem, we notify them and they give 500, 700 or 1000 taka* (app. 6-12 USD) *among themselves"* (Teacher, school 18). At two schools, the community provides financial support, but not every time needed, such as school 4, where the head teacher says, *"Yes, they help, but minimally. For example, we have two teachers assigned by Save the Children. Besides Save the Children we have to pay them 1000 tk* (app. 13 USD) *per person. In this situation, the community helps"*. At the three schools coded as 0.33, the community, or someone in the community, has provided financial support to the school, but the support is very limited or unreliable as expressed by teachers at school 10, *"The village or parents don't contribute financially for toilet maintenance except the chairman"*, and school 16, *"…for the last two months we can't pay the cleaner because the community stopped providing money and right now we have no fund"*. The

community does not support maintenance of school sanitation in any way at seven schools, coded as 0: *"The villagers don't contribute to toilet maintenance at the school, not even mistakenly. Even when we ask the students to bring their exam fees (10-15tk), we have to face questions from 70% of the parents"* (Teacher, school 3).

Active SMC

Most schools have an "active" SMC in the sense that they meet monthly and the majority of members attend the meetings: the SMC at 14 of 16 schools have met every month for the previous six months and at least seven of 12 members attended the last three meetings at 11 schools. However, there are still schools where meeting attendance and frequency are low, such as school 3 where the SMC met only three times in the previous five months with an average of four to five members at the last three meetings. Based on the case data, all SMCs that are highly involved in school sanitation meet monthly with at least eight members. However, meeting frequency and attendance do not guarantee sanitation activity. For example, the SMC at schools 12 and 15 meet every month with nine and eight members on average, respectively, yet neither is involved in sanitation at the school. For this reason, we coded the SMC at each school based on their involvement in school sanitation specifically, regardless of meeting frequency or attendance.

Six schools were coded as 1, where SMC activities include sanitation, such as monitoring the toilets, talking with students and/or parents about toilet use or handwashing, and managing maintenance needs: *"Now [the SMC] are building a boundary around the tank so that it can't blow away anymore"* (Teacher, school 19), and *"[The SMC] also gave a speech about*

handwashing in the mother assembly. This is helpful. A mother becomes conscious by the speech of another mother. When they go home, they tell their children that they heard about handwashing after toilet use and before eating. They tell their children to do that too" (Teacher, school 10). The situation at the three schools assigned a score of 0 reveal a different story where the SMC doesn't participate in school sanitation in any way: *"the SMC is active only during meetings but not the rest of the time"* (field officer, school 12); and *"the SMC doesn't do anything related to sanitation and handwashing"* (Teacher, school 15).

Government support

We included both government primary schools (GPS) and registered non-government primary schools (RNGPS) in the analysis. GPS typically receive government funding for expenses such as teacher salaries and utility bills, while RNGPS usually need to cover these costs through other sources. In addition, there are two funds offered by the government: the contingency fund and the school-level improvement plan (SLIP) fund. All GPS, and some RNGPS, receive the contingency fund which is usually 700 tk (app. 9 USD) per month and meant for photocopies and other managerial needs. The SLIP fund, intended for maintenance and school improvements, is typically 20,000 to 30,000 tk (app. 240-370 USD) for the year and is only provided to a portion of schools each year, including some RNGPS.

Four schools, coded as 1, were currently receiving the maximum government funding including both contingency and SLIP funding. School 10, an RNGPS, also has the SLIP fund, but was coded as 0.67 since they don't have the contingency fund. Eight schools were coded as 0.33; three RNGPS and five GPS. These schools have access to contingency funding, which they use

for minor maintenance needs out of necessity, despite the main purpose of the fund being for photocopies and other teaching related expenses. The remaining three schools, coded as 0, are RNGPS schools that receive no funding from the government in any form.

Maintenance plan

During data collection, we perceived that having a maintenance plan, specifically, one dedicated teacher (or one for each gender) assigned to manage the toilets and following a cleaning schedule, was influential to on-going toilet maintenance. Accordingly, we coded schools with both of these characteristics as 1 and schools with a cleaning schedule but no singular, dedicated person responsible for carrying it out as a 0.67. This is based on theory and case knowledge that suggest that following a cleaning schedule is a positive condition, but may not be as effective if a specific teacher is not held accountable for executing it. There were no schools with a dedicated person responsible for toilet maintenance that did not have a cleaning schedule.

Five schools were assigned a code of 1, as exemplified by school 4 where the head teacher describes clear responsibilities, saying that *"one teacher is responsible for the toilet monitoring and maintenance and another teacher is responsible for ring well monitoring and maintenance"*. Students recognize these roles as well as girls from school 4 explain, *"there is an assigned teacher for the boys named [] sir and [] mam is assigned for the girls. The teachers always remind us about health, sanitation and hygiene issues*". All five of these schools follow a cleaning schedule that is led or monitored by the dedicated teacher. An additional five schools, coded as 0.67, follow a regular cleaning schedule but there is not one specific teacher responsible for sanitation. At the other end of the spectrum, there were six schools coded as 0 that do not

have a specific teacher responsible for the toilets, and according to students the cleaning schedule is rarely followed if there is even a schedule at all. As the boys at school 17 described in a focus group discussion, *"We are bound to use the urinals because we have no option left. The toilets are only cleaned once or twice… only when visitors come to our school"*. All case schools fell into one of these three categories and we did not utilize a score of 0.33 for this condition.

Presence of a champion

We coded schools as 1 if teachers, students and/or the field officer identified someone as a champion and the research team felt they were the main source of sanitation activity at the school whose absence would likely lead to the discontinuation of these activities. In the coding, an active team of teachers where no single person was identified as being the "cause" of the activeness were coded as 0.33. Examples of this scenario are schools 10, 16 and 19 where the teachers work as a team and coordinate well with the SMC, but if any one teacher left the school, activities would likely continue.

Following this coding scheme, schools 8 and 14 were coded as 1. The head teacher at school 14 was identified as a champion by students, *"Oh my gosh! If we forget to put soap [in the toilet] and madam finds out, she tells us to put it in. She asked us affectionately, 'Why didn't you tell me? Did I ever say that I will not give you soap? Whenever you need soap just come to me'"* (focus group, boys), and the field officer, *"This school really works as a team with the lead of the head teacher"*. The temporary teacher assigned by Save the Children at school 8 was identified by multiple students as a champion who said, "*We have a list of who should collect*

water when. The teacher [name] made the list" (focus group, girls), and *"Yes, [name] talks to us about proper toilet use. … [name] taught us about handwashing"* (focus group, girls). Four schools were coded as 0.67 for the presence of someone who takes action to improve sanitation services at the school but does not lead all the improvements needed. School 4 provides an example, where a teacher describes the SMC vice president as *"…very active in sanitation and hygiene issues… When [he] comes to see the school, first of all he checks the toilet, if it is dirty, he starts to clean it himself"*. A score of 0.33 was assigned to five schools where there is someone interested in school sanitation, but they have taken only limited or infrequent action or their departure would likely have little effect on the continuation of activities, such as school 13 where *"…the head of SMC is very active all year long, he visits the school every month and talks with the students about health and sanitation…"* (Teacher). At the remaining six schools, no champion was identified by teachers, students, the field officer, or data collectors: e.g. *"there is no teacher that is responsible for sanitation and hygiene at the school and no one from the village is very involved"* (Teacher, school 1).

Analysis

We performed truth table analysis on the calibrated outcome and conditions for each case using fs/QCA 2.5 software. The software creates a table with all logically possible combinations of conditions (in this case, 2^6 or 64 since we have six conditions) and for each combination, calculates a raw consistency (representing the degree to which the combination is a subset of the outcome) and PRI consistency (indicating the extent to which the combination is a subset of both the outcome and the negated outcome) (Ragin, 2006; Smithson & Verkuilen, 2006; Ragin, 2008b). The consistency scores, based on the empirical cases, are used to code the outcome of

each combination of conditions as present or absent, using a minimum raw consistency cut-off of 0.8 and considering any large gaps between raw consistency and PRI consistency as recommended in QCA literature (Jordan, et al., 2011; Ragin, 2008a; Ragin, 2008b). All configurations with empirical evidence from at least one case school were included.

RESULTS

Of the 16 case schools analyzed, seven were coded as having well-managed sanitation services (a score of greater than 0.5) and nine were coded as poorly managed (a score of less than 0.5). The pathways to each outcome are presented in Figures 14 and 15 where the lines between conditions represent a pathway. Each pathway is considered sufficient to produce the outcome, where the necessary conditions are likely needed to produce the outcome, but insufficient on their own (Berg-Schlosser et al., 2009; Jordan, Gross, Javernick-Will, & Garvin, 2011). In QCA nomenclature, necessity and sufficiency are calculated through *consistency* measures, which evaluate the frequency with which conditions are present when the desired outcome is achieved. Conditions with a consistency score of 0.9 or higher are considered "necessary" or very common, while combinations of conditions with a consistency score of at least 0.8 are considered sufficient (Ragin 2008a). To avoid confusion between the consistency measure of necessary conditions and sufficient pathways, we use the term "necessity score" when referring to the consistency measure for necessity. A second measure of "goodness-of-fit" used in QCA is *coverage*, which indicates how well the necessary and sufficient conditions are represented by the empirical cases (Rihoux & De Meur, 2009).

Pathways to well-managed school sanitation services

Analysis of the case schools with well-managed sanitation reveals three sufficient pathways (Figure 14). The solution coverage is 0.81, meaning that 81% of memberships in the positive outcome can be explained by these three pathways. The solution consistency is 1.0, meaning that all cases with the characteristics in the pathways have well-managed sanitation services, or they are 100% "consistent" in providing well-managed sanitation services. The cases explained by each pathway are shown in the right column.

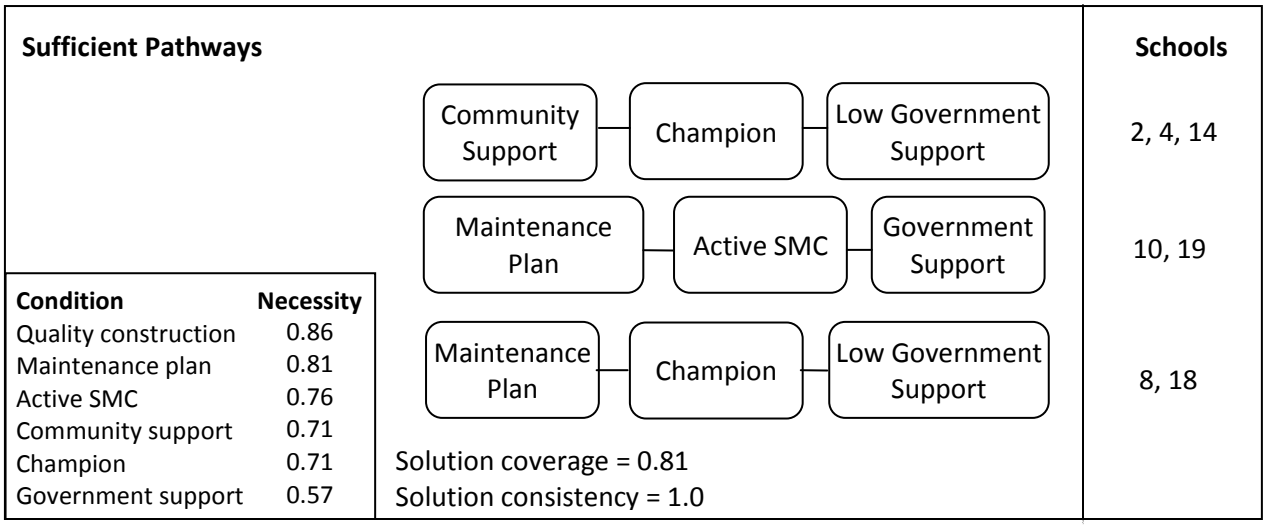


Figure 14. Pathways to well-managed school sanitation services in Bangladesh

Based on necessity scores, none of the individual conditions meet the cut-off of 0.90 to be considered "necessary". However, if we run necessity analysis on community support *or* government support, we find that financial access, from either of these two sources, is necessary with a score of 0.90. This is further reflected in an independent cost analysis of the *Shishuder Jonno* program which highlighted the need to transfer maintenance costs from Save the Children to the government and/or community (Save the Children, 2012). Though important, financial

access alone is not sufficient for well-managed services however, as illustrated at school 1, where the teacher said *"we have a strong fund from the government and we don't spend all the money in a year. So we always have money for maintaining"*, yet the toilets are frequently broken down and they were waiting for Save the Children to repair a broken pipe. Hence, other conditions are needed to create the motivation to utilize available funds to create reliably functioning and clean sanitation services to students, as seen in the pathways.

The first pathway is comprised of quality construction in addition to financial support from the surrounding community, the presence of a champion, and the absence of SLIP funding from the government. It is interesting to note the absence of government SLIP funding in this and the third pathway. We hypothesize two reasons for this from further analysis of the case schools. One, RNGPS, which normally receive little to no government support, tend to have very active and independent teachers as exemplified by a teacher at school 16, *"We are a non-government school. We built this school and we are running it. We paid for everything"*. Teachers at RNGPS are often motivated to create a positive school environment so that parents continue to send their children and the school is eventually given GPS status. Two, government funding is described by teachers as delayed and distributed at random, restricting planning and quick recovery from breakdown at schools that depend primarily on government support, as teachers explain that *"The government takes a long time to process the funding. We don't get the money in due time"* (school 3), and *"If we go to the government office, the process will be like: you applied for a blanket in the winter, they will give it to you in summer. It takes a season to repair with government involvement"* (school 16).

The second pathway combines quality construction with the presence of a maintenance plan, an active SMC, and current government SLIP funding. Both of the schools explained by this pathway have a toilet cleaning schedule with one dedicated teacher responsible for sanitation (coded as 1) and the SMC is highly active, including rapidly responding to repair needs identified by the teachers and talking with students and parents about hygiene (coded as 1). As the only pathway without reliance on an individual sanitation champion, the second pathway may provide insight into a more robust option than pathways 1 and 3.

The nationalization of all schools in 2013 may have implications for the sufficiency of pathways that explain only RNGPS. Pathways 1 and 2 each explain both GPS and RNGPS case schools, implying that as RNGPS nationalize, these two pathways are apt to remain sufficient. However, the two schools explained by the third pathway are RNGPS and the sufficiency of this pathway may not hold post-nationalization. Identifying the common conditions among these two schools with poor quality construction, the third pathway is comprised of the presence of a maintenance plan, a champion, and low government support (contingency fund only), Beyond the longevity concerns as RNGPS convert to GPS, the generalizability of this pathway may be limited, as the "necessary" condition of financial access is not present, particularly as more time passes and repair needs become more costly. Looking deeper at the case data, the moderate success of school 8, with an outcome score of 0.67, is likely dependent on the temporary teacher who is partially funded by Save the Children and has been very active in promoting sanitation and hygiene at the school, and the success of school 18 is likely due to financial support from the community, a very active SMC, and a champion head teacher.

Considering the potential tenuity of pathway 3, two options are presented (pathways 1 and 2) depending on the local context. For example, if adequate financial support from the community for maintenance cannot be secured and there is no reliable champion, the conditions in pathway 2 may present more realistic areas to focus resources; and, vice-versa, if the school does not have government SLIP funding, then focusing on the conditions in pathway 1 may be more effective. Only some schools receive SLIP funding each year, suggesting that either government funding will need to increase to provide all schools with SLIP funding (in addition to encouraging SMC involvement and a dedicated teacher for school sanitation), or community support and a champion will be needed at the schools without current access to this fund.

Pathways to poorly managed school sanitation services

Analysis of case schools with poorly managed sanitation confirm findings from the analysis of schools with well-managed services. Three sufficient pathways to poorly managed services are identified (Figure 15). The first two pathways demonstrate the negative effect of insufficient financial access (from the government or community), where the absence of a champion or an inactive SMC combined with limited financial support is sufficient for poorly managed sanitation. The third pathway suggests that schools with government funding that have an inactive SMC, no maintenance plan and no champion are unlikely to provide reliable sanitation services. All three of the case schools explained by this pathway are GPS and though they have substantial financial government support through SLIP funding, there may be little motivation for teachers to maintain sanitation services without pressure from a champion, an active SMC, or the motivation of RNGPS teachers to “prove” their ability to run a quality school.

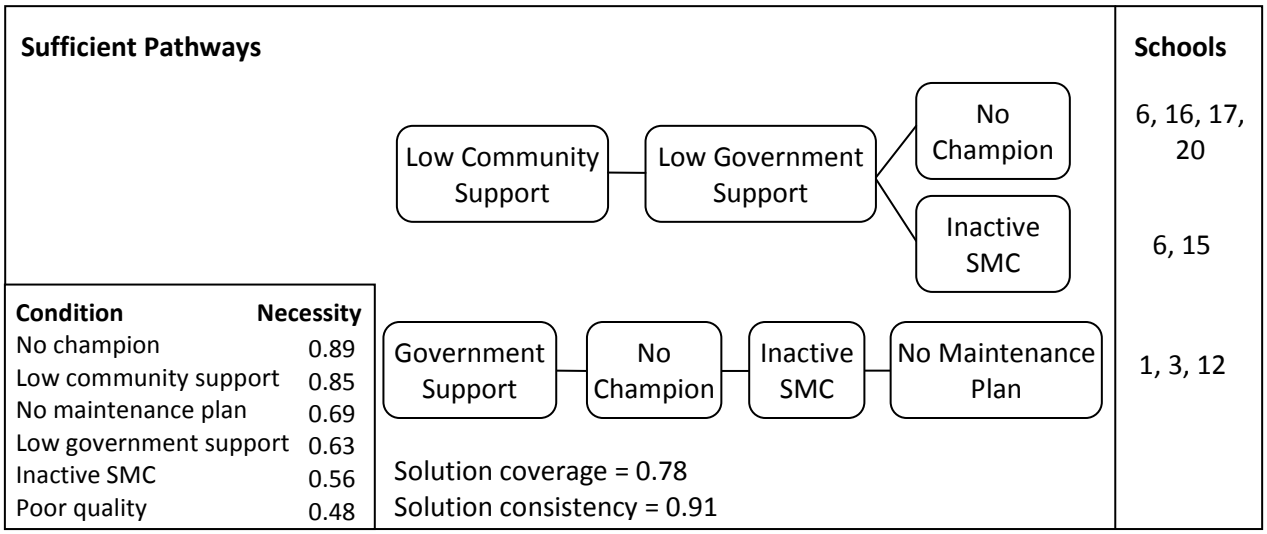


Figure 15. Pathways to poorly managed school sanitation services in Bangladesh

DISCUSSION

Comparison with results from similar study in Belize

Results support those from a similar study in Belize (Chatterley, Linden, Javernick-Will, 2013) and provide additional information regarding domain conditions in Belize. The necessary condition of local involvement upfront identified in the Belize study is echoed in case schools in Bangladesh: this condition was removed from analysis because it was constant as all schools with SMCs and teachers involved in planning and construction and feeling respected in the process. As a result, this serves as a domain condition in the Bangladesh schools. No schools in Belize receive government support for operations and therefore this domain condition was not included in the Belize analysis. Findings from Bangladesh where government funding varied between schools, provide some indication of the effect the absence of government support may have and how it may be compensated for in Belize, specifically through quality construction, the presence of a champion, and community support (pathway 1 in Figure 14). Interestingly, these conditions comprise the third pathway identified in the Belize study; the pathway that explains

the most case schools, which were also the only schools that received *financial* contributions from the community. Without government support, schools in Belize tend to rely more heavily on the presence of a champion, which is found in four of the five pathways to well-managed services, where the remaining pathway includes community support. This resonates with the need for a champion (which may be tenuous over time) and community support, in the absence of government funding as discovered in Bangladesh.

Implications for policy and programming

Integrating these findings into national policy and future intervention programming may foster improved management of school sanitation and hygiene services at scale. We discuss potential strategies for augmenting policy and programming based on insights from teachers, students and field officers during data collection.

Encourage local construction monitoring

Though the majority of the toilets were high quality, Save the Children staff described challenges with some contractors who compromised quality to reduce costs. Based on teacher feedback, frequent monitoring by the Save the Children engineer encouraged high quality construction: *"I think the quality was good because the engineer was very mindful of the construction. When the roof fell apart because of the poor foundation, the next day the engineer told the contractor to rebuild it. They didn't use the brick, sand, rod, etc. from the old construction, for the new construction"* (Teacher, school 3). However, the engineer is unable to monitor the entire process at every school and additional local monitoring was common in the schools with high quality construction: "*The construction materials were very good quality. If something breaks, it is…not*

the fault of construction or materials, because we checked the materials" (Teacher, school 12). Save the Children encouraged local monitoring and many teachers felt their concerns were respected and acknowledged: *"The contractor brought a van of poor quality bricks, but we complained to the engineer about it and he forced the contractor to return the bricks and use new bricks for the construction"* (Teacher, school 7); and *"When they made the septic tank cover, we complained to [the contractor] that the cover he made was not good quality. But he didn't listen to us. When he placed the cover on the tank, it was broken… [The Save the Chlidren manager] told me not to sign the attestation form until everything seemed ok to me"* (Teacher, school 14). Despite this, there were some schools that were not open during construction, or where teachers and parents may have felt uncertain of how to monitor construction or placed limited importance on sanitation. Further guidance regarding how to check the materials and construction process and promotional strategies based on local priorities and motivations may increase local involvement in monitoring efforts.

Activate the SMCs to promote sanitation and hygiene

According to teachers and the field officers, barriers to SMC activity include that members are busy with their personal work as explained by a teacher at school 3, *"as usual they don't attend the meeting because that may hamper their work. The SMC doesn't have time to visit the school"*, and personal conflicts between teachers and the SMC leadership as described by the field officer for school 19, *"The president of the SMC resigned 9-10 months ago because of personal problems between him and the head teacher. The vice president has been the new president for six months. Six months ago, the SMC was not active, but now it is better"*. Fortunately, other case schools provide examples of how it may be possible to "activate" the

SMC. At school 16, the head teacher contributes the recent increased activity of the SMC to a training session conducted by Save the Children and the local government, which focused on sanitation and hygiene themes during the third and final day. Teachers at school 4 shared experiences with community members from their visit to a school awarded best school in the sub-district by the government and said, *"At the beginning, the villagers, even the SMC, didn't show interest in the school. We showed the villagers the activity* (the school visit) *using a projector in the schoolyard. Only then the villagers and the SMC were very interested in the school"*.

Expand government involvement in school sanitation maintenance

A number of schools did not know when they would receive the SLIP fund next, and a more streamline process of applying for maintenance funds when schools have a major and unexpected breakdown may help schools more efficiently address repair needs. Additionally, more direct involvement of government education officers in sanitation and hygiene may help this theme gain support at the government level. All case schools reported frequent visits from the assistant upuzilla (sub-district) education officer (AUEO) or assistant education officer (AEO), ranging from every two weeks to three months, to check attendance records and lessons. Unfortunately, sanitation and hygiene are meagerly included in inspections, if at all, as described by one teacher who says, *"The AUEO visits our school once a month, but they don't check anything related to the toilets or handwashing"*. Though toilet cleanliness is sometimes inspected, only school 4 felt sanitation and hygiene was prioritized by the education officer, saying *"He gave priority to the health and sanitation issue…"* when describing AUEO visits. Expanding upon the positive influence of AUEO and AEO visits, more formal inclusion of

sanitation and hygiene (specifically, functioning and clean toilets with water and soap) in school inspections has the potential to motivate teachers to maintain facilities as well as provide an opportunity for education officers to become familiar with sanitation needs and aid schools in efficient acquisition of maintenance funding.

Another area where government education officers can become more involved is the SMC and teacher hygiene training. Currently, the last day of the three-day teacher refresher training offered by the government in Meherpur each year is dedicated to hygiene education training. However, this theme is taught by Save the Children personnel. Training and encouraging education officers to conduct this final day of training may also help foster greater interest in sanitation and hygiene services as part of quality education.

Encourage community support and participation

Without adequate government funding, schools rely on community support to address major repair needs. Unfortunately, teachers report that they often have trouble securing financial contributions from the community: *"The villagers don't participate financially, that's the greatest challenge for funding toilet maintenance"* (Teacher, school 8). Even schools where teachers feel parents would contribute, express hesitation in asking for their support: *"We feel embarrassed to ask the villagers for the money"* (Teacher, school 16); and *"…we are confident that if we asked them for 1000 bars of soap, no matter what, they would give it to us. But we don't ask them for soap. We are happy that they are sending and receiving their children regularly. We don't expect more than that from the parents"* (Teacher, school 20).

However, despite the low average income in the area, there is evidence that households are willing to pay for community water services: in many communities, families contribute 10 to 20 tk (app. 0.13-0.25 USD) per month to maintain community arsenic treatment units (Ramendra Mallik, personal communication, January 10, 2013). Based on an average student population of 271 and assuming each family has on average two children at the school, this would amount to 203-406 USD per year, similar to the SLIP fund, if families contributed the same to school sanitation and hygiene.

The school visit sharing activity at school 4 described previously, where teachers shared their experiences from a visit to another school deemed "successful" by the government with the villagers, provides an example of how parents could be encouraged to support school services, as one teacher explains, *"After that, whenever we ask the students to bring extra money for school activities the parents are willing to pay it"*. This experience may have helped parents feel more included in school activity as well as create social pressure to provide their children with a healthy school environment like the school visited by the teachers. The SMC may also be a source of advocacy in the community and a number of teachers reported their positive influence, such as the teacher at school 14 who says, *"In the local community, we use the SMC to raise awareness about sanitation and handwashing. The SMC members also live here so they can influence the people*".

Establish a national framework for school sanitation maintenance plans

It should be noted that the presence of a cleaning schedule does not guarantee the schedule will be followed, as expressed in the Little Doctor focus group at school 10, "*Our teacher made some*

groups for toilet cleaning, but the fact is sometimes the other group who is not from the little doctors, don't clean the toilet. They only clean the toilet when they wish"; and monitoring by a teacher is likely necessary as school 15 explains, "*We need to monitor though when [the students] clean the toilet"*. Monitoring student cleaning and repair needs was much more common at schools where one teacher was responsible for sanitation, usually appointed by the field officer or head teacher. Little Doctors could play an important role as well, such as the Little Doctors at school 7 who explain their toilet cleaning schedule: "*We divide our work... Like, my role number is one, so I will clean today. Tomorrow, role number two will clean the toilet, etc"*. Institutionalizing a framework for school sanitation maintenance where there is one teacher responsible who engages students in the process and is held accountable by government education officials during school inspections, in national school sanitation guidelines with associated government trainings or competitions, may bring this model to scale.

Encourage local champions

The identified champion varied between the field officer at school 2, the SMC vice president at school 4, the Save the Children-hired temporary teacher at school 8, the assistant teacher at school 15, and the head teacher at schools 14 and 18. The champion teacher at school 15 was identified as *"…the only local teacher. The others are not from the community and don't really care"* (field officer, school 15), suggesting that local teachers may be more likely to take on a champion role. School health competitions for SMC members may also cultivate champions as described by the teacher at school 4, "*There is an SMC member named [] who is the vice president of the SMC. He is very active in sanitation and hygiene issues. He placed first among the whole upuzilla and zilla for the activity"*. On the other hand, teacher transfer may remove

champions from a school that is relying on them for continued activities, as students from school 3 explain: *"When we were in grade 4 we had a teacher named [] but he transferred to another school. Since then no one talks to us about handwashing"* (focus group, girls, school 3).

To an extent, the field officers are all acting as champions, and though active field officers can be a positive influence, caution may be needed to discourage schools from relying on them, such as in school 2 where their leadership is reported as the main reason for well-managed services. Field officers that are seen as the school's champion, though well-intended and possibly benefiting the school in the short-term, may actually hinder long-term sustainability if the focus on sanitation and hygiene departs with them, either when they leave for the day or at the end of the Save the Children program: *"if teachers believe in hygiene and act accordingly, it will work, but if they only do things when the field officer comes, it won't"* (field officer, school 11). There is a tendency for some field officers to want to be seen as a champion, as one field officer explains *"it's really the field officers work and the field officer should have the credit"*. Though normally very positive, this aspiration may hinder the continuation of activities after the field officer departs if sanitation leadership is not transferred to the teachers and SMC, as expressed by another field officer, *"I will not be here long term but if somehow I can manage the SMC to get involved with the program, it will run for a longer time"*. The fact that *Shishuder Jonno* is a long-term program (10 years, 2008-2018) has the potential to greatly influence sustainability as it allows for gradual transition of responsibilities, and encouraging and incentivizing field officers to help schools gradually take independent responsibility for their sanitation services may increase their long-term effectiveness. Acting as a temporary champion, the field officer can pass along knowledge and motivation to maintain services, as seen at school 19 where the teacher

says *"We have many things to learn from [the field officer]. He can explain everything in a very simple and easy way";* eventually relinquishing their role to the teachers and SMC as in school 4 where the field officer reports, *"I only have to look and see, but it is really the teachers and the SMC who do it all"*.

Study limitations

Conditions that were constant among the case schools and hence excluded from the analysis should be considered when evaluating the generalizability of findings. These include, but are not limited to, the national policy environment in Bangladesh, local involvement in planning and construction, the technology type installed (pour-flush toilets to septic tank), the presence of external monitoring by field officers multiple times per week, weekly hygiene classes including information on proper toilet use and handwashing with soap which all student focus groups could recall, and 98% of intervention cost funded by an NGO, with the government of Bangladesh covering the remaining 2% (Save the Children, 2012). Additionally, three conditions were excluded due to limited variation: vandalism, water scarcity, and Little Doctor activity. However, the exclusion of these conditions does not appear to impact results. The schools with vandalism (schools 1 and 17), water scarcity issues (schools 3, 10, and 17), and less active Little Doctors (schools 1 and 17) had numerous other low scoring conditions and none of these schools can be explained by any of the three pathways to well-managed services identified. The other conditions present (or absent) are also in line with other schools with poorly-managed sanitation services and it is unlikely that removing the vandalism or water scarcity issues alone would result in well-managed sanitation services at these schools. However, these challenges may deserve further attention as they have the potential to hinder improvement in other areas if not addressed.

A further limitation is that data were collected from one point in time and the condition of facilities on the day of the research visit may be atypical. However we attempted to capture any deviation through student focus group discussions and teacher interviews, which provided a longitudinal perspective through answering questions regarding past downtimes in service provision and average cleanliness.

CONCLUSION

Based on empirical evidence from 16 case schools in Meherpur, Bangladesh, fsQCA identifies financial access as “necessary”, or very common, among schools with toilets that are reliably functioning and clean with soap and water available. Though important, financial access alone is insufficient for well-managed sanitation services and three sufficient pathways are presented including conditions that motivate action. The two schools explained by the third pathway are RNGPS, where teachers are known to be highly motivated due to the low job security in non-government schools, and the sufficiency of this pathway is unlikely as all school nationalize in 2013. School 8 is in a particularly delicate situation as they lack the “necessary” condition of adequate funding from the government or community and their resilience to larger and more expensive repair needs over time may be questionable. The other pathways, which explain both GPS and RNGPS, provide two options for promoting well-managed school sanitation and hygiene, which can be weighed based on local context: if the school does not currently have government SLIP funding, efforts should focus on cultivating the conditions in pathway 1, specifically, securing community support and promoting a champion. Vice-versa, if the community will not financially support maintenance and there is no reliable champion, pathway

2 may be more effective, indicating the need for government SLIP funding, an active SMC and a maintenance plan with one teacher held accountable, in these schools.

Comparison of the results from Bangladesh to those of Belize highlights the need for community support and the reliance on champions in the absence of government support. Results presented in this study, where government support varied between schools, expand upon this finding to suggest that schools with government support still require a source of motivation to maintain services, such as an active SMC or a maintenance plan. These findings may have broader implications for school sanitation in other low-income countries, and institutionalizing structures that foster the conditions identified in the pathways to well-managed services could scale these lessons to a national level and may have broader implications at a global level.

CHAPTER 8

CONCLUSION - ROADMAP TO WELL-MANAGED SCHOOL SANITATION: FUZZY-SET QUALITATIVE COMPARATIVE ANALYSIS OF MULTI-COUNTRY DATA

ABSTRACT

This multi-country cross-case fuzzy-set qualitative comparative analysis aims to provide more generalizable results by combining data from case schools in Peru, Belize and Bangladesh. Analysis reveals two sufficient pathways to well-maintained school sanitation, both of which include high quality construction and local involvement in planning and construction. The first pathway combines these conditions with the presence of a local champion and the second with financial support from the government and community. Additionally, three pathways to poorly maintained services are identified. All sufficient pathways to poorly maintained services include the absence of financial support from either the government, community, or both, indicating the significance of reliable financial access to on-going maintenance and the negative impact that the absence of support for recurrent costs can have on capital investment. The potential implications of findings on policy and programming are discussed as well as the theoretical contribution of the research method and results.

INTRODUCTION

This final chapter summarizes findings from Peru, Belize and Bangladesh, including a cross-case fuzzy-set qualitative comparative analysis (fsQCA) of schools from all three locations. These findings may have broader implications for school sanitation in other low-income countries,

SUMMARY OF FINDINGS FROM PERU

The rural Peruvian Amazon presents a very challenging setting for sustaining school water, sanitation and hygiene (WASH) services. The small rural communities are dispersed throughout the jungle and river transport can be slow and expensive making it difficult for government officials to regularly monitor school activity and for communities to procure repair parts and services to maintain WASH infrastructure. Additionally, there is an urban misperception that rural villages don't require water and sanitation services with the rationale that they can collect water from the river and relieve themselves in the jungle. This results in the majority of rural Loreto schools being constructed without WASH services despite Peruvian national standards requiring that all primary schools have one toilet for every 50 boys, one toilet for every 30 girls, and one sink for every 30 students. Construction of schools without these services leaves students with an exiguous understanding of the importance of sanitation and results in schools operating without services until parents, an NGO or the government intervenes. Unfortunately, the majority of post-construction sanitation interventions in rural Loreto are of poor quality and the fact that these additions were an afterthought often shows in the construction and maintenance.

Five of the seven school toilets visited were in a poor state, including two schools where the pits were full and students had no access to sanitation without leaving school. Maintenance needs included missing or broken doors/walls, unbearable odor, and/or filthy conditions including feces on the floor and seat. Further, none of the schools provided soap and water for students to practice handwashing; a potential health hazard for children as schools can be a breeding ground for illness (Greene, et al., 2012; Koopman, 1978). Unfortunately, despite poor school WASH

conditions, student, teacher and mothers' priorities do not reflect a desire to improve this situation despite knowledge that WASH services, in particular handwashing, have an impact on health. A likely reason for the low prioritization of WASH in schools is that school is rarely in session due to extremely high rates of teacher absenteeism, trivializing potential impacts of school WASH intervention. Barriers including the construction of schools without WASH services, teacher absenteeism, low prioritization of school WASH, and inadequate budget for school WASH construction and maintenance will likely need to be addressed prior to or in parallel with successful sanitation intervention.

SUMMARY OF FINDINGS FROM BELIZE

In a study of 15 case schools in southern Belize, crisp-set Qualitative Comparative Analysis (csQCA) revealed that local involvement in planning and implementation is *necessary* for continued maintenance of school toilets years after school WASH program completion, specifically that school staff and parents felt respected and part of the decision process. Though necessary, local participation upfront is not sufficient for sustainable infrastructure and must be combined with other conditions in one of five identified pathways. Quality construction and the presence of a local WASH champion are each present in four of the five solution pathways. Review of the pathways suggests that if there is no local champion at the school, the construction and materials used must be of high quality for the school to be able to maintain services in addition to their other educational tasks. In half of the schools whose facilities were broken down, there was no community support for O&M and/or there were challenges with vandalism, though local involvement in planning may help to address these concerns in the process by increasing local ownership. The familiarity of the toilet technology implemented had the smallest

influence and was found in only two of the five pathways to well-maintained school toilets, while unfamiliar technology was found in only one of the pathways to breakdown. This does not mean that technology choice is unimportant, but suggests that the quality of the infrastructure and social factors such as local involvement may have a stronger influence than the specific technology selected. To reach scale and effectively improve the continued maintenance of school WASH, these findings need to influence policy and programming in Belize and recommendations based on local perspectives were discussed.

SUMMARY OF FINDINGS FROM BANGLADESH

In Meherpur, Bangaldesh, 16 case schools were evaluated post-intervention of a Save the Children school WASH program. Based on empirical evidence, fuzzy-set Qualitative Comparative Analysis (fsQCA) identified financial access (from either the community or government) as "necessary", or very common, among schools with toilets that are reliably functioning and clean with soap and water available. Though necessary, financial access alone is insufficient and three sufficient pathways of condition combinations are identified. Surprisingly, the absence of government support is found in two of the three pathways to sustained services. We hypothesize two reasons behind this: (1) that Registered Non-Government Primary School (RNGPS) teachers are often more motivated as they are trying to demonstrate the quality of the school to hopefully be recognized as a Government Primary School (GPS), and (2) that the current funding structure for school maintenance which grants maintenance funding in unpredictable intervals may lead to long down times while waiting for support. Quality construction and the presence of a maintenance plan, specifically that there is one teacher responsible for sanitation and hygiene who monitors adherence to a cleaning schedule, is also

common among the schools with well-managed services. Based on these results and insights from students, teachers and Save the Children field staff, recommendations for institutionalizing findings were provided for further consideration.

MULTI-COUNTRY CROSS-CASE ANALYSIS

Case selection

In order to develop a more generalizable "roadmap" to sustainable school sanitation, results from all three locations are combined in a multi-country cross-case comparative analysis using fsQCA. Schools that met the following criteria were included in the analysis: (1) toilet infrastructure is at least two years old or has had a breakdown or repair need since construction, and (2) there is someone available who can answer questions about the toilet construction process. All 15 case schools from Belize and all 16 case schools from Bangladesh meet these criteria, while only three schools in Peru had someone available who could answer questions about the toilet construction process. In total, 34 case schools were included in the analysis.

Condition selection

An abundance of causal conditions in the analysis, termed *limited diversity* in QCA notation, can lead to a description of each individual case as opposed to a generalizable explanation based on cross-case analysis. In order to reduce the number of causal conditions included in the analysis, a combination of the *significance* and *second look* approaches were employed drawing from the six strategies recommended in QCA literature (Amenta & Poulsen, 1994; Yamasaki & Rihoux, 2009). Using the significance approach, conditions are selected based on statistical significance, while the second look approach allows the researcher to add one or several conditions that are

considered important although dismissed in previous analysis. Using this reduction logic, conditions were selected in two stages: (1) conditions were selected based on statistical association ($p < 0.05$) with the outcome based on ordinal data from all three locations; (2) conditions that did not meet the statistical significance criteria were reevaluated for inclusion based on theory and empirical data. Four conditions met the statistical significance criteria: quality construction, community support for maintenance, the presence of a WASH champion, and local involvement in planning and construction. One additional condition was included, government support for maintenance, based on theory that financial support for on-going maintenance is crucial (IRC, 2007; Nagpal, 2010; Saboori, et al., 2011) and case data from Bangladesh where schools without government support may have other motivating factors and analysis of collective influences may provide further insight.

Operationalizing the outcome and conditions

The coding scheme used to operationalize the outcome and causal conditions into ordinal values is presented in Table 28. Definitions are similar to those used in Chapters six and seven with the following adaptations: (1) ordinal coding for all conditions as opposed to the binomial structure used for csQCA in the Belize study; (2) descriptions are broadened to permit coding of schools in different contexts (e.g. School Management Committee (SMC) and Parent Teacher Association (PTA) are considered analogous); and (3) the local involvement and government support conditions were redefined to promote greater variation between cases in order to meet the recommended 30% variation between cases (Rihoux & De Meur, 2009 p. 45). The outcome measure includes the presence of soap and water for handwashing as was included in the Bangladesh study. Belize outcome scores were adjusted to reflect this addition.

Table 28. Coding scheme used for outcome and causal conditions

Condition	fsQCA coding scheme	Source
OUTCOME Well-managed sanitation services	Minimum of the following two measures: *Functional toilets*[a]*:* 1: students have reliable access to functional services 0.67: all toilets usually function, but repair needs are not always efficiently addressed 0.33: some toilets are frequently unusable; repairs are not timely addressed 0: students do not have reliable access; repairs are rarely addressed, if at all and *Reliably clean toilets*[b]*:* 1: all toilets are clean and quickly cleaned when dirty 0.67: usually more or less clean, with some instances where they remain dirty 0.33: frequently unclean with visible urine, dirt and terrible smell 0: rarely clean with visible feces present	Students Observation Teachers
Quality construction	1: high quality; no repair needs due to poor quality construction 0.67: mostly high quality, but minor repair needs due to poor quality construction 0.33: not high quality, but so far repair needs have been caused by something else 0: poor quality; have had major repair needs because of poor quality construction	Teachers Field officer Observation
Community support	1: community has contributed financially to toilet O&M when needed 0.67: community contributes in-kind to maintenance when needed or financially but not every time the school requests help 0.33: community members provide limited support, such as providing a few bars of soap 0: community does not contribute financially or in-kind to O&M of the toilets	Teachers Field officer
Government support	1: the school has government funding for salaries in addition to a small operations fund (i.e. contingency fund in Bangladesh) and a maintenance fund (i.e. SLIP fund in Bangladesh) (e.g. GPS with SLIP funding) 0.67: the school has government funding for salaries and some funds that could cover small toilet maintenance needs (e.g. GPS); or they do not receive funding for salaries but they do get money for maintenance (eg. RNGPS with SLIP funding) 0.33: the school has government funding for salaries, but no operations or maintenance funding (e.g. all schools in Belize); or the school does not receive money for salaries but they do receive funding for maintenance. (e.g. RNGPS with contingency funding) 0: the school does not receive any government funding	Teachers Field officer
WASH champion	1: someone voluntarily takes extraordinary interest in school sanitation & is recognized by others (without whom hygiene activities would likely diminish or discontinue) 0.67: someone leads sanitation activities but doesn't include all aspects of maintenance and hygiene practices or there are others identified who may continue their role 0.33: someone takes interest in sanitation at the school, but they don't always take action or there are others who would likely continue their role in their absence 0: There is no one identified as taking interest in sanitation at the school	Teachers Students Field officer Observation
Local involvement	1: the school and PTA/SMC/community were involved in planning and construction, including monitoring construction, their input was incorporated, and they felt respected 0.67: the school or PTA/SMC/community was involved in both planning and construction, or both parties were involved but to a limited extent (e.g. attended meetings or chose the location, but didn't regularly monitor construction 0.33: the school or PTA/SMC/community was involved but not in both planning and construction; or in both but to a limited extent (e.g. attended meetings, not all input was incorporated) 0: Neither the school or PTA/SMC/community was involved to any extent or their input was ignored and they felt disrespected	Principal Teachers

[a] "Functional" = waste is easily flushed with water, the building structure, doors & locks are in working condition providing privacy, water is available for flushing and anal cleansing, and soap is available in or near the toilet
"Reliable" = minor critical repairs (needed for use) such as a door lock or clogged toilet are repaired within 24 hours, major critical repairs such as a broken pan or door are repaired within 1 week, minor non-critical repairs (not necessary for use) such as a broken tap are repaired within 1 week, and major non-critical repairs such as a broken water pump are repaired within 1 month
[b] "Clean" = no visible feces on the floor/walls/seat, no flies, and no foul smell

The redefined coding for local involvement and government support resulted in lower scores for local involvement in Belize cases based on the greater involvement reported in Bangladesh comparatively, and an increase in government support scores from 0.33 to 0.67 for schools in Bangladesh that received government funding for teacher salaries as well as a small operations budget (i.e. contingency fund) (Table 29). All Belize schools are coded as 0.33 for government support based on Belize education policy which states that "Government funding covers 100% of teacher salaries... Schools are, however, responsible for the non-funded proportion as well as all operation and maintenance costs. User fees are thus essential for the operation of the school system and schools are able to charge the fees that they consider to be justified" (Ministry of Education Belize, 2012). School fees in case schools ranged from BZ$0 to BZ$15 (7.50 USD) and most schools need to fundraise to local businesses and the community.

Table 29. Data matrix for causal conditions of school sanitation in Peru, Belize and Bangladesh

School	Quality construction	Community support	Government support	Champion	Local involvement	Outcome
BZ1	1	0	0.33	1	0.33	1
BZ5	1	1	0.33	1	0.67	1
BG18	0.33	1	0.33	0.67	1	1
BG19	1	1	1	0.33	1	1
BZ2	1	0.67	0.33	0	0.33	0.67
BZ3	0	0.67	0.33	1	0.33	0.67
BZ4	1	1	0.33	1	0.33	0.67
BZ6	1	1	0.33	1	0.67	0.67
BZ7	1	0	0.33	1	0.67	0.67
BZ8	1	0	0.33	1	0.67	0.67
BG2	0.67	1	0	0.67	1	0.67
BG4	1	0.67	0.33	0.67	1	0.67
BG8	0.33	0	0.33	1	0.33	0.67
BG10	1	0.33	0.67	0.33	1	0.67
BG14	0.67	1	0.67	1	1	0.67
BZ10	0	0	0.33	1	0	0.33
BZ13	0	0.67	0.33	0	0	0.33
BZ15	0	0.67	0.33	0	0	0.33
BG12	1	0.67	1	0	1	0.33
BG13	1	0	0.67	0.33	0.33	0.33
BG15	1	0	0	0.67	1	0.33
BG16	0.33	0.33	0	0.33	1	0.33
BG20	1	0	0.67	0	1	0.33
PE2	0.33	0.67	0	0	0	0.33
BZ9	0	0	0.33	0	0	0
BZ11	0	0	0.33	0	0	0
BZ12	0	0	0.33	0	0.67	0
BZ14	0	0	0.33	1	0	0
BG1	0	0	1	0	1	0
BG3	1	0	1	0	1	0
BG6	0	0	0.67	0	1	0
BG17	0.67	0.33	0.33	0	0.67	0
PE1	0	0.67	0	0.33	1	0
PE3	0	0.67	0	0	0.67	0

Analysis

Truth table analysis was conducted on the calibrated outcome and causal conditions using fs/QCA 2.5 software. Only configurations of causal conditions represented by at least two empirical cases were included in the analysis. The increased frequency threshold from one case

in the studies presented in Chapters six and seven, to two empirical cases is because (1) there are a greater number of total cases included in the analysis (34 compared to up to 16) and configurations represented by one case only represent 2.9% of empirical evidence and may be less relevant; and (2) an interest in more coarse-grained results that may increase the generalizability of findings. These reasons are based on recommendations in QCA literature (Ragin, 2009 pp. 106-107). Following removal of configurations not represented by at least two cases, the degree to which the remaining configurations are a subset of the outcome is assessed to determine if the outcome is present or absent for each configuration. A consistency cut-off of 0.78 for the analysis of well-maintained sanitation and 0.82 for the analysis of poorly maintained sanitation. Although QCA literature recommends a minimum consistency threshold of 0.8, 0.78 is used in the first analysis based on further discussion in the literature which describes this cut-off threshold as a loose recommendation and suggests using a lower value if there is a substantial gap between a consistency score slightly below 0.8 and the next lowest score (Ragin, 2009 pp. 108-109).

RESULTS & DISCUSSION

Of the 34 case schools analyzed, 15 were coded as having well-managed sanitation services (a score of greater than 0.5) and 19 were coded as poorly managed (a score of less than 0.5). The pathways, or combinations of causal conditions, to produce each outcome are presented in Figure 16 and Figure 17 where the lines between causal conditions represent a pathway. Each pathway is considered sufficient to produce the outcome, where the necessary conditions are likely needed to produce the outcome, but insufficient on their own (Berg-Schlosser et al., 2009; Jordan, Gross, Javernick-Will, & Garvin, 2011). In QCA nomenclature, necessity and sufficiency are calculated

through *consistency* measures, which evaluate the frequency with which conditions are present when the desired outcome is achieved. Conditions with a consistency score of 0.9 or higher are considered "necessary" or very common, while combinations of conditions with a consistency score of at least 0.8 are considered sufficient (Ragin 2008). To avoid confusion between the consistency measure of necessary conditions and sufficient causal recipes, we use the term "necessity score" when referring to the consistency measure for necessity. A second measure of "goodness-of-fit" used in QCA is *coverage* which indicates how well the necessary and sufficient conditions are represented by the empirical cases (Rihoux & De Meur, 2009).

Pathways to well-managed school sanitation services

Two sufficient causal pathways to well-managed school sanitation services are identified, both of which include quality construction and local involvement (Figure 16). The first pathway combines these conditions with the presence of a WASH champion, while the second pathway combines them with financial support for maintenance from the government and the community. The combination of both government and community support suggests the positive impact that a combined top-down, bottom-up approach can have on the continued maintenance of school WASH services without the tenuous reliance on a local WASH champion. The solution coverage is 0.63 meaning that 63% of the summed outcome scores are represented by these pathways. The solution consistency is 0.90 meaning that the solution pathways presented are 90% consistent in producing the outcome of well-managed school sanitation based on the empirical cases.

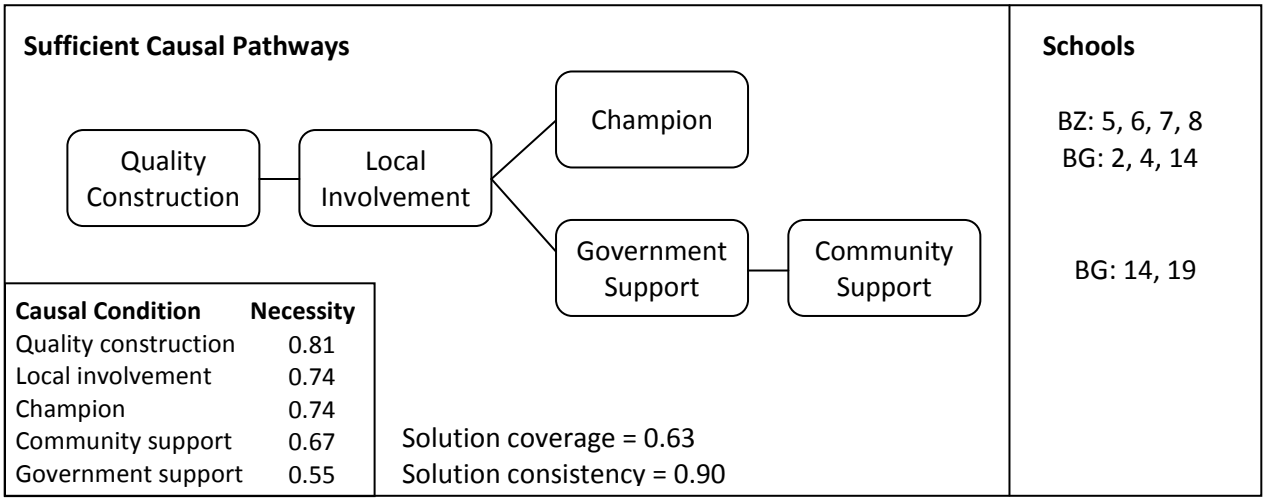


Figure 16. Pathways to well-managed school sanitation
(intermediate solution, frequency threshold = 2, consistency threshold = 0.78)

Pathways to poorly managed school sanitation services

Analysis of poorly managed school sanitation uncovers three sufficient pathways: (1) low community support and the absence of a local champion; (2) low community and government support, no local involvement and poor quality construction; and (3) low government support combined with poor quality construction and the absence of a local champion (Figure 17). These pathways represent 83% of the summed outcome scores and are 92% consistent in producing the outcome of poorly managed sanitation.

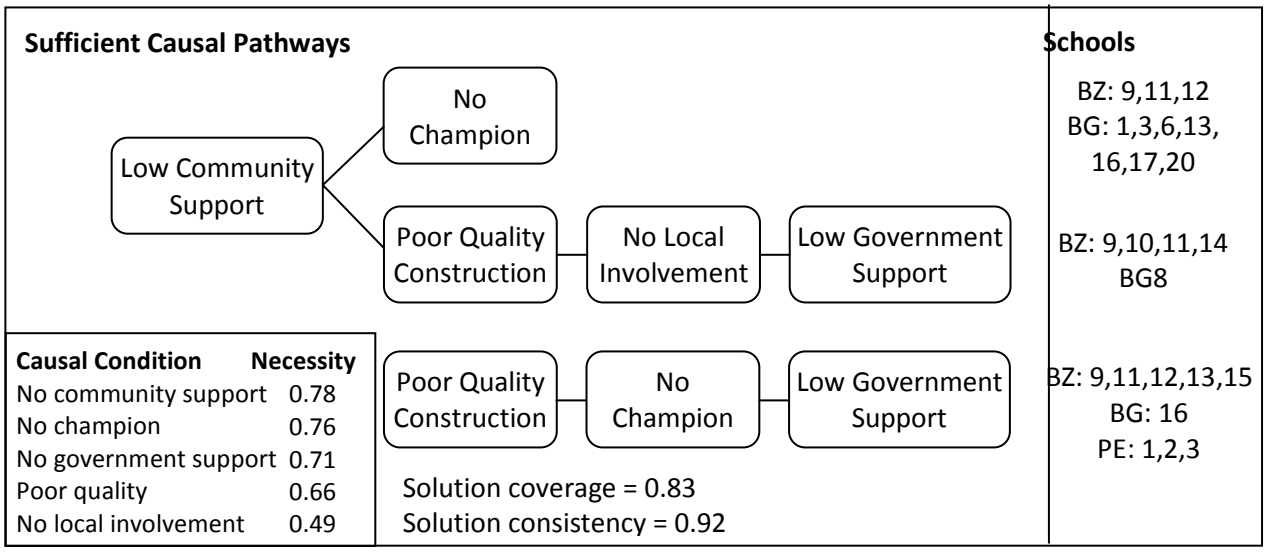


Figure 17. Pathways to poorly managed school sanitation
(intermediate solution, frequency threshold = 2, consistency threshold = 0.85)

IMPLICATIONS OF FINDINGS

Case data from Peru, Belize and Bangladesh provide empirical evidence for the importance of quality construction, local involvement in planning and construction, and on-going financial support for school WASH. The positive influence that local WASH champions can have is also elucidated in a second pathway. Findings offer tangible decision-making support by providing evidence of key policy and programming strategies that are necessary and sufficient for well-managed school WASH over time. This information can be used by government, NGO, community and school-level authorities to improve their current WASH services or plan future programming. Beyond the implications for improving WASH in schools, this research provides an example of using the QCA approach as a small-N tool in WASH research and sustainability analysis. Potential widespread implications of findings are discussed subsequently.

Local champions have been anecdotally discussed in the WASH sector as a common causal condition of reliable service provision, though limited evidence has been published. These findings provide evidence for the positive impact that champions can make on the continued provision of WASH services and discusses local insights into how to promote champions, including limiting teacher transfer, hiring local teachers or placing teachers in their home community when possible, and incentivizing continued maintenance through service provision that teachers consider beneficial (as found in Belize) or through external monitoring or inter-school competitions or sharing as seen in Bangladesh where teacher visits to another school inspired them and the community to improve their own school and regular visits from Save the Children field officers encourage continued activity.

Without the presence of a champion, case data shows that government and community financial support for maintenance are needed. This indicates the importance of a combined top-down (government funding) and bottom-up (community funding) approach to promote on-going maintenance. In response, encouraging community involvement and fiscal support through requiring financial contribution to construction or fiscal management of construction funds by the PTA/SMC may help improve ownership and understanding of fiscal responsibilities of the intervention (Breslin, et al., 2009; Marks & Davis, 2012). Additionally, community support for operation and maintenance of school WASH services could be institutionalized by clearly defining responsibilities of the government and the community (considering financial capacities) in national policy and guidelines. Considering the low income level of many communities, increased government spending is likely needed to improve the sustainability and hence impact of school WASH, both to ensure quality construction as well as provide adequate on-going

maintenance support to schools. Increased government investment in WASH in schools which also addresses the findings to incorporate this with community support and ensuring quality construction may have a substantial pay back considering the high cost of premature infrastructure breakdown and the decreased or even negative impacts on health and education that can result from unreliable or inadequate service provision caused by frequently broken down or unhygienic facilities. A discussion of these potential costs follows.

Based on a recent cost analysis, the cost of pour-flush latrine construction in schools in Meherpur, Bangladesh is $27.08/child including overhead costs of $0.06 (Save the Children, 2012). The cost of latrine maintenance is estimated at $0.24/child/year and sanitation awareness raising activities are $0.01/child/year. Assuming a 10 year latrine lifetime and a 5% discount rate, this is an annualized cost of $3.97/child/year. However, the cost increases exponentially if the service lifetime decreases due to poor maintenance. With over 17 million primary school children in Bangladesh, the increased annualized cost of premature breakdown of school WASH facilities can have a substantial impact on the national budget. The alternative to increased spending due to premature breakdown is that students don't have access to WASH services for the remainder of the expected service lifetime, and potential health and attendance impacts will not be realized without access to the facilities needed for the behavior changes that lead to improved health. Further, even if facilities last their expected lifetime, if services are unreliable, unhygienic or unacceptable to students, impacts of WASH investments are unlikely or may even have a negative effect (Greene, et al., 2012; Hunter, 2009). The cost of inadequate WASH access can be substantial and the World Bank estimates an annual loss of 6.3% of the Bangladesh GDP due to poor sanitation, with health-related losses as the largest hindrance to economic growth

(WSP, 2012). The World Health Organization also highlights the financial benefits of improved sanitation and estimates that for every $1 spent on sanitation, $5.50 is returned in economic returns through increased productivity (Hutton, 2012). For the study locations included in this dissertation specifically, the benefit-cost ratio is calculated as 5.84 for Peru, 5.65 for Belize and 2.17 for Bangladesh. Benefits include reduction in diarrhea including diarrheal associated deaths and indirect adverse health impacts such as malnutrition, time saved from the proximity of improved WASH services and economic savings from seeking less health care, reduced losses of productive time due to disease and to reduction in premature mortality.

It is every child's right to a quality education that includes WASH facilities that are reliably functioning and hygienic. Though this rationale should be sufficient for WASH in schools intervention, resource limitations may call for further evidence of the need to invest in school WASH maintenance. It is hoped that findings from this dissertation will support funding allocations and accountability structures that include capital costs for quality construction that encourages local participation, as well as recurrent costs for WASH in schools maintenance based on empirical evidence of the necessity of these conditions for reliable service provision and the associated economic and social impacts. In parallel, and a potential result of increased investment in WASH in schools, champions should be encouraged and recognized at the school/community and district and national level.

REFERENCES

Abraham, B., Fogde, M., Von Muench, E., & Wendland, C. (2011). *Sustainable sanitation for schools*: Sustainable Sanitation Alliance.

Adams, J., Bartram, J., Chartier, Y., & Sims, J. (2009). *Water, Sanitation and Hygiene Standards for Schools in Low-cost Settings*. Geneva.

Albonico, M., Engels, D., & Savioli, L. (2004). Monitoring drug efficacy and early detection of drug resistance in human soil-transmitted nematodes: a pressing public health agenda for helminth control. *International Journal for Parasitology 34*, 1205-1210.

Amenta, E., & Poulsen, J. D. (1994). Where to begin: a survey of five approaches to selecting independent measures for qualitative comparative analysis. *Sociology Methods Research, 23*(1), 22-53.

Bar-David, Y., Urkin, J., & Kozminsky, E. (2005). The effect of voluntary dehydration on cognitive functions of elementary school children. *Acta Pædiatrica, 94*(11), 1667-1673.

Basurto, X. & Speer, J. (2012). Structuring the calibration of qualitative data as sets for qualitative comparative analysis (QCA). *Field Methods, 24*(2), 155-174.

Berg-Schlosser, D., & De Meur, G. (2009). Comparative research design: case and variable selection. In B. Rihoux & C. C. Ragin (Eds.), *Configurational comparative methods: qualitative comparative analysis (QCA) and related techniques* (pp. 19-32). Thousand Oaks, CA: SAGE Publications.

Berg-Schlosser, D., Meur, G. D., Rihoux, B., & Ragin, C. C. (2009). Qualitative Comparative Analysis (QCA) as an Approach. In B. Rihoux & C. C. Ragin (Eds.), *Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques*. Thousand Oaks, CA: Sage Publications.

Betancourt, D., Callejas, R., Contreras, A., Duey, M., Fernandez, M., Hicks, P., et al. (2010). *Alianza Regional para el Mejoramiento de las Condiciones de WASH en Escuelas*. Paper presented at the Seminario de Intercambio de Experiencias sobre Gobernanza de Servicios de Saneamiento Sostenibles, Centroamerica, San Salvador.

Bethony, J., Brooker, S., Albonico, M., Geiger, S. M., Loukas, A., Diemert, D., et al. (2006). Soil-transmitted helminth infections: ascariasis, trichuriasis, and hookworm. *Lancet, 367*, pp. 1521-1532.

Bethony, J., Brooker, S., Albonico, M., Geiger, S. M., Loukas, A., Diemert, D., et al. (2006). Soil-transmitted helminth infections: ascariasis, trichuriasis, and hookworm. *Lancet, 367*, 1521-1532.

Bhutta, Z. A., Ahmed, T., Black, R. E., Cousens, S., Dewey, K., Giugliani, E., et al. (2008). What works? Interventions for maternal and child undernutrition and survival. *The Lancet, 371*(9610), 417-440.

Blackman, T., Wistow, J., & Byrne, D. (2011). A qualitative comparative analysis of factors associated with trends in narrowing health inequalities in England. *Social Science & Medicine, 72*(12), 1965-1974.

Bleakley, H. (2007). Disease and Development: Evidence from Hookworm Eradication in the American South*. *Quarterly Journal of Economics, 122*(1), 73-117.

Blum, D., & Feachem, R. G. (1983). Measuring the Impact of Water Supply and Sanitation Investments on Diarrhoeal Diseases: Problems of Methodology. *International Journal of Epidemiology, 12*(3), 357-365.

Bolt, E., Shordt, K., & Krukkert, I. . (2006). *School Sanitation and Hygiene Education Results from the Assessment of a 6-Country Pilot Project*. New York and Delft.

Boudet, H. S., Jayasundera, D. C., & Davis, J. (2011). Drivers of conflict in developing country infrastructure projects: experience from the water and pipeline sectors. *Journal of Construction Engineering and Management, 137*(7), 498-511.

Bowen, A., Ma, H., Ou, J., Billhimer, W., Long, T., Mintz, E., et al. (2007). A Cluster-Randomized Controlled Trial Evaluating the Effect of a Handwashing-Promotion Program in Chinese Primary Schools. *American Journal of Tropical Medicine and Hygiene, 76*(6), 1166-1173.

Breslin, N., Mukherjee, R., & Duey, M. (2009). Gender & Water: Rethinking Women, Girls and Water Supply and Sanitation. *Water and WasteWater International, 24,* 36-39.

Burgers, L. (2000). *Background and Rationale for School Sanitation and Hygiene Education*. New York.

Cairncross, S. (1990). Health Impacts in Developing Countries - New Evidence and New Prospects. *Journal of the Institution of Water and Environmental Management, 4*(6), 571-577.

Cairncross, S., Hunt, C., Boisson, S., Bostoen, K., Curtis, V., & Fung, I. C. (2010). Water, sanitation and hygiene for the prevention of diarrhoea. *International Journal of Epidemiology, 39*, 193-205.

Cairncross, S., & Shordt, K. (2004). It does last! Some findings from a multi-country study of hygiene sustainability. *Waterlines, 22*, 4-7.

Calderon, J. (2004). *Agua y Saneamiento: El Caso del Peru Rural*: ITDG Oficina Regional para America Latina.

Carter, R. C., & Rwamwanja, R. (2006). *Functional sustainability in community water and sanitation: A case study from South-West Uganda*: Diocese of Kigezi, Cranfield University and Tearfund.

Carter, R. C., Tyrrel, S. F. and Howsam, P. (1999). Impact and Sustainability of Community Water Supply and Sanitation Programmes in Developing Countries *Journal of the Chartered Institution of Water and Environmental Management, 13*, 292-296.

CDC. (2007). *Healthy youth: an investment in our nation's future*. Atlanta, GA: U.S. department of health and human services, CDC, coordinating center for health promotion.

ÇelİksÖz, A., Aciöz, M., DeĞerlİ, S., Çinar, Z., Elaldi, N., & Erandaç, M. (2005). Effects of giardiasis on school success, weight and height indices of primary school children in Turkey. *Pediatrics International, 47*(5), 567-571.

Chatterley, C. (2011). *National Assessment of WASH in Schools - Belize: Analysis of 2009 survey data to assess water, sanitation and hygiene in Belizean schools*. Belize City: Ministry of Education and UNICEF Belize.

Chatterley, C., Gray, D., & Leslie, J. (2010). *School Water, Sanitation, and Hygiene Plus Community Impact (SWASH+) – Central America: 2009 Schools Mapping/Monitoring Report*.

Chatterley, C., Linden, K. G., & Javernick-Will, A. (2012). Identifying drivers of sustainable school sanitation in Belize. *Journal of Water, Sanitation and Hygiene for Development.* In-press.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.): New Jersey: Lawrence Erlbaum

Cotlear, D., & Kudo, I. (2007). *What can a Regional Governmet do to Improve Education? The Case of Junin Region, Peru*.

Curtis, V., Kanki, B., Cousens, S., Diallo, I., Kpozehouen, A., Sangare, M., & Nikiema, M. (2001). Evidence of behaviour change following a hygiene promotion programme in Burkina Faso. *Bulletin of the World Health Organization, 79*(6), 518-527.

Curtis, V., Schmidt, W., Luby, S., Florez, R., Toure, O., & Biran, A. (2011). Hygiene: new hopes, new horizons. *Lancet Infectious Diseases, 11*, 312-321.

de Clercq, D., Sacko, M., Behnke, J., Gilbert, F., & Vercruysse, J. (1998). The relationship between Schistosoma haematobium infection and school performance and attendance in Bamako, Mali. *Annals of Tropical Medicine and Parasitology, 92*(8), 851-858.

Devnarain, B., & Matthias, C. R. (2011). Poor access to water and sanitation: consequences for girls at a rural school. *Agenda: Empowering women for gender equality, 25*(2), 27-34.

deWilde, C. K., Milman, A., Flores, Y., Salmerón, J., & Ray, I. (2008). An integrated method for evaluating community-based safe water programmes and an application in rural Mexico. *Health Policy Plan, 23*(6), 452-464.

DFID. (1998). *DFID Guidance Manual on Water Supply and Sanitation Programmes*. London: Department for International Development (DFID).

Dreibelbis, R., Greene, L. E., Freeman, M. C., Saboori, S., Chase, R. P., & Rheingans, R. (2012). Water, sanitation, and primary school attendance: A multi-level assessment of determinants of household-reported absence in Kenya. *International Journal of Educational Development*.

Edwards, P. (2006). *Learning lessons on sustainability in Bangladesh*. The Hague Netherlands: IRC International Water and Sanitation Centre.

Enedu, S. (2007). *Baseline Assessment of the Water, Sanitation and Hygiene Situation of Primary Schools in the Stann Creek and Toledo Districts of Belize*: Ministry of Education Belize.

Fincham, J. E., Markus, M. B., & Adams, V. J. (2003). Could control of soil-transmitted helminthic infection influence the HIV/AIDS pandemic. *Acta Tropica, 86*(2-3), 315-333.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry, 12*(2), 219-245.

Freeman, M. C., & Clasen, T. (2011). Assessing the Impact of a School-based Safe Water Intervention on Household Adoption of Point-of-Use Water Treatment Practices in Southern India. *American Journal of Tropical Medicine and Hygiene, 84*(3), 370-378.

Freeman, M. C., Clasen, T., Brooker, S., Akoko, D., & Rheingans, R. (2012). The impact of a school-based hygiene, water quality and sanitation intervention on soil-transmitted helminth reinfection: a cluster-randomized trial. Manuscript submitted for publication.

Freeman, M. C., Greene, L. E., Dreibelbis, R., Saboori, S., Muga, R., Brumback, B., et al. (2011). Assessing the impact of a school-based water treatment, hygiene and sanitation programme on pupil absence in Nyanza Province, Kenya: a cluster: randomized trial. *Tropical Medicine & International Health*.

García, M., Pérez, H., Valencia, A., Aponte, A., & Alvarez, J. C. . (2006). *Evaluación del Programa de Saneamiento Escolar y Educación en Higiene Departamento del Cauca, Colombia, 2005*.

Glaesser, J., & Cooper, B. (2011). Selecting cases for in-depth study from a survey dataset: an application of Ragin's configurational methods. *Methodological Innovations Online, 6*(2), 52-70.

Greene, L., Freeman, M. C., Akoko, D., Saboori, S., Moe, C., & Rheingans, R. (2012). Impact of a school-based hygiene promotion and sanitation intervention on pupil hand contamination in Western Kenya: a cluster randomized trial. *American Journal of Tropical Medicine and Hygiene, 87*(3), 385-393.

Guevarra, A. (2008). *Unidad de Saneamiento Basico*. Iquitos: Presentation from DIRESA-DESA Loreto.

Guinan, M., McGuckin, M., & Ali, Y. (2002). The effect of a comprehensive handwashing program on absenteeism in elementary schools. *American Journal of Infection Control, 30*(4), 217-220.

Hall, A., Hewitt, G., Tuffrey, V., & Silva, N. d. (2008). A Review and Meta-Analysis of the Impact of Intestinal Worms on Child Growth and Nutrition. *Maternal and Child Nutrition, 4*, 118-236.

Harry, B., Sturges, K. M., & Klingner, J. K. (2005). Mapping the process: An exemplar of process and challenge in grounded theory analysis. *Educational Researcher, 34*(3), 1-13.

Hunter, P. R., Zmirou-Navier, D., & Hartemann, P. (2009). Estimating the impact on health of poor reliability of drinking water interventions in developing countries. *Science of the Total Environment, 407*, 2621-2624.

Hutton, G. (2012). *Global costs and benefits of drinking-water supply and sanitation interventions to reach the MDG target and universal coverage*. Geneva: World Health Organization.

Hutton, G., & Haller, L. (2004). *Evaluation of the Costs and Benefits of Water and Sanitation Improvements at the Global Level*. Geneva.

IRC. (2007). *Towards Effective Programming for WASH in Schools: A manual on scaling up programmes for water, sanitation and hygiene in schools.* (No. 48). Delft, The Netherlands: IRC International Water and Sanitation Centre.

IRC. (2012). *Providing a basic level of water and sanitation services that last: cost benchmarks. (WASHCost Infosheet 1).* . The Hague, The Netherlands: IRC International Water and Sanitation Centre.

Isham, J., Narayan, D., & Pritchett, L. (1995). Does Participation Improve Performance? Establishing Causality with Subjective Data. *The World Bank Economic Review, 9*(2), 175-200.

Jenkins, M., & Scott, B. (2010). *Sanitation marketing for managers: guidance and tools for program development*. Washington, DC: USAID.

Jenkins, M. W. (1999). *Sanitation Promotion in Developing Countries: Why the Latrines of Benin are Few and Far Between.* University of California Davis.

Jordan, E., Gross, M., Javernick-Will, A. N., & Garvin, M. J. (2011). Use and misuse of Qualitative Comparative Analysis. *Construction Management and Economics, 29*(11), 1159-1173.

Kistner, M. (2009). Dysfunctional Elimination Behaviors and Associated Complications in School-Age Children. *The Journal of School Nursing, 25*(2), 108-116.

Koirala, H. R., & Robertson, L. (2006). *Participatory Assessment of the School Sanitation and Hygiene Education Programme in Nepal*.

Koopman, J. S. (1978). Diarrhea and School Toilet Hygiene in Cali, Colombia. *American Journal of Epidemiology, 107*(5), 412-420.

Le Hesran, J.-Y., Akiana, J., Ndiaye, E. H. M., Dia, M., Senghor, P., & Konate, L. (2004). Severe malaria attack is associated with high prevalence of Ascaris lumbricoides infection among children in rural Senegal. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 98*(7), 397-399.

Long, J. S. (1997). *Regression models for categorical and limited dependent variables*. Thousand Oaks, CA: Sage Publications.

Lopez-Quintero, C., Paul, F., & Neumark, Y. (2009). Hand Washing Among School Children in Bogotá, Colombia. *American Journal of Public Health, 99*(1), 94-101.

Luong, T. V. (2003). De-worming school children and hygiene intervention. *International Journal of Environmental health Research, 13*(S1), S153-S159.

Marks, S., & Davis, J. (2010, October 26). *Community participation and sense of ownership for the water system: Evidence from Kenya.* Paper presented at the Water and Health: Where Science meets Policy, Chapel Hill, NC.

Marks, S. J., & Davis, J. (2012). Does user participation lead to sense of ownership for rural water systems? Evidence from Kenya. *World Development, 40*(8), 1569-1576.

Mathew, K., Zachariah, S., Shordt, K., Snel, M., Cairncross, S., Biran, A., et al. (2009). The sustainability and impact of school sanitation, water and hygiene education in southern India. *Waterlines, 28*(4).

Mbatha, T. (2011). Addressing girls' challenges of water and sanitation in a rural schooling context in Swaziland. *Agenda: Empowering women for gender equality, 25*(2), 35-42.

McMahon, S. (2010). *SWASH+ assessing the feasibility and acceptability of girls' urinals: final report*: Emory University Rollins Schools of Public Health, Care, and Water.org.

Melghem, L. (2003). *Escuela y Casa Saludable: Una experiencia exitosa en Honduras*. Lima, Peru.

Miguel, E., & Kremer, M. (2004). Worms: Identifying impacts on education and health in the presence of treatment externalities. *Econometrica, 72*(1), 159-217.

Ministerio de Salud de El Salvador. (2007). *Norma tecnica para la autorizacion sanitaria del funcionamiento de instituciones destinadas a la atención o enseñanza de niños y niñas de edad preescolar, escolar y adolescentes*. San Salvador.

Ministerio de Vivienda del Peru. (2006). *Reglamento Nacional de Edificaciones*.

Ministry of Education Belize. (2012). *Improving access, quality and governance of education in Belize. Education sector strategy 2011 - 2016*.

MoES Uganda. (2006). *Sanitation and Hygiene in Primary Schools in Uganda*. Kampala: Ministry of Education and Sports.

Montgomery, M. A., Bartram, J., & Elimelech, M. (2009). Increasing Functional Sustainability of Water and Sanitation Supplies in Rural Sub-Saharan Africa. [Article]. *Environmental Engineering Science, 26*(5), 1017-1023.

Mooijman, A., Snel, M., Ganguly, S., & Shordt, K. (2010). *Strengthening water, sanitation and hygiene in schools – a WASH guidance manual with a focus on South Asia.* The Hague: IRC.

Nagpal, T. (2010). *Clean Start: Focusing on school water, sanitation and hygiene: a reflection from GWC*: Global Water Challenge.

Nauges, C., & Strand, J. (2011). *Water hauling and girls' school attendance: some new evidence from Ghana*: World Bank.

Njuguna, V., Karanja, B., Thuranira, M., Shordt, K., Snel, M., & Cairncross, S. (2008). *The Sustainability and Impact of School Sanitation, Water and Hygiene Education in Kenya*. New York and Delft: United Nations Children's Fund and IRC International Water and Sanitation Centre.

Nokes, C., & Bundy, D. (1993). Compliance and absenteeism in school children: implications for helminth control. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 87*(2), 148-152.

Nokes, C., & Bundy, D. A. P. (1994). Does helminth infection affect mental processing and educational achievement? *Parasitology Today, 10*(1), 14-18.

O'Reilly, C. E., Freeman, M. C., Ravani, M., Migele, J., Mwaki, A., & Ayalo, M. (2008). The impact of a school-based safe water and hygiene programme on knowledge and practices of students and their parents: Nyanza Province, western Kenya, 2006. *Epidemiology and Infection, 136*, 80-91.

Obure, A. F. (2009). *Scaling school water, sanitation and hygiene in rural Kenya: An assessment of the Kenya education sector support program*: Emory University Center for Global Safe Water, CARE, Water.org.

OneWorld South Asia. (2013). Government to take over all primary schools in Bangladesh. *OneWorld South Asia*. Retrieved from http://southasia.oneworld.net/news/government-to-take-over-all-primary-schools-in-bangladesh#.UUCsu9ZT-7y

Onyango-Ouma, W., Aagaard-Hansen, J., & Jensen, B. B. (2005). The Potential of Schoolchildren as Health Change Agents in Rural Western Kenya. *Social Science & Medicine, 61*(8), 1711-1722.

Oroche, M. R., Torres, G. A., & Sigmon, C. (2010). *Monitoring and Evaluation of CONAPAC Rural Clean Water Program Report: Water Quality Testing and Community Perspectives in the Amazon Region of Peru, 2010*. Iquitos: Prepared for CONAPAC.

Oster, E., & Thornton, R. (2010). Menstruation, Sanitary Products and School Attendance: Evidence from a Randomized Evaluation. *American Economic Journal: Applied Economics*.

Ozturk, I. (2001). The role of education in economic development: a theoretical perspective. *Journal of Rural Development and Administration, 33*(1), 39-47.

Permani, R. (2009). The role of education in economic growth in east asia: a survey. *Asian-Pacific Economic Literature*, 1-20.

Ragin, C. C. (1987). *The Comparative Method: Moving Beyond Qualitative and Quantitative Strategies*. Berkeley and Los Angeles: University of California Press.

Ragin, C. C. (2006). Set relations in social research: evaluation their consistency and coverage. *Political Analysis 14*, 291-310.

Ragin, C. C. (2008a). *Redesigning Social Inquiry: Fuzzy Sets and Beyond*. Chicago: University of Chicago Press.

Ragin, C. C. (2008b). *User's guide to fuzzy-set qualitative comparative analysis*. Tuscon, AZ: University of Arizona Department of Sociology.

Ragin, C. C. (2009). Qualitative Comparative Analysis Using Fuzzy Sets (fsQCA). In B. Rihoux & C. C. Ragin (Eds.), *Configurational comparative methods: qualitative comparative analysis (QCA) and related techniques*. Thousand Oaks, CA: SAGE Publications.

Ragin, C. C., & Sonnett, J. (2004). Between Complexity and Parsimony: Limited Diversity, Counterfactual Cases, and Comparative Analysis: UC Los Angeles: Department of Sociology, UCLA.

Rihoux, B., & De Meur, G. (2009). Crisp-set qualitative comparative analysis (csQCA). In B. Rihoux & C. C. Ragin (Eds.), *Configurational comparative methods: qualitative comparative analysis (QCA) and related techniques* (pp. 33-68). Thousand Oaks, CA: SAGE Publications.

Rihoux, B., & Ragin, C. C. (Eds.). (2009). *Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and related techniques*: Sage Publications.

Rodgers, A. R., Ajono, L. A., Gyapong, J. O., Hagan, M., & Emerson, P. M. (2007). Characteristics of latrine promotion participants and non-participants; inspection of latrines; and perceptions of household latrines in Northern Ghana. *Tropical Medicine & International Health, 12*(6), 772-782.

Saboori, S., Mwaki, A., & Rheingans, R. D. (2010). Is soapy water a viable solution for handwashing in schools? *Waterlines, 29*(4), 329-336.

Saboori, S., Mwaki, A., Porter, S. E., Okech, B., Freeman, M. C., & Rheingans, R. D. (2011). Sustaining school hand washing and water treatment programmes: lessons learned and to be learned. *Waterlines, 30*(4), 298-311.

Save the Children. (2009). *Shishuder Jonno baseline survey report*. Dhaka: Save the Children-USA.

Save the Children. (2012). *School health and nutrition program cost analysis in Bangladesh*. Dhaka: Save the Children.

Sidibe, M., & Curtis, V. (2007). *Can hygiene be cool and fun? Insights from school children in Senegal*. Nairobi: World Bank Water and Sanitation Program (WSP).

Smithson, M., & Verkuilen, J. (Eds.). (2006). *Fuzzy set theory: applications in the social sciences*. London: SAGE.

Snel, M. (2004). *The Worth of School Sanitation and Hygiene Education (SSHE): Case Studies*. Delft: IRC International Water and Sanitaiton Centre.

Snelling, A. M., Saville, T., Stevens, D., & Beggs, C. B. (2011). Comparative evaluation of the hygienic efficacy of an ultra-rapid hand dryer vs conventional warm air hand dryers. *Journal of Applied Microbiology, 110*(1), 19-26.

Sommer, M. (2010a). Putting mentrual hygiene management on to the school water and sanitation agenda. *Waterlines, 29*(4), 268-278.

Sommer, M. (2010b). Where the education system and women's bodies collide: the social and health impact of girls' experiences of menstruation and schooling in Tanzania. *Journal of Adolescence, 33*, 521-529.

Strina, A., Cairncross, S., Barreto, M. L., Larrea, C., & Prado, M. S. (2003). Childhood Diarrhea and Observed Hygiene Behavior in Salvador, Brazil. *American Journal of Epidemiology, 157*(11), 1032-1038.

Sutton, S. (2004). *Preliminary desk study of potential for self supply in sub-saharan africa.* : UK SC: WaterAid and the Rural Water Supply Network.

SWASH+. (2010). *Quality: Several Far-ranging Factors Drive the Success of School WASH*.

UN-Water. (2012). *UN-water global analysis and assessment of sanitation and drinking water (GLAAS) 2012 report: the challenge of extending and sustaining services*: UN-Water and the World Health Organization.

UN. (1948). *Universal Declaration of Human Rights, Article 26, Proclaimed by the General Assembly of the United Nations, December 10, 1948.*

UN. (1959). Declaration of the Rights of the Child, Principal 7, Proclaimed by General Assembly of the United Nations, Resolution 1386(XIV) of 20 November 1959.

UN. (2002). *General Comment No. 15*. Geneva: United Nations Economic and Social Council.

UN. (2010, July 28). *General Assembly Adopts Resolution Recognizing Access to Clean Water, Sanitation as Human Right*, New York.

UNESCO. (2008). *Los Aprendizajes de los Estudiantes de América Latina y el Caribe*. Santiago.

UNICEF et al. (2010). *Raising Clean Hands: Advancing Learning, Health and Participation through WASH in Schools*. New York: United Nations Children's Fund in partnership with CARE, Dubai Cares, Emory University, IRC International Water and Sanitation Centre, Save the Children, Water Advocates, WaterAid, Water For People and WHO.

UNICEF et al. (2012). *Raising even more clean hands: advancing health, learning and equity through WASH in schools*. New York: United Nations Children's Fund.

UNICEF/WHO. (2009). *Diarrhoea: Why children are still dying and what can be done*. Geneva.

Vernon, S., Lundblad, B., & Hellstrom, A. L. (2003). Children's experiences of school toilets present a risk to their physical and psychological health. *Child: care, health and development, 29*(1), 47-53.

Waddington, H., Snilstveit, B., White, H., & Fewtrell, L. (2009). *Water supply, sanitation and hygiene interventions to combat childhood diarrhea in developing countries*: International initiative for impact evaluation.

WaterAid. (2009). *Management for Sustainability: Practical lessons from three studies on the management of rural water supply schemes*. Dar es Salaam: WaterAid Tanzania.

WaterAid. (2011). *Sustainability Framework.* London: WaterAid.

WHO. (2003). *The Right to Water* (Vol. 3). Geneva: World Health Organization.

WHO. (2004). *Water, sanitation and hygiene links to health. Facts and figures*. Geneva: World Health Organization (WHO).

WHO. (2005). *Deworming for Health and Development: Report of the third global meeting of the partners for parasitic control*. Geneva.

WHO. (2008). *Guidelines for Drinking-water Quality*. Geneva.

WHO/UNICEF. (2008). *Progress on Drinking Water and Sanitation: Special Focus on Sanitation*. New York and Geneva: World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply and Sanitation (JMP).

WHO/UNICEF. (2009). *Water, Sanitation and Hygiene Standards for Schools in Low-cost Settings*. Geneva World Health Organization.

WHO/UNICEF. (2012). *Progress on drinking water and sanitation 2012 update*: World Health Organization and the United Nations Children's Fund.

Wong, M. L., Lubek, I., Dy, B. C., Pen, S., Kros, S., & Chhit, M. (2003). Social and behavioural factors associated with condom use among direct sex workers in Siem Reap, Cambodia. *Sex Transm Infect, 79*, 163-165.

World Bank. (1976). *Measurement of the Health Benefits of Investments in Water Supply*: International Bank for Reconstruction and Development.

World Bank. (2008). *Education for all in Bangladesh: where does Bangladesh stand in achieving the EFA goals by 2015?* Dhaka: Human Development Unit, South Asia Region, The World Bank.

WSP. (2001). *Promoción de la salud y la higiene a través del sistema educativo escolar en Perú.* Lima, Peru.

WSP. (2012). *Economic impacts of inadequate sanitation in Bangladesh*: Water and Sanitation Program.

Xuan, L. t. T., Hoat, L. N., Rheinlander, T., Dalsgaard, A., & Konradsen, F. (2012). Sanitation behavior among school children in a multi-ethnic area of Northern rural Vietnam. *BMC Public Health, 12*(140).

Yamasaki, S., & Rihoux, B. (2009). A commented review of applications. In B. Rihoux & C. C. Ragin (Eds.), *Configurational comparative methods: qualitative comparative analysis (QCA) and related techniques* (pp. 123-145). Thousand Oaks, CA: SAGE Publications.

Yin, R. (2003). *Case study research: design and methods.* Thousand Oaks, CA: SAGE Publications.

Zwane, A., & Kremer, M. (2007). *What works in fighting diarrheal diseases in developing countries? A critical review*: World Bank Res Obs.

APPENDIX A – Survey tools used in Peru

Información General	
Fecha de Visita:	Nombre de Escuela:
Elevación	Comunidad:
UTM (X)	Municipalidad:
UTM (Y)	Región:
UTM Zona	País:

OBSERVACIONES
Monitoreo y Evaluación para WASH Sostenibles en Escuelas

Método de colección de los datos: Visitar y observar el sistema de agua, los baños y las lavabos
Materiales necesarios: La encuesta siguiente, el transcripto de consentimiento, lápiz, camera (si obtiene permiso para tomar fotos), 1-2 viales para la colección de agua (si obtiene permisión para tocar una muestra de agua)

No.	Preguntas	Marque "X" solamente en una de las opciones (a menos que se indique lo contrario)
	Información General	
Q1	Ubicación	1.Rural ___ 2.Peri-Urbana ___ 3.Ciudad pequeña ___ 4.Otro(explique):
	Abastecimiento de Agua	
Q2	Tipo de sistema de agua **(Escribe el nombre del tipo del sistema y tomar un foto)**	
Q3	Fuente	1.Rio__ 2.Laguna___ 3.Quebrada/Corriente___ 4.Manantial___ 5.Pozo___ 6.Entubado de una planta de tratamiento___ 7.Entubado pero fuente desconocido___ 8.Charco___ 9.Agua Lluvia___ 10.otros (nombre):
Q4	Punto de colección en la escuela	1.Conexiones adentro del edificio___ 2.Pileta publica adentro a la escuela___ 3.Pileta publica afuera de la escuela___ 4.Baldes adentro de la escuela__ 5.Escuela no tiene agua___ 6.Otros (explique):
Q5	¿Es un sistema autónomo (abastecimiento de agua sólo sirve a la escuela) o parte de un sistema que sirve a más de la escuela (como la comunidad en general)?	1.Sistema independiente___ 2.Sistema escolar parte de un mayor régimen__ 3.No sabe___
Q6	Número de puntos de colección de agua dentro de la escuela	
Q7	Número de puntos de colección de agua que están funcionamiento y tienen agua	
Q8	¿Hay agua disponible el día de la visita?	1.No___ 2.Si___ 3.No sabe___

Q9	La cantidad disponible en el día de la visita	Litros por minuto de la sistema de agua: Cantidad de agua en los baldes (en total):
Q10	¿Cuál es el estado del sistema de agua en la opinión del entrevistador?	1.Funciona bien__ 2.Necesita reparación pero esta funcionamiento___ 3.No esta funciona___ 4.No sabe___ 5.Otra (explique):
Q11	¿Los alumnos tienen acceso a instalaciones de lavado de manos?	1.No__ 2.Si, dentro de los 10 metros de los baños___ 3.Si, más de 10 metros de los baños___ 4.No sabe___
Q12	Si tomó una muestra de la Calidad del Agua, de donde? **(marca todos que aplica)**	1.Del fuente de agua___ 2.De la sistema de agua__ 3.De los baldes en la escuela___ 4.De grifos a dentro de la escuela___ 5.No se tomó una muestra de agua___ 6.Otras (explique):
Q13	Donde y como los alumnos colectan el agua mientras a la escuela?	Donde: Cómo es el agua obtenida:
Saneamiento		
Q14	Tipo de baño se está utilizando en la escuela (Escribe el nombre del tipo y tomar un foto)	
Q15	Cuantos baños están para niños y niñas?	Niños: Niñas: En total (si no están separados):
Q16	Hay baños separados para docentes?	1.No__ 2.Si___, Cuantos:
Q16	¿Existen evidencias de que los baños de los alumnos están en uso?	1.No___ 2.Si (explique la evidencia)__
Q16	Que es el estado de los baños (por observación)	1.Funciona bien___ 2.El hueco esta lleno___ 3.Hay otras problemas técnicas__ (explique) 4.Otros (explique):
Q17	¿Existe orina y / o heces en el suelo / paredes / etc. en los baños?	1.No___ 2.Si__
Q18	¿Las moscas pueden entrar y salir de la cámara que contiene heces / orina en los baños?	1.No___ 2.Si__
Q19	Los baños se huelen?	1.No___ 2.Si, mucho___ 3.Si, un poco__
Q20	Hay baños separados para los alumnos y los docentes?	1.No__ 2.Si___ 3.No sabe___
Lavado de Manos		
Q21	¿Los alumnos tienen acceso a jabón (o otro agente de limpieza) y agua para lavado de manos cerca del lavadero el día de la visita?	1.Sí, los alumnos tienen jabón y agua___ 2.Los alumnos tienen agua pero no hay jabón___ 3.Los alumnos tienen jabón pero no hay agua___ 4.No hay agua ni jabón disponible__ 6.No sabe___
Q22	Hay evidencia para la promoción de lavado de manos en la escuela?	1.No__ 2.Si (explique):

ENCUESTA DE DIRECTOR(A) / PROFESOR (A)
Monitoreo y Evaluación para WASH Sostenibles en Escuelas

Método de colección de los datos: entrevista de 20-30 minutos (puede hacer notas adicionales al fin de la encuesta)

Materiales necesarios: La encuesta siguiente, el transcripto de consentimiento, lápiz, grabador de voz (si obtiene permiso para grabar)

No.	Preguntas	Marque "X" solamente en una de las opciones (a menos que se indique lo contrario)
	Información General	
Q1	Tipo de escuela **(marca todos que aplica)**	1.Inicial__ 2.Primaria__ 3.Secondaria__ 4.Otros (explique):
Q2	Cuantos estudiantes asisten a la escuela primaria?	Total:___ Niñas:_____ Niños:_____
Q3	Cuantos docentes enseñan en la escuela?	Total:____ Mujeres:_____ Varones:_____
Q4	Cuántas horas al día son los estudiantes en escuela?	
Q5	Cuántas horas al día son los docentes en escuela?	
	Abastecimiento de Agua	
Q6	El sistema sólo sirve a la escuela o más de la escuela (como la comunidad en general)?	1.Sistema independiente _____ 2.Sistema sirve más de la escuela____ 3.No sabe _____
Q7	Cuando se construyó el sistema de agua?	Junio del 2009
Q8	Quien pagan para la construcción originalmente?	1.Un ONG pagado ____% 2.El gobierno pagado _____% 3.La escuela pagado _____% 4.La comunidad pagado _____% 5.El comité de padres pagado _____% 6.Otro pagado _____% 7.No sabe____
Q9	Quien se encarga de los gastos de mantenimiento del sistema de agua	1.Un ONG___ 2.El gobierno___ 3.La escuela___ 4.La comunidad___ 5.El comité de padres___ 6.Otro (explique):
Q10	Cuanto es el gasto para agua mensualmente?	
Q11	Quienes se encargan del mantenimiento (limpieza, cuidado, reparaciones del sistema de agua)	1.Personal administrativo___ 2.Docentes__ 3.Alumnos__ 4.Padres de familia___ 5.Otros (explique):
Q12	Quienes responsables para la colección de agua para la escuela?	
Q13	Cuanto tiempo se tardan en reparar y solucionar los problemas del sistema de agua?	
	Saneamiento	
Q14	Cuando se construyeron los baños?	
Q15	Quien pagan para la construcción originalmente?	1.Un ONG pagado _____% 2.El gobierno pagado _____% 3.La escuela pagado _____% 4.La comunidad pagado _____% 5.El comité de padres pagado ____% 6.Otro pagado _____% 7.No sabe____

Q16	Los baños sirven más de la escuela o solo la escuela?	1.Sirven más de la escuela___ 2.Sirven solo la escuela__ 3.No sabe___
Q17	Quienes se encargan del mantenimiento (limpieza, cuidado, reparaciones) de los baños?	1.Personal administrativo___ 2.Docentes__ 3.Alumnos__ 4.Padres de familia___ 5.Otros (explique):
Q18	Quien se encarga de los gastos de mantenimiento de los baños?	1.Un ONG___ 2.El gobierno___ 3.La escuela___ 4.La comunidad___ 5.El comité de padres__ 6.Otro (explique):
Q19	Cuanto es el gasto mensualmente para los baños?	
Q20	Cuanto es el gasto mensualmente para la escuela en total?	
Q21	Cuanto tiempo se tardan en reparar y solucionar los problemas de los baños?	
Lavado de Manos		
Q22	Con qué frecuencia se compra jabón para la escuela?	
Q23	En su opinión, cuando los estudiantes lavado sus manos?	
Enlaces de la Comunidad		
Q24	Es la comunidad involucrada en la construcción, el mantenimiento, o la financiación de los servicios en la escuela? **(marca todos que aplican)**	1.Construcción__ 2.Maneniamiento__ 3.Financiamiento__ 4.Otras (explique):
Q25	Tiene la escuela actividades de extensión para ayudar a mejorar el agua, saneamiento o lavado de manos en la comunidad?	1.No__ 2.Sí___ 3.No sabe___
Q26	Si la respuesta es 'Sí', cuales son las actividades de extensión?	
Impactos de Salud y Asistencia		
Q27	En su opinión hay menos casos de enfermedades en los alumnos con el sistema de agua?	1.No hay una diferencia___ 2.Si, un poco menos casos___ 3.Si, mucho menos casos___ 4.No sabe__ 5.No hay una sistema de agua___ 6.No estaba aquí o no recuerda antes del sistema___ 7.Otros (explique):
Q28	En su opinión hay menos casos de enfermedades en los alumnos con los baños	1.No hay una diferencia___ 2.Si, un poco menos casos__ 3.Si, mucho menos casos___ 4.No sabe___ 5.No hay baños___ 6.No estaba aquí o no recuerda antes de los baños___ 7.Otros (explique):
Q29	Toma fotos de los registros de asistencia para ver si hay mejoradas a asistencia escolar después los instalaciones?	1.No__ 2.Si___ Notas:
Q30	Si no hay registros de asistencia, en su opinión hay impactos de asistencia escolar con el sistema de agua y los baños?	Con el sistema de agua: Con los baños:

Más Preguntas		
Q31	Qué conocimiento tiene Usted sobre el cuidado del agua?	
Q32	Cree usted que el sistema de agua y los baños son adecuado para su escuela?	1.No___ 2.Si___ Por qué?/Notas:
Q33	Cuáles son los desafíos con respeto a agua, saneamiento e lavado de manos en la escuela?	
Q34	Cuál es el tema que más interesa para su escuela con respeto a agua, saneamiento, lavado de manos o ninguna de estas? Y por qué?	1.Agua__ 2.Saneamiento__ 3.Lavado de manos___ 4.Ninguna de estas___ Por qué?:

ENCUESTA DE LOS PADRES
Monitoreo y Evaluación para WASH Sostenibles en Escuelas

Método de colección de los datos: entrevista de 15-20 minutos en las casas elegidas al azar (puede hacer notas adicionales al fin de la encuesta)

Materiales necesarios: La encuesta siguiente, el transcripto de consentimiento, lápiz, grabador de voz (si obtiene permiso para grabar)

No.	Preguntas	Marque "X" solamente en una de las opciones (a menos que se indique lo contrario)
Información General		
Q1	Qué conocimiento tiene Usted sobre el cuidado del agua?	
Q2	En su opinión, cuál es la importancia de contar con el servicio de agua y saneamiento en la escuela aquí?	1.Muy Importante y necesario __ 2.Un poco importante y necesario___ 3.No es importante o necesario___ 4.No sabe, no opina___ Por qué?:
Q3	En su opinión, cuál es la importancia de contar con el servicio de agua y saneamiento en la casa?	1.Muy Importante y necesario__ 2.Un poco importante y necesario___ 3.No es importante o necesario___ 4.No sabe, no opina___ Por qué?:
Q4	*Si las respuestas son el mismo, Preguntar:* En su opinión, cual es más importante para la salud y educación de los niños y niñas: servicios de la escuela o servicios de la casa? Y por qué?	1.Servicios de la escuela___ 2.Servicios de la casa__ 3.Servicios de la escuela y casa por igual___ 4.No sabe, no opina___ Por qué?:
Q5	En su opinión, cuales son los desafíos en la escuela aquí?	
Abastecimiento de Agua		
Q6	Donde recoger su agua para tomar?	
Saneamiento		
Q7	Usted tiene un baño mejorado en su casa?	1.No___ 2.Sí___
Q8	Qué tipo de baño tiene?	

Lavado de Manos		
Q9	Cada cuanto tiempo compra jabón	1.Cada 1 semana___ 2.Cada 2 semanas___ 3.Cada 3 semanas___ 4.Cada mes__ 5.Otro (explique):
Q10	Usted en que usa más el jabón **(marca todos que aplica)**	1.Para lavarse las manos___ 2.Para bañarse__ 3.Para lavar la ropa__ 4.Para lavar los platos__ 5.Otros (explique):
Q11	Cuando sus hijos lavado las manos? **(marca todos que aplica, pero no dice los opciones)**	1. Antes de comer___ 2.Despues de usar el baño__ 3.Antes de cocinar___ 4.Otros (explique):
Impactos de Salud		
Q12	En su opinión, hay menos casos de enfermedades (diarreicas) en sus hijos por el causa de agua potable y/o el baño?	1.No hay un cambio___ 2.Sí, hay un poco menos casos___ 3.Sí, hay mucho menos casos___ 4.No sabe__
Q13	En su opinión y experiencia, cuál puede mejorar la salud en niños y niñas más: mejoras en el agua o el saneamiento o lavado de manos? O usted piensa que ninguno de estos mejorar salud de niños y niñas en su comunidad?	1.Mejoras en agua__ 2.Mejoras en saneamiento__ 3.Lavado de manos__ 4.Ningunos están importante___ 5.Por qué?
Enlaces entre la Escuela y la Comunidad		
Q14	La comunidad o los padres están involucrando con los servicios a la escuela?	1.No___ 2.Sí__ Explique:
Q15	Hay actividades que realiza la escuela para educar a la población sobre la importancia del agua, saneamiento y lavado de manos	1.No___ 2.Sí__ Explique:

Actividad de los Papelitos

APPENDIX B - Recommended standards for WASH in Belizean schools

Recommended standards are presented below based on recommended international standards for WASH in schools (WHO/UNICEF, 2009) and national standards used in Latin America. Recommended standards are modified and adapted to align with the realities of Belize. Infrastructure quantity standards are scaled to provide fewer students per facility at schools with a small student population and provide an achievable and realistic number of facilities in schools with large student populations.

Standard	Details
1. Safe water available	1.1. Access to an improved water source (*a source that is likely to provide safe water: including piped water, protected wells/springs, rainwater collection. Unprotected wells/springs, surface water (rivers/lakes/canals), bottled water and tanker trucks are not improved sources.)* 1.2. Water used for drinking and handwashing is treated 1.3. Water used for drinking and handwashing has free chlorine residual or absence of *E. coli* in 100 mL samples
2. Sufficient quantity of water available	2.1. Water is available throughout the school day and school year (for boarding schools, water must be available 24 hours per day throughout the boarding school year) 2.2. Water quantity is sufficient for school needs and to encourage good hygiene: 5 L/person/day if dry sanitation, 10-20 L/person/day if flush toilets and an additional 20 L/person/day for boarding schools (recommended) 2.3. Sufficient number of safe water access points: 1 for every 150 students
3. Sufficient washing facilities available	3.1. Soap is available to students 3.2. Soap is available at the handwashing facilities (recommended)[31] 3.3. Sufficient number of running water handwashing facilities[32]: 1 for 1-20 students; 2 for 21-50 students; over 50, add 1 facility for every 100 3.4. Within 10 meters of toilets (recommended) 3.5. For boarding schools: Laundry facilities with detergent and water; 1 shower for every 20 users
4. Hygiene promotion	4.1. Use of HFLE curriculum 4.2. Evidence of promotion 4.3. Facilities & resources enable good hygiene practices
5. Adequate toilets available	5.1. Access to improved sanitation (*private facilities that separate human excreta from human contact; including pit latrines (if a stable concrete/wood slab between user and hole), ventilated improved pit (VIP) latrines, flush toilets, pour-flush toilets, and composting toilets)* that is: 5.2. Clean (free of urine and feces on the seat/floor/walls; inspected & cleaned daily) 5.3. Adequately ventilated (screened ventilation pipes/windows) 5.4. Adequately illuminated (can see clearly with the door closed) 5.5. Functioning properly 5.6. Private & secure 5.7. Accessible to small children 5.8. Accessible to students with physical disabilities 5.9. Culturally and geographically appropriate 5.10. Accessible by a safe and clear walkway and surrounding area
6. Sufficient quantity of toilets	6.1. Sufficient number for girls: 1 toilet for 1-20 girls; 2 for 21-50; over 50, add 1 for every 50 girls 6.2. Sufficient number for boys: 1 toilet for 1-20 boys; 1 toilet & 1 urinal for 21-50 boys; over 50, add 1 toilet and 1 urinal for every 100 boys 6.3. Separate facilities are available for boys & girls (recommended)

[31] Based on WASH Project evaluation results, soap kept in the classroom is typically not used by students and soap should be kept at the handwashing facilities in parallel with student hygiene education to take care of the soap.

[32] Based WASH Project evaluation data, bucket-pour handwashing facilities are typically not used and running water facilities are recommended. A bucket with a tap would be sufficient in place of a sink.

APPENDIX C - Suggested EMIS questionnaire for WASH in schools in Belize

The following monitoring tool is modified from the UNICEF WASH in Schools Monitoring Package to capture areas of specific interest to WASH in Belizean schools and based on proposed standards. It is intended for use in the EMIS data collection conducted annually nationwide. Data will help identify areas in need of improvement over time. In addition, when principals complete the questionnaire each year, it will serve as a reminder of the importance of WASH in schools. The number of questions is based on discussions with the EMIS office to allow one double-sided page dedicated to WASH. Most EMIS questionnaires will have fewer WASH questions if at any at all.

Question 1: Does the school have access to an improved water source (*a source that is likely to provide safe water)*? (check one)

Yes ☐	No ☐
-Piped water -Protected well -Protected spring -Rainwater collection	-Unprotected well -Unprotected spring -Surface water (river/lake/canal) -Bottled water (if primary source) -Tanker truck

Question 2: As far as you know, is the school's water source treated? (check one)

Yes ☐ No ☐ Don't know ☐

Question 3: Is water treated before drinking at the school? (check one)
(*treating/purifying water **in the school** in some way such as boiling, chlorination, bleach, ceramic filters, candle filters or biosand filters.)*

Always ☐ Sometimes ☐ Never ☐

Question 4: How often is the water source functional? (check one)

Always ☐ Most days ☐ Some days ☐ Rarely or never functional ☐

Question 5: <u>When the water source is functional</u>, does it provide enough water for the needs of the school, including water for drinking, handwashing and food preparation? (check one)

Yes ☐ No ☐ Water source is not functional ☐

Question 6: How many water access points are at the school, not including handwashing facilities? (insert **number**) *(A water access point includes classroom water buckets, drinking water fountains, running water taps not used for handwashing, well pumps, and storage tank taps)*

	Functional	Not Functional
Number of water access points at the school		

Question 7: Does the school have improved toilet facilities (*private facilities that separate human excreta from human contact)*? (check one)

Yes ☐	No ☐
-Pit latrine (if stable concrete or wood slab between user and hole) -Ventilated Improved Pit (VIP) latrine -Flush toilet to sewer or septic tank -Pour-flush toilet to sewer or septic tank	-Flush or pour-flush toilet <u>not</u> piped to sewer, septic tank or enclosed pit -Pit latrine without slab (open pit) -Bucket -No facilities (fields/bush)

Question 8: How many toilets and urinals are there in the school? (insert ***number***)
(A toilet is defined as an individual stall/seat/squat-plate/drop-hole where a single child can defecate in private. Functional means that at the time of filling out this questionnaire, the toilets are not broken and can be used by children. Not functional means that the toilet is broken, full, or damaged in such a way that it cannot be used.)

	Functional	Not Functional
Exclusively for girls		
Exclusively for boys		
For boys or girls (unisex toilets)		
Boys urinals (50 cm of urinal wall = 1 urinal)		

Question 9: On average, are the toilets in adequate condition and accessible to all students? (check one for each category)

	Yes	No
Adequate lighting (can see clearly with the door closed)		
Adequate ventilation (screened ventilation pipes/windows)		
Adequate privacy (secure lock and building structure)		
Clean (no urine or feces on the seat, walls or floor)		
Child-friendly (smaller toilets/lower handles for younger children)		
Accessible to students with physical disabilities		
Walkway to and area around toilet is clean (grass is cut short, etc.)		

Question 10: How many handwashing stations are there in the school: (insert number) *(If there are no handwashing facilities, enter "0")*

	Functional	Not Functional
Running water		
Bucket/scoop-pour water		

Question 11: Is sufficient soap (or ash) available? (check one)

Always ☐ Sometimes ☐ Never ☐

Question 12: Where is the soap (or ash) kept for student use?

At handwashing facilities ☐ In the classroom ☐ Other ☐ There is no soap ☐

Question 13: Is HFLE curriculum taught by ALL teachers at the school? (check one)

Yes ☐ No ☐

Question 14: Is solid waste (garbage) collected and disposed daily? (check one)
(Check yes if the school collects garbage from classroom, kitchen and bathroom receptacles daily and stores it in a safe place from which it is later disposed.)

Yes ☐ No ☐

APPENDIX D - Responsibilities of key actors for WASH in Belizean schools

Government and non-government organizations working in schools in Belize need to coordinate to limit overlapping activities. Overarching goals and individual organization roles to meet those goals need to be identified and agreed upon by all parties. Based on feedback and suggestions from the December 2010 visit, defined and agreed upon responsibilities and periodic meetings with key actors would limit overlap and improve efficiency. Suggested roles and responsibilities are presented in the table below. These should be utilized as a starting point for groups to come to a mutual agreement of how responsibilities should be divided. Knowledge of overarching goals and clear responsibilities of each organization will allow groups to work individually in a more efficient manner.

Group	Roles & Responsibilities
Students	Practice and encourage proper use of WASH facilities • Use WASH facilities properly and with respect • Encourage fellow students and community members to use and maintain WASH facilities properly and keep them clean (e.g. through school health clubs) • Participate in the design and construction process
School Teachers	Encourage healthy behaviors and maintain/clean facilities over time • Provide input during planning/implementation of infrastructure • Organize the care and maintenance of infrastructure over time • Monitor the state and use of school WASH facilities • Encourage children's proper use of WASH facilities at school/home through hygiene education
School Principals	Encourage healthy school conditions and liaison between key actors • Provide input during planning/implementation of infrastructure • Ensure liaison with education authorities and other authorities at district and local level • Develop and enforce rules when required • Encourage parent-teacher liaison • Create conditions in which teachers and students are motivated to maintain WASH facilities and ensure proper use
PTA and/or Communities	Offer upfront input and support maintenance of WASH facilities • Advocate locally for school WASH improvements • Raise funds and help plan school WASH improvements with school directors and teachers • Support maintenance of school WASH facilities • Support provision of soap and toilet paper • Encourage children's proper use of WASH facilities
School Management	Support new construction and maintenance of WASH facilities • Support school maintenance of facilities over time • Provide additional parts/facilities as needed • Contribute financially to infrastructure construction

Group	Roles & Responsibilities
Ministry of Education	Provide resources and direction for WASH in schools • Water access point infrastructure • Adequate toilets including sufficient quantity & facilities for students with physical disabilities • Handwashing facilities • Provide hygiene education curriculum • Monitor school WASH facilities through the EMIS • Enforce WASH in schools standards • Work through schools to increase community involvement in WASH in schools HFLE officers • Provide training and enforce hygiene education at schools • Encourage school and community involvement in WASH programs • Support liaison between school staff and the MoE district offices • Coordinate with HECOPAB officers District officers • Coordinate with local environmental health services, public works departments, etc. to ensure that sufficient technical support is provided
Ministry of Health	Ensure hygienic/healthy conditions • Inspect school kitchens, toilets and water quality • Provide health advice to MoE for WASH in Schools programming • Support child nutrition through schools • Child vaccinations, provision of micronutrients, surveillance of preventable diseases HECOPAB officers • Provide training and advice to teachers on healthy school environments and proper hygiene • Encourage school and community involvement in WASH programs • Support liaison between school staff and the MoH district offices • Coordinate with HFLE officers
Ministry of Works	Provide potable water infrastructure for rural schools and review designs • Provide counsel for infrastructure location and construction • Ensure correct design and construction of school WASH facilities • Ensure correct maintenance and training of local infrastructure maintenance staff
Ministry of Public Utilities	Provide potable water infrastructure for urban schools • Provide water connection lines
Ministry of Human Development	Support WASH in Schools programs • Particularly with respect to ensuring adequate WASH facilities for students with physical disabilities
Emergency Management Organization (NEMO)	Emergency Management • Ensure that schools designated as emergency shelters are equipped with adequate facilities • Ensure that school facilities function properly when shelters return to regular school operation
UNICEF	Facilitator/Coordinator • Provide support in the form of financial backing and program guidance • Provide monitoring of stakeholder responsibilities to help improve programming • Coordinate efforts between partners, donors and the MoE to ensure WASH in schools are properly reflected in MoE priorities and partners are moving toward these priorities
Other NGOs (such as Rotary, Plenty Belize, etc)	Implementation Support • Support schools and the MoE by providing planning and technical advice, financial support, and encouraging involvement at the local level • Coordinate efforts with the MoE to reduce duplication of work

APPENDIX E – Survey tools used for the WASH Project evaluation in Belize

Signed consent forms were obtained from school principals and verbal consent was obtained from students that were interviewed. All data except the handwashing observations were collected on an android platform cell phone using Field-Level Operations Watch (FLOW) which automatically skips unnecessary questions and offers a more user-friendly format. Additional qualitative information was captured on paper or recorded.

KEY INFORMANT INTERVIEW

The key informant interview should be conducted with the principal or a teacher who has been at the school for at least three years and takes ten minutes to one hour depending on the length of answers given.

Question	Response
General	
1. District	Toledo_____
	Stann Creek_____
2. Classification	Rural_____
	Urban_____
	Small Town_____
3. City/Town/Village?	
4. Name of School?	
5. Type of management	Roman Catholic _____
	Anglican_____
	Methodist_____
	Adventist_____
	Baptist_____
	Government_____
	Private_____
6. Type of school	Pre-school only_____
	Primary school only_____
	Both pre-school and primary school_____
7. Location (GPS)	_____
8. Position of interviewee	Principal_____
	Teacher_____
9. Year interviewee started working at the school?	_____
10. Number of male students	_____
11. Number of female students	_____
12. Number students with physical disabilities	_____
Admin/Support	
13. What are the most common reasons that FEMALE students are absent from school?	Sick _____
	Hungry _____
	Have to work in the fields_____
	Don't want to come_____
	Distance from home_____
	Bad weather/raining_____
	Have to help at home_____
	Menstrual cycle_____

14. What are the most common reasons that MALE students are absent from school?	Sick_____
	Hungry_____
	Have to work in the fields_____
	Don't want to come_____
	Distance from home_____
	Bad weather/raining_____
	Have to help at home_____
15. Was "the WASH project" implemented at this school?	yes_____
	no_____
	don't know_____
Only answer if you responded Yes to Q15	
16. What did "the WASH Project" include?	Toilet construction_____
	Toilet remodel_____
	Drinking fountain construction_____
	Rainwater catchment_____
	Water storage_____
17. Was everything completed?	yes_____
	no_____
	don't know_____
Only answer if you responded Yes to Q15	
18. Are you happy with the results of the WASH project?	No _____
	Somewhat_____
	Yes_____
	Don't know _____
19. Why/why not?	_____
Only answer if you responded Yes to Q15	
20. Have you noticed a difference at the school because of the WASH project?	No _____
	Yes_____
	Don't know_____
21. What changes have you noticed?	_____
22. Does the school have a Parent Teacher Association (PTA)?	No_____
	Yes_____
	Don't know_____
Only answer if you responded Yes to Q15	
23. Was the school administration involved with the planning and implementation of the WASH project?	No_____
	Somewhat_____
	Yes _____
	Don't know_____
24. How was the school administration involved?	_____
Only answer if you responded Yes to Q15	
25. Was the PTA or community involved with the planning and implementation of the WASH project?	No_____
	Somewhat_____
	Yes _____
	Don't know_____
26. How was the PTA or community involved?	_____

27. Who cleans the toilets?	Hired labor (not including parents)_____
	PTA/parents - unpaid_____
	PTA/parents - paid_____
	Teachers_____
	Students_____
	Don't know_____
	There are no toilets_____
28. Who provides the cleaning materials for the school?	PTA/parents_____
	School management_____
	School administration_____
	Government_____
	Aid organizations_____
	Don't know_____
	N/A there are no cleaning supplies _____
29. Are gloves ALWAYS used for toilet cleaning?	No_____
	Yes_____
	Don't know_____
30. Who provides soap for the school?	PTA/parents_____
	School management_____
	School administration_____
	Government_____
	Aid organizations_____
	Don't know_____
	N/A there is no soap at the school_____
31. Who provides toilet paper for the school?	PTA/parents_____
	School management_____
	School administration_____
	Government_____
	Aid organizations_____
	Don't know_____
	There is no toilet paper_____
32. When the water facilities or toilets break, who fixes them?	Hired labor (not including parents)_____
	PTA/parents - unpaid_____
	PTA/parents - paid_____
	School management_____
	School administration_____
	Government_____
	Aid organizations_____
	Don't know_____
	There are no WASH facilities_____
33. Who pays for the repairs?	PTA/parents_____
	School management_____
	School administration_____
	Government_____
	Aid organizations_____
	Don't know_____
	There are no WASH facilities_____

34. What are the damages to the water and sanitation facilities usually caused by?	Improper use by students_____
	Poor quality materials_____
	Vandalism from outside the school_____
	Old age of the facilities_____
	Don't know_____
	N/A we don't ever have damages _____
35. Does the school have a written maintenance plan for the water and sanitation facilities?	No_____
	Yes but can't find quickly_____
	Yes able to show a copy_____
Water	
36. Is the water service constant during the school year?	Not constant during ALL months of the year_____
	Not constant during SOME months of the year_____
	Remains constant throughout the year_____
37. If the water is not constant, what are the reasons?	Seasonal - the source runs low during certain times of the year_____
	Operational - the water system breaks down_____
	N/A the water is constant_____
38. Do you feel that normally the quantity of water is sufficient for school needs and to encourage good hygiene?	No_____
	Somewhat - if we are careful we have enough to get by_____
	Yes we have plenty of water_____
	Don't know_____
Sanitation	
39. Are there separate toilets for boys and girls?	yes_____
	some _____
	no_____
40. Are there separate toilets for students and teachers?	yes_____
	some_____
	no_____
41. Do you feel there are a sufficient number of toilets at the school?	yes_____
	no_____
Handwashing Facilities	
42. What facilities does the school provide students for washing hands?	Wash basins with bucket collected water_____
	Wash basins with running water_____
	None_____
43. Where are handwashing facilities located?	Immediately outside the classrooms_____
	Inside the classrooms_____
	Immediately outside the toilet unit_____
	Inside the toilet unit_____
Hygiene Education	
44. Has hygiene education been taught by teachers at the school this year?	No_____
	Yes_____
	Don't know_____
Only answer if you responded Yes to Q44	
45. What is included in the hygiene education?	Proper handwashing_____
	Proper toilet use_____
	Water treatment_____
	Proper disposal of solid waste_____
	Don't know_____

46. Have the teachers taken a workshop/training on teaching hygiene education in the past year?	No_____
	Yes_____
	Don't know_____
47. Do teachers use the HFLE Curriculum?	Poor - all teachers are NOT using _____
	Fair - few teachers are implementing _____
	Good - all teachers are trained to use and are implementing_____
48. Is the community involved in hygiene related activities at or through the school?	No_____
	Yes_____
	Don't know_____
Only answer if you responded Yes to Q48	
49. Can you explain what activities the school does with the community related to hygiene?	Health fairs_____
	Parades_____
	House to house hygiene promotion_____
50. How strong would you say the link/connection is between the community and the school with respect to hygiene promotion/education?	No link at all_____
	Weak_____
	Moderate_____
	Strong_____
Nutrition	
51. Does the school have a feeding program?	No_____
	Yes_____
Only answer if you responded Yes to Q51	
52. As part of the school feeding program, is food provided for free or at a reduced cost to low-income students?	No_____
	Yes at a reduced cost_____
	Yes for free_____

WASH FACILITIES INSPECTION

The facilities inspection should include all improved water systems, toilets, drinking water facilities and handwashing basins, even if they are no longer in use. The same set of specific questions will be asked of up to two improved water sources and up to four improved toilets as well as drinking water fountains, drinking water buckets and handwashing basins. In total, the inspection should take 20 minutes to one hour depending on the number of facilities. Ask students or a teacher to accompany you so you can ask questions during inspection.

Question	Response
General	
1. District?	Toledo _____
	Stann Creek_____
2. Name of Village/Town/City?	
3. School Name	_____
4. Location (GPS)	_____
Water (repeat questions 5-20 for each improved water source at the school)	
5. Is there an improved water source?	yes_____
	no_____
Only answer if you responded no to Q5	
6. Type of unimproved water source?	river_____
	unprotected spring_____
	pond_____
	lake_____
	scoophole_____
	unprotected well_____
	no water source_____
Only answer if you responded yes to Q5	
7. Type of improved water source?	piped to school_____
	well with handpump_____
	well with electric pump_____
	rainwater catchment_____
	protected spring_____
8. Photo of the main water source	_____
Only answer if you responded yes to Q5	
9. Was this water source part of "the WASH Project"?	yes_____
	no_____
	don't know_____
Only answer if you responded yes to Q5	
10. When was the main water system constructed/rehabilitated?	less than 2 years_____
	2-5 years_____
	6-10 years_____
	more than 10 years_____
	don't know_____
Only answer if you responded yes to Q5	
11. Is the main water system independent or part of the community water system?	part of the community system_____
	independent_____
12. Is water available the day of the visit?	yes_____
	no_____
Only answer if you responded yes to Q5	
13. STATUS: What is the status of the school's improved water system? (researcher judgement)	Functioning properly_____
	Functioning but with problems_____
	Broken down - no current access to improved water source_____

Only answer if you responded yes to Q5	
14. Is the improved water system still in use?	yes_____
	no_____
Only answer if you responded no to Q14	
15. Why is the improved water system not being used by the school?	water is unsafe_____
	too far from the school_____
	broken down_____
	unreliable water _____
16. Is the main water source treated?	yes_____
	no_____
	don't know_____
Only answer if you responded yes to Q14	
17. What type of treatment is used for the main water source?	chlorination_____
	slow sand filtration_____
	ceramic filtration_____
	pasteurization_____
18. Is there residual chlorine in the main water source?	yes_____
	no_____
	not tested_____
19. Was a water sample taken from the main water source?	yes_____
	no_____
20. *E. coli* detected in main water source? (CFU/100 mL or P/A if Presence/Absence)	_____
Drinking Water	
21. Are there drinking water fountains or other running water drinking points?	yes_____
	no_____
Only answer if you responded yes to Q21	
22. Photo of the drinking water fountains	_____
Only answer if you responded yes to Q21	
23. Were the drinking water fountains part of "the WASH Project"?	yes_____
	no_____
	don't know_____
Only answer if you responded yes to Q21	
24. When were the drinking water fountains constructed/refurbished?	less than 2 years_____
	2 - 5 years_____
	6 - 10 years_____
	more than 10 years_____
	don't know_____
Only answer if you responded yes to Q21	
25. Is water available from the drinking fountains the day of the visit?	yes_____
	no_____
Only answer if you responded yes to Q21	
26. STATUS: What is the status of the water fountains or other running water drinking water source?	functioning properly_____
	functioning but with problems_____
	broken down_____
Only answer if you responded yes to Q21	
27. Are these drinking water facilities still being used by the school?	yes_____
	no_____
Only answer if you responded no to Q27	
28. Why are the drinking fountains not in use?	broken down_____
	water tastes/smells bad_____
	unhygienic _____

Only answer if you responded yes to Q27	
29. Is the water from the drinking fountains treated?	yes_____
	no_____
	don't know_____
Only answer if you responded yes to Q29	
30. What type of treatment is used for the first drinking water source?	chlorination_____
	slow sand filtration_____
	ceramic filtration_____
	pasteurization_____
Only answer if you responded yes to Q27	
31. Is there residual chlorine in the drinking fountain water?	yes- free chlorine_____
	yes- total chlorine only_____
	no_____
	not tested_____
Only answer if you responded Yes to Q27	
32. Was a sample of drinking water taken?	yes_____
	no_____
Only answer if you responded Yes to Q32	
33. E. coli detected in the drinking fountain water (report as CFU/100 mL if quantitative or P/A if Presence/Absence)	_____
34. Are there drinking water buckets used at the school?	yes_____
	no_____
Only answer if you responded yes to Q34	
35. Photo of drinking water buckets	_____
Only answer if you responded yes to Q34	
36. Were the drinking water buckets part of "the WASH project"?	yes_____
	no_____
	don't know_____
Only answer if you responded yes to Q36	
37. When were the drinking water buckets implemented?	less than 2 years_____
	2-5 years_____
	6-10 years_____
	more than 10 years_____
	don't know_____
Only answer if you responded Yes to Q34	
38. Is water available from the drinking water buckets the day of the visit?	yes_____
	no_____
Only answer if you responded yes to Q34	
39. STATUS: What is the status of the drinking water buckets?	functioning properly and clean with hygienic collection method_____
	functions but with problems and/or unhygienic collection method_____
	broken down and/or very dirty_____
Only answer if you responded yes to Q34	
40. Is the water from the drinking water buckets treated?	yes_____
	no_____
	don't know_____
Only answer if you responded yes to Q40	
41. What type of treatment is used for the drinking water buckets?	chlorination_____
	slow sand filtration_____
	ceramic filtration _____
	pasteurization_____

Only answer if you responded yes to Q38	
42. Is there residual chlorine in the drinking water buckets?	yes- free chlorine_____
	yes- total chlorine only_____
	no_____
	not tested_____
Only answer if you responded yes to Q38	
43. Was a water sample taken from the drinking water buckets?	yes_____
	no_____
Only answer if you responded yes to Q43	
44. *E. coli* detected in water from the drinking water buckets (report as CFU/100 mL if quantitative or P/A if Presence/Absence)	_____
45. Is there standing water on the school grounds?	yes_____
	no_____
46. Are there drinking water facilities that cater to smaller children?	yes_____
	no_____
47. Are there drinking water facilities accessible to students with physical disabilities?	yes_____
	no_____
Sanitation – Repeat questions 48-65 for each toilet installation	
48. Is there improved sanitation at the school?	yes_____
	no_____
Only answer if you responded yes to Q48	
49. What type is the main toilet facility?	piped to sewer system_____
	piped to septic tank_____
	ventilated improved pit (VIP) latrine_____
	pit latrine with slab_____
	composting toilet_____
50. Photo of the main toilet facility	_____
Only answer if you responded yes to Q48	
51. Was this main toilet facility a new construction or remodel?	new construction_____
	remodel_____
	don't know_____
Only answer if you responded yes to Q48	
52. When was the main toilet facility constructed/refurbished?	less than 2 years_____
	2 - 5 years_____
	6 - 10 years_____
	more than 10 years_____
	don't know_____
Only answer if you responded yes to Q48	
53. Was this main toilet facility constructed or refurbished as part of "the WASH Project"?	yes_____
	no_____
	don't know_____
Only answer if you responded yes to Q48	
54. Is this main toilet facility still being used by the school?	yes_____
	no_____
Only answer if you responded no to Q54	
55. Why is the main toilet facility not used?	structure is unsafe_____
	hole/tank is full_____
	broken down_____
	students don't like it_____

Only answer if you responded yes to Q54	
56. How far is the main toilet facility from the school building?	inside or attached to the building_____
	within 10m of the building_____
	10-30m from the building _____
	more than 30m from the buildng_____
Only answer if you responded yes to Q54	
57. Does the main toilet facility have sufficient lighting?	Poor - can't see clearly with the door shut_____
	Fair - Insufficient lighting with the door shut_____
	Good - sufficient lighting with the door shut_____
Only answer if you responded yes to Q54	
58. Does the main toilet facility have sufficient ventilation?	Poor - no ventilation_____
	Fair - insufficient or unsafe ventilation (bugs can enter; little airflow)_____
	Good - sufficient and safe ventilation_____
Only answer if you responded yes to Q54	
59. Is the main toilet facility secure and private?	Poor - others can easily see in (missing doors/pieces of wall_____
	Fair - others could see in but not easily (broken lock small cracks/gaps_____
	Good - secure lock others can't see in_____
Only answer if you responded yes to Q54	
60. How does the main toilet facility smell?	Poor - highly intolerable _____
	Fair - slightly intolerable_____
	Good - clean smell no foul odor_____
Only answer if you responded yes to Q54	
61. If not water sealed, are the toilet holes covered in the first toilet facility?	Poor - no hole covering available_____
	Fair - presence of cover but not covered_____
	Good - fully covered_____
	N/A- water sealed_____
Only answer if you responded yes to Q54	
62. How clean is the main toilet facility?	Poor - urgent intervention needed (any presence of fecal matter or major presence of urine dirt trash and/or graffiti)_____
	Fair - improper use (some presence of urine dirt trash and/or graffiti)_____
	Good - proper use (absence of graffiti trash dirt urine or fecal matter)_____
Only answer if you responded yes to Q54	
63. STATUS: What is the structural condition of the main toilet facility?	Poor - most don't function properly major repairs needed (broken doors cracked floors/toilet)_____
	Fair - all or most function but repairs needed (visible damage but works properly)_____
	Good - all function well (no visible damage or repairs needed)_____
Only answer if you responded yes to Q54	
64. Are handwashing facilities available within 5 m of the main toilet facility?	yes_____
	no_____
Only answer if you responded yes to Q64	
65. What is the structural condition of the sinks at the main toilet facility?	Poor - none are functioning major repairs needed_____
	Fair - all or some function but repairs are needed_____
	Good - all function well no repairs needed_____
General Sanitation Questions	
66. Number of unisex toilets that are functioning and in use	_____
67. Number of total unisex toilets that should be functioning and in use	_____
68. Number of girls' toilets functioning and in use	_____
69. Number of total girls toilets that should be functioning and in use	_____

70. Number of boys toilets that are functioning and in use	_____
71. Number of total boys toilets that should be functioning and in use	_____
72. Number of boys urinals (every 0.5 meters of urinal wall = 1 urinal)	_____
73. Are the toilets appropriately sized for the age group that uses them?	yes_____
	somewhat_____
	no_____
74. Are there toilets that are accessible to children with physical disabilities?	yes_____
	no_____
75. Are there any unimproved toilet facilities that are in use at the school?	yes_____
	no_____
76. Is there a trash bin in the toilet stalls?	yes_____
	some_____
	no_____
77. How is trash from the toilet bins disposed of?	thrown directly in a pile to later be burned/buried/collected_____
	sealed in a bag to later be burned/buried/collected_____
	N/A- there are no trash bins in the toilets_____
78. What type of sanitary cleansing material is observed in the toilets or trash bins?	appropriate (toilet paper- sanitary tissues- etc)_____
	Inappropriate (leaves- newspaper- corncobs- etc)_____
	none_____
	don't know - unable to see_____
79. Is toilet paper available to students?	yes_____
	no_____
Only answer if you responded yes to Q79	
80. Where is toilet paper kept for student use?	in the toilet stall_____
	in the classroom_____
	no toilet paper is provided by the school_____
HW facilities	
81. Is soap and water available for handwashing the day of the visit?	Neither soap nor water_____
	Soap but no water_____
	Water but no soap_____
	Yes both soap and water_____
82. Where is soap kept for handwashing?	at the toilet sink_____
	at the classroom handwashing basin_____
	in the classroom to take to the toilet_____
	N/A- no soap is provided to students_____
83. Number of functioning running water handwashing points?	_____
84. Total number of running water handwashing points?	_____
85. Number of bucket handwashing points?	_____
86. Average condition of bucket access handwashing facilities?	Dirty & Unacceptable (water appears used and dirty standing water nearby)_____
	Clean & Acceptable (clear/unused water method to pour over hands no standing water)_____
87. Is there hand drying material available at the handwashing points?	yes_____
	no_____
Only answer if you responded yes to Q87	
88. Is the hand drying material clean and hygienic? (if reusable, appears clean and seems to have been recently washed)	yes_____
	no_____

STUDENT INTERVIEW

The student interview was conducted with five male and five female students from standard five and/or six, fewer students if time was running short. For statistical significance, a larger sample size should be used if time permits. Consent was obtained verbally using a consent transcript approved by the University of Colorado Human Subjects Research Committee (IRB Protocol 0110.37) and student names were not recorded. Each interview takes 5-15 minutes depending on the length of student responses.

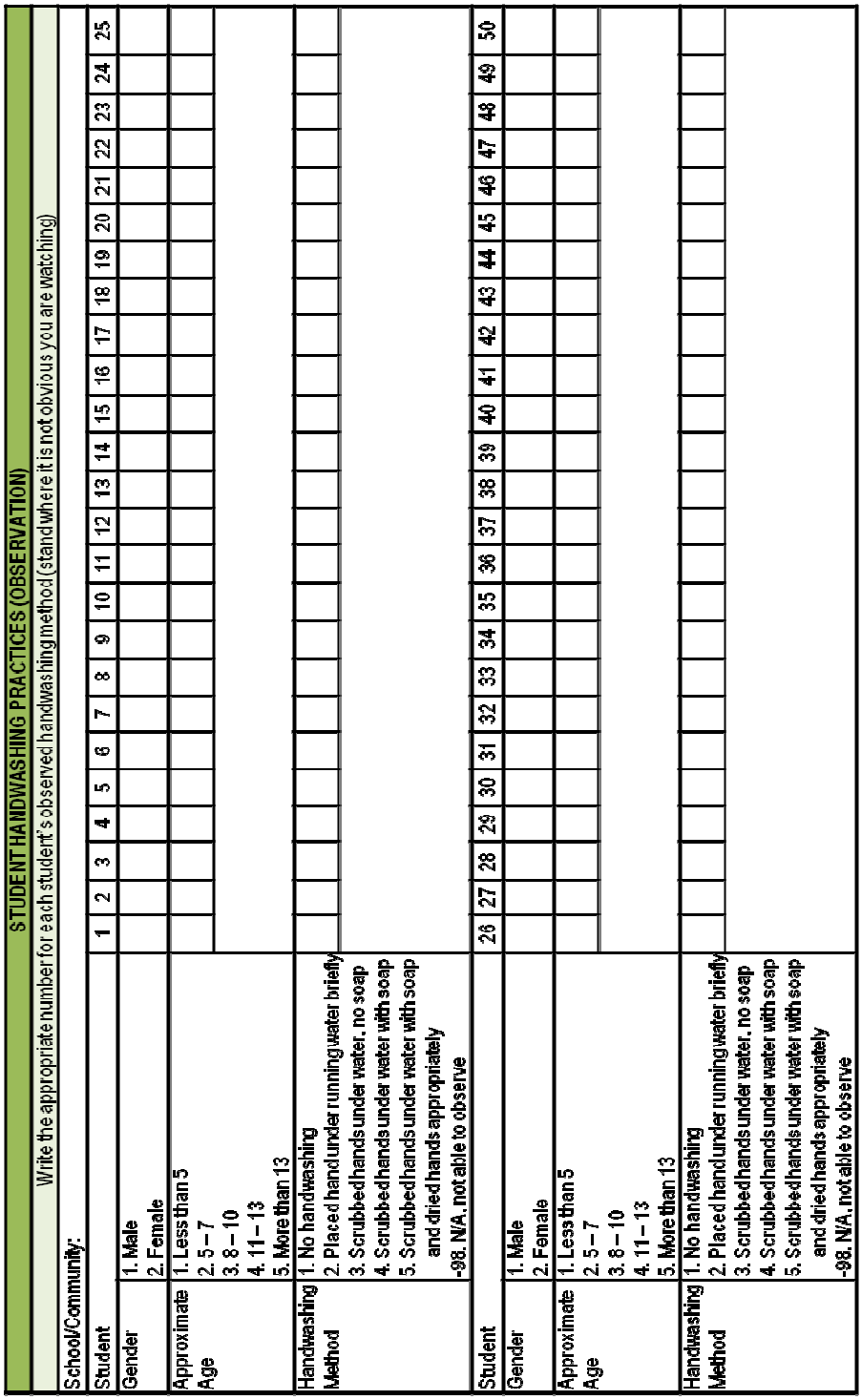
Question	Response
General	
1. District?	Toledo_____
	Stann Creek_____
2. School/community?	
3. Student number (of total interviewed)	_____
4. Consent obtained?	No_____
	Yes_____
5. Gender?	Male_____
	Female_____
6. Age?	_____
WASH knowledge	
7. Can you tell me what we could do to make dirty/unsafe water safe to drink?	Chlorination_____
	Filtration_____
	Boiling_____
	Don't know_____
	No response_____
8. If you were to make a poster to remind students about proper bathroom use, what would you include in your poster?	Do not write on walls_____
	Cover the hole/put the toilet seat down_____
	Be gentle/respectful with the fixtures_____
	Only proper materials in the toilet/hole_____
	Garbage and/or toilet paper in the bin_____
	Don't waste toilet paper_____
	Flush the toilet_____
	Don't go to the bathroom on the floor or seat_____
	Keep clean_____
	Close/lock door_____
	Don't waste water_____
	Wash your hands after_____
	Don't play in the bathroom_____
	Don't know_____
	No response_____
9. When do you think it is important to wash your hands? (mark "yes" if can list both after toilet use and before eating/handling food)	No_____
	Yes_____
	Don't know_____
	No response_____
10. Why do you think handwashing is important? (Mark "yes" if mentions reduction of hygiene/sanitation related illnesses)	No_____
	Yes_____
	Don't know_____
	No response_____
11. How many seconds do you think you should wash your hands for?	_____

WASH Satisfaction	
12. Do you drink the water at your school?	No I bring it from home_____
	No I do not drink any water while at school_____
	Yes_____
	No response_____
13. Do you like the water at your school?	No_____
	Yes_____
	Don't know_____
	No response_____
Only answer if you responded No to Q13	
14. Why not?	Dirty_____
	Smells bad_____
	Tastes bad_____
	Unsafe_____
	Not enough_____
	Hard to obtain_____
	Don't know_____
	No response_____
Only answer if you responded Yes to Q13	
15. Why?	Tastes good_____
	Cold/cool_____
	Clean - it looks clear_____
	Clean - they put chlorine in it_____
	Don't know_____
	No response_____
16. Do you like the toilets at your school? (probe: Is there anything you would want to change about them?)	No_____
	Yes_____
	Don't know_____
	No response_____
Only answer if you responded No to Q16	
17. Why not?	Dirty_____
	Smells bad_____
	No privacy_____
	Too dark_____
	Hole is scary_____
	No Toilet Paper_____
	Don't know _____
	No response_____
18. Why?	Clean_____
	"Healthy"_____
	Flushes/Sewerage_____
	Don't know_____
	No response_____
19. Do you feel that as a student, you could help improve the water and the toilets at your school?	No_____
	Yes_____
	Don't know_____
	No response_____
Health/Attendance	
20. Have you been sick in the past 2 weeks?	No_____
	Yes_____
	Don't remember_____
	No response_____

Only answer if you responded Yes to Q20	
21. What illness/illnesses did you have?	Stomach ache_____
	Diarrhea_____
	Skin infection_____
	Scabies_____
	Conjunctivitis_____
	Malaria_____
	Cold/flu_____
	Don't remember_____
	No response_____
Only answer if you responded Yes to Q20	
22. Were you absent from school because of this illness?	No_____
	Yes_____
	Don't remember_____
	No response_____
23. Have you missed school for any other reasons in the past 2 weeks?	No_____
	Yes_____
	Don't remember_____
	No response_____
Only answer if you responded Yes to Q23	
24. What was the reason?	Tired_____
	Hungry_____
	Had to work_____
	Did not have transport_____
	Don't remember_____
	No response_____
25. In the past when you missed school, what were the reasons?	Tired_____
	Hungry_____
	Had to work in field_____
	Did not have transport_____
	Had to help at home_____
	Raining/poor weather_____
	Don't remember_____
	I have never missed school before_____
	No response_____
Impact at home	
26. Do you ever tell your parent about something interesting you learned at school?	No_____
	Yes_____
	Don't know_____
	No response_____
27. Can you give an example of something you told them about?	_____
Only answer if you responded Yes to Q26	
28. Did you feel like your family listened to you or changed something at home because of what you told them?	No_____
	Yes_____
	Don't know_____
	No response_____

STUDENT HANDWASHING PRACTICES OBSERVATION

Student handwashing practices were observed throughout the school visit. These data were recorded on paper. Depending on the size of the school and if observations were possible during classroom breaks, five to forty students were observed in each school during visits of two to three hours in length.



STUDENT HANDWASHING PRACTICES (OBSERVATION)

Write the appropriate number for each student's observed handwashing method (stand where it is not obvious you are watching)

School/Community:

Student		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Gender	1. Male 2. Female																									
Approximate Age	1. Less than 5 2. 5 – 7 3. 8 – 10 4. 11 – 13 5. More than 13																									
Handwashing Method	1. No handwashing 2. Placed hand under running water briefly 3. Scrubbed hands under water, no soap 4. Scrubbed hands under water with soap 5. Scrubbed hands under water with soap and dried hands appropriately -98. N/A, not able to observe																									

Student		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Gender	1. Male 2. Female																									
Approximate Age	1. Less than 5 2. 5 – 7 3. 8 – 10 4. 11 – 13 5. More than 13																									
Handwashing Method	1. No handwashing 2. Placed hand under running water briefly 3. Scrubbed hands under water, no soap 4. Scrubbed hands under water with soap 5. Scrubbed hands under water with soap and dried hands appropriately -98. N/A, not able to observe																									

construction

Access to water

APPENDIX F - Recommended design changes for WASH Project infrastructure

Based on observation and student and teacher interviews, the following design changes are suggested for the WASH Project infrastructure:

To improve the WASH Project toilets: (1) build separation walls high enough that students can't climb or look over into the neighboring toilet stalls; (2) consider how the pit or septic tank will by emptied in the design; (3) for pit latrines, increase the size of stalls and include tile and nice fixtures (do not use the cone shaped fixtures as student report feeling like they are going to fall in when they sit on them because their feet are out in front of them); (4) provide a simpler lock mechanism that can be locked from the inside but not the outside (a strong hooking mechanism would work) as well as a strong pad lock for the outside to use at the end of the day (The current locks can be locked with no one inside and multiple toilets were accidently locked during visits and students were seen relieving themselves outside instead of retrieving the key. They are also not reassuring to the students and a hook where it is obvious it is locked well and provides security may provide more assurance to students, particularly girls); (5) include a urinal for boys; (6) if there are old toilets that can't be refurbished, destroy them for safety purposes; (7) provide a security mechanism for the sinks in communities where vandalism is of concern (tt is not recommended that sinks be constructed inside individual toilet stalls however since students tend to feel rushed when others are waiting outside and may not wash their hands properly if at all; sinks outside the stalls also allow for monitoring of student handwashing practices).

Drinking water fountain recommended design changes: (1) larger diameter drainage pipe and higher quality drain cover (one school replaced that pipe on their own to a larger diameter); (2) ensure there is proper drainage around the fountain and lengthen the basins to catch more water; and (3) provide a security mechanism where vandalism is of concern.

Rainwater catchment recommended design changes: (1) install quick disconnect valves at the exit pipe or provide a separate drain with a larger diameter pipe that can be accessed for tank cleaning and allow larger sized items to exit; (2) ensure rough filtration of water prior to entering tanks; and (3) ensure screens are securely covering all tank holes to prevent mosquitoes from entering.

APPENDIX G – SURVEY TOOLS USED IN BANGLADESH

TOILET OBSERVATION – 15 minutes (morning), 10 minutes (afternoon)

Observe toilets in the morning (AM) when you first arrive (after introductions and permission) and again in the afternoon (PM) before leaving. Observe at the same two times at each school. Two people should observe separately each time and any differences should be discussed and consensus achieved.

Date:	AM time:	PM time:	Observer:

Number of toilets and urinals (do not include toilets meant for teachers only)

		a. Functional *(unlocked, able to use, privacy)*	**b. Not-Functional** *(locked, unable to use, no privacy)*
O1	Number of **total** boys toilets		
O2	Number of boys urinals (50cm = 1)		
O3	Number of **total** girls toilets		
O4	Number of **total** co-ed toilets		
O5	Number of Save the Children toilets		
O6	Who uses the Save the Children toilets?	☐ Teachers	☐ Girls ☐ Boys

Condition of Save the Children latrines (do not include latrines meant for teachers only)

	Observation	
O7	Date of toilet inauguration (*m/yr)*	
O8	Toilet type	☐ 1. Flush ☐ 2. Pour-flush ☐ 3. Traditional dry latrine ☐ 4. Other (specify):_____
O9	Connected to	☐ 1. Septic tank ☐ 2. Other (specify): _____
O10	Still in use	☐ 1. Yes ☐ 2. No (specify why): _____
O11	Separate stalls/stance for girls & boys	☐ 1. Yes ☐ 2. No
O12	Separate stalls/stances for students & teachers	☐ 1. Yes ☐ 2. No
O13	Sized appropriately for users *(small pan, easy to reach lock and water access)*	☐ 1. Yes ☐ 2. No
O14	Distance from school building	☐ 1. > 30 large paces (steps), >30m ☐ 2. 10 to 30 large paces (steps), 10-30m ☐ 3. Less than 10 large paces (steps), <10m ☐ 4. Inside/attached to building

O15	Cleanliness *(take photos of each stall)* *(check for wall smearing)*	☐ ☐ 1. No feces on floor/wall/seat in any ☐ ☐ 2. Visible feces on floor/wall/seat in some ☐ ☐ 3. Visible feces on floor/wall/seat in all ☐ ☐ 4. Major presence of feces in all/most
O16	Flies	☐ ☐ 1. No flies in any toilets ☐ ☐ 2. Flies in a few ☐ ☐ 3. Flies in all
O17	Smell	☐ ☐ 1. No foul smell in any ☐ ☐ 2. A bit of a foul smell in some ☐ ☐ 3. A foul smell from inside all ☐ ☐ 4. A foul smell from outside the toilets
O18	Doors	☐ 1. All doors close/lock ☐ 2. Some do not close/lock ☐ 3. No doors close/lock ☐ 4. Doors are missing
O19	General functionality *(take photos of each toilet)* *(test each toilet if possible)*	☐ ☐ 1. All stances function well; no repairs needed ☐ ☐ 2. All function but minor repairs are needed ☐ ☐ 3. One or more stances don't function ☐ ☐ 4. None of the stances function
O20	Water seal functionality	☐ ☐ 1. Water seal is functioning in all stalls ☐ ☐ 2. Water seal is broken in some stalls ☐ ☐ 3. Water seal is broken in all stalls
O21	Privacy	☐ 1. Others can't see in and lock is secure ☐ 2. Others can't see in, but lock is not secure ☐ 3. Others can see in, but not easily (cracks) ☐ 4. Others can easily see in (holes)
O22	Lighting (with door closed)	☐ ☐ 1. Sufficient light ☐ ☐ 2. Can't see clearly ☐ ☐ 3. Can barely see, if at all
O23	Water source in the toilet	☐ 1. Functional tap ☐ 2. Non-functional tap ☐ 3. Jerry can
O24	Sufficient quantity of water	☐ ☐ 1. Yes, sufficient for washing and flushing ☐ ☐ 2. Insufficient for proper washing and flushing ☐ ☐ 3. No water
O25	Location of handwashing facilities	☐ 1. Inside toilet stall ☐ 2. Just outside toilets (within 10 paces) ☐ 3. Inside or near the classroom ☐ 4. No handwashing facilities
O26	Availability of soap and water at the handwashing facilities	☐ ☐ 1. Water & soap ☐ ☐ 2. Water only ☐ ☐ 3. Soap only ☐ ☐ 4. No
O27	Evidence of soap use? Note.	
O28	**Total functional** handwashing taps (#)	

TEACHER INTERVIEW GUIDE – 1.5 hours

Introduce yourself and explain the purpose of the study (based on the key points in the consent form). This is not an evaluation; it's a study to help Save the Children improve their SHN program. Their honest responses will remain confidential and will be very helpful. The interview will take about 1.5 hours and can be completed by multiple people if there is not one person available for that long.

The following interview guide provides a baseline for questions, but follow-up and probing questions may be needed to provide in-depth answers. If there is a lack of clarity on any questions, other teachers should be asked for confirmation. Note who gave which answers in the data collection sheet (R1, R2, R3). Familiarize yourself with the questions so that the interview flows like a conversation.

School, Date, Audio File:

Respondent 1 Position/Gender, R1:

Respondent 2 Position/Gender, R2:

Respondent 3 Position/Gender, R3:

General Questions

T1. How many female students are enrolled at the school?

T2. How many male students are enrolled at the school?

Demand *(ask someone who was present at implementation)*

T3. How was the school selected to have Save the Children toilets constructed? What was the process to be involved? Did you have to submit an application? *(probe for any evidence of demand)*

Construction *(ask someone who was present at implementation)*

T4. Could you describe the construction (or repair) process for the toilets? Who paid for materials? Who paid for construction? *(probe: anyone else?)* Who constructed the toilets? Where were they from? *(probe: if it was a repair, who constructed the original toilets and who made the repairs?)*

T5. Did anyone monitor the toilet construction (or repair)? If yes, can you explain the construction monitoring? Did anyone "insure the design"? Who? Was there a written document?

T6. How do you feel about the quality of the construction/repair and materials used for the toilets provided by Save the Children?

Local Participation *(ask someone who was present at implementation)*

T7. Was the school involved in planning and construction of the toilets? If yes, who? *(probe: teachers, students)* How? *(probe: design and location decisions, attending meetings)*

T8. Was the village (or parents) involved in planning and construction of the toilets? Who? How? *(probe: design and location decisions, attending meetings)*

T9. Was the SMC involved in planning and construction of the school toilets? Who? How? *(probe: design and location decisions, attending meetings)*

Latrine Maintenance *(ask someone who has been at the school since implementation)*

T10. Has anything needed repair in the Save the Children built latrines? If yes, what broke? How long did it take to repair? Why? What do students do while toilets are being repaired?

T11. When things break in the toilets, what are the reasons usually? *(probe: poor quality construction or materials, improper use by students, vandalism)*

T12. Has there ever been a time where water was not available in the toilets in the past week? Month? Year? If yes, what are the reasons? What's the longest time there has been no water in the toilets? How often does this happen? *(note running water vs. bucket-collected)*

T13. Do you feel the quantity of water at the school is sufficient for all school needs and to encourage good hygiene (toilet cleaning, flushing and handwashing)? If no, why not?

Maintenance Planning

T14. What are the challenges you face with maintaining the latrine facilities? What do you think is essential to ensure that toilets are repaired in a timely manner?

T15. Who is responsible for repairing the latrines provided by Save the Children? Was this responsibility clear upfront prior to construction? *(probes: Who pays? Who makes the repairs?)*

T16. Who cleans the school toilets? How often are the toilets cleaned?

T17. Does anyone monitor the school toilets for cleanliness and repair needs? Who? How often?

T18. Do you have a maintenance plan for the school toilets? What's included? *(probe: does it say who is responsible for cleaning, repair, monitoring? frequency of activities?)* Is it written down? *(note if plan is observed)*

T19. Did anyone at the school or village receive training on how to maintain the toilets? If yes, can you describe the training? What was included? *(probe/check for: daily/weekly cleaning; fixing broken taps, water seals, inside bolt/locks; provision of soap; emptying the latrine once filled, etc.)* Who was trained? By who? When was the training?

T20. If yes, do you feel this training has been helpful? *(note: ask someone who was trained)* Why/why not? If not all teachers were trained, did they pass along the information to others? *(note: ask someone who was not directly trained if possible)*

Supply Chain

T21. If the tap broke in the toilet, what would you do? How long do you think this would take to repair? Why? How far away can a replacement part be found *(distance, time)*? How far away can someone who knows how to fix it be found *(distance, time)*?

T22. If the toilet platform/slab cracked, what would you do? How long do you think this would take to repair? Why? How far away can replacement parts be found *(distance, time)*? How far away can someone who knows how to fix it be found *(distance, time)*?

Local Support & Access

T23. Does the village or parents contribute financially or in-kind to toilet maintenance at the school? *(probe: amounts, examples)*

T24. Does the village or parents provide soap for the school? If so, is this sufficient to cover the year? If not sufficient, how much of the year's soap supply is covered by the village/parents?

T25. Do HHs all have their own toilet? Similar to the school toilet? If not, is it a familiar design? Were latrines provided to some community members by Save the Children?

T26. Do people from the village ever use the school toilet? Are there any issues with vandalism?

Active SMC (or other WinS committee)

T27. Does the school have an SMC? If yes, what does the SMC do related to sanitation and handwashing at the school? Has the SMC supported toilet maintenance at the school in the past year? Has this been helpful? How?

T28. How many times did the SMC meet between January 1 and June 1, 2012? How many of the SMC members attended in the last 3 SMC meetings?

Government Involvement & Support

T29. Has anyone from the government visited the school to discuss sanitation or handwashing this year? If yes, who? How often do they visit? What do they do when they come? What do they say? *(note: if more than one person visits, follow questions for each government person)*

On-going Support from Save the Children (or partner NGO)

T30. How many times has the Save the Children Field Officer visited your school between January 1 and June 1, 2012? What do they do/say when they come? *(probe: anything else? note activities and messages related to the toilets or handwashing).* Has anyone else from Save the Children visited this year? Who?

Access to Funding for O&M

T31. How does the school pay for toilet maintenance needs (repairs and cleaning materials)? Any other sources? Where does this money come from (note if multiple sources)? How much is available from each source? *(If they have not had repair needs, ask as a hypothetical question)*

T32. What are the challenges with finding funding for toilet maintenance? *(note: try to avoid appearing as a funder, only a researcher/student/volunteer)*

Local WASH Champion — ask FOs which of their schools have a champion

T33. Is there a teacher that is responsible for sanitation and hygiene at the school? What is their role?

T34. Is there anyone in the village or SMC who is highly involved in sanitation and hygiene at the school? If yes, who? What do they do?

Children's Engagement

T35. Are there little doctors at this school? If yes, what do they do? *(probe: anything else? Are they involved in toilet maintenance and student handwashing? How? How often?)*

Hygiene Education & Promotion

T36. Do teachers provide hygiene education to the students? If yes, how frequently? In all classes? What teaching materials are used? *(note if the materials were observed and if the handwashing lesson was signed off in the log book)*

T37. Are there any challenges in providing hygiene education? If so, what?

T38. Have any teachers been trained on hygiene education this year? If yes, how many? Who trained them? What did the training consist of? *(probe: anything else? toilet use and handwashing?)*

T39. How frequently would you say an individual student hears handwashing reminders at school? How is the message given? *(probe: from teachers, little doctors, etc.)*

T40. Has the school conducted handwashing activities in the past year? Was the community involved? How so? What percentage of the community was involved?

T41. Do you think parents encourage their children to develop good handwashing practices at home? What percentage of homes in the village do you think have water and soap for handwashing?

Handwashing (Outcome)

T42. Is soap (or ash) always available for students to wash their hands? *(probe: If yes, has there been a time in the past week when there was no soap? Past month?)*

T43. Where is soap available for students to use?

T44. What are the challenges to providing soap/ash/sand?

T45. Who provides the soap (or ash) at the school? How do they pay for it? Where is this money from?

T46. What percentage of students do you think wash their hands after using the school toilet? What percentage do you think use soap? What percentage do you think wash both hands?

T47. Is there a process for monitoring student handwashing? If yes, what is the process?

T48. When students don't wash their hands after using the school toilet, what are usually the reasons?

Local Satisfaction

T49. Are you satisfied with the Save the Children built toilets? What do you like about them? Is there anything you would change? *(probe: anything else?)*

T50. What advice would you give Save the Children to improve their sanitation and hygiene program? *(probe: planning, design, construction, training, and anything else felt to be important)*

Closure

T51. Is there anything you want to add?

LITTLE DOCTOR INTERVIEW – 10 minutes

During the school day, ask to speak with at least one little doctor to ask a few questions.

Hello, my name is [INTERVIEWER NAME] and I am working with Save the Children here in the Bangladesh and the University of Colorado in the U.S.A. I'm here at your school to learn about water and sanitation at schools in Bangladesh. I would like to ask you a few questions about your thoughts on the school's sanitation and hygiene, such as the toilets and handwashing, and your experiences as a little doctor. The interview will take about 10 minutes and will be recorded so that I can be sure to remember exactly what you said later, but I will not share the recording with anyone and if you prefer, I don't have to record it.

Your teacher selected you for an interview since you are a little doctor at the school. You do not have to participate if you don't want to. You can quit any time along the way if you want as well. If you don't like a question, you don't have to answer it. Nothing bad will happen to you if you decide that you don't want to participate or you don't want to answer a question. Other than the research team, such as me, no one will know your answers. Not even other people at the school or in the community.

Would you like to participate in the interview?

If "no", thank the student and tell them they are free to go
If "yes", thank the student and start the interview

Interview Questions

D1. Do you like being a little doctor? Why/why not?

D2. What is your role as a little doctor? How often do you meet with your peers? What do you discuss during peer sessions?

D3. Do your teachers and peers support your role as a little doctor? How?

D4. Do you clean the toilets at school? How do you feel about cleaning the toilets? Do other students or teachers help?

STUDENT FOCUS GROUP GUIDE – 45 minutes

After the voting activity, select 3-4 female students and 3-4 male students (not including little doctors) to participate in a focus group (separately) for 30 minutes each. Snacks should be provided but food should not be used as an incentive for participation. To maintain comfort and confidentiality, ask to be alone with the students (no teachers or field officers). The focus group should be recorded and gender of respondents noted. No little doctors should be included since they are interviewed separately.

Student Consent Script

The key points of the script should be memorized and discussed with students before the focus group.

Hello, my name is [FACILITATOR NAME] and I am working with Save the Children here in the Bangladesh and the University of Colorado in the U.S.A. I'm here at your school to learn about water and sanitation at schools in Bangladesh. I would like to ask you a few questions about your thoughts on the school's sanitation and hygiene, such as the toilets and handwashing. The group interview will take about 45 minutes and will be recorded so that I can be sure to remember exactly what you said later, but I will not share the recording with anyone and if you prefer, I don't have to record it. You have been selected to participate at random from class 4 (or 5). You do not have to participate if you don't want to. You can quit any time along the way if you want as well. If you don't like a question, you don't have to answer it. Nothing bad will happen to you if you decide that you don't want to participate or you don't want to answer a question. Other than the research team, such as me, no one will know your answers. Not even other people at the school or in the community.

Would you like to participate in this group interview?
If "no", thank the student and tell them they are free to go
If "yes", thank the student and include them in the focus group

Focus Group

School, Date, Audio file:

Number of students who gave informed consent:

Start by asking students general questions about the school and village. (e.g. What their favorite subjects are? Do they like sports?) Share with them a bit about you as well.

Handwashing

S1. Is there a place at the school to wash your hands? Where?

S2. In the past week, has there ever been a time where water was not available for handwashing? Past month? Year? How often is it not available?

S3. Is there soap at the school that you can use to wash your hands? Where is the soap normally kept? *(probe: at sink, at handpump, in classroom, have to ask teacher)*

S4. In the past week, has there ever been a time where soap was not available for handwashing? Past month? Year? How often is it not available?

S5. Out of 10 students from class 1 to class 4 at your school, how many do you think wash their hands after using the school toilet? *(probe: facilitate discussion among the students to try to come to an agreed number)*

S6. Of the [Number from S5] students that wash their hands after using the toilet, how many do you think use soap (or ash/sand) when they wash their hands?

S7. Of the [Number from S5] students that wash their hands after using the toilet, how many do you think wash both hands when they wash their hands?

S8. Why do you think sometimes people wash their hands after using the toilet, and sometimes they don't? *(probes: any other reason?)*

S9. Why do you think sometimes people use soap/ash/sand and sometimes they don't?

S10. What are the reasons for sometimes washing only one hand and sometimes both?

Hygiene Education and Promotion

S11. Does anyone ever talk to you or remind you about handwashing? Who? *(probe: parents, teachers, friends, little doctors, field officers)* What do they say? When? *(probe: during class, which class? outside class, when?)* How often does someone talk to you about handwashing? *(probe: at least once per month, only once ever, etc.) (Note: go through all the questions for each information source given)*

S12. Are there signs or paintings about handwashing at your school? What do they say?

S13. Are the signs helpful? How are they helpful?

S14. Does anyone ever talk to you about proper toilet use? Who? *(probe: parents, teachers, friends, little doctors)* What do they say? When? How often? *(Note: go through all the questions for each information source given)*

S15. Are there little doctors at your school?

S16. What do they do? *(probe: anything else?)*

S17. Do they talk to you about anything? What do they tell you? *(probe: anything else?)* How often do you have little doctor sessions?

Toilet Use & Maintenance

S18. In the activity earlier there was a question about using the toilet at school. When students avoid going to the school toilet, what are the reasons? Does this happen a lot in your school? How often?

S19. Has there ever been a time that you couldn't use the toilet when you needed to? When was the last time? How long was the toilet unavailable? How often does this happen? What are the reasons? *(probe: are there any other reasons?)*

S20. Are there ever times when water is not available in the toilets at school? *(probe: frequency and duration with no water)*

S21. Are there times when the school toilets are dirty? Could you describe what it's like when they're dirty? How long do they stay dirty before they are cleaned?

S22. Are the toilets at school comfortable to use? What do you like about them? *(probe: anything else?)* If you could change something about them, what would you change? *(probe: anything else?)*

S23. Do your homes have a similar type of toilet? What's different? Which type do you prefer? Why?

Closure

S24. Is there anything you want to add about toilet use and handwashing at the school or home?