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THE PERVASIVENESS OF TECHNOCRACY IN SANITATION DEVELOPMENT AND ITS IMPACT ON PROJECT SUSTAINABILITY: A CASE STUDY OF THE MICROBIAL FUEL CELL LATRINE PILOT PROJECT IN NYAKROM, GHANA

A Thesis Presented
By
KATHRYN FOX

Submitted to the Graduate School of the University of Massachusetts Amherst in partial fulfillment of the requirements for the degree of

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Landscape Architecture and Regional Planning
THE PERVERSIVENESS OF TECHNOCRACY IN SANITATION
DEVELOPMENT AND ITS IMPACT ON PROJECT SUSTAINABILITY: A
CASE STUDY OF THE MICROBIAL FUEL CELL LATRINE PILOT PROJECT
IN NYAKROM, GHANA

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ABSTRACT

THE PERVASIVENESS OF TECHNOCRACY IN SANITATION DEVELOPMENT AND ITS IMPACT ON PROJECT SUSTAINABILITY: A CASE STUDY OF THE MICROBIAL FUEL CELL LATRINE PILOT PROJECT IN NYAKROM, GHANA

FEBRUARY 2015

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Approximately 2.5 billion people in the world currently lack access to adequate sanitation facilities. Improving sanitation access in the developing world is vitally important to public health, economies, and the environment. Non-governmental organizations and the private sector have played a significant role in increasing sanitation access through the construction of sanitation and hygiene systems. However, these projects have been plagued with sustainability problems with the rate of non-functional systems remaining consistently at 30 to 40 percent since the 1980s. Studies have found that meaningful community engagement and the consideration of community capacity during project development are vitally important to long-term project sustainability. However, development practitioners frequently undervalue the importance of these factors and fail to adequately employ them when developing sanitation projects.

This thesis examines the dominance and impact of one key influence that leads development practitioners to overlook community context and engagement – the prioritization and overvaluation of technological solutions to development problems.
Through a case study of the Microbial Fuel Cell (MFC) Latrine built by three University of Massachusetts Amherst engineers in Nyakrom Ghana I demonstrate an example of the impact that a technocratic focus can have on the operation and maintenance sustainability of a sanitation project.

In this thesis I maintain that the technocratic focus of this project is not unique but is part of a larger trend toward technocracy among water, sanitation, and hygiene development donors and practitioners. These technological approaches can neglect the important role that political, social, economic, and cultural factors play in increasing sanitation access. This thesis reviews three frameworks that the MFC Latrine engineers and other practitioners could use to better understand and incorporate community capacity and participation into sanitation projects – Asset Based Community Development, the appropriate technology framework by the World Health Organization and IRC Water and Sanitation Centre, and the WASHTech Technology Applicability Framework.
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CHAPTER 1
INTRODUCTION

In 2012, the United Nations Children’s Fund (UNICEF) and the World Health Organization (WHO) Joint Monitoring Program on Water and Sanitation estimated that approximately 2.5 billion people, or 37 percent of the world’s population, do not have access to “improved” sanitation facilities (UNICEF and WHO 2014). This is a significant improvement from 1990 when UNICEF and WHO estimated that 51 percent of the world’s population did not have access to adequate sanitation. However, sanitation access has not increased equitably throughout the world. While some countries have seen significant growth in coverage since 1990, other countries, particularly those in Sub-Saharan Africa and South Asia, have seen little to none as demonstrated in figure 1.1. In Sub-Saharan Africa, approximately 70 percent of people still do not have access to improved sanitation (UNICEF and WHO 2012).

Since the International Drinking Water and Sanitation Decade of the 1980s, non-governmental organizations (NGOs) and the private sector have led the effort to increase water and sanitation access in developing countries (Carter 2012). These NGOs typically take responsibility for funding, planning, and constructing water supply, sanitation, and hygiene (WASH) projects (Carter 2012). After construction, the community that will use the system is typically expected to operate and maintain it (Carter 2012). This community-based operation and maintenance usually requires the community to organize

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1 An improved sanitation facility has a connection to a public sewer, connection to a septic system, is a pour-flush latrine, a simple pit latrine, or a ventilated improved pit latrine. Unimproved facilities include: public or shared latrines, open pit latrines, or bucket latrines.
a voluntary committee, perform basic maintenance, protect water sources, and finance the upkeep of the system (Carter 2012).

Figure 1.1 World map showing disparities in sanitation access (UNICEF and WHO 2014)

Unfortunately, for the past few decades, sanitation development projects have been plagued with sustainability problems. The rate of non-functional systems has remained consistently at 30 to 40 percent since the 1980s (McPherson and McGarry 1987, Bredero and Brikke 2003, Lockwood and Smits 2011, Carter 2012, European Union Court of Auditors 2012). Studies have shown that sustainability is most negatively impacted when communities lack the capacity or resources to operate and maintain the systems as they were originally planned (Narayan 1995, WaterAid 2011, Lockwood and Smits 2011); the technology is inappropriate for the context in which it was built (Narayan 1995, Bredero and Brikke 2003, WaterAid 2011); there is inadequate financial capital for operation and maintenance (Narayan 1995, WaterAid 2011, Lockwood and
Smits 2011, Carter 2012, Barnes et al. 2011); and/or communities do not have participation in the planning process and ownership over the system (Narayan 1995, Carter et al. 1999, Barnes and Ashbolt 2010, Barnes et al. 2011, WaterAid 2011). However, despite the importance of community participation and contextual factors to the sustainability of WASH operation and maintenance, development practitioners often fail to understand and adequately incorporate them into the development of WASH systems.

1.1 Research Focus

At its heart, this thesis is an examination of a key underlying reason why development practitioners and NGOs often overlook the importance of context and community engagement to the sustainability of WASH operation and maintenance – the dominance and prioritization of WASH technology by development practitioners and donors. The orientation of development donors and practitioners to technical solutions is nothing new. Development professionals have long emphasized technical solutions to the developing world’s problems. However, this trend is particularly problematic for WASH development where the longevity and sustainability of projects are so dependent on the context in which they are built.

As such, the primary objective of this thesis is to understand the prevalence and persistence of technocracy in the field of WASH development and the ways and extent to which this approach could impact the sustainability of WASH projects. The focus of this thesis on the impact of technocracy on WASH project sustainability resulted from an analysis that I conducted of the Microbial Fuel Cell (MFC) Latrine project that was built by University of Massachusetts Amherst engineers in Ghana.
The MFC Latrine is a single-user toilet and urinal connected to a microbial fuel cell that turns human waste and urine into compost, electricity, and treated wastewater. The MFC Latrine was developed by a team of five engineers including two environmental engineering graduate students from the University of Massachusetts-Amherst and three engineering professors (one environmental engineering faculty from UMass, two mechanical engineering faculty from Arizona State University). In 2011, the Gates Foundation Grand Challenge Exploration initiative funded development of the first prototype and the team’s initial trip to Ghana with a $100,000 grant. In May 2012, the engineers spent three weeks constructing the pilot MFC Latrine at the Nyakrom Secondary Technical School in Nyakrom Ghana.

However, within a couple of weeks after the MFC Latrine team left Nyakrom in May 2012, they learned that the users were not operating and maintaining the latrine properly. In the fall of 2012, the engineers gave me the opportunity to help them analyze the factors that impacted operation and maintenance in the fall of 2012. I used a grounded theory approach to identify and analyze the primary factors that occurred during the planning and construction phases of the project, from November 2011 through May 2012, which negatively impacted the operation and maintenance of the MFC Latrine pilot project.

In the analysis I quickly found that the engineers’ prioritization of the MFC Latrine technology led them to overlook and misunderstand the contextual factors and engagement of the school community. It was with that finding that I decided to focus this thesis on understanding the prevalence of this technocratic approach to WASH development and the possible impacts of this approach on WASH sustainability. I use the
case study of the MFC Latrine project to show a specific example of how the prioritization of technology could impact the operation and maintenance sustainability of a sanitation project. The full case study is presented in chapter 4.

In chapter 5 I review relevant literature and professional studies to demonstrate the pervasiveness of technocracy in WASH development and how this could more widely impact WASH project sustainability. I provide evidence from the development literature about the challenges that technocratic approaches pose to development challenges to show how technocracy could present problems for the sustainability of sanitation projects.

1.2 Thesis Outline

In chapter 2 I describe the methods used to collect and analyze data for the MFC Latrine case study. In particular, I define the grounded theory analysis method I used to identify the factors that impacted MFC Latrine operation and maintenance.

Following the methodology, in chapter 3, I review academic literature to identify and describe the major factors that typically impact the sustainability of sanitation development projects. I use this literature later in the thesis when I analyze the MFC Latrine pilot planning and construction phases and consider the factors that may have negatively impacted the operation and maintenance of the pilot project.

In chapter 4, I then present the case study of the MFC Latrine pilot project. In this chapter, I first describe the original project proposal and what actually occurred during the planning, construction, and operation and maintenance phases of the project. I then describe and analyze the factors that negatively impacted operation and maintenance.
In chapter 5, I discuss and contextualize the case study’s findings. In particular I demonstrate that the prioritization of technology in MFC Latrine pilot is reflective of a larger trend toward technocracy in WASH development. The primary purpose of this chapter is to discuss the prevalence and ascendance of the technocratic approach to WASH development. I review literature to demonstrate how this trend could possibly impact sanitation project sustainability.

Chapter 6 provides specific recommendations of tools and frameworks that the MFC Latrine team could use to better understand community context and capacity to improve the sustainability of the latrine operation and maintenance at the school or in future iterations of the MFC Latrine.

I conclude the thesis with chapter 7 where I summarize the findings and discuss the limitations of this research and future research needs.
CHAPTER 2
METHODOLOGY

2.1 Case Study Research Design

The purpose of the MFC Latrine case study is to identify the primary factors that occurred during the planning and construction phases that negatively impacted the operation and maintenance of the pilot project in Ghana. Throughout the past couple years, the engineers have analyzed and reflected on the technological aspects of the project that need improvement. As such, I do not evaluate the science or technology of the pilot project. Instead, I focus on the “softer” aspects of the planning and construction phases that often influence the sustainability of operation and maintenance practices. This can include features such as community engagement and capacity and the social and cultural characteristics of the school and the engineers.

I used a grounded theory approach to identify the various categories of influences on the MFC Latrine pilot operation and maintenance, the levels and relationships of those categories to one another, and the properties of each of those categories. According to Charmaz, “grounded theory methods consist of systematic, yet flexible guidelines for collecting and analyzing qualitative data to construct theories ‘grounded’ in the data themselves” (Charmaz 2006, 2). Rather than beginning research with a specific hypothesis to prove or established set of theories to test, grounded theorists start with their data when doing research and ground their findings and theories in the data. Grounded theory is primarily used to create deep, nuanced description and interpretation about a phenomenon (Charmaz 2006). Theorists use their data to develop a theoretical
framework that “refines, extends, challenges, or supercedes extant concepts” (Charmaz 2006, 169). In grounded theory, researchers use theoretical concepts that have emerged from the data to support or question existing literature and theories (Brown 2006).

Grounded theorists typically use a method of “constant comparison” throughout all stages of the analysis. This means that theorists are constantly comparing data with data to identify themes and important concepts. These themes and concepts shape subsequent data collection and analysis until overarching theory begins to emerge, after which theorists start comparing the data to the emerging theory. The grounded theory analytical process typically consists of coding, memoing, diagramming, and sorting to identify and develop core categories and theories (Charmaz 2006). Coding means assigning descriptive categories or themes to portions of text. Memoing and diagramming consists of writing down notes and ideas and creating diagrams to help develop categories and theories. Coding, memoing, and diagramming are iterative and occur throughout the grounded theory process.

I decided to use a grounded theory approach over a more positivist approach for the analysis of the MFC Latrine, because I wanted to develop a deep understanding of the factors that occurred during the planning and construction phases of the pilot project that impacted operation and maintenance. I wanted to find the explicit and implicit explanations for the disintegration of the latrine operation and maintenance and develop a breadth and depth of knowledge about what had occurred during the planning and construction of the MFC Latrine that impacted its operation and maintenance. Grounded theory is a fitting approach to achieve this goal in that it allows an understanding of the MFC Latrine pilot to emerge from the data itself.
2.2 Case Study Data Collection

The data for the analysis came primarily from semi-structured interviews with the three primary engineers of the MFC Latrine project. I conducted the first interview with Joe Goodwill, a doctoral candidate in Civil and Environmental Engineering, in September 2012. I interviewed Dr. Caitlyn Butler, the principal investigator and Assistant Professor of Civil and Environmental Engineering, in November 2012. I conducted the final interview with Cynthia Castro, a doctoral candidate in Environmental Engineering in February 2014.

Grounded theorists typically seek to collect “rich data” from a small number of cases that are chosen to help develop a deep understanding of a particular event or situation (Charmaz 2006). Theorists continue collecting data until all categories have been “saturated” and no new categories or properties emerge (Charmaz 2006). Given that Goodwill, Dr. Butler, and Castro were primarily responsible for the planning and construction phases of the project, I did not seek to interview anyone else. Other possible interviews could have included the two professors at Arizona State University or Mary Kay Jackson, the engineer in Ghana. However, given the peripheral role that these three played during the planning and construction phases, I did not believe that their interviews would add anything new to the analysis of what occurred during the planning and construction phases.

Before each interview, I developed an initial list of questions and topics that I wanted to cover. My interview with Goodwill had a fairly broad focus. I asked him a wide range of questions to obtain basic information about the planning and construction of the latrine, the operation and maintenance, and his perceptions about what went well
and what could have gone better. In keeping with the “constant comparison” method, the questions I asked Dr. Butler and Castro were more focused and oriented toward collecting information on particular themes and categories of information that I had identified as important while analyzing the previous interviews. I recorded each interview, with the engineers’ permission, using a hand-held recorder. I transcribed each interview, verbatim, in Microsoft Word.

For the analysis and interpretation, I also drew upon project documents supplied by the engineers to supplement the information I collected from the interviews. These documents include the Gates Foundation proposals; correspondence from the Gates Foundation to Dr. Butler regarding the first proposal; monitoring data from 2012; the slideshow that the engineers presented to the school in Ghana; and the construction, maintenance, and data collection manuals that the engineers developed and gave to school officials before they left Ghana.

2.3 Case Study Data Analysis

I began coding Goodwill and Dr. Butler’s interviews in the fall of 2012 during Dr. Ellen Pader’s class, Interpreting Qualitative Research. I uploaded both transcriptions into the qualitative research software program, MAXQDA, for coding. For Goodwill’s interview, I first did line-by-line coding, followed by focused coding. For Dr. Butler’s interview, I did sentence-by-sentence coding, followed by focused coding. For both interviews, the focused coding concentrated on specifically identifying factors that may have negatively impacted operation and maintenance. Instead of having two coding systems (one from each interview) to compare, I sought to create just one coding system.
that covered both interviews, enabling me to compare the interviews at a conceptual level in addition to a substantial level.

After coding both interviews separately, I had a long list of relatively disorganized codes about the factors that may have affected operation and maintenance of the latrine. I reorganized the list of codes in MAXQDA, categorizing and sorting the codes into broader categories of codes that made the most analytical sense. After this reorganization, I went back through both interviews to ensure that all ideas and relevant parts of the interviews had been properly coded. The full initial code system is included in the appendix.

In January 2014, I switched from using MAXQDA to using Nvivo 10, a qualitative research software package produced by QSR International. At this point, I had not revisited the MAXQDA code system presented above in approximately nine months. As such, when I uploaded Goodwill and Dr. Butler’s interview transcriptions in Nvivo 10, I took the opportunity to recode both interviews to see whether I would create the same codes or whether new codes would emerge. For both interviews, I did focused coding, once again concentrating on the factors that may have impacted operation and maintenance. After interviewing Castro in February 2014, I uploaded her interview transcription to Nvivo 10 and did focused coding as well. This list of focused codes is included in the appendix.

Once I had finished focused coding all three interviews in Nvivo, I compared and reflected on the codes that I had created during the fall of 2012 and in February 2014. In general, the focused codes I created in February 2014 were similar to the focused codes that I created in the fall of 2012. However, I did not yet understand the relationships of
these codes to one another. For instance, was one of the identified factors actually caused by another? Could some of these codes be collapsed into one larger code? I created diagrams to develop the levels of codes and to explore the relationships of these codes to one another. I began this process by thinking backwards about the disintegrating operation and maintenance. I identified the factors that directly led to the failing operation and maintenance and continued backwards until I had identified the highest level of influences on latrine operation and maintenance.

I determined that there were four core categories of codes that had the most significant impact on the latrine operation and maintenance. These core categories are:

- Prioritizing technology
- Insufficient time
- Inadequate engagement and education with the school community
- Insufficient information about the school context and users

Once I had identified the core categories, I did axial coding for each category. According to Charmaz, axial coding “specifies the properties and dimension of a category and reassembles the data you have fractured during initial coding to give coherence to the emerging analysis” (Charmaz 2006, 60). During axial coding, a grounded theory researcher elaborates on each category and draws connections between categories and their subcategories and properties (Charmaz 2006). Properties are the elements that make up the broader category – the who, when, where, how, and why of the category (Charmaz 2006).

To do this axial coding, I made a parent code for each of the four core categories in Nvivo and went back through the three interviews to code every statement that
pertained to each of these categories. I printed out the full list of coded statements for each category to more easily examine each one. I then went through the printed lists and created sub-codes to identify the specific properties of each code. Over several weeks, I developed a list of properties that make up each concept. I developed more diagrams and memos to explore the range of properties and their relationships to one another and to the core categories. The core categories and their properties are discussed at length in the Chapter 4, Analysis of the MFC Latrine Pilot Planning and Construction. Figure 2.1 shows a visual description of the data analysis process.

Figure 2.1 Data analysis process
CHAPTER 3

LITERATURE REVIEW

Prior to beginning the analysis of the MFC Latrine pilot project, I had already completed a literature review on the concept of sustainability in the fields of international water and sanitation development. Grounded theorists typically review the extant literature later in their research process than do researchers taking a more positivist approach. However, the concept of sustainability and what influences it has been a long-discussed topic in the fields of water and sanitation development. A literature review on how academics and professionals conceptualize sustainability provides important context and insight for the analysis. In particular, I use this literature review in the analysis chapter to demonstrate how the initial operation and maintenance of the latrine is reflective of the factors that typically impact sanitation project sustainability.

In this chapter, I examine the definition of sanitation sustainability and the factors that academics and professionals have found most significantly impact sustainability. In Chapter 5, Discussion and Interpretation and Chapter 6, Tools and Frameworks, I review additional literature to situate my main findings and to provide information on the best practices and solutions to improve sustainability.

3.1 Sustainability of Sanitation Development Projects

The most frequently cited definition for sustainable water, sanitation, and hygiene (WASH) services came from Len Abrams in 2000. He said that sustainable WASH systems “continue to work and provide benefits over time” (Abrams 2000, Carter et al.)
2010, WaterAid 2011, Lockwood and Smits 2011). Other professionals and scholars have added that sustainable systems are operated and maintained at the local level with limited external support (Bredero and Brikke 2003); do not adversely impact the environment, people, or other services (Bredero and Brikke 2003, Barnes 2011); and have all costs covered at the local level (Bredero and Brikke 2003, Abeysuriya et al. 2008).

In 1987, McPherson and McGarry provided one of the first comprehensive reports about WASH sustainability. They found that in numerous developing countries, including Nepal, Bangladesh, and Kenya, 30 to 50 percent of water supply systems were no longer functioning (McPherson and McGarry 1987). Since then, studies have shown that the number of unsustainable WASH systems in the developing world has remained consistently at 30 to 40 percent (Bredero and Brikke 2003, Lockwood and Smits 2011, Carter 2012, European Union Court of Auditors 2012).

Because the continued functioning of these systems is crucial to public health, the environment, and economies, a number of studies have sought to determine the factors that negatively impact sustainability. Key studies have collectively identified over 50 different factors that impact the sustainability of rural water supply and sanitation projects (Narayan 1995, Carter et al. 1999, Bredero and Brikke 2003, Carter et al. 2010, Barnes and Ashbolt 2010, Barnes et al. 2011, Triple-S 2011, WaterAid 2011, Carter 2012). However, the factors largely fall into four broad categories: insufficient community capacity to operate and maintain systems; poor quality and inappropriateness of the technology; inadequate financial capital for construction, operation, and maintenance; and ineffective and insufficient community participation and ownership.
Below I describe each of these categories and the corresponding literature in greater detail.

3.2 Community Capacity to Operate and Maintain Systems

Since the 1980s, non-governmental organizations (NGOs) have often taken responsibility for the construction of systems and the initial capital investment, while leaving the management of the systems up to communities (Carter 2012). Community management is typically administered through a community WASH user committee that is charged with overseeing the proper operation and maintenance of the system and collecting tariffs (Carter 2012). According to Harvey and Reed (2006), community management of WASH systems has prevailed for the past few decades for several reasons: there is limited government capacity and commitment to provide adequate service delivery; it works well for NGOs who can construct the project, hand off responsibility to communities, then leave the area for months or years; and it fits the western “cultural idealization” of communities in low-income countries.

However, the one factor all the studies claim negatively impacts sustainability is the lack of community capacity to operate and maintain systems (Narayan 1995, Carter et al. 1999, Bredero and Brikke 2003, Carter et al. 2010, Barnes and Ashbolt 2010, Barnes et al. 2011, Lockwood and Smits 2011, WaterAid 2011, Carter 2012). Communities frequently do not have the skills, knowledge, or resources to maintain the physical infrastructure of the system, particularly when there are major problems such as rapid corrosion of important parts or when the WASH technology is not harmonious with the community’s existing social and cultural traditions and capacity (Narayan 1995, Carter et al. 1999, Bredero and Brikke 2003, Carter et al. 2010, Barnes and Ashbolt 2010, Barnes
et al. 2011, Lockwood and Smits 2011, WaterAid 2011, Carter 2012). Similarly, communities often need help securing needed supplies; responding to major disruptions to the systems such as climate change impacts, population increases, and natural disasters; and managing conflict and power issues surrounding the user committees (Narayan 1995, WaterAid 2011).

Lyons and Reimer (2006) identified two perspectives on the definition of community capacity. One perspective sees community capacity as a static resource, for instance, high levels of leadership equals high levels of capacity. However, the more popular perspective is that community capacity is a process whereby communities “organize their assets and resources to achieve objectives they consider important” (Lyons and Reimer 2006). Chaskin (2001) adopts the latter perspective in his definition of community capacity. He describes it as “the interaction of human capital, organizational resources, and social capital existing within a given community that can be leveraged to solve collective problems and improve or maintain the well-being of a given community. It may operate through informal social processes and/or organized effort” (Chaskin 2001, 295).

Both Chaskin (2001) and Reimer (2006) outline the process through which community capacity is built and used. In his model of community capacity, Chaskin (2001) said that community capacity is made up of four fundamental characteristics – sense of community, level of commitment for what happens in the community, ability to solve problems, and access to resources. Three different levels of social agency – individuals, organizations, and networks – engage these characteristics to perform certain functions, such as organizing and mobilizing citizens for collective action. Performing
these functions can lead to an increase in the fundamental characteristics of community
capacity or can lead to other outcomes that benefit the community. Chaskin (2001)
additionally found that communities use different strategies for building their community
capacity. Each community is subject to community-level or regional-level factors that
may inhibit or facilitate their community capacity.

Similar to Chaskin, Reimer (2006) describes the process of community capacity
as starting with basic community assets and liabilities such as economic and social
capital, human skills and abilities, and natural resources. Individuals and groups
reorganize and manage those assets and liabilities to produce outcomes. These outcomes
can then become new assets and liabilities (Reimer 2006).

At the heart of both of these models of community capacity is the existing assets,
or capital, of communities, which are used to build more community capacity or to
produce other beneficial outcomes. All communities have access to seven different
forms of capital: physical, human, social, financial, environmental, political, and cultural
(Green and Haines 2011, Green and Goetting 2010). The amounts and types of capital
that exist within each community are unique, interdependent, differ in importance and
value between communities, and are in constant flux (Bebbington 1999, Kretzmann and

Both Chaskin (2001) and Reimer (2006) stated that ‘social capital’ is one of the
fundamental characteristics of community capacity. Social capital is most commonly
defined as the relationships, trust, networks, and norms that facilitate collective action
(Putnam 1993, OECD 2001) and is both an individual and community asset (Marre and
It is developed over long periods of time and does not wear out with use, but diminishes if it is not used (Roseland 2005).

Ballet et al. (2007) pointed out that social capital is contextual and will look different and have different outcomes in different places. They argued that the social capital of a community is closely tied to its cultural capital. Cultural capital is defined as “the product of shared experience through traditions, customs, values, heritage, identity, and history” (Roseland 2005, 11). The relationships, networks, and norms of social capital are deeply embedded in the cultural context of a community and together, social and cultural capitals define a community’s power relations (Ballet et al. 2007).

In line with the argument that social capital is fundamental to community capacity, both Barnes and Ashbolt (2010) and Narayan (1995) emphasized in their studies that understanding the community’s existing social fabric and conditions is important to securing the sustainability of WASH projects. Understanding existing power relations, relationships, and social structure is necessary to develop a functioning user committee (Barnes and Ashbolt 2010, Carter 2012). However, one of the common critiques of community-based management of natural resources is that it is often based on unrealistic, romanticized, and oversimplified assumptions about communities’ social structure (Li 2002, Leach et al. 1999). In particular, plans for community-based management assume that communities are relatively homogenous and that social consensus and solidarity will prevail over social divisions (Leach et al. 1999). This leads to management plans that do not reflect or respect the divisions and power relations within a community (Leach et al. 1999).
3.3 Quality and Appropriateness of the Technology

Sustainability of WASH systems is negatively affected when the technology used is inappropriate for the community, i.e., it does not provide the level of service the community wants (or provides more service than the community wants), replacement parts are difficult to get hold of, or the basic operation and maintenance needs exceed the skillset of the community (Narayan 1995, Bredero and Brikke 2003, WaterAid 2011). Sustainability will also suffer when the quality of the technology is poor (WaterAid 2011).

“Appropriate technology” is a concept that is frequently touted as a way to overcome some of these issues with technology in development (Schumacher 1973, Zelenika 2011, Smillie 2000). Appropriate technology was conceived in 1965 by a British economic planner, Ernst F. Schumacher. Schumacher and the non-profit he founded called the Intermediate Technology Development Groups (ITDG) advocated for development technologies that were “appropriate” for developing societies, particularly rural areas (Zelenika 2011). Appropriate technologies would be small-scale, simple, not capital-intensive, and non-violent in that they would not cause social and environmental disruption (Zelenika 2011). These intermediate technologies would fall somewhere between “labor-intensive, inefficient traditional technologies” and large-scale, capital-intensive technologies (Schumacher 1973, Zelenika 2011, Smillie 2000).

Ten years later, there were approximately 500 groups with an appropriate technology focus, and by 1980, the number had further increased to 1,000 (Smillie 2000). Appropriate technology has been applied to a wide range of sectors including healthcare, education, and water supply and sanitation (Murphy et al. 2009, Zelenika 2011). While
its definition has evolved and varies widely, currently, developing appropriate technologies typically means implementing technologies that are context specific and developed for a particular locality (Murphy et al. 2009, Zelenika 2011). Appropriate technology must: meet basic needs of users; incorporate sound technology; meet local capabilities by using local materials and resources; be affordable and sustainable; encourage local participation; be culturally and socially appropriate; and consider gender issues (Murphy et al. 2009, Zelenika 2011).

However, critics of appropriate technology say that appropriate technologies are complex and difficult to design, implement, and disseminate, and can fail if there is not adequate and stable funding and institutional support (Smillie 2000, Zelenika 2011). In a study of appropriate technology projects, Zelenika (2011) found that appropriate technology development came up against four types of barriers: 1) social barriers (e.g., cultural norms, developing trusting relationships, socio-economic limitations); 2) communication and information barriers (e.g., not having access to knowledge, outcomes of other projects); 3) technological barriers (e.g., technical robustness, specifications); and 4) socio-technical barriers (e.g., differing definitions of technical appropriateness, difficulties with dissemination and adoption of technology).

### 3.4 Financial Capital for Maintenance and Renewal

Another factor that most of the studies identified as an obstacle to sustainability is inadequate financial capital to cover the costs of operation, maintenance, and system renewal (Narayan 1995, WaterAid 2011, Lockwood and Smits 2011, Carter 2012, Barnes et al. 2011). Frequently, at the beginning of the project life-cycle, planning is done for the initial capital investment to construct the WASH system but not for the post-construction
management and renewal costs (Lockwood and Smits 2011, Barnes et al. 2011, Carter 2012). After a WASH system is constructed, communities will need financial resources to pay for supplies, maintenance, and repairs. They will need to begin putting money aside for the possibility that the entire system will one day need to be replaced (Carter 2012, Lockwood and Smits 2011).

However, frequently, there is a lack of planning and understanding within the user community about the recurring costs needed to maintain the system and who is responsible for these costs (Lockwood and Smits 2011, WaterAid 2011, Carter 2012). Carter (2012) posits that frequently, the financial costs that communities are supposed to raise are “unacceptable, unaffordable, or impractical.” WaterAid (2011) raises the reality that there are often certain individuals or households within communities that must be subsidized, including those that are too poor to pay regular tariffs. What often ends up happening is that when systems break down, user committees attempt to collect the needed money at the last minute, often without success, and the WASH services become non-functional (Lockwood and Smits 2011, WaterAid 2011, Carter 2012).

The financial aspects of WASH projects are one of the least understood and studied (WaterAid 2011, Lockwood and Smits 2011, Carter et al. 2010). Practitioners do not fully know the true recurrent costs of a WASH service and how to convey those costs to users and set up an adequate tariff structure to cover the costs (Carter et al. 2010). The studies recommend that NGOs and communities use financial forecasting and planning to ensure that the entire life-cycle costs of systems are understood and covered by community tariffs (Narayan 1995, WaterAid 2011, Lockwood and Smits 2011, Carter 2012, Barnes et al. 2011). WaterAid (2011) also proposes that communities seek funding
support and cost-sharing with external agencies, especially local governments and institutions.

3.5 Community Participation and Ownership

In 1995, the World Bank’s study on WASH sustainability found that community participation in service planning and decision-making was the single most important factor in service sustainability (Narayan 1995). Since then, other studies have confirmed this point (Carter et al. 1999, Barnes and Ashbolt 2010, Barnes et al. 2011, WaterAid 2011). When communities do not have meaningful input during the planning, design, and implementation phases of the project and do express their need and desire for the service, communities will have low motivation and capacity to operate and maintain the systems post-construction (Narayan 1995, WaterAid 2011). Demand for the service is necessary to overcome challenges to service management (WaterAid 2011). If an NGO expects a community to change its practices and develop ownership over the service, community participation must be a priority throughout all stages of a project (Barnes and Ashbolt 2010, Narayan 1995, WaterAid 2011). Communities must have control and decision-making power over all implementation details – the what, when, how, and where of WASH implementation (Narayan 1995).

However, not all community participation processes are implemented effectively. Theories about public participation practices describe a spectrum of ways in which participation is interpreted and used (Arnstein 1969, Pretty et al. 1995, Rowe and Frewer 2005). At one end of the spectrum is passive participation, where citizens are simply informed and educated about projects, and tokenism, where practitioners extract some information and opinions from citizens, but the citizens lack any decision-making power
(Arnstein 1969, Pretty et al. 1995, Rowe and Frewer 2005). At the other end of the spectrum is partnership, where practitioners and citizens negotiate and share decision-making, and citizen control, where citizens have full power over decision-making (Arnstein 1969, Pretty et al. 1995, Rowe and Frewer 2005).

Development practitioners have a tendency to standardize participatory approaches (Barnes and Ashbolt 2010) and to focus on addressing issues concerning the physical infrastructure of WASH services rather than the social organization needed to maintain it (Narayan 1995). Given the variations in social context across communities, studies recommend that development practitioners should tailor participation for different communities (Barnes and Ashbolt 2010, Barnes et al. 2011).

3.6 Conclusion

Although the literature is comprehensive and clear about the factors that directly impact sustainability, it is not explicit about the underlying influences on those factors. For example, there is abundant literature that discusses the necessity of sufficient community capacity to operate and maintain WASH projects; however, the literature does not often discuss why development practitioners build projects that are not within a community’s capacity to operate and maintain. The literature is also clear about the impact of ineffective community participation processes on sustainability, but does not discuss why development practitioners conduct ineffective participation processes in the first place. What are the factors that lead development practitioners to create context-inappropriate projects with ineffective community participation?

The next chapter describes the case study analysis of the MFC Latrine project in Ghana. This case study provides an example of one of the major reasons why
development practitioners overlook the importance of context and community participation – the prioritization of the technology. I discuss this concept at length in the context of the larger WASH field in chapter 5.
CHAPTER 4
ANALYSIS OF THE MFC LATRINE PLANNING AND CONSTRUCTION

The primary purpose of this chapter is to present the case study of the MFC Latrine and identify the factors that most significantly impacted the operation and maintenance of the MFC Latrine pilot project. Rossman and Rallis (2012) define analysis as detailed description of a project that provides deep insights about the processes, activities, and people of the project. With that definition in mind, in this chapter, I present an analysis of the planning and construction phases of the MFC Latrine pilot that took place from the receipt of the first grant in the November 2011 through the end of the engineers’ first trip to Ghana in May 2012. I use a grounded theory approach to identify the key factors that led to the initial disintegration of the operation and maintenance of the pilot project.

I begin this chapter by first describing the original plan and expectations for the pilot project as described in the original Gates Foundation proposal, the timeline and activities that occurred during the planning and construction phases, and what actually occurred during the operation and maintenance phases to provide context for the analysis. I spend the rest of the chapter identifying and detailing the primary factors that impacted the operation and maintenance of the MFC Latrine pilot. The interviews with Dr. Butler, Goodwill, and Castro provide the bulk of the data for the chapter, although I also draw upon written project reports and proposals to fill in details.
4.1 Original Plan for the MFC Latrine Pilot Project

In October 2010, Dr. Butler submitted a proposal to the Gates Foundation Grand Explorations competition for the MFC Latrine. As stated in the proposal, the goal of the project was “to adapt pit latrines in the developing world to remove organic substrates and nitrogen compounds from human waste while simultaneously producing electricity. This will be accomplished by using a microbial fuel cell that directly transforms biochemical energy into carbon neutral electricity” (Butler 2010). Figure 4.1 shows a diagram of the MFC Latrine. It is set up as a basic composting latrine, where all waste from the toilet goes into a chamber above the ground. All the solid waste settles in the composting chamber where it will turn into useable compost over time. The liquid waste is filtered from the solid waste into the anode where bacteria consume the organic matter and deliver an electron to the cathode. In a separate intermediate chamber, urine (ammonium) from the urinal is transformed into nitrate by bacteria and the effluent is delivered to the cathode. In the cathode, microorganisms capture the energy from the electrons delivered from the anode and reduce the nitrate to nitrogen gas, which leads to the creation of electricity (Butler 2010, Butler et al. 2012).

According to the original proposal, the engineers would complete the project in two phases. Phase 1 would consist of constructing and testing the MFC Latrine at the University of Massachusetts-Amherst campus, identifying materials needed for the technology that would also be readily accessible in the developing world, and developing a construction and maintenance plan.
During phase 2, the engineers would first go on a site visit to the chosen village in Ghana, choose an appropriate location for the MFC Latrine and begin to educate the residents about the project. Dr. Butler anticipated that this first site visit would occur during May 2011 (Butler, personal communication, January 2014). The engineers would then go on a second trip in the summer of 2012 to install the MFC Latrine and to hire a local Ghanaian graduate student to monitor it and educate the users for three months after its installation (Butler 2010).

In the proposal, Dr. Butler identified both technical and social metrics that the engineers would use to evaluate the success of the project. The technical indicators would consist of metrics on organics, nitrogen removal, and electricity output. The social metrics would measure the economic value, social acceptance, and sustainable health
impact of the MFC Latrine (Butler 2010). Upon success of the pilot, Dr. Butler planned to develop a business opportunity for the village by which they would be trained on, and take responsibility for, any further MFC Latrine construction, monitoring, and maintenance (Butler 2010).

4.2 Implementation of the Planning and Construction Phases

In reality, the implementation of the planning and construction of the MFC Latrine pilot did not occur as anticipated in the project proposal. The funding for the MFC Latrine pilot started later than Dr. Butler had originally anticipated, in November 2011 as opposed to the spring of 2011. According to Dr. Butler, this meant that the engineers were left with only one summer in which they could travel to Ghana. As a result, they made just one site visit to Ghana in May 2012 to build the MFC Latrine (Butler, personal communication, January 2014).

When the funding for the pilot began in November 2011, Dr. Butler hired Castro as a graduate research assistant to design, build, and test a prototype of the MFC in a lab at the University of Massachusetts-Amherst. Castro began developing the reactor in December 2011 and spent the next five months designing and constructing the MFC in the lab. By May, Castro had designed and built a prototype of the MFC that the engineers would construct in Ghana.

During this same time period, Dr. Butler recruited Goodwill to create a construction plan for the latrine superstructure. Goodwill had led the development of multiple sanitation projects in rural Africa prior to this project, particularly in Malawi. He developed the idea for the composting part of the latrine and the list of materials that they would need to build the latrine superstructure.
Throughout the planning phase, Dr. Butler oversaw the efforts of Goodwill and Castro and coordinated with the two engineering professors at Arizona State University (ASU), where Dr. Butler was previously employed, to plan the trip and choose the Ghanaian village in which the latrine would be built. The ASU professors, Brad Rogers and Mark Henderson, run a non-profit out of the ASU campus called GlobalResolve. GlobalResolve develops technologies and programs for energy, clean water, and economic development in rural areas of developing countries. Through GlobalResolve, Henderson and Rogers had developed numerous development projects throughout Ghana. They used their connections in Ghana to identify the town of Nyakrom for the MFC Latrine pilot.

Nyakrom is a town of approximately 22,000 people located in south-central Ghana, about two hours west of Accra, the capital city of Ghana. In July 2011, three people died from a cholera outbreak in Nyakrom (Ghana News Agency 2011a). A few months later, the 1,500 students of the Nyakrom Secondary Technical School (Nyastech) appealed to the Nyakrom municipal authorities and the Minister for Food and Agriculture for better sanitation facilities, claiming that they had only one bathhouse and a five-seater shared toilet facility located a distance from their dorms (Ghana News Agency 2011b). As a result, when Dr. Butler, Castro, Goodwill, and the two professors from ASU traveled to Nyakrom for the three-week construction trip in May 2012 to build the first MFC Latrine prototype, the town Chief, Nana Bonsu, advised the engineers to construct the latrine at Nyastech.

Nyastech is a boarding school for approximately 1,500 high school students from around the country (Garbrah, personal communication with Castro Castro, May 2013).
The students range in age from 13 to 19 with about two-thirds boys and one-third girls (Garbrah, personal communication with Castro Castro, May 2013). Approximately 600 of the students live in hostels at the school and the other 900 commute from their homes, mostly by foot (Knutson 2014).

During the first week of the trip, Nana Bonsu hired local construction workers to help build the MFC Latrine, and the engineers and construction workers began to build the latrine superstructure. The latrine superstructure would consist of a single toilet and urinal housed in small, enclosed cinder block structure. Nana Bonsu recommended that the engineers build a Western-style toilet, as opposed to the squat toilet that the engineers had initially planned to construct. The functioning of the MFC technology also required that there be a urinal to provide regular stream of urine to the MFC.

The second week, the engineers and construction workers finished building the superstructure and began to build the MFC. During these first two weeks, the engineers and construction workers made frequent trips to the market in town to buy materials.
With the exception of the graphite rods, a key element of the MFC, all the materials for the superstructure and the MFC were acquired in Ghana. They finished building the MFC during the third week and gave a presentation to the school science classes that described how the MFC Latrine works and how to use it properly. At the end of the presentation, the science teachers helped the engineers choose six students to act as the “stewards” of the MFC Latrine. In order for the waste to stabilize and compost, after every use of the toilet, the users would need to throw either toilet paper or wood chips into the toilet. The student stewards would be responsible for refilling the toilet paper and woodchips and keeping the latrine clean. The engineers spent the final few days before they left giving tours of the MFC Latrine to the students and faculty.

Figure 4.3 Latrine superstructure and microbial fuel cell. Credit: Cynthia Castro 2012

Toward the end of the trip, the engineers created a memorandum of understanding with Mary Kay Jackson, an American engineer living in Ghana who co-founded a nonprofit called Pure Home Water. The memorandum made her the “owner” of the
latrine and primarily responsible for monitoring and collecting data on its performance. She agreed to monitor and collect data twice per month. The memorandum also made Jackson responsible for repairs to the MFC Latrine. She would pay for repairs with the Gates Foundation grant money.

4.3 Initial Operation and Maintenance of the MFC Latrine

When the engineers left Ghana in May 2012, the operation and maintenance phase of the project began. The engineers expected that the students and school staff would use the latrine as instructed and the student stewards would clean the latrine and ensure that the woodchips and toilet paper were replenished. Jackson would monitor the latrine and collect data on the technical metrics. However, a couple of weeks after the engineers left, they received a report from Jackson that the latrine was unclean, and the users had not used the wood chips and had filled the urinal with toilet paper. After that, Jackson monitored the MFC Latrine only about once every other month, as opposed to twice per month – the frequency to which she had initially agreed.

The improper use of the latrine had negative implications for the functioning of the MFC Latrine. Without consistent urinal use and the influx of ammonium that comes from it, the MFC was unable to produce consistent electricity. In the laboratory at the University of Massachusetts-Amherst, the MFC had produced a maximum of 2.5 mW/m³ of electricity. However, during the first three months of operation in Ghana, the MFC produced a maximum of 0.6 mW/m³, closer to the average operation the engineers observed in the laboratory (Butler et al. 2012). Furthermore, without regular disposal of toilet paper and woodchips into the composting chamber that would stabilize the sludge, the latrine would be unable to produce useable compost.
4.4 Analysis of the MFC Latrine Planning and Construction

In the initial proposal for the MFC Latrine, the engineers had planned to conduct extensive education and engagement with users during their trips to Ghana. During their interviews, the engineers expressed regret that they did not spend more time engaging and educating the school community and paying more attention to the “social” aspects of planning and construction. They felt that the lack of attention to what one of the engineers called “social planning” negatively impacted the latrine operation and maintenance.

There is no doubt that the engineers faced significant, unexpected time constraints during the implementation of the planning and construction of the latrine that impacted their ability to carry out the initial plan for the latrine. As discussed early in this chapter, the funding for the MFC Latrine began later than expected, in November 2011, as opposed to May 2011. This left Dr. Butler and Castro with significantly less time to develop the MFC prototype in the lab and meant that Castro was developing the
prototype right up until the engineers left for the trip to Ghana in May 2012. This
timeline also meant that the engineers were unable to make the initial planning site visit
to Ghana to choose a location and educate and engage with the users. Castro described
additional time challenges during the construction trip to Ghana. The construction of the
latrine superstructure and MFC took longer than they had originally anticipated. Castro
claimed that this left them with little time at the end of the trip to engage and educate
users and to observe the initial implementation of the MFC Latrine. Instead, they spent
nearly the entire trip constructing the MFC Latrine.

The time constraints impacted the activities and timeline of the planning and
construction phases; however, these constraints do not tell the whole story. The engineers
knew both before and after the planning and construction phases that the non-
technological aspects of the project, such as the education and engagement of the users,
would be important to its successful implementation. As such, why, when they were
confronted with the time constraints, did the engineers sacrifice the original goals of
working with and empowering the community and tracking the economic value, social
acceptance, and health impact of the latrine?

4.4.1 Prioritizing Technology

Through the grounded theory analysis, I found one clear overarching answer to
this question – the consistent prioritization of the technological aspects of the project. The
most obvious evidence of this was the engineers’ almost exclusive focus on developing
and building the latrine superstructure and the MFC throughout the planning and
construction phases. From the beginning, the engineers intended the MFC Latrine to be
an “experiment” and not a system the school could rely upon for their sanitation needs.
They put significant effort into developing the MFC prototype, buying materials, constructing the MFC Latrine, and creating guides for construction and monitoring. Since returning, they have focused on building new versions of the MFC that produce more electricity and can be built in other parts of Ghana. When discussing the implications of poor operation and maintenance of the latrine, the engineers focused on how the insufficient operation and maintenance would hurt performance data, the electricity outputs of the latrine, and their chances for further funding.

This prioritization of the MFC Latrine technology spurred the development of other factors that negatively impacted the operation and maintenance of the MFC Latrine. Prioritizing technology led to inadequate engagement and education with the school community and an insufficient understanding about the school context and the users. As a result, the school did not develop ownership over the MFC latrine, the users were not educated and motivated to operate and maintain the latrine properly, and the latrine was not integrated into the existing maintenance systems and practices of the school. Ultimately, this led to the initial breakdown in operation and maintenance of the latrine. Throughout the rest of this chapter, I describe each of these elements in more detail. Figure 4.5 illustrates each of these factors and their relationships to one another.
4.4.2 Inadequate Education and Engagement with the School

As discussed in Chapter 3, Literature Review, meaningful community participation is critical to the sustainability of the operation and maintenance of WASH projects (Narayan 1995, Carter et al. 1999, Barnes and Ashbolt 2010, Barnes et al. 2011, WaterAid 2011). The literature discusses the importance of having communities engaged throughout all phases of a project, from planning through construction and implementation (Barnes and Ashbolt 2010, Narayan 1995, WaterAid 2011). The community and the users should have decision-making power, particularly in planning for the operation and maintenance of the project (Narayan 1995).
Throughout the MFC Latrine planning and construction the engineers communicated little with school leaders, faculty, staff, and students and infrequently solicited their input into the construction of the latrine. Throughout the construction phase, the engineers informally educated and engaged students and faculty about the latrine, telling students and staff about it whenever they stopped by the site during construction. The only formal presentation happened a few days before the engineers left Nyakrom when the engineers gave a presentation to the science classes about how the system works and how to operate and care for the latrine. At the end of the presentation, the engineers and the science teachers chose six students to help maintain the latrine. Their responsibilities would include filling the bucket of wood chips, replenishing toilet paper, and keeping the latrine clean. Before leaving, the engineers gave the headmaster and science teachers, a copy of the construction and maintenance manual and a year’s supply of toilet paper. The science teachers also received a copy of the presentation that was given to the students. This was the extent of what the engineers did to engage the school in the construction of the latrine and to educate the school community on the operation and maintenance of the latrine.

In retrospect, the engineers all collectively identified the lack of education and engagement with the school as their primary regret. They claimed that they should have held more assemblies and formal meetings with the school community to teach them about the latrine and to develop their interest in the project. One of the engineers talked about the need for “continued education” where the students and faculty are continuously engaged and educated about the latrine and the importance of maintaining it.
Ultimately, the lack of education and engagement with the school community led the users to develop little ownership over the MFC Latrine and to not fully understand how to properly operate and maintain it. As I will discuss in the next section, the lack of communication and engagement with the school and focus on technology led the engineers to collect insufficient information about the school community. Figure 4.6 demonstrates the causal relationship between prioritizing technology and inadequate education and engagement.

Figure 4.6 Relationship between prioritizing technology and inadequate education and engagement

4.4.3 Insufficient Information about Context

A consequence of this lack of communication with the school and the focus on technology was that the engineers did not have the necessary information to successfully
integrate the MFC Latrine into the school context. In particular, they did not have sufficient information about the existing school maintenance systems, the sanitation preferences of the students and faculty, and what would motivate the students to operate and maintain the latrine properly. Instead, they based the planning and construction and the plans for maintenance on misinformation and assumptions about the school, its systems, and its people. Figure 4.7 demonstrates the relationship between inadequate education and engagement and prioritizing technology with insufficient information about the context and users. Below I discuss each of the three categories of assumptions that the engineers made about the context: school maintenance systems, users’ motivations to operate and maintain the MFC Latrine, and users’ sanitation preferences.

Figure 4.7 Relationship between inadequate education and engagement and prioritizing technology
**Maintenance Systems:** The lack of communication and involvement with the school, particularly the school leadership, meant that the engineers did not have sufficient information about existing maintenance systems. As a result, they made assumptions about the MFC Latrine maintenance at the school and who would be primarily responsible for the maintenance.

The MFC Latrine maintenance primarily consists of keeping it clean, ensuring the availability of toilet paper or woodchips, making repairs when needed, and harvesting the compost on an annual basis. The primary plan that the engineers made for the maintenance of the latrine was to recruit six students to be the “stewards” of the MFC Latrine. However, in hindsight, the engineers were unsure about whether the student stewards were actually the appropriate people to charge with maintenance. They conceded that they did not fully understand how facilities are typically maintained and cleaned at the school and the role that the students play in cleaning and maintaining facilities. One of the engineers said that, “Our impression is that students do a lot of the work so we didn’t think it was a stretch to extend it to the toilet. But they may be coordinated in a way that is not under the umbrella of this.”

While in Ghana, the engineers developed a memorandum of understanding with Mary Kay Jackson that made her responsible for repairs to the MFC Latrine in the short-term. Jackson would pay for repairs out of the grant money. However, over the long-term, the engineers were unsure about who would make and pay for repairs to the MFC Latrine if the grant money ran out or Jackson ended her involvement with the project.

The impact of these assumptions about how the MFC Latrine would be maintained at the school was that the MFC Latrine was not formally integrated into the
existing school maintenance systems and did not have a long-term, sustainable maintenance plan. This is a key reason why the MFC Latrine was not sufficiently cleaned or maintained after the engineers left.

**Motivation of Users:** When the engineers did educate and engage the school community on latrine operation and maintenance, they made assumptions about what would motivate the students and faculty to take ownership of the latrine. A common assumption that the engineers made was that, because the school has a strong science and technology focus, the science would motivate students and staff to properly operate and maintain the latrine. When the engineers spoke to the students and faculty about the latrine, they often framed it as a science experiment. According to one of the engineers, “We framed it as, well, you’re science students and this is our experiment, this is how you can participate.” The school assembly focused heavily on the implementation and functioning of the technology, describing how the MFC Latrine works and how the users should operate it.

The engineers had strong feelings of ownership over the latrine and seemed to project those feelings onto the school and the latrine, assuming that the school community would value and have pride in the unique latrine as well. According to one of the engineers, when talking about the students who were recruited to help maintain the latrine, “The hope with having the ambassadors that they would take care of it because it’s like your baby.” Another engineer stated that, “I thought we had an environment where people were pretty well educated. I thought we had a lot of stakeholder buy-in…I thought it would be a point of pride thing. We tried to impress on people that this is the
first thing like it ever. This is a big deal. And we left and I don’t think the message took the way I hoped it would.”

While the engineers were present in Ghana, there was significant excitement from the students and faculty about the MFC Latrine. However, that excitement dwindled when the engineers left and they were unable to sustain enthusiasm toward the MFC Latrine. In hindsight, the engineers found that these messages were not as compelling as they had hoped they would be. Given the poor and improper operation and maintenance, the users were clearly not motivated by these messages.

**Sanitation Preferences of the Users:** Throughout the interviews, the engineers raised concerns about whether the latrine design was appropriate for the school. The latrine design required the users the throw toilet paper or wood chips in the toilet after use. The paper or wood would help stabilize the sludge and make it compostable. However, the report from Jackson indicated that the users were throwing the toilet paper in the wood chip basket and then the urinal when the basket got full. After their return to the United States, the engineers found out that in Ghana there are places where septic systems cannot process toilet paper. As a result, people throw toilet paper into waste baskets. A similar issue occurred with the style of toilet. On a recommendation from Nana Bonsu, the engineers had created a sit-down, Western-style toilet for the latrine; however, it appeared from the photos and reports from Jackson that some of the users were squatting on top of the toilet seat to use the latrine.

The engineer’s decisions about the design and requirements of the operation of the toilet were largely based on misinformation and assumptions about the sanitation preferences of the school. In developing the latrine, the engineers assumed that the users
would use a urinal, were familiar with sit-down and composting toilets, and would use and throw toilet paper into the toilet. However, in reality, because the school community consists of students and faculty who hail from different parts of Ghana, they had a wide range of familiarity with the type of sanitation facility that the engineers had developed.

4.5 Conclusion

The MFC Latrine pilot reflects some of the common contributors to unsustainability as described in chapter 3. The literature describes effective community participation as one of the most important influences on the sustainability of WASH projects. However, the engineers did not adequately engage the school community in the planning and decision-making about the latrine. As a result, the school lacked the motivation and knowledge to properly operate and maintain the latrine, and the engineers did not have adequate information about the context to tailor the operation and maintenance systems to the existing capacity and preferences of the school community.

The prioritization of the MFC Latrine technology led the engineers to overlook and misunderstand the contextual factors and the importance of community engagement. In the next chapter, I demonstrate that this focus on technology is not unique to the MFC Latrine project but is part of a larger trend toward technocracy in the WASH development field.
CHAPTER 5

INTERPRETATION AND DISCUSSION

In the case study, as I analyzed the reasons why the school community did not have ownership, knowledge, or motivation to operate and maintain the MFC Latrine, I found that the consistent prioritization of the technology led to the unsustainable operation and maintenance of the latrine. However, the prioritization of the technology in the MFC Latrine project is not unique to this project. It is indicative of the pervasiveness of technocracy in water and sanitation development projects and philanthropy and in engineering culture and education. This trend toward technocracy, which emphasizes technical solutions and expertise and the application of business principles to development problems, directly influenced the MFC Latrine project.

In this chapter, I describe the prevalence and persistence of the technocratic approach to international development, particularly in water and sanitation development. I discuss the documented problems with this technocratic approach in international development and the ways in which this trend has directly impacted the MFC Latrine pilot project. I emphasize that while technology certainly has a role to play in improving access to sanitation, there are numerous, critical, non-technical factors that impede access to sanitation. The idea that sanitation access is primarily a technological problem with technological solutions fails to account of the importance of context and the social, political, economic, and cultural dimensions of the world’s sanitation challenges.
5.1 Prevalence and Persistence of Technocracy in Development

In the developed world, we define the major historical periods of social transformation, such as the urban revolution and the first and second industrial revolutions, by the technologies that facilitated the transformations (Smillie 2000, Toyama 2011). Infrastructural improvements, such as irrigation, roads, water systems, hospitals, and schools, are often seen as essential precursors to growth and development (Smillie 2000). As such, technology is often considered an essential ingredient to economic progress in the developing world and has long occupied a central role in international development (Smillie 2000, Smith 2009, Murphy et al. 2009, Toyama 2011).

In the past two decades, organizations and governments have increasingly looked to technology to solve some of the developing world’s most significant problems. The Millennium Development Goals, created by the United Nations in 2000, which set the standards by which development organizations and governments measure progress and success in international development, are largely oriented towards the development and dissemination of technologies (United Nations 2000). The 2002 World Summit on Sustainable Development and the 2005 Report of the Commission for Africa highlighted the importance of science and technology for development (Commission for Africa 2005, Smith 2009). The 2005 UN Millennium Project on Science and Technology advocated for a reorientation of development policy to focus on science and technology to achieve the Millennium Development Goals. The report claimed that the lack of adequate infrastructure in the developing world, such as telecommunications, electricity, and
transportation networks, is a key obstacle to reducing poverty (Juma and Yee-Cheong 2005).

5.1.1 Technocracy in WASH Development and Philanthropy

The sanitation sector is one field of development that has consistently turned to technological solutions. Although development NGOs provide a diversity of services in the sanitation sector, including hygiene education, capacity-building, and policy dialogues, the cornerstone of many sanitation initiatives has long been the development and construction of latrines and toilets (Carrard et al. 2009, Byars et al. 2009). The Millennium Development Goals measure the success of water supply initiatives by the number of water points developed, and sanitation progress is measured by the number of available toilets (United Nations 2000). As a result, in order to achieve these goals, development agencies prioritize building more and more toilets and water points (Breslin 2010)

Philanthropic organizations have a played a particularly predominant role in pushing for technical solutions to the world’s sanitation challenges. In 2009 and 2010, U.S. foundations gave approximately $145 million to WASH projects, up from $17 million in 2005 and 2006 (Foundation Center 2012). The largest portion of this funding, 42 percent, went to the development of low-cost basic drinking water supply and sanitation technologies (Foundation Center 2012). Figure 5.1 provides a break-down of funding to different types of WASH projects.
### Figure 5.1 Foundation funding to different types of WASH projects 2009-2010 (Foundation Center 2012)

<table>
<thead>
<tr>
<th>Subject Area</th>
<th>% of grant dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-cost basic WASH technology</td>
<td>42%</td>
</tr>
<tr>
<td>Policy and administrative management</td>
<td>20%</td>
</tr>
<tr>
<td>WASH research</td>
<td>14%</td>
</tr>
<tr>
<td>WASH and livelihoods</td>
<td>10%</td>
</tr>
<tr>
<td>Waste management/disposal</td>
<td>6%</td>
</tr>
<tr>
<td>WASH and disaster relief</td>
<td>4%</td>
</tr>
<tr>
<td>WASH advocacy</td>
<td>3%</td>
</tr>
</tbody>
</table>

Since 2006, the Gates Foundation has led U.S. foundation funding of WASH projects (Foundation Center 2012). In 2009 to 2010, the Gates Foundation gave $74.4 million to WASH projects – more than three times the amount given by the second largest funder (figure 5.2). As the largest private funder of WASH projects (Foundation Center 2012) and the largest U.S. foundation (Foundation Center 2014), the Gates Foundation has significant influence over the direction and focus of the sectors it funds. The Foundation is notorious for the technocratic focus of its grant-making (Birn 2005, Freshi and Shaikh 2011). In its initiatives to improve public health, the foundation has focused on improving and creating vaccines, controlling insects through genetic and chemical strategies, innovating new condom designs, and reinventing the toilet (Birn 2005, Bill and Melinda Gates Foundation 2013).
In the past several years, the Gates Foundation has held a couple of competitions to spur the development of new technologies that will improve sanitation access—the Grand Challenges in Global Health in 2010 and the Reinvent the Toilet competition in 2011. The Gates Foundation claims that traditional sanitation systems are an obstacle to achieving greater sanitation access because they are capital-, water-, and energy-intensive and require considerable maintenance. In the competitions, inventors compete for grants and prize money to create new technologies that will provide an alternative to traditional sanitation systems (Grand Challenges in Global Health 2010, Bill and Melinda Gates Foundation 2013).

The funding for the MFC Latrine project that Dr. Butler received in 2010 came from the Gates Foundation Grand Challenges Explorations in Global Health in collaboration with the Gates Foundation Water Sanitation and Hygiene program. The objective of the Grand Challenges competition was to “Generate innovative ideas with the potential to catalyze a next-generation of sanitation technologies across the sanitation
value chain, from containment to treatment and reuse” (Bill and Melinda Gates Foundation 2011).

The Gates Foundation orientation toward the use of technology to increase sanitation access has pushed the MFC Latrine team to focus their efforts on developing and improving the MFC technology. In 2013, Dr. Butler applied for a second round of funding from Gates. She proposed not only making improvements to the MFC technology but also proposed returning to Nyakrom to improve community integration and education of the latrine. However, in response to the proposal, the Gates Foundation staff encouraged Dr. Butler to focus on increasing the electricity output of the MFC. As such, the engineers have diverted their work to focus on improving the MFC technology, primarily its electricity output (Butler, personal communication, January 2014).

5.1.2 Technocracy in Engineering Education and Practice

The Gates Foundation funding is not the only factor that led the engineers to prioritize the MFC Latrine technology. The technology focus of the engineers was also influenced by the culture of engineering education and practice which emphasizes the centrality of technology (Robinson & McIlwee 1991, Hauser-Kastenberg et al. 2003, Cech 2014). During their interviews, the engineers said they focused on the technology because, as engineers in academia, it is the cornerstone of their graduation requirements and essential to the successful acquisition of research funding and tenure.

Academics who study engineering education and practice have found that current engineering culture separates technical considerations from social responsibility and public welfare considerations (Robinson & McIlwee 1991, Hauser-Kastenberg et al. 2003, Cech 2014). The culture devalues personal relationships and “inexact” knowledge
about the social, economic, and environmental contexts in which technologies are built (Robinson & McIlwee 1991, Hauser-Kastenberg et al. 2003, Cech 2014). Hauser-Kastenberg et al. (2003) characterized the current culture of engineering as being focused on the “economy of technology” as opposed to the “ecology of technology.” The economy of technology assumes that technology is neutral and context-free and that social responsibility is an afterthought (Hauser-Kastenberg et al. 2003). In contrast, the ecology of technology, considers the impact of technology on human life, society, and the environment (Hauser-Kastenberg et al. 2003).

Studies have shown that engineering education perpetuates this culture. Cech (2014) conducted a study of whether engineering undergraduate students at the Massachusetts Institute of Technology, the University of Massachusetts-Amherst, Smith College, and Olin College consider and value public welfare when thinking about their professional identities and responsibilities as engineers. She found that as students become further integrated into their engineering programs that their public welfare beliefs decline and that these beliefs do not rebound after they graduate. The study concluded that engineering education fosters a culture of disengagement that devalues the importance of public welfare considerations in engineering practice (Cech 2014). The culture of disengagement consists of three ideological pillars: 1) depoliticization or the idea that engineering practice should be separate from social and political concerns, 2) technical/social dualism which separates technical and social competencies and devalues the social ones, and 3) meritocracy which advances the notion that inequalities do not need resolution because those who do not succeed deserve what they get (Cech 2014).
Engaging with the community and understanding the social, cultural, political, and economic context of engineering projects is not typical of an engineering design process in the U.S. Historically, U.S. engineers have only considered the social impact of engineering and technology in times of crisis, such as disasters (Cech 2014). The MFC Latrine engineers were entrenched in this engineering culture and it undoubtedly influenced their priorities and technology focus.

5.2 Problems with a Technocratic Development Approach

Unfortunately, the technocratic approach has frequently failed to improve the quality of life of people in developing nations. In the 1960s and 1970s, the Green Revolution brought new seed varieties, infrastructure, pesticides, and fertilizers to the developing world, under the promise of increasing agricultural production. However, in some cases they drastically altered the lives of farmers and required them to employ more intensive and riskier agricultural techniques (Smith 2009). The polio vaccine has not disseminated as widely as hoped and eradicated polio due to mistrust of the vaccinators in some parts of the world (Smith 2009). Attempts to increase energy production through hydro-electric schemes have led to massive displacement of communities and environmental damage (Smith 2009).

As I further discuss below, studies have shown that maintaining a technological focus can amplify inequalities and depoliticize development challenges. This focus can neglect the important influence of context – both the context of the community in which the WASH project is built and the context of the development practitioners.
5.2.1 Amplifies and Exacerbates Inequalities

Technologies can act as amplifiers, highlighting and exacerbating existing inequalities in societies (Smillie 2000, Toyama 2011). The extent to which technology can positively impact human life, depends to a large degree on the economic capacity, power, social skills, and education of the person using the technology (Smillie 2000, Toyama 2011). Technology costs money and requires skill and education to use. The more money a person has, the greater access to technology they will have, and the more skills and education a person has, the more value they will glean from technology (Toyama 2011). For these reasons, the creation of a new technology will not level the playing field; inequalities will persist.

In the case of sanitation in Ghana, private toilets and waste collection has increased in Accra over the past couple of decades; however, only Accra’s wealthiest residents who can afford sanitation services have obtained these improvements (Obeng-Odoom 2011). The existing inequalities determine who benefits from sanitation technology, and the resulting disparities in sanitation access can cause inequalities to deepen even further.

5.2.2 Depoliticizes Development Challenges

Reducing development challenges to technical problems with technical solutions could cause them to become depoliticized and stripped of any solutions that lead to political or social change that would positively improve quality of life (Ferguson 1990, Birn 2005, Freshi and Shaikh 2011). In his book about an agricultural development project in Lesotho, Ferguson (1990) makes this case that the development project can crush any political challenges by casting the problem as a technical one that needs a
technical development solution. Critics of the Gates Foundation’s technological approach to development claim that this approach “lets world leaders off the hook” (Freshi and Shaikh 2011) because they cast development challenges as being technological problems, not political, economic, or social ones (Birn 2005, Freshi and Shaikh 2011).

5.2.3 Undervalues the Importance of Context

Development initiatives often discuss the need for “technology transfer” – transferring technology from the developed to the developing world (Smillie 2009). This concept implies that technology is something that is neutral and independent of context, it can simply be transported from one setting to another (Smillie 2000). However, the idea of a neutral engineer or neutral technology is a myth (Hauser-Kastenberg et al. 2003). In reality, both the context in which the technology is being built and the setting and person from which the technology originates influences the implementation and impact of development initiatives.

Technology is a product of the context in which it is created. Technologies consist of knowledge, processes, organization, and techniques that embody the cultural, social, historical, and organizational contexts in which they were created (Smillie 2000). The values, assumptions, and beliefs of the engineer, the engineering profession, and the industry and society of the engineer all influence the technology (Hauser-Kastenberg et al. 2003).

Technology does not exist in a vacuum. Successful development interventions often require solutions that are grounded in the context in which they are implemented. Chapter 3, Literature Review, provided evidence of this in the case of water and sanitation development. Building a new sanitation system is frequently not enough to
improve sanitation access. Sanitation systems often fail when communities do not have the capacity to operate and maintain the technology (Bredero and Brike 2003, WaterAid 2011). Neglecting to understand the influence of context is problematic for WASH project sustainability. Increasing access to sanitation in the developing world will require more than new technology. It will require developing a deeper understanding of specific community contexts and consideration of how the complex social, cultural, political, and economic contexts may impact the implementation and success of WASH projects.

5.3 Ghana’s Sanitation Context

Ghana is a prime example of a country that has a complicated sanitation context with numerous economic, political, and social factors that must be addressed in order to truly expand sanitation access. In 2011, Ghana was the fastest growing economy in Sub-Saharan Africa and moved from low-income to lower middle-income status in the World Bank country classifications (World Bank 2011). However, while Ghana’s economy continues to grow, the country has made little progress in providing its citizens with access to adequate sanitation facilities. The number of people without adequate sanitation access in the Sub-Saharan country of Ghana falls well below the Sub-Saharan Africa average. In 2012, just 14 percent of Ghana’s population had access to improved sanitation facilities, and approximately 19 percent of Ghanaian households still practiced open defecation (UNICEF and WHO 2014).

Inadequate sanitation access poses a major public health and economic problem for Ghana. According to the World Bank (World Bank Water and Sanitation Program 2012), approximately 19,000 Ghanaians die each year from diarrheal diseases, 90 percent of which can be attributed to poor sanitation and hygiene. Each year there are
approximately 1,800 cases of cholera due to fecal contamination of water sources. The World Bank conservatively estimates that Ghana’s poor sanitation costs the country US$290 million annually from premature deaths, productivity losses, and health care costs (World Bank Water and Sanitation Program 2012).

Many of the challenges that the nation faces in improving sanitation access have to do with the structure of the sanitation sector in Ghana. Since the 1980s, the Ghanaian government, with support from international institutions and donors, has consistently decentralized Ghana’s sanitation services, devolving responsibility for funding, planning, constructing, and maintaining sanitation facilities to private companies, local governments, communities, and individual households (Republic of Ghana 1987, Bohman 2010, Agyenium and Gupta 2010, Obeng-Odoom 2011).

Sanitation provision in Ghana is currently guided by the Environmental Sanitation Policy (first created in 1999, as noted above but revised in 2010) (Government of Ghana 2010) and the Ghana Shared Growth and Development Agenda for 2010-2013 (NDPC and UNDP 2010). These policies advocate for three primary methods of sanitation provision:

1) Contracting out delivery of services wholly or partially to the private sector: Private firms and NGOs are expected to provide the bulk of sanitation services in Ghana, from construction through waste collection and treatment. Their programs are under the supervision of the local assemblies (metropolitan, municipal, and district governments).

2) Encouraging and requiring communities to provide services for themselves:

   Communities are expected to be largely autonomous in attaining adequate sanitation
and work together to develop appropriate infrastructure, maintain facilities, prevent pollution, and sanction any citizens who fail to participate or adhere to agreed-upon sanitation norms. It is expected that households and communities will fully cover the costs of the sanitation hardware.

3) Requiring local governments (Assemblies) to provide at least 20 percent of sanitation services, and facilitate all planning, monitoring, and public relations related to sanitation provision.

Unfortunately, this decentralization has not improved sanitation access in Ghana as initially hoped. Inadequate investment, private sector corruption and profit-seeking, unaffordable options for the country’s poorest citizens, and incapacity of local governments and communities to provide services all create significant barriers to improving Ghana’s sanitation services.

5.3.1 Inadequate Investment

The sanitation sector in Ghana is severely underfunded with the government investing less than 0.1 percent of GDP into sanitation services (WB WSP 2012). A 2008 World Bank report estimated that Ghana needed to spend 0.5 percent of its GDP on the sanitation sector in order to meet the sanitation Millenium Development Goal (Morella et al. 2008). In the rural areas, where sanitation access is lower, it is estimated that Ghana needs US$165 million to meet the hardware requirements alone; however, current financing from the government and NGOs is just US$8 million annually (WB WSP et al. 2010).

Not only has funding been inadequate overall, but funding has been uneven between the rural and urban subsectors. While donors have provided considerable
financial support to the rural and small town subsector, donor funding for urban sanitation has been largely absent (WB WSP et al. 2010). Given that it is projected that half of Ghana’s population will live in cities by 2015 (Bohman 2010), this uneven funding could pose a major challenge to the expansion of sanitation access.

5.3.2 Corruption and Profit-seeking in the Private Sector

As noted above, Ghana’s Environmental Sanitation Policy expects the private sector to provide the majority of sanitation services in the country. However, because of the lack of performance measurements and monitoring, it is unclear about whether the private sector has actually helped to improve sanitation services (WB WSP et al. 2010). In his study of municipal services in Ghana, Obeng-Odoom (2011) found that, in Accra, the private sector increased the percentage of waste collected between 1996 and 2000; however, the vast majority of the waste was collected in high and middle income neighborhoods. Toilet management was known to be a profitable business. One person in the study described it as a “goldmine” due to its low operation costs and high profits from user fees (Obeng-Odoom 2011).

5.3.3 Lack of Affordable Sanitation Options

An unfortunate outcome of the profit seeking and corruption in the private sector sanitation services is that sanitation options are often unaffordable for Ghana’s poorest citizens. Obeng-Odoom (2011) argues that the private sector has improved sanitation services for middle and high income households but has not benefitted Ghana’s poorest residents. In Accra, Ghana’s capital city, the current cost for sanitation services is US$132 per household per year. This means that the poorest 20 percent of households,
whose average annual income is US$409, would pay approximately 32 percent of their annual income for sanitation services (Boot and Scott 2009).

For many poor households, the lack of affordable sanitation services means that households frequently rely upon informal, and often illegal, methods for disposing of their waste. Many poor households use children (their own, or those working as domestic servants) or informally hire other people to dispose of human waste. These methods exist outside of formal laws and regulations guiding sanitation and so, oftentimes, children or informal workers will dispose of waste in places other than the official places for waste disposal, such as in their backyards (Oteng-Ababio 2011, Grieco 2008).

5.3.4 Inability of District Assemblies to Provide Adequate Services

At the 1987 Ghana Conference on Water and Sanitation, the government and donors highlighted the need to increase the capacity of the local Assemblies in order to ensure that they have the skills and resources to be able to adequately provide sanitation services (Republic of Ghana 1987). However, since then, the capacity of local governments to effectively deliver sanitation services has not improved. Recent sanitation plans and reports (NDPC and UNDP 2010, WB WSP et al. 2010) have emphasized that Assemblies lack the capacity to provide sanitation services and regulate and monitor services provided by private companies and communities. Assemblies need additional training, logistical support, and financial empowerment in order to be able to steer their own water and sanitation agenda and adequately monitor and regulate sanitation practices (WSP et al. 2010).
5.3.5 Limits of Community Management of Sanitation Services

Since the 1987 conference, the government of Ghana and international institutions have attempted to require or encourage the involvement of communities in providing themselves with sanitation services (Republic of Ghana 1987, Government of Ghana 2010). Current sanitation policies and programs promote the idea of communities and households seeking out sanitation options and covering the full costs of construction and maintenance of facilities. While there is no data demonstrating specifically whether communities in Ghana have successfully created and maintained sanitation facilities, anecdotally, there is evidence that communities can have a difficult time finding adequate sanitation options, constructing facilities, and funding construction and maintenance without significant support from the government (Doe and Sohail Khan 2004, WB WSP et al. 2010).

5.4 Conclusion

In the case of the MFC Latrine project in Nyakrom, it is clear that prioritizing the technological aspects of the project was not sufficient to ensure a sustainable sanitation system. Technological approaches to development challenges can neglect the important influence of political, social, economic, and cultural factors. These factors can create barriers to sanitation access, not only on the community level but also on a much larger, country-wide scale. Developing a deep understanding of the context in which a sanitation project is being built is essential to the development of sustainable sanitation systems. In the next chapter, I provide recommendations for tools and frameworks that the MFC Latrine engineers could use to assess community capacity and develop context-appropriate sanitation.
CHAPTER 6
TOOLS AND FRAMEWORKS

Throughout this thesis I have established that understanding and incorporating community context and capacity is critically important for sustainable WASH projects. However, identifying and utilizing community capacity in development projects is much easier said than done. Ever-present time and resource constraints can confound practitioners’ ability to collect useful and thorough data on community capacity and incorporate that information into development interventions. Collecting information about social and cultural capacity can be particularly abstract and time consuming.

Government agencies, international institutions, and development professionals have created tools and frameworks to guide practitioners, such as the MFC Latrine team, toward more effective community participation practices, to educate communities about sanitation and hygiene practices, and to identify and create demand for WASH systems.

In this chapter I focus on tools and frameworks that development professionals have created to identify community context and capacity. I describe three specific tools that could help the MFC Latrine team identify community context and capacity. These tools include asset-based community development, an appropriate technology framework from the WHO and IRC Water and Sanitation Centre, and the WASHTech Technology Applicability Framework.

6.1 Asset-Based Community Development

Asset-based community development (ABCD) is a participatory process for identifying and utilizing a community’s assets and strengths. John Kretzmann and John
McKnight at Northwestern University created the ABCD approach as an alternative to the needs-based approach to community development (Kretzmann and McKnight 1993). The needs-based approach focuses on addressing community needs and deficits. Asset-based planning, on the other hand, focuses on identifying and building on the existing strengths of a community (Kretzmann and McKnight 1993).

Asset-based development has been primarily applied in U.S. community development contexts. However, the Asset-Based Community Development Institute has touted its potential for international development as well (Russell 2009). According to Russell (2009), a long history of needs-based development has created communities in the developing world that define themselves by their needs and what they lack and believe that only their deficiencies will attract aid resources. The ABCD approach would give communities in the developing world more agency and ownership over their community’s development by basing development projects in a community’s strengths and existing resources (Russell 2009).

Kretzmann and McKnight (1993) developed a process for identifying and mobilizing community assets. The first step is to map all of the assets of individual, citizens’ associations, and local institutions. The definition of assets is broadly described as anything that can be utilized to improve the community (Work Group for Community Health and Development 2014). Assets can include people, physical structures, community services, and organizations and businesses. Information should be collected about the assets of individuals and specific groups as well as the assets of the community as a whole (Kretzmann and McKnight 1993). This information can be collected through questionnaires, interviews, or in group meetings (Kretzmann and McKnight 1993). It is
important to ensure that there is a diversity of community members involved in identifying assets (Kretzmann and McKnight 1993).

Practitioners should tailor questions about assets to their specific project. Before creating the questions, practitioners should ask themselves why they are collecting this information and for what purpose they want to use it (Work Group for Community Health and Development 2014). The Work Group for Community Health and Development also suggests defining the target community (in terms of geography, size, and demographics) before beginning the project (Work Group for Community Health and Development 2014). ABCD professionals have not created a pre-set list of questions that practitioners can use to identify assets. However, Kretzmann and McKnight (1996) identified three categories of assets to help practitioners understand the range of assets that may exist in a community:

1) Assets and capacities located inside the community, under community control
   a. Individual assets
      • Skills, talents, and experience of residents
      • Individual businesses
      • Home-based enterprises
      • Personal income
   b. Organizational assets
      • Associations of businesses
      • Citizens associations
      • Cultural organizations
      • Communications organizations
      • Religious organizations

2) Assets located within the community but largely controlled by outsiders
   a. Private and non-profit organizations (e.g., higher education institutions, hospitals, social service agencies)
   b. Public institutions and services (e.g., public schools, police, libraries, fire departments, parks)
c. Physical resources (e.g., vacant land, housing, waste and energy resources)

3) Resources originating outside the community, controlled by outsiders

a. Welfare expenditures

b. Public capital improvement expenditures

c. Public information

When the MFC Latrine team or other development practitioners enter a new community for which they have little information, taking stock of the community’s assets can be an important and fruitful exercise. It could help the practitioners to 1) begin engaging the community in the project and 2) collect information about the community’s capacities that may be useful to the development project. In the case of the MFC Latrine team, the engineers may find that the community has existing resources that the team could use as they develop the latrine and create plans for its operation and maintenance. For instance, the engineers may find out that there is someone in the community with a technical background or that there is a regular community gathering at which information could be disseminated. Additionally, it will help the team to avoid making assumptions about the community’s capacity to properly operate and maintain the latrine.

Although there are some reasons why ABCD may be useful for the MFC Latrine team, its lack of specificity may make it difficult for the team to apply. In order to implement the ABCD approach, they may need the help of a social scientist who can help them to craft relevant questions, develop appropriate methods for collecting information, and collect and analyze the information in the field. The next framework I review has aspects that are similar to ABCD but is more specific to sanitation development.
6.2 Appropriate Technology Framework

The WHO and IRC Water and Sanitation Centre developed this often-cited framework to “link technology choice to community operation and maintenance” (Bredero and Brikke 2003). The WHO and IRC created this framework in response to the belief that governments and development practitioners were neglecting to consider what communities need to sustain the operation and maintenance of water supply and sanitation projects. It identified the technical, environmental, institutional, community, managerial, and financial factors that influence technology selection and sustainability. Figure 6.1 represents the full range of factors.

The framework emphasizes that technology selection must involve communities from the very beginning of project planning and that the project should be demand-driven as opposed to resource-driven. After the community has requested the improved service, the development agency should conduct a participatory assessment with the community that identifies the community needs, preferences, behavior, and resources in regards to sanitation and hygiene. This can include collecting information about:

- Existing waste disposal
- Hygiene and defecation behavior
- Cultural, social, and religious factors that influence sanitation
- Local capacities and resources (material, human, and financial)
- Motivations, expectations, and preferences of users

With this information, development practitioners and the community can determine which technology option would work best for the community. Considerations could include community ability and willingness to pay, availability of materials, and
consistency of operation and maintenance requirements with existing sanitation behavior and local capacities.

Figure 6.1 Factors that influence the selection of community sanitation technology (Bredero and Brikke 2003)

<table>
<thead>
<tr>
<th>Factors of general relevance</th>
<th>Factors specifically relevant to O&amp;M</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Technical factors</strong></td>
<td></td>
</tr>
<tr>
<td>— design preference (substructure, floor slab, squatting or raised seat, superstructure); technical standards and expected lifetime of the technology; availability of construction materials; cost of construction.</td>
<td>— O&amp;M requirements; ease of access; use of decomposed waste; pit-emptying technique.</td>
</tr>
<tr>
<td><strong>2. Environmental factors</strong></td>
<td></td>
</tr>
<tr>
<td>— soil texture, stability, permeability; groundwater level; control of environmental pollution; availability of water; possibility of flooding.</td>
<td>— O&amp;M implications for environmental protection; protection against groundwater contamination; protection from flooding.</td>
</tr>
<tr>
<td><strong>3. Institutional factors</strong></td>
<td></td>
</tr>
<tr>
<td>— existing national/local strategies; roles and responsibilities of actors implied; training capacity; availability of subsidies and loans; availability of masons, carpenters, plumbers, sanitary workers, pit-emptyers and pit-diggers.</td>
<td>— pit-emptying services (municipal/private); sewerage maintenance capacity; potential involvement of the private sector; rational budget allocations for sanitation; training and awareness education; monitoring.</td>
</tr>
<tr>
<td><strong>4. Community factors</strong></td>
<td></td>
</tr>
<tr>
<td>— sociocultural aspects: taboos, traditional habits, religious rules and regulations, cleansing material, preferred posture, attitude to human feces, gender-specific requirements; motivational aspects: convenience, comfort, accessibility, privacy, status and prestige, health, environmental cleanliness, ownership; discouraging factors: darkness, fear of falling in the hole, or of the pit collapsing, or of being seen from outside, smells, insect nuisance; social organization factors: role of traditional leadership, religious leaders, schoolteachers, community-based health workers; other factors: population densities, limited space for latrines, presence of communal latrines.</td>
<td>— O&amp;M costs; O&amp;M training and awareness for sanitation; health awareness and perception of benefits; presence of environmental sanitation committee; women's groups; social mobilization on hygiene and sanitation behaviour.</td>
</tr>
</tbody>
</table>

Similarly to ABCD, utilizing this framework could provide the MFC Latrine team with potentially important information about the community context and capacities and could provide the team with an opportunity to begin engaging the community. However,
this framework also emphasizes identifying community capacities, needs, and preferences specific to sanitation projects. It suggests that practitioners should work with the communities to match up the sanitation technology options with the capacities, needs, and preferences of the community. The MFC Latrine team may find the more specific suggestions for information collection and the list of influencing factors (figure 6.1) more useful than ABCD for honing questions and methods that they may use in the field.

However, as with ABCD, this framework still lacks clear instruction and specificity on the process and the questions to ask. For engineers without a background in the social sciences and community engagement, this lack of specificity may make it difficult for them to employ this framework without the help of a social scientist. I believe that the MFC Latrine engineers would benefit from a framework with a clearer process and more specific questions and direction on information to collect. The WASHTech Technology Applicability Framework that I discuss next is potentially more useful in this regard.

6.3 Technology Applicability Framework

WASHTech, a project of the European Union, developed the Technology Applicability Framework (TAF) the focus of which is “assessing WASH technology and their readiness to provide lasting services in a given context” (WASHTech 2013, 9). This framework considers not only the technical function, characteristics, and performance of a proposed water or sanitation project, but also the context. In particular it emphasizes the need to assess the six dimensions of sustainability: social, economic, environmental, institutional, technology, and the knowhow and skills of the community. The creators of TAF developed it because they believed that existing tools to assess the applicability of
technology are too simplistic and that there is a dearth of assessment tools that focus on social aspects of communities (WASHTech 2013). Figure 6.2 represents the two key steps of TAF – screening and assessment.

Figure 6.2 Two primary steps of TAF (WASHTech 2013)

The first step of TAF is screening. The purpose of this step is to first eliminate all obviously inappropriate technology options. During this step development practitioners ask themselves if there is a need for this technology and if the technology is feasible (WASHTech 2013).

The second step is assessment. The purpose of this step is to analyze the six dimensions of sustainability. The framework identifies 18 indicators, 3 for each sustainability dimension (see figure 6.3 for all indicators). The development practitioner must then collect information on each of the indicators from each of the three actor groups: the user/buyer of technology, the producer/provider of the technology, and the
regulator/investor/facilitator of technology introduction process. For each indicator, there are three to seven guiding questions that practitioners can ask during group discussions and interviews to understand the issues around each indicator (WASHTech 2013).  

Figure 6.3 Six sustainability dimensions and the 18 indicators

Once information regarding each indicator has been collected, the practitioner should hold a scoring workshop with all groups to give each indicator a score using the scoring system in figure 6.4. This scoring is meant to highlight possible barriers to

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2 The “indicator sheet” with the guiding questions for each of the 18 indicators is too long to include in this thesis. The indicator sheet for sanitation projects can be downloaded on the WASHTech TAF website: http://www.washtecnologies.net/en/taf/taf-selection-tool/details/563
sustainability and will help identify what capacity needs to be built or what barriers need to be addressed to improve sustainability. The scoring is represented visually through a diagram like the example in figure 6.5 (WASHTech 2013).

Figure 6.4 Scoring system for the 18 indicators

Figure 6.5 Visual representation of the indicator scoring
I believe that of the three frameworks this one may be the most useful to the MFC Latrine team. A key obstacle for the engineers in collecting information about the Ghana context and community capacities is their lack of experience and time to collect this information from the community. In order to apply the first two frameworks, the engineers would undoubtedly need help from a social scientist who can help them to craft more questions, develop an appropriate method for collecting data, and to implement it in the field. The TAF, on the other hand, is specific and provides a straightforward, structured process for collecting and analyzing community information.

6.4 Conclusion

As the MFC Latrine team considers how to improve the MFC latrine at Nyastech and explores new locations for the latrine, the engineers should learn from the mistakes made during the pilot planning and construction. They should prioritize learning about and incorporating the context into their plans, formally engaging and educating the community throughout all stages of the project, and avoiding projecting their own preferences and assumptions onto the community. Doing so may help to improve the sustainability of future versions of the MFC Latrine. Frameworks such as the three presented above may not provide the engineers with a silver bullet for learning about a community’s ability to sustainability operate and maintain the latrine. However, these frameworks can provide the engineers with some direction and ideas for how they can go about engaging a community and collecting information about a community’s context and capacities.
CHAPTER 7
CONCLUSION

There is no denying that technology has a role to play in the expansion of sanitation access. To improve sanitation, people will need access to toilets, pipes, storage containers, and systems that treat waste. However, as I have argued throughout this thesis, technologies alone are insufficient to significantly expand access to sanitation. Social, cultural, political, environmental, and economic factors have an important influence on who gets access to sanitation and in what form. If communities do not have the capacity to operate and maintain a sanitation system or they do not feel ownership over the system, it does not matter how innovative the technology is.

The MFC Latrine case study demonstrated that when the engineers prioritized the technology over conducting meaningful community engagement and education and collecting comprehensive information about the community context and capacities, it had negative implications for the operation and maintenance sustainability of the latrine. The school users did not feel ownership over the latrine and did not have the knowledge or motivation to properly operate and maintain it. This is one example of how a technocratic focus can impact the sustainability of a sanitation project. However, the history of technocracy in international development suggests that a common consequence of this approach is a disregard for the importance of context.

The scope of this study is defined by limitations outside of my control and delimitations that I have chosen to impose on this research. I chose to limit the primary data sources for the case study data to the interviews and conversations I had with the
three University of Massachusetts-Amherst engineers. The three engineers were primarily responsible for the planning and construction of the MFC Latrine pilot. These interviews gave me substantial, sufficient, rich data on the activities of the planning and construction phases. While contact with the ASU engineers, the Nyakrom school, May Kay Jackson, or the village chief may have enhanced my description about the operation and maintenance of the latrine after the engineers left Ghana, my primary focus was on what occurred during the planning and construction. Given that the three University of Massachusetts Amherst engineers were primarily responsible for planning and construction, it did not seem beneficial to interview anyone else.

I also chose to focus on sustainability as the primary desired outcome of the MFC Latrine pilot project and sanitation development projects in general, as opposed to focusing on other potential outcomes, such as improved public or environmental health, community empowerment, increased knowledge about sanitation and hygiene, or the development of a new sanitation technology. The reasons for this focus were twofold; first, the literature about the sustainability of sanitation development projects is significant – sustainability is an issue that the field has wrestled with since the 1980s and is critical to the attainment of all other outcomes. Secondly, the MFC Latrine team members spoke explicitly about the need to create a more sustainable project and even wrote about it in their second proposal to the Gates Foundation. For these reasons, the literature review, analysis, discussion, and recommendations all focused on the sustainability of sanitation development projects generally and the MFC Latrine project specifically.
The primary limitation of this study is that I provide just one example of one sanitation project that was impacted by a technology focus. The specific impacts I identified as resulting from the prioritization of technology in the MFC Latrine planning and construction, such as the lack of information about the users and context and inadequate community engagement, are not generalizable to other technocratic sanitation projects. In Chapter 5, Interpretation and Discussion, I reviewed literature to demonstrate how other academics have made similar findings about how technological approaches to development can neglect the importance of context. However, while there is sufficient data and research to support the claim that technocratic WASH approaches are pervasive, there is not enough research on the impact of technocracy on WASH sustainability to situate the findings of the MFC Latrine case study.

That said, one of my primary suggestions for future research is for the WASH field to conduct research on the specific impacts of technocracy on WASH project sustainability. If funders and practitioners are going to persist in pushing for technological solutions to increase WASH access, the responsible thing to do would be to evaluate the effectiveness of these approaches.

The WASH development sector has developed consensus and a thorough set of research about the factors that directly impact sustainability, in particular, insufficient community capacity to operate and maintain or a lack of motivation and ownership over the service. However, while there is a large amount of material and research about how to conduct effective community engagement, the field seems to lack a useful set of best practices, tools, and frameworks that practitioners can use to evaluate community capacity. I found two of the three frameworks I reviewed in chapter 6 to be lacking and
the third, which I found to be the most useful, is only a year old. The field has a long way to go in developing the capacity of practitioners to analyze, understand, and incorporate existing community capacity into WASH development plans.

Additionally, the time has come for more studies that seek to uncover the reasons why development practitioners conduct ineffective and unsustainable practices in the first place. What other factors aside from the trend toward technocracy cause practitioners to conduct unsustainable practices? What is causing practitioners to bow to these influences? Is it pressure from funders? A lack of diversity in backgrounds and experiences among practitioners? Inadequate time and funding? A lack of knowledge and skill? Exploring the underlying reasons why development practitioners continue to perform ineffective community participation or create context-inappropriate sanitation systems can only help create better accountability and awareness in the field.
APPENDIX

CODING SYSTEMS

Initial Coding System
- Making assumptions/generalizations
  - Chiefs speak for community
  - Politics
  - Sanitation practices
- Misjudging what would motivate users to O&M
- Not planning and preparing
  - For specific context
  - For education
  - For making repairs
- Passive and informal education process
- Prioritizing technology
  - Adapting materials to fit technology
  - Not incorporating known sanitation practices and preferences
- Putting a lot of faith into local decision-makers
  - About site selection
  - About construction of latrine
  - About type of sanitation facility
- Technically complicated
- Things perceived as important for latrine’s success but not implemented
  - Local materials
  - Monitoring/data collection
  - Easy maintenance
  - User buy-in and involvement
- Top-down decision-making
- Treating latrine as an experiment

Focused Codes
- Focusing on technology
- Community education and engagement
- Inflexible time and not enough time
- Assuming universality
- Not enough pre-trip research about context
- Not having a solid maintenance plan
- Not enough social planning
- Valuing western education
- Assuming technology is all you need
• Miscommunication
• Lack of reliable contacts
• Relying on western-style sanitation
• Poor relationship with school
• Location
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