Small Water Enterprises, Security, and Sustainability:

A Case Study in Accra, Ghana

by

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ABSTRACT

Many global development initiatives focus on improving access to safe and affordable water. Governments and infrastructure in rapidly urbanizing cities struggle to meet the increased demand for water, especially in peri-urban and informal settlements of sub-Saharan Africa. The private sector, in the form of small water enterprises (SWEs), plays an increasing role in satisfying demand for water, but their greater effects have seldom been investigated. This research explores how SWEs affect access to household water in a peri-urban settlement of Accra, Ghana and investigates their social, economic, and environmental impacts in the community. This research also examines how SWEs influence security and sustainability goals within the framing concepts of the US Army's Stability doctrine and the United Nations Sustainable Development Goals (SDGs). The methods employed in this study were interviews, observation, and review of existing literature and case studies. Results of this qualitative analysis reveal that while SWEs increase and diversify local access to clean water, provide economic opportunities and jobs—especially to women—they also present environmental and health concerns when unregulated and unaddressed by educators, city officials, and community leaders. Further, in cases where municipal governments cannot provide safe and consistent access to clean water in the given location, results show that SWEs enterprises can work in cohesion with both the SDGs and the US Army stability goals. Moving forward, city officials, development programs, and US Army stability doctrine should consider supporting SWEs to increase water access and improve other developmental outcomes, while working to avoid potentially negative environmental and health outcomes.

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INTRODUCTION

Water is a fundamental human necessity and essential to support human health and security, improve social equity, promote broad economic development, and protect the function of earth systems. Global freshwater use has been identified as one of the nine planetary boundaries regulating the safe operating space of earth to support humanity (Butler 2017; Rockstrom et al. 2009). Following the 2012 United Nations Rio+20 Summit in Brazil, the U.N. advanced its 2030 agenda for Sustainable Development with the goal to inspire a transition towards a sustainable and resilient planet through bold and transformative change (United Nations General Assembly 2015). The foundation of the agenda is the list of 17 Sustainable Development Goals (SDGs) and 169 targets designed to build upon the successes and address the failures of the Millennium Development Goals (MDGs) (Sachs 2012; United Nations General Assembly 2015). The SDG's aim to integrate environmental, social, and economic goals and recognize tradeoffs and synergies between priorities. SDG 6 recognizes the fundamental need for clean water, stating that all countries should "ensure availability and sustainable management of water and sanitation for all" (United Nations General Assembly 2015, 14). Adoption of the SDGs indicates the international community's commitment to improve access to clean water for all global citizens.

The ways in which people access water and the quality of that water varies around the world. In major cities of high-income countries, obtaining clean water is as simple as turning on a tap. In sub-Saharan Africa, an estimated 29% of the population has to travel 30 minutes or more to obtain improved water (UNICEF 2016). The burden of fetching water falls disproportionately on women and children, which comes with great opportunity costs, often in the form of educational time or child care (UNICEF 2016). Recognizing the unfair burdens that fetching water places on women and children, aid and development agencies have focused their attention

on providing closer access to clean water, looking for cheaper solutions than conventional piped infrastructure. Alternative approaches to conventional piped infrastructure include social enterprises and informal water networks.

Social enterprises use businesses to spark social, environmental or financial change to achieve philanthropic ends, representing a departure from top-down development policies towards grass-roots approach (Nicholls 2006). Several NGOs and aid programs focus on capacity building in residents to be able to run private water businesses such as wells or water stations. These capacity building programs recognize the social, political, and financial barriers on expanding urban water supply and work around it through building capacity in the local populace through private industry (Nicholls 2006). Social enterprises are different from previous western development agendas because they focus on building human capacity, and not just providing money or infrastructure to establish or restore basic services.

The US military is also involved in the business of establishing and restoring basic services such as water and sanitation, and may also benefit from better understanding social enterprises. The US military's primary role is to protect and defend the homeland, but it also conducts many operations other than war. "Contrary to popular belief, United States military's history is one characterized by stability operations, interrupted by distinct episodes of major combat" (US Army 2008, 1–1). At the basic tactical level, the military provides immediate relief for essential services until the host-nation or civil authorities can take control. Soldiers providing bottled water to hurricane victims would be an example of this. At strategic levels the military works with host-nation governments and other civilian agencies to establish stability through the US Army's five primary stability tasks: create a safe and secure environment, establish rule of law, improve social well-being, and create stable governance and a sustainable economy (US Army 2012a). The US Army finds itself restoring water services and improving of water access

as a part of stability activities and while working with the US US State Department, host-nation governments, and with international aid agencies.

The US Army and international aid agencies may have different missions, one to promote security and stability, the other to promote human development, but they also share many objectives and goals. They both concur that providing safe and reliable access to water for a population will help to achieve their ends. With aligned goals, the focus then becomes determining how the international body (both military and civilian) most effectively approaches and addresses water access challenges with minimal negative outcomes.

Study Justification

Acknowledging and identifying the complexity of water challenges in urban areas is only part of the problem. Finding interventions that work towards a better system state is an even more difficult problem. This study assesses Small Water Enterprises (SWEs) as an intervention that can increase access to clean water, but it does not discern whether this is the best intervention available, nor does it present it as an intervention that should come at a cost of efforts to provide water through formal municipal services. This study supports, in agreement with military doctrine, that municipal water supply should be the first resort if infrastructure can be expanded to provide for citizens in a timely manner (US Army 2012a). Where local government can be involved, it should be; however, some cities are growing faster than infrastructure can keep up with, and therefore citizens will look elsewhere for water, including the private industry. From a pragmatic perspective, it is important to assess not only the effectiveness of these SWEs, but also to use a systems perspective to understand the social, economic, and environmental impacts of their proliferation. This research presents a cases study that assesses SWEs as a means to increase water access in Nima, a densely populated settlement of Accra, Ghana. It also investigates observed social, economic, and environmental impacts of these SWEs.

The challenge of providing accessible and clean water varies by location. Geography, climate, culture, government capability, and community capacity are all factors that affect the problem. Some regions may have abundant groundwater or surface water supplies, but its waters may be contaminated or access may be limited by socio-economic factors such as the cost of drilling wells and maintaining pumps. These challenges are often made more complex in urban areas where infrastructure cannot keep pace with population growth rates. A report form World Wildlife Foundation found that the greatest urban water challenges are "water scarcity, decreasing water quality and pollution, water overuse and associated salt-water intrusion in addition to infrastructural, institutional, and social problems" (Engel et al. 2011, 5). Table 1 presents several water challenges, common interventions to address these challenges, and considerations or tradeoffs associated with the listed interventions.

Water Challenges	**Possible Interventions**	**Considerations/Tradeoffs**
Water Scarcity	Increase water reuse capacities; import water; conservation efforts	Cost of water reuse infrastructure; increasing cost of water through water imports; energy used and harmful emissions released in water imports; economic impacts of conservation efforts
Water Source Contamination	Increase green infrastructure, increase water treatment capacity; reduce wastewater discharge; increase sanitation services;	Cost of green infrastructure; Land or relocation of existing people and businesses needed to implement green infrastructure in cities; cost of increased water treatment capacities; education required for water conservation efforts; cost of expanding sanitation services
Temporal Water Shortages/ Intermittent Services	Increase local storage capacities; increase conservation efforts	Cost of increasing storage capacities; sanitation concerns for water storage; economic impacts of conservation efforts; socio-economic impacts of water price increases

Table 1: Common Water Challenges, Intervention Methods, and Associated Tradeoffs. Source: (Engel et al. 2011)

Accra is an example of a city where significant groundwater resources exist, but it still experiences water scarcity, water source contamination, and intermittent services. Due to

population growth, many residents, especially the poorest, do not have access to piped municipal water leaving them to purchase more expensive water or travel distances to fetch water daily. Contamination, mostly from human activities, prevent the use of surface water sources, and illegal connections on the existing municipal pipes cause intermittent water services. While water access in Accra has improved over the past couple decades, it is consistently challenged by providing pro-poor access (Mosello 2017).

Other areas contend with climatic challenges to water supply such as water scarcity and drought. In these cases, citizens may have the means to access water (pipes and storage tanks), but little water to collect. Mexico City provides an example of a city that experiences higher demand for water than it can provide. Mexico City gets a portion of water from local groundwater sources including the aquifer underneath the city, but it imports a large amount of water through 883km of pipes from the distant Lerma-Balsas and Cutzamala river basins (Tortajada and Castelán 2003). Solutions to meet increasing water demands at the turn of millennia focused on expanding expensive hard infrastructure—more pipes and bigger pumps to bring in more water to city residents. This approach to Mexico City's water challenges were "neither sustainable, nor economically feasible… environmentally and socially desirable, and did not address poor management practices" (Tortajada and Castelán 2003, 129). The failure of Mexico City officials to provide a sustainable solution to their water challenges that also avoided negative social and environmental outcomes highlights the importance of evaluating intervention methods using systems thinking. Learning from past mistakes, this research attempts to evaluate the SWE's as an intervention method to increasing water access in disadvantaged urban populations. The research questions proposed below provide a guide to assessing SWEs in Nima, a community in Accra, Ghana.

Research Question

1. How do SWEs affect social, economic, and environmental outcomes in the context of the UN's Sustainability Development Goals and the US Army's stability doctrine?

1a. What are means of residential water supply in Nima Community, Accra, Ghana?

1b. What are the trends of increasing residential urban access to water supply in Nima neighborhood of Accra, Ghana?

Contribution to Knowledge

Accra is not unique in its struggle to provide piped water for a growing population. This challenge is shared by many other growing cities across the world, but especially in sub-Saharan Africa where water challenges meet an acute lack of capacity in formal and informal institutions (United Nations 2018b). The creation of SWEs to increase water access is an attractive alternative solution but its wider outcomes are seldom documented. The assessment of SWEs from a systems perspective provides academic insight to individual and human behavior that has practical applications on how to improve water access in poor peri-urban communities. While Nima and several neighboring communities in Accra have previously been the subject of several water and sanitation studies, this research provides new insight by positioning findings under the framing concepts of the UN's SDGS and the US Army's Stability Doctrine (Abraham et al. 2015; Ainuson 2009; Fiasorgbor 2013; Morinville 2017; Odunuga 2010; Stoler 2013)

Contribution to Practice

The US Army will find itself operating in increasingly complex environments in the coming decades. As the battlefield changes, so does the need to understand changing operational variables as well as the need to update doctrine for operating in urban environments. Larger cities with more interconnectedness present different challenges recognized by the Chief of Staff of the US Army's Strategic Studies Group, which led a multi-year research project on Dense Urban

Areas (M. Harris et al. 2014). The complex nature of stability activities conducted in urban environments require systematic approaches, interventions, and solutions that account for social, economic, and environmental impacts to avoid unintended consequences that could work against end-state objectives. Military planners and civil-military operations leaders should approach and analyze intermediate or long-term solutions to providing water or improving local hydrological infrastructure.

Reasons for Interest in Study

As of June 2018, the US Army has active duty personnel deployed in over 136 countries worldwide, yet there are zero ongoing combat operations (Department of Defense 2018). In Iraq, the U.S. military continues to train and assist Iraqi security forces which is considered a "stability operation" under US Army doctrine and a civil military operation (post conflict) under joint forces doctrine (US Military 2018). In Afghanistan, the US Army has also transitioned to stability activities since ending combat operations in 2014. Through the study of SWEs in a previously unfamiliar area, my goal is to learn how to investigate a potential solution to improving basic services. The topic is especially relevant to me as an Army engineer whose operational branch is relied upon for conducting assessments of existing essential services or restoring essential services.

The subject also appeals to me because my entire military career has been marked by training for deployments to Iraq and Afghanistan. Despite a more recent shift back to training for conventional warfare, friends and coworkers continue to rotate in and out of these places where combat operations ended years ago. I have a persisting personal desire to understand how US military forces and civilian agencies could improve during phase zero (pre-combat operations), transitional phases, and stability activities to either avoid military intervention, or accelerate a transition of power back to a capable foreign government. Despite having almost zero interaction

with US State Department personnel or aid agencies during a personal deployment to Afghanistan, the need for military decision-makers and leaders to understand the role, capability, and responsibility of US State Department, aid agencies, and local government agencies in stability activities has not gone unnoticed by myself and my peers, despite a decreasing US State Department budget that is on track to return to pre-September 2001 levels. As the US State Department budget decreases, the defense spending budget increased $54 billion in 2017 which is greater than the combined budget of the US State Department and USAID (Corrigan 2018; Fuchs 2017; G. Harris 2017). While its typical to see fluctuations in US State Department, USAID, and Department of Defense spending, the takeaway is that fluctuation in budgets and employment numbers require a redundancy in capabilities between the Department of Defense, US State Department, and aid agencies on the international development stage. As the US State Department withdraws from humanitarian assistance operations, the Department of Defense may be required to increase their operational footprint. I am specifically interested in increasing water access because it's a basic human need and a globally relevant challenge. The challenges to increase water access are recognized and relevant globally, and will only require more attention in the future due to the predicted effects of climate change.

To understand how SWEs increase water access to achieve military stability goals and the UN SDGs, this research will examine relevant literature on development, social enterprises, US Army stability doctrine, and the UN SDG 6. The research methodology section establishes my philosophy, approach, and strategy to answering the research questions, and also outlines the methods used in this study. A description of the case study area, Nima, is provided along with observations from the research before discussing SWEs in the context of relevant literature in the analysis. Lastly, the conclusion brings together the main points and findings and discusses the limitations of this study.

CHAPTER 2

LITERATURE REVIEW

This literature review integrates and critiques knowledge from international development theory, military doctrine, and research in the nexus of water and development to inform the case study of small water enterprises in Accra. Critiquing the literature provides a contextual backdrop for a systems approach to understanding the social, economic, and environmental effects of small water enterprises on security, sustainability, and development.

International Development Theory

The term "development" emerged in the English language in the 18th century as a synonym to "unfolding," but the application of development as a distinct area of research is relatively new (Crush 1995). As a field of research, development rose following World War II in the United States at a time when national interest was focused on ensuring countries in Europe did not succumb to Soviet Union influence (Halperin 2013). Since then, the term development evolved through definitions influenced by society's own self realizations (or limitations of) and has even been examined within social psychological theories such as in-group-outgroup theory, which spawned the binary worldview of a "first world" and a "third world" (Solarz and Sauvy 2012). Development journeyed from measurements of seemingly objective economic data like GDP per capita or average household income to more subjective metrics such as happiness, agency, well-being, and freedom as development grew roots in subcategories of human development and sustainable development. (Halperin 2013; Martinussen 1997; Roberts 2014; Sen 2000). Subsequently, definitions of development often depend on "the ideological, epistemological, or methodological orientation of their purveyor" (Simon 1997, 184). That is, development theory is infused with value and ideology. Therefore, this research does not seek a concrete definition of development nor does it attempt to define the end goals of development.

Although the definition remains fluid and contextual, a theme arises in the body of knowledge that suggest there is an underlying consensus on the minimum goal of development. That is, the foundation of development involves meeting basic needs for survival at a minimum (Simon 1997). Maslow's Hierarchy of Needs categorizes basic needs into two areas: safety and physiological (Maslow 1943). Safety includes both freedom from life threatening diseases as well as violence and abuse. Physiological needs include water, food, and shelter. This consensus that basic needs form the foundation of development goals is reflected in the United Nations Sustainable Development Goals. Several targets assign basic needs along the following metrics: SDG 1: no poverty; SDG 2: zero hunger; SDG 6: clean water and sanitation; and SDG 11: sustainable cities and communities (addresses housing and safety) (United Nations, 2015). Additionally, many development agendas of the global south use metrics such as access to potable water, literacy rates, nutrition levels, and life expectancy.

There is a wide body of research that questions the role of international development in the 'global south' citing concerns over sovereignty, self-determination, and cultural preservation while also recalling historical tales of western exploitation and mistreatment:

> The legacy of colonialism demands that Westerners show special caution and sensitivity when advancing arguments of universalism in the face of clashing cultural values. Westerners must also remember the political, economic, and cultural power that lies behind even their best-intentioned activities. Anything that even hints of imposing Western values is likely to be met with understandable suspicion, even resistance. (Donnelly, 2007, 304)

The legacy of colonialism has been a concern for both aid and development agencies as well as western governments and military powers. It is an important matter to address and relevant to the topic of this research. Dependency theory, popular in the 1970-1980s rooted itself in the idea that colonialism was responsible for the stagnant economies of underdeveloped

countries and explained many failed "development projects" that occurred post-WWII (Halperin 2013; Lehmann 1997). Works by Escobar (1995) and Watts (1995) focus on the political economy of development, which tail dependency theory in adding that western powers abused development for economic gains and geopolitical power. The collective of these works are referred to as the anti-development movement and according to Simon (1997), their emergence can be partially attributed to the lack of success of any one development agenda. Simon (1997) also criticizes the anti-development movement for its 'simplistic approaches,' lumping all policies, objectives, and practices into one failed development project.

Postmodern development theories superseded anti-development theories. As a reaction to the anti-development movement and in an effort to evaluate the unequal success and uneven results of past development agendas, postmodernists argues that no one theory, agenda, or method enjoys universal acceptance (Simon 1997). While no single theory enjoys universal acceptance, there are still trends in postmodern development theories: the emergence of human development and sustainable development. Particularly, human development centers on the capacity, agency, and social capital of individuals (Anand and Sen 2000; Sen 2000). Human development establishes the idea that the capacity of the individual forms the basis for all development. For example, the human development index uses life expectancy, education, and standard of living indicators as measurements of development and marks a shift from traditional development indexes that focus on national metrics to individual-centered metrics (Haq 1990; United Nations Development Programme 1990).

Sustainable development, closely related to and often integrated with human development, derives from principle that development should "meet the needs and aspirations of the present generation without compromising the ability of future generations to meet their needs" (Brundtland 1991). This report asserts that the "industrialized world must take a full share of responsibility to ensure that the international community helps rather than hinders sustainable

development." Another example of sustainable development leading the international development agenda was the 2015 UN resolution 70/1 which outlined the UN General Assembly's goals (U.N. General Assembly 2015). This resolution replaced the previously outdated Millennium Development goals and renamed them 'Sustainable Development Goals,' signaling the integration of sustainable development practices into the mainstream international development agenda (Sachs 2012).

Social Enterprises in Development

There is an ongoing debate within the international development agenda on methods of implementation and best practices in achieving positive outcomes. The evolution of aid projects mirrors the changes in international development theory. One major shift in aid and development projects has been the shift away from large-scale giveaways and subsidies that were originally designed to lift whole regions and countries out of poverty. Polak (2009) describes a scenario that occurred numerous times in poor and developing countries. By doing so, he highlights the problem with development hand-outs:

> Many organizations have donated village hand pumps to provide clean drinking water to village families, only to return two years later to find that 80 percent of them were not working-because nobody had assumed ownership, so when the pumps broke, nobody fixed them. (p. 83)

This example blames a lack of ownership as the primary reason for failure, but there are other reasons that large scale development hand-outs are unsuccessful. These include but are not limited to: corruption, emergence of unintended consequences from the hand outs (including market disruption), and a lack of cultural understanding and needs. Polak (2009) summarizes the failure of large-scale development hand-outs and subsidies in what he calls the 'three greatest

myths of poverty eradication:' people can be lifted out of poverty through donations, big business will end poverty, and national economic growth will end poverty.

Development practices have largely departed from top-down, large-scale development projects and now look towards more postmodernist methods that focus on sustainability, social capital, and building community and individual capacity at local levels. Two large themes emerge: the rise of social enterprises and the entrance of the private sector as the juggernaut of international aid (Adelman 2009; Drayton 2006). In 2007 alone, global philanthropy, remittance, and private capital investment accounted for 83% of the developed world's economic strategies with developing countries while government aid accounted for only 17% (Center for Global Prosperity 2009). The increase of funding from private capital investment reflects the rise of private sector in development. According to Adelman (2009), "private philanthropy tends to focus more on local ownership of projects, transparency, accountability, sustainable outcomes, and efficient delivery of services" (p. 24). These two emergent themes are not mutually exclusive; however, they are more often related since the private sector is both a financier and driver for projects, while enterprises become the vehicle for change.

Social enterprises are the result of a converging of private investment and traditional aid programs led by individuals working for positive social change (Munro et al. 2016). They are a convergence of financial resources along with experience and goodwill. The term "enterprise" is associated with commercial business activity, but social enterprises are a specific type of enterprise. Social enterprises are defined as organizations that exist for a social purpose and engage in trading to fulfill its mission - using market-based techniques to achieve social ends (Barraket et al. 2017; Munro et al. 2016). Although there is some room for interpretation for the definition, social enterprises use business as a driver for social development (Dart 2004). Social entrepreneurship, like social enterprises, inhabits the nexus between commercial activities and social change, but is also slightly different from social enterprise (Luke and Chu 2013). Arguing

the need to distinguish between the two similar terms, Luke and Chu (2013) posit that social enterprises focus on the purpose of social business while social entrepreneurship focuses on the process of "underlying innovative and entrepreneurial activity for social purposes" (p. 764). This means that not every social enterprise is entrepreneurial because it may not be innovative.

The US Army is also interested in drivers for change and although their doctrine supports the creation of small-scale enterprises in the private section, the term social enterprise is not mentioned in its stability activities doctrine (US Army 2012a, paras. 2–87). The next section introduces US Army stability doctrine, its connection to international development, and places urban water challenges within the context of military operations.

US Army Stability Doctrine

This section addresses the US Army's stability doctrine and introduces terms to understanding connections between the military, interagency organizations, and development. The highest level of doctrine is called joint doctrine and includes how-to-guides for conducting operations with multiple branches of the military (e.g., Air Force and Army). Each branch of the military has their own doctrine that specializes in their responsibilities during wartime and peacetime missions. This research focuses primarily on the US Army doctrine for stability activities, but will also include references from joint operations since the Army's doctrine is nested under joint doctrine. This research also focuses on the Army's doctrine because the Army is responsible for land warfare, or 'unified land operations' which makes it the branch that is primarily responsible for stability activities involved with water infrastructure and development on land. All unified land operations fall under one of three classifications: offense, defense, and stability activities (US Army 2017). Offensive and defensive operations are traditionally more kinetic with land forces conducting missions to destroy, dislocate, disintegrate, and isolate an enemy. Stability activities leverage US forces to "affect civilians in order to attain conditions that

support establishing a lasting, stable peace" (US Army 2017, paras. 4–51). Common mission tasks in stability activities use mechanisms such as compel, control, influence, and support (US Army 2017).

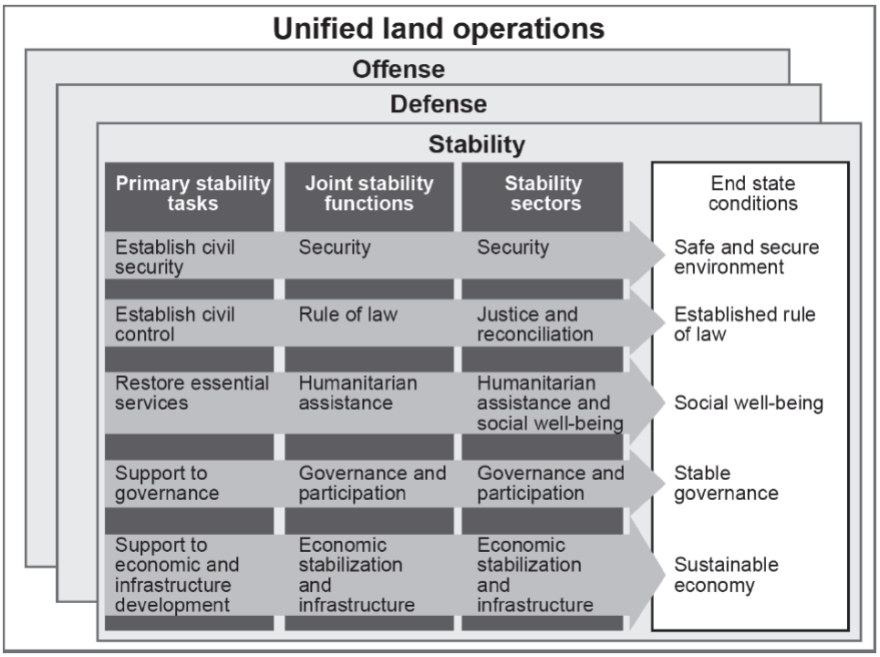

Figure 1: US Army Stability Tasks and End state Conditions. Source ARDP 3-07 (Stability Operations) 2012

Stability activities are "conducted as a part of operations outside the United States in coordination with other instruments of national power to maintain or reestablish a safe and secure environment, and provide essential government services, emergency infrastructure reconstruction, and humanitarian relief" (Department of the Army, 2012b, paras. 1-1). With the goal of long-term stability, stability tasks are based on four principles: conflict transformation, unity of effort, legitimacy and host-nation ownership, and building partner capacity (Department of the Army, 2012b, paras. 1-1). Figure 1 outlines the US Army's five primary stability tasks, and depicts how these tasks align with the five joint stability functions. It should be noted that newer military doctrine, specifically ADRP 3-0 Operations, lists a sixth stability task, 'conduct security cooperation' but the stability doctrine, ADRP 3-07 has not been updated as of the time this

research. The ultimate goal of stability activities is "to create conditions so that the local populace regards the situation as legitimate, acceptable, and predictable" (US Army 2012a, paras. 1–1). While stability tasks do not have to occur in any particular order, they usually focus on ending violence or conflict first, then move to enable governmental, economic, and societal institutions, and lastly focus on adherence to laws, rules and norms (US Army 2012a). The formal framework for stability activities describes the temporal aspect of implementing stability tasks (initial response phase, transformation phase, and fostering sustainability phase) and the five stability tasks and 'end state conditions' lie within this formal framework (US Army 2012a). When referring to the stability framework in this text, I am more often referring to the five primary stability tasks and their end-goals referred to in figure 1.

So where do urban water access problems fit into the military's primary stability tasks? How can solutions to improve access to clean water be mutually beneficial to a country's stability as well as the national security of another country? The answer to these questions lies in the nexus between sustainability and security problems. As such "restoring essential services" and "support to economic and infrastructure development" are two of the US Army's five primary stability tasks that address increasing access to water by working with governmental or non-governmental agencies (ADRP 3-7, 2012). Essential services include transportation, telecommunications, energy, and municipal services such as water. If a municipality has not provided these essential services, how can the US Army restore a service that never existed yet is required for such stability? The current answer found in military doctrine serves to support the host nation and civilian relief agencies at the local level:

> Military forces often may support host-nation and civilian relief agencies with efforts to restore essential services. However, when the host nation cannot perform its roles, military forces often execute these tasks directly or to support other civilian agencies and organizations. Effective forces properly scale these activities to local capacity for

> sustainment. Proper scaling also creates the best opportunity for the local populace to create small-scale enterprises to provide as many of these essential services as possible through the private economy. (Department of the Army, 2012a, paras. 2-87)

The military proposes the stimulation and encouragement of small-scale enterprises and the private economy to fill gaps in essential services, such as access to clean water. Small-scale water enterprises are exactly what several NGOs propose will improve access to clean water in Ghana. Similar to many other sustainability solutions, small-scale enterprises can address more than one stability task. Another stability task is to support economic and infrastructure development (US Army 2012a) Social enterprises can help address economic growth through the support of small businesses:

> In the transformation phase, Army units provide start-up capital for small businesses through small enterprise grants. Army units use the commanders' emergency response program (CERP) and other Title 10 or 22, United States Code, funding sources to provide start-up capital for micro or small businesses. (Department of the Army, 2012b, paras. 6-25)

This describes the experiences of many privately funded aid and development organizations in an attempt to support social enterprises. In this case, the US Army supports an enterprise in an attempt to create peace and stability; stability is its intended social result. Lastly, it is thought that small-scale enterprises have the ability to affect change in more than just economic and infrastructure dimensions (Nicholls, 2008). Other local problems such as gender equality and environmental justice may be addressed through the encouragement of small-scale enterprises:

> We believe there is considerable, and largely unmet, potential for SEs (social enterprises) to effect positive social change in fragile and conflict-affected states in Africa through

> their focus on developing sustainable solutions to social problems and their capacity for scaling up or out. (Izarali et al., 2017, 62)

It is clear that there is a shared interest by the military, aid agencies, NGOs, and developers in solving water access challenges. This problem is most acute in areas where municipal services do not provide safe and clean access to water for its citizens. This research adds to the existing literature about stability activities by exploring how small-scale enterprises can both increase access to clean water, improve other sustainable development objectives, and achieve the military stability objectives.

Sustainable Development Goal 6: Water and Sanitation

To position this research in the nexus of security and sustainability, the UN Sustainable Development Goal 6 (SDG 6) must be analyzed. Using the UN's framework to both implement and assess its progress on water access is useful for understanding SWE's effect on water access. Supplementing the research with ongoing efforts to achieve "universal and equitable access to safe and affordable drinking water for all" provides a foundation to assess SWEs as a specific method in this case study (United Nations General Assembly 2015, 18). Notably different from the 2000 Millennium Development goals, SDG 6 contains six core targets, two methods of implementation targets, and nine indicators (See figure 2).

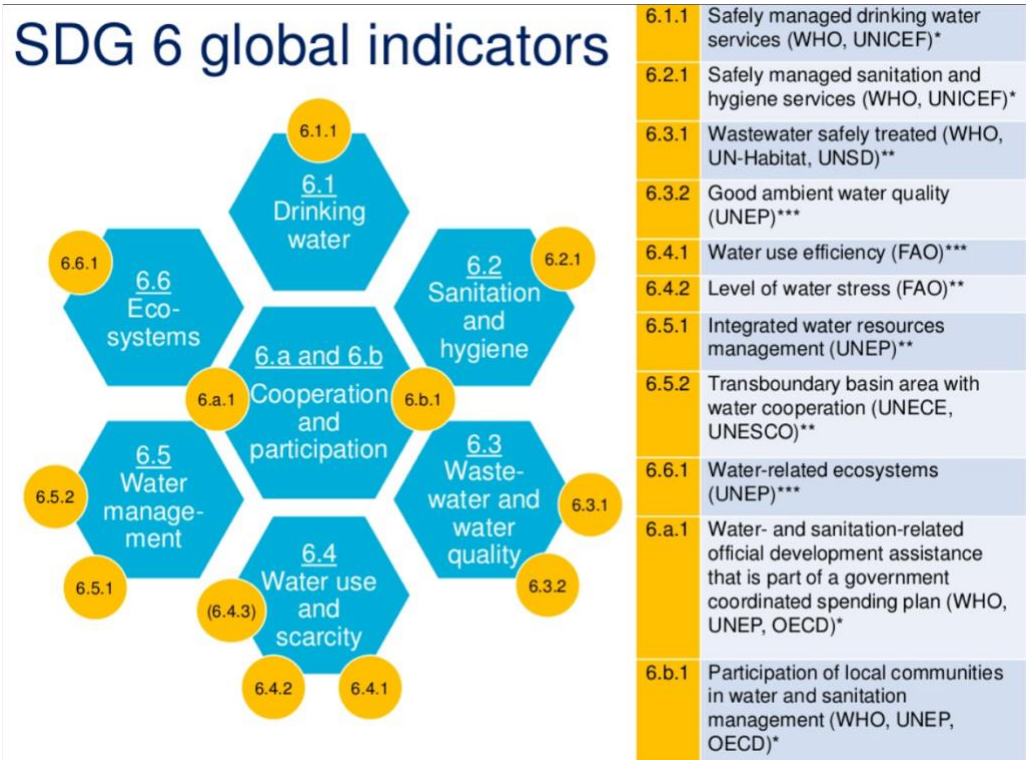

Figure 2: SDG 6 targets, indicators, and methods of implementation. Image Source: www.oecd.org/gov in Slideshare.

These eight targets, plus 10 other water-related targets outlined in other goals, reflect the increased importance and attention given to water and sanitation in SDG 6 and among international development circles (Bartram et al. 2018). SDG 6 highlights the importance of linking sanitation systems to water access. While the current study focuses on the access to clean water, elements of the case study will include the potential consequences of increasing access to water without considering downstream infrastructure. For instance, untreated wastewater released back into water systems in urban areas can lead to contaminated water sources, exacerbating water scarcity issues and increasing cases of waterborne diseases.

The methods of implementation (MoI) targets provide an action-oriented framework for implementation by listing essential activities to effectively reach the six core targets (United Nations 2018b). Governance, finance, capacity development, and data acquisition and monitoring comprise the activities listed in the MoI targets and the UN states these activities are interlinked and mutually reinforcing (United Nations 2018b). While the MoIs are recognized as a major improvement over the Millennium Development Goals, they do not come without critique (Adams and Smiley 2018; Bartram et al. 2018; Guppy, Mehta, and Qadir 2019; Lele 2017). Adams and Smiley (2018) assert that the MoI of SDG 6 fail to adequately address inequalities in water sources, availability, affordability, and accessibility, asserting that many of these inequalities are a result of the urban-periurban-rural, formal-informal, and socio-economic strata divides. Their research, focusing on sub-Saharan Africa, contends that urban areas have better access to water because of a wider range of sources, but face issues of availability and reliability due to rationing, reduced water pressure, long wait times and water contamination. Lele (2017) echoes the concern for SDG 6's attention to inequalities, except in the context of sustainability and environmental justice. Instead of focusing on *intra*generational justice, Lele (2017) criticizes that SDG 6, and most researchers, focus too much on *inter*generational justice. Even so, Lele (2017), despite its criticism, fails to offer solutions in the context of SDG 6.

Bartram et al. (2018) critiques several MoIs stating that MoI 6a (cooperation focused) places too much emphasis on Official Development Assistance (ODA) when most of the current funding for water and sanitation projects come from domestic sources. They also note that MoI 6a fails to properly account for assistance in the form of advice or knowledge (as opposed to financial) which could lead to potential undervaluing of ODA between developing countries. In addressing MoI 6b (community participation) Bartram et al. (2018) argues that MoI 6b should specifically address the right to information and the role of users in decision-making when addressing community participation in water and sanitation issues.

Addressing some of these critiques, the United Nations conducted a high-level political review in July 2018 to conduct an in-depth review SDG 6. It concluded that "at current progress, SDG 6 is not on track to be achieved by 2030" (United Nations, 2018a, 2). The forum cited political engagement, data gaps, climate change, and ineffective financing as notable challenges. The forum recommended improved water governance, increased focus on eliminating inequalities, increased support for diversified means of financing, increased focus on capacity building, leveraging smart technologies, and increasing multi-stakeholder partnerships to increase effective cooperation (United Nations 2018a). Capacity, governance, financing, and addressing inequalities are common focal themes observed through water challenges arising from both the United Nations grey literature and academic critiques of the SDGs.

The literature introduced in this section demonstrates an international will to address and solve challenges of water access globally, but also recognizes the complexity of problems that persist. Most importantly, previous research has established the need for systems thinking approaches that consider social, economic, and environmental outcomes, instead of shortsightedly addressing only the problem at hand. In addressing water challenges, solutions may require diverse approaches at appropriate scales. There is promising research that social enterprises can affect multi-dimensional change, leading to positive second and third order effects. SWEs may be a solution that also improves water access, while having positive multi-dimensional outcomes, and this research hopes to contribute to that greater effort. The following methods section charters the path of this research, explaining how it will investigate the effectiveness of SWEs and its social, economic, and environmental outcomes in the case of Nima.

CHAPTER 3

RESEARCH METHODS

Research Philosophy and Ontology

The nature of this research seeks to answer established questions in a bounded environment and test conceptual frameworks and theories through interviews with participants and observations by the author. As a case study focusing on social beings, this research employs subjectivist epistemology where absolute truths rarely exist. Understanding of social phenomena is constructed by developing shared interpretations of experience between the researcher and the study participants, situated within specific temporal, geographic, social, political, and economic circumstances. Observations in this study run through the lens of the researcher, who cannot avoid slight influences in interview questions and answers, and whose field notes are filtered through a mind with personal perspectives and experiences. While it is my intention to maintain independence and reduce interference during interviews and observation, I also acknowledge the views of interpretivism in which elements of the study have to be interpreted by the researcher. The nature of reality described in this study is socially constructed; the knowledge generated is relative to context. This is particularly relevant as an "outsider," because race and nationality of a researcher can affect individual participants' behavior (Cilliers, Dube, and Siddiqi 2015).

To avoid the major bias effect of interpretivism, literature reviews and outside research will be used to ground observations and analysis in peer-reviewed knowledge. Ultimately the observations of this case study and the ensuing knowledge produced are a result of one case study and cannot represent generalizations without integrating similar observations from similar case studies. The end goal of conducting this single case study is two-fold: to answer the research questions posed creating contextual knowledge that applies to a single place at a single time, and to develop the conceptual underpinnings of future social scientific inquiries. The latter purpose

requires description of the case study (see section "Case Study Observation"), acknowledgement of case study limits, and proposal for future studies.

Research Approach

Research in this study examines specific observations and evaluates theoretical "fit" into existing frameworks and theories of change. In other words, does the case study adhere to or fit with general conclusions and expectations derived the existing literature? If observations do not align with predicted outcomes, this may present future areas of research. This research employs inductive reasoning by taking case specific observations and then applying them to a broader framework and theory. When combined with knowledge from other case studies, this allows for pattern detection and development of theoretical propositions or testable hypotheses. While this research identified a topic, frameworks, and background knowledge in the broad subjects before beginning fieldwork, its observations were exploratory and open-ended. The researcher did not know what social, economic, and environmental outcomes would be discovered surrounding the existence of small water enterprises in the Nima community of Accra, Ghana.

Framework

This research employs two conceptual frameworks: The United Nations Conceptual Framework for the SDGs and the US Army's Stability Framework. While the SDGs exist to specifically end all forms of poverty, fight inequalities, and tackle climate change, the US Army stability framework creates conditions of security and stability. The two frameworks have slightly different goals, but share many similarities. Both frameworks uphold that progress in social, economic, and environmental dimensions are interconnected and interdependent. Investment in one area may enhance other areas as well. The idea of interconnected and interdependent progress is associated with a systems analysis. This concept, as it relates to water, is best described by the

UN Synthesis Report, "achieving SDG 6 is essential for progress on all other SDGs and vice versa. Sustainable management of water and sanitation underpins wider efforts to end poverty, advance sustainable development and sustain peace and stability" (United Nations, 2018c, 21). In other words, success in one dimension affects success in others; likewise, failure in one dimension negatively affects the others.

Examining a case study in light of both these frameworks is novel and a comprehensive literature review could not find any evidence of formal connections between the two (including formal connections with the former MDGs), despite seeming intuitively similar. In an interview with US Army's Peacekeeping and Stability Operations Institute, the formal proponent for the Army's Stability Doctrine, the UN's SDGs are covered and discussed in courses on stability activities, but no formal connection was known or identified by the interviewee (participant 9). While the two frameworks share conceptual similarities, they do have differences (see figure 3).

Figure 3: Comparison of UN SDGs and US Army Stability Tasks.

One of the major differences in the frameworks is the emphasis placed on the environment. Not to be confused with operational environment, a term used in military doctrine to describe all conditions, circumstances, and influences of an operation, the environment discussed here is the biophysical environment. There are 162 references to environment in ADRP 3-07, Stability Operations, and none of them refer to the biophysical environment (US Army 2012a). The biophysical environment referenced in the UN SDGs includes the quality and conservation of air, land, and water resources. Four SDGs explicitly address the biophysical environment while zero US Army stability tasks explicitly address the biophysical environment. There is research available that recommends greater environmental considerations in stability and

reconstruction operations articulating the positive and negative impacts on soldiers, relations with local populace, diplomatic relations, financial liabilities (Mosher et al., 2008). While not a criticism of the US Army's stability goals, this discussion helps explain connections and differences between the two frameworks: one seeks to improve sustainable development while the other focuses on stability and security.

The second biggest difference between the two frameworks is the definition and use of the word *sustainable*. In the 61 references to sustainable or sustainability in ADRP 3-07, Stability Operations, 15 of those are references to sustainable economy, nine references to sustainable peace, and four references to sustainability phase (US Army 2012a). While the doctrine does not explicitly provide a definition for sustainable, it does state "Sustainability involves the local ability to maintain the project and the capacity to utilize it after the operation" (Department of the Army, 2012b, paras. 2-95). *Sustainability* in the US Army Stability doctrine refers to a condition's ability to exist over time. In contrast, The UN SDGs adhere to the definition set forth by the Brundtland Report (1991). That is, to "meet the needs and aspirations of the present generation without compromising the ability of future generations to meet their needs" which includes the element of intergenerational equity (Brundtland, 1991, 39). The concept of equality is a core component of the SDGs and is directly related to two goals: Goal 5: Gender equality and Goal 10: Reduced inequalities.

Other noticeable differences between the two frameworks are the absence of US Army stability tasks specifically dealing with consumption, partnerships, and equality. With the exception of responsible consumption, which is not addressed, US Army stability doctrine does mention both partnerships and equality, just not explicitly in a task. While the UN partnership goal focuses on coordinating policies internationally and promoting investment, stability doctrine promotes coordination and cooperation of military and civilian efforts in both foreign and domestic governments and organizations in all tasks and phases where possible. Under the

Army's support to governance task, social capital development is encouraged through "promoting human rights, advancing equity and equality (including gender, social and economic resources, political representation, ethnicity, and race), and supporting democracy and self-determination" (Department of the Army, 2012b, paras. 2-50).

Research Strategy

Given the purpose, philosophy, and approach of this research, the strategy employed to explore my research questions is a case study. The case study records the impacts of SWEs in the Nima community of Accra, Ghana on water access and its linkages with other social, economic, and environmental outcomes. I approach the research questions from an anthropological and ethnography background. The main research question asks about the "how" which is the crux of employing case study research. The "how" focuses on contemporary events and does not require control over behavioral events (Yin 2018). The two supporting research questions ask "what." These are descriptive questions—mainly about the water access in Nima—and can be answered through existing surveys and literature, interviews, and observation. The elements of this case study include the research questions, the description of the case, an analysis linking case to frameworks, their interpretation and the discussion. The aggregate of the descriptive portion of this case will help answer the "how" of the main research question. While many case studies have propositions, this case study has a purpose since it is exploratory (Yin 2018). This purpose is to explore the linkages of small water enterprises to other social, economic, and environmental variables common in the UN SDGs and the US Army's Stability Framework. In the analysis and discussion section, this research will attempt to employ two analytic techniques: (1) explanation building (explain why Nima has been successful in increasing access to water) and (2) pattern matching with the two other identified case studies (described later in this section), and logic models (examining SWEs as an intervention method to increasing water access).

Research Methods

The fieldwork for this research consisted of two weeks spent in Ghana. Additional offsite research occurred between June 2018 and March 2019. The primary data collection strategies used for this research were: semi-structured interviews and observation augmented with existing literature and case studies.

Semi-structured interviews.

A total of 9 interviews were conducted in person and at the location of each participant's choosing. One interview was conducted via telephone while the others were conducted at various locations in and around Accra, Ghana. Of those interviews, 1 was with a governmental organization, 2 were with non-governmental organizations, 1 was with a community-organized group, 1 was with a local business producing sachet water, and 5 were with individuals who sell water or operate other water-related businesses on the informal market. A translator and community liaison were available for all interviews with Nima citizens who sold water or conducted commercial business dealings with water. Participation was voluntary and participants were not compensated for their time. Each interview lasted 45-60 minutes. Appendix 1 assigns participant numbers for each interviewee and includes non-personally identifying information on each participant. Participants were briefed on the study and the purpose of the research using the interview consent form, and verbal consent was also obtained. Recruitment was assisted by the community liaison verbally and via telecommunications.

Observation.

The study also included a tour and observation of two wastewater treatment plants to understand the full water cycle in Accra, a participant led tour of Nima and their most recent

water source additions, and a tour of a water-sachet factory. The direct observation of the treatment plants shed light on a systems perspective of the water cycle in Accra. It is important to understand the downstream infrastructure needed to handle increased water effluent that would occur if the city increases formal water supply to its residents, as well as the associated environmental impacts that occur when infrastructure is not equipped to handle that increased effluent.

Similar case studies.

Water access challenges in Nima and surrounding neighborhoods in Accra have been studied in the past. There are two past case studies that examine both the use of domestic water supply for commercial activities and the challenges to adequate water supply. These cases are used as additional supporting evidence to augment my own observations in both water access challenges and the social, economic, and environmental outcomes of SWEs.

In 2010, Kehinde Odunuga conducted an "Analysis of Domestic Water Use for Commercial Activities among the Poor in Alajo and Sabon Zongo Communities of Accra, Ghana" (Odunuga 2010). Sabon Zongo (#2 in figure 4) lies 5.2 kilometers southwest of Nima and Alajo (#3 in figure 4) lies three kilometers northwest of Nima (this research's focus). The qualitative study examined differences in these two communities in both water prices and income generated from water-related business. The study found that income from water-related business contribute to either all or more than half of the household income of water-related business operators and that water prices in these communities are tenfold higher than water prices charged by the water utility. This impacts profits of small water businesses, which disproportionately affect women. The study also examined health and sanitation issues associated with water access.

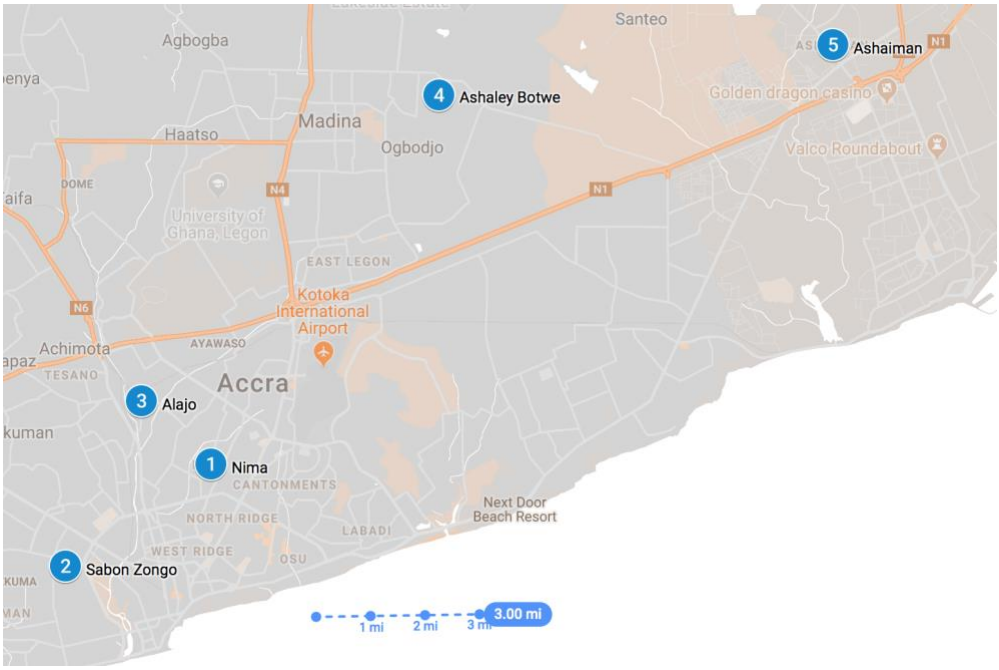

Figure 4: Map of Similar Case Study Locations

In 2009, Kweku Gyan Ainuson conducted a case study comparison to examine solutions for adequate water supply in three communities within Accra, Ghana: Nima, Ashaley Botwe, and Ashaiman. In addition to detailing the means and prices of water supplies in the case study areas, this study also describes how water supply inadequacies in disadvantaged communities affect other aspects of life such as health, household economics, commercial activities, and women and children's daily lives. The study employed qualitative methods via interviews and focus groups and quantitative methods via data analysis of household surveys. This case study is particularly useful for this research because it studies the same community, a decade prior, thus providing a temporal comparison of the community's access to water over the past decade.

Research Design

Table 2 organizes the research questions into supporting questions that help investigate the research questions, as well as the specific methods employed to explore these questions.

Research Questions	Sub-questions	Methods
What are means of residential water supply in Nima Community, Accra, Ghana	• Where are the water points? • Is the water potable? • How far do residents travel for water? • How many users/day use the source? • Average Cost of Water • Are there limits to this water supply (amount, time of day)? • What are the barriers to piped water supply from GWC?	-Interviews -Participatory Observation -NGO Reports -Existing Peer-reviewed surveys -Photographs
What are the trends of increasing residential urban access to water supply in Nima neighborhood of Accra, Ghana?	• What are the means of potable water supply available in Nima? • Who/what is financing these trends? • Who is benefitting from these trends? • What conditions existed that are associated with or attributed to increased water access by residents?	- Participatory Observation - Interviews
How do SWEs affect social, economic, and environmental outcomes in the context of the UN's Sustainability Development Goals and the US Army's stability doctrine	• How does increased water supply affect the daily lives of residents? • Does the means of water access have noticeable economic impacts? What are they? • Does increasing water access affect gender or age disproportionately? How? • Are these trends linked to social changes within the community? • Are these trends sustainable?	-Participatory Observation -Interviews -Existing peer reviewed literature

Table 2: Supporting Questions and Methods to Explore Research Questions

CHAPTER 4

CASE STUDY OBSERVATIONS AND DESCRIPTION

While the literature review focused on the macro water-related topics within sustainability and security lenses, the following section will focus on the micro water-related observations in the case study area: The Nima Settlement in Accra, Ghana.

Nima

While Ghana remains one Africa's top achievers across 97 indicators and 17 SDGs, ranking 6th among 51 countries in Africa in a 2018 SDG index, there is much room for improvement amongst the world stage, and national averages do not always address regional and local inequalities (The SDGs Center for Africa and the Sustainable Development Solutions Network 2018). Nima is a peri-urban settlement located on the northern side of the business district in Accra. It is densely populated, with an estimated population of 82,329 people in 2008 (Fiasorgbor 2013). The ethnic population is diverse but the majority of residents from Northern Ghana and neighboring Western African countries (Agyei-Mensah and Owusu 2012). The predominant religion in Nima is Islam and Nima has become known as welcoming place for Muslim immigrants looking to establish a life in Accra (Agyei-Mensah and Owusu 2012). Walking the community, it is outwardly dense, characterized by narrow pathways, few streets, multifamily dwellings and compounds, and small-scale food and beverage vendors along main thoroughfares.

In 1997, a group of women, concerned with the sanitation situation in Nima reached out to the Ghana Red Cross Society for assistance in improving latrine access, water access, and trash pickup. With help from the Ghana Red Cross Society and a local NGO legal union who provided training in citizen local engagement, the group of women launched an education campaign for community members to deposit trash at designated collection points. They organized a

reoccurring clean-up of a then notorious gutter, Nima Gutter, which was filled with trash and served as a breeding ground for insects. With additional assistance from the local legal office, which included interns from Harvard University as a part of the Ghana Project, they were able to terminate an existing trash pickup contract and negotiate a contract with a more reliable trash pickup company (Simkin 2016). The Mother's Club established a sanitation committee that included other members of the community such as pastors, imams, a youth leader, and opinion leaders. This committee which still exists today, allowed them to apply for financial assistance from the World Bank for projects in their community. The first project they received funding for was a project to purchase and install 14 poly-tanks (water storage tanks). When the pipes were dry, women in Nima previously used a water point at the Accra airport, five kilometers away from their community. The water storage tanks allowed them to deliver and store water for household use within their community, although they still had to fetch potable water from other sources. Shortly after installing the tanks, Ghana Water Company installed piping to the tanks.

To address the shortage of nearby drinking water, the Mother's Club began work with an international non-profit organization to install a borehole, pump, and filtering equipment so the community could have access to drinking water. The project was a part of Global Community's Water Access, Sanitation, and Hygiene for the Urban Poor (WASH-UP) program that received funding from USAID and The Coca Cola Company. The project paid for the well and the pump but also provided training and assistance in running the water point to include sales and operations that would support its maintenance costs. The Mother's Club has been collecting revenue for the water it provides at a rate that pays for its maintenance and operations.

While visiting the Mother's Club, the president stated that the goal of selling drinking water was to not only to put money aside for routine maintenance, but also to save up revenue to build another well and pump within the community. Work accomplished through the Mother's Club of Nima, which now has over 200 members (members are not required to be mothers), has

been formally recognized by parliament, which the club agrees has bolstered their legitimacy and authority as well as their ability to apply for and receive funding for projects in Nima. The Mother's Club of Nima charges its members GHS5 (USD $1) each month in dues. The dues pay for refreshments during meetings, any transportation expenses occurred for meetings outside Nima, and also serves as a 'social emergency' fund for members who incur unexpected financial difficulties. Examples of emergencies included a member losing a house in a flood or covering medical expenses for a child involved in a motor accident. This influential group has had major impacts on Nima's water and sanitation over the past ten years which will be discussed further in the following section.

Nima's Waterscape

Due to Ghana's climate and access to natural resources, it is endowed with abundant freshwater sources that are essential to the country's health, economy, and environmental sustainability. On a national level, a little over a quarter of the population receives water from an improved source located on premises when needed, while just over half the population has access to water from an improved source within 30 minutes roundtrip (National Development Planning Commission 2018). Given Ghana's abundance of freshwater, these statistics should be higher. In the 2018 UNDP report of Ghana's progress in SDG 6, the report cites multiple reasons for water access issues including "inappropriate management practices, poor agricultural practices, surface mining, desertification, population growth, economic growth, and urbanization" (National Development Planning Commission 2018). Similar to other parts of sub-Saharan Africa and many other developing regions experiencing high rates of urbanization, major quality of life differences exists among both urban-rural divides, and within urban areas. Partly due to lasting effects of colonization, older wealthier neighborhoods in urban areas enjoy better water services (Morinville 2017). While 95% of residents in the Greater Accra region have access to improved

water within 30 minutes, roughly 50-60% of Nima residents have access to safe piped water, and the rest rely on rainwater and packaged water (Ainuson 2009; Fiasorgbor 2013).

Water sources.

In Nima, residents use water from multiple sources. Quality, price, and reliability of service affect source selection. Water used for bathing, washing clothes, and other daily household activities typically comes from the city's water provider, Ghana Water Company Limited, (GWCL), or piped water, if available, while drinking water, or "pure water" typically comes from a borehole or is purchased in sachets. Water sachets are 500ml of water in a sealed plastic bag. In addition to concerns over the quality of water flowing from the pipes, residents explained that the water pressure is low and results in periods where no water flows at all (participant 1). These periods can last hours, days, or weeks and are unpredictable. Residents explained they generally have no idea when the water will flow and when it will not. The only consistency pointed out was that the pipes go dry more often in the dry season and during than day rather than the night. There are several piped water stations or access points in the community that sell the Ghana Water Company water which residents use for daily household activities if they do not have their own pipe access. These water points are usually run by residents who purchased a water connection from the GWCL and use this resource to make money selling to neighbors. These access points may also include compound landlords who have different arrangements with their tenants on accessing and paying for shared water. Some of these water points started their water vending business with a borehole selling pumped ground water but converted to piped water when the borehole went dry. 30 liters of this city piped water sells for GHS0.50 (USD $0.10) These water vending stations are especially useful for when the pipes go dry as they use poly tanks to store water that fill up when the water flows. Residents don't consider the piped city water safe for drinking although the Ghana Water Company claims that its

water is tested hourly at the treatment plant and meets acceptable drinking water standards (Adogla-Bessa, 2016). In addition to skepticism of water quality, residents interviewed claimed that ever since the water source for Ghana Water Company switched from Lake Volta to Lake Weija in 2004, the water doesn't taste good (participant 1, participant 5).

Residential drinking water comes primarily from purchased containers, both plastic bottles and cheaper plastic bags called sachets, and also from groundwater boreholes or plants that treat GWCL. Although bags of water are referred to as "pure water" there is no guarantee that water purchased in plastic bags has actually been treated properly or tested regularly due to lapses in regulation of water businesses or the failure of businesses to register. In 2014, approximately 500 sachet water producers were registered with Ghana's Standard Authority (GSA) in Accra, but it was estimated that there were actually over 3000 of them (Morinville 2017). Water sachet business that are not registered with GSA do not receive inspections by a team of 30 inspectors employed by Ghana's Food and Drug Authority.

One of the interviews conducted for this study was with two managers of a sachet plant just outside Nima that had opened two months earlier. The plant drew water from a borehole outside and filtered it with zeolite crystals, sea-membrane, and UV light. The plant was a franchise of Mobile Water. In exchange for producing water of a certain quality, the sachet plant could sell their water in Mobile's plastic bags with their brand name. The plant had two bagging machines which cost just under USD $2,000 each and less than 10 employees were running the operation. The plant produces around 72,000 sachets each day. Managers explained that their biggest challenge to consistent production was reliable electricity. The plant borrowed money for the borehole filtration equipment, and associated machinery and when the power goes out they have trouble meeting the financial obligations to repay their loans. If their production continues without major interruptions they anticipate they'll pay off their debts in 2-3 years. The business operates on an 8-year agreement with the land owner, which is about how long they expect the

borehole to pump water. They explained that boreholes eventually run dry after this amount of time, not because of equipment failure, but because of water table drawdown. When asked if anyone had inspected their plant for water quality, they stated Mobile would be conducting quality control on the plant twice a year, but they had not yet received their inspection. This was the largest water vendor interviewed in this research and it was the only one run by men, although it should be noted that women ran the bagging machines.

Water tankers were not prevalent in Nima since the many residents did not live along an access routes big enough for a vehicle. Instead, water is brought in on motorbikes commonly called MotorKings (see figure 5) with cargo beds attached to them.

Figure 5: Motorbikes outfitted with cargo beds like this, called Motorkings deliver water to residential areas where larger trucks are unable to pass through. Image by Natalie Mallue 31 July 2018.

The other source of potable water in Nima comes from community-managed boreholes. Boreholes were added in 2017 through the NGO Global Communities (formerly CHF), with funding from USAID. The water stations are another sign of improved water access and sanitation in the community (Participant 5). The project started in 2010 with a mapping project to determine existing services and plan for the best way to provide additional water and sanitation services. The project was a part of a larger program by Global Communities called Water Access

Sanitation and Hygiene for the Urban Poor (WASH-UP) and included water and sanitation improvements Nima as well as two other slums communities in Accra. According to the final project report from Global Communities, the WASH-UP program had the following goals:

- To increase household access to affordable, improved, and sustainable drinking water supply.
- To increase household access to improved and sustainable sanitation facilities.
- To promote innovative economic enterprises in the areas of water and sanitation.
- To improve hygiene and sanitation behaviors among the urban poor.
- To strengthen local governance for water supply, sanitation service, and hygiene promotion. (USAID 2012)

Water pricing.

The price of water in Ghana depends on its source and quantity purchased. The smallest typical unit sold is the water sachet which is a half-liter. Participants in this study purchased for consumption (or sold for business) water sachets at GHS 0.20 (USD $0.04) per sachet. The price of sachet water is regulated and announced by the National Association of Sachet and Packaged Water Producers (NASPAWAP). Since my trip to Ghana, the price of Sachet water increased to GHS 0.30 (USD $0.06) per sachet. NASPAWAP cites increasing tariffs as the reason for the sharp price increase (Dokosi 2018). The Public Utilities Regulatory Commission (PURC), which also regulates the price of electricity, regulates the price of water for water provided by the Ghana Water Company. Water rates change 1-3 times per year and are published on PURC's website as well as on the radio. Table 3 contrasts the prices residents pay for private water in Nima with the prices for GWCL piped water. Since many residents of Nima rent their homes, they share a GWCL pipe within their compound. Landlords set the price residents pay in various arrangements, but in both cases in this research, participants paid GH₵15/month regardless of their consumption.

DOMESTIC WATER RATES IN NIMA							
	Date	Typical Size Sold (Liters)	Water Source	Price GHS	Price/Liter GHS	Source	Typical Use
Private Water	July-18	0.5	Sachet "Pure Water:	GHS 0.20	GHS 0.40	Various	Drinking
	July-18	30	Private Standpipe	GHS 0.50	GHS 0.02	GWCL	Household
	July-18	30	Private Borehole	GHS 2.00	GHS 0.10	Community Borehole	Drinking
	July-18	Monthly Flat Rate	Shared Pipe Connection	GHS 15.00	NA	GWCL	Household
Public Utility	Jun17-Sep18	0-5000	Standpipe	GHS 2.98	GHS 0.0030	GWCL	Household
	Jun17-Sep18	>5000	Standpipe	GHS 5.07	GHS 0.0051	GWCL	Household
	Sep18-Current	0-5000	Standpipe	GHS 2.68	GHS 0.0027	GWCL	Household
	Sep18-Current	>5000	Standpipe	GHS 4.56	GHS 0.0046	GWCL	Household

Table 3: Domestic Water Rates in Nima

While the price of private water is much higher than the price of water from GWCL, participants complained more about quality and consistency of service than they did the price of water. This is consistent with other studies of water access in and around Nima (Abraham et al. 2015; Odunuga 2010). While none of the water-related business entrepreneurs cited the cost of water being too high, there may be hidden costs associated with time spent fetching water. Participant 2 was an owner of a catering business that employed 10 people. She cited that workers pay, rice, and oil were her largest business expenditures. When questioned about her processes for fetching water every day, she also explained that because there is no water connection at her business, her 10 workers spend 1.5-2 hours fetching water in 20 gerry cans and 4-100L barrels every morning. While the cost of water for her business is GHS 20 (USD $4) daily, the employment cost of fetching water may go unrealized by business owners.

Barriers to water access.

Only one participant (1) interviewed had their own private connection with GWCL, while two others had connections in their compound. The participant who had her own connection on her land explained that her husband had requested the connection at least ten years ago "back when it was easier" to get a connection, and her perception was that it is more difficult to get a GWCL connection at the time of the study. GWCL's website detailing the requirements for new service connections require the applicant to submit a valid building permit, as well as a name and address of applicant amongst other items. In an informal settlement where buildings may not have valid building permits or addresses, many residents are automatically ineligible to apply for a service connection. Additionally, as observed in this case study, the majority of residents rent their home or room from a landlord; therefore, it is the landlord's decision and responsibility to install a service connection. Landlords who are not present may not see the benefit of installing a pipe connection if water can be accessed through other means, while tenants will not want to invest in a piped connection on land they do not own, or in living arrangements that do not guarantee their future stay. Land tenure is a barrier towards increasing piped water supply to residents throughout Nima and a common challenge for the expansion of water services urban and peri-urban areas experiencing rapid growth across sub-Saharan Africa (Sjöstedt 2011).

Another barrier to increasing piped water supply in Nima was the physical geography of the settlement. One major road, Nima Road split Nima into Nima-East and Nima-West and served as the main artery for the community. Water effluent runs along makeshift open-air drains while electricity lines are strung overhead from house to house on scrap boards and along rooftops in haphazard arrangements. Open sewer drains run alongside internal roads and paths and there seems to be no official setback from the road to buildings, and if there is, it is not enforced. Narrow streets, pathways, and an irregular layout that developed as the settlement experienced growth presents challenges to residents, city planners, and even the private industry. In a story told by participant 5, when the Mother's Club of Nima purchased polytanks for the

community, they had to be rolled along rooftops to reach their destination in the dense community of Nima since the roads and pathways were too narrow for truck delivery. The lack of service roads and sidewalks along streets leave little space for upgrading infrastructure, laying pipes, and delivering water. Appendix 2 depicts a vehicular accessibility map of a portion of Nima. It shows that only two routes through that portion of the settlement are accessible by vehicle.

Water treatment.

As previously mentioned, water effluent from homes and commercial activity runs into open air drains that line walkways and streets throughout Nima. Nima lacks a city-wide drainage system and toilets are pit latrines and that get emptied via truck where trucks can access them or pan latrines that get emptied into open drains. The sanitation situation varied across Nima. In some parts, there was noticeably less rubbish along the streets and pathways and the drains were generally free of debris, while other parts of Nima faced clogged drains (see figure 6). Residents

Figure 6: An open drain along New Town Road in Nima-West. Picture by Natalie Mallue 24 July 2018

complained that trash thrown into drains and canals caused flooding when it rained, causing sewage to enter homes. The drains were filled primarily with plastic bags and bottles. The lack of toilets is apparent as tied off plastic bags, known as flying toilets, are used as substitute toilets and can be found in the drains and thrown along the roadways. Most of the homes in Nima don't have

bathrooms. Public toilets and bathhouses exist, but cost anywhere from GHS 0.20 (USD $0.04) to GHS 1.00 (USD $0.20) to use with the more expensive toilets being cleaner and more private (Doris 2014).

A visit and tour of Accra's water treatment facilities shed light on the greater infrastructure problems facing the city. Nima is not alone in its sanitation challenges. The city as a whole suffers from inadequate water-treatment and grey water infrastructure. The water treatment plant for Accra is located next to the Korle Lagoon, the outlet for all major drainage channels in the city, including wastewater that makes its way from Nima. The extremely polluted water, a result of human activities and rapid population growth, flows out to the sea largely untreated (Aglanu and Appiah 2014; Boadi and Kuitunen 2002). The Mongo water treatment plant operates at full capacity and only treats 15% of Accra, partly because much of the city does not have sewer access. Next door from the Mongo treatment plant was Lavender Hill Fecal Treatment plant which just opened 2016-2017 and treats wastewater from trucks. Before the opening of Lavender Hill, trucks had limited options on where to dump their waste. Long lines at private waste facilities and lapses in regulation enforcement led to the common practice of illegal dumping into the ocean. Even when wastewater is dumped at private facilities, it may not receive full treatment before being dumped into the ocean as evident in a visit with one private fecal treatment plant. The manager explained that solid waste was shipped to landfill while remaining liquid was "oxidized" and released back into the ocean. When asked if the water released back into the ocean was clean, he replied 'no.'

Small water enterprises.

Two organizations with similar models were working to improve water access through the support of community-run or private enterprises. Their models are programs that sidestep the barriers of piped municipal water and work better for peri-urban informal settlements. Global

Communities, which has already been discussed was the first. Their project, WASH-UP, aimed to "promote innovative economic enterprises in the areas of water and sanitation" and "strengthen local governance for water supply, sanitation service, and hygiene promotion" in addition to increasing affordable access to water and sanitation services (USAID 2012). The success of the Mother's Club of Nima is evidence of a successful implementation of a program that improves affordable water access and has positive social outcomes (improved governance) and economic outcomes (promote economic enterprises).

Another non-governmental organization in Ghana is trying to close the water access gap through the creation of small water enterprises. Safe Water Network (SWN), operating in Ghana and India, works with targeted communities to establish sustainable water stations that provide safe and affordable water. They also emphasize training in the maintenance and operations of these water stations, recognizing that many water solutions fail after a year due a lack of capacity and technical expertise to maintain the equipment. The water stations draw water from existing contaminated water sources like lakes, rivers, and ponds or a borehole and use a variety of filtering technologies to provide clean water that is sold at the station. SWN works with the District Assembly (formal district-level government, below the regional level) and the community to establish a community water board and ensure the community agrees to the terms of establishing and operating the station. SWN provides money from grants for an initial investment which covers civil works, training, community engagement, and initial operating costs until the station begins collecting revenue. The initial cost ends up being around $35USD/person (depending on the size of the community). The community provides the land, water source access and may also contribute to some of the initial costs. The station is initially operated by SWN but eventually transfers ownership to the District Assembly who holds it in a trust with the community. Revenue from the station is use to cover operating costs, repair costs, and maintenance reserves.

According to their program director, SWN's 83 water stations have provided water to over 400,000 people throughout Ghana (the formal public water utility currently serves around 10 million people) (Safe Water Network 2017). Like Global Communities' WASH-UP program, there are social, economic, and environmental outcomes in their programs besides offering affordable safe water to communities. The model explicitly considers environmental impacts by both being able to filter contaminated water into drinking water and by using solar power, which also reduces operating costs and infrastructure requirements. In an interview with SWN, their model includes working with communities on sanitation and hygiene practices associated with water and they also teach members how to do business accounting for the owning and operation of the station. They encourage the growth of the private sector around water, such as water delivery. While SWN doesn't specify these health, governance, and economic outcomes as goals in their program model, they are part of the program's processes and linked to the program's success. When asked in the interview what effects they've noticed in communities where they've established water station, they stated that other small water enterprises show up like water delivery businesses and individual vendors. One community established private bath houses for travelers.

One of the major criticisms of relying on small water enterprises to increase water access is that the cost of water obtained through private business is higher than water provided by municipal services (Abraham et al. 2015; Ainuson 2009). First, this criticism ignores the nuances that in Nima, the quality of piped water and privately purchased water can vary greatly so both may be needed until the quality of water, or perceived quality of water improves. Second, this research is not advocating to replace municipal service water with small water enterprises, nor does it offer up small water enterprises as a panacea for water access challenges. Promoting water access through private enterprise is a means to diversify water sources where they might not be available otherwise. While providing piped water access to each residential compound or

residence may be a long-term goal where possible, improving water access around dense urban and peri-urban areas can increase the number of private vendors and promote market competition that can drive down water prices or at least standardize the price of water by type as seen in Nima. Private water vendors can provide intermediate means of water access, increase job opportunities, and increase household income for many residents of disadvantaged communities. Small water enterprises may also stick around as permanent fixture just like it has in developed countries whose markets for bottled water remains established despite having access to reliable and safe water. Small water enterprises are here to stay for the near future due to consumer preferences for convenience, social norms, personal image, health belief, and taste (Etale, Jobin, and Siegrist 2018).

CHAPTER 5

ANALYSIS AND DISCUSSION

This section covers broader outcomes of improved water access and integrates those outcomes under the framing concepts of the UN's SDGs and the US Army's Stability doctrine. Following the hybrid framework set forth in the methods sections, the social, economic, and environmental outcomes surrounding small water enterprises in Ghana will be described as observed from field research with supporting evidence from other case studies. While most of the observations on water access and trends were listed in the previous section, their cohesion within UN's and US Army's framing concepts, and previously discussed literature, are discussed in this section. More broadly, this discussion also considers how small water enterprises contribute towards sustainability and security goals.

Social Outcomes

Governance.

The settlement of Nima is a densely populated informal settlement. As an informal settlement, it is helpful to look beyond the level of state governance into local urban governance. Obeng-Odoom (2012) distinguishes urban governance in urban development as "a cluster of ideas, namely decentralization, entrepreneurialism, and democratization… that go beyond the state-market framework and produce outcomes that meet the needs of urban citizens" (p. 206). This lens of governance is especially important in informal settlements since they're often centers of weak governance where citizen leaders fill the gaps of official enforcement, rule of law, business, and welfare. The Mother's Club of Nima is a perfect example of Obeng-Odoom's definition of urban governance. Their existence rose not from any higher decree, but from a desire within the community to improve existing conditions. Just as the settlement of Nima is considered an informal settlement in some regards, the leadership from the Mother's Club started

out as informal- with no official means of enforcement. As the group gained members and started getting funding, their legitimacy within the community materialized, as they were recognized by the president of Ghana and members of parliament when they got funded by the World Bank for a project (participant 5). The emergence of this local group is a form of governance in that they have helped provide or improve water and sanitation services in Nima, including the organization of a community water board.

The appearance of a water governing body, at the scale of a neighborhood, supports the UN's SDG MoI 1: governance, citing "good water governance is an essential pillar for implementing SDG 6" (United Nations 2018b, 15). It does not necessarily mean that governance has to be at the community level, but the Mother's Club provide an example of where governance at higher levels failed to adequately address basic services, so a lower level of governance stepped up to address its own problems. The Mother's Club did not appear out of thin air—they received training, funding, and investments in capacity which also align with two more of the SDG 6's MoIs: finance and capacity.

The SDG MoI's are a vehicle for change, just as the Mother's Club of Nima was. While this research sought to understand the governance *outcomes* of SWEs, there may be more evidence that local governance was actually an input to increasing water access that allowed SWEs to flourish. Just as governance in the US Army's stability doctrine is a foundation for stability and security, and governance is a *method* of implementation for SDG 6, it appears that improvements in local government preceded the improvement of water access in Nima.

Health.

Previous case studies cited complaints by residents of contaminated piped water, even mentioning fecal matter in their water (Abraham et al. 2015; Fiasorgbor 2013). None of the residents interviewed during this visit complained of this specific contamination. Residents

interviewed did complain about the taste and that they distrusted the quality of water coming from their pipes (participants 1 & 5). Whether or not the availability of water contributed directly to health issues was not supported by this case study, but there are several connections between health, water, and sanitation. The first is the availability of water for washing hands and personal hygiene. Keeping people from getting sick through water and sanitation improvements is one of the reasons the Mother's Club came together. They explicitly asked for hand washing stations and provided education to their community members on the importance of hand washing.

In addition to coordinating hand washing stations, the Mother's club of Nima worked to get additional toilets installed in the community. There was a lack of adequate toilets in the community, especially ones that women felt comfortable using (due to privacy and cleanliness concerns). A 2013 study in Nima found that 95% of women do not go to public toilets because they do not provide enough privacy and 48% of residents said they were too far from their homes anyways (Fiasorgbor 2013). Even when toilets are clean, private, and nearby, they still cost GHS 0.30-.50 (USD $0.06-0.10) to use (Peprah et al. 2015). Privacy, cleanliness, convenience and the cost of using public toilets leaves many women and children using plastic bags or pans and dumping them into the drains, constituting a form of open defecation that creates higher risks for diarrheal diseases, cholera, intestinal worms, hepatitis and others. Inadequate toilets are directly linked to poor health outcomes. Poor sanitation leading to illness and disease are costly, with one study estimating each Ghanaian pays $12 per year due to effects caused by poor sanitation (Peprah et al. 2015). While that statistic may not seem significant, it's important to remember that unlike averaging costs across the whole population, the ill-effects of poor sanitation are not spread equally. Women, children, and the elderly are more vulnerable than men to the poor outcomes of inadequate sanitation facilities due to cultural norms in privacy and the higher frequency of sanitation needs.

Gender Outcomes

Similar to the unequal effects of poor sanitation on women, children and the elderly, challenges to water access and improvements have varying degrees of impact on different populations. In the interview with the Mother's Club, participant 5 explained how women would have to walk 5km to fetch water every day when the pipes were dry before they had boreholes and additional water access points in Nima. It was implied that this was the job of women, just as water vending is considered a women's job in Accra. The gender-assigned role of fetching water is common throughout sub-Saharan Africa. Women are also responsible household chores, cooking food, caring for children and these traditional roles are practiced in Nima. This means that the more time women spend fetching water, the less time is spent on those activities. In previous research within Nima, time spent fetching water negatively affected school-aged children who should be going to school and instead assisted in household chores or the women's business activities that augment household income (Doris 2014). This was not directly observed in this research study, but instead, improved access to water (since previous studies) led to increased income-generating activities for women. The observed effects were that women were able to easily sell water and run businesses without the interrupting burdens of water fetching. Improved water access in Nima (as described by Participants 1, 2, and 5) allowed them to focus on making additional income for their households. As stated by participant 3, there's no requirement for selling water, anyone can do it. The universal need for water combined with the ease of acquiring and selling water makes it a popular choice for supplemental income among women in Nima. Increased household incomes could be spent on food, education, and improved healthcare.

Although not directly observed or measured, there is evidence that increasing the role of women in informal economic sectors leads to changes in traditional household gender norms (Agyei-Mensah and Wrigley-Asante 2014). Specifically, increasing the contribution by women to

household incomes increases their influence in the household and within their communities. Household incomes contributions by women operating on the informal economy observed in Nima may be linked to the rise of influence of women both in the household and in their community, as in the case of the Mother's Club of Nima. Changing traditional household roles affects both genders. The challenge to the role of men as the head of the household, combined with men's ability to fulfil traditional expectation, can "threaten the man's honor, reputation, and masculinity" (Agyei-Mensah and Wrigley-Asante 2014, 132). Further research would be needed on the specific outcomes for both men and women on changing traditional household roles.

Economic Outcomes

In many cities like Accra, rapid urbanization brings economic development to the city, but it also brings economic challenges to city managers including job shortages, infrastructure expansion, housing shortages, encroachment on city green spaces, and water and sanitation challenges (Abraham et al. 2015). Water plays an important role and is connected in some way to each of those challenges. Most notably, when the demand for water exceeds the city's capacity to provide, the private sector often fills the gap. Lapses in formal services for the disadvantaged populations in urban and peri-urban settlements bring opportunities for income-producing activities such as water vending. Increasing water access that results in the normalization of water prices access brings a wider array of economic and job opportunities like food production, food vending, construction, and hair dressing services.

Informal activities play a large role on the economy of Accra and the income of households, especially in marginalized neighborhoods. The 2000 census showed that 54 percent of households relied on income from self-employment activities on the informal economy (Kang et al. 2010). The role that water plays within the sector, is significant for household incomes, social welfare, and improved economic outcomes. A 2015 study by Abraham, Martin, Cofie, and

Rascid-Sally focused on the income that water-related business generates. Out of 443 respondents in 10 urban and peri-urban communities in the greater Accra metropolitan area, including Nima, 59.14% of respondents were engaged in commercial activities that relied upon water access and in some cases that activity comprised up to 80% of household income (Abraham et al. 2015). Water is a central ingredient to domestic livelihoods, just as other basic services such as electricity or fuel might be. Basic services, infrastructure, and economic development should not be separated and must develop together. This idea supports the observation that improvements in water access allowed the women interviewed to operate their own businesses and make additional money for their household. Improvements in water access allowed them to increase productivity or dedicate more time to other activities.

Environmental Outcomes

The diversification of water access through SWEs can have positive and negative environmental outcomes. Safe Water Network's model converts contaminated water into pure water and their model for operating off the grid promotes renewable energy. The vending of water through stations and taps doesn't inherently negatively impact environmental sustainability. There is also evidence that household businesses who pay for water in small quantities use less water on average than those with a piped connection (Abraham et al. 2015). This means purchasing water from SWEs encourages water conservation which is important in water scarce areas. These are examples of outcomes that can help improve environmental sustainability, but there are several more examples of how SWEs and water-related businesses can degrade the physical environment. The largest concern is for the plastic produced from bottled water and the more prevalent plastic water sachets. Plastic packaging offers a cheap and convenient storage vessel for water. As observed in Nima, plastic waste lines the open-channel drains and enters waterways. The problem is worse in disadvantaged areas where residents rely more heavily on

packaged water, and there's also less reliable or non-existent trash services, leading to increased plastic litter and clogged drainage infrastructure. This is the reality for most residents of disadvantaged neighborhoods in Accra, but it doesn't have to be. The Mother's Club of Nima was successful in educating community members on where to throw their refuse, organizing cleanups of the community's water canal, and renegotiating refuse pickup contracts to provide more reliable trash pickup. While this alleviates the immediate effects of plastic refuse in drains and entering waterways, like much of the world, there's still a concern for the amount of single-use plastic that ends up in waterways or landfills that could be avoided with higher quality water delivered via pipe or more sustainable packaging.

SWEs in Context

The discussion thus far demonstrated the connection between water access and social, economic, and environmental outcomes. This research observed improved water and sanitation trends in Nima from previous studies and in exploring the trends of water around water access, two themes emerged. Figure 8 graphically depicts these two themes. The first theme addresses possible inputs that resulted in improved water access through small water enterprises. The second theme relates to the outcomes observed and perceived by increasing water access through SWEs.

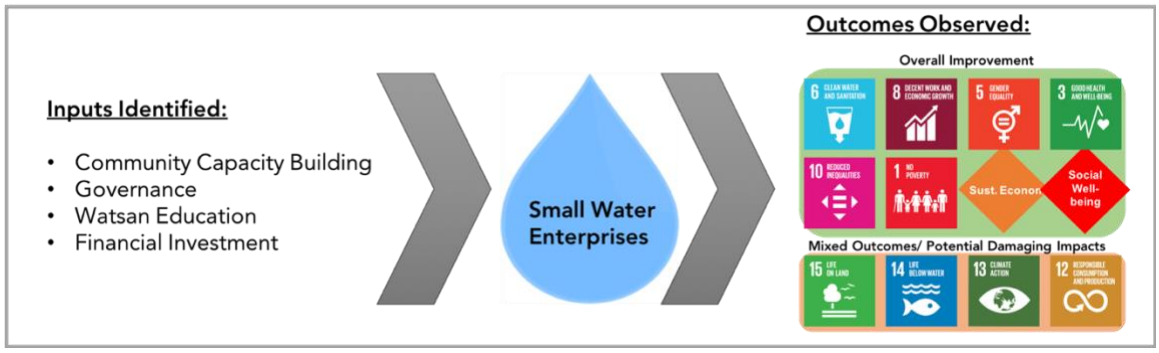

Figure 7: Inputs and Outcomes Surrounding SWEs in Nima

The inputs were investments from external actors like Global Communities, a legal resource center, Ghana Red Cross Society, the World Bank, and internal actors like the women who stepped forward to provide leadership within the community. External actors provided internal actors with capacities like: applying for project funding, record keeping, establishment of a community water and sanitation committee, and the technical capacity to run a water station. Both Global Communities and the legal resource center helped a group of concerned women turn their ambition into informal governance within Nima. The community water and sanitation committee engaged the private sector, the district assemblies, and NGOs and provided the missing link between those actors and the poorer residents of Nima. In addition to providing capacity, several of these organizations educated the women of the Mother's Club. The legal resource center helped arrange a teacher that taught women how to read and write so they could apply for program funding and keep records. The Ghana Red Cross Society educated community members on health and sanitation practices which emphasized the need for increased water access. The women worked to spread this educational investment within their own community. What started as a group of 10 women receiving education from Ghana Red Cross turned into a group of 200 empowered women. Lastly, the NGOs, their investment in the community, and the education provided to the women of Nima was not free. There were systems of accountability to ensure that results from financial investments were tangible and recorded on project reports. The success of the Mother's Club of Nima is evidence that domestic and foreign capital investment can still be effective in improving the livelihoods of the poor. Its effectiveness supports recent international development theory that everyone has a part to play.

The outcomes from the proliferation of SWEs are numerous and they underscore the UN's Secretary General's statement in the UN's 2018 Synthesis Report on Water and Sanitation which states, "Water is life. Progress in nutrition, health, education, work, equality, environmental protection and international cooperation are all related to the availability and

sustainable management of water aid universal access to effective systems for disposing of our waste" (United Nations 2018b, 5). Outcomes described in this research refer to those observed from the author and those perceived by the research participants. First and most directly, SWEs increased access to water in Nima. Water vendors sell water sachets where residents would not have other access to trusted drinking water sources. The accessibility of ground water through boreholes (although at a hefty price to drill) mean that with financial assistance, residents can start selling their own water. Women in Nima previously walked 5km to a water station near the airport and now they access water through boreholes and increased GWCL piped connections in Nima. Improved water access in Nima indicates improvement within the targets set forth in SDG 6, but there are still deficiencies. Deficiencies include realizing equitable access (Nima still lacks the amount of household connections enjoyed by wealthier neighborhoods and pays more overall for water) and improving water resource quality by reducing pollution (reliance on water sachets increase plastic waste).

The connection between SWEs and increased household incomes supports targets within SDG 1- no poverty, SDG 8- decent work and economic growth, and SDG 10- reduced inequalities. Overall, SWEs support multiple targets within SDG 8 by increasing per capita economic growth (8.1) and increasing economic productivity (8.2). Increased access to water created by small water enterprises primarily creates small-scale commercial businesses on the informal market such as food production, small-scale agricultural production, hair dressers, and sanitation services. The income provided by SWEs and their associated commercial businesses could contribute to target 10.1, "…achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average" depending on the scale and success of these businesses (United Nations General Assembly 2015, 21). The additional income also has the potential to contribute to SDG 1, specifically targets 1.1 and 1.2 through reduced poverty—especially among women and children whom these businesses support. The extension of water

networks created by SWEs diversified the sources of water supply which could increase resilience to water scarcity, climate-related events, and other economic, social, and environmental shocks which directly supports target 1.5. The low-skill needed for many of these businesses means that they provide easy entrance into the market and job opportunities for the poor and disadvantaged including migrants and women, which supports target 8.5 that calls for "decent work for all women and men, including young people and persons with disabilities…" (United Nations General Assembly 2015, 19). While the informal nature of these jobs has benefits, they also have drawbacks and its why target 8.3 which encourages "the formalization and growth of micro-, small- and medium-sized enterprises…"(United Nations General Assembly 2015, 19). While the creation of these businesses creates income for households, their informal nature means that income is not taxed and does not contribute towards growing the city infrastructure that is desperately needed for cities with growing populations. Exclusion from the formal job market also means employees aren't guaranteed labor rights or a safe and secure working environment which is part of target 8.8. Additionally, their informal nature means they're largely unregulated by any quality control bodies and environmental regulators which doesn't completely support target 8.4 calling for improving resource efficiency in consumption and production and decoupling economic growth from environmental degradation. Finding ways to regulate some of these businesses could improve SWEs economic outcomes in relation to SDG 8. Solutions on how to best regulate the fluid and everchanging nature of SWE's and their associated water-related commercial activities while still maintaining the benefits of their simplicity is an important and needed area of research.

Role of Small Water Enterprises in US Army Stability Doctrine

The study of water access in informal settlements provides applicable knowledge in the complexities and nuances of improving basic services in urban and peri-urban settings in rapidly

urbanizing landscapes. While US Army stability doctrine primarily addresses "access" to water and basic services, it doesn't provide equal attention to the more common complaints of water access brought up by participants in this study: quality and reliability of supply. This also underscores the importance of engaging the population about their basic services since Nima deals with broken infrastructure along with the lack of infrastructure. Maps provided by the GWCL may show many water access points in Nima, but the truth on the ground is that many of those water access points don't work, seldom work, or don't provide clean water. Additionally, this case study illuminated the barriers behind affordable and safe water access are not simple. It is not always that its citizens or the municipal government cannot afford to pay for a connection or improved infrastructure. Participants cited land tenure problems as the top reason they didn't have a piped water connection to their residence or compound. Most of the participants interviewed in Nima rented their land and needed proof of ownership in order to apply for a pipe connection with the city. Participants cited lack of interest by the landlord in getting this done or the inability of residents to contact the landlord about it. The physical layout of the settlement also makes infrastructure upgrades more difficult. In these cases, financial investment alone cannot solve water access problems. Solutions may also need to improve community capacities, education, and governance along with financial investment to be more successful.

While understanding all the complexities and nuances of barriers to basic services in each context may be an unrealistic expectation for rotationally deployed commanders and staff members, it underscores the US Army's need to work with host nation government officials where functioning government exists, local residents in identifying context specific challenges, and aid and development workers with experience in the area of operations. It also highlights the need for training in stability activities because learning to ask the right questions about service and infrastructure is a practiced skill. The exploratory research approach I employed led to several lessons learned on what questions to ask and which themes to explore. This research, in

addition to adding to the educational body of knowledge on water access, also served as an individual training on assessing water access in a foreign country. The prior formal training I received as an engineer officer conducting infrastructure assessments (known as SWEAT-MSO for sewer, water, electricity, academics, trash, medical, safety, and other) paled in comparison to the interviews on water access conducted in this research because of the complexity of barriers (both real and perceived) and the many ways in which water access can be categorized and assessed.

The link between improved security and SWEs is not a direct one, but there is an established link. The effects of SWEs in local communities combined with effects from improvements in other tasks can create a more stable and secure environment. The failed and fragile-states framework that the US Army stability doctrine is founded on states that early phases of intervention among failed or failing states requires more coercive actions to eliminate threats and reduce violence. As these direct threats are reduced, military forces turn their focus towards "building host nation capacity and encouraging sustained development" (Department of the Army 2012a, paras. 169). Nation building works to reduce causes of instability and fragility and these causes are often multifarious and complex which require a systematic multifaceted intervention. Increasing access to water and the other positive outcomes associated with SWEs can provide a piece of that intervention.

How could the US Army support SWEs?

The US Army's efforts to improve access to clean water in contingency operations looks different in each operational phase. During violent conflict the efforts are focused on kinetic operations, while later phases will resemble aid and development projects. The applications for this case study lie more in the "transformation" and "fostering sustainability" phases of stability activities. While the US Army should rely heavily on host nation government and local leaders

who will stay around longer, Army Soldiers can still serve as connectors between citizen leaders, motivated change makers, NGOs, government agencies, and institutions that can provide guidance, capacity building, education, and/or financial investment.

The US Army's stability doctrine can learn from the work between the Mother's Club of Nima and the NGOs previously mentioned as examples of a systems approach to improving basic services, health, community capacity (and governance), and economic opportunities through multifaceted approaches that enhanced stakeholder participation, required active community involvement, engaged and supported the private sector, and increased capacity of community members. The WASH-UP program assisted over 200 entrepreneurs to develop business plans and continue to provide assistance to their most promising entrepreneurs throughout the project to ensure their businesses survived with the hope that they would scale up their businesses in the future (USAID 2012).

Most importantly, US Army doctrine might consider linking outcomes within "restoring essential services" and "support to economic and infrastructure development" to goals related to: health, governance, social change, and environmental sustainability. Even though stability doctrine specifies that 'none of the primary tasks are performed in isolation,' it doesn't clearly articulate the inherent interconnectedness of essential services (and infrastructure) improvements to the aforementioned outcomes. The connection between these is demonstrated in the Nima Case study, backed up by augmenting case studies, and restated within the WASH-UP project report which list specific achievements in behavior change, and business development when the main goal was to install toilets, hand wash stations, and boreholes. Formally linking essential services and infrastructure with social, economic, and environmental outcomes could be implemented in the planning phases. Operational planners could ensure lines of effort along these two stability activities in particular are linked to positive social, economic, and environmental outcomes. Staff needs to be creative in how to measure some of the more subjective outcomes such as gender

equality or community governance, but it should not discourage planners and commanders from including these outcomes, as long as they are desired by the host nation.

CHAPTER 6

GENERALIZATIONS, TRANSFERABILITY, AND LIMITATIONS

The results of this single case study should not be conferred to apply to broader populations without the supporting evidence of other similar case studies. The defining characteristics of this case study were its location in a developing country of sub-Saharan Africa and in a peri-urban informal settlement that experienced foreign and domestic intervention programs within the past decade. Even within those defining characteristics there can be many differences. For example, there are other informal settlements in Accra where the price of water by type has not normalized because it is poorer and therefore it can be assumed that SWE's do not lead to many of the positive outcomes observed in Nima. Additionally, Accra's climate and geography allow its residents to access groundwater by drilling boreholes. The nature of SWEs and their outcomes in areas where water is scarcer may be different. The results of the outcomes observed in this case mean that these are *possible* outcomes associated with similar cases, but not proven or definite.

The transferability of this case study would be improved by conducting a demographic survey to include factors such as education, gender, and income. Having this demographic data would improve analysis techniques allowing for better comparative case studies outside of Nima or a longitudinal case study of Nima in the future. It does not invalidate the observed results of this case study, but it is recognized as a limiting factor for its transferability to other communities outside of Nima in the future.

This research is augmented by the results of previous case studies in Nima and nearby neighboring communities, but it cannot be considered a comparative case study or a longitudinal case study because the same methods and procedures were not used to allow a true comparison. In the future, a longitudinal case study that incorporates a survey would strengthen results and quantify more of the social, economic, and environmental outcomes of small water enterprises in

Nima. The interviews, a qualitative method, provided insight on some of the more subjective outcomes (governance, gender outcomes, and residential perceptions), but a survey would provide quantitative analysis that would strengthen the results of outcomes (i.e. improvements in household incomes due to SWE's, decreased time spent fetching water, number of sanitation related health problems…etc.) which was one of the weaknesses of this research.

As with many single case studies, especially those of exploratory nature, internal validity in a main concern. The concern for internal validity is why outside existing case studies were included in the case study observations and discussion sections. Many of the observations listed in this case study were observed or measured in the other case studies. The exception to this is the observation that the water and sanitation situation in Nima is improving. Other case studies relied upon did not focus on trends, but rather describing the conditions at the time of research. Additionally, this research used respondent validation to verify and clarify notes from interviews and observations from the research trip.

CHAPTER 7

CONCLUSIONS

While this case study was limited in scope and does not address the complete context of Nima, it appeared through interviews that water access and sanitation has improved since the previous studies of water access in Nima. In answering this research's first question, "What are means of residential water supply in Nima Community, Accra, Ghana," it became apparent there were additional water means in the community including additional water storage tanks, GWCL piped connections, and pure-water borehole access. The addition of these means of water access impacted the lives of the women interviewed in this research. The most direct impact was their improved access to both domestic-use water and potable water. The women interviewed viewed themselves as business owners in which fetching water, the cost of water, nor the cleanliness of water was not their top concern. These observations don't mean that the water and sanitation situation in Nima is good; Nima still has a long way to go in providing affordable safe access to everyone, but recent improvements are moving it in the right direction according to the residents interviewed.

The improvements are noticeable and they assist in answering the second research question, "What are the trends of increasing residential urban access to water supply in Nima neighborhood of Accra, Ghana?" The trend of increasing water sources was due to investments in the community by internal and external actors working in concert to improve water and sanitation. Externally, Global Communities invested financial capital, educational assistance, and capacity while internal actors worked to spread education, organize leadership (and governance) and community participation. The improved access to water was essential to starting household commercial businesses on the informal economy. The trend of increasing water access in Nima had observed social, economic, and environmental outcomes that generally led to improved performances in United Nation's SDG targets, as well as the US Army's stability goals.

Looking deeper into effects of SWEs provides answers to this research's third question, "how do SWEs affect social, economic, and environmental outcomes in the context of the UN's Sustainability Development Goals and the US Army's stability doctrine?" The increase of water access, coupled with population growth contributes to an increase both in additional SWEs and in household commercial businesses. These two outcomes of increasing water access provide additional household income to poor families, increase worker productivity, and expand economic opportunities amongst poor and disadvantaged populations. This was the major economic outcome of SWEs. The major social outcomes of SWEs were improved gender equality for women and improved sanitation and health conditions. Since SWEs are more prevalent among women, they contribute more to their household incomes and this is possibly changing the role and decision-making power of women in traditionally patriarchal households. The increased access to water for sanitation as well as increased household incomes improves sanitation facilities and services, leading to improved health outcomes.

While SWE's generally improved social and economic outcomes in Nima, they are associated with mixed and potentially damaging environmental outcomes. The convenience and affordability of plastic packaging used in pure water sachets combined with poor refuse pickup leads to additional plastics entering drains, waterways, and landfills in the community when unregulated or unenforced. While the Mother's Club of Nima was successful in cleaning up their immediate community, other parts of Nima remained wrought with plastic refuse. The informal nature of other household commercial activities, while generally conserving more water, could lead to equally damaging environmental outcomes when unregulated (as is common among informal activities).

One of the biggest challenges for governments facing the expansion of informal economy jobs and services is learning how to regulate them to improve environmental outcomes, provide protection for employees, and collect revenue to support functioning government and

infrastructure while still keeping the benefits of their accessibility and flexibility. This research underscores the need for more focus on solving this challenge.

Considered an input to the success of SWEs, informal community governance can have effective influences on water and sanitation conditions. The role and leadership of women and the investment of capacity and financial resources from outside organizations in the establishment of the Mother's Club of Nima is an example of successful community leadership. This research recommends additional examination on the conditions where informal governance or community leadership in disadvantaged communities can flourish. If a second research trip to Ghana were possible, I would explore this topic more in depth.

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APPENDIX A

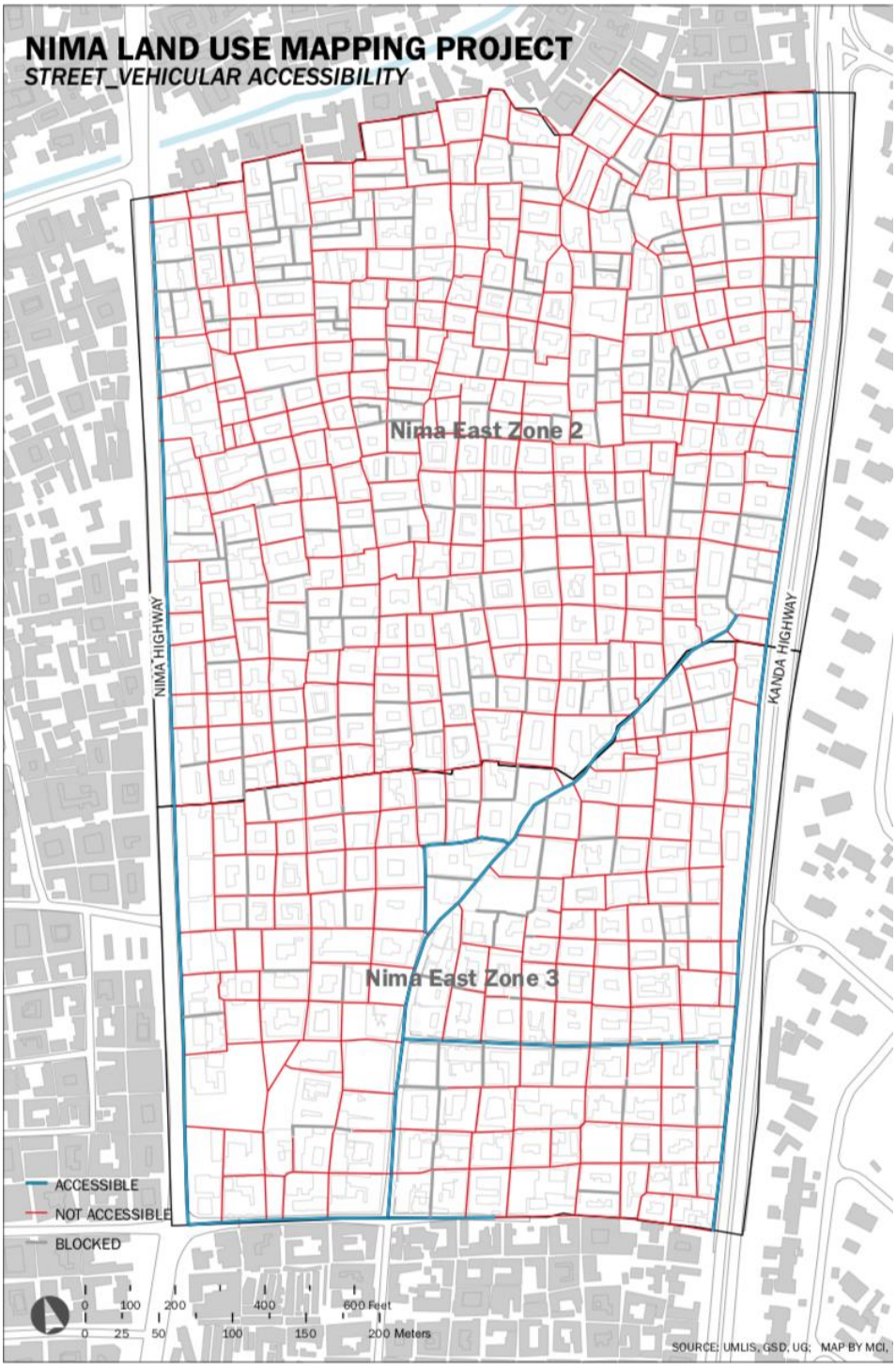
PARTICIPANT IDENTIFICATION AND DESCRIPTION

Participant #	Description
1	Owner and manager of a water storage tank/ water point in Accra New Town. Older woman who has been a water vendor for 20 years. Her husband is a butcher and they have three children. She resells water from the Ghana Water Company that she stores in a poly tank her family purchased with a loan. She gets most of her business when the GWC pipes are dry. She also sells sachet water at her water point.
2	54-year old owner and manager a catering business. She rents that land she conducts business on and has to fetch water twice a day for food preparation operations. Her business employs 14 people, 10 of whom spend 1.5-2 hours a day fetching water.
3	Older woman who works as sanitation worker in the morning, sweeping the highway, sells sachet water from her house in the afternoon, and sells sachet water at the local market in the evening. She uses her profits as a water vendor to support her brother's child's education costs.
4	Older woman who is a food and sachet water vendor. She has been selling water, fanta, and eggs at the local market in Old Nima for 20 years. Self-described business woman.
5	Mother's Club of Nima: a local community group organized to address sanitation and water issues in Nima. Worked with several organizations to install 14- polytanks in the community to store water from Ghana Water Company. In 2017, they worked with NGO Global Communities to open a

	borehole water point to sell pure water in Nima. They currently run the water point as a business, using profits to maintain the borehole with goals to save up to drill another borehole in the future.
6	Water Sachet Production Plant Manager and Operator; 2 middle-aged men who have one borehole and two machines that bag water into sachets. Their business opened in May 2018. The plant grosses about $6,000 GCD/day.
7	Center for Conflict Transformation and Peace Studies in Damango, Ghana. Interviewed the Executive Director on water issues and governance.
8	Safe Water Network NGO. Interviewed the Country director, Business Development director, and the program manager. This NGO works with communities in Ghana to build and establish water stations that are owned and operated by the community through a sustained business model.
9	US Army Peacekeeping and Stability Operations Institute (PKSOI). Interviewed former military officer and current professor and expert on Stability Activities at PKSOI. PKSOI is the US Army's formal proponent for stability doctrine.

APPENDIX B

NIMA-EAST VEHICLE ACCESS MAP. SOURCE: (KANG ET AL., 2010)


NIMA LAND USE MAPPING PROJECT
STREET_VEHICULAR ACCESSIBILITY
Nima East Zone 2
Nima East Zone 3
NIMA HIGHWAY
KANDA HIGHWAY
ACCESSIBLE
NOT ACCESSIBLE
BLOCKED
0 100 200 400 600 Feet
0 25 50 100 150 200 Meters
SOURCE: UMLIS, GSD, UG; MAP BY MCI,

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