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Opportunities to Mainstream Gender in Water and Wastewater Infrastructure Projects: A Case Study in Barbados

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Opportunities to Mainstream Gender in Water and Wastewater Infrastructure Projects: A Case Study in Barbados

by

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DEDICATION

I dedicate this thesis to my mother, Aletha, who has moulded me into the person I am today. She has been a tower of strength, love and support and has inspired me to respond rather than react in moments of crisis. Most of all, I treasure the fact that she let me learn to fly on my own at an early age, an act which has facilitated my growth to date and which has made possible the successful completion of this thesis.

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ABSTRACT

According to the World Resources Institute, Barbados is one of seven Caribbean countries ranked as being the most water stressed territories in the world. Prevailing drought conditions for the period 2010-2016 further compromised its water security while confirming predictions of a drier regional Caribbean climate. The simultaneous failing of at least 50-year-old water infrastructure at many points in the distribution network adds to these water stress conditions, and presents a financial burden to the local water utility in the form of lost revenues, and increased energy consumption for pumping.

Climate change and its impacts are not gender-neutral, and water infrastructure projects developed to mitigate and or adapt to climate change impacts will have different degrees of gender dimensions, based on the social and economic contexts within which populations are embedded. Incorporating gender differences in climate projects is smart economics, and as such the Green Climate Fund (GCF) is the first international fund to mandate the integration of a "gender-sensitive approach" throughout project life cycles. The Barbados Water Authority (BWA) is applying, with the Caribbean Community Climate Change Center (5Cs), for funding from the Green Climate Fund to pursue an Energy-Water-Nutrient Nexus for Sustainable Coastal Infrastructure (EWN-SCI) project. The proposed project will develop an interdisciplinary program in Barbados that implements demonstration sites with integrated water supply, resource recovery, and renewable energy management systems that are designed to mitigate greenhouse gas emissions, support

climate change adaptation strategies, build technical capacity in the Caribbean region, and share lessons learnt with the rest of the Caribbean Community (CARICOM) countries.

The overall goal of this research is to present practical guidelines, and approaches to mainstream and operationalize gender throughout the life cycle of water and wastewater infrastructure projects using an Energy Water Nutrient nexus project in Barbados. The objectives to guide this research are (1) to determine the institutional and legal frameworks that inform the types and extent of gender mainstreaming activities to be incorporated in the development of water and wastewater climate infrastructure projects in Barbados, (2) to characterize the current landscape for integrating gender into the design and management of water and wastewater infrastructure in Barbados, and (3) evaluate and recommend opportunities for gender integration in the life cycle of water and wastewater infrastructure in Barbados.

Literature and tools for categorization of the gender dimensions of water and wastewater infrastructure (centralized and decentralized) projects in Small Island Developing States, and particularly Caribbean nations to determine the scope, and type of appropriate gender mainstreaming activities are limited. In the literature, gender equality as a goal of climate financing mechanisms was introduced retroactively for several multilateral climate funds due to sub-optimal project outcomes from gender blind projects. Projects implemented by these funds globally, post inclusion of explicit gender equality outcomes can provide direct, or indirect guidance on appropriate gender mainstreaming activities to be included in the development of water and wastewater infrastructure projects in Barbados. Case studies on water and sanitation gender vulnerabilities in Jamaica provide one of the few ideal sources of information on Caribbean gender mainstreaming activities.

To inform objective 1, literature on Barbados' population, socio-economic statistics, and national gender and climate change policies was used to determine the status and scope of institutional and legal commitments to gender mainstreaming the development of water and wastewater climate adaptive infrastructure in Barbados. To satisfy objective 2, a gender profile of technical and leadership roles at the BWA was created, and social media information, results of a water user survey, focus groups and interviews were analyzed to gain cultural context, and community insight on existing gender inequalities, impacts resulting from the types of water infrastructure projects pursued and their methods of implementation. The survey, focus groups and interviews were conducted in Barbados during the period 10/20/16 to 11/8/16. This period was characterized by unprecedented water shortages and interruptions which were reflected in the feedback from the data analysis. For objective 3, gender impacts of the infrastructural components of the EWN-SCI projects were described, and opportunities to address these concerns across the individual infrastructure project cycles were proposed.

There are currently no legislative commitments to gender equality in water and wastewater resources management in Barbados. A Draft National Policy on Gender is presently before parliament but the policy does not address gender and water. The BWA has more men than women employed in technical (45% vs 3.5%), and leadership (9.1% vs 3.9%) roles which directly contribute to the design and management of the utility's projects. Most of these individuals are in the middle or near the end of their careers (> 40 years of age), and thus present a timely opportunity to recruit, train and promote women to fill these roles.

On social media (Facebook and Twitter), many individuals described the challenges experienced during the water shortages. Individuals also criticized the BWA for their lack of

communication during this period. The lack of an online presence by the BWA represented a lost opportunity to engage its stakeholders on collaborative solutions that could temporarily or permanently alleviate the challenges.

The water user survey revealed a statistical significant association ($p \leq 0.05$) between gender and type of water storage container used at the household level. Men were more likely than women to report use of larger plastic buckets and tanks, while women showed a preference for smaller buckets and bottles. Identification and consideration of design parameters such as preference for type and size of storage receptacle, system elevation, position of cleaning access point, and need for a pump will facilitate or limit the successful adoption or adaptation of rainwater harvesting systems. The proposition of a research arm of the utility that could study gender dimensions of health impacts of water quality and water interruptions, and economic studies assessing feasibility of introducing a tariff structure on water provision were priority projects from the BWA. Investment in equipment at the national government lab, and at the University of the West Indies (UWI) Chemistry Department represents a skills building and economic empowerment opportunity for women who form the bulk of workforce at these institutions.

The key recommendations identified from the Gender Impact Assessment for the model EWN-SCI Projects were to the need to identify clear gender objectives and targets prior to project implementation to ensure their incorporation in the project. Budgetary allocations to appoint a gender focal point who would coordinate these activities are also recommended. Job creation is one the main areas for distribution of project benefits for the EWN-SCI Project. Since the current skillsets for technical jobs at the BWA bias allotment to men, and at the UWI Chemistry Department there is bias in favor of women, targeted training

and recruitment should be aimed at the under-represented sex for each position. Additionally the inclusion of socio-economic information as a criterion for prioritization of locations for intervention was recommended.

CHAPTER 1: INTRODUCTION

1.1 Introduction

Water influences the development and evolution of cultures. The time spent collecting water dictates the rhythm and beat of community life in many places. Women and children spend 125 million hours each day collecting water, which is on average more time spent on any other domestic water related activity (Water.org 2016). In July 2010 access to water and sanitation was officially designated as a basic human right by the United Nations, however currently there are still 663 million and 2.4 billion persons on earth for whom access to improved sources of drinking water and improved sanitation respectively, are beyond their reach (WHO/UNICEF 2015).

Globally, the expansion and maintenance of water infrastructure has not kept pace with population growth (Zimmerman 2009, ASCE 2013). In urban cities where more than half of the world's population resides, challenges such as water pollution, limited sewer infrastructure, reduction in access to potable water, and water-borne diseases are intensified (Wagner 2013). Climate change further exacerbates these challenges and introduces new vulnerabilities to global food, energy, and water security, in part due to a higher frequency and severity of droughts (Misra 2014).

According to the World Resources Institute, Barbados is one of seven Caribbean countries ranked as being the most water stressed territories (ratio of total annual water withdrawals to total available annual renewable supply) in the world (WRI 2017). In recent

years, Barbados' water security has been further compromised due to a prolonged 6 year drought (2010 – 2016), confirming predictions of a climate that is drier in the region (Pulwarty et al. 2010). The simultaneous failing of at least 50-year-old water infrastructure at many points in the distribution network adds to these water stress conditions, and presents a financial burden to the local water utility in the form of lost revenues, and increased energy consumption for pumping. Since the 1970s, Barbados and much of the Caribbean has witnessed increases in electricity consumption (and associated emissions of greenhouse gases which contribute to climate change) at a much higher rate than population growth (UNEP 2010). A significant portion of this energy consumption can be attributed to water production in Barbados where the local water utility is currently the largest customer of the energy utility. With interruptions in water availability women have been disproportionately impacted since they are responsible for most domestic water-related activities, and future development plans need to address these challenges (Suchorski 2009).

Utilities must now address climate change and gendered impacts, in addition to their traditional scope of financial viability, infrastructure stability, customer satisfaction, operational resiliency, employee and leadership development, community sustainability, operational optimization, water resource adequacy, product quality, and stakeholder understanding and support in the projects they pursue (Water and Waste Digest 2016).

1.2 Motivation

Climate change and its impacts are not gender-neutral, and infrastructure projects developed to mitigate and or adapt to climate change impacts, will have different degrees of gender dimensions based on the social and economic contexts within which populations are embedded (Dunn 2012, Rodenberg 2009, Schalatek and Burns 2013). In support of this view,

the Green Climate Fund (GCF) is the first international fund from its onset to mandate the integration of a "gender-sensitive approach" throughout the life cycle of all projects they finance (Schalatek and Burns 2013). As of July 2015, the Caribbean Community Climate Change Center (5Cs) was accredited as a regional implementing entity by the Board of the Green Climate Fund, and now provides Caribbean nations access to over US $10 billion in funding, which represents the newest and largest climate finance mechanism in the world.

Projects that systematically address, rather than reinforce gender inequalities that increase the vulnerability of specific groups to climate change, will provide greatest benefits, and be most effective (Schalatek and Burns 2013). Incorporating gender differences in climate projects is reported to be simply smart economics (UNFCC 2015).

In the Caribbean, small populations, limited funding for water and wastewater infrastructure projects, and over twenty years of regional and national climate change policies and commitments, incentivize utilities to re-envision/diversify their portfolio to include climate adaptive and resilient projects. The Barbados Water Authority (BWA) is applying with the 5Cs for funding to pursue an Energy-Water-Nutrient Nexus for Sustainable Coastal Infrastructure (EWN-SCI) project. While the 5Cs is the accredited agency with the GCF, the BWA is the implementing agency with the University of the West Indies (UWI) and the University of South Florida (USF) as partnering organizations. The proposed project will develop an interdisciplinary program in Barbados that implements demonstration sites with integrated water supply, resource recovery, and renewable energy management systems that are designed to mitigate greenhouse gas emissions, support climate change adaptation strategies, build technical capacity in the Caribbean region, and share lessons learnt with the rest of the Caribbean Community (CARICOM) countries.

With the exception of renewable energy projects, limited literature exists on gender analyses of climate resilient infrastructure projects. The "Resource Guide – Mainstreaming Gender in Water Management", and "Guide on Gender Mainstreaming – Energy and Climate Change Projects," published by the United Nations Development Program (UNDP) and United Nations Industrial Development Organization (UNIDO) respectively, provide the most comprehensive case study list of gender mainstreaming in climate change projects (Khosla 2006, UNIDO 2014). Notably missing from these publications are case studies from Small Island Developing States (SIDS), and particularly Caribbean nations. Literature and tools for categorization of the gender dimensions of water and wastewater infrastructure (centralized and decentralized) projects to determine the scope, and type of gender mainstreaming activities are absent or unpublished. This thesis provides a rationale and context for the inclusion of gender perspectives in the development of water and wastewater sector infrastructure projects for Caribbean Small Island Developing States, using the Barbados Water Authority as a Case Study.

1.3 Site Description

The proposed Energy-Water-Nutrient Nexus for Sustainable Coastal Infrastructure project is located in Barbados, a Small Island Developing State bordered by the Caribbean Sea on the west coast, and the Atlantic Ocean on the east (see Figure 1.1). It is the most easterly of the islands of the Lesser Antilles, and is located at 13^{o} 4' north latitude and 59^{o} 37' west longitude, it extends ~34 km north-south and ~23 km at its widest point east-west, has a coastline of 97 km and an area of 431 km^2. In 2010 Barbados was classified as a developed country in the United Nations Human Development Index (HDI), however due to its small island status it is still considered a developing country (United Nations 2012).

The BWA is the Statutory Body charged with supplying the island with potable water, as well as providing wastewater treatment and disposal services to the sewered areas of Bridgetown (the capital), and the South Coast. Barbados has one of the highest potable water (98%) and improved sanitation coverage (total of 99.8% of which 8% is sewered) in the Caribbean region (WHO2015).

Figure 1.1: Map of Central America and the Caribbean showing Barbados, location of Energy-Water-Nutrient Nexus for Sustainable Coastal Infrastructure (EWN-SCI) project. (CIA 2017)

In Barbados and other Caribbean countries, government subsidies mask the true cost of water production and delivery to the customer. Many Caribbean islands currently experience non-revenue water (NRW) losses of at least 30%, representing a vital resource and economic loss to the utility and country (Gessel 2015, Audain 2015). Non-revenue water losses also represent increased fuel consumption and carbon emissions due to the energy loss associated with the production and distribution of potable water that never reaches the end-user (Santana et al. 2014, Mo. et al. 2011). With a projected drier and warmer climate,

reduced rainfall will lead to decreased ground water recharge, and increased water demands from a growing population (Pulwarty et al. 2010). Coupled with a projected sea level rise of one (1) meter by the end of the century, this will result in saltwater intrusion of groundwater resources, potential impairment of groundwater quality, the destruction of mangroves and coral reefs (UNEP 2010), and a 14-30% reduction in coral calcification rates (Kleypas et al. 1999). Lower water quality also impacts the carbon intensity of water treatment (Cornejo et al. 2014).

Diverse terrain and scattered-low population densities make pumping water uphill, and over large distances costly and more energy intensive, thus limiting island-wide water connection and sewer coverage in many SIDS. The limited reuse of wastewater for potable or non-potable functions constitutes another loss of resources to the utility in the form of water, nutrients and energy, and a lost opportunity to mitigate greenhouse gas emissions (Cornejo et al. 2013).

Design and planning for expansion and upgrade of water infrastructure should be holistic to anticipate impacts on ecosystem and community dynamics, as well as built for redundancy. This will ensure that proposed interventions complement and do not replace existing reliable infrastructure. The BWA must build local capacity to pursue projects that recoup water, energy, nutrients, and monetary losses, and that demonstrate climate change adaptation for small island nations throughout the world. For this to happen efficiently, the BWA plans to develop regional and international partnerships for areas where local expertise is lacking. The case study presented identifies opportunities to mainstream and operationalize gender in the proposed BWA EWN-SCI project.

1.4 Objectives

The overall goal of this research is to present practical guidelines, and approaches to mainstream and operationalize gender throughout the life cycle of water and wastewater infrastructure projects using the Green Climate Fund framework for an Energy Water Nutrient nexus project in Barbados. Three objectives guide this research: (1) to determine the institutional and legal frameworks that inform the types and extent of gender mainstreaming activities to be incorporated in the development of water and wastewater climate adaptive infrastructure projects in Barbados, (2) to characterize the current landscape for integrating gender considerations into the design and management of water and wastewater climate adaptive infrastructure in Barbados, and (3) to evaluate and recommend opportunities to integrate gender considerations in the life cycle of water and wastewater climate adaptive infrastructure in Barbados.

To achieve these objectives, Chapter 2 provides a Literature Review on the scope of gender and development literature highlighting the range of Caribbean expertise and knowledge gaps for integration of gender considerations in water sector infrastructure projects. The Literature Review also includes a summary of the policies and supporting legislation of Caribbean and International institutions and bodies that can support and guide the development of gender sensitive climate adaptive water and wastewater infrastructure sector projects in Barbados. Chapter 3 summarizes the Methodology used to obtain the data needed to answer Objectives 1, 2 & 3. Data collection methods included reviews of policies and legislation that guide the management of water resources in Barbados, of BWA employee data to create a gender profile of the organization, and of social media information addressing stewardship of local water resources. Focus groups, interviews and surveys were

also administered to stakeholders of the BWA to solicit perceived priorities for management and development of water resources projects in Barbados. Chapter 4 presents the Results and Discussion in which there is an analysis of the information obtained and a discussion of these results to answer each objective. Chapter 5 presents Conclusions for the project and Recommendations for Further Research opportunities in this area.

CHAPTER 2: LITERATURE REVIEW

This Chapter presents an overview of the scope of gender and development literature with an emphasis on the expertise and scholarship that exists in the Caribbean region, the Caribbean Community (CARICOM) nations in particular, and also highlights common data limitations in assessing progress towards achieving gender equality in infrastructure projects. It then discusses the role of global development goals in providing a framework for the creation of individual country commitments to furthering gender equality and combating climate change. Since climate change is an obstacle to achievement of universal gender equality, the context for inclusion of gender perspectives in international climate finance mechanisms is also described. The final section of the chapter concludes with a summary of International and Caribbean institutional capacities and legal frameworks that inform the types and extent of gender mainstreaming activities that can be incorporated in the development of the Energy-Water-Nutrient Nexus for a Sustainable Coastal Infrastructure project in Barbados.

2.1 Gender and Development

The stimulus for the sea of literature on the topic of Gender and Development can be attributed to the ground breaking study - *Women's Role in Economic Development*, published in 1970 by Ester Boserup (Boserup et al. 2017). Since the commissioning of this study by the United Nations General Assembly in 1962, many researches have committed explicit focus on this area, resulting in dedicated institutes and university programs designed around this

topic at both the undergraduate and graduate levels. Some of this resulting research can be found in the journals - Gender and Development and the Caribbean Review of Gender Studies (established in 1993 and 2007 respectively), which are two publications dedicated to exploring the links between theoretical and practical gender and development work, and promoting and supporting the debate of best practices and new ideas.

Gender is a socially constructed concept that refers to the roles assigned and opportunities ascribed to men and women, within a specific cultural context, and at a particular point in time on the basis of their sex (Hannan 2001, Dunn 2012). Since gender roles are socially constructed and not biologically determined, they can be changed. This change may be desired since it can lead to reversal of existing inequalities and progress towards gender equality.

Gender equality is defined as the creation of equal rights, power and opportunities for women and men by allowing them to contribute on an even footing economically, politically, socially and culturally (UNFCC 2015, UNIDO 2014). It entails that society values the roles played by men and women equally. Gender equity leads to equality and is the process through which men and women are treated fairly. This often includes proactively compensating for disparity in historical and social disadvantages that otherwise reinforce the inequitable basis on which women and men operate. The ultimate goal of gender integration and therefore mainstreaming is to transform unequal social and institutional structures into equal and just structures for both men and women (Dunn 2012). This is achieved by pursuing actions that lead to gender equality and gender equity.

Strategies to achieve gender equality and equity have been explored in gender discourse on thematic areas such as Reproductive Rights (Dennis and Zuckerman 2008, Kane

2008), Conflict and Violence (Haylock et al. 2016, Cagna and Rao 2016, Cockburn 2013), Social Protection (Asaki and Hayes 2011, Kukrety and Mohanty 2011), Education (Blickenstaff 2005, Zelezny-Green 2014), Diversity (Van der Hoogte and Kingma 2004), Business and Enterprise (Jones et al. 2012), Work (Thompson 2009), Rural Livelihoods and Agriculture (Cahn and Liu 2008, Holmes and Slater 2008), Water, Sanitation and Hygiene (WASH) (Acey 2010, Nawaz et al. 2010, Mjoli 1998), Health (Simard and Konnick 2001, Smith 2001), Energy (UNIDO 2014, Oparaocha and Dutta 2011), Climate Change and Climate Justice (Terry 2009, Dankelman 2002) and Development Goals (Esquivel 2016, Goetz and Jenkins 2016, Antrobus 2005, Johnson 2005).

Particularly in the Caribbean, there exists gender expertise on topics such as Caribbean Sexuality (Flynn 2014, Nixon and King 2013, Crawford 2012), Men and Masculinities (Nixon 2015, Lewis 2014), HIV/AIDS (Brown 2013), Gender-Based Violence (DeShong 2015, Holder-Dolly and Youssef 2013), Water and Sanitation (Dunn 2012, UNDP 2009 a), Climate Change and Disaster Risk Reduction (Constable 2017, Dunn 2016, UNDP 2009 b, Bynoe 2008), and Environmental Justice (Dunn 2009). Research in all of these areas actively supports many regional and national policy initiatives. A commonality among all of these themes explored is their specific acknowledgement of women as a vulnerable population, with their vulnerability linked to their predominant subordinate status in society due to the existence of patriarchal power hierarchies, and a reduced access to resources. In spite of this, the gender and development approach is not concerned with women alone, but proposes interventions based on an assessment and incorporation of the separate/individual needs of both women and men.

The development of infrastructure (e.g. water, energy, transport, information and communication technologies (ICT)), and infrastructure services is a key policy and public-sector investment area for many countries. Missing sex-disaggregated information required to understand differences between men and women in terms of who uses infrastructure, and distribution of benefits from policy and investment in this area, is vital to integrate gender into public policy (UNECE 2017). In the area of transportation the World Bank Group has developed a suite of online resources that provide engineers and scientists with practical tools and case studies on the design of gender responsive projects, and strategies to track the production of sex-disaggregated data during and post construction that is needed to assess the overall impact of the investment (World Bank 2017). The Gendered Innovations project at Stanford University builds upon this argument and demonstrates how the inclusion of sex and gender analyses in research leads to innovation in the areas of Engineering, Science, Environment, Health and Medicine (Gendered Innovations 2017).

2.2 Gender Equality at the Intersection of Sustainable Development

The 8 United Nations (UN) Millennium Development Goals (MDGs), operational from 2000–2015, were established to set global quantifiable time-bound targets that addressed extreme poverty while promoting gender equality, education and environmental sustainability (UN 2000). On September 25, 2015, UN member states adopted 17 Sustainable Development Goals as part of the 2030 Agenda for Sustainable Development (UN 2015). The SDGs are praised for their move beyond the narrow vision, goals and targets for development of the 8 MDGs. They are rooted in human rights principles, and were developed in an inclusive manner with a universal scope, as compared to the top-down bureaucratic

formation of its predecessor (Esquivel 2016, Razavi 2016). Table 1 compares the MDGs and SDGs, both of which include a goal of gender equality.

The MDGs have been referred to as a "Major Distraction Gimmick," as their lack of recognition of the interconnectedness of their targets with the development of separate goals, was a distraction from the Beijing Declaration in 1995 and other Platforms for Action on Women (Antrobus 2005). Among gender specialists, who are proponents and critics of the SDGs, there is consensus that all of the goals directly, or indirectly bring into focus the global need for inclusion of gender equality, and women's empowerment initiatives in all goal setting of sustainable development initiatives (Esquivel 2016, Koehler 2016, Stuart et al. 2016; Fukuda-Parr 2016, Ponte et al. 2016, Razavi 2016, Rosche 2016).

Table 2.1: Comparison of the Millennium and Sustainable Development Goals for overlap and alignment

Comparison	Millennium Development Goals	Sustainable Development Goals
Overlap	1. Eradicate extreme poverty and hunger	1. No Poverty 2. Zero Hunger 8. Decent Work and Economic Growth 10. Reduced Inequalities
	2. Achieve universal primary education	4. Quality Education
	3. Promote gender equality and empower women	5. Gender Equality
	4. Reduce child mortality 5. Improve maternal health 6. Combat HIV/AIDS, malaria and other diseases	3. Good Health and Well-Being
	7. Ensure environmental sustainability	6. Clean Water and Sanitation 11. Sustainable Cities and Communities 12. Responsible Consumption and Production 14. Life Below Water
	8. Develop a global partnership for development	17. Partnerships for the Goals
Non-Overlap		7. Affordable Energy and Clean Energy
		9. Industry, Innovation and Infrastructure
		13. Climate Action
		16. Peace Justice and Strong Institutions

In spite of these shortcomings, both the MDGs and SDGs provide a global common framework for setting international directives (often transposed into regional policies and national laws) with measurable targets and progress indicators, that facilitate the crafting of global aid agendas needed to support achievement of these goals. These development goals are agreed upon by all governments, and provide mechanisms for accountability of both donor countries/agencies and aid recipients (Antrobus 2005).

Climate Change is the single biggest threat to sustainable development (UN 2017), and it is not gender neutral (Dunn 2012, Rodenberg 2009, Schalatek and Burns 2013). According to the United Nations Framework Convention on Climate Change (UNFCCC), climate change refers to "a detectable change of climate (e.g. using statistical techniques) which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and which is in addition to natural climate variability observed over comparable time periods" (UN 1992). By virtue of their size, climate impacts are exacerbated in Small Island Developing States (SIDS) such as those in the Caribbean, due to their location in natural disaster prone regions, reliance on small, open economies that are sensitive to external shocks, densely populated coastal areas, limited funds, resources and high debt to gross domestic product (GDP) ratios (Constable 2017). Although SIDS are the most vulnerable to climate change impacts, they have contributed the least to greenhouse gas emissions (cited as the primary contributor to global climate changes), and are therefore eligible for global climate finance and adaptation finance (CDKN 2014). Climate finance, subsidies, tariffs, taxes, loans, and insurance policies are a few innovative approaches that can be explored to access funding to build SIDS climate resilience (GWP 2017).

The SDG 13 – "Take urgent action to combat climate change and its impacts," recognizes the disproportionate burden of these impacts on the poor and other vulnerable groups such as women and children. At the same time, women and girls develop effective coping strategies and build resilience given their experiences with climate change impacts (Trotz 2008). The verdict on how they are compensated for that knowledge, leadership or integrated into established decision making bodies that control power in their communities is still out (Trotz 2013). Both women and men have important insights to contribute to designing and implementing effective climate responses, and should be fully included in decision-making related to climate change (OECD DAC 2016). Within this context climate finance mechanisms need to integrate gender perspectives in the development of resource mobilization strategies (Rodenberg 2009, Schalatek and Böll 2016, OECD DAC 2016).

2.3 A Gender Lens in International Climate Finance Mechanisms

Support for gender equality in climate change interventions has increased rapidly in recent years. In 2013, 29% of the Organization for Economic Co-operation and Development - Development Assistance Committee members' bilateral aid to climate change (USD 6.9 billion) targeted gender equality (OECD DAC 2016). A survey of experiences from international development programs by the Overseas Development Institute (ODI) through its Climate Funds Update initiative, found that increasing the gender-responsiveness of public climate change funding improves program effectiveness and efficiency (Schalatek et al. 2016).

Figure 2.1 presents an overview of the complex global climate change finance architecture (see Figure 2.2 for abbreviation key). A combination of Multilateral Funds such as the Global Environment Facility (GEF) and the Climate Investment Funds (CIF), and

Bilateral channels facilitates the flow of finance from donor to recipient countries. Additionally, a growing number of recipient countries bypass these channels, and access funding directly in nationally established climate change funds (Nakhooda et al. 2015).

For most existing climate financing mechanisms, gender considerations were not incorporated into their design and operationalization from their onset. Reviews of gender-blind programs and projects highlighted many large investments with sub-optimal project outcomes, and this has prompted the retroactive incorporation of gender considerations in several multilateral climate funds' structure and programming guidelines. Key climate financial mechanisms supporting development projects in the Caribbean are summarized below.

The CIFs (USD 8.1 billion), established by the World Bank (WB) in 2008, comprise 4 funds – Clean Technology Fund (CTF – USD 5.3 billion), Pilot Project for Climate Resilience (PPCR – USD 1.2 billion), Forest Investment Program (FIP – USD 785 million), and the Scaling Up Renewable Energy in Low Income Countries Program (SREP – USD 796 million). None of these funds have gender policies, and therefore rely on the gender policies of their implementing regional multilateral development banks (MDBs) to provide the framework for integrating gender considerations in the projects funded. The WB is one implementing MDB of the CIF that has had a mandate to mainstream gender since 1977; however, critical analyses of gender inclusion in infrastructure development in World Bank Projects have found a lack of meaningful integration (Ferguson and Harman 2015). A 2012 comprehensive CIF gender review confirmed that the CIFs needed to do much more to address gender considerations systematically (Schalatek et al. 2016).

The Adaptation Fund (AF) (USD 357.5 million) was established in 2007 under the Kyoto Protocol. In July 2011, operational guidelines were adopted that require the inclusion of gender considerations in project and program planning, as well as in project consultation processes as an important review criterion. A Gender Policy and Action Plan for the AF was approved in March 2016 (AF 2016, Schalatek et al. 2016).

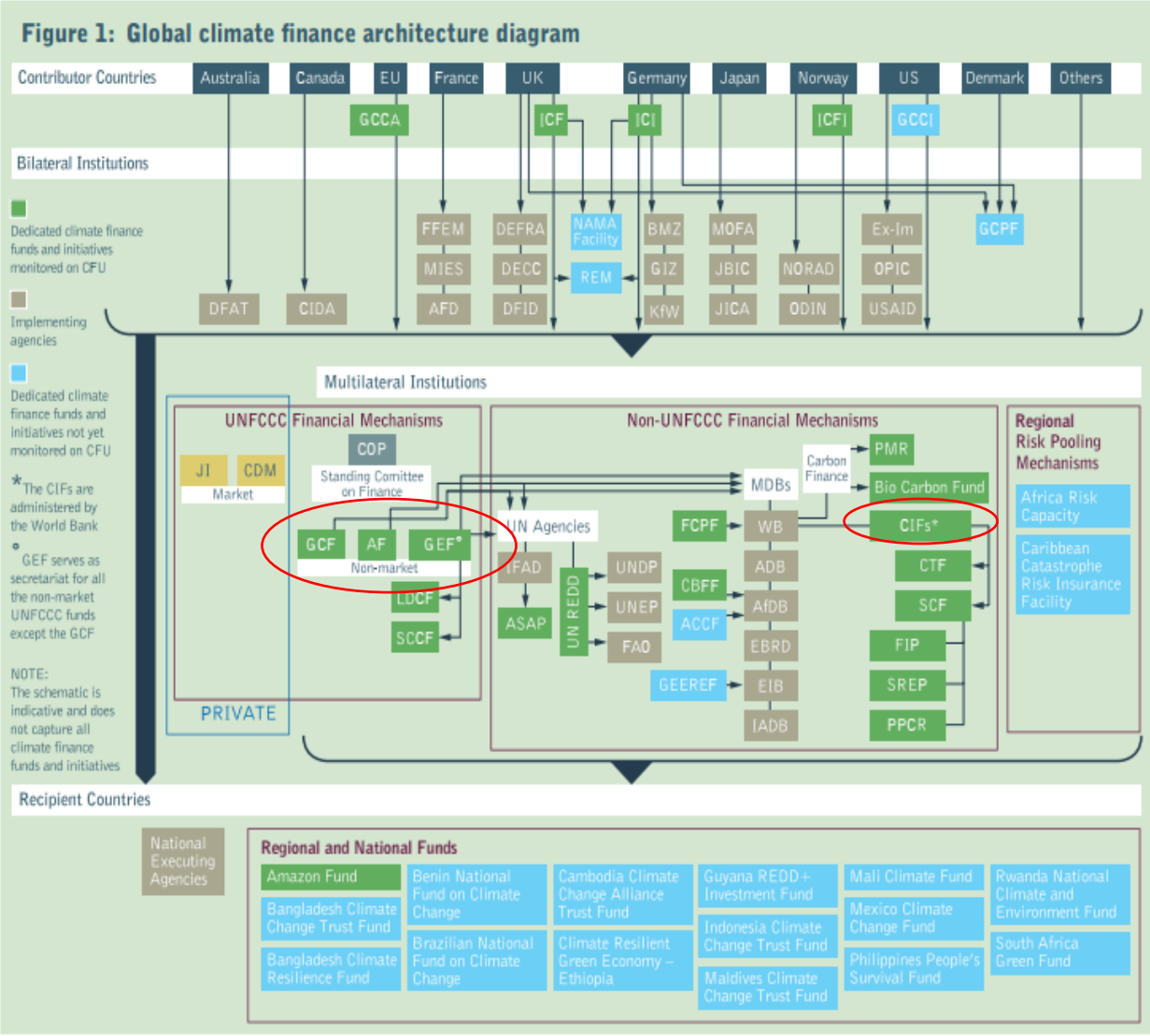

Figure 2.1: Summary of public global climate finance mechanisms. (Global climate finance architecture, Climate Funds Update in conjunction with Heinrich Böll Stiftung, retrieved online http://www.climatefundsupdate.org/about-climate-fund/global-finance-architecture ©CCBYNCSA; Climate Funds Update 2017)

Implementing Agencies and Institutions	
AfDB	African Development Bank
AFD	French Development Agency
ADB	Asian Development Bank
BMZ	Federal Ministry of Economic Cooperation and Development
CIDA	Canadian International Development Agency
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DFAT	Department of Foreign Affairs and Trade (Australia)
DFID	Department for International Development
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
Ex-Im	Export-Import Bank of the United States
FAO	Food and Agriculture Organisation
FFEM	French Global Environment Facility
GIZ	German Technical Cooperation
IADB	Inter American Development Bank
IFAD	International Fund for Agricultural Development
JBIC	Japan Bank of International Cooperation
JICA	Japan International Cooperation Agency
KfW	German Development Bank
MIES	Inter-ministerial Taskforce on Climate Change
MOFA	Ministry of Foreign Affairs
NORAD	Norwegian Agency for Development Cooperation
ODIN	Ministry of Foreign Affairs
OPIC	Overseas Private Investment Corporation
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USAID	US Agency for International Development
WB	World Bank

Multilateral Funds and Initiatives	
AF	Adaptation Fund (GEF acts as secretariat and WB as trustee)
ACCF	Africa Climate Change Fund
ASAP	Adaptation for Smallholder Agriculture Programme
CBFF	Congo Basin Forest Fund (hosted by AfDB)
CDM	Clean Development Mechanism (implemented under the Kyoto Protocol)
CIF	Climate Investment Funds (implemented through WB, ADB, AfDB, EBRD, and IADB)
CTF	Clean Technology Fund (implemented through WB, ADB, AfDB, EBRD, and IADB)
FCPF	Forest Carbon Partnership Facility
FIP	Forest Investment Program (implemented through WB, ADB, AfDB, EBRD, and IADB)
GCCA	Global Climate Change Alliance
GCF	Green Climate Fund
GEF	Global Environment Facility
GEEREF	Global Energy Efficiency and Renewable Energy Fund (hosted by EIB)
JI	Joint Implementation (implemented under the Kyoto Protocol)
LDCF	Least Developed Countries Fund (hosted by the GEF)
PMR	Partnership for Market Readiness
PPCR	Pilot Program on Climate Resilience (implemented through World Bank, ADB, AfDB, EBRD, and IADB)
SCCF	Special Climate Change Fund (hosted by the GEF)
SCF	Strategic Climate Fund (implemented through WB, ADB, AfDB, EBRD, and IADB)
SREP	Scaling Up Renewable Energy Program (implemented through WB, ADB, AfDB, EBRD, and IADB)
UNREDD	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation

Bilateral Funds and Initiatives	
GCCI	Global Climate Change Initiative (US)
GCPF	Global Climate Partnership Fund (Germany, UK and Denmark)
ICF	International Climate Fund (UK)
ICFI	International Climate Forest Initiative (Norway)
ICI	International Climate Initiative (Germany)
NAMA facility	Nationally Appropriate Mitigation Action facility (UK and Germany)
REM	REDD Early Movers (Germany and UK)

Figure 2.2: List of agencies identified in the global climate finance mechanisms in Figure 2.1. (Global climate finance architecture, Climate Funds Update in conjunction with Heinrich Böll Stiftung, retrieved online http://www.climatefundsupdate.org/about-climate-fund/global-finance-architecture ©CCBYNCSA; Climate Funds Update 2017)

The Global Environment Facility (USD 70.5 billion – USD 12.5 billion in grants and USD 58 billion in co-financing) is one of the oldest international climate funds (GEF 2017). However, official gender considerations became more prominent in program review and approval processes with the adoption of the 2012 Policy on Gender Mainstreaming and 2014 Gender Equality and Action Plan. All GEF implementing agencies must demonstrate that they have made efforts to analyze gender considerations in GEF projects. It also requires all

implementing agencies to establish policies, strategies, or action plans that promote gender equality and satisfy minimum requirements on gender mainstreaming (Schalatek et al. 2016).

The Green Climate Fund (USD 10.3 billion – USD 9.9 billion announced and signed) was established in 2010 by the United Nations Framework Convention on Climate Change (GCF 2017). It is the first multilateral fund to begin its operations with a comprehensive gender-responsive approach in place. The governing instrument for the GCF prominently anchors a gender mainstreaming mandate under its funding objectives and guiding principles. A Gender Policy and Action Plan approved in 2015 complements these objectives (Schalatek et al. 2016). The GCF allocates its resources to low-emission and climate-resilient projects and programs in developing countries, and advanced economies have formally agreed to jointly mobilize US $100 billion per year by 2020 which would make it the largest climate finance mechanism in the world (GCF 2017). The first round of funding for GCF projects was approved in 2015.

Table 2.2 provides a summary of the gender mainstreaming policies adopted by climate finance mechanisms and implementing agencies, and lists the general focus areas of the projects approved for funding by these mechanisms for CARICOM countries. From this table we can see that there exists expertise in CARICOM on the development and implementation of water and wastewater resources management and renewable energy projects.

Table 2.2: Gender policy instruments and Caribbean Community (CARICOM) countries' project focal areas of international climate finance mechanisms

Classification	Name	Year Established	Fund Amount (USD)	Gender Policy Instrument/ Gender Mainstreaming Action (Year adopted/approved)	Focus Area of CARICOM Projects	Source
UNFCC Financial Mechanism	Green Climate Fund (GCF)	2010	$10.3 billion	Gender Policy and Action Plan (2015)	Energy and Legal and Regulatory Environment for Energy Development, Water Management	GCF 2017
UNFCC Financial Mechanism	Global Environment Facility (GEF)	1992	$70.5 billion	GEF Policy on Gender Mainstreaming (2012) Gender Equality Action Plan (2014)	Energy, Capacity Building, Disaster Risk Management, Water Resources, Ecosystem/Biodiversity Protection, Mining,	GEF 2012, GEF 2017
UNFCC Financial Mechanism	Adaptation Fund (AF)	2007	$357.5 million	Amended Operational Policies and Guidelines (2011) Gender Policy and Action Plan (2016)	Water Resources, Agriculture, Soil Management, Coastal Protection, Capacity Building-Gender Readiness	AF 2016, AF 2017,
Non-UNFCC Financial Mechanism	Climate Investment Funds (CIF)	2008	$8.3 billion	No gender policy but relies on gender policies of implementing agencies	Disaster Management, Water Resources, Climate Data and Information Management, Agriculture, Forestry, Energy	CIF 2017
Contributor – European Union (EU)	Global Gender and Climate Alliance (GGCA)	2007	-	European Union – Strategic Engagement for Gender Equality 2016-2019	Capacity Building, Child Empowerment, Protection. Gender-Based Violence, Agriculture, Heritage Development, Water Resources, Public Health, Social Services,	GGCA 2017
Contributor – United States	US Agency for International Development (USAID)	1961	-	Gender Equality and Female Empowerment Policy (2012)	Women's Reproductive Health, Family Planning, Education, Water and Climate Change	USAID 2012
Contributor - Japan	Japan International Cooperation Agency (JICA)		-	Gender Mainstreaming – Inclusive and Dynamic Development (2011)	Disaster Risk Management, Energy, Education, Agriculture, Water Utility Economic Regulation, Water Resources, Solid Waste Management, Wastewater Management	JICA 2011

Table 2.2 continued

Classification	Name	Year Established	Fund Amount (USD)	Gender Policy Instrument/ Gender Mainstreaming Action (Year adopted/approved)	Focus Area of CARICOM Projects (Year)	Source
Implementing Agency	Inter-American Development Bank (IDB)	1959	-	Operational Policy on Gender Equality in Development (2010)	Tourism, Social Investment, Transport, Disaster Management, Water Infrastrucutre	IDB 2017, IDB 2010
Implementing Agency	World Bank (WB)	1945	-	World Bank Gender Strategy (2016-2023)	Public Health, Tourism, Education, Entrepreneurship, Transportation, Capacity Building, Energy, Education, Communication Infrastructure, Disaster Risk Management , Economic Development, Water Resources	World Bank 2015
Implementing Agency	Caribbean Development Bank (CDB)	1969	-	Gender Equality Policy and Operational Strategy (2008)	Water Resources, Solid Waste Management, Education, Agriculture, Transportation, Disaster Risk Reduction Management	CDB 2008

2.4 What is a Gender Analysis?

A gender analysis is a useful tool to identify points of intervention in the project cycle at which existing or potential disparities in gender impacts can be compensated for or eliminated. For a gender analysis, quantitative sex disaggregated data provides statistical measures of the gender differentials and inequalities. Conversely, qualitative data that is much harder to find in the gender and water infrastructure field provides explanations for the disparities observed (Roehnr2016). Figure 2.3 presents the 4 main steps of a Gender Analysis – 1) Screening, 2) Data Collection, 3) Gender Impact Assessment, and 4) Gender Mainstreaming the Project Cycle – and details associated with each step.

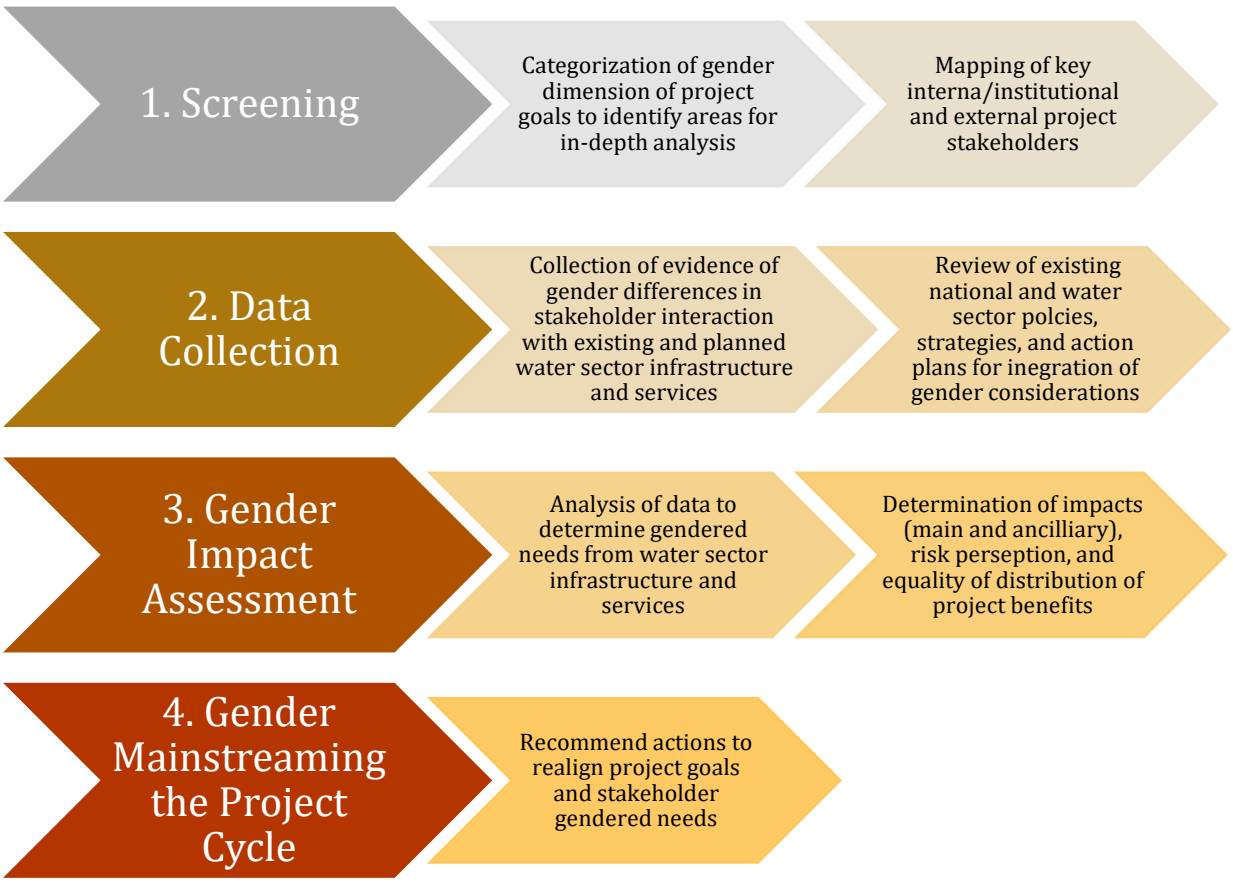

Figure 2.3: Overview of the Gender Analysis Steps applied to water and wastewater projects (data adapted from Roehnr 2016)

Step 1 is Screening which involves a rough audit of the scope of project activities for gender integration and categorization of gender dimensions. At this stage, project developers can anticipate the expected contribution of project activities to gender equality, and categorize the integration of gender goals as: targeted, significant, limited and minimal. Table 2.3 presents minimum gender project outcomes for each gender categorization.

Project managers can also anticipate the gender dimensions of their projects by assessing the applicability of the categories introduced below to project outcomes. Examples of gender-specific aspects of traditional gender dimensions are detailed in Table 2.4.

Table 2.3: Guidelines for the categorization of gender objectives in projects (data adapted from UNIDO 2014)

Categorization of Gender Objectives	**Suggested Minimum Gender Project Requirements**
Targeted	Ensure project objective and key results address one or more clearly defined gender issue, and formulate gender-responsive targets, indicators and a baseline to monitor and evaluate gender equality results.
Significant	Ensure at least 50 per cent of the project outputs have activities promoting gender equality and/or the empowerment of women.
Limited	Ensure at least 20 per cent of the project outputs have clearly identified activities promoting gender equality and/or the empowerment of women, including gender-responsive indicators and a corresponding budget or at least one indicator in each project output refers to gender in some way.
Minimal	Include a description of why the project is not expected to noticeably contribute to gender equality and/or women's empowerment. For example, the project does not have direct contact with communities or the project does not directly determine the use of resources, goods, or services accessed by women and men.

Table 2.4: Gender dimensions that can potentially impact water sector project design or outcomes (data adapted from Roehnr 2016)

Dimension	**Examples of Gender-Specific Aspects**
Political	Key words: participation, power Power and participation of the sexes in decision-making impacts project design due to the gendered difference in perceptions and attitudes towards climate-related problems.
Legal	Key words: Land rights Expansion of water and sewer infrastructure can encounter issues of land rights if private property interests with intended construction course. The presence of a national/sectoral gender policy can also guide project operations.
Socio-economic	Key words: access to resources, income, education, division of labor, property ownership Existing division of labor in technical fields can reinforce gender disparities if technology implementation requires specific skills.
Socio-cultural	Key words: Religion, cultural patterns, norms Interruptions in water supply can increase time requirements for domestic activities necessitating clear communication policies for household planning. Cultural or religious festivals that utilize water should be considered/accounted for in creation of educational & communication material.
Socio-psychological	Key words: Gender identity, gender roles, attitudes, risk perception Gender identities and societal expectations of being a man or woman can translate into different water consumption patterns which are guided by different value systems e.g. fairness and ethics vs. cost-performance
Physical, biological	Key words: Physical differences between the sexes Health impacts due to water quality can impact men and women differently for biological reasons influencing their choices of appropriate water treatment and use options.

After identifying the gender dimensions of the project, consultations with key stakeholders must be completed for the data collection. Key stakeholders can be divided into two (2) broad categories:

1. Institutional/internal which includes upper management of project partners, utility middle management and human resources personnel,
2. External which includes networks of women's groups, utility customers especially those who will be directly affected by project activities, institutions providing small grants for water sector projects, and elected-area officials.

Step 2 is Data Collection in which information collected for the gender analysis provides the evidence for the gender dimensions identified in the screening process. Data disaggregated by sex can be obtained from secondary and primary sources. The data describes general measures such as participation in decision making, income and asset distribution, education levels, labor division and time use, perceptions on management and distribution of benefits arising out of the use of the resources by the utility, and access and threats to the use of energy, water, and nutrient resources. Data collection provides a simultaneous picture of what information is available, and the gaps that should be filled by statistics and further research. Table 2.5 summarizes goals, sources and mixed-method approaches to information collection for the gender impact assessment.

Step 3 is the Gender Impact Assessment in which Project goals can change or reinforce gender inequalities. The questions that guide the gender analysis serve to identify how the conditions and opportunities of women and men are affected. A gender analysis of an EWN-SCI project should answer the five (5) general questions: 1) What is the context? 2) Who does what? 3) Who has what? 4) Who decides? and 5) Who benefits?

The first four (4) questions characterize and describe the cultural context of the site of proposed project, as well as the perceptions and realities of stakeholders as they interact with infrastructure and services provided by the water and/or wastewater utility. The fifth question identifies direct and indirect benefits of the proposed project, and is usually the location of recommendations for points of gender interventions. Collectively, this information can help with project redesign or identify areas for further research during project implementation.

Table 2.5: Sample data to be collected for a gender analysis of a water and wastewater sector infrastructure project

Goal of Data Collected	Source of Information/ Stakeholder Consulted	Method of Data Collection	Type of Information Obtained
Analysis of integration of gender perspectives in legislation	National policies, strategies and action plans	Document review, interviews	Legal status of women in the country of intervention, gender norms and values
Analysis of institutional structures and capacities for gender mainstreaming	Institutional Partners	Document reviews, interviews and focus groups	Gendered division of labor and time use, differentials in education
Identification of socio-cultural, economic, political and health gender issues	Internal and External	Surveys, focus groups and social media	Water sources, connection penetration, collection, storage, storage maintenance, transportation, sewer coverage
Context of access, use, and threats to energy, water and nutrients	Internal and External	Document review, interviews	Local energy mix, fertilizer source and use, water reuse practices

Step 4 is Gender Mainstreaming the Project Cycle entails setting gender outcomes, outputs and indicators to track the project's progress in changing conditions of men and women in terms of power, agency and access to resources. These changes are tracked across the project cycle which is divided into the stages of (1) Formulation, (2) Implementation and (3) Monitoring and Evaluation.

2.5 Regional Caribbean Gender Initiatives and Policies

Many CARICOM countries do not routinely collect sex-disaggregated data needed to support a gender analysis of a water/wastewater development project. For the GCF, countries that are unable to provide baseline gender data in their proposals must include plans for system strengthening to enable applicants to conduct a proper gender analysis early in their program (Schalatek and Burns 2013).

The Global Environment Facility Caribbean Regional Fund for Wastewater Management (GEF CReW) was a 4 year project started in 2011 by the IDB and the United Nations Environment Programme (2017). GEF Crew has held capacity building workshops on Gender, Climate Change and Monitoring and Evaluation Issues in Sanitation Management which would have provided patrons with knowledge on useful types of sex-disaggregated information to be collected (GEF CReW 2017). GEF CReW possibly represents one of the few regional programs with access to sex disaggregated information for wastewater management and can share this knowledge with the rest of the Caribbean. Linnette Vassell, a Community Development & Gender Specialist at the Ministry of Water and Housing in Jamaica, and also the facilitator of GEF CreW workshops on gender mainstreaming is a key person in the Caribbean region with experience in the areas of Gender and Water, Sanitation and Hygiene (WASH) policy development.

The Global Water Partnership (GWP) created in 1996 is an international network that fosters the implementation of integrated water resources management, through the coordinated development and management of water, land, and related resources in order to maximize economic and social welfare, without compromising the sustainability of ecosystems and the environment (GWP 2016). An active supporter of the Dublin Principle,

the GWP believes that women play a central role in providing, managing, and safeguarding water resources. In its 2014 Gender Strategy, the GWP acknowledges that women's meaningful participation will have a positive influence on gender inclusion in policy and practice, and encourages member countries to produce gender-disaggregated data which can play a decisive role in advancing strategic planning and decision-making regarding gender and women's empowerment in the water sector (GWP 2016). As a member of the GWP-Caribbean, Barbados has access to databases and case studies of GWP projects. This partnership represents another opportunity for the BWA to access sector specific information that includes gender mainstreaming recommendations.

The Memorandum of Understanding (MOU) on gender equality and empowerment signed by CARICOM and UN-Women on January 9, 2017 includes collaboration on the provision of Caribbean-wide data, statistics and analysis on the implementation of the gender dimensions of the SDGs, and the SIDS Accelerated Modalities of Action known as the SAMOA Pathway (CARICOM 2017). Although the focal point (gender-based violence information) is not gender information on water and wastewater use, this MOU represents a complementary region-wide effort on increasing human capacity to identify and develop a data infrastructure framework that documents gender differences in development issues.

Expertise on the topic of Gender, Climate Change and Disaster Risk Management with a focus on water and sanitation issues exists in Jamaica at the University of the West Indies' (UWI) Institute of Gender and Development Studies (IGDS), Mona Unit and the Friedrich Ebert Stiftung Foundation (Dunn 2013). The United Nations Development Programme in Jamaica also has a case study on the Impact of Climate Change on Water and Sanitation in Jamaica. A study by McGill University for the Caribbean Water Initiative (CARIWIN) has also

addressed gender differences in water use and impacts of service interruption in Barbados (Suchorski 2009). The Center for Resource Management and Environmental Studies at UWI Cave Hill, Barbados also has expertise on gender and climate, and from personal communication there is a soon to be published master's thesis on gender and disaster risk management in the Caribbean.

To identify meaningful opportunities to integrate gender concerns in water and wastewater infrastructure projects in Barbados, stakeholders of the BWA must be consulted to gather baseline information that will provide the cultural and gender context needed to ensure successful project design and implementation. These data collection strategies are described in Chapter 3.

CHAPTER 3: METHODS

Using a gender analysis framework, the methodologies listed below were chosen to obtain baseline information that could characterize the landscape in Barbados for integration of gender perspectives in the proposed Energy-Water-Nutrient Nexus for Sustainable Coastal Infrastructure (EWN-SCI) Project by the Barbados Water Authority (BWA). The following five activities were undertaken as part of the baseline gender assessment for this research.

1. The Government of Barbados' population and economic statistics, national gender policies and assessments were obtained and reviewed to develop a comprehensive description of the socio-economic environment and national legislative commitments to gender equality and climate adaptation in Barbados.
2. BWA employee data was obtained and reviewed to determine the organization's workforce gender profile for technical and leadership roles who will directly influence the design and management of projects.
3. Social media commentary on the quality of services experienced/received by customers of the BWA was reviewed, to gain cultural context and community insight on existing gender inequalities, and impacts resulting from the types of water infrastructure projects pursued and their methods of implementation. The EWN-SCI project team members provided a list of key stakeholders for further consultation for data collection (see Tables 3.3 and 3.4).

4. A water user survey was created and executed to determine gendered differences in social, economic and health concerns related to water use, treatment and infrastructure projects pursued to alleviate existing challenges and build sector resiliency.
5. Focus groups were conducted and interviews were administered to project partners, and Key Agency and Business Sector personnel, to identify issues with the management of water and wastewater resources, and opportunities to maximize use of these resources with a goal of building climate resiliency.
6. Gender Impacts of the infrastructural components of the EWN-SCI projects were described, and opportunities to address these concerns across the individual infrastructure project cycles were proposed.

Details on the data collection strategies (Activity #2 BWA workforce gender profile, Activity #3 survey of social media platforms, Activity #4 water user survey, Activity #5 focus groups and key informant interviews, and Activity #6 environmental, social and gender impact assessment) are described in greater detail in the following sections.

3.1 Barbados Water Authority Workforce Gender Profile

The BWA provided data on the age, gender and post (job title) for its 779 employees as of June 28, 2016. The data was processed to create an age profile of the institution, as well as disaggregate technical, non-technical and leadership (senior management) positions by gender. For the purposes of this thesis, technical was defined as all posts related to project management, engineering, science, vocational, heavy equipment operation and field work activities of the utility. All other employees were classified as non-technical. Leadership posts included all job titles with the words manager, supervisor, senior, foreman, chief, superintendent and director. The organization gender profile (of technical and leadership

roles) was used to identify positions of power/power differentials and gender disparities that directly impact the design priorities and distribution of benefits from water and wastewater projects.

3.2 Social Media Analysis

During a 5-month period (June 8–November 8, 2016), Google Trends was used on a monthly basis to conduct separate searches of key words 1) "water" and "Barbados Water Authority" using inclusion criteria of "Barbados" as geographical location, 2) "Past 12 months" as duration, and 3) "All Categories" and "Web Search" as sources of information. With these criteria, Google Trends summarized the interest over time and frequency of posts on related topics to these key words, and disaggregated them by sub-regions/parishes in Barbados (See Figure 3.1). Each topic and parish could be further disaggregated to identify the interest patterns in the topic over time. This information was used to refine/focus the search criteria for use in IBM Watson Analytics for Social Media, as well as identify key dates for further review of Barbados' Online Newspapers and the social media site Facebook for context on why these topics were trending.

IBM Watson Analytics for Social Media is a social media analytics technology that sifts through the traffic of social networks for specific content using key topics and themes to identify interesting relationships and patterns. It automatically creates data visualizations of this social information that can be used to measure and gauge persons' sentiments and reactions to a product or event, and/or determine effectiveness of campaigns or specific events. It can also extract multiple snippets of conversations from a single social post for a true picture of social sentiment, as well as compare social media analytics with other data sources to reveal new insights (IBM 2017).

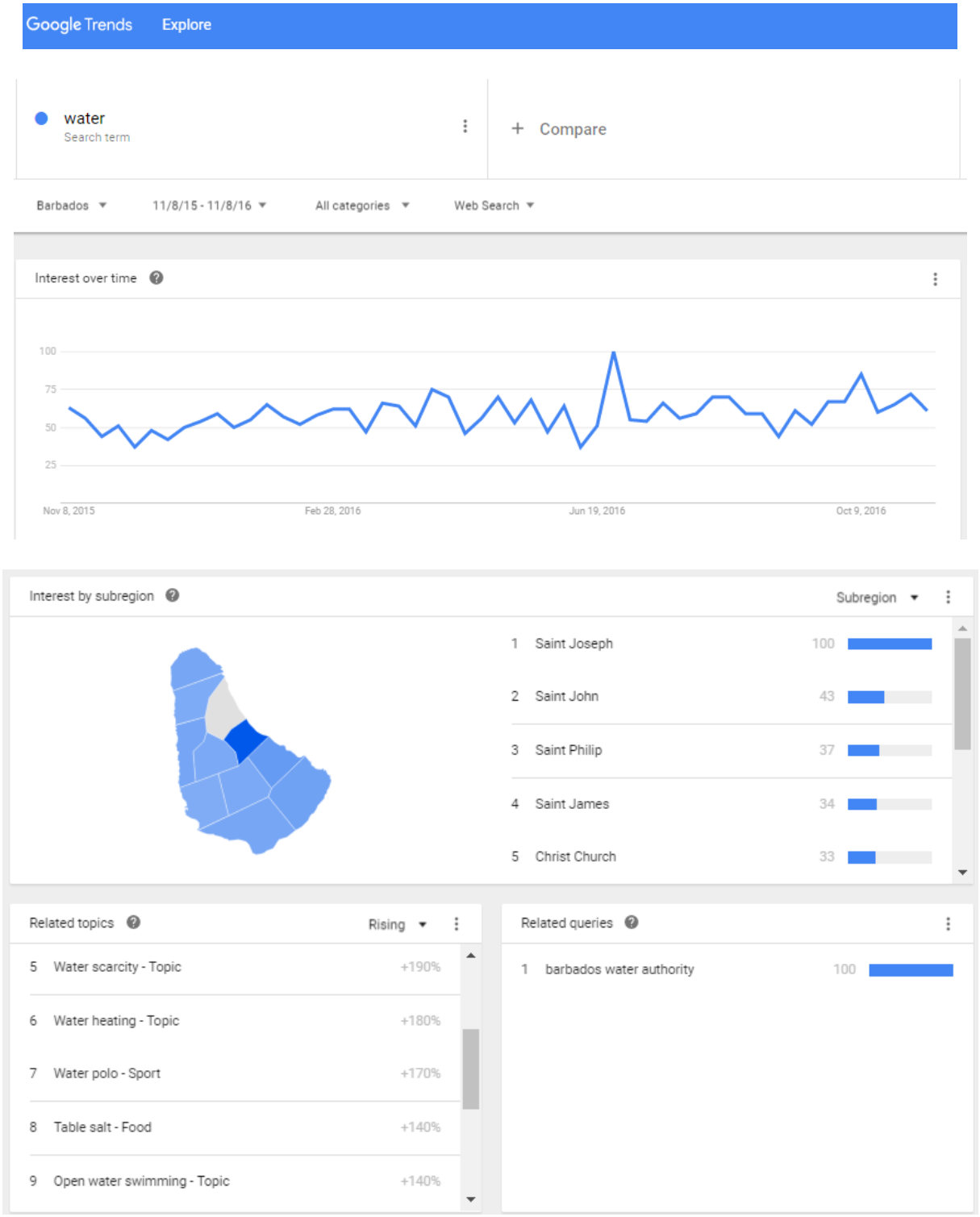

Figure 3.1: Example of interest over time by subregion in comments or searches for the Barbados Water Authority and other related topics on Google Trends. (Google 2017)

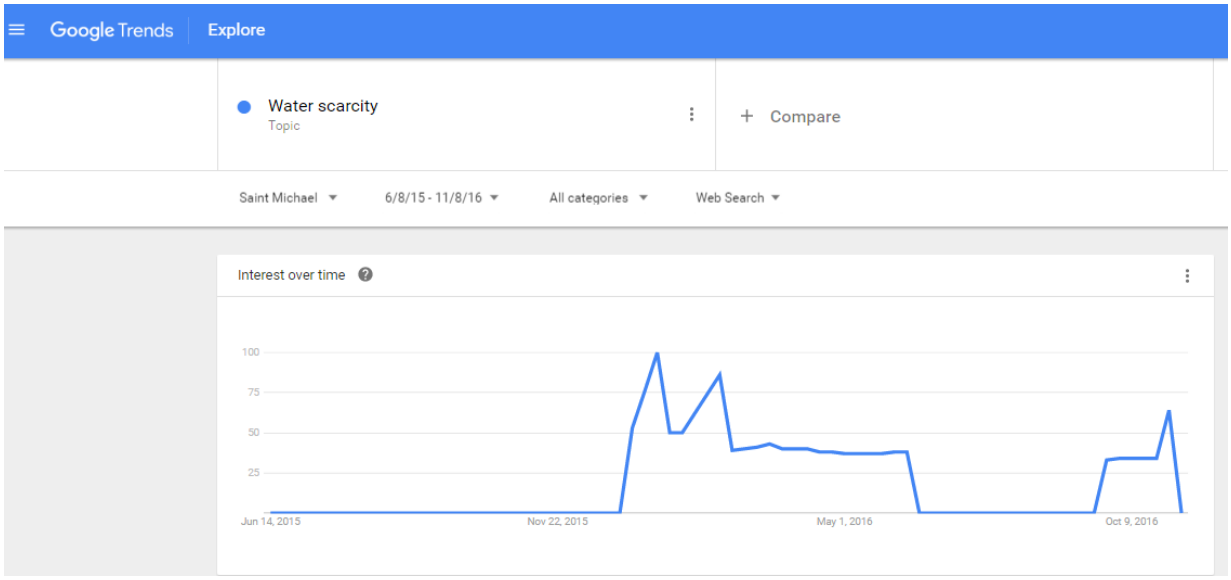

Figure 3.2: Example of breakdown of the Interest over time on the topic "Water Scarcity" for the Parish of St. Michael using Google Trends. (Google 2017)

IBM Watson Analytics for Social Media was used to review 8,699 documents that were written in English and sourced from 2 social media platforms – Facebook and Twitter. This identified stakeholder/customer perceptions and sentiments on the management and quality of water and wastewater services provided by the Barbados Water Authority for the period June 8, 2015 to November 8, 2016. A snapshot of the program user interface and summary of the topics and themes used as search criteria are presented in Figure 3.1. The results obtained from this search were further sorted by country to only include social media mentions/posts from Barbados. The data visualization tools available in the program were used to provide a count of the frequency of topic posts, summarize the sentiment percentage per topic (positive, neutral, ambivalent, and negative) which were further assessed for accuracy by individual review of the posts referenced, and provide demographics (gender if relevant) of the author posting the comments.

Facebook was further surveyed for additional general population views on this topic. Key phrases like #barbadoswater, #barbadoswaterauthority and #barbadoswatercrisis that were trending from the Google Trends and IBM Watson Analytics for Social Media platforms were used to guide the search. In this review, two parishes – St. John and St. Joseph were highlighted as areas of special concern and further analysis due to extended and frequent water interruptions.

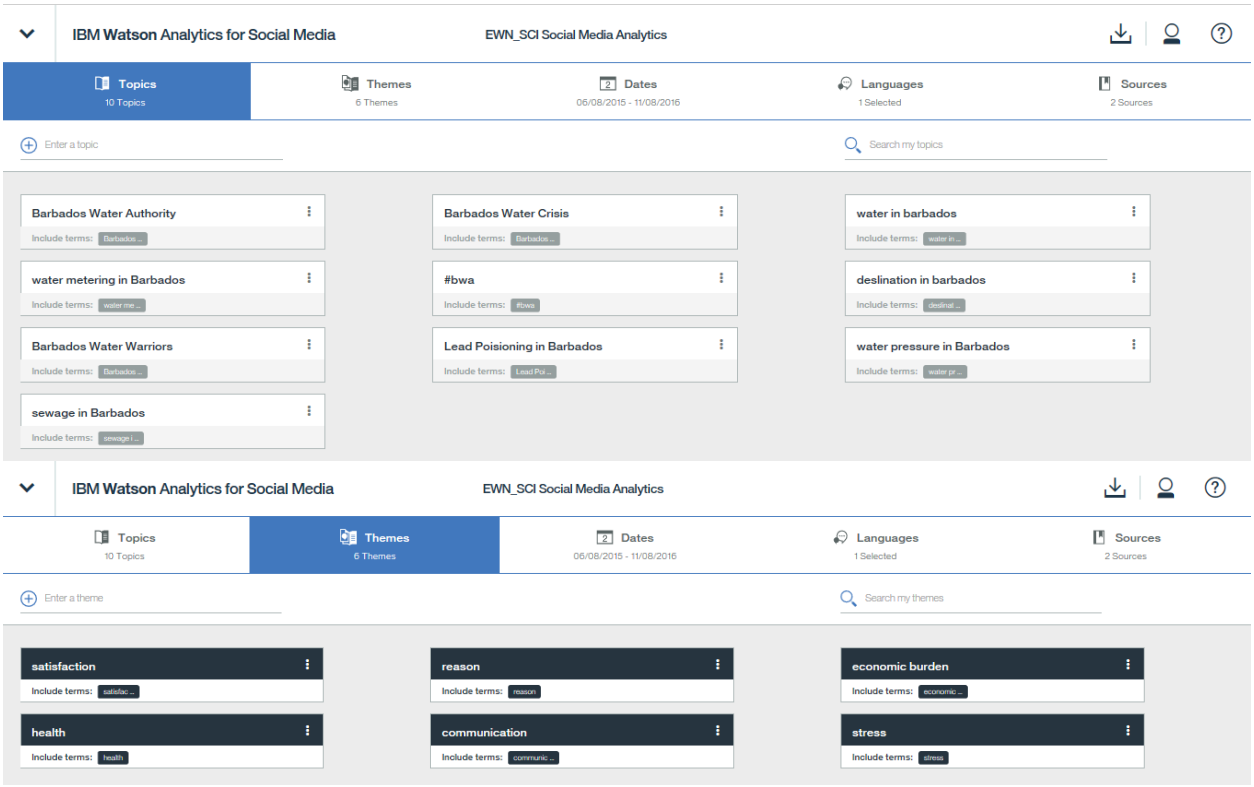

Figure 3.3: Example of IBM Watson Analytics for Social Media interface with search criteria identified

3.3 Water User Survey

The 27 question Water User Survey (Appendix C) was administered to 229 persons and captured information on basic demographics, access, use and water storage patterns indicative of existing coping strategies, knowledge and stewardship of wastewater

management, BWA stakeholder engagement practices, customer satisfaction with respect to communication, cost, quality and supply of BWA services, and health concerns related to water resources provision and management in Barbados. The survey tool was developed in collaboration with members of the EWN-SCI project team to formulate and validate the questions and potential responses. Table 3.1 below summarizes the themes addressed by the survey questions that will guide and provide the framework for presenting the results and discussion in Chapter 4.

The survey tool was developed to gather primary data at the resident level from all eleven parishes in Barbados (see Figure 3.4). These surveys were administered in Barbados during the period October 20–November 8, 2016. Budgetary and time constraints rendered an island-wide survey to be unfeasible, resulting in the selection of a representative cross-section that would provide for a meaningful survey. The total number of respondents surveyed was 229. A minimum of 205 respondents were needed to allow for reporting of statistics at a 95% confidence interval and a +/- 7% confidence level. A stratified population sample was gathered from each parish using the 2010 Population and Housing Census statistics as the population reference (BSS 2010). Efforts were made to maintain a 50:50 gender representation in the 229-person sample (120 females and 109 males).

Permission for this study was granted by Institutional Review Board (IRB) at the University of South Florida under study #Pro00027337 and Amendment Ame1_Pro00027337 (see Appendix B). The IRB approval process ensures that the survey and study protocols are ethically developed and it requires the research team to inform potential participants of the purpose and use of the information, explains the questions in a non-coercive way, and enrolls only willing individuals.

Table 3.1: Themes covered by Water User Survey Questions

Question		Themes							
No.	**Data Type**	**Demographics**	**Water Access & Use**	**Water Storage & Treatment**	**Waste Reuse & Wastewater Management**	**Stakeholder Engagement (Communication, Information Flows & Stewardship)**	**Cost of Water and Wastewater Services**	**Water Quality & Supply**	**Health Impacts**
1	Ordinal	X	-	-	-	-	-	-	-
2	Nominal	X	-	-	-	-	-	-	-
3	Nominal	X	-	-	-	-	-	-	-
4	Nominal	X	-	-	-	-	-	-	-
5	Nominal	-	X	-	-	-	-	X	-
6	Nominal	-	X	-	-	-	-	X	-
7	Nominal	-	-	X	-	-	-	X	-
8	Nominal	-	-	X	-	-	-	X	-
9	Nominal	-	-	X	-	-	-	X	X
10	Nominal	-	-	-	X	-	-	-	-
11	Nominal	-	-	X	-	-	-	X	-
14	Nominal	-	-	-	X	-	-	-	-
15	Nominal	-	-	-	-	X	-	-	-
16	Nominal	-	-	-	-	X	-	-	-
17	Ordinal	-	-	-	-	-	X	-	-
18	Ordinal	-	-	-	-	-	X	-	-
21	Ordinal	-	-	-	-	X	-	-	-
22	Ordinal	-	-	-	-	X	-	-	-
23	Ordinal	-	-	-	-	-	X	-	-
24	Ordinal	-	-	-	X	-	X	-	-
25	Ordinal	-	X	-	-	-	-	X	-
26	Ordinal	-	X	-	-	-	-	X	-
27	Ordinal	-	-	-	-	-	-	-	X

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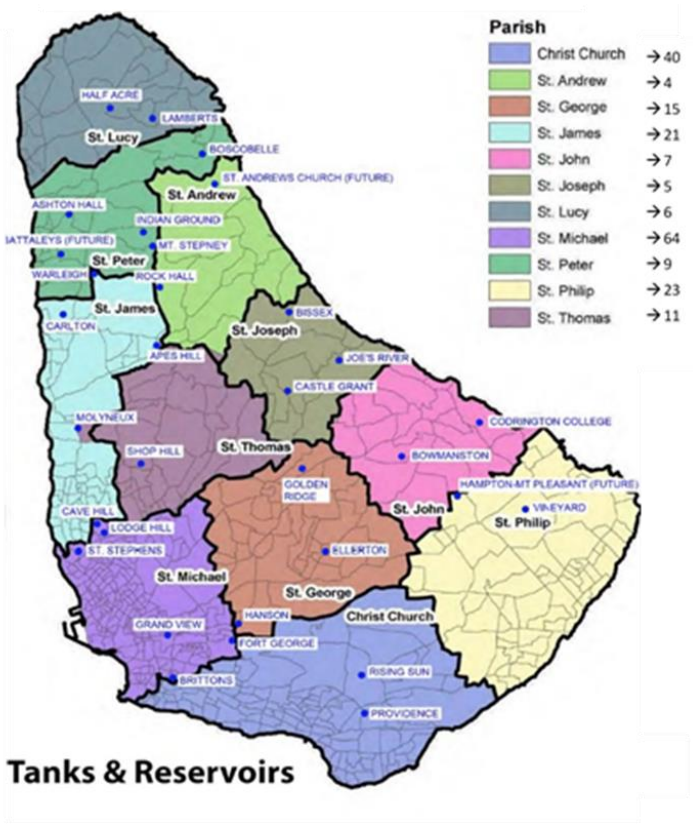

Figure 3.4: Parishes, locations of tanks and reservoirs, and minimum sample sizes of the surveyed population in Barbados by Parish (adapted from Burnside 2009)

Random and referral sampling techniques were used to obtain study participants, and only Barbadians 18 years of age and older were surveyed. A list and map of the locations where surveys were administered are available in Table 3.2 and Figure 3.5. The survey was an anonymized 27 multiple choice or multi-select questionnaire, and responses were based on respondent experiences; as such, they required no special knowledge to answer survey questions.

All surveys were administered by the author or a member of the University of South Florida (USF) IRB approved project team so there was an opportunity to capture other qualitative data that contextualized the survey responses provided. In addition to the survey question responses, respondents volunteered or were asked for general comments on

strategies to improve the management of water and wastewater resources in the country. This qualitative data collected was summarized during data processing, and integrated into relevant response categories.

Table 3.2: List of locations where water user surveys were administered during the period 10/20/16 to 11/8/16

Survey Locations and Represented Parishes in Barbados	
Cheapside Public Market, St. Michael	Princess Alice Bus Terminal, St. Michael
Temple Yard, St. Michael	Fairchild Street Bus Terminal, St. Michael
Barbados Water Authority Building, St. Michael	Restaurant in Holetown, St. James
University of the West Indies Institute of Gender Studies Department, St. Michael	Boardwalk on South Coast, Christ Church
University of the West Indies Management Studies Department, St. Michael	Grocery Store, St. Andrew
University of the West Indies UWI Chemistry Department, St. Michael	Restaurant in St. Andrew
University of the West Indies Cave Hill Campus, St. Michael	Shopping Malls along the South Coast, St. Michael & Christ Church
Neighborhood Pharmacy, Christ Church	Open Air Plaza in St. Peter
Restaurant in Dover, Christ Church	Grocery Store in St. Lucy
Round House Restaurant, St. Joseph	Payne's Bay Fish Market in St. Michael
Caribbean Water and Wastewater Association Conference (Oct 24-28, 2016), Trinidad and Tobago	

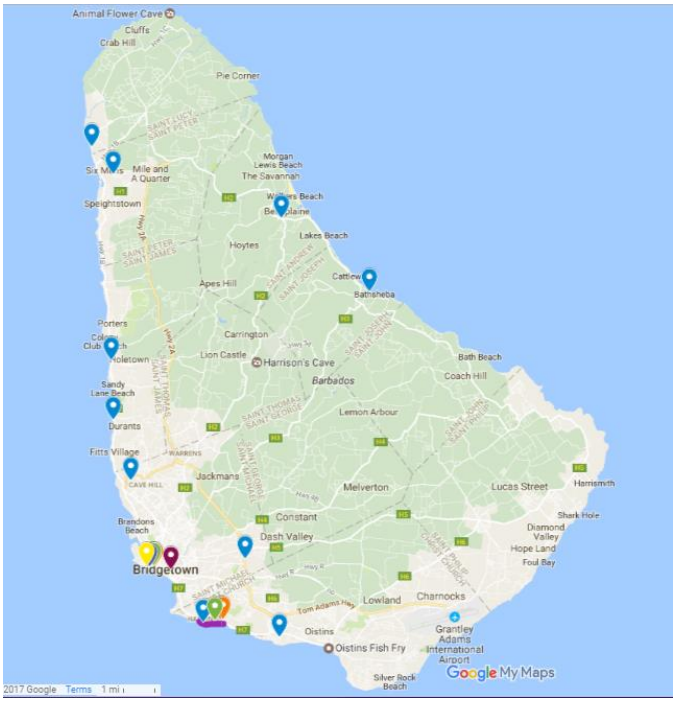

Figure 3.5: Map of Barbados showing the spatial relationship between locations where the water user surveys were administered during the period 10/20/16 to 11/8/16

To support the discussion, some responses were re-categorized into similar groups. All of the survey responses were disaggregated by gender to glean agreement and diversion in responses by women and men and are presented in Appendix E. Sex disaggregated data can be used to predict negative or positive impacts of proposed interventions on specific populations, and used to provide recommendations for projects aimed at improving access, storage, treatment and addressing health considerations in projects implemented. All instances of re-categorization are indicated in the results. Responses were also cross-referenced by parish in some instances to determine accuracy of information, and/or pin-point areas of vulnerability and need for targeted intervention. Survey questions 12, 13, 19 and 20 were not included in this analysis due to low response numbers, and/or a lack of clarity of respondents to question framing, and the researcher's confidence in subsequent responses.

Statistical software package IBM SPSS (version 23) was used to analyze the data for statistical significant differences. For each survey question (except 17, 18 and 24) a Pearson Chi-Square Test of Independence was performed to determine statistical significance of responses by gender within the sample population. The Chi-Square Test computed expected frequencies for the survey response categories and compared them with the recorded frequencies, disaggregated by gender to identify statistical significant differences in how men and women responded to specific questions. To determine significance of the Chi-Square results, the following criteria were applied: a p-value > 0.05 is not significant and a p-value < 0.05 is significant. A significant response indicates that there is an association between gender and the response observed. The Mean (ME) and Standard Error of the Mean (SE) were determined for ordinal data when available, to extrapolate the representativeness

of the mean survey response obtained for a question, to that of the expected mean response of the overall population of Barbados. This information was also disaggregated by gender. Use of the ME and SE as a test of population representativeness is subjective, but the rule of thumb used and applied in this analysis is as follows: if SE < ME result is representative, and if SE > ME, the result is not representative.

3.4 Focus Groups

Two (2) Semi-structured focus groups were conducted with management level BWA, and UWI EWN SCI project team members (see Table 3.3). These focus groups were conducted in Barbados during the period October 20–November 8, 2016.

For the 12 individuals who comprised the BWA focus group, an effort was made to maintain a 50:50 gender representation. Relevant questions posed to the specific groups solicited feedback on strategies that could be taken to increase climate resiliency of the utility, clarify knowledge gaps on the rationale for incorporation of gender perspectives/considerations in development of water infrastructure projects, and identify opportunities to improve the gender equity in distribution of benefits of proposed activities (see Appendix D).

Each focus group was facilitated by the author, and 2 additional researchers from the USF IRB approved team in a convenient, non-threatening location (i.e. conference rooms of the respective organizations). The researchers encouraged open and free discussion relevant to the themes, but also allowed the conversations to organically evolve in an effort to glean nuanced perspectives from the group. Finally, notes were taken during the process and summarized by the USF researchers to contribute to the context of the assessment and to add to recommendations for the utility.

Table 3.3: List of organizations and departments of the project partners that participated in the two (2) focus groups conducted during the period 10/20/16 to 11/8/16

Project Partner (No. persons in focus group)	**Organization's Name and Department**
Public Utility (12)	**Barbados Water Authority** Pipes Replacement Project Manager Water Quality Technician Safety and Health Officer Financial Controller General Manager of Utility Customer Service Supervisor Administrative Assistant Utility Board Members
Academia (4)	**University of the West Indies** Institute for Gender & Development Studies

3.5 Interviews

Eighteen (18) interviews were held during the period October 20–November 8, 2016 in Barbados and Trinidad and Tobago with representatives from key water and gender related agencies, and business sectors, to discuss issues related to management of water and wastewater resources across the island (see Table 3.4). Interviews ranged between 30 minutes and 2 hours. The interviews were anonymized and used to provide baseline data to broadly categorize the perspectives of the range of stakeholders. A list of the interview questions can be found in Appendix D.

Table 3.4: Organizational affiliations, titles, and representative sectors of the stakeholders interviewed during the period 10/20/16 to 11/8/16

Organizational Affiliation	**Title**	**Representative Sector**
Altman Realty	Executive Director	➢ Private ➢ Business, Housing Infrastructure
Barbados Water Authority	Customer Service Director	➢ Public Utility
Barbados Water Authority	Financial Controller	➢ Public Utility
Barbados Water Authority	Health and Safety Officer, Human Resource Manager	➢ Public Utility
Barbados Water Authority	Mechanical Engineer for Pumping/Reservoirs	➢ Public Utility
Caribbean Development Bank	Senior Operations Officer	➢ Development Agency
Caribbean Hotel Energy Efficiency Action Program	Director	➢ Tourism ➢ Energy

Table 3.4 continued

Organizational Affiliation	Title	Representative Sector
Caribbean Water and Wastewater Association	Utility CEOs, Government Ministers, Engineers and Technicians	➢ Public Utility ➢ Private Companies
Innotech	Facilities Manager for BWA Building	➢ Business Infrastructure
Environmental Protection Department	Director	➢ Regulation
RENTech	Executive Director	➢ Private ➢ Energy
Retired	Farm Owner	➢ Entrepreneur ➢ Agriculture
SIR Water Management Limited	Managing Director	➢ Entrepreneur ➢ Wastewater
Stantec Engineering Consulting Firm	Senior Engineering Consultant	➢ Private ➢ Wastewater ➢ Business, Infrastructure
Torque Engineering Procurement and Construction Management	Managing Director and Mechanical Engineer	➢ Entrepreneur
University of the West Indies-Chemistry Department	Faculty	➢ Education
University of the West Indies-Management Studies Department	Faculty and BWA Board Member	➢ Education ➢ Public Utility

The interviewees were identified based on their real or perceived expert knowledge on feasible and priority water sector projects, and/or roles as major influencers in the implementation of development projects that build climate resiliency. Lastly, perspectives on existence of gender issues/considerations for the implementation of the EWN-SCI and other proposed activities were explored. The information gathered was used to provide sector and context-specific recommendations about the portfolio of climate resilient projects the BWA can pursue, as well as potential partnerships that should be forged for successful project implementation.

3.6 Gender Impact Assessment

The proposed Energy-Water-Nutrient Nexus for Sustainable Coastal Infrastructure (EWN-SCI) was used to identify potential gender impacts associated with the construction and operation and management phases of the project. These gender impacts were

characterized as significant (S) or limited (L) based on proximity to and duration of exposure to the impact. Impacts with significant gender dimensions were mapped across the project life cycle of the individual EWN-SCI infrastructural components, and interventions for addressing these were proposed. The main infrastructural components of the EWN-SCI project that were analyzed for impacts are listed below:

1. Water Loss Reduction (WLR) program, including 20 km of pipeline rehabilitation.
2. 2.5 MW photovoltaic renewable energy production at the BWA's water supply facilities servicing both urban and rural populations of Barbados.
3. Wastewater reuse pilot site using effluent from centralized and decentralized systems.
4. Rainwater harvesting demonstration sites to increase water supply resilience at the household/building level.

CHAPTER 4: RESULTS AND DISCUSSION

This chapter presents results and discussion required to satisfy Objectives 1, 2 and 3 of this thesis. To answer Objective 1, results from the literature review on Barbados' population, socio-economic statistics, and national gender and climate change policies are used to determine the status and scope of institutional and legal commitments, to gender mainstreaming the development of water and wastewater climate adaptive infrastructure in Barbados. These results are presented and discussed in Section 4.1. To answer Objective 2, Section 4.2 characterizes the Barbados landscape for opportunities to integrate gender into the design and management of water and wastewater infrastructure. It first presents a gender profile of technical and leadership roles at the Barbados Water Authority, followed by an analysis of the social media information obtained, and then discusses the responses from the water user survey, focus groups and interviews. The chapter concludes with Section 4.3 – a gender impact assessment which describes potential gender impacts associated with the infrastructural components of the proposed EWN-SCI project. Using the EWN-SCI project as a model of future climate adaptive water and wastewater infrastructure projects in Barbados, opportunities to integrate solutions to the gender impacts identified and highlighted in the landscape characterization (Section 4.2) are discussed across the life cycle of the individual project components in response to Objective 3.

4.1 Demographics, Gender and Climate Change Legislative Profile

Barbados is classified as a developing country which has achieved a high human development index with a score of 0.75 (on a scale of 0 to 1) (UNDP 2015). This high ranking reflects long life expectancy, high levels of school enrollment and length of education, and high income per capita, all of which improved from 1980. Despite these rankings, prominent features of a 2010 Barbados Country Assessment of Living Conditions include the poor being associated with larger household sizes, more children 15 years and under, overcrowding in households, low human capital, low paying jobs and unemployment, female-headed households concentrated in both urban and rural areas and engagement in informal sector activity. Poorer households have few material assets with insecure tenure of property, and although there is universal secondary level education, few children are able to take advantage of such education because of their economic circumstances (SALISES 2012). Table 4.1 summarizes demographic statistics for Barbados.

Table 4.1: Key Population and Gender Statistical Indicators for Barbados

Indicator	Male	Female	Total	Year	Source
Population	136,629	148,015	284,644	2013	WB 2017
Human Development Index (HDI)			Rank 38 of 187 countries. 0.75	2015	UNDP 2015
Gender Development Index (GDI)			Rank 28 of 144 countries, 0.739	2014	World Economic Forum 2016
Life Expectancy	73 years	78 years		2012	WHO 2015
Literacy Rate	99.7%	99.7%		2012	BSS 2010
Participation rate (labor force as percentage of total adult population)	67.7	60.4	63.9	2014	BSS 2010
Wage Gap (average male wage 18.9% higher than average female wage)		71.1%		2004	World Economic Forum 2016
% poor households headed by females		62.2%			SALISES 2012
% non-poor households headed by females		47%			SALISES 2012

The 2010 Barbados Population and Housing Census included questionnaires from 226,193 persons representing 78,936 occupied households in 94,173 dwelling units. However, the total population for the 2010 Census (Table 4.2) was estimated at 277,821 and was derived by adjusting the tabulated population for non-enumerated persons and those persons living in institutions (2,513). For Barbados, there are 11,546 disabled persons, 57% of whom are female.

The ethnic groups present in Barbados by percentage are black (92.4%), white (2.7%), mixed (3.1%), East Indian (1.3%), other (0.2%), and unspecified (0.2%). The migration rate of Barbados is –0.3 migrants/1,000 people. While there is a small percentage of the population exiting the country, there are great shifts in some parish populations.

Table 4.2: Estimated resident population by parish and sex for Barbados (BSS 2010)

Parish	Sex		Total	% Projected Growth in 2040*
	Male	Female		
Barbados (country)	133018	144803	277821	
Christ Church	25624	28712	54336	44%
St. Andrew	2646	2493	5139	-4%
St. George	9603	10164	19767	8%
St. James	13272	15226	28498	31%
St. John	4099	4864	8963	-3%
St. Joseph	3279	3341	6620	-1%
St. Lucy	4718	5040	9758	2%
St. Michael	42694	45835	88529	-21%
St. Peter	5404	5896	11300	3%
St. Philip	14951	15711	30662	31%
St. Thomas	6728	7521	14249	11%

* Projected growth model based on parish data and completed by Burnside (2009)

Although there is evidence of considerable human development in Barbados, this has not translated into an associated high level of gender equality. The gender gap index developed by the World Economic Forum is a measure of gender equality. On this index, out

of 144 countries, Barbados ranks 28 with a score of 0.739 (0 = inequality, 1 = equality) (2016). According to the Barbados Country Gender Assessment (Allen and Maughan 2016), the measure shows near equality with respect to educational attainment and health and survival, with female achievement surpassing male achievement in education. In terms of economic opportunity, the attainment of women is assessed to be 80% that of men (0.791 in 2013), while in terms of political participation, it is 15% that of men (0.150 in 2013). The country assessment shows that the positions of women and men have hardly changed since 2006.

Water and wastewater treatment usually fall under the field of Civil and Environmental Engineering. In the Caribbean, the main training institutions with this program are the University of the West Indies St. Augustine Campus in Trinidad and Tobago, the University of Technology in Jamaica, and the University of Guyana. Figure 4.1 shows total enrollment data for the overall engineering program at UWI. The percentages of females has remained constant over nearly a decade with ~30% and ~45% enrollment between 2006 and 2014 for undergraduate and graduate engineering programs respectively. This is significantly different from the overall UWI enrollment, which showed the proportion of females to males was 68.5% to 31.5% for total University enrollment, with the St Augustine campus having 63% female enrollment for 2013/2014.

Faculties of Science & Technology exist at all three campuses, including Cave Hill, and their average total female enrollment between 2006 and 2014 was 53% compared with 36% for the Faculty of Engineering (Figure 4.2). The Faculty of Science & Technology includes disciplines and research relevant to the EWN-SCI proposal like chemistry for water quality testing.

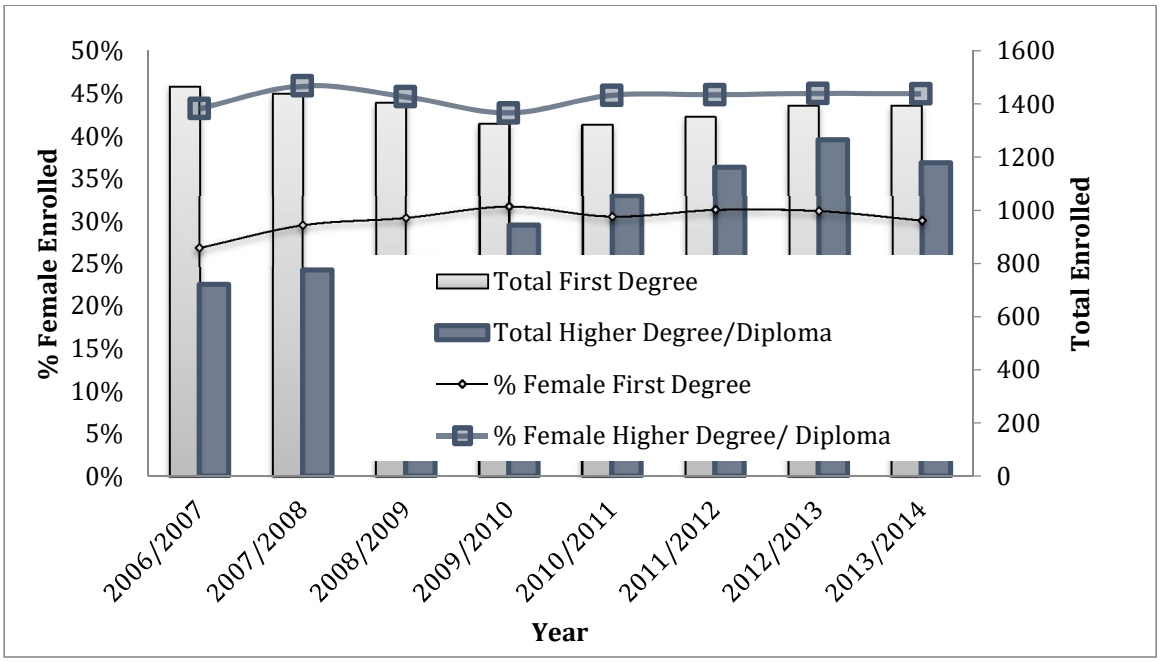

Figure 4.1: University of the West Indies (UWI) total enrollment in the Faculty of Engineering. Taken from UWI Vice Chancellor's Annual Reports 2006-2014.

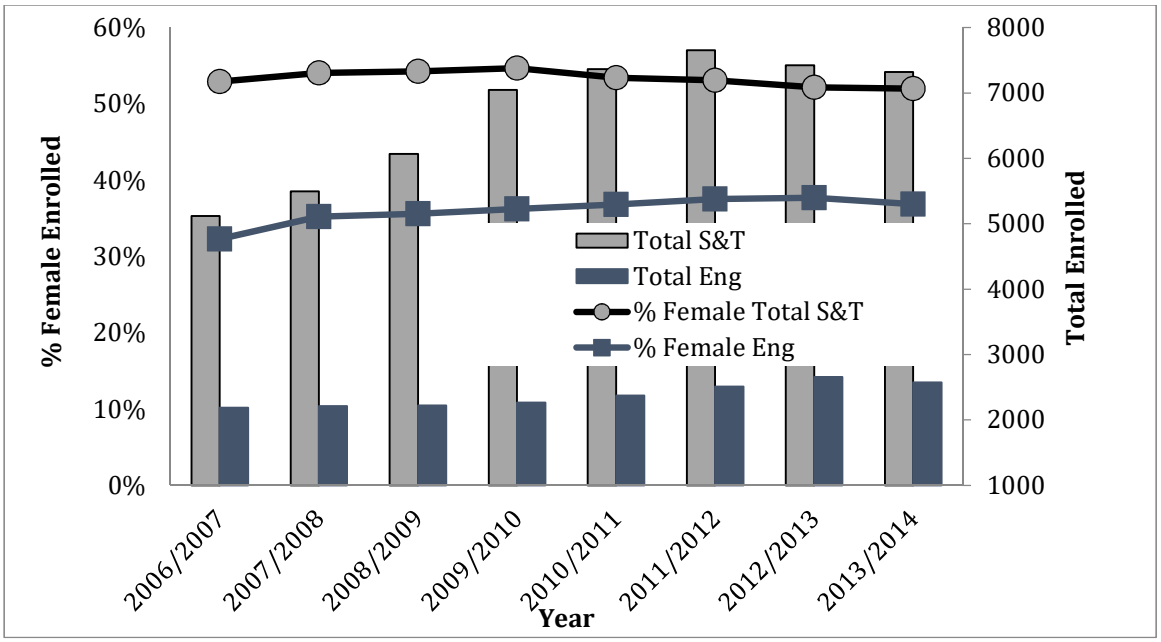

Figure 4.2: University of the West Indies (UWI) total enrollment in the Faculty of Engineering and Faculty of Science & Technology. Taken from UWI Vice Chancellor's Annual Reports 2006-2014.

The Barbados Bureau of Gender Affairs is responsible for the integration of gender in all national development policies and programs to achieve local gender equity and equality. A Draft National Policy on Gender has been formulated and is presently before parliament for consideration. Although the Draft Barbados Gender Policy has not been made public, from personal communication with one of its drafters we understand that the policy does not address gender and water.

Many Caribbean territories have national policies on women which are distinct from gender policies which address the needs of men and women (McFee 2014). As of July 2011 six (6) countries in the Anglophone Caribbean (Cayman Islands, Trinidad and Tobago, Dominica, British Virgin Islands, Jamaica, Bahamas, and Belize) had committed to drafting at least one national gender policy (McFee 2014). The time required for movement from a stage of drafting to implementation varies by territory, e.g. 4 years in the Cayman Islands and > 10 years in Trinidad and Tobago (McFee 2014). A review of key development areas that inform the process of consultation, formulation and presentation of national gender policies revealed that it did not explicitly include infrastructure or water in this checklist (McFee 2014). Jamaica has successfully integrated gender equality and equity concerns across and within most sectors of its state machinery. In its National Policy on Gender Equality, Jamaica identifies the Ministries of Health, Housing and Water as the responsible institutions to ensure to specific health and social needs of men/women are met e.g. access to safe water and sanitation, and equitable distribution of housing solutions, with an emphasis on rural women who are severely impacted on a daily basis (BWA & GAC 2010). The USF researchers proposed the creation of a Policy Paper on Gender and Water as an Action Plan item of the proposed EWN-SCI project.

The Government of Barbados approved a National Climate Change Policy in 2012. The country's Intended Nationally Determined Contribution (now known as NDC) as communicated to the United Nations Framework Convention on Climate Change in 2015, lists 6 national plans and strategies for which climate change adaptation would be incorporated (INDC 2015). These include:

1. Medium Term Growth and Development Strategy 2013–2020
2. Physical Development Plan
3. White Paper on the Development of Tourism in Barbados and National Adaptation Strategy to Address Climate Change in the Tourism Sector in Barbados
4. Coastal Zone Management Plan
5. Storm Water Management Plan
6. Other sectoral plans including for agriculture, fisheries, water and health

For these policies, it was also noted that efforts would be taken to incorporate gender and/or inclusion of perspectives of vulnerable groups. While gender issues are referred to in places in the documents relating to these developments, no strategies are articulated by which gender equity can be integrated beyond stating that vulnerable groups, variously listed to include women and young men, should be targeted and should participate in actions to address environmental threats and damage.

The Fair Trading Commission Act of 2002 established a Fair Trading Commission to safeguard consumer interests by determining principles, rates and standards of service for regulated service providers; monitor general business conduct, investigate possible breaches of the Acts administered by the FTC, and maintain effective competition in the economy (FTC 2016). The BWA is one of the three utilities monitored by the FTC. The FTC

held stakeholder consultations across Barbados on the BWA in June, July, and September of 2016 to solicit comments on the establishment of specific mandatory standards of service for the BWA, and the level of compensatory payment for failure to reach the designated targets (FTC 2016). The stakeholder feedback from these meetings can provide useful information to identify how the current management of water and wastewater resources of the BWA affects the conditions and opportunities of women and men. Summary content from these meetings found in Barbados Today online newspaper and video features is used to provide context for some of the survey responses (Barbados Today 2017).

The Barbados Water Authority doesn't currently have a gender policy to inform gender mainstreaming activities at the institution, or projects it pursues. In this instance, the utility can use some of the projects developed in other CARICOM countries and listed in Table 2.2 in the literature review, as a point of reference for knowledge on this area. Although the specific objectives of these projects, and the types and extent of gender mainstreaming activities proposed may differ from those required of the proposed BWA project, these projects can serve as a repertoire of baseline data, technical "know-how," lessons learnt and summary of best practices for the BWA. All of this information could enhance the BWA's capacity for incorporating gender throughout the project cycle. Awareness of the gender mainstreaming requirements of different funds reduces duplication of data collection efforts, facilitates streamlined/strategic gender data collection and management, which increases the project's robustness, and increases its opportunities for successful submission to multiple financing mechanisms.

Since the BWA is applying to the GCF for funding of the EWN-SCI proposal, the following water and energy management GCF approved (but no funding disbursed) projects

in SIDS will provide additional context on expectations of appropriate gender mainstreaming activities (e.g. % of project funds to be allocated to objectives pursuing gender equality, requirements to produce sex-disaggregated data as monitoring objectives) (GCF 2017).

1. Project FP007 Support of Vulnerable Communities in the Maldives to Manage Climate Change-Induced Water Shortages
2. Project FP008 Fiji Urban Water Supply and Wastewater Management Project
3. Project FP013 Improving the Resilience of Vulnerable Coastal Communities to Climate Change Related Impacts in Viet NamVietnam?
4. Project FP015 Tuvalu Coastal Adaptation Project
5. Project FP020 Sustainable Energy Facility for the Eastern Caribbean
6. Project FP035 Climate Information Services for Resilient Development in Vanuatu
7. Project FP036 Pacific Islands Renewable Energy Investment Program

4.2 Landscape Characterization for Gender Integration

4.2.1 Barbados Water Authority Employee Gender Profile

As of June 28, 2016 the Barbados Water Authority had in its employment 779 persons inclusive of 219 women (28.1%) and 560 men (71.9%). The workforce age ranged from 20–67 years with a mean age of 39 years. Table 4.3 provides a summary of descriptive statistics of the age of the BWA employees disaggregated by gender. Approximately half of the BWA employees (61 %) are aged 40-59 years, with the majority of men being 50-59 years (23%) and women 40-49 years (9.9%). Figure 4.3 provides age profile for the water utility disaggregated by gender.

Table 4.3: Descriptive statistics for the age of the Barbados Water Authority employees as of 6/28/16

	Descriptive Statistics					
	Population					
Factor	Population (N)	Minimum	Maximum	Mean	Standard Error of the Mean	Standard Deviation
Age (years)	779	20	67	39.97	0.382	10.67
	Gender					
Male	560	21	20	49.23	0.443	10.47
Female	219	20	67	44.72	0.443	10.51

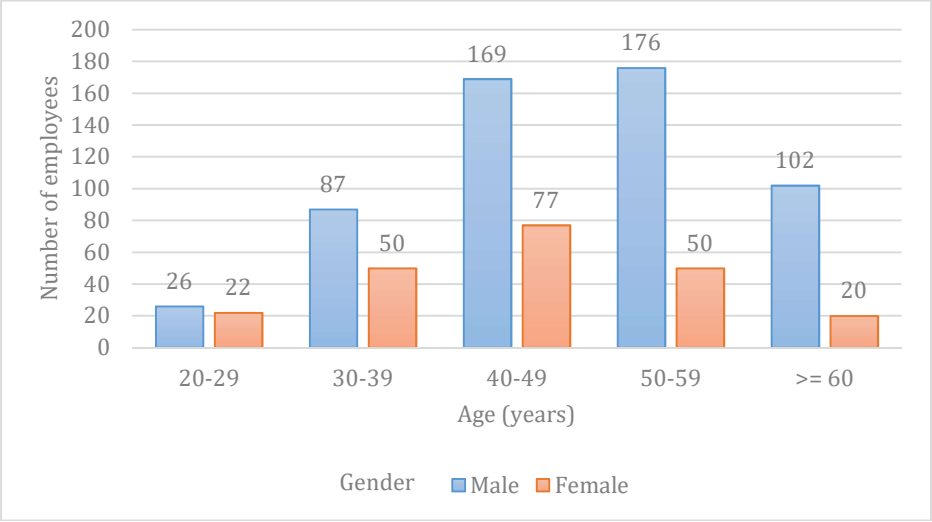

Figure 4.3: Barbados Water Authority employee age profile disaggregated by gender as of 6/28/16

The BWA staff are almost equally employed in technical (48.5%) and non-technical roles (51.5%), with technical being defined as all job titles related to project management, engineering, science, vocational, heavy equipment operation and field work activities of the utility, and non-technical referring to all other capacities. Men and women are almost evenly represented in non-technical roles (26.8% and 24.6% respectively), while there are significantly more men (45%) than women (3.5%) employed in technical roles (Table 4.5).

Table 4.4: Gender disaggregation of Technical and Non-Technical roles at the Barbados Water Authority as of 6/28/16

	Gender		
Role	Male	Female	Total
Non-Technical	209	192	401
Technical	351	27	378
Total	560	219	779

Employees with the requisite technical skills will be the most eligible, and first to benefit from potential jobs created by the EWN-SCI projects. From technical fields identified in Figure 4.4 below, the greatest disparity in employment is in the vocational area, 26.8% men to 0.8% women. Artisan electricians, fitters, masons, plumbers, welders, heavy equipment operators, sewage inspectors and workshop employees dominate the vocational category. The Barbados Vocational Training Board (BVTB) is one of the main vocational training institutions in the island, and data available for 2013 reported the male-female ratio of graduates as 62.7 to 37.3. This statistic was a meager improvement from 2003, where the male-female ratio of graduates was 66.6 to 33.4 (BML 2013). These national statistics can explain the BWA vocational category gender distribution, whose available labor pool is skewed in favor of men.

Although a small category (3%), Scientists was the only group in which women outnumbered men (2% to 1% respectively). This is not surprising, as the UWI statistics presented in section 4.1 and in Figure 4.2 show greater enrollment of women in the Faculty of Science and Technology than men. Also similar to UWI Faculty of Engineering statistics, there were more male (1.9%) than female (0.5%) engineers at the BWA.

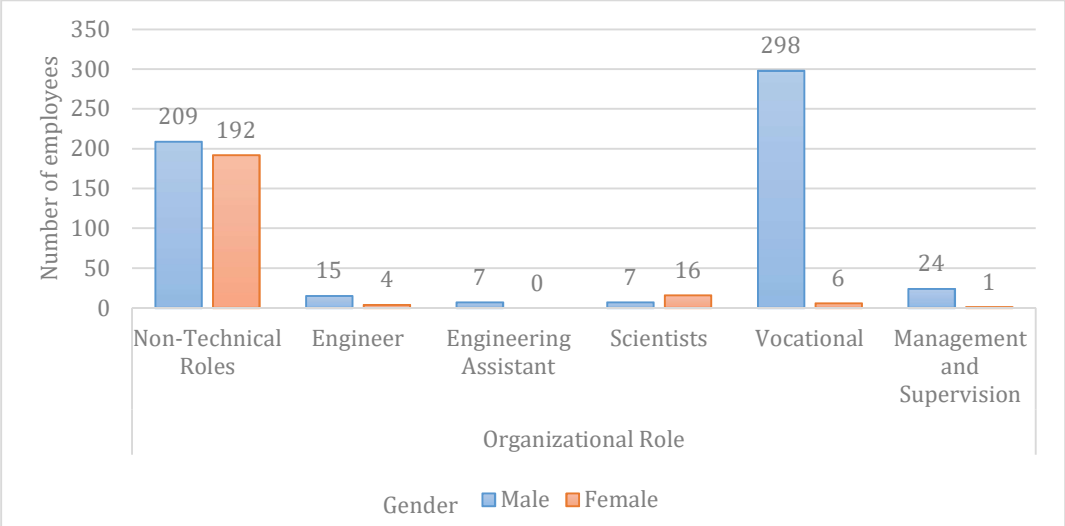

Figure 4.4: Gender disaggregation of technical and non-technical Barbados Water Authority employees as of 6/28/16

Similar to the technical roles, there was greater occupation by men than women in leadership and non-leadership roles. For the 101 leadership jobs identified (13% total jobs), 70.3% of them are occupied by men and 29.7% by women (see Table 4.6). In Colombia, an in-depth analysis of one water company revealed significant gender inequality in the workplace (Aqueduct and Sewage Management Office). From a total staff of 1,226 (988 men, 238 women), only 3 women held middle management positions, the majority performed administrative roles, women only received recognition if they obtained a graduate degree abroad or were very efficient relative to their counterparts, and plant operations activities only involved 7 women whose orders were resisted by men (Maharaj 2003).

Table 4.5: Gender disaggregation of Leadership and Non-Leadership roles at the Barbados Water Authority as of 6/28/16

	Gender		
Role	Male	Female	Total
Non-Leadership	489	189	678
Leadership	71	30	101
Total	560	219	779

Technical and leadership staff will make the greatest contribution to the design and management of projects pursued by the utility. The current gender distribution biases participation and benefit distribution which will accrue to those already present. Technical and leadership roles at the BWA place power and agency in decision making collectively with men. In spite of this, with the majority of persons in these roles aged > 40 years, and thus in the middle or nearing the end of their careers, there is an opportunity to recruit, train and promote new or existing employees to fill these roles (see Figure 4.5).

Gender quotas in political and corporate spheres have found that they do indeed increase female leadership for which the primary constraint is not a lack of interest (in Norway), and female leadership influences policy outcomes as gender differences in economic status and work responsibilities are considered (in India) (Pande and Ford 2011). Increased representation in both of these areas has not come at a cost of efficiency. Conversely, although in Guyana quota systems have increased the visibility and representation of women in politics, the distance between women and patriarchal norms and structures remains, as the quota system is grounded in a feminist framework and not a gendered one (Khan 2014).

Specifically in the water sector, in South Africa and the Dominican Republic (DR) legislation requiring at least 30% and 40% female participation in water policy and as water committee members respectively (Maharaj 2003). Although in the DR this legislative commitment to gender equity has experienced some success, in South Africa it did not guarantee meaningful participation of women in decision-making, since women were reluctant to voice their opinions in mixed groups due to cultural concerns (Maharaj 2003). Recruitment, training and promotion to fill more technical and leadership roles is just one

step that can increase the diversity of opinions available to balance stakeholder views on priorities for project design and management.

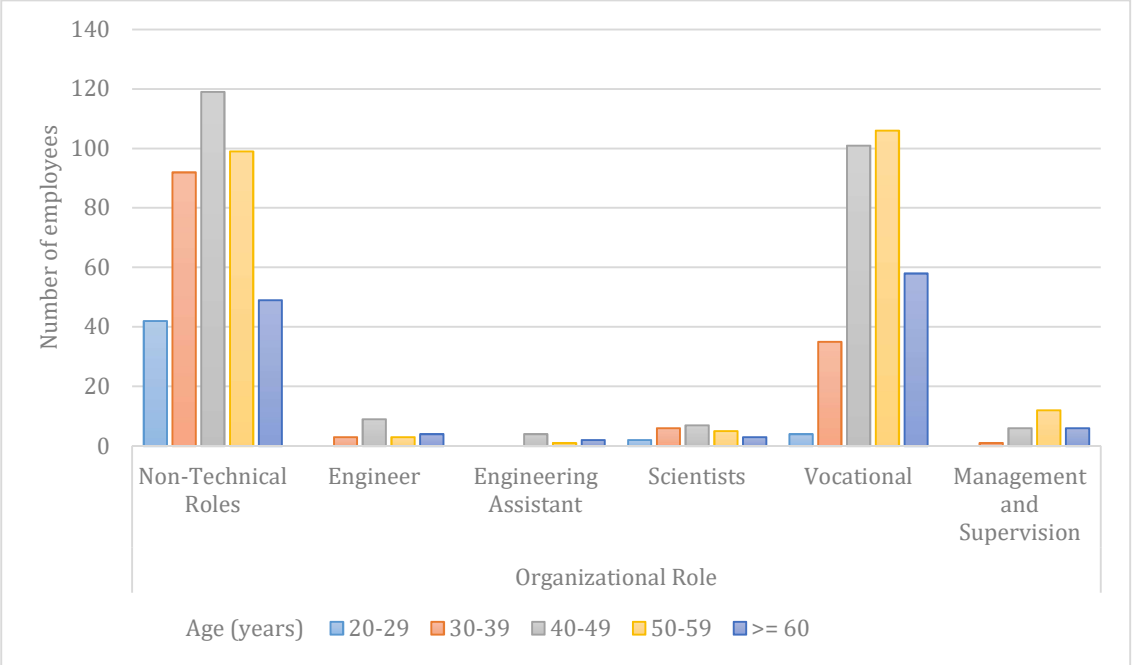

Figure 4.5: Age disaggregation of technical and non-technical roles at the Barbados Water Authority as of 6/28/16

4.2.2 Social Media Analysis

The search for key words "water" and "Barbados Water Authority" on Google Trends for the period 6/8/15-11/8/16 revealed related topics such as water scarcity, smart metering and bottle water. Table 4.7 highlights some of the related topics or phrases and the most frequent origin of these posts online by parish is summarized in Table 4.6. The related topics identified by Google Trends were used to refine the search parameters in IBM Watson Analytics for Social Media.

Table 4.6: Summary of topics by source parish that were dominant on Google Trends for Barbados for the period 6/8/15-11/8/16 based on search terms "water" and "Barbados Water Authority"

	Parish										
Topic	**Christ Church**	**St. Andrew**	**St. George**	**St. James**	**St. John**	**St. Joseph**	**St. Lucy**	**St. Michael**	**St. Peter**	**St. Philip**	**St. Thomas**
Water	X	-	-	-	-	-	-	-	X	X	X
Barbados Water Authority	X	-	-	-	-	-	-	X	-	-	-
Water Scarcity	-	-	-	-	-	-	-	X	-	-	-
Drainage	-	-	-	-	-	-	-	X	-	-	-
Desalination	-	-	-	-	-	-	-	X	-	-	-
Lead Poisoning	X	-	-	X	-		-	X	-	-	-
Smart Meter	X	-	-	-	-	-	-	X	X	-	-
Pressure	-	-	-	-	-	-	-	-	-	-	-
Bottle Water	-	-	-	-	-	-	-	X	-	-	-

Of the 8,699 documents reviewed in IBM Watson Analytics for Social Media, 59 documents (from the available/accessible 10% of Twitter posts) provided relevant context to perceptions on the quality of the management and services provided by the BWA. Facebook did not yield any useful information since the program is currently only Beta Testing access to 500 pages from Top 10 Business Industries. Therefore comments from individual's Facebook pages could not be accessed in this program.

For the period June 8, 2015–November 8, 2016, the search criterion "#bwa" produced 9640 mentions, but none of these were applicable to this study as they did not originate in Barbados, and the majority posts associated with this were attributed to Kevin Gates of the music record label Bread Winner's Association. The topics "Barbados Water Authority" and "water in Barbados" received a total of 50 and 9 mentions respectively on Twitter (Figure

4.6). When the filter "Author Country = Barbados" was applied, the number of mentions decreased to 21 and 1 respectively.

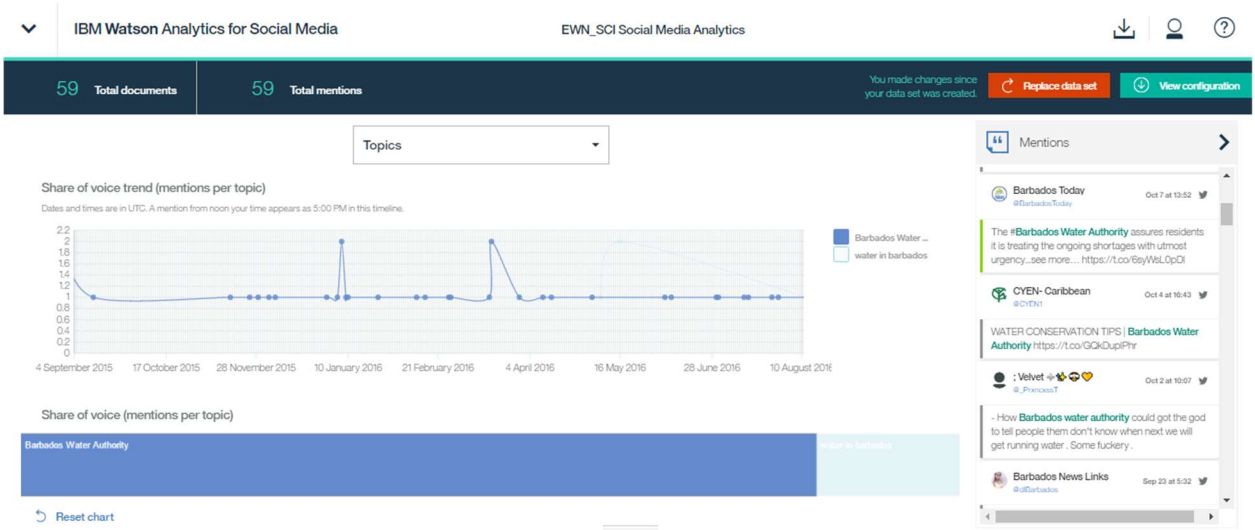

Figure 4.6: Count of Twitter mentions related to search criteria "Barbados Water Authority" and "water in Barbados" in IBM Watson Analytics for Social Media for the period 6/8/15-11/8/16

The Sentiments tool of the Social Media Analytics programs categorizes mentions as positive, neutral, ambivalent, and negative (Figure 4.7). Of the 59 mentions analyzed, 7, 1, 44 and 7 were categorized as positive, ambivalent, neutral and negative respectively. Closer inspection of the ambivalent categorization revealed that typos, use of dialect (vernacular) and sarcasm skewed the programs recognition and subsequent categorization of mentions as neutral instead of negative. For example, the mentions that stated "I don't understand why I pay Barbados Water Authority Barbados every month and EVERY DAMN DAY I wake up to no water," and "Barbados Water Authority need to get it together" were incorrectly categorized as neutral. Instead of negative

IBM Watson for Social Media Analysis also has the ability to disaggregate mentions by gender, marital and parental status (once this information is available) via its

Demographics tool. Disaggregation of the 59 mentions by gender is available is Figure 4.8. In this figure, it can be noted that when gender information was available, the majority of authors engaged in Twitter discourse on water management in Barbados were female.

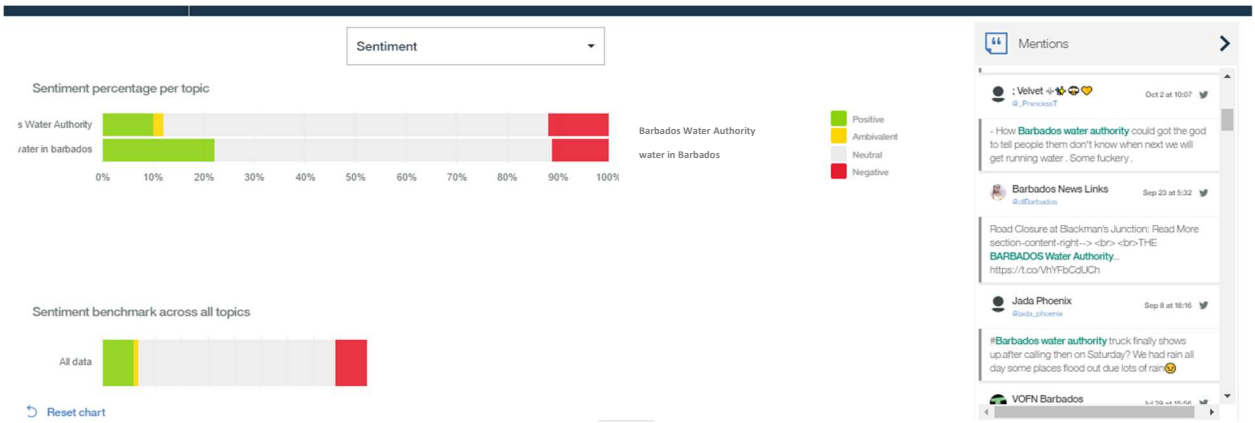

Figure 4.7: Sentiment percentage per topic for 59 mentions associated with the search criteria "Barbados Water Authority" and "water in Barbados" using IBM Watson for Social Media Analysis for the period 6/8/15-11/8/16

Google Trends and IBM Watson for Social Media Analysis are useful and inexpensive tools that can quickly identify key topics of discussion for a defined population. With reference to concerns about provision of water services in Barbados, the water authority can use this information to craft and tailor public and online announcements that directly provide answers to their constituents' concerns. For the period under review, many communities in Barbados were experiencing extended water interruptions in part due to burst mains, and a campaign to install smart water meters in the island resulted in economic burden and frustration for some persons whose water bills increased (by double in some instances) from pre-installation amounts. A proactive communication policy that leverages all avenues to engage with its stakeholders will boost confidence and trust of the utility and provide the greatest benefits

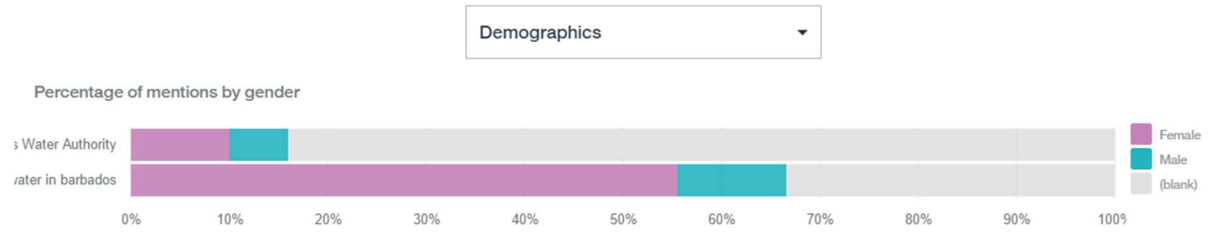

Figure 4.8: Gender disaggregation for 59 mentions associated with the search criteria "Barbados Water Authority" and "water in Barbados" using IBM Watson for Social Media Analysis for the period 6/8/15-11/8/16

There are 76.1 internet users per 100 people and 116 mobile cellular subscriptions per 100 people in Barbados (World Bank, 2016). The number of persons accessing information from the internet is relatively high. The BWA currently has a highly informative website; however, it is not linked with any social media sites. Facebook is by far the most common social media platform used in Barbados with the islands two major newspapers having the highest numbers, 157,758 for the Nation News and 143, 997 for Barbados Today respectively. By comparison, these two sites only have 11.3 and 10.8 thousand twitter followers respectively.

Over the past year, many communities in Barbados particularly in the parishes of St. Joseph and St. John have experienced extended water interruptions. As reported in different online and print media, some persons have not received running water in their taps for almost a year (Barbados Today 2017). These stories have been shared widely on social media and the term #BarbadosWaterCrisis has been used to describe this occurrence. Videos posted on the two newspaper Facebook Pages with the #BarbadosWaterCrisis revealed hundreds of comments providing feedback on issues raised by residents across the island. These posts highlight the gendered impacts of these interruptions and generate the

discourse on potential long term solutions that build community and sector climate resiliency.

Barbados has a 98% potable water coverage, so these interruptions are unprecedented, and many persons in the population were not prepared to respond to this situation. Groups such as Pledge Water Barbados and Weekend Water Warriors have emerged in the wake of this crisis and have taken the lead in providing relief to these communities in the form of bottled water delivery. The situation is exacerbated as persons lament the fact that they continue to receive a bill although they have not received water. There are many reports of women's inability to cook and subsequent diet substitution with dry foods, inability to wash and clean their households, and rash development on babies and young children. Reduced productivity at work due to stress from waking up at infrequent hours to gather water from standpipes when possible was another concern. Current BWA relief efforts including provision of community tanks and water trucks are viewed as inadequate particularly for the elderly, who may not have someone to collect water in receptacles for them, and working parents who may not be at home when these tanks are filled and subsequently emptied. Businesses such as hair salons and food places have also experienced economic burden as these sectors are highly water reliant.

Many persons criticize the BWA for their lack of communication, which prevents adequate planning of water related household duties by individuals, particularly women. Individuals also question the criteria used by the BWA to determine priority areas for mains replacement and other infrastructure maintenance projects, as it is perceived that relief is provided to richer before poorer areas. Some persons propose that the BWA provide

subsidies, or facilitate the expansion of rainwater harvesting at the household throughout the nation as part of a long-term solution to water interruptions and climate variability.

Informally, the BWA has already been responding on the ground to crises based on social media posts by customers; however, no formal engagement online exists. The Public Relations Unit of the BWA will support development and use of a comprehensive social media platform that truly engages with customers, tourists, and others. Climate vulnerability and limited resources in Barbados make EWN-SCI outputs learning lessons for the world, and media can be created that promotes the "reverse innovation" possibilities and showcases the interdisciplinary and proactive leadership of the BWA and its project partners.

4.2.3 Water User Survey

BWA's institutional goal is to be the most efficient, reliable, cost effective, and consumer-oriented utility contributing to the social and economic development of Barbados. Table 4.8 outlines the utility's strategic imperatives to achieve their goal. Each imperative either directly or indirectly impacts customers through service provisions and/or cost.

As the BWA engages its broad base of stakeholders, it employs various means of knowledge-sharing approaches, and information exchange opportunities. However, the mere creation of these approaches and opportunities does not necessarily mean that they are being deployed in a way that benefits the most vulnerable or diverse group of stakeholders. As such, this analysis will underscore the benefits of the current approaches that are working in BWA's favor, recommend ways to optimize these existing methods, propose new strategies to meaningfully engage with a broad swath of BWA stakeholders,

particularly those who have previously been underserved, and outline strategies to cater to different genders. Appendix E provides all the survey responses disaggregated by sex.

Table 4.7: List of Barbados Water Authority's strategic imperatives that impact their stakeholder involvement strategies (Barbados Water Authority Strategic Planning Document 2016)

BWA's strategic imperatives impacting stakeholders
Reduce non-revenue water
Increase customer awareness
Measure and improve service quality
Identify customer service needs
Enhance customer service delivery channels
Improve customer responsiveness
Strengthen service delivery through process re-engineering and ICT enablement
Enhance customer experience

The survey questions (previously provided in Table 3.1/Appendix C) will be analyzed and discussed around the themes of demographic information (Questions 1, 2, 3, 4), water access, use, and supply (Questions 5, 6, 25), water storage, treatment, quality and health (Questions 7, 8, 9, 10, 26, 27), water reuse practices and wastewater management (Questions 11, 14), stakeholder engagement (Questions 15, 16, 21, 22) and cost of water and wastewater services (Questions 17, 18, 23, 24). All results are disaggregated by gender (which are provided in Appendix E), and select questions are cross-referenced by parish. Pearson Chi-Square, Mean (ME) and Standard Error of the Mean (SE) statistical tests are used to discuss the significance of the results observed within the sample by gender, and as being representative of the overall Barbados population. Tables 4.9 and 4.10 present a summary of the Pearson Chi-Square and ME and SE results.

For the Pearson Chi-Square analyses, only Questions 2, 7 and 9 obtained statistical significant associations ($p \leq 0.05$) between gender and parish, types of water storage containers used and presence of mosquitoes in the storage containers respectively (Table 4.9). This would indicate that for each of these questions, the count of men or women who selected a particular response was either more or less than would be expected for this size study population. Possible explanations for these results are proposed in the discussion of the respective questions. For Questions 21-27 addressing themes of concerns when contacting BWA, opinions on stakeholder engagement with projects, reasonableness of cost of water and wastewater service, satisfaction with water supply and quality, impact of water quality negatively on health, each question obtained a result of SE < ME (Table 4.10). This would indicate that the mean responses observed in the sample population would also be expected to be reflective or representative of the expected mean response for the overall Barbados population.

As indicated by the social media analysis (Section 4.2.2) this survey was administered during unprecedented water shortages and interruptions, and these factors will be taken into consideration in the ensuing analysis and discussion. Additional potential confounders that might influence interpretation of the results, such as age and education factors, were considered in the discussion as permitted by available data. The following paragraphs discuss the demographic information captured in Questions 1 to 4 of the survey instrument. The average age of the survey respondents (Question 1) was 39.7 years old with a range from 18 to 84 years. Table 4.11 summarizes descriptive statistics of the age for the surveyed population by gender. Since the SE is less than the ME, the age distribution of the surveyed population is reflective of the overall population.

Table 4.8: Summary of Pearson Chi-Square test of independence results between gender and responses to the questions posed in the Water User Survey administered to customers of the Barbados Water Authority (BWA) between 10/20/16-11/8/16

Question		Statistics				Comparison with p-value	Results Significant?
No.	Summary	Population Size (N)	Pearson Chi-Square Statistic	Degrees of freedom (d.f.)	Probability		
1	Age	229	60.267	54	0.26	> 0.05	No
3	Parish	229	19.116	10	0.039	< 0.05	Yes
4	Education	229	5.743	7	0.57	> 0.05	No
5	Primary Drinking Water Source	229	4.492	5	0.481	> 0.05	No
6	Supplementary Drinking Water Sources	129	5.578	4	0.223	> 0.05	No
7	Types of Water Storage Containers	180	14.541	6	0.024	< 0.05	Yes
8	Water Storage Reasons	184	8.131	7	0.321	> 0.05	No
9	Mosquitoes in Storage Containers	192	10.698	2	0.005	< 0.05	Yes
10	Water Reuse Practices	229	7.29	4	0.121	> 0.05	No
11	Treat Primary Drinking Water Source	229	8.612	7	0.282	> 0.05	No
14	Septic Maintenance	229	13.997	8	0.082	> 0.05	No
15	Methods to the Contact BWA	229	7.84	6	0.25	> 0.05	No
16	BWA Methods to Inform the Public	229	15.142	10	0.127	> 0.05	No
17a	Cost of BWA Water Service	222	8.197	7	0.316	> 0.05	No
21	Concerns Addressed when BWA is contacted	156	0.938	2	0.626	> 0.05	No
22	Ability to contribute opinions to BWA Projects	211	0.689	3	0.876	> 0.05	No
23	Cost of Water Service Reasonable	205	2.371	4	0.668	> 0.05	No
24	Cost of Wastewater Service Reasonable	56	3.186	4	0.527	> 0.05	No
25	Satisfaction with BWA Water Supply	220	2.768	4	0.597	> 0.05	No
26	Satisfaction with Water Q-quality	219	0.651	4	0.957	> 0.05	No
27	Water Quality Negatively Impacts Health	202	3.118	4	0.538	> 0.05	No

Table 4.9: Mean (ME) and Standard Error of the Mean (SE) by Gender for N respondents to survey Questions 21 to 27. Questions 21 to 27 have themes of concerns when contacting BWA, opinions on stakeholder engagement with projects, reasonableness of cost of water and wastewater service, satisfaction with water supply and quality, impact of water quality negatively on health. N represents population size and SF represents data recoded for a 3-category Likert-scale.

Question			**Male**			**Female**		
No	Themes	N	ME	SE	Representative of the Population?	Mean	SE	Representative of the Population?
21	Concerns Addressed when BWA is contacted	156	1.81	0.10	Yes	1.95	0.11	Yes
21 SF		156	1.81	0.10	Yes	1.95	0.11	Yes
22	Ability to contribute opinions to BWA projects	211	1.69	0.08	Yes	1.64	0.07	Yes
22 SF		211	1.20	0.05	Yes	1.15	0.39	Yes
23	Cost of Water Service Reasonable	205	2.62	0.15	Yes	2.67	0.14	Yes
23 SF		205	1.74	0.09	Yes	1.71	0.09	Yes
24	Cost of Wastewater Service Reasonable	56	3.04	0.23	Yes	2.71	0.25	Yes
24 SF		56	2.00	0.15	Yes	1.82	0.17	Yes
25	Satisfaction with BWA Water Supply	220	2.39	0.14	Yes	2.34	0.12	Yes
25 SF		220	1.59	0.08	Yes	1.54	0.08	Yes
26	Satisfaction with Water Q-quality	219	2.19	0.12	Yes	2.29	0.12	Yes
26 SF		219	1.46	0.08	Yes	1.54	0.08	Yes
27	Water Quality Negatively Impacts Health	202	3.97	0.13	Yes	3.86	0.13	Yes
27 SF		202	2.56	0.08	Yes	2.44	0.08	Yes

Table 4.10: Descriptive statistics for Question 1 on the survey population age disaggregated by gender

	Descriptive Statistics					
	Population					
Question 1	N	Minimum	Maximum	Mean	Standard Error of Mean	Standard Deviation
What is your age?	229	18	84	39.97	0.961	14.549
	Gender					
Male	229	19	78	42.3	1.343	14.026
Female	229	18	84	37.86	1.346	14.748

The survey data broadly characterizes a representative sample of the population within each of Barbados' 11 parishes (Question 3). Christ Church and St. Michael were the most abundantly sampled parishes. 48% % of survey respondents were male and 52% of respondents were female. Although this is a fairly even distribution, a significant Chi-Square probability of 0.039 was obtained for the association between gender and parish. This means that either more men or women were likely sampled in a particular parish. Inspection of this distribution in Table 4.12 revealed a > 4% difference in sampling of men and women in the parishes of St. Michael (17.5% to 10.5%) and St. Philip (3.1% to 7.9%) which could be responsible for the significant result obtained. This information was considered in all other analyses disaggregated by parish.

Table 4.11: Survey responses for Question 3 on the parish of respondents disaggregated by gender

		Parish											
Gender		St. Andrew	Christ Church	St. George	St. James	St. John	St. Joseph	St. Lucy	St. Michael	St. Peter	St. Philip	St. Thomas	Total
Male	Count	1	18	12	15	5	2	4	40	3	7	2	109
	% of Total	0.4%	7.9%	5.2%	6.6%	2.2%	0.9%	1.7%	17.5%	1.3%	3.1%	0.9%	47.6%
Female	Count	3	24	11	15	2	3	3	24	6	18	11	120
	% of Total	1.3%	10.5%	4.8%	6.6%	0.9%	1.3%	1.3%	10.5%	2.6%	7.9%	4.8%	52.4%
	Count	4	42	23	30	7	5	7	64	9	25	13	229
	% of Total	1.7%	18.3%	10.0%	13.1%	3.1%	2.2%	3.1%	27.9%	3.9%	10.9%	5.7%	100.0%

Figure 4.9 shows the parish of the survey respondents disaggregated by the highest level of education they have achieved (Question 4). The first important feature that can be gleaned from this graph is the number of individuals holding a Bachelor's

Degree - 32% is the highest percentage from the entire sample. Following this, 25% and 16% of survey respondents have finished secondary school and have an associate's degree, respectively. The sample population from St. Andrew's parish is the only one where an individual with tertiary education was not included in the survey. The minor bias reflected in the educational level of the survey population can be attributed to the use of the referral sampling methodology.

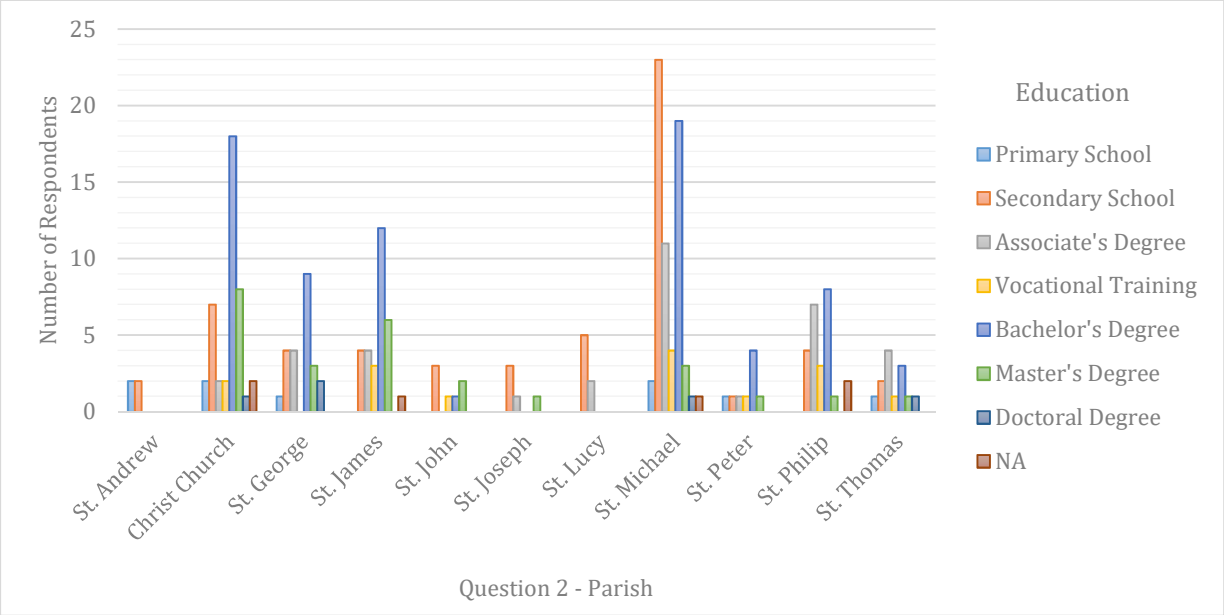

Figure 4.9: Survey responses to Question 3 on parish or respondents disaggregated by highest level of education achieved

Figure 4.10 further separates the educational parameter by gender to reveal that the top three educational levels of the respondents (i.e. bachelor's degree, secondary school, and associate's degree) have more female representation than male. Such is also the case for vocational training and primary school education. Broadly speaking, this is consistent with national statistics that show females, on average, attend school for longer than their male counterparts, 17 years for females as compared to 14 years for males (BSS 2010). However,

when considering the two highest educational levels, doctoral and master's degrees, there are almost double the number of men represented (i.e. 20 males and 11 females). This is consistent with UWI demographic data for engineering, and could reflect the referrals approach used for surveys, given that the survey team and partners had high university faculty representation

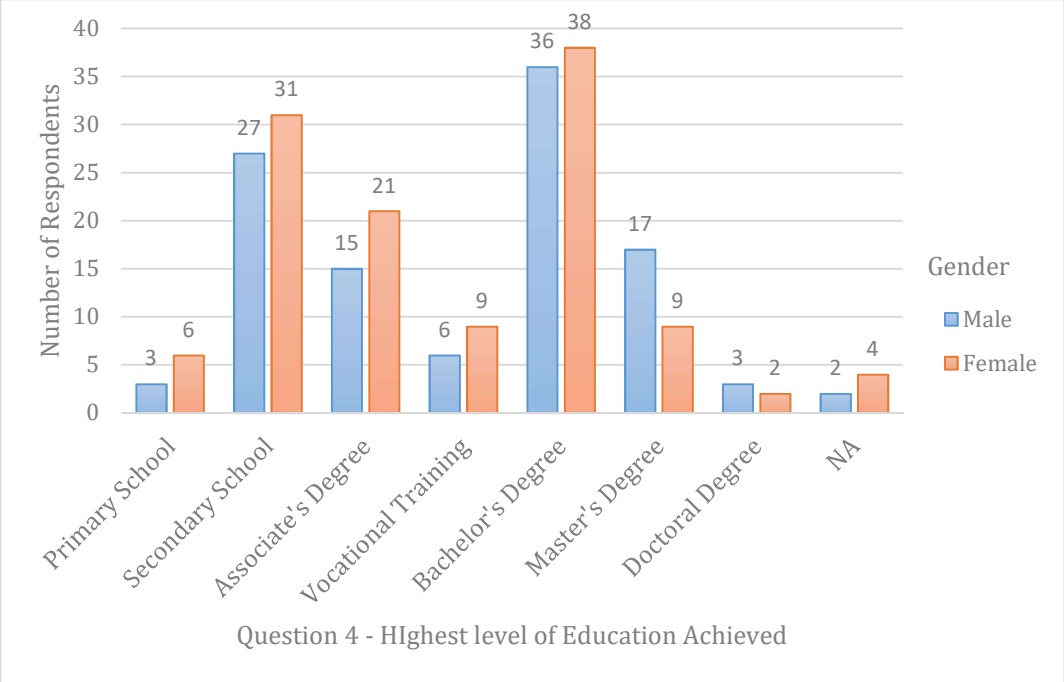

Figure 4.10: Survey responses to Question 4 on highest level of education achieved disaggregated by gender

Questions 5, 6 and 25 which discuss water use access, use and satisfaction with the supply system are discussed in the following paragraphs. Questions 5 and 6 addressed the primary and supplementary sources of drinking water accessed and used by the respondents. Figure 4.11 shows that the primary source of drinking water for the majority of the respondents is the tap in their house (90.8%). This observation is consistent with the national statistic of 98% potable water coverage. The second most common source of primary drinking water, bottled water (7.4%) was also the most cited supplementary source

(48%). The heavy reliance on piped infrastructure for the source of potable water (indicative of 43% respondents citing they have no supplementary source of drinking water) demonstrates the cultural expectation of and need for limited interruptions in supply from the water utility (Figure 4.12). There was no association between gender and any of the survey responses to source of primary drinking water (N=229, p=0.481) and use of a supplemental source of drinking water (N=129, p=0.223). With reference to the use of a supplemental source by parish there was also no association observed between gender response and primary source of drinking water used (N=129, Pearson Chi-Square = 48.797, p=0.160, d.f.= 4).

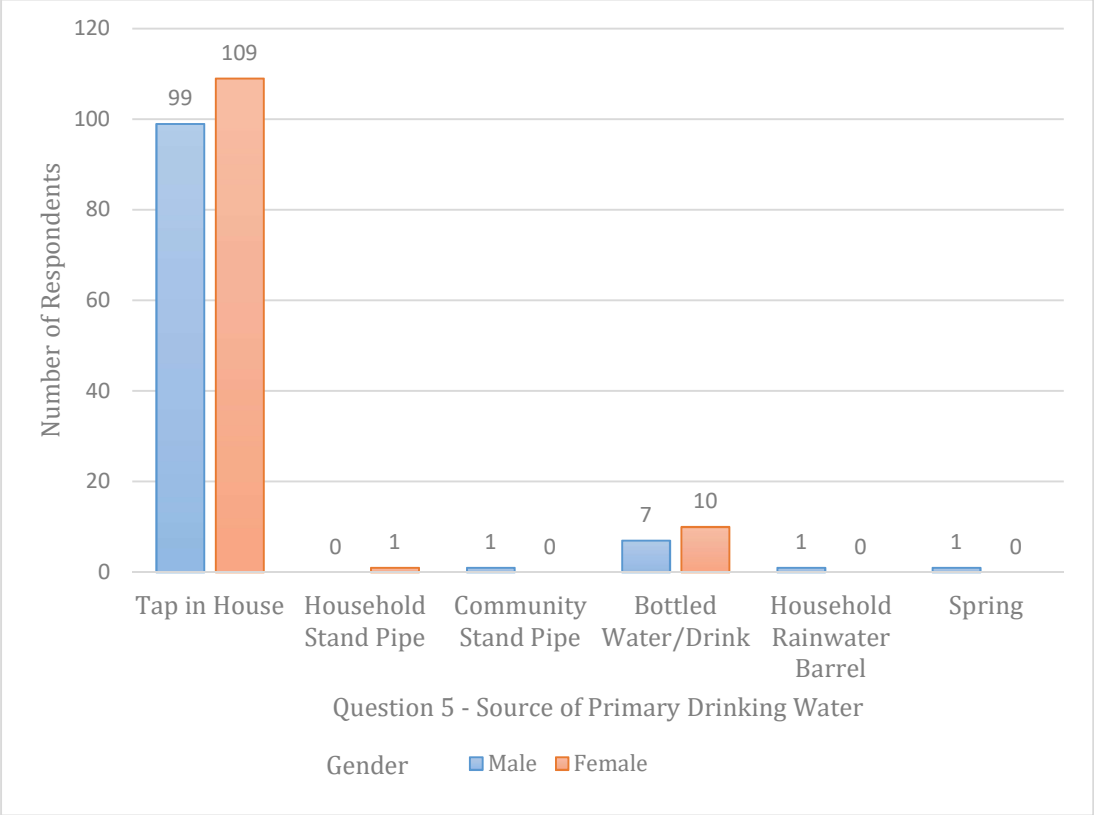

Figure 4.11: Survey responses to Question 5 on primary source of drinking water disaggregated by gender

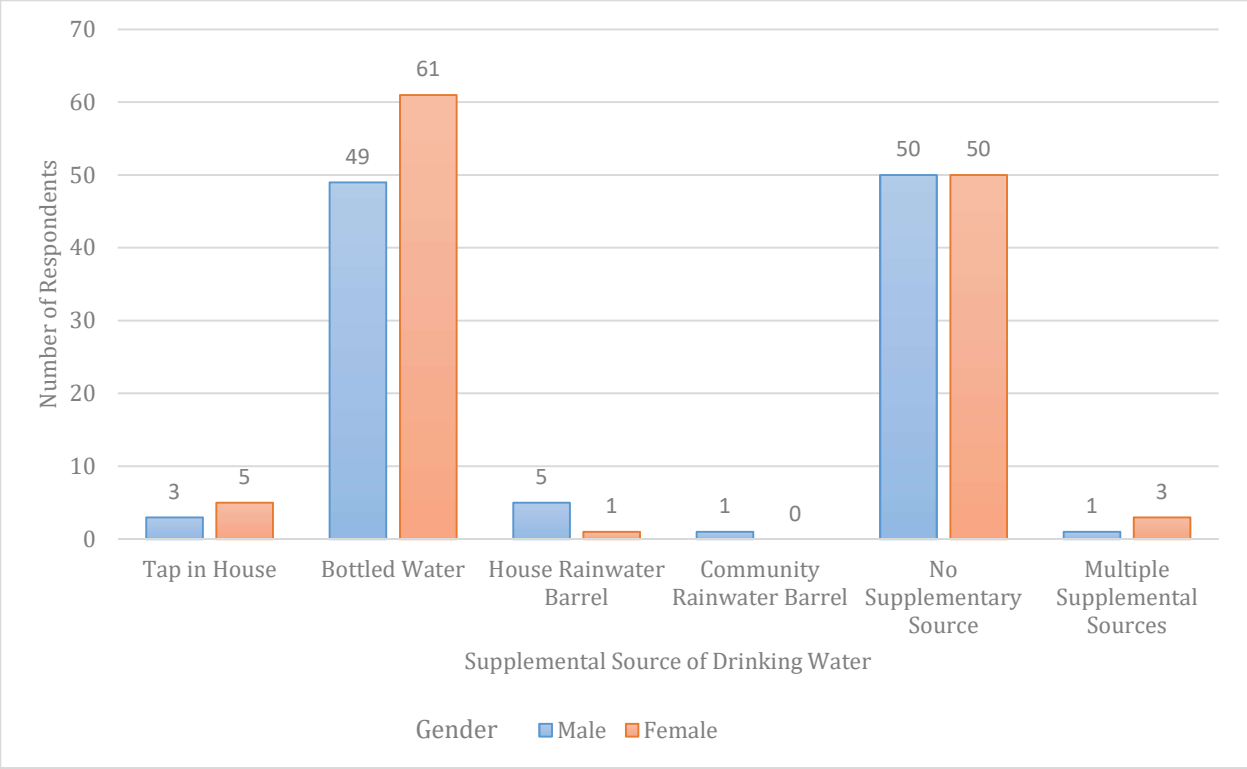

Figure 4.12: Survey responses to Question 6 on supplemental drinking water sources disaggregated by gender

64.6% of the survey respondents indicated that they agreed or strongly agreed with the statement "Overall my household is satisfied with the BWA water supply system (Question 25). Smaller percentages of respondents disagreed or strongly disagreed (22.7%) or were indifferent or neutral (8.7%) to this statement (Figure 4.13). The ME and SE for males (2.39, 0.14) and for females (2.34, 0.12) for Question 25 indicate that "agree" can be representative of the average sentiment of the Barbadian population. Since the Likert scale ranges from 1 to 5 progressing from strongly agree andto? strongly disagree respectively, a score of 2.34-2.39 would provide a mean of agree as being representative of the Barbadian population to this question. The Chi-Square test of independence also noted that there is no significant association between gender and satisfaction with the water supply system (N=220, p=0.811).

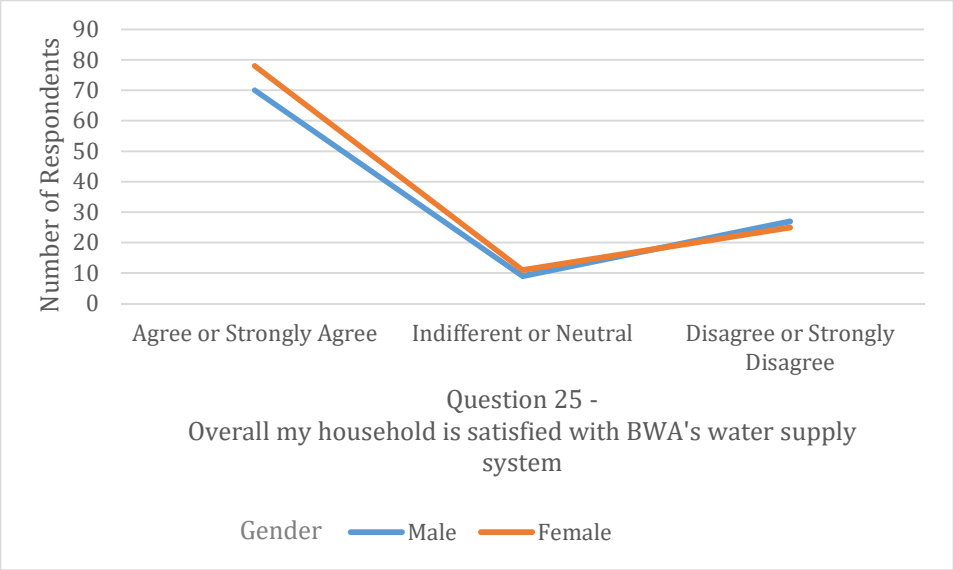

Figure 4.13: Survey responses to Question 25 on household satisfaction with the Barbados Water Authority's water supply system disaggregated by gender

Survey questions 7,8,9,10,11 and 26 addressing issues of water storage, treatment and quality are discussed in the following paragraphs. In spite of access to piped infrastructure, many respondents (78.6%) were in the habit of storing water at the household level as indicated in responses? to Question 7 (Figure 4.14). Of this group, more women (43.7%) than men (34.9 %) reported that they stored water. The three (3) most common responses to type of storage receptacle were buckets (25.8%), multiple containers (22.3% comprising mainly buckets, plastic bottles, and plastic tanks. and barrels in order of decreasing frequency), and plastic tanks (15.3%). The Chi-Square test (N=180, p=0.024) revealed a significant association between gender and choice of storage container used. Women were more likely to use small receptacles (buckets and plastic bottles), while men would cite larger receptacles (plastic tanks and barrels) as storage containers. Disaggregation of types of storage containers used by parish revealed no significant association (N=180, Pearson Chi-Square=53.658, d.f=60, p=0.705).

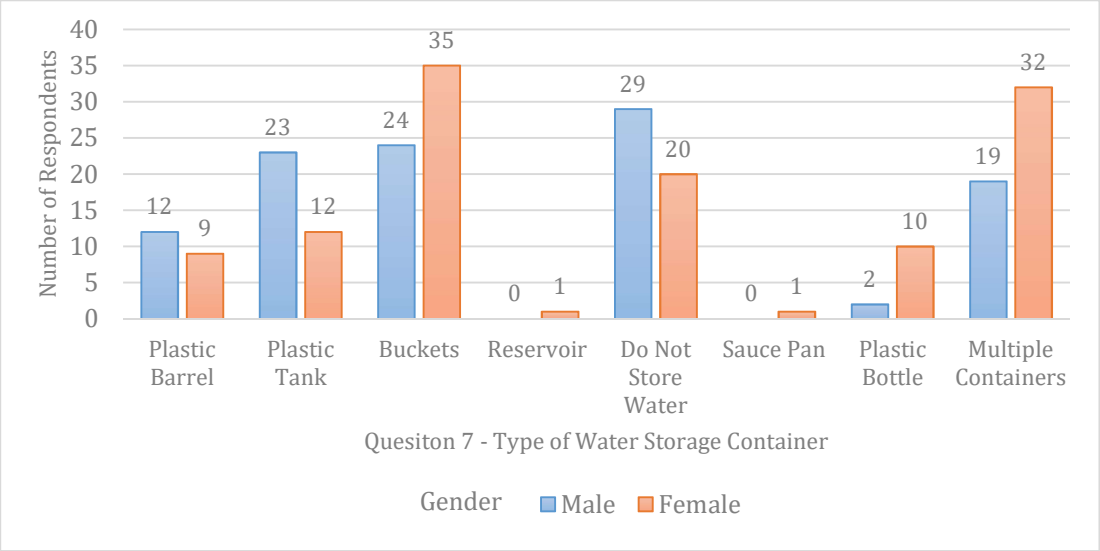

Figure 4.14: Survey responses to Question 7 on type of container used to store water at the household disaggregated by gender

With a projected drier climate in the Caribbean (UNEP 2010), expansion of rainwater harvesting (RWH) at the household level is a potential solution to build community resilience and safeguard from water interruptions from the BWA. The preference for use of plastic tanks and barrels by men could indicate an easier adoption and maintenance of RWH systems that use these larger receptacles. Assistance of some kind (extension officers, grants, subsidies) to install these systems, or for redesign of the RWH system to include preferences by women and ensure its affordability may be specifically needed to ensure both groups benefit equally from such an intervention. Affordability of design is very important as many households have to rely on their relatives in Diaspora to provide monetary support that will cover costs for household infrastructure upgrades (Trotz 2008). For example one custodian from the parish of St. Lucy indicated that her family who lived overseas paid for a water storage system for her that is on a platform with a pump. The initial installation of this system was at a cost of approximately $2,000, she incurs a recurring cost for purchase of filters. She does not mind this additional cost as she grew up going to a plantation property to go to a

well to get water, and is thankful for the BWA piped water today. The Government of Barbados has had success in the past distributing inflatable water storage containers that are smaller than the plastic tanks and barrels, and can be considered in the approach of increasing storage capacity at the household level.

The two (2) main reasons reported for water storage at the household level were "Multiple Concerns" (32.8%) and "as a back-up during interruption from BWA" (28.4%) (Figure 4.15). In order of decreasing frequency, the category Multiple Concerns (32.8%) included "as a back-up during interruption from BWA", "for household convenience", "in case of natural disaster" and "as water source in dry season". One respondent from Bathsheba in the parish of St. John indicated that she stores 37 buckets of water at home since water coming through her tap has been infrequent in previous months. One study in Barbados found that women spend more than on average than men storing water at the household level for domestic activities (Suchorski 2009). There was no association between gender and the water storage reasons provided (N=184, p=0.231).

Barbados is one of many Caribbean territories that have experienced outbreaks of Dengue, Chikungunya and Zika virus, all carried by the *Aedes aegypti* mosquito within the last 5 years (Roth et al. 2014). Since women are the primary care-givers at home they have the responsibility and burden of caring for those (elderly and children) affected by diseases (UNDP 2009, Maharaj 2003).The *Aedes aegypti* mosquito is usually found around the household and usually breeds in water receptacles to complete its lifecycle (Chadee et al. 1998). All mosquitoes need a source of water to complete their lifecycle.

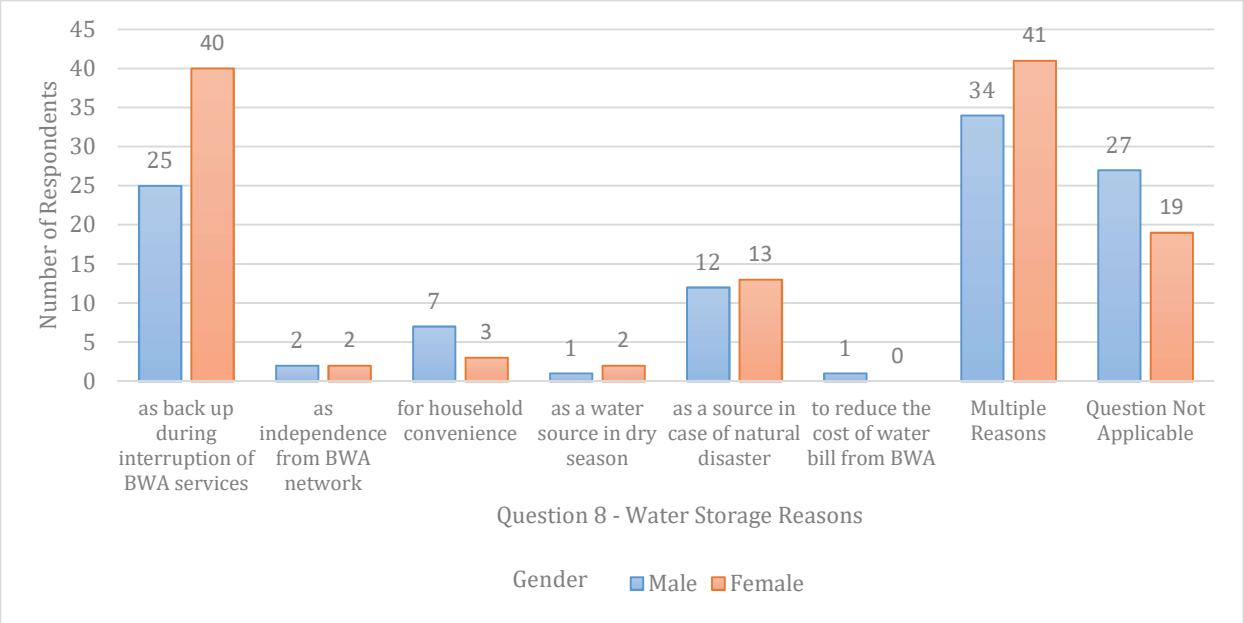

Figure 4.15: Survey responses to Question 8 on water storage reasons disaggregated by gender

Although many of the respondents (74.2%) did not notice mosquitoes in the water storage containers (Question 9), the potential for mosquito breeding is always a threat and concern for public health (Figure 4.16). The absence of some mosquitoes is possibly explained by the prevailing drought conditions. With reference to gender and reported absence/presence of mosquitoes, a significant association (N=192, p=0.005) was observed with women either more likely to report seeing mosquitoes or unable to check storage containers. Figure 4.16 summarizes responses received to Question 9.

The tests for statistical significance of independence by gender for Questions 7, 8 and 9 were reported for sample sizes N=180, 184 and 192 respectively. All of these questions were based on whether the respondent stored water at the household, and therefore N for the Pearson Chi-Square test should have been the same for each question. The differences in N observed can possibly be explained by a fluid and varied definition of storage as temporary vs longer term as perceived by the respondents. Subconscious differences in definition may

make one question seem applicable and another inapplicable. Due to this ambiguity, the significant association observed cannot be confirmed.

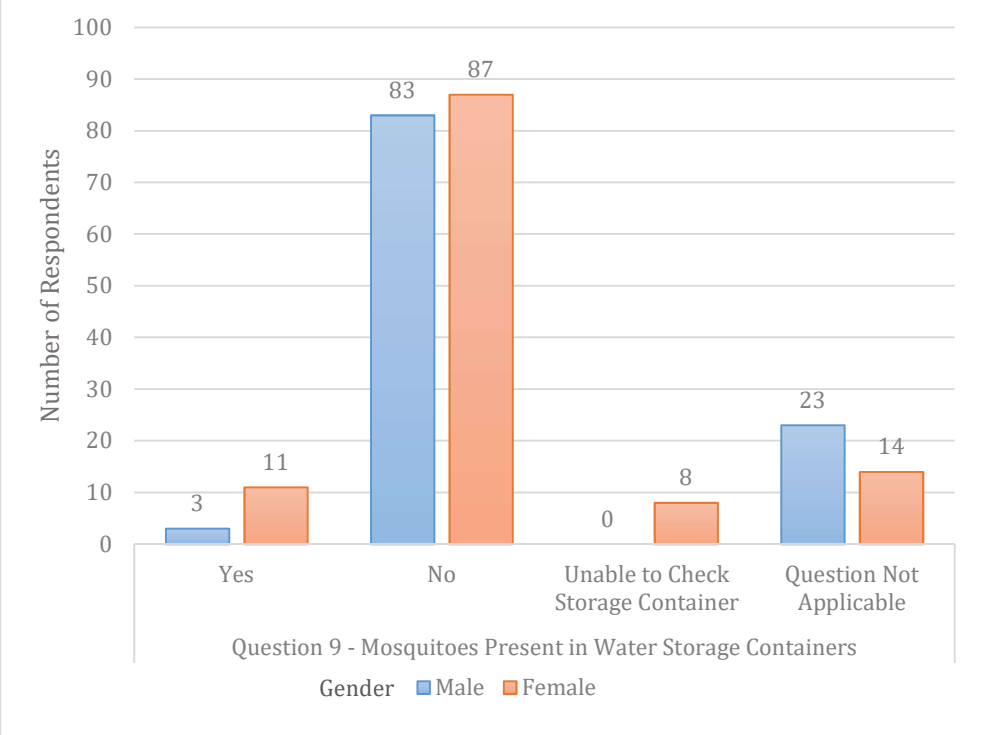

Figure 4.16: Survey responses to Question 9 on visibility of mosquitoes in water storage containers disaggregated by gender

Reuse of water at the household level for different purposes and from varied sources (Question 10) was not a common practice by the survey respondents (71.6%). A statistical significant association between gender and water reuse practices reported was not observed (N=229, p=0.121). Figure 4.17 summarizes the water reuse practices reported in the survey.

Roughly half of the survey respondents (51.5%) reported that they administered treatment of some form to their primary drinking water source (Question 11). Looking at Figure 4.18, it can be seen that use of a household filter (21.4%) and boiling (17.9%) were the most common water treatment practices observed. In instances where water treatment was observed respondents indicated the water was being used for children. Additionally,

there was no significant association between gender and the responses obtained (N=229, p=0.282). Water treatment or lack thereof (48.5%) can be indicative of perceptions of and satisfaction with the water quality received.

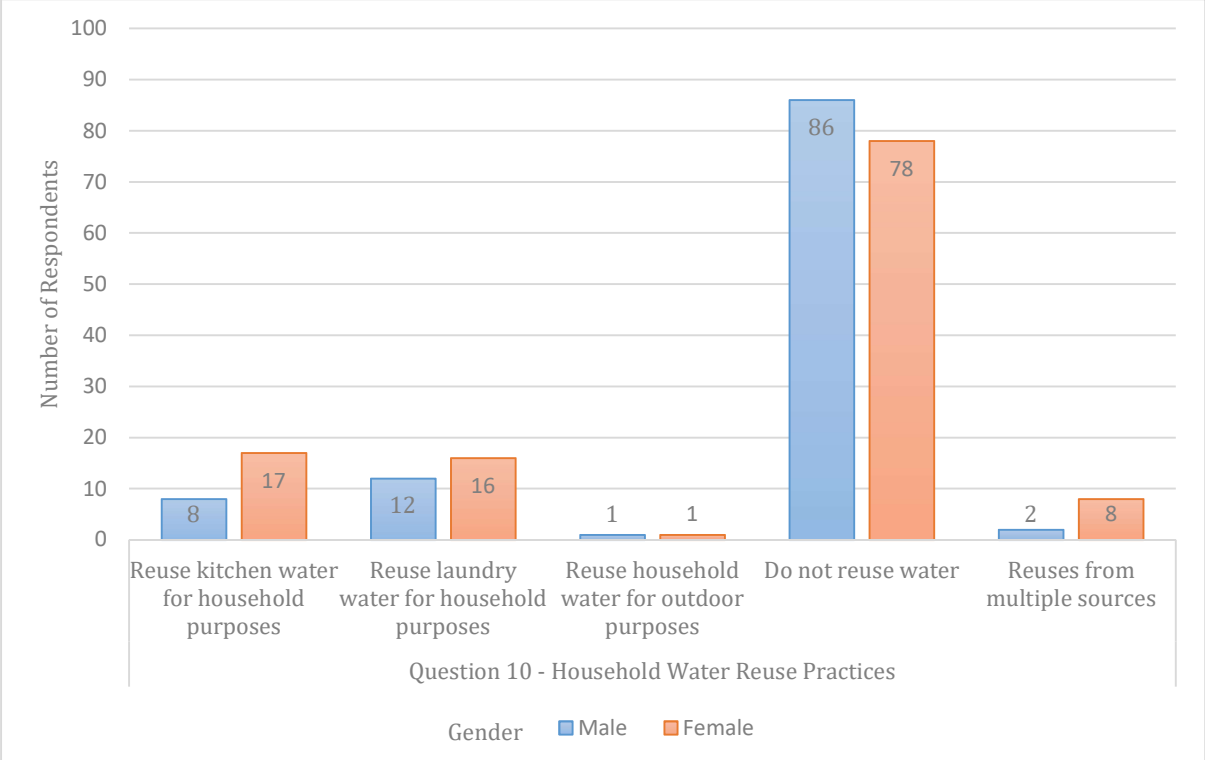

Figure 4.17: Survey responses to Question 10 – Water Reuse Practices disaggregated by gender

Responses to the Likert Scale Question 26 (Overall my household is satisfied with BWA's water quality) directly addresses this point. The majority of respondents (66.4%) either agreed or strongly agreed that they were satisfied with the water quality provided by the BWA. A much smaller number of respondents (18.3% and 10.9%) either disagreed or strongly disagreed, and were indifferent or neutral, respectively about their satisfaction with the BWA water quality (Figure 4.19).

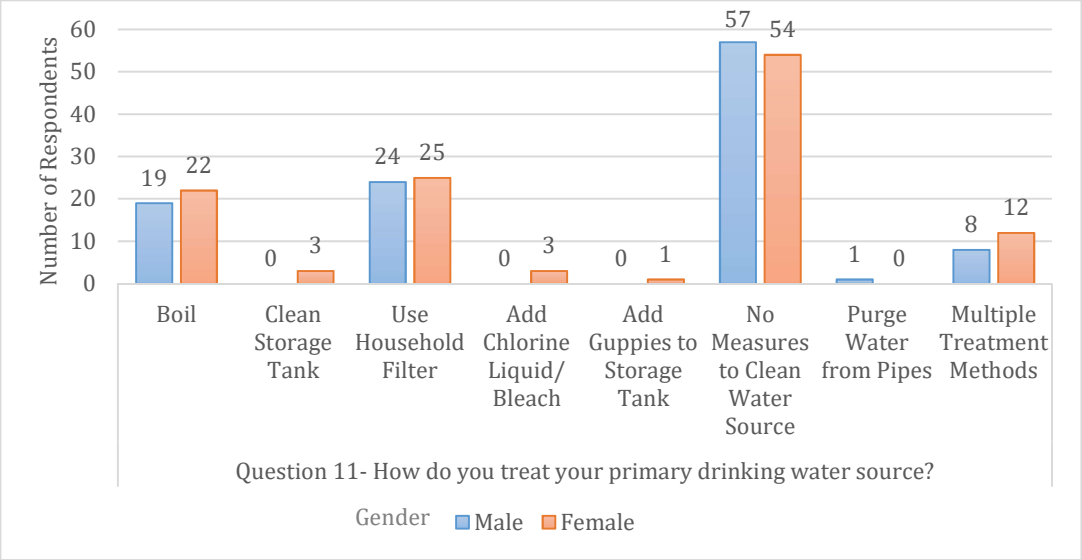

Figure 4.18: Survey responses to Question 11 on water reuse practices disaggregated by gender

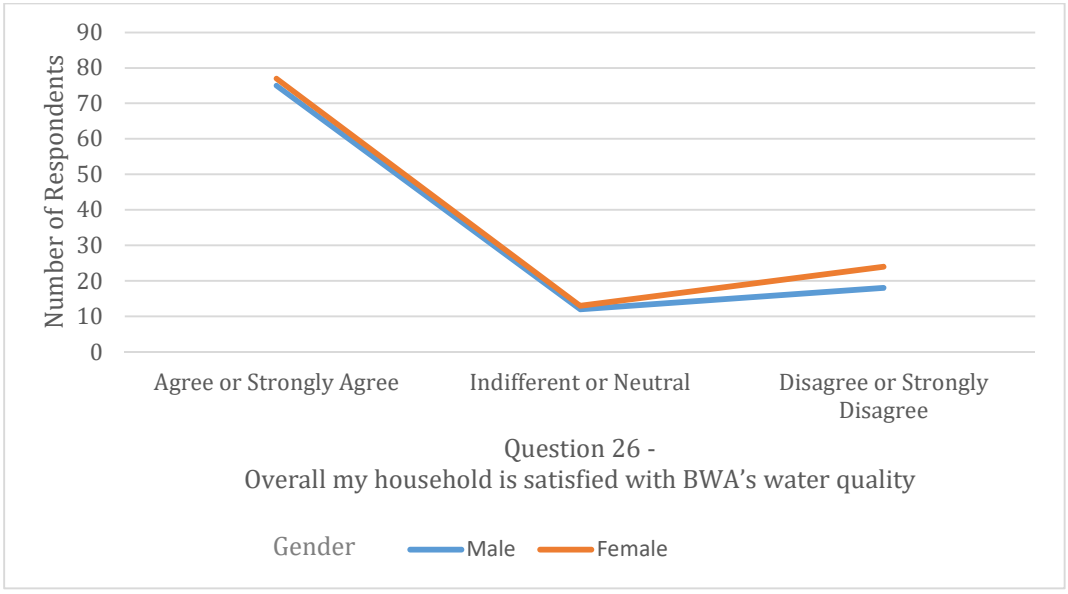

Figure 4.19: Survey response to Question 26 on household satisfaction with the water quality provided by the Barbados Water Authority (BWA) disaggregated by gender

Similar to Question 11, there was no significant association between gender and satisfaction with the BWA's water quality (N=219, p=0.758). The reported ME and SE (2.19, 0.12) for males and (2.29, 0.12) for females for Question 26 indicate that mean response for the Barbados population to this question would be agree (2.19-2.29 on the 5 point Likert

Scale). Most Barbadians are satisfied with the BWA's water quality. Qualitative information obtained during data collection indicates that persons primarily treat the water by boiling for use in tea and for use by babies. The use of softeners was to correct for taste, which was often attributed to the limestone in the water. A small number of respondents reported an infrequent need to purge the pipe due to increased sediment loads observed after a repair in the pipe distribution network.

For most respondents, treatment of the water does not appear to be for health reasons. In response to Question 27 – "I am concerned that the BWA's water quality negatively affects the health of my household," the majority of respondents (61.6%) disagreed or strongly disagreed with the statement. Responses of agree or strongly agree and indifferent or neutral were 17.9 % and 8.7% respectively (Figure 4.20).

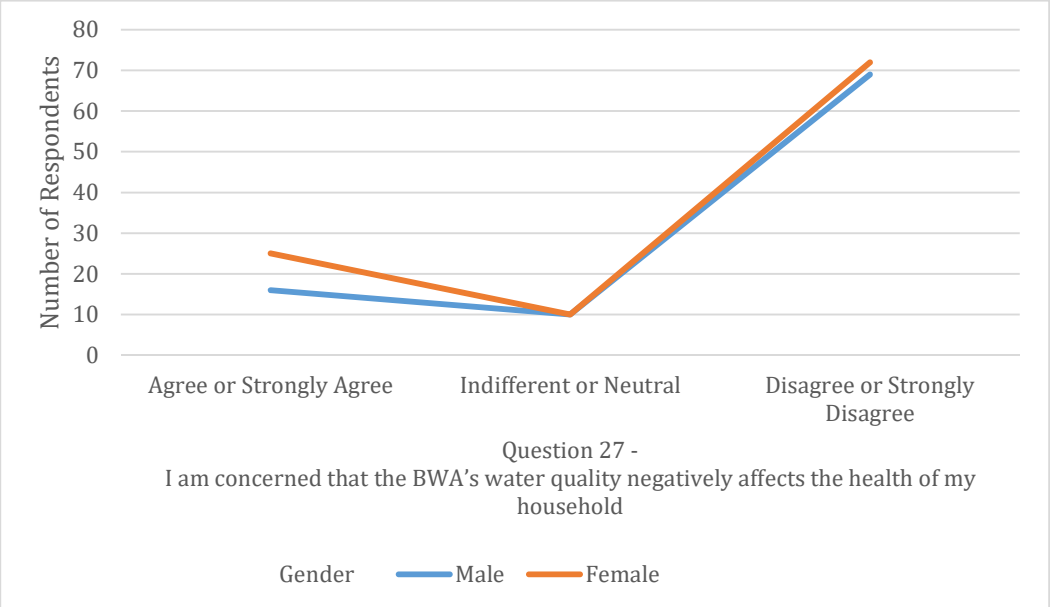

Figure 4.20: Survey responses to Question 27 on the negative impact of the Barbados Water Authority's water quality on health disaggregated by gender

Similarly, the reported ME and SE (3.97, 0.13) for males and (3.86, 0.13) for females for Question 27 would indicate a mean Barbados population sentiment of indifference or neutrality to disagreement with the statement "I am concerned that the BWA's water quality negatively affects my health" (3.86-3.97 on the 5 point Likert scale). The Chi-Square test of independence revealed no association between gender and perceptions of a negative impact of the water quality on health (N=202, p=0.538).

Knowledge gaps on the type of wastewater management services used were highlighted in Question 14 – "How do you maintain your septic system?" The distribution of responses to this question can be seen in Figure 4.21. 49.8% of respondents reported that they did not use a septic tank but instead used a suckwell. Further disaggregation of this information by parish revealed that 46.9% (53) of the suckwell responses were for the parishes of St. Michael and Christ Church. In Barbados only these 2 parishes are connected to the sewer, and it is possible that some of these responses are incorrectly attributed to use of a suckwell as it is mainly the tourist locations connected to the centralized wastewater treatment plants. An additional 17.9% of the respondents indicated that they did not know how their septic tank was maintained. Of those respondents indicating a connection to the sewer (9.2%), 3.9% or 9 responses incorrectly indicated this choice, given the parishes where they lived. Of those who reported having a septic tank, 15 % indicated that their septic tank was pumped regularly (5-7 years). No significant association between gender and septic maintenance activities was recorded (N=229. p=0.082).

Questions 15, 16, 21 and 22 address the status and potential for effective communication between the BWA and its stakeholders. In response to Question 15 -**.** "How do you contact BWA?" most persons reported that they used the BWA Hotline (38.3%)

(Figure 4.22). A Multiple Methods approach (15.3%) was the second most cited response and this was usually a combination of the BWA Hotline, a visit to the BWA Office and/or a Call to a BWA Employee. A large number of the study population indicated that they Never Contact the BWA (34.1%). Qualitative information received for this question usually cited a perception that their concerns will not be addressed, or that they had no problems and thus never contacted the utility. The Chi-Square test revealed no association between gender and contact method employed (N=229, p=0.25). Figure 4.22 summarizes the methods used by respondents to contact the BWA.

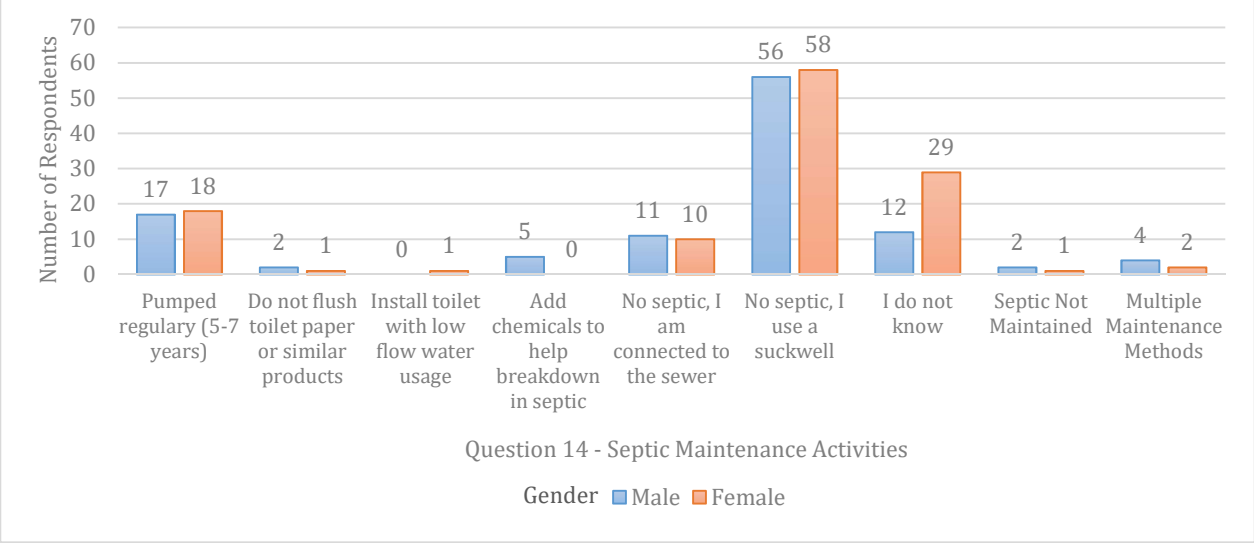

Figure 4.21: Survey responses to Question 14 on activities performed to maintain the septic system disaggregated by gender

Question 16 - "How does BWA inform you of new projects, changes, or issues to your water and sewage services?" revealed that Radio Ads were the common method cited (21.4%). A close second response was Multiple Approaches (21%), which comprised mostly radio ads, word-of-mouth and newspapers. The largest individual response category (34.5%) to this question was that many persons were Never Informed by the BWA on new projects or changes in service.

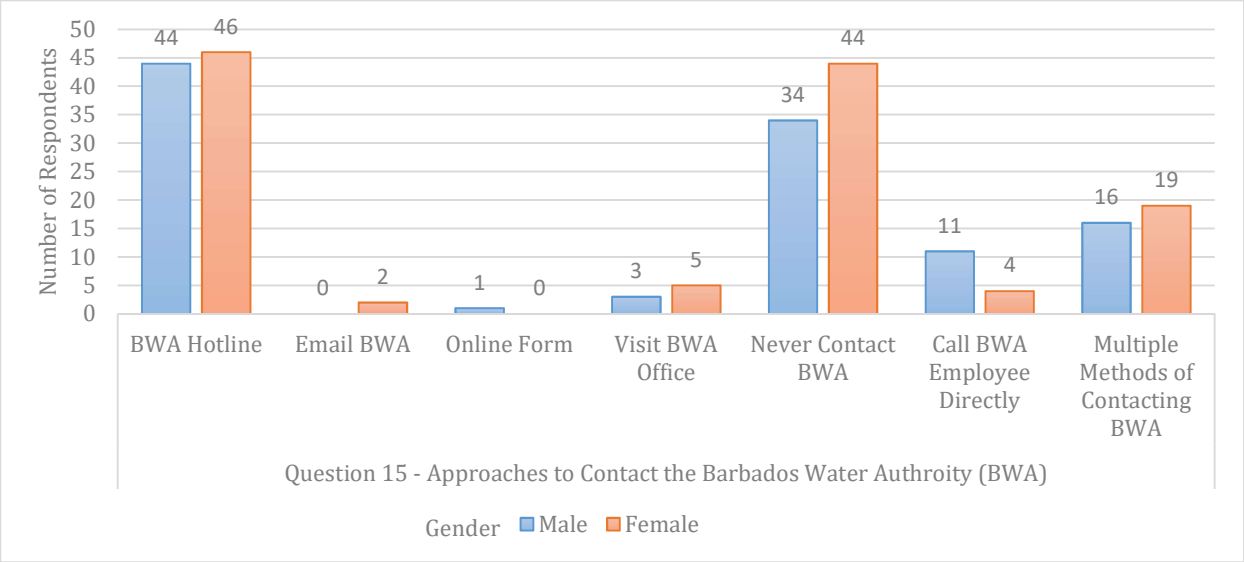

Figure 4.22: Survey responses to Question 15 on approaches used to contact the Barbados Water Authority disaggregated by gender

In general, women were more likely to cite that they received some form of information from the utility, and this may be due to a greater interest and need to know about interruptions or changes in the service which directly impact their water-related domestic activities. However, no association between gender and methods of communication by the BWA were observed (N=229, p=0.25). Figure 4.23 summarizes the results recorded to Question 16.

Questions 15 and 16 highlight a bottleneck in the flow of information or communication between the BWA and its stakeholders, with persons feeling that their concerns may not be addressed if they contact the utility, and/or that the utility does not do enough to engage with all sections of the population. The social media analysis revealed a missed opportunity for the BWA to engage with stakeholders online, and these further reiterate and highlight the isolation of some persons from communicating with the utility. Clear communication policies that leverage most of these used and received methods of communication are needed.

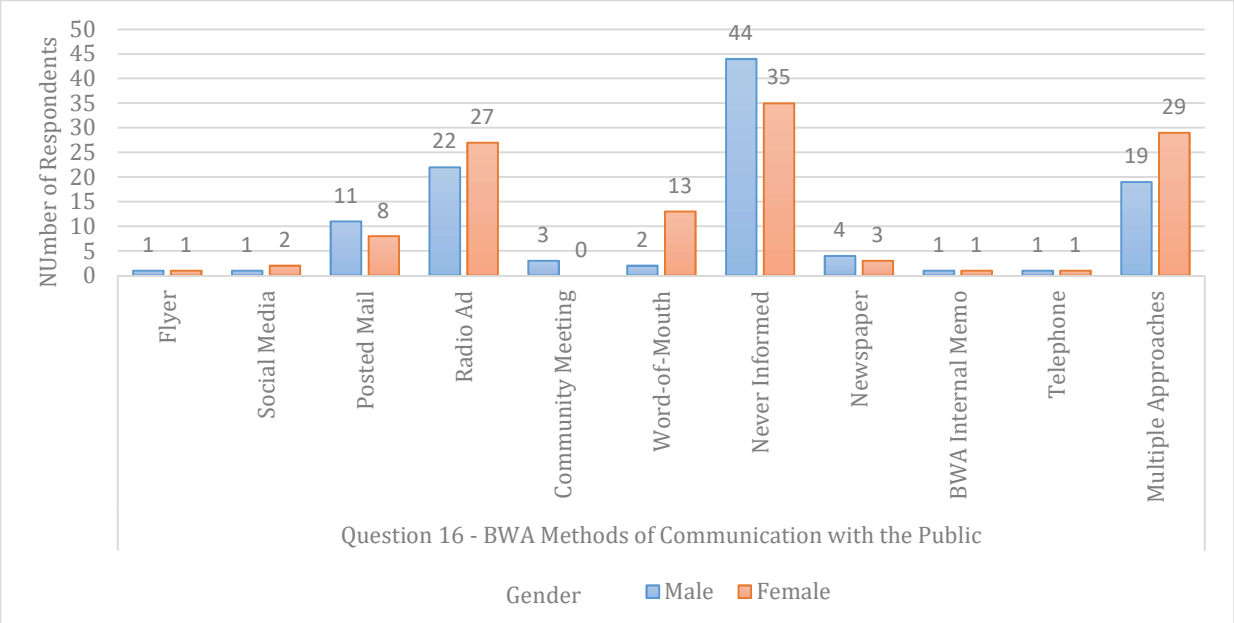

Figure 4.23: Survey responses to Question 16 on methods of communication used by the BWA to engage its stakeholders disaggregated by gender

These bottlenecks are directly confirmed in response to Question 21 – "When I contact BWA, my concerns are addressed?" which recorded 24.8% of the respondents as saying that they either disagree or strongly disagree with the statement. In spite of these bottlenecks, the majority of survey respondents (34%) either agree or strongly agree that their concerns are addressed. A smaller section of the study population (8.3%) reported indifference or neutrality to the question. The results from Question 21 are presented in Figure 4.24.

Although in Figure 4.24 it can be seen that more men than women agreed or strongly agreed with the statement, and a reversal of frequency in gender from indifference to strongly disagree, there was no significant association between gender and response observed from the Chi-Square test (N=156, p=0.626). The ME and SE for men (1.81, 0.10) and women (1.95, 0.11) indicate that a mean and representative response for the Barbadian population to this question is agree (equal to 2 on the 5 point Likert-scale).

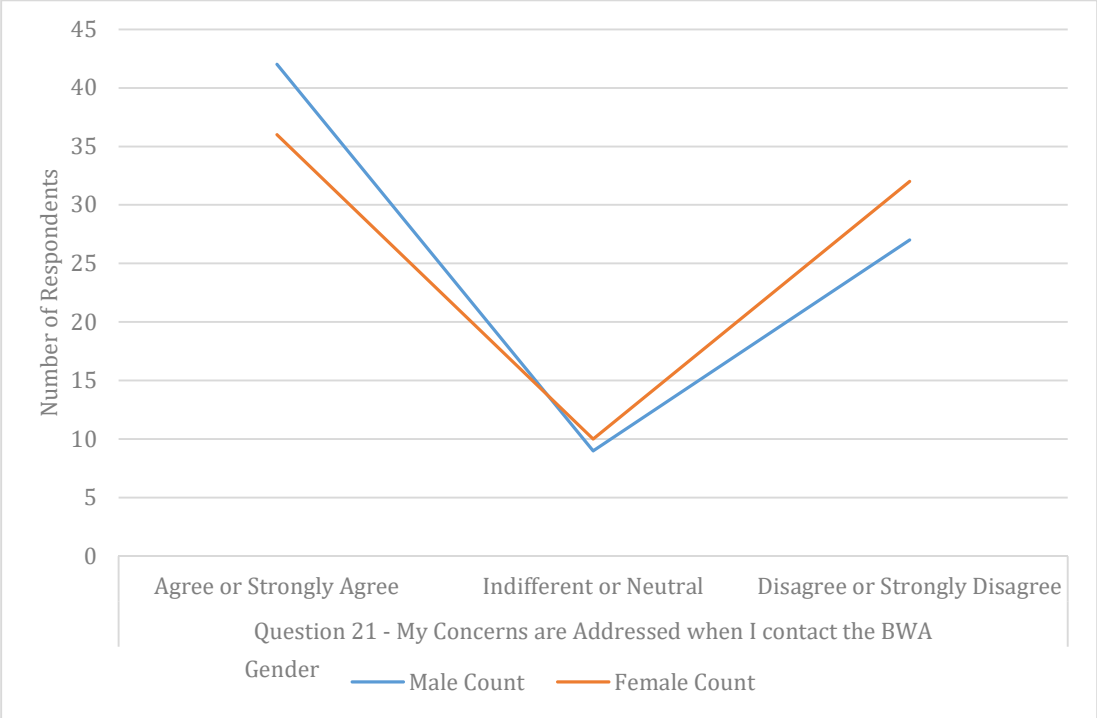

Figure 4.24: Survey responses to Question 21 on concerns of stakeholders being addressed when they contact the Barbados Water Authority disaggregated by gender

Question 22 – "I should be able to contribute to decisions made about water projects?" concludes the survey analysis of the status and potential for BWA stakeholder engagement. Most respondents (78.2%) agree or strongly agree that their opinions should be considered in decisions made about water management in Barbados. Few responses of indifference or neutrality (11.8%) and disagree or strongly disagree (2.2%) were recorded. No significant association between gender and responses recorded were found (N=211, p=0.876). The ME and SE for men (1.69, 0.08) and women (1.64, 0.07) indicate that agree would be the average response of the Barbadian population to this question. Figure 4.25 presents the results from Question 22.

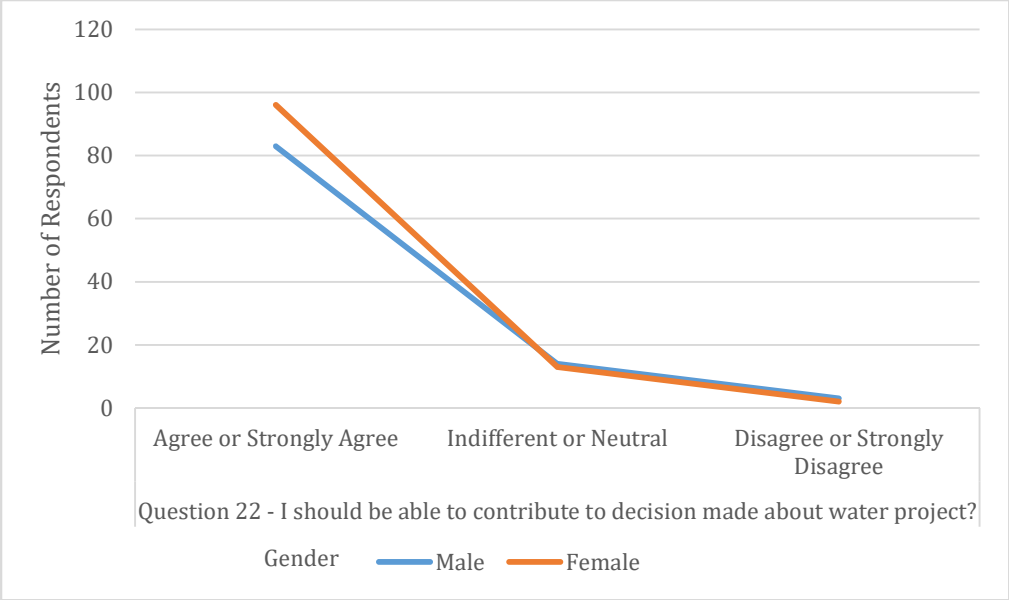

Figure 4.25: Survey responses to Question 22 on ability to contribute to decisions made about water projects disaggregated by gender

Questions 17, 18, 23 and 24 captured information on the cost and perceptions on affordability of water and wastewater in Barbados. Question 17 asked respondents to provide their household's average monthly expenditure on a) water services and b) wastewater services. Figure 4.26 presents an overview of the responses to part a – cost of water services. Average monthly expenditure for 81.7 % of the study population ranged from BDS $25-$600 with a mean and median of BDS $83.97 and BDS $60 respectively. The most cited (36.6%) expenditure range was BDS $25-$50 and this was populated by mostly women (58.3%). The minimum possible monthly expenditure on water from the BWA is $32 comprising the connection fee and up to 8 m^3 of water. Some respondents (9 or 3.9%) quoted expenditures under BDS $32, which likely reflects a credit or subsidy. Another 14.8% of the study population reported that they didn't know the cost of the water because it was included in their rent. Eight respondents (3.5%) did not provide a response and in most instances, it was because they did not know. One individual reported that they hadn't

received a water bill in months since their water meter had been broken and attempts to get it fixed had been unsuccessful. The Chi-Square test of independence found no significant association between gender and average monthly expenditure quoted (N=222, p=0.316).

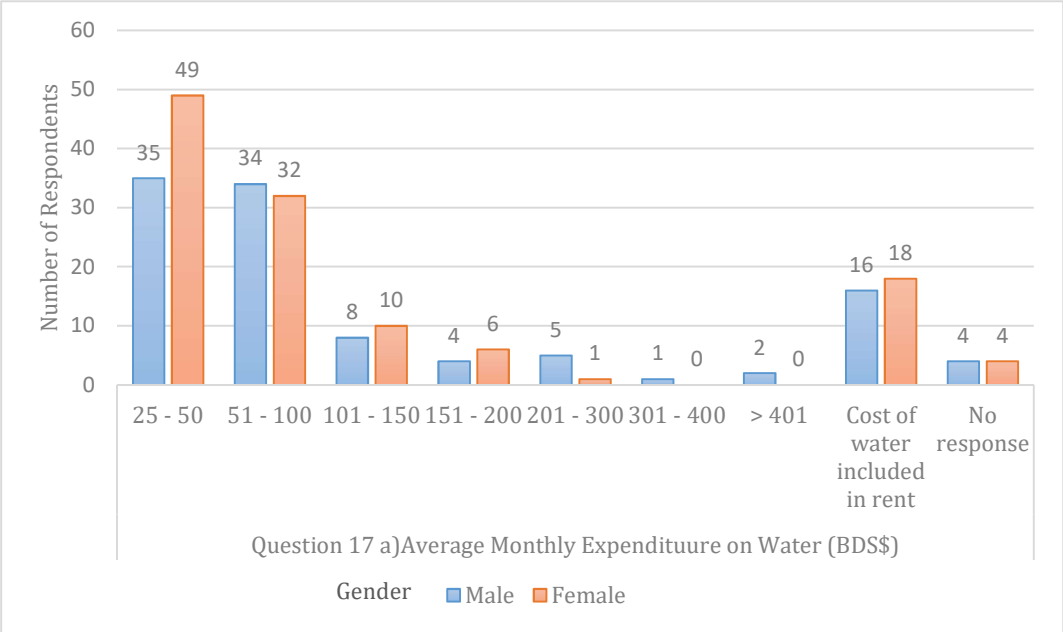

Figure 4.26: Survey responses to Question 17(a) on average monthly expenditure on water disaggregated by gender

Responses to Question 17 b) average monthly expenditure on wastewater also revealed a lack of knowledge on this area. In discussing Question 14, it was highlighted that only the parishes of St. Michael and Christ Church (which make up 46 % of the study population) have some sewage coverage. Of this population, 39% indicated that they were not connected to the sewer. Only 4.8 % of the respondents were able to provide expenditure values that ranged from BDS $0.50-$66 with a mean and median value of BDS $32.7and $35 respectively. It should be noted that some of the prices quoted that were less than BDS $6 seemed unreasonable and are most likely inaccurate. Limited data points made statistical tests for gender association with responses recorded not possible. Figure 4.27summarises the information obtained for Question 17 (b).

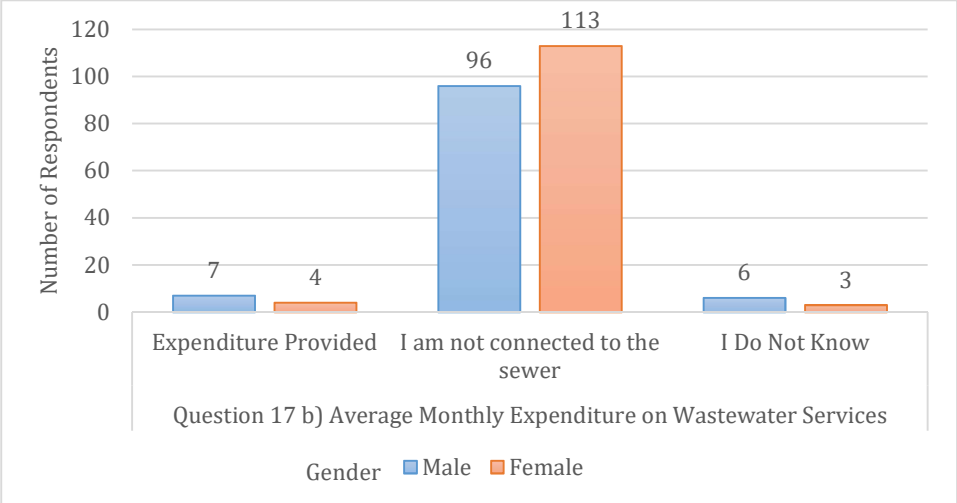

Figure 4.27: Summary of information available for Question 17 (b) on average monthly expenditure on wastewater services provided by the Barbados Water Authority disaggregated by gender

With respect to Question 18 – "If you buy water (outside of BWA), how much do you spend on purchased water per month?" 60.3% of respondents indicated that they purchased water, but only 42.8% of them could provide expenditure amounts (Figure 4.28). The expenditure ranged from BDS $2-$500 with a mean of BDS $56.5 and median of BSD $27.

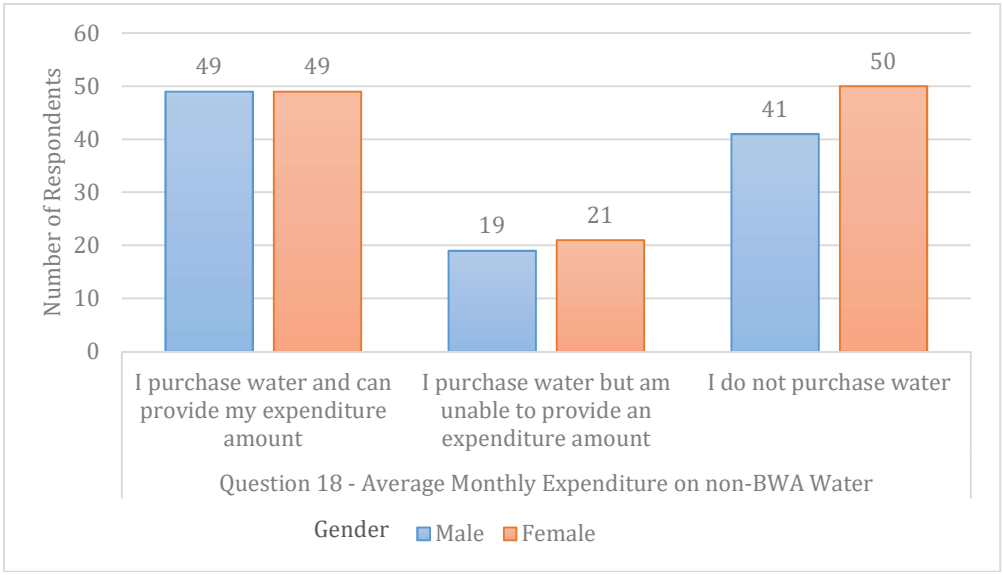

Figure 4.28: Summary of information available for Question 18 on average monthly expenditure on non-Barbados Water Authority (BWA) water disaggregated by gender

Figure 4.29 summarises the survey responses to Question 23 – "The current cost for the water service offered is reasonable". From the image, it can be seen that the most frequent response to this question is agree or strongly agree (53.7%), followed by disagree or strongly disagree (29.3%) and indifferent or neutral (6.6%). It should be noted that 10.5% of the population indicated that the question did not apply to them. The responses of men and women were roughly equal along the Likert scale for this question. The Chi-Square test of independence found no significant association between gender and response recorded (N=205, p=0.668), and the ME and SE for men (2.62, 0.15) and women (2.67, 0.1) revealed that the average Barbadian population response to this question would be agree transitioning to indifferent or neutral.

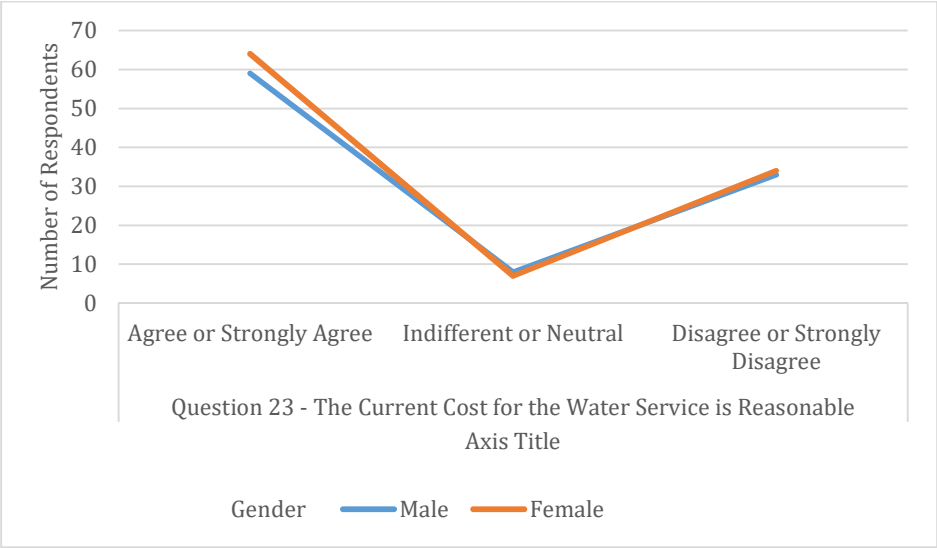

Figure 4.29: Survey responses to Question 23 on the reasonableness of the current cost for the Barbados Water Authority water service disaggregated by gender

In response to Question 24 – "The current cost for the wastewater service offered is reasonable," the choice "It does not apply to me" was most common (75.5%). Figure 4.30 summarises the responses for the remainder of the population (6.1% agree or strongly agree, 2.2% indifferent or neutral and 3.9% disagree or strongly disagree).

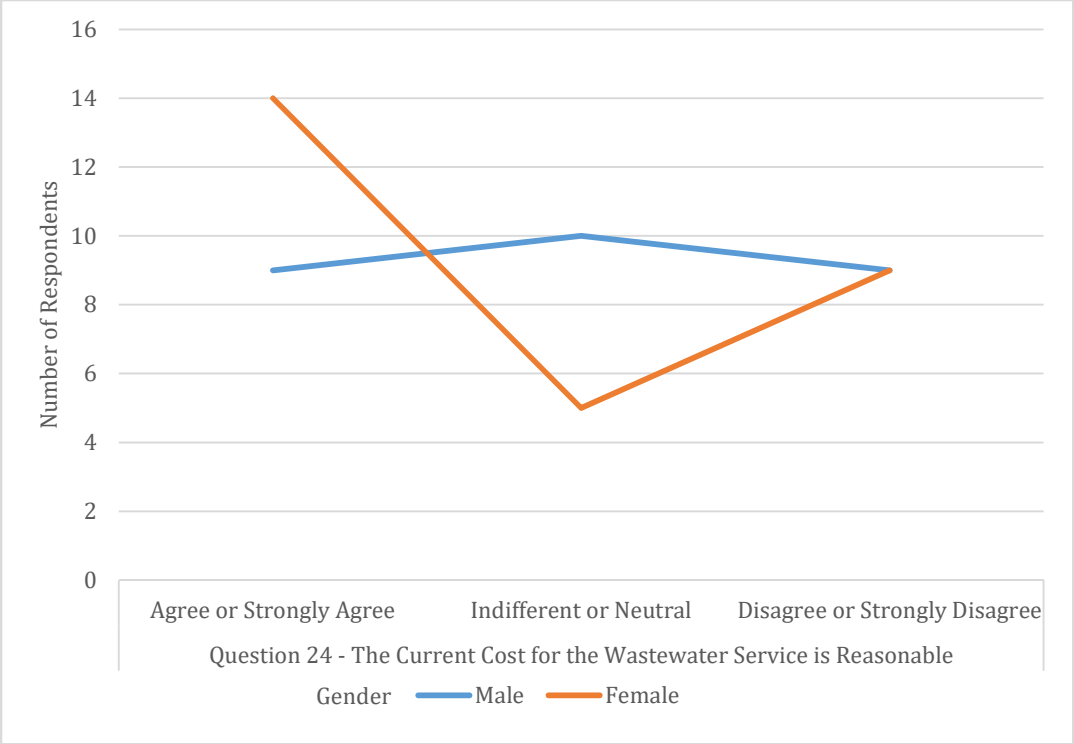

Figure 4.30: Survey responses to Question 24 on the reasonableness of the current cost for the Barbados Water Authority wastewater service disaggregated by gender

Although the number of respondents in Figure 4.30 is small, it can be seen that the response of men was roughly even across all categories, while responses of women fluctuated across the categories with most of them reporting agree or strongly agree. Chi-Square test of independence found no association between gender and the responses provided (N=56, p=0.527). The ME and SE for men (3.04, 0.23) and women (2.71, 0.25) suggest that for the Barbadian population, the mean response for men would be indifferent or neutral and agree for women. However, the small sample size (N=56) available for this question may negate the representativeness of this result.

Water production in Barbados is significantly subsidized by the Government. The BWA is unable to cover their production costs with the aged infrastructure that exists. Increasing the consumer's bill would be one way to generate revenue; however, equity issues

must be considered. The Fair Trading Commission is currently undertaking independent reviews that will inform the BWA on any allowable future fee increases. For individuals connected to the sewer, ⅓ of their bill from the utility is for the wastewater management service. The BWA is in the process of upgrading its billing software to include patterns of water usage as m^3 over time, and listing the cost of the wastewater service as a separate line item so that individuals can better track their water usage. This initiative should provide persons with more information and agency to monitor and manage their water consumption and/or losses especially in prevailing scarcity conditions.

4.2.4 Focus Groups

4.2.4.1 Barbados Water Authority

The Barbados Water Authority Focus Group was held on November 1, 2016 to discuss strategies to build utility climate resiliency, assess institutional capacity for gender mainstreaming and identify opportunities to incorporate gender considerations in institutional operations and project development. A summary of key projects or activities proposed by the group that can build utility climate resiliency and for which direct or indirect gender dimensions could be considered includes:

1. Mains Replacement

For the proposed mains replacement, the group discussed potential deficiencies in the criteria for selection of priority mains for replacement. Currently the number and frequency of bursts are the criteria used. It was suggested that social factors such as number of persons impacted, presence of schools, clinics and elderly care facilities as well as demographics of affected customer homes, e.g. gender and age should also factor into the criteria for mains replacement. The Sacramento Suburban Water District in its Distribution

Main Asset Management Plan have considered similar criteria for prioritizing areas for distribution main replacement, and have ranked areas with these features higher than others (SSWD 2014). The Customer Service department indicated that an upgrade of their management information system will allow them to capture such demographics, and share this information with other departments. A review of previously proposed projects for the BWA also indicate this type of geographic information system (GIS) integrated approach to mains replacement selection has been proposed but is yet to be implemented This discussion expanded the focus group's traditional considerations of gender dimensions as quota requirements, to the larger scope of responsibility of the utility to its customers and gendered impacts of service provision.

2. Renewable Energy Integration

Integration of more renewable energy capacity at pump stations has the potential to create additional jobs for individuals with the requisite technical skillsets. As indicated in Table 4.3, of the 779 persons on staff at the BWA, 48.5% are employed in technical fields with 92% being men and 7.1% as women. If this existing distribution of labor continues, men are the most likely beneficiaries of the additional jobs.

Proposed strategies to increase the participation of the underrepresented gender in any new jobs as a result of the project included job advertisements encouraging specific applicants, and targeted recruitment of desired individuals. Internal rotation of employees was also discussed to broaden participation in jobs created; however, no consensus was reached on strategies to address concerns of the physical suitability of women for specific roles. As of 2015 women only represented approximately 20% of the global energy industry,

where they mostly work in non-technical fields. (UNIDO 2015), Strategies that actively support gender balance and promote women empowerment are encouraged.

3. Pilot Wastewater Resource Recovery Systems

Similarly, for the pilot wastewater resource recovery system, the main gender concern was the proportion of males to females currently employed with the BWA with the requisite technical skills to perform the anticipated tasks required for operation and maintenance (O&M) of the system. The project was originally developed by a six-member student team from the USF's Civil and Environmental Engineering department and UWI's Student Entrepreneurial Empowerment Development (SEED) Project. The team comprised five females, one of whom is an entrepreneur whose start up business would potentially add value (via cosmetics) to the plants grown in the pilot system. Agricultural training programs encouraging youth and women in Barbados to become agripreneurs are currently being sponsored by the agricultural sector, and these participants could be targeted for interest in reuse projects. In Jamaica lack of or limited access to irrigation water for agriculture is a challenge in rural areas. Land ownership and or tenure is often a requirement to use water from the National Irrigation Commission, leaving many farmers and particularly women without access (UNDP 2009). Wastewater reuse is a potential source of irrigation water that is currently under-developed.

4. Research Projects

Focus group participants believed that a research arm of the utility would greatly improve the efficiency of operations and delivery of services. Two specific projects of interest with clear gender dimensions were i) health studies that assessed the impacts of water quality and water interruptions, and ii) economic studies that assessed the feasibility

of a stratified tariff increase based on customers' willingness and ability to pay for water services. A financial case for a tariff increase was particularly supported, since present cost of water does not reflect true production costs, and there was the recognition that such an increase would economically disadvantage some customers/homes more than others. There was an overall recognition of the need for better communication with its stakeholders particularly at the community level. Greater stewardship of the resource at all levels of power is needed to facilitate sustainable community growth and assist in poverty reduction.

5. Internal Revolving Fund to support Household Rainwater Harvesting and Household Residential Recharge

The current water crisis in Barbados due to the prolonged periods of no rainfall raised the many challenges faced by the BWA and country, and opportunities for innovative and sustainable solutions that would require decentralized approaches. Since 1996, buildings over a certain size have been required to install rainwater tanks; however, there is no requirement that the tanks be used. Figure 4.31 provides the possible locations of over 18,000 water tank sites in Barbados.

Given the high cost of electricity in Barbados, many people do not install pumps required to access the rainwater and some argue that the tanks end up breeding mosquitoes. Architectural designs do not take advantage of gravity fed systems and plumbing for uses like flushing toilets is not popular and some believe it is illegal. Given the potential for rainwater harvesting to offset water needs from the BWA and therefore its pumping costs, this was seen as a useful thing to encourage households to do. Similarly, with the increase of

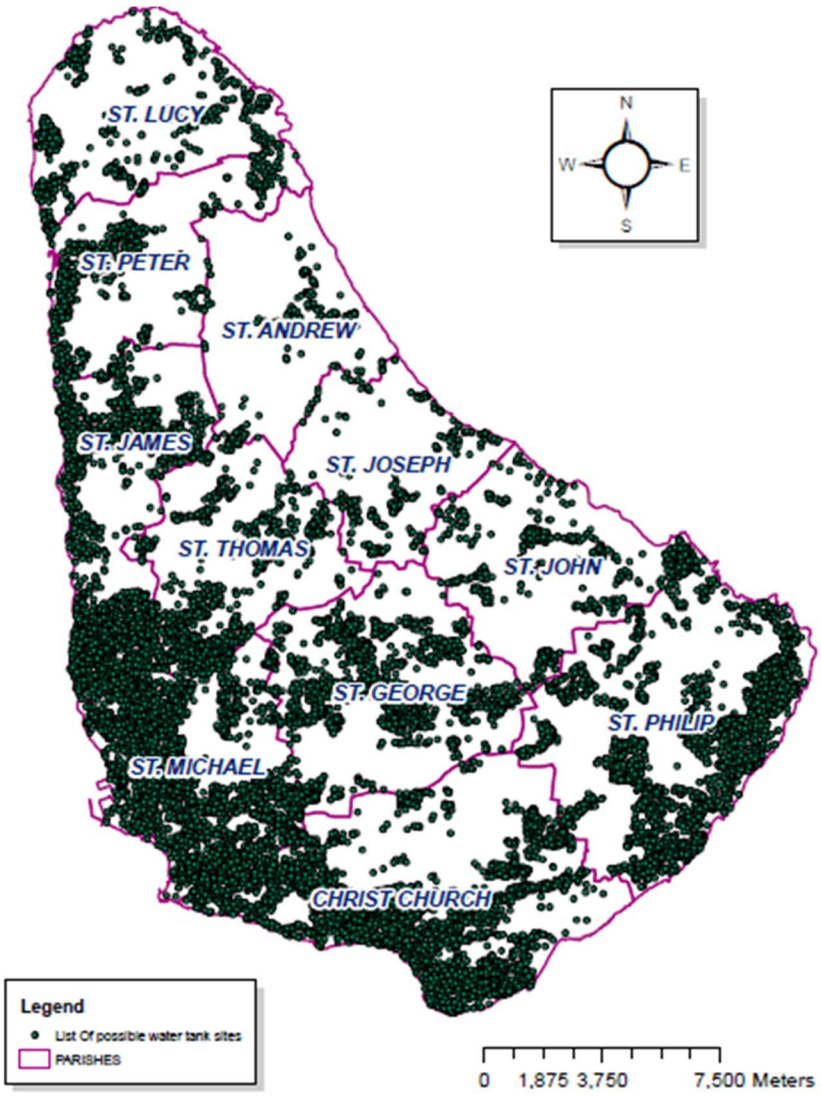

Figure 4.31: List of possible water tank sites in Barbados by parish (Source: Geographic Information System (GIS) file from Barbados Town and Country Planning 2017)

impervious areas in built environments, options to encourage rainwater recharge (e.g. rain gardens) were discussed, especially for households with little space for rainwater tanks/cisterns. The team agreed that demonstration sites for public education need to be located on BWA properties; however, they recognized the importance of showcasing these pilots in areas with existing water champions throughout Barbados. The BWA also recognized the need for its employees to serve in an official capacity as community water

champions, since many of its customers already informally access information directly from employees. Partnering with the engineers, plumbers and the Barbados Vocational Training Board/Polytechnic Institutes to create manuals and provide training on rainwater harvesting and publicize the options for use was recommended by the group.

During the focus group sessions, the concept of gender mainstreaming was particularly new to many of the BWA employees. Organizational members could benefit from gender training that includes roles of focal points, and gender sensitive budgeting. These findings are consistent with other initial responses at a Gender and Water Alliance Conference from water sector professionals, at the project management level who did not understand gender issues or how to mainstream gender in their work (Maharaj 2003). Institutional commitments to affirmative action can also ensure increased participation of the underrepresented group in projects (Maharaj 2003). Steps should also be taken to improve the current unequal employment of men and women overall (72% vs 28% respectively) and participation in supervisory roles (70% vs 30% respectively) at the BWA. Targeted interventions in this regard will significantly reduce existing gender biases in decision-making on water and wastewater management in Barbados. Sustained education and outreach initiatives by the BWA are also needed to provide opportunities for continuous community participation in planning and design of context specific solutions.

4.2.4.2 UWI Institute of Gender and Development Studies

The University of the West Indies Institute of Gender and Development Studies (UWI IGDS) Cave Hill Unit has staff with expertise in the areas of gender, sexuality, human rights, gender-based violence, Caribbean men and masculinities, and Caribbean feminism. The areas of gender and climate change are lesser explored topics by this department. In 2015,

they included a 3-hour workshop titled “Women and Water” for the first time in their Caribbean Institute for Gender and Development (CIGAD) biennial summer program. An environmental engineering professor from the USF taught this workshop. Faculty at the UWI IGDS Sister Unit at the Mona Campus in Jamaica have already delivered gender, climate change and disaster risk reduction training to 92 undergraduates in the region and are available to guide and mentor to increase competency in Barbados. Proposed activities to integrate the Cave Hill campus IGDS program with EWN-SCI include expansion of CIGAD to include additional seminars on women and water that are open to non-CIGAD program participants, production of educational materials on the rationale and context for recognizing and incorporating gender perspectives in development projects, and recruitment of M.S. and Ph.D. students to pursue research that directly supports EWN-SCI project goals. The group also recommended targeting its CIGAD graduates (11 institutes have been held to date) to train them on EWN-SCI topics that would be applicable to the communities where they live, and for which they can become champions for sustainable water infrastructure.

4.2.5 Interviews

4.2.5.1 Financial Institution

The Caribbean Development (CDB) Bank has been recently accredited as a regional implementing entity for the Green Climate Fund. It has funded BWA projects in the past, some with similar components included in EWN-SCI, though not from the holistic framework for building an ecosystem for sustainability driven initiatives. The Senior Operations Officer interviewed suggested that the organizations involved with EWN-SCI should work closely with the CDB to avoid duplication of efforts and build on each other’s findings. The need to

build capacity at the UWI IGDWS Cave Hill Unit in development of water sector projects was identified, and strategies to do this included requests in project Terms of Reference issued for consultants to utilize the department for some sub-contracts. The CDB recently completed a gender assessment of Barbados; however, there was little emphasis on engineering and infrastructure (Allen and Maughan 2016). The CDB has a gender policy that its borrowers must follow and has hired their third gender equality specialist in a few years.

4.2.5.2 Caribbean Water and Wastewater Association

The research team used the Caribbean Water and Wastewater Association (CWWA) Conference held in Trinidad and Tobago from October 24-28, 2016 as an opportunity to interview utility CEOs, engineers and other water sector professionals from Barbados and the wider Caribbean. Some participants, primarily male, were actively opposed to developing actions based on gender considerations. They believed the gender analyses were looking for problems that did not exist. There was the sentiment that there was no reason to establish procedures benefitting one or other sex because everyone is considered equal. Concepts of gender neutrality often lead to a lack of information and quantitative data through which differences can be identified. On the other hand, there was a fixation by some persons on the thought that gender equality = women equality, and for water infrastructure projects, gender mainstreaming meant a narrow focus on filling job quotas. There is a lack of recognition of the skewed nature of opinions thought of as reality, due to the domination of discourses by one sex in the engineering field. There also exists an intolerance/insensitivity towards women of child-bearing age as one interviewee commented that "women enter baby making mode" and therefore do not want to return to work once the child is born.

4.2.5.3 UWI Department of Chemistry

For the 2015-2016 academic year, 67.1 % of the 70 students enrolled as degree seeking students in the Chemistry Department at the UWI, Cave Hill Campus were women (UWI 2016). Many of the faculty in the Chemistry Department (at least 50% of whom are women) are engaged in water quality related research, and would provide expertise and students to be engaged in the EWN-SCI project as part of its objectives to build interdisciplinary water utility-university partnerships. The installation of new meters by the BWA and prevailing water scarcity conditions at the time of the interview, also increased awareness of faculty on the relationships between water infrastructure and water quality. Opportunities to market improved rainwater harvesting systems were identified given the limited understanding of how current residential systems worked Chemistry faculty highlighted their need to purchase analytical equipment and acquire funding for equipment maintenance as immediate needs to be effective participants in these partnerships. The current gender distribution of chemistry students indicates that women are likely beneficiaries of the EWN-SCI project in the form of research opportunities, student assistantships, and research stipends to complete required work.

4.2.5.4 Environmental Protection Department

The Environmental Protection Department (EPD) recently completed a Policy Paper on Wastewater (WW) Reuse, according to the Director. Presently, WW reuse is limited to drip irrigation, though there is a residential development and some pilot sites where wastewater is reused for toilet flushing. The EDP supports pilot projects that will demonstrate that WW reuse for agriculture is a safe (subsurface irrigation) and a viable option, as well as an analysis of perceptions of WW reuse for agriculture to assess potential

stigma. If a business case can be made for WW reuse, the potential to significantly expand to other systems like packaged treatment plants, septic systems, and suckwells (unlined holes in ground) can be explored to allow for distribution of these reuse benefits to all individuals. Pilot systems that also serve as demonstration sites are critical for educating the public, getting their buy-in, and building the reuse market.

The EPD is also concerned about the impact of nutrient loading to the sea from effluent of decentralized sanitation systems inclusive of septic tanks, sewage package plants and thousands of suckwells on the island. At the same time, the nitrogen effluent requirements for packaged wastewater plants was recently increased from 5 to 20 mg/L. Limited analytical resources and understaffing have resulted in a backlog within the national government analytical lab. This prevents execution of a regular sampling and testing campaign around the coast. The government analytical lab is primarily staffed by females and they would be direct beneficiaries of the EWN-SCI project, were funds from the project to be allocated to the lab for use as an independent 3rd party lab.

4.2.5.5 Health Sector

"In Barbados, the solution to pollution is dilution". These were the sentiments of a Pan-American Health Organization (PAHO) employee. There was concern with improper nutrient management from wastewater, including the BWA's sewage treatment plants, the packaged plants of hotels and businesses, or household septic systems and suckwells. High groundwater nitrate levels are of concern for drinking water in certain parts of Barbados, and the impact of nutrient loadings to the sea are of concern for impacts on corals and marine environment. Contaminants from wastewater discharge and stormwater runoff can potentially result in increased ear, nose and throat diseases from swimming in the sea,

especially just after a storm. To reduce these nutrient loads, resource recovery projects should be pursued with the incentive for people being the added value that one would get in the form of water and nutrients for potential food or an income generating agricultural product.

4.2.5.6 Tourism

A representative from the Caribbean Hotel Energy Efficiency and Renewable Energy Action Program (CHENACT) surmised that up to 50% of the water and energy bills of some larger hotels can be attributed to on-site leakages. Rather than reduce the water and energy consumption by pursuing efficiency measures, the hotels sometimes choose to absorb the costs or lay off staff to recoup the difference. Since 70-80% of the hospitality sector are women, women are most likely laid off as a direct result of water wastage. The BWA can recommend that hotels conduct a water audit to identify opportunities to reduce water consumption. Additionally, the project pursued in 2010 by the BWA where they distributed 10,000 water efficiency devices should be revisited to determine the number of systems installed and what worked and did not work from the initiative.

4.2.5.7 Business Sector

The Altman Real Estate Group was interested in reuse of the treated effluent from their Limegrove Shopping Mall for agricultural production. The group has land available for the pilot site and would ultimately like to use the produce for resale to restaurants at their mall and to the Holetown community. The Altman Real Estate Group represents one of many companies in Barbados that have decentralized wastewater treatment systems and believe that discharge of the effluent to the sea is a waste of the resource. Similar sentiments were expressed by SIR Water Management Limited, a packaged wastewater plant supplier in

Barbados. At one of the SIR sites, cut flowers are grown and some areas are believed to benefit from treated effluent. A female employee was pointed out as being the reason for the inclusion of edible produce on a small part of the land which is for her personal use. Although women are less likely to be land owners, they are key decision makers in the productive use of land for agriculture (IFAD 2012, UNDP 2009). Recognition of this fact means that women possess knowledge that is crucial to water management that may often be overlooked due to land-tenure issues (IFAD 2012, Maharaj 2003). Innotech manages the BWA headquarters building, including a packaged wastewater treatment plant located there. Their effluent discharged into a suck well and the results from their effluent analyses are sent to a consultant. The possibility of reuse of the effluent for agriculture was seen as a positive for piloting at this facility.

4.3 Gender Impact Assessment

This section addresses the gender impacts of the four main project components of the EWN-SCI project: 1) Pipe replacement and rehabilitation (20 km) as part of a Water Loss Reduction (WLR) program; 2) Photovoltaic (PV) installation of 2.5 MW of renewable energy at the BWA's water supply facilities; 3) Wastewater reuse pilot site using effluent from centralized and decentralized systems; and 4) Rainwater harvesting demonstration sites to increase water supply resilience at the household/building level. The impact of gender on each project component is evaluated. The chapter concludes with opportunities and strategies to address some of the gender concerns identified in the impact assessment, and from the social media analysis, water user survey, focus groups and interviews throughout the life cycle of the project components.

4.3.1 Impact Description

Table 4.13 summarizes an Environmental and Social Impact Assessment (ESIA) that was completed for the EWN-SCI project (Trotz et al. 2017). The ESIA covered impact categories that were environmental (air quality, water quality, soil cover, noise, and land use) and social (health and safety, sanitation, socio-economic, road network, visual amenity) during the construction and O&M phases of each of the four major infrastructure components. The impacts were characterized by type (direct or indirect), nature (positive or negative), and duration (temporary or permanent). For this research, a gender concern (significant or limited) was added to each impact considered in the ESIA. Characterization of the gender concern as significant or limited is subjective, but is informed and influenced by the proximity to and duration of exposure to the impact.

Table 4.12: Summary of environmental and social impacts assessed for each aspect of the Energy-Water-Nutrient Nexus for Sustainable Coastal Infrastructure (EWN-SCI) project during the construction and operation and maintenance phase. Impacts are characterized by type (D-direct or I-indirect), nature (P-positive or N-negative), duration (T-temporary or M-permanent) and gender dimension (S–significant or L-limited).

Impact	Pipe Replacement	Photovoltaic Installation	Pilot Project: Wastewater Reuse	Pilot Project: Rainwater Harvesting
Environmental				
Air quality	D, N, T, L	D, N, T, L	D, N, T, S	-
Water quality	D, P, M, S	I, N, M, L	D, P, M, S	D, P, M, L
Soil cover	D, N, T, L -	D, N, P, L	D, P, M, L	D, P, M, L
Noise	D, N, T, L	D, N, T, L	D, N, T, L	D, N, T, L
Land use	D, N, T, L	D, N, M, L	D, P, M, S	D, P, M, L
Social				
Health and safety	D, N, T, S	D, N, M, L	D, P, M, S	D, P, M, S
Sanitation	I, N, T, L	I, N, T, L	D, P, M, S	-
Socio-economic	I, P, M, S	I, P, M, S	D, P, M, S	D, P, M, S
Road network	D, N, T, L	-	-	-
Visual amenity	D, N, T, L	I, N, M, L	I, N, P, L	D, N, M, L
Gender				
Environment	S	L	S	L
Social	S	S	S	S
Economic empowerment	L	L	S	S
Improve access and mobility of women	L	L	L	S
Job training	L	L	S	S

Additionally, a new gender category was created to summarize the overall environmental and social impacts on gender. Three other gender categories were included to reflect the metrics used from the literature, the GCF and IADB projects evaluated using the ENVISION™ rating system. Details on the impacts identified in the table are provided in Sections 4.3.1.1 to 4.3.1.4.

4.3.1.1 Pipe Replacement

During the construction process when the pipes are being replaced, there will be temporary negative impacts that directly affect the air quality as old pipes are being excavated from the ground, and new ones installed. The excavation process will unearth soil at various depths, bringing a variety of particulate matter and coarse debris to the surface. Furthermore, the majority of the machinery used throughout the construction phase of the project typically burns diesel fuel which produces acute areas with concentrated amounts of harmful air emissions. These emissions increase the project's overall greenhouse gas (GHG) values and carbon footprint. Additionally, as the pipes are being installed, chemicals used to fit and combine joins oftentimes emit harmful fumes that have short-term impacts to the local air quality levels. Lastly, depending upon waste management practices, burning of excess materials also will negatively impact air quality.

The majority of the water quality-based environmental impacts are positive with direct and in-direct, long-term benefits associated with the O&M phase of the pipe replacement. Conversely, the construction portion of the proposed project reveals some short-term threats. When new pipes are installed, it is possible that the older ones, like those made with asbestos, are not managed properly and can potentially become a hazard source for the surrounding environment and people. Once pipes are installed, it is possible that they

transfer dirty water to households and that can impact human health. These are small negative impacts that can be managed with a proper safety and health plan. Continued O&M of the project also has an indirect positive implication to water quality, because the reduced rate of total withdrawal from the aquifer prevents zones of stress along the coastal portions of the aquifer that, if overtaxed, result in areas of saltwater intrusion. Since Barbados is a water-scarce nation, this project's positive contribution at protecting the country's most limited natural resource is particularly critical and provides benefits to the entire population.

On the other hand, while many of the effects from this project do permanently benefit the environment during the O&M phase, there are still some short-term, negative impacts to consider during the construction of the project. These impacts are associated with installation practices that, if done improperly, have the potential to contaminate the drinking water supply and surface waterbodies. Water contamination has the potential to impact everyone, but especially individuals without the means to purchase from additional sources. When pipes are replaced, if they are ineffectively sealed or have inappropriately cleaned joints, external contaminants from the surrounding area or remaining residue from the pipe replacement could leak inside through preventable cracks.

As excavation of existing pipes, installation of the new piping network, and repaving of the roads take place, there will be direct, negative impacts to the surrounding neighborhood. Importantly, however, is the fact that these impacts will occur temporarily during the construction phase and are unlikely to have any long-term effects.

Temporary, negative health and safety threats are possible during the pipe replacement project as potentially hazardous situations may exist from the construction

processes. For instance, the 20 km of pipe to be replaced represents an extensive distance where local foot-traffic may be negatively impacted or construction workers could accidentally injure themselves in an open hole. There are also toxic chemical adhesives or cleaners used on the pipes which could cause respiratory problems, headaches, or other acute illnesses. Additionally, given the length of pipe to be replaced, there may be onsite congestion of construction equipment or overhanging threats from other mechanical equipment. While these issues may not cause any traffic accidents on adjacent road networks, it is still necessary to mention them. Lastly, temporary disconnections will have to be made and this could affect residences and businesses if enough forewarning is not given as well as appropriate alternatives for water supply in order to maintain the health and safety of the impacted communities.

There will be permanent indirect, positive implications to all stakeholders from the pipe replacement and rehabilitation because of the economic returns to BWA. These economic returns come through energy savings from not pumping water that is lost to leaky pipes as well as energy savings from reduced consumption directly from the grid. The location chosen for the pipe replacement will result in direct positive impacts to the area being serviced. In the same vein, direct negative impacts are also possible due to prolonged service interruption, and economic burden to areas of greater need. Additionally, interdisciplinary capacity building and knowledge sharing that is integrated through university-utility partnerships of EWN-SCI will have great socio-economic benefit to Barbados.

Job creation is a direct benefit of the pipe replacement project. The BWA subcontracts some of its pipe replacement projects that use horizontal drilling and pipe bursting

techniques and as such, does not control the gender distribution of persons employed by the contracted party. Since mostly men in Barbados are employed in the pipe replacement field, they will be direct beneficiaries of this project. Additionally, since the construction phase is only temporary, workers will endure limited impacts. Dust suppression strategies, use of face masks, safety goggles, noise reducing headsets, and other mitigation efforts detailed in a construction and management plan, and which complies with Occupational Safety and Health Administration (OSHA) guidelines, are needed to limit the incidence of associated respiratory impacts. Individuals who live or work near these construction zones will also experience temporary air and noise pollution and road congestion impacts.

4.3.1.2 Photovoltaic Installation

The PV panels will be installed on an impervious foundation at the water utilities' pumping stations. Due to this placement, the ground cover provided by panels will not reduce existing water infiltration rates during rain events. It is possible, however, that over the course of the PV panels' lives, there may be some leaching of metals into the runoff. Additionally, the routine O&M processes require cleaning of the panels, and since some of the chemicals may be potentially toxic, there is the potential for indirect water quality impacts.

With respect to noise impacts, the PV installation will have direct, negative, temporary effects like those associated with the pipe replacement. Stakeholders near to the construction sites who are present during daytime working hours will also experience the noise impacts.

Depending upon the exact placement of the panels, there are permanent health and safety precautions for both the construction and O&M phases. For instance, photovoltaic

panels require maximum exposure during daylight hours, so they are often placed in elevated locations which will require extreme caution and use of harnesses during installation and cleaning. Furthermore, threats are experienced during routine maintenance either from chemicals used for cleaning the panels or from the wastewater produced from cleaning that is difficult to characterize and may have skin irritant properties.

There will be permanent indirect, positive impacts to the BWA from the photovoltaic installations attributed through economic returns and energy savings from reduced consumption from the local energy grid. Additionally, the interdisciplinary capacity building and knowledge sharing that is integrated through university-utility partnerships of EWN-SCI will have great socio-economic benefit to Barbados. The overall improved performance of the BWA translates to increased efficiency and effectiveness of services for water and wastewater treatment that would ultimately have a positive impact in Barbados.

Photovoltaic installation, like pipe replacement, creates jobs. However, in this instance, the installations are performed by male BWA engineers. With a goal of increasing energy dependence through renewable energy integration, the BWA will need this expertise over the long term. Currently, there are more male than female engineers at the BWA, so training to increase the number and capacity of female engineers to fill this permanent role will ensure both men and women have access to this opportunity.

4.3.1.3 Pilot Project: Wastewater Reuse

Some negative, temporary impacts to air quality are associated with the wastewater reuse pilot project. These effects have a direct impact to the local environment during the O&M phase. Oftentimes in wastewater treatment facilities, odors are associated with improperly functioning systems. Such is also the case for this project. A negative air quality

impact such as odor is a likely symptom of a deeper, more substantial operations-based issue.

Overall, the water quality impacts of the wastewater reuse pilot project are direct, positive, and long-term to the environment and the people of Barbados. These benefits exist predominantly in the form of reduced nutrient loads to the effluent stream through nitrogen and phosphorous uptake by plants in the hydroponic system. The reduced nutrient load directly affects the receiving water body—Carlisle Bay, a key tourist area and coral reef habitat. As the pilot project is scaled up, so too would the positive effects to Carlisle Bay's water quality (i.e. improved visibility, reduced algal growth on corals). Equally important to consider, though, is that throughout the lifetime of the pilot wastewater reuse project, as with any wastewater treatment process, chemical addition is typically used as a disinfectant that must be properly handled and used with appropriate spill management practices, in order to prevent any environmental impacts to nearby water bodies.

Minor temporary soil disturbances occur, such as excavation of top soils or removal of native soils as the foundation is put in place for the wastewater reuse systems. Removal or degradation of the soils could impact future growth of plants, landscaping, or food crops. Furthermore, the topsoil disturbance, soil removal, or excavation procedures may influence future erosion in the adjacent areas if proper steps are not taken to manage such impacts. Next, if the heavy equipment typically used for earth moving is parked in one location for an extended period of time, issues could arise from the soil being temporarily over-compacted. Such compactions may influence the soil's normal water storage capacity, potentially resulting in areas of poor infiltration and localized ponding. Lastly, for the lifetime of the

projects, the soil in the areas upon which the foundations have been laid will no longer be of productive use.

With respect to land use, the wastewater reuse project can be constructed on unused green space at the current location of the Bridgetown Sewage Treatment Plant, so the effect of the system will actually be a direct, permanent, positive change as under-utilized areas will become productive for research and development purposes.

There are significant health and safety precautions necessary for individuals to consider during O&M of the pilot project, such as exposure to fecal contamination, and waterborne disease vectors. Reasonable mitigating measures included in established OSHA protocols such as the use of proper safety gear (i.e. safety mask, gloves, long pants/shirts) can eliminate the associated threats.

The pilot site for production of value-added products from reused water and reclaimed nutrients from the Bridgetown Sewage Treatment Plant's effluent stream has direct, positive impacts to long-term wastewater management in Barbados, and throughout the Caribbean region. In particular, the best practices from this project will be promoted, adapted, and transferred to other regional water utilities for their development of high-value cash products from a previously unutilized resource.

The research and data collection may also be useful in the private wastewater sector to promote decentralized resource recovery innovations that would be suitable to implement at a household or clustered level using septic or package plant systems. There, however, are no foreseeable impacts to the current sanitation provisions offered by the Bridgetown Sewerage Treatment Plant, because the useful product will simply be siphoned from the current effluent stream, yielding no effects to current daily operations. Any changes

to normal operations will be overseen by a trained professional on staff, as well as a group of skilled student interns associated with the project team members' institutions (BWA, UWI and USF).

When pilot projects are installed and operated to their optimal capacity, direct positive impacts are experienced over their lifetimes. For instance, value-added products can be produced hydroponically from the wastewater reuse project, while economic savings, the skilled student interns, and other scientists and engineers working on different aspects of the project will receive economic support for their work. The project team members can directly influence the distribution of labor by gender in this regard by setting targets to employ more of the under-represented sex. For example, the Chemistry department at the UWI is predominantly female (staff approximately 50% and students 67%) should try to increase participation of males in the program (UWI 2016). The national analytical lab which is currently backlogged also has the potential to be directly and positively affected if budgetary allocations in the EWN-SCI project are made to support this lab, which is also predominantly staffed by females.

4.3.1.4 Pilot Project: Rainwater Harvesting

Due to the topography of the island, many households along the southern and western coasts lie outside the basin where much of the rainwater infiltration occurs. As such, installing rainwater harvesting systems has a positive, direct, and permanent impact to water quality issues that exist in the nearshore coastal areas. For instance, rainwater harvesting systems can be considered localized measures for flood mitigation, because smaller volumes of water are falling from household roofs onto nearby roads, removing stress from the overburdened, often clogged storm drains. Additionally, decentralized

rainwater harvesting reduces the volume of storm water runoff traveling from the island's ridges down to the vulnerable reefs, picking up contaminants from the roadways along its path. While the majority of the impacts are positive, it is also important that reasonable measures be taken if hazardous chemicals are used to clean the rainwater vessels or patch any holes. In addition, if water is stored for long periods of time, depending upon the material of the container, the water quality may be compromised due to leaching of the tank material; reuse potential may be limited to non-potable uses.

Like the Wastewater Reuse project, minor and temporary soil disturbances such as excavation of top soils are anticipated for the rainwater harvesting pilot. However for the lifetime of the project, the soil in the areas upon which the foundation has been laid will no longer be of productive use. Similarly, for land use, unused space (roof in this instance) and an adjacent, modestly sized area will be designated for demonstration and education purposes.

The primary, negative health concern for the rainwater harvesting systems is the potential exposure to waterborne disease vectors (microbial pathogens and mosquitoes). Appropriately designed rainwater harvesting systems with clean catchments and storage receptacles, supported by good hygiene at point of use offers water with very low health risk. Conversely, inappropriately designed and managed systems can pose high health risks. Identification and consideration of design parameters such as preference for type and size of storage receptacle, system elevation, position of cleaning access point, and need for a pump, will facilitate or limit the successful adoption or adaptation of rainwater harvesting systems. Educational material on the control of potential health impacts can be available as part of the pilot site display. Furthermore, the permanent, positive health and safety benefits

of the system are in its promotion of storm water management efforts which prevent localized flooding, reduction of water quality impacts from storm water on local waterbodies, and decentralized approach to water storage which improves household water security.

Green jobs created through the widespread adoption of rainwater harvesting systems that require skilled labor for appropriate design, construction and maintenance can be seen as one potential economic benefit of this project. Inclusion of design perspectives from women and men can result in systems that can be easily installed by both parties, thus inclusion of both sexes in the job market. Designs need to be based on realistic assumptions that only women and men can provide if they are included and ensures women benefit from water improvements (IFAD 2012). Reduced water withdrawal from the central distribution network also results in cost and water savings to the utility through decreased non-revenue water losses and associated inefficient pumping.

4.3.2 Gender Mainstreaming the EWN-SCI Project Cycle

Many of the gender impacts highlighted in the previous sections can be effectively mitigated or maximized with planning in the design phase of the project. Stakeholder consultation, inclusive of utility employees, affiliated business contractors and resource users is needed to firstly identify the challenges, and propose solutions for mitigation or adaptation. The diversity of the population engaged will determine the breadth of issues uncovered and resolved. In the stakeholder engagement process. Efforts should be made to capture and incorporate feedback from traditionally underrepresented groups.

For example, operational health and safety plans can be updated and enforced as needed based on field worker experience of hazards not previously documented. Service

interruptions and construction impacts from pipe replacement to the broader population can be mitigated with clear communication policies that provide adequate notice, using effective channels such as radio ads and social media posts. Stakeholder engagement on design of rainwater harvesting systems can be targeted to individuals more likely engaged in water storage practices at the household level, thus minimizing poor design and limited use. Public education and outreach campaigns based on research of existing knowledge, such as identifying wastewater management misconceptions (e.g. use of centralized or decentralized systems), and demonstrations of untapped potential of wastewater as an income and food generator for motivation of different individuals. Including targets for job creation while considering existing gendered division of labor, and required training and/or recruitment to address disparities can also be considered in the project design phase. Table 4.13 projects and proposes activities and strategies to address these concerns throughout the project cycle.

Table 4.13: Opportunities to integrate gender considerations in the project cycle of an Energy-Water-Nutrient Nexus for Sustainable Coastal Infrastructure (EWN-SCI) project in Barbados

		Project Phase		
Project Component	**Gender Integration**	**Formulation (Design)**	**Implementation (Construction)**	**Monitoring & Evaluation (Operation & Maintenance)**
Across all projects	- General Management	- Set Gender Objectives and Targets - Provide budgetary allocations for objectives - Appoint a Gender Specialist or Focal Point to coordinate & manage activities	- In-depth gender analysis and impact assessment is conducted - Formulate institutional gender policy & partner with UWI IGDS - Gender training for key project personnel	- Monitor production of sex disaggregated data for gender objectives - Regular reporting and case study generation as a knowledge sharing tool

Table 4.13 continued

		Project Phase		
Project Component	**Gender Integration**	**Formulation (Design)**	**Implementation (Construction)**	**Monitoring & Evaluation (Operation & Maintenance)**
	- Job creation, training and safety	- Research training and recruitment needed for all positions - Consider Operational Safety and Health Administration (OSHA) needs	- Targeted recruitment of underrepresented group based on project objectives - Partner with vocational & polytechnic institutions - Enforce OSHA guidelines	- Monitor and report on sex of recruited employees - Update OSHA plans to reflect worker experiences
	- Stakeholder Engagement and Communication	- Stakeholder identification - Research on appropriate communication channels - Develop communication guidelines leveraging all platforms, especially online media	- Ensure equal voice among women and men in the decision-making processes of the project & as water champions in communities - Follow communication guidelines	- Monitor and report on stakeholder sentiment and feelings towards project disaggregated by sex - Update communication guidelines using feedback
Pipe Replacement	- Inclusion of socio-economic criteria in decision for prioritizing pipe replacement and rehabilitation	- Identification of geographical information needs to complete community profiles	- Create data infrastructure and gather geographic information - Use information to compare benefits of alternative interventions	- Track benefits of intervention including metrics of number and types of individuals impacted
Pilot Project: Wastewater Reuse	- Education and outreach to address wastewater knowledge gaps	- Gather baseline information on wastewater management	- Creation of education and digital media to target wastewater knowledge gaps - Build reuse pilot site(s)	- Monitor system adoption disaggregated by sex
Pilot Project: Rainwater Harvesting (RWH)	- Appropriate design and affordability of RWH system	- Identify criteria that limit country-wide rainwater harvesting	- Conduct workshops on RWH design and price the system - Build RWH demonstration site(s)	- Track design and cost of systems adopted disaggregated by sex

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH

5.1 Summary of Findings

The overall goal of this research was to present practical guidelines and approaches to mainstream and operationalize gender throughout the life cycle of water and wastewater infrastructure projects for an Energy Water Nutrient nexus project in Barbados.

This thesis reviewed the Government of Barbados' demographic statistics and national gender and climate change policies to determine legislative commitments to gender equality and climate adaptation in water and wastewater infrastructure in Barbados. It then presented a gender profile of technical and leadership roles at the Barbados Water Authority, followed by an analysis of social media information, and responses from a water user survey, focus groups and interviews that characterized the Barbados landscape for opportunities to integrate gender into the design and management of water and wastewater infrastructure. Anticipated gender impacts associated with environmental and social impacts of infrastructural components of a model Energy Water Nutrient nexus project were described, and opportunities to address these impacts as well as those identified through the gender landscape characterization were proposed for the life cycle of the project. For the water user survey Pearson Chi-Square Test of Independence was performed to determine statistical significance ($p \leq 0.05$) of responses by gender within the sample population. The Mean (ME) and Standard Error of the Mean (SE) were determined to extrapolate representativeness ($SE < ME$) of mean survey responses to the mean overall response of the population of Barbados.

There were three objectives that guided this research and each will be discussed below in terms of conclusions gleaned from this research.

1. Objective 1was to determine the institutional and legal frameworks that inform the types and extent of gender mainstreaming activities to be incorporated in the development of water and wastewater climate infrastructure projects in Barbados.

The literature review discussed the scope of gender and development literature with an emphasis on the expertise and scholarship that exists in the Caribbean region. The common absence of sex-disaggregated information was highlighted as a key limitation to the assessment of progress towards achieving gender equality globally, and in infrastructure projects. Global development goals with targets of gender equality, and climate change as the single biggest threat to sustainable development have provided the framework for international climate finance mechanisms to integrate gender mainstreaming activities in their objectives and interventions (UN 2015, UN 2017), .

Gender equality as a goal of climate financing mechanisms was introduced retroactively for several multilateral climate funds (except for the Green Climate Fund) due to sub-optimal project outcomes from gender blind projects. Projects implemented by these funds globally and in the Caribbean can provide direct or indirect guidance on appropriate gender mainstreaming activities that can be included in the development of water and wastewater infrastructure projects in Barbados. Case studies on water and sanitation gender vulnerabilities in Jamaica are also ideal sources of information to inform Caribbean gender mainstreaming activities.

Outside of rhetoric in climate adaptation policies, there are currently no legislative commitments to gender equality in water and wastewater resources management in

Barbados. A Draft National Policy on Gender is presently before parliament but the policy does not address gender and water. Additionally, the BWA does not have a Gender Policy. A Policy Paper on Gender and Water as an Action Plan item of the EWN-SCI project as well as creation of a Gender Policy for the BWA was proposed.

2. Objective 2 was to characterize the current landscape for integrating gender into the design and management of water and wastewater infrastructure in Barbados.

The Barbados Water Authority is the Statutory Body charged with supplying the island with potable water (98% coverage), as well as providing wastewater treatment (99.8% improved sanitation coverage of which 8% is sewered). The BWA has more men than women employed in technical (45% vs 3.5%), and leadership (9.1% vs 3.9%) roles which directly contribute to the design and management of the utility's projects. Most of these individuals are in the middle or near the end of their careers (> 40 years of age), and thus present a timely opportunity to recruit, train and promote women to fill these roles. Many Barbadians were engaged on Twitter and Facebook sharing their frustrations, and proposing solutions to water management under the prevailing water shortages (e.g. rainwater harvesting) from 2015-2016. The lack of an online presence by the BWA represented a lost opportunity to engage its stakeholders on collaborative solutions that could temporarily or permanently alleviate the challenges.

There was a statistical significant relationship ($p < 0.05$) between gender and type of water storage container used at the household level. Women were more likely to report the use of small containers such as buckets, while men showed a preference for larger containers such as plastic tanks and barrels. This difference has implications for the design of a country-appropriate rainwater harvesting system. The proposition of a research arm of the utility

that could study gender dimensions of health impacts of water quality and water interruptions, and economic studies assessing feasibility of introducing a tariff structure on water provision were priority projects from the BWA. Investment in equipment at the national government lab, and at the University of West Indies Chemistry Department represents a skills building and economic empowerment opportunity for women who form the bulk of workforce at these institutions.

3. Objective 3 was to evaluate and recommend opportunities for gender integration in the life cycle of water and wastewater infrastructure in Barbados.

The key recommendations identified from the Gender Impact Assessment for the model EWN-SCI Projects were the need to identify clear gender objectives and targets prior to project implementation to ensure they are incorporated in the project. Budgetary allocations to appoint a gender focal point who would coordinate these activities are also recommended. Job creation is one the main areas for distribution of project benefits. Since the current skillsets for these technical jobs bias allotment to men, there will be need for targeted training, recruitment and promotion of women to fill these roles. Specific on-the-job hazards can also be minimized by enforcement of OSHA training. A clear stakeholder engagement and communication plan is needed to capture and respond to the concerns of all sections of the population. Social media communication will be key to this strategy moving forward. Specifically for the pipe replacement project, the inclusion of socio-economic information as a criterion for prioritization of locations for intervention is recommended.

This Case Study in Barbados is unique because it allowed for an identification and assessment at a small scale of numerous challenges experienced by countries with a high

population density and centralized potable water coverage, old and failing water infrastructure, and demonstrated vulnerability to climate change impacts. Gender mainstreaming lessons learnt here are therefore transferrable to other countries which share these unique features. These results can also inform the development of ENVISION™ Certification guidelines that will include gender considerations as a criteria for sustainable infrastructure.

5.2 Recommendations for Future Research

This study gathered baseline information on gendered differences in use and management of water and wastewater in Barbados that will inform the creation of objectives and project targets to mainstream gender in future Energy-Nutrient-Water sector infrastructure developments. Since these results were captured under drought conditions, it is recommended that similar data collection be deployed under non-drought conditions which may give rise to other impacts and associated priorities. Future work should also include an in-depth gender analysis that will capture not only time division of labor on domestic water-related activities, but also analyze cultural, political, legal and social drivers that have historically influenced the use and access to water and wastewater services in Barbados.. This information can be used to monitor project benefits in terms of time saved as a result of interventions made.

Additional Research Questions related to this topic that can be explored include: (1) What are the impacts of unequal distribution and chronic unreliability on households at the parish level? (2) What opportunities for job training and entrepreneurial activities at vocational levels are anticipated from the EWN-SCI project? (3) How can infrastructure be

integrated in Caribbean Gender Policies? (4) What are models of successful partnerships between utility partners and education and research institutions?

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APPENDICES

Appendix A: List of Acronyms

AF	Adaptation Fund
ASCE	American Society of Civil Engineers
BML	Barbados Ministry of Labour
BSS	Barbados Statistics Survey
BVTB	Barbados Vocational Training Board
BWA	Barbados Water Authority
CARICOM	Caribbean Community
CARIWIN	Caribbean Water Initiative
CCBYNCSA	Creative Commons Attribution - Non Commercial - Share Alike
CCCCC/5Cs	Caribbean Community Climate Change Center
CDB	Caribbean Development Bank
CDM	Comprehensive Disaster Management
CEO	Chief Executive Officer
CHENACT	Caribbean Hotel Energy Efficiency and Renewable Energy Action Program
CGA	Country Gender Assessment
CIA	Central Intelligence Agency
CIGAD	Caribbean Institute for Gender and Development
CIF	Climate Investment Funds
CWWA	Caribbean Water and Wastewater Association
ESIA	Environmental and Social Impact Assessment
EU	European Union
EWN-SCI	Energy-Water-Nutrient Nexus for Sustainable Coastal Infrastructure
FIP	Forest Investment Program
FTC	Fair Trading Commission
GGCA	Global Gender and Climate Alliance
GCF	Green Climate Fund
GDI	Gender Development Index
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEF CReW	Global Environment Facility Caribbean Regional Fund for Wastewater Management
GHG	Greenhouse Gas
GWP	Global Water Partnership
HDI	Human Development Index
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
IBM	International Business Machines??
ICT	Information and Communication Technology
IDB	Inter-American Development Bank
INDC	Intended Nationally Determined Contribution
IRB	Institutional Review Board
JICA	Japan International Cooperation Agency

MDB	Multilateral Development Bank
MDG	Millennium Development Goal
ME	Mean
MOU	Memorandum of Understanding
MW	Mega Watt
NDC	Nationally Determined Contribution
NRW	Non-Revenue Water
O&M	Operation & Maintenance?
ODI	Overseas Development Institute
OECD DAC	Organisation for Economic Co-operation and Development - Development Assistance Committee
OSHA	Occupational Safety and Health Administration
PPCR	Pilot Project for Climate Resilience
PV	Photovoltaic?
RWH	Rainwater Harvesting
SDG	Sustainable Development Goal
SE	Standard Error of the Mean
SEED	Student Entrepreneurial Empowerment Development
SIDS	Small Island Developing States
SREP	Scaling Up Renewable Energy in Low Income Countries Program??
SWM	Schweitzer-Mauduit International???
UN	United Nations
UNDP	United Nations Development Program
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Program
UNFCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations International Children's Emergency Fund
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
USF	University of South Florida
UWI	University of the West Indies
UWI IGDS	University of the West Indies Institute of Gender and Development Studies
WASH	Water, Sanitation and Hygiene
WEFTEC	Water Environment Federation Technical Exhibition and Conference??
WHO	World Health Organization
WLR	Water Loss Reduction
WRI	World Resources Institute
WW	Wastewater

Appendix B: IRB Approval Letters for Study and Amendment

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX (813) 974-7091

August 22, 2016

Maya Trotz, PhD
Civil and Environmental Engineering
4202 East Fowler Avenue
ENB 118
Tampa, FL 33620

RE: **Expedited Approval for Initial Review**
IRB#: Pro00027337
Title: Gender Analysis for a Proposed Project on Sustainable Coastal Infrastructure for the Energy-Water-Nutrient Nexus in Barbados.

Study Approval Period: 8/22/2016 to 8/22/2017

Dear Dr. Trotz:

On 8/22/2016, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):
IRB Protocol_Version 1_7_28_16.docx

Consent/Assent Document(s)*: Both forms granted a waiver
Verbal Consent_Focus Group Document
Verbal Consent_Questionnaire Document

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent document(s) are only valid during the approval period indicated at the top of the form(s). Consent forms granted a waiver are not stamped.

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve

Figure B.1: IRB Approval Letter for Study Pro00027337

only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110. The research proposed in this study is categorized under the following expedited review category:

(6) Collection of data from voice, video, digital, or image recordings made for research purposes.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Your study qualifies for a waiver of the requirements for the documentation of informed consent as outlined in the federal regulations at 45CFR46.117(c) which states that an IRB may waive the requirement for the investigator to obtain a signed consent form for some or all subjects if it finds either: (1) That the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. Each subject will be asked whether the subject wants documentation linking the subject with the research, and the subject's wishes will govern; or (2) That the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context. (Verbal consent forms)

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John Schinka, Ph.D., Chairperson
USF Institutional Review Board

Figure B.1 continued

USF
UNIVERSITY OF
SOUTH FLORIDA

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX (813) 974-7091

10/31/2016

Maya Trotz, PhD.
Civil and Environmental Engineering
4202 East Fowler Avenue
ENB 118
Tampa, FL 33620

RE: **Expedited Approval of Amendment**
IRB#: Ame1_Pro00027337
Title: Gender Analysis for a Proposed Project on Sustainable Coastal Infrastructure for the Energy-Water-Nutrient Nexus in Barbados.

Dear Dr. Trotz:

On 10/31/2016, the Institutional Review Board (IRB) reviewed and **APPROVED** your Amendment. The submitted request and all documents contained within have been approved, including those outlined below.

No new staff will be included. The number of participants has been increased to 250, the location of Trinidad and Tobago (at the Caribbean Water and Wastewater Association Conference) has been added, and additional Inclusion Criteria has been added.

Justification for the changes are outlined below: Since receiving IRB approval of the gender analysis study protocol, all of the researchers participating in the study received notice of the Caribbean Water and Wastewater Association conference in nearby Trinidad and Tobago. Noticing that it would provide an opportunity to expand the number of survey participants, the decision was made among research group members to apply for an amendment to the current protocol such that the only edits would be made in expanding the number of participants and including an new geographical location for conducting surveys—Trinidad and Tobago.

Approved Item(s):
Protocol Document(s):
IRB Protocol_Revised Version 2_10_15_16_Accepted Changes.docx

The IRB does not require that subjects be reconsented.

Figure B.2: IRB Approval Letter for Amendment Ame1_Pro00027337

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with USF HRPP policies and procedures and as approved by the USF IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John Schinka, Ph.D., Chairperson
USF Institutional Review Board

Figure B.2 continued

Appendix C: Water User Survey

Table C.1: Water User Survey administered to customers of the Barbados Water Authority during the period 10/20/16 – 11/8/16

1. Age (write in):	**9. If you store water, have you ever noticed mosquitos in any of your tanks? (Select one.)**
2. Gender (circle): MALE / FEMALE	(a) YES (b) NO
3. Parish, Community (write in):	(c) unable to check storage container
4. Your highest level of education is? (select one)	**10. Do you take any of these measures to reuse water from your home? (Select all that apply.)**
(a) primary school (b) secondary school (c) associate's degree (d) vocational certificate (e) bachelor's degree (f) master's degree (g) doctoral level	(a) reuse kitchen sink water for other household purposes (b) reuse laundry water for other household purposes (c) other, please write in:
5. What is your primary source of drinking water? (Select only one.)	**11. What does your household do to clean your primary drinking water source? (Select all that apply.)**
(a) tap in house (b) household stand pipe (c) community stand pipe (d) bottled water/drink (e) household rainwater barrel (f) community rainwater barrel (g) other, please write in below:	(a) boil (b) clean storage tank (c) add chlorine tablets (d) use household filter (e) add chlorine liquid/bleach (f) installed mesh on tank (g) add layer of oil to storage tank (h) add guppies to storage tank (i) no measure to clean water source (j) other, please write in:
6. What are your supplemental sources for drinking water? (Select all that apply.)	**12. If applicable, who performs these tasks? (Select one.)**
(a) tap in house (b) household stand pipe (c) community stand pipe (d) bottled water/drink (e) household rainwater barrel (f) community rainwater barrel (g) no supplemental source	(a) head of household (b) child (c) neighbor (d) relative or renter (e) paid worker

Table C.1 continued

7. If you store water at your household, what type of container do you use? (Select all that apply.)	**13. What is their gender? M F**
(a) plastic barrel (b) plastic tank (c) bucket(s) (d) reservoir (e) do not store water	**14. How do you maintain your septic system? (Select all that apply.)**
8. If you store water at your household, what are your reasons? (Select all that apply.)	(a) have septic pumped regularly (every 5-7 years) (b) do not flush toilet paper or similar products (c) install toilets with low-flow water usage (d) add chemicals to help breakdown in septic system (e) I do not use septic, I am connected to the BWA system (f) i do not use septic, I treat my wastewater by (write in):
(a) as back up during interruption of BWA services (b) as independence from BWA network (c) as a source of non-contaminated water (d) for household convenience (e) as a water source in dry season (f) as a water source in wet season (g) as a source in case of natural disaster (h) to reduce the cost of water bill from BWA	
15. How do you contact BWA? (Select all that apply)	**16. How does BWA inform you of new projects, changes, or issues to your water and sewage services? (Select all that apply.)**
(a) call BWA Hotline (b) post on social media (c) email customer care (d) post letter to BWA (e) fill out form on BWA website (f) visit a BWA office **(**g) attend public meetings (h) never contact BWA directly (i) other, please write in:	(a) flyer at payment stations (b) social media updates (c) emails (d) posted mail (e) door-to-door flyers (f) TV ads (g) radio ads (h) billboard (i) community meetings (j) word-of-mouth (k) surveys (l) never been informed m) other, please specify

Table C.1 continued

17. For the past three months, what is your household's average monthly expenditure on **a) water services? BDS$_____ b) wastewater services? BDS$_____**
18. If you buy water (outside of BWA), how much do you spend on purchased water per month? **BDS$_____.**
19. Given your current monthly consumption, what is the maximum your household would be **ABLE** to pay per month for water services? **BDS$_____.**
20. Given your current monthly consumption, what is the maximum your household would be **WILLING** to pay per month for water services? **BDS$_____.**

Using a scale of 1 to 5 please indicate the level of satisfaction with items listed below. The numbers indicate

1 – I strongly agree 2 – I agree 3 – I am indifferent 4 – I disagree

5 – I strongly disagree 6 – This question does not apply to me

ITEMS	1	2	3	4	5	6
21. When I contact BWA, my concerns are addressed?						
22. I should be able to contribute to decisions made about water projects?						
23. The **current cost** for the water service offered is reasonable						
24. The **current cost** for the wastewater service offered is reasonable						
25. Overall, my household is **satisfied** with BWA's **water supply system**						
26. Overall, my household is **satisfied** with BWA's **water quality**						
27. I am concerned that the BWA's water quality negatively affects the **health** of my household. Some of my concerns are:						

Appendix D: Focus Group and Interview Questions

Table D.1: Focus Group Questions for the Barbados Water Authority and University of the West Indies Institute of Gender and Development Studies during the period 10/20/16 – 11/8/16

No	Question
Barbados Water Authority	
1	Work in groups of 2-3 persons to identify projects you believe the Barbados Water Authority should pursue to improve its climate resiliency
2	Can you identify any potential gender impacts of the projects suggested?
University of the West Indies Institute of Gender and Development Studies	
1	What role do men and women in play in the management of water and wastewater in Barbados? If differences in roles exist, why do you think this is?
2	What role can the UWI IGDS play in promoting equitable management of water and wastewater resources in Barbados?

Table D.2: Interview Questions for Stakeholders of the Barbados Water Authority during the period 10/20/16 – 11/8/16

No	Question
1	How would you describe the management of water and wastewater in Barbados?
2	As a professional in the (business, health, environmental protection, etc.) sector what role do you believe your group should play in stewardship of the water and wastewater resources in Barbados?
3	Can you think of any gender concerns that arise from the current management of water and wastewater in Barbados? What are the roles of women and men? Is there a difference?
4	What do you think can be done to make the management of water and wastewater in Barbados climate resilient?
5	What would you recommend to ensure equal participation of men and women in the design and management of water and wastewater infrastructure in Barbados?

Appendix E: Water User Survey Results

Table E.1: Survey responses to Question 1 on Age disaggregated by gender

			Age					
			18 - 30	31 - 40	41 - 50	51 - 60	61 +	Total
Gender	Male	Count	27	20	36	15	11	109
		% of Total	11.80%	8.70%	15.70%	6.60%	4.80%	47.60%
	Female	Count	46	24	25	16	9	120
		% of Total	20.10%	10.50%	10.90%	7.00%	3.90%	52.40%
Total		Count	73	44	61	31	20	229
		% of Total	31.90%	19.20%	26.60%	13.50%	8.70%	100.00%

Table E.2: Survey responses to Question 3 on Parish disaggregated by gender

			Parish											
			St. Andrew	Christ Church	St. George	St. James	St. John	St. Joseph	St. Lucy	St. Michael	St. Peter	St. Philip	St. Thomas	Total
Gender	Male	Count	1	18	12	15	5	2	4	40	3	7	2	109
		% of Total	0.40%	7.90%	5.20%	6.60%	2.20%	0.90%	1.70%	17.50%	1.30%	3.10%	0.90%	47.60%
	Female	Count	3	24	11	15	2	3	3	24	6	18	11	120
		% of Total	1.30%	10.50%	4.80%	6.60%	0.90%	1.30%	1.30%	10.50%	2.60%	7.90%	4.80%	52.40%
Total		Count	4	42	23	30	7	5	7	64	9	25	13	229
		% of Total	1.70%	18.30%	10.00%	13.10%	3.10%	2.20%	3.10%	27.90%	3.90%	10.90%	5.70%	100.00%

Table E.3: Survey responses to Question 4 on highest level of education achieved disaggregated by gender

			Education								
			Primary School	Secondary School	Associate's Degree	Vocational Training	Bachelor's Degree	Master's Degree	Doctoral Degree	NA	Total
Gender	Male	Count	3	27	15	6	36	17	3	2	109
		% of Total	1.30%	11.80%	6.60%	2.60%	15.70%	7.40%	1.30%	0.90%	47.60%
	Female	Count	6	31	21	9	38	9	2	4	120
		% of Total	2.60%	13.50%	9.20%	3.90%	16.60%	3.90%	0.90%	1.70%	52.40%
Total		Count	9	58	36	15	74	26	5	6	229
		% of Total	3.90%	25.30%	15.70%	6.60%	32.30%	11.40%	2.20%	2.60%	100.00%

Table E.4: Survey responses to Question 5 on source of primary drinking water disaggregated by gender

			Primary Source of Drinking Water						
			Tap in House	Household Stand Pipe	Community Stand Pipe	Bottled Water/Drink	Household Rainwater Barrel	Community Rainwater Barrel	Total
Gender	Male	Count	99	0	1	7	1	1	109
		% of Total	43.20%	0.00%	0.40%	3.10%	0.40%	0.40%	47.60%
	Female	Count	109	1	0	10	0	0	120
		% of Total	47.60%	0.40%	0.00%	4.40%	0.00%	0.00%	52.40%
Total		Count	208	1	1	17	1	1	229
		% of Total	90.80%	0.40%	0.40%	7.40%	0.40%	0.40%	100.00%

Table E.5: Survey responses to Question 6 on supplemental sources for drinking water disaggregated by gender

			Supplemental Water Sources						
			Tap in House	Bottled Water	House Rainwater Barrel	Community Rainwater Barrel	No Supplementary Source	Multiple Supplemental Sources	Total
Gender	Male	Count	3	49	5	1	50	1	109
		% of Total	1.30%	21.40%	2.20%	0.40%	21.80%	0.40%	47.60%
	Female	Count	5	61	1	0	50	3	120
		% of Total	2.20%	26.60%	0.40%	0.00%	21.80%	1.30%	52.40%
Total		Count	8	110	6	1	100	4	229
		% of Total	3.50%	48.00%	2.60%	0.40%	43.70%	1.70%	100.00%

Table E.6: Survey responses to Question 7 on type containers used to store primary drinking water disaggregated by gender

			Water Storage Containers								
			Plastic Barrel	Plastic Tank	Buckets	Reservoir	Does Not Store Water	Sauce Pan	Plastic Bottle	Multiple Containers	Total
Gender	Male	Count	12	23	24	0	29	0	2	19	109
		% of Total	5.20%	10.00%	10.50%	0.00%	12.70%	0.00%	0.90%	8.30%	47.60%
	Female	Count	9	12	35	1	20	1	10	32	120
		% of Total	3.90%	5.20%	15.30%	0.40%	8.70%	0.40%	4.40%	14.00%	52.40%
Total		Count	21	35	59	1	49	1	12	51	229
		% of Total	9.20%	15.30%	25.80%	0.40%	21.40%	0.40%	5.20%	22.30%	100.00%

Table E.7: Survey responses to Question 8 on reasons for storage of drinking water at the household disaggregated by gender

			Water Storage Reasons								
			as back up during interrupt-tion of BWA services	as indepen-dence from BWA network	for household convenience	as a water source in the dry season	as a source in case of natural disaster	to reduce the cost of water bill from BWA	Multiple Reasons	Question Not Applicable	Total
Gender	Male	Count	25	2	7	1	12	1	34	27	109
		% of Total	10.90%	0.90%	3.10%	0.40%	5.20%	0.40%	14.80%	11.80%	47.60%
	Female	Count	40	2	3	2	13	0	41	19	120
		% of Total	17.50%	0.90%	1.30%	0.90%	5.70%	0.00%	17.90%	8.30%	52.40%
Total		Count	65	4	10	3	25	1	75	46	229
		% of Total	28.40%	1.70%	4.40%	1.30%	10.90%	0.40%	32.80%	20.10%	100.00%

Table E.8: Survey responses to Question 9 on presence of mosquitoes in water storage containers disaggregated by gender

			Mosquitoes Present in Water Storage Containers				
			Yes	No	Unable to Check Storage Container	Question Not Applicable	Total
Gender	Male	Count	3	83	0	23	109
		% of Total	1.30%	36.20%	0.00%	10.00%	47.60%
	Female	Count	11	87	8	14	120
		% of Total	4.80%	38.00%	3.50%	6.10%	52.40%
Total		Count	14	170	8	37	229
		% of Total	6.10%	74.20%	3.50%	16.20%	100.00%

Table E.9: Survey responses to Question 8 on measures taken to reuse water at the household disaggregated by gender

			Water Reuse Practices					
			Reuse kitchen water for household purposes	Reuse laundry water for household purposes	Reuse household water for outdoor purposes	Does not reuse water	Reuses from multiple sources	Total
Gender	Male	Count	8	12	1	86	2	109
		% of Total	3.50%	5.20%	0.40%	37.60%	0.90%	47.60%
	Female	Count	17	16	1	78	8	120
		% of Total	7.40%	7.00%	0.40%	34.10%	3.50%	52.40%
Total		Count	25	28	2	164	10	229
		% of Total	10.90%	12.20%	0.90%	71.60%	4.40%	100.00%

Table E.10: Survey responses to Question 11 on methods used to clean primary drinking water disaggregated by gender

			Methods to Clean Primary Drinking Water Source								
			Boil	Clean Storage Tank	Use Household Filter	Add Chlorine Liquid/ Bleach	Add Guppies to Storage Tank	No Measures to Clean Water Source	Purge Water from Pipes	Multiple Treatment Methods	Total
Gender	Male	Count	19	0	24	0	0	57	1	8	109
		% of Total	8.30%	0.00%	10.50%	0.00%	0.00%	24.90%	0.40%	3.50%	47.60%
	Female	Count	22	3	25	3	1	54	0	12	120
		% of Total	9.60%	1.30%	10.90%	1.30%	0.40%	23.60%	0.00%	5.20%	52.40%
Total		Count	41	3	49	3	1	111	1	20	229
		% of Total	17.90%	1.30%	21.40%	1.30%	0.40%	48.50%	0.40%	8.70%	100.00%

Table E.11: Survey responses to Question 14 on strategies used to treat septic tanks disaggregated by gender

			Septic Maintenance Strategies									
			Pumped regularly (5-7 years)	Do not flush toilet paper or similar products	Install toilet with low flow water usage	Add chemicals to help breakdown in septic	No septic, I am connected to the sewer	No septic, I use a suckwell	I do not know	Septic Not Maintained	Multiple Methods	Total
Gender	Male	Count	17	2	0	5	11	56	12	2	4	109
		% of Total	7.40%	0.90%	0.00%	2.20%	4.80%	24.50%	5.20 %	0.90%	1.70%	47.60 %
	Female	Count	18	1	1	0	10	58	29	1	2	120
		% of Total	7.90%	0.40%	0.40%	0.00%	4.40%	25.30%	12.70 %	0.40%	0.90%	52.40 %
Total		Count	35	3	1	5	21	114	41	3	6	229
		% of Total	15.30%	1.30%	0.40%	2.20%	9.20%	49.80%	17.90 %	1.30%	2.60%	100.0 0%

Table E.12: Survey responses to Question 15 on methods used to contact the Barbados Water Authority disaggregated by gender

			Approaches to Contact the Barbados Water Authority							
			BWA Hotline	Email BWA	Online Form	Visit BWA Office	Never Contact BWA	Call BWA Employee Directly	Multiple Methods of Contacting BWA	Total
Gender	Male	Count	44	0	1	3	34	11	16	109
		% of Total	19.20%	0.00%	0.40%	1.30%	14.80%	4.80%	7.00%	47.60%
	Female	Count	46	2	0	5	44	4	19	120
		% of Total	20.10%	0.90%	0.00%	2.20%	19.20%	1.70%	8.30%	52.40%
Total		Count	90	2	1	8	78	15	35	229
		% of Total	39.30%	0.90%	0.40%	3.50%	34.10%	6.60%	15.30%	100.00%

Table E.13: Survey responses to Question 16 on approaches the Barbados Water Authority uses to communicate with the public disaggregated by gender

			Approaches the Barbados Water Authority uses to communicate with the public											
			Flyer	Social Media	Posted Mail	Radio Ad	Community Meeting	Word-of-Mouth	Never Informed	Print Media	BWA Internal Memo	Phone	Multiple Methods	Total
Gender	Male	Count	1	1	11	22	3	2	44	4	1	1	19	109
		% of Total	0.40%	0.40%	4.80%	9.60 %	1.30%	0.90%	19.20%	1.70 %	0.40%	0.40 %	8.30%	47.60 %
	Female	Count	1	2	8	27	0	13	35	3	1	1	29	120
		% of Total	0.40%	0.90%	3.50%	11.8 0%	0.00%	5.70%	15.30%	1.30 %	0.40%	0.40 %	12.70%	52.40 %
Total		Count	2	3	19	49	3	15	79	7	2	2	48	229
		% of Total	0.90%	1.30%	8.30%	21.4 0%	1.30%	6.60%	34.50%	3.10 %	0.90%	0.90 %	21.00%	100.0 0%

Table E.14: Survey responses to Question 21 on "When I contact the Barbados Water Authority my concerns are addressed?" disaggregated by gender

			Concerns Addressed when I contact the BWA						
			Strongly Agree	Agree	Indifferent or Neutral	Disagree	Strongly Disagree	Question Doesn't Apply	Total
Gender	Male	Count	12	30	9	15	12	31	109
		% of Total	5.20%	13.10%	3.90%	6.60%	5.20%	13.50%	47.60%
	Female	Count	12	24	10	12	20	42	120
		% of Total	5.20%	10.50%	4.40%	5.20%	8.70%	18.30%	52.40%
Total		Count	24	54	19	27	32	73	229
		% of Total	10.50%	23.60%	8.30%	11.80%	14.00%	31.90%	100.00%

Table E.15: Survey responses to Question 22 on "I should be able to contribute to decisions made about water projects?" disaggregated by gender

			I should be able to Contribute my Opinion to BWA Projects						
			Strongly Agree	Agree	Indifferent or Neutral	Disagree	Strongly Disagree	Question Doesn't Apply	Total
Gender	Male	Count	51	32	14	3	0	9	109
		% of Total	22.30%	14.00%	6.10%	1.30%	0.00%	3.90%	47.60%
	Female	Count	57	39	13	2	0	9	120
		% of Total	24.90%	17.00%	5.70%	0.90%	0.00%	3.90%	52.40%
Total		Count	108	71	27	5	0	18	229
		% of Total	47.20%	31.00%	11.80%	2.20%	0.00%	7.90%	100.00%

Table E.16: Survey responses to Question 23 on "The current cost for the water service offered is reasonable?" disaggregated by gender

			Cost of Water is Reasonable						
			Strongly Agree	Agree	Indifferent or Neutral	Disagree	Strongly Disagree	Question Doesn't Apply	Total
Gender	Male	Count	29	30	8	16	17	9	109
		% of Total	12.70%	13.10%	3.50%	7.00%	7.40%	3.90%	47.60%
	Female	Count	23	41	7	16	18	15	120
		% of Total	10.00%	17.90%	3.10%	7.00%	7.90%	6.60%	52.40%
Total		Count	52	71	15	32	35	24	229
		% of Total	22.70%	31.00%	6.60%	14.00%	15.30%	10.50%	100.00%

Table E.17: Survey responses to Question 24 on "The current cost for the wastewater service offered is reasonable?" disaggregated by gender

			Cost of Wastewater is Reasonable						
			Strongly Agree	Agree	Indifferent or Neutral	Disagree	Strongly Disagree	Question Doesn't Apply	Total
Gender	Male	Count	3	6	10	5	4	81	109
		% of Total	1.30%	2.60%	4.40%	2.20%	1.70%	35.40%	47.60%
	Female	Count	6	8	5	6	3	92	120
		% of Total	2.60%	3.50%	2.20%	2.60%	1.30%	40.20%	52.40%
Total		Count	9	14	15	11	7	173	229
		% of Total	3.90%	6.10%	6.60%	4.80%	3.10%	75.50%	100.00%

Table E.18: Survey responses to Question 25 on "Overall, my household is satisfied with BWA's water supply system?" disaggregated by gender

			Satisfaction with BWA Water Supply						
			Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Question Doesn't Apply	Total
Gender	Male	Count	38	32	9	11	16	3	109
		% of Total	16.60%	14.00%	3.90%	4.80%	7.00%	1.30%	47.60%
	Female	Count	34	44	11	13	12	6	120
		% of Total	14.80%	19.20%	4.80%	5.70%	5.20%	2.60%	52.40%
Total		Count	72	76	20	24	28	9	229
		% of Total	31.40%	33.20%	8.70%	10.50%	12.20%	3.90%	100.00%

Table E.19: Survey responses to Question 26 on "Overall my household is satisfied with BWA's water quality?" disaggregated by gender

			Satisfaction with BWA Water Quality						
			Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Question Doesn't Apply	Total
Gender	Male	Count	37	38	12	9	9	4	109
		% of Total	16.20%	16.60%	5.20%	3.90%	3.90%	1.70%	47.60%
	Female	Count	39	38	13	13	11	6	120
		% of Total	17.00%	16.60%	5.70%	5.70%	4.80%	2.60%	52.40%
Total		Count	76	76	25	22	20	10	229
		% of Total	33.20%	33.20%	10.90%	9.60%	8.70%	4.40%	100.00%

Table E.20: Survey responses to Question 27 on "I am concerned that the BWA's water quality negatively affects the health of my household?" disaggregated by gender

			Water Quality Negatively Affects Customer Health						
			Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Question Doesn't Apply	Total
Gender	Male	Count	8	8	10	22	47	14	109
		% of Total	3.50%	3.50%	4.40%	9.60%	20.50%	6.10%	47.60%
	Female	Count	8	17	10	19	53	13	120
		% of Total	3.50%	7.40%	4.40%	8.30%	23.10%	5.70%	52.40%
Total		Count	16	25	20	41	100	27	229
		% of Total	7.00%	10.90%	8.70%	17.90%	43.70%	11.80%	100.00%

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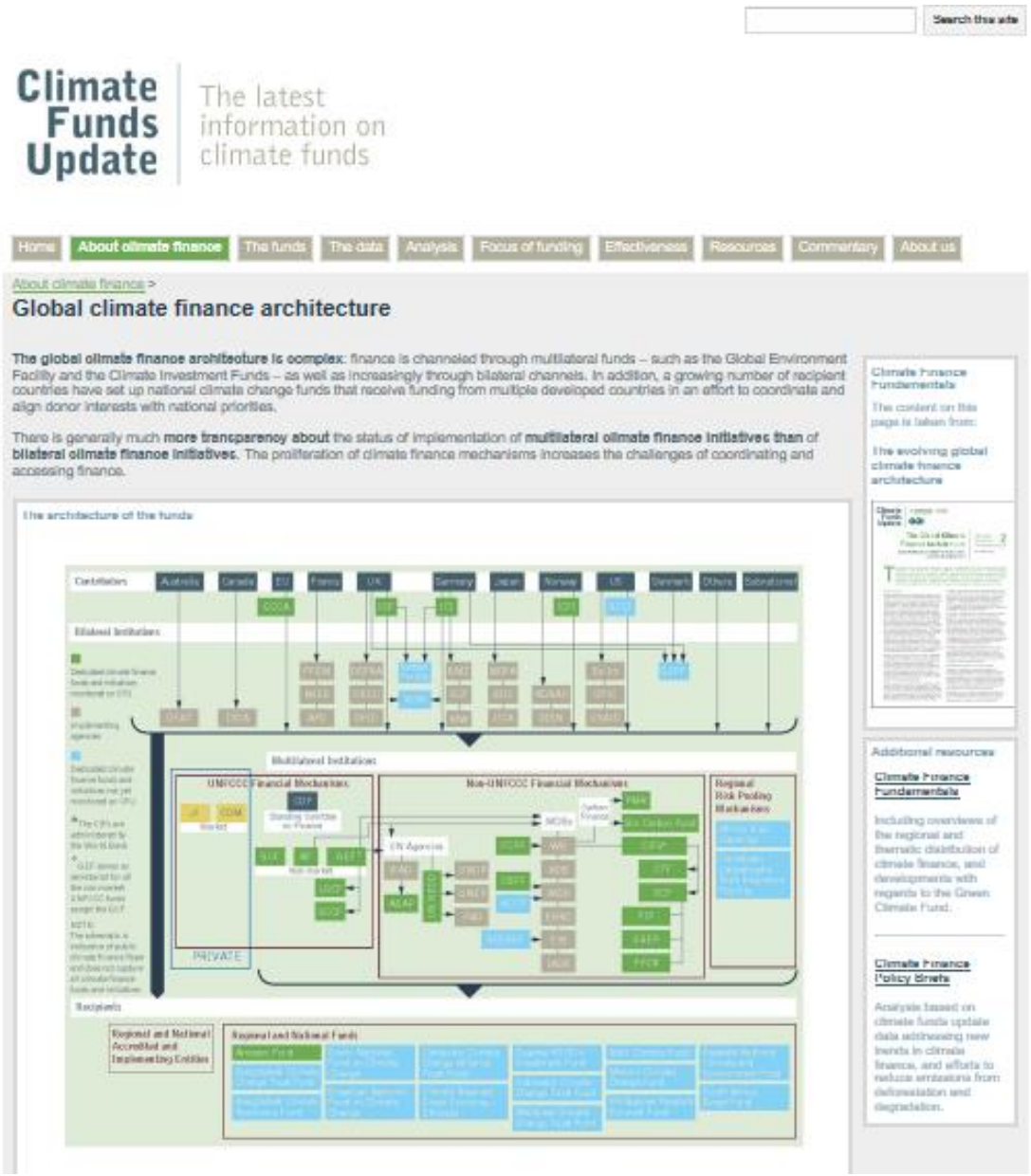

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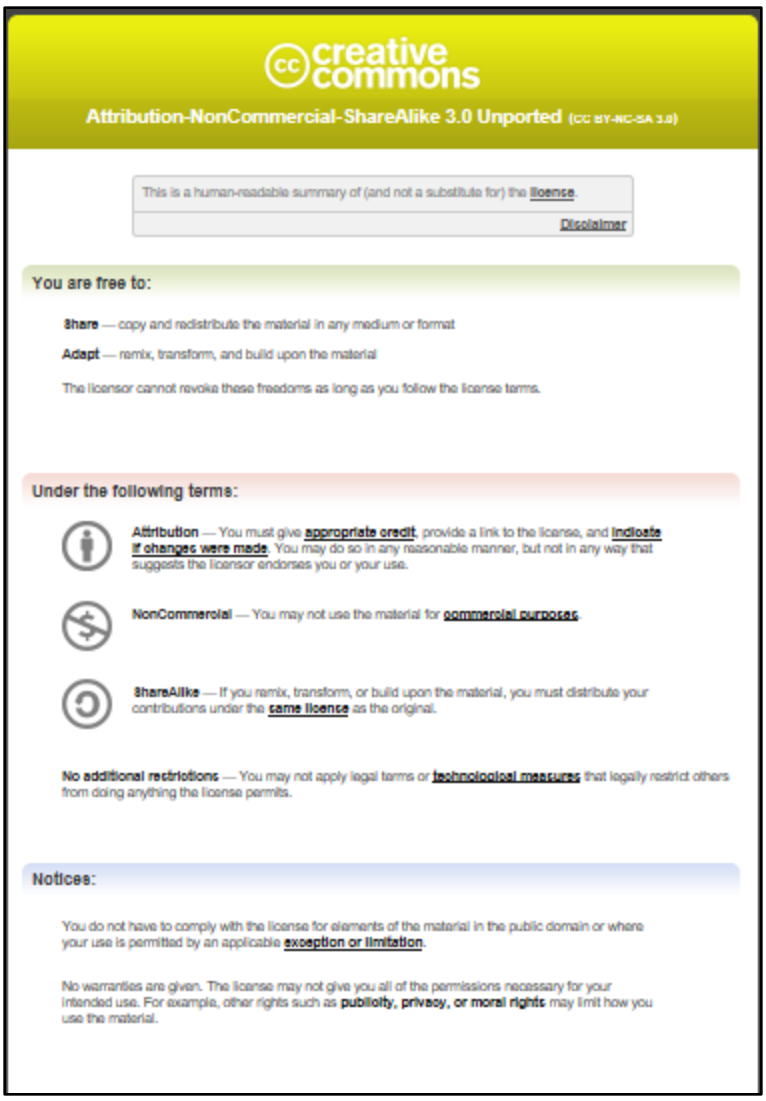
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Wainella Nicola Isaacs is a native of Guyana, South America, and presently an Environmental Engineering Ph.D. Student at the University of South Florida (USF). She is a 2013 graduate of the University of the West Indies (UWI), St. Augustine with a B.Sc. (First Class Honors), Majors: Chemistry & Environmental and Natural Resource Management, Minor: Economics. She was Valedictorian of the UWI Graduating Class of 2013 for the Faculties of Science & Technology and Food & Agriculture.

Wainella's research interest lies at the nexus of Engineering, Natural Resource Development and Public Health. Her graduate training will provide her with the technical skills needed to manage and/or advise on infrastructure development projects in the water and energy sectors. These skills, she is convinced, could enhance efforts in alleviating and mitigating the current and projected environmental, water and energy challenges that confront Guyana and the Caribbean Region at large.