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SOCIO-ECONOMIC AND PHYSICAL DEVELOPMENT INFLUENCES ON WATER USE IN BARBADOS

by

Alicia Suchorski
Department of Bioresource Engineering,
McGill University, Montreal

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ABSTRACT

Master of Science Alicia Suchorski **Bioresource Engineering**

SOCIO-ECONOMIC AND PHYSICAL DEVELOPMENT INFLUENCES ON WATER USE IN BARBADOS

Water scarcity has gained increasing awareness globally, and the small island developing states of the Caribbean, including Barbados, are not exempt from this global crisis. There is a large amount of variation to be found between Barbados' 11 parishes demographically, economically, and socially, with tourism encapsulating an especially significant sector for both the economy and water use, emphasized in certain parishes most prevalently.

Surveys were carried out in four coastal parishes and respondents were asked various water-related questions for their household. The survey addressed a myriad of issues such as water availability, quality, categorizing responsibilities of water-related tasks, as well as a number of other topics. The number of surveys conducted was equivalent to one per cent of each parish population. The chi-square test for the analysis of a two-way contingency table was conducted to determine the influence of development and gender on parish households in differential water use, access, and perceptions of water. Surveys were completed to provide clarity to the objectives of the research which were twofold: to determine whether the amount of economic, social, and physical development of a parish influences the access and distribution of domestic water to households; and to uncover gender perceptions related to water use and determine how water use patterns and water consumption vary between genders in households.

Parish development was a much stronger indicator for water usage and distribution rather than gender. All questions compared across parishes yielded at least one statistically significant response with the exception of determining whether water shortages affected lifestyles. Parish water use was highest in St. Philip (898.1 L/week/capita) and lowest in St. Lucy, (729.9 L/week/capita). The gender analysis provided statistically insignificant results except for the total respondents' water quality, and a household's satisfaction with their water situation, which were only significant for the total population and St. Lucy categories. Regarding division of labour within households, women still occupy the majority of tasks relating to water by spending on average 12.6 hrs/week on water-related domestic tasks; while males and children spend almost 5.6 hrs/week and 1.70 hrs/week respectively.

RÉSUMÉ

Maîtrise en Science Alicia Suchorski **Génie des bioressources**

INFLUENCE DU DÉVELOPPEMENT SOCIO-ÉCONOMIQUE ET PHYSIQUE SUR L'ACCÈS À L'EAU ET SUR LES IMPLICATIONS ENTRE LES SEXES POUR L'USAGE DE L'EAU À LA BARBADE

Le phénomène de la rareté de l'eau connait une sensibilisation de plus en plus importante au niveau global. Les petites îles en voie de développement dans les Caraïbes, dont la Barbade, ne sont pas exemptées de cette crise mondiale. Ses onze paroisses diffèrent significativement d'une à l'autre, que ce soit au niveau démographique, économique, social et notamment au niveau du tourisme qui est un secteur particulièrement significatif pour l'économie et pour l'utilisation de l'eau, dont l'impact est plus présent dans certaines paroisses que d'autres.

Des sondages ont été effectués dans quatre paroisses littorales et les répondants ont été interrogés sur des questions connexes à l'usage de l'eau pour leur ménage. Le sondage adressait un bon nombre de problèmes tels que la disponibilité de l'eau, la qualité de l'eau, la catégorisation des responsabilités d'utilisation de l'eau pour des tes tâches diverses, et ce, parmi tant d'autres. Dans chaque paroisse, 1% de la population a été sondé. Le test du chi-carré a été effectué sur les données de sondage réalisées auprès des ménages afin de déterminer l'influence du sexe et du développement sur les écarts entre l'utilisation, l'accès et les perceptions de l'eau. Ces sondages ont été effectués pour éclairer les objectifs de la recherche qui étaient doubles. Premièrement pour déterminer si le niveau de développement économique, social, et physique d'une paroisse influence l'accès et la distribution de l'eau domestique aux ménages. Deuxièmement, pour découvrir les perceptions liées au sexe quant à l'utilisation de l'eau, la détermination des modèles d'utilisation de l'eau et la variation de la consommation d'eau entre les sexes d'un même ménage.

Le niveau du développement d'une paroisse est un indicateur beaucoup plus fort de la façon dont l'eau est employée et distribuée que le sexe. La comparaison des questions posées à travers les paroisses ont chacune généré au moins une réponse statistiquement significative, exception faite de la détermination du fait qu'une pénurie d'eau affecte le style de vie ou non. La paroisse ayant utilisé le plus d'eau est Saint Philippe (898.1 L/semaine/personne) et le moins d'eau est Saint Lucie, (729.9 L/semaine/personne). L'analyse effectuée en fonction du sexe a

donné des résultats statistiquement insignifiants exceptés pour l'analyse de la qualité de l'eau pour l'ensemble de la population totale, et la satisfaction d'un ménage face à leur situation d'eau dont les résultats étaient significatifs pour seulement l'ensemble de la population totale et la catégorie de Sainte Lucie. Concernant la répartition des tâches dans des ménages, les femmes s'occupent toujours de la majorité des tâches domestiques touchant à l'eau en y dépensant approximativement en moyenne 12.6 heures/semaine tandis que les mâles et les enfants n'y passent respectivement que 5.6 heures/semaine et 1.7 heures/semaine.

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I would like to thank my research assistants from the 2007 BFSS programme, Jennifer Bedore and Kim McGrath for their incredible work and dedication to this project. Surveying would have been impossible without the two of them. Jennifer Bedore deserves a double nod for returning with me to Barbados in April of 2008 to help me complete household surveying in the parishes of St. Joseph and St. Philip.

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LIST OF ACRONYMS AND ABBREVIATIONS

ARWR	Available Renewable Water Resources
BBC	British Broadcasting Corporation
BSS	Barbados Statistical Service
BWA	Barbados Water Authority
Cap-Net	Capacity Building for Integrated Water Resources Management
CARIWIN	Caribbean Water Initiative
CIDA	Canadian International Development Agency
c.v.	Critical value
ED	Enumeration District
EU	European Union
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GEM	Gender Empowerment Measure
GDI	Gender Development Index
GWA	Gender and Water Alliance
GWP	Global Water Partnership
GWP TAC	Global Water Partnership Technical Advisory Committee
HDI	Human Development Index
HDR	Human Development Report
HPI1	Human Poverty Index for developing countries
INSTRAW	United Nations International Research and Training Institute for the Advancement of women
IWRM	Integrated Water Resources Management
L	litres
MDG	Millennium Development Goal
mm	millimetres
PAHO	Pan American Health Organization
TRWR	Total Renewable Water Resources
UN	United Nations
UNDAW	United Nations Division for the Advancement of Women

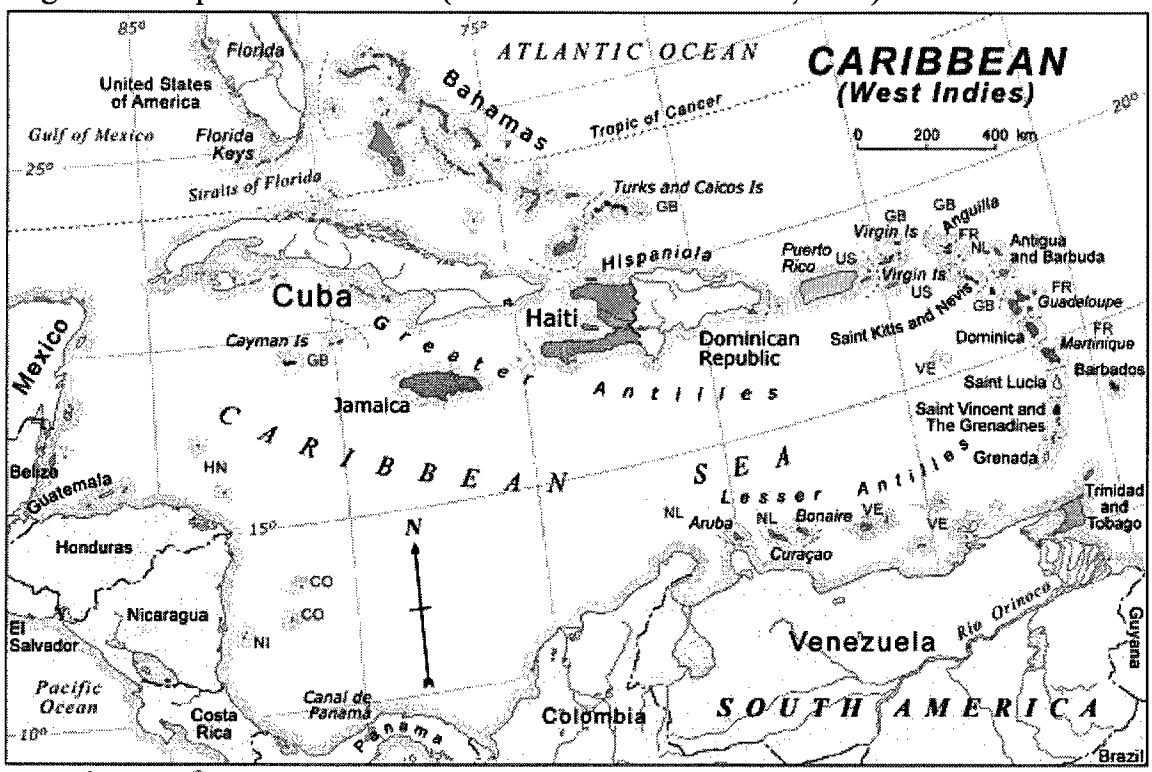
UNDP	United Nations Development Programme
UN-Water	United Nations Water
WHO	World Health Organization
WSSD	World Summit on Sustainable Development
ZINWA	Zimbabwe National Water Authority

1. Introduction

Barbados is a small island developing state in the Eastern Caribbean, belonging to the Windward Islands of the Lesser Antilles (Figure 1.1). It has a population of approximately 260, 000, with a substantial amount of the population located near the capital of Bridgetown on the southwest coast of the island, as well as the western and southern coasts (Barbados Statistical Service (BSS), 2000). Barbados is a relatively well-established nation, with a good road network and social infrastructure in place with a Human Development Index (HDI) ranking in 2008 of 37 (out of 179 nations). Barbados also has a Human Poverty Index for developing countries (HPI-1) value of 3.0%, ranking it fourth among 135 developing countries for which the index has been calculated (UNDP, 2008). This index focuses its attention on the proportion of people underneath a threshold level in the same dimensions of human development as the human development index - living a long and healthy life, having access to education, and a decent standard of living. By not simplifying the scope of poverty and looking beyond income deprivation, the HPI-1 represents a multi-dimensional alternative to the simplistic $1.25 per day (PPP US$) poverty measure (UNDP, 2008). Therefore, the country is on the cusp between developed and developing nations. Historically, sugarcane was the most important aspect of the Barbadian economy. As the sugar industry in the Caribbean is losing its clout, the most important sectors in Barbados' economy include tourism (12.4% of total 2004 GDP), wholesale and retail (18.2% of total 2004 GDP) and the (offshore) financial services sector (19.0% of total 2004 GDP) (Barbados Tourism Investment, 2006).

Although annual rainfall is estimated at 1422 mm per year, much of that is concentrated in the wet season between the months of June to December; during the dry season, rainfall can be as minimal as 25mm per month (FAO, 2000). Agriculture is the largest user of water in Barbados (water-technology.net, 2008). Tourism, although already having stated its importance to Barbadian society (and economic prosperity), is also an important component in the issue of water allocation and availability. Water plays a vital role in the development of any country; this development however is under the auspices that Barbados is a water scarce nation. The recognition of water scarcity is a global phenomenon, "there is widespread recognition that the world is facing a growing water crisis, affecting the well-being of millions if the poorest people [...] The United Nations reports 1.1 billion people (one in six of the world's population) lack access to improved drinking water, and 2.4 billion lack access to sanitation" (UN DAW, 2005).

Figure 1.1 Map of the Caribbean (Natural Resources Canada, 2003)



With ever increasing pressure placed on water through both the processes of population growth and increasing consumptive patterns, the proper management of water will become even more essential than is currently. Equitable allocation of water will need to consider all human uses of the resource – consumption, municipal, agricultural, industrial, and recreational. There is also the ever growing requirement for the consideration of environmental needs, and thus the management of water needs to incorporate ecological requirements for water (amount and quality) into its regime under the umbrella of sustainable development. This type of holistic approach to water resources management forms the basis of Integrated Water Resources Management (IWRM). The Global Water Partnership (GWP) defines IWRM as, "A process that promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems" (GWP TAC, 2000). IWRM, which conveys in its theory the sustainable use of water resources, contains three elements: environmental sustainability, economic efficiency, and social equity (Cap-Net, GWA 2006). Within the category of social equity lies the issue of addressing gender inequalities within water resources

management. The term gender, as the FAO defines, is not biologically determined but socially constructed. It is "a central organizing principle of societies, and often governs the processes of production and reproduction, consumption and distribution. Gender roles vary among different societies and cultures, classes, ages and during different periods in history. Gender-specific roles and responsibilities are often conditioned by household structure, access to resources, specific impacts of the global economy, and other locally relevant factors such as ecological conditions" (FAO, 1997). Gender plays a significant role in the realm of water due to the fact that when water is not supplied by a piped system, the burden of water collection falls on women and children, who must expend a huge amount of time and energy on this activity (Cap-Net, GWA, 2006). Projects that have gender as a consideration generally are more efficient and sustainable in the long term (UN DAW, 2005), and so it is extremely significant not only the success of a project but for matter of equity that gender be included in water-related projects. The objectives of this research as they relate to IWRM will be carried through by the CARIWIN project to be implemented in Barbados and the other partner countries of Grenada, Guyana, and Jamaica. The purpose of CARIWIN is to implement IWRM into these three countries and to strengthen the project partner CIMH (Caribbean Institute for Meteorology and Hydrology); as a regional training institution and information centre of excellence in equitable and sustainable IWRM.

1.1. Objectives

The objectives of this research were to:

i. Determine whether the amount of economic, social, and physical development of a parish influences the access and distribution of domestic water to households;
ii. Uncover gender perceptions related to water use and determine how water use patterns and water consumption vary between genders in households.

1.2. Scope

Although Barbados is a small country; it is spatially and socio-economically varied amongst all parishes. It remains difficult to extrapolate from this research and generalize on behalf of the remaining parishes, let alone to the rest of the Caribbean nations which vary quite significantly socially, physically, in economic development, as well in terms of water resources and issues. Therefore, the scope of this thesis is limited to the four parishes explored in the research,

although issues of gender can be generalized for the rest of the country. The research conducted covered 1% of each parish population; and although it would have been ideal to survey everyone in the given parishes, time and financial limitations prevented a larger sample size to be obtained. Thusly, parish generalizations will be made from the given sample size although even within each parish there were considerable differences.

1.3. Thesis outline

This thesis is presented in a traditional format which explores plausible explanations to the research objectives. The first section is a summary of the existing literature covering the subjects of Barbados and its development, tourism and water, IWRM, the relationship between gender and water in the broader global context, and the same relationship in the regionally-specific context of the Caribbean. Following the literature review are the methodological outlines used in the research. The results of the development and gender analyses are presented, followed by a discussion of the results. The main findings and conclusions are summarized, while the final section documents suggestions for further research.

2. Literature review

2.1. Barbados, water, and development

Barbados is a spatially small nation with an area of approximately 431 km^2 and a population of 260,000. It is one of the most densely populated countries globally with a density of 623 people per square kilometer (Government of Barbados, 2000). Population growth has decreased to 0.3%, equating Barbados in this regards with many of the most developed countries globally.

Although the capital Bridgetown has the greatest concentration of people with 37 % of the population residing there (PAHO & WHO, n.d.), the rest of the population has settled along the south-east, south and west coasts of the island, predominantly in the coastal areas of the parishes of Christ Church, St. Michael, St. James, and the southern reaches of St. Peter (Government of Barbados, 2000). This pattern of development is deeply rooted in the historical impact of the incorporation of Barbados into the mercantile and capitalist systems, which has led to a highly skewed and spatially disproportionate distribution of settlement and economic activities in the southern and western coastal strips with subsequent social inequalities (Potter, 1986). The author continues on by stating that tourism, as one of the main staples of the Barbadian economy, has served to perpetuate the inequalities of this uneven development.

Barbados has always placed a strong emphasis on both education and health care, both being universally available to everyone. Education is actually mandatory for all children under the age of sixteen (PAHO and WHO, n.d.). The literacy rate in the country for the 15 and above category stands at 97 % (three per cent illiteracy). This rate overshadows not only the 12 % illiteracy representative of Latin America and the Caribbean as a region, but also surpassing the upper middle income nations as a group who have ten per cent illiteracy. The rate of infant mortality has been steadily decreasing, and adults in Barbados may now expect to live for 76 years. Child malnutrition may be observed in six per cent of the population of children under five years old (Government of Barbados, 2000).

Almost ninety per cent of the island is composed of a coral limestone formation that produces gently undulating hills, "interrupted at points by deep gullies and a series of almost vertical cliffs that are old coral reef formations. The gullies extend from the central upland region to the coastline, and form an integral part of the island's natural drainage system" (Government of Barbados, 2000). The remaining landscape of the island is characterized by an area of clays where the coral has been eroded known as the Scotland District (Government of Barbados, 2000).

Barbados is a water-scarce nation. It is ranked as one of scarcest nations in terms of freshwater availability globally, and it has been decreasing in availability of water (in cubic meters) per capita for the last half century (Government of Barbados, 2000; ITT Industries, n.d.). The predominant source for potable water (approximately 90 per cent of source water) comes from groundwater withdrawals (water-technology.net, 2008) from an extensive karst aquifer system. The available water resources on the island such as surface water, spring water, and runoff are minimal in comparison to groundwater availability. Table 2.1 highlights the available water resources in Barbados in m^3 per day.

Table 2.1: Available water resources in Barbados (Government of Barbados, 2000)

Water Source	**Availability (m^3/day)**
Groundwater	202.591
Surface water	15,909
Spring water	5,455
Wastewater	30,018
Runoff	1,455
Total	225,410

Potable water is pumped from 21 groundwater wells in the karstic coralline part of the island and 2 spring wells in the Scotland District (FAO, 2000). There is very little surface water on the island available for potable water consumption. Therefore, the remaining water comes from the desalination plant located in Bridgetown in St. Michael. Water coverage is virtually universal on the island: "there is almost ninety-eight percent coverage of potable water supply. Ninety-six percent of the population receives piped water directly into their homes, while the remaining population has access from public sources" (UN, 2004). Agriculture is the nation's largest user of water (23.5% of BWA figures for total consumption), and the domestic sector follows closely behind by using 22% of the total water supply (water-technology.net, 2008). Domestic use of water is regulated by a metered system controlled by the nation's regulatory body on potable water supply, the Barbados Water Authority (BWA). In Barbados, water is metered and everyone (with some exceptions) must pay for it. Since it is tabulated on a meter, cost is directly proportional to consumption; the more water a household uses the more that they have to pay. Table 2.2 presents the prices set by the BWA charged to homeowners for their water usage.

Table 2.2: Water price charged by the BWA per cubic meter of water (BWA, 2008)

Amount of Water Consumed (m^3)	Price/m^3 (Barbados $)
0-11	20 flat rate
11-19	1.55
20-31	1.94
32-51	2.91
51+	4.80

New developmental patterns are challenging the way in which water is used on the island. With the conversion of several large areas of plantation into golf courses, these new uses reflect:

> [...] the changing economy of the island with tourism now the primary source of foreign exchange. Spatially, a coastal pattern of an urban-suburban-tourist zone with enclave manufacturing, a concentration of services, and modern retailing with many new elite residential areas, stretching from the parish of Christ Church, through St. Michael and St. James to Speighstown in St. Peter, have developed. (Momsen, 2007)

The growing number of tourists on the island coupled with increasing pressures from the growing population place strains on the environment and water resources. For example, the total amount of potable water consumed in 1998 was 57 million m^3 compared to 45.4 million m^3 in 1988 and 39.7 million m^3 in 1978 (Government of Barbados, 2000).

A serious problem regarding water distribution in Barbados is that of burst pipes and mains losing water throughout the island. Old and degrading infrastructure is much to blame for the lack of efficiency in water distribution systems in the country. Approximately 60% of water is estimated to be lost (Government of Barbados, 2000; water-technology.net, 2008). However, most of the island is connected to the public water supply and receive reliable and good quality water. The following two tables from the Barbados Water Authority demonstrate some of the commonest occurrences of burst pipes and burst mains on the island. The highlighted areas are burst pipes which occurred in either St. Joseph or St. Philip (two of the parishes involved in this study).

Table 2.3 accounts for burst pipes on the island from April 2007 to April 2008. Burst pipes refer to breaks or damages to any part of a domestic service connection to the water distribution mains network, which may have resulted in disruption from the time of damage of the service, and at the very least during the repair of the service (Distribution Department, 2008). These were quite numerous in occurrence, with areas of St. Joseph and St. Philip accounting for most of the

burst pipes throughout the year.

Table 2.4 tallies the occurrences of burst mains on the island from April 2007 to April 2008. Burst mains are breaks or damage on the transmission and distribution water mains in the network which would have resulted in disruption to water supply (Distribution Department, 2008). With the combined occurrences of burst pipes and burst mains, St. Joseph and St. Philip suffer from many water disruptions.

Table 2.3: Occurrences of burst pipes from April 2007 to April 2008 (Distribution Department, 2008)

Sub – district	Parish	Apr 07	May 07	Jun 07	Jul 07	Aug 07	Sep 07	Oct 07	Nov 07	Dec 07	Jan 08	Feb 08	Mar 08	Apr 08	Total
Blades Hill	St Philip	2	1	3	1	0	4	2	0	1	0	1	4	4	**23**
Edgecliff	St Thomas	0	0	0	0	0	0	2	0	1	0	5	0	0	**8**
Horse Hill	St Joseph	5	10	1	4	1	1	0	0	3	2	3	2	4	**26**
Rock Hall	St Peter/ St Andrew	1	1	2	2	1	1	0	2	0	0	0	2	1	**13**
Ruby	St Philip	2	5	58	14	9	45	23	0	0	0	2	5	5	**168**
Shop Hill	St Thomas	0	3	3	1	3	5	0	1	2	1	1	1	3	**24**
Sugar Hill	St Joseph	4	1	1	1	0	2	5	2	1	2	3	3	1	**26**
Union	St Philip	3	2	2	6	1	5	21	4	3	6	7	2	1	**63**
Winwards Gardens	St Philip	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		17	**23**	**70**	**29**	**15**	**63**	**53**	**9**	**11**	**11**	**22**	**19**	**19**	**361**

Table 2.4: Occurrences of burst mains from April 2007 to April 2008 (Distribution Department, 2008)

Sub - district	Parish	Apr 07	May 07	Jun 07	Jul 07	Aug 07	Sep 07	Oct 07	Nov 07	Dec 07	Jan 08	Feb 08	Mar 08	Apr 08	Total
Blades Hill	St Philip	0	0	0	0	0	0	0	0	1	0	0	0	0	**1**
Edgecliff	St Thomas	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Horse Hill	St Joseph	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Rock Hall	St Peter/ St Andrew	0	1	1	0	0	1	1	1	0	0	0	0	0	**5**
Ruby	St Philip	0	3	2	1	0	0	0	0	0	1	0	3	1	**11**
Shop Hill	St Thomas	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Sugar Hill	St Joseph	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**
Union	St Philip	0	1	1	1	0	0	0	0	1	1	1	0	0	**6**
Winwards Gardens	St Philip	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		0	**5**	**4**	**2**	**0**	**1**	**2**	**1**	**2**	**2**	**1**	**3**	**1**	**24**

In comparing Barbados to other Caribbean nations in terms of available water resources, it bodes very poorly and is actually ranked last among Caribbean nations in terms of available renewable water resources (ARWR). Table 2.5 summarizes the annual precipitation received by various Caribbean nations and the ARWR per capita per year.

Table 2.5: Freshwater resources available in other Caribbean countries (FAO, 2008a)

Country	**Annual Precipitation (mm/year)**	**Actual available RWR per capita (m^3/year)**
Antigua & Barbuda	1 030	800
Barbados	1 422	332
Cuba	1 335	4 326
Dominica	2 083	-
Dominican Republic	1 410	4 489
Grenada	2 350	-
Guyana	2 387	333 795
Haiti	1 440	3 002
Jamaica	2 051	4 885
St. Kitts & Nevis	1 427	545
St. Lucia	2 301	-
St. Vincent & the Grenadines	1 583	-
Trinidad & Tobago	2 200	3 883

As depicted by the table, many of the Caribbean states are well-endowed with available water resources. Other tourism-dependent nations such as the Dominican Republic and Jamaica have over ten times a greater amount of available freshwater resources. The values provided in this table are graphical displayed in Figure 2.1 on page 14. Table 2.5 takes the information provided in Table 2.4 and takes it a step further by looking at available water in terms of per capita use throughout the nations. Water withdrawal is classified by agricultural, domestic and industrial withdrawal in km^3 per year. As this table demonstrates, water withdrawal as a percentage of the total available renewable water resources is low for the majority of the countries, except for Barbados which extracts water at a greater rate than natural replenishment (this is achieved through the provision of desalinated water). Cuba and the Dominican Republic withdraw the most amount of water for agricultural, domestic, and industrial purposes, taking into account that they have larger economies and are the most populous nations in the Caribbean.

Table 2.6: Water withdrawal in the Caribbean (FAO, 2008a)

Country	Water withdrawal by sector (km^3/year)			Total water withdrawal per capita (m^3/year)	Total freshwater withdrawal as a % of ARWR
	Agriculture	Domestic	Industrial		
Antigua & Barbuda	0.001	0.003	.001	76.9	3.27
Barbados	0.02	0.03	0.04	336	113
Cuba	5.64	1.56	1.00	733	21.5
Dominica	-	-	-	210	-
Dominican Republic	2.24	1.09	0.06	398	16.1
Grenada	-	-	-	97.1	-
Guyana	1.60	0.03	0.01	2 195	0.68
Haiti	0.93	0.05	0.01	121	7.06
Jamaica	0.20	0.14	0.07	157	4.35
St. Kitts & Nevis	-	-	-	-	-
St. Lucia	-	0.0125	-	103	-
St. Vincent & the Grenadines	-	-	-	85.8	-
Trinidad & Tobago	0.02	0.21	0.08	240	8.07

Although not enough research went into this aspect of the study, there is bearing in touching upon the history of Barbados in regards to slavery and colonialism as it has potential impacts on how gender relations (especially regarding natural resources) have been structured throughout time and what impact it has left. The slave situation in Barbados was unlike what was seen in other colonies at the time. First of all, Barbados was the one Caribbean plantation colony where "black women outnumbered black men for most of the slavery period" (Beckles, 1988).

Slave women and men in Barbados were not segregated into domestic and public work. Women toiled in the same field performing the same tasks that men did, fully integrated into the system and expected to perform equally to men. They worked together in the same groups throughout the day from sunrise until sunset (Sutton and Makiesky-Barrow, 1981; Beckles, 1988; Barrow, 1993). Although in general women did not possess the same strength that men did, slave owners arguably judged that field cultivation required "more stamina than strength, and in this regard, recognised that women were no less suitable. In addition, West African women were

already acculturised to agricultural tasks, more so than men, and might have been considered more adaptable, at least in the short run" (Beckles, 1988). Capitalism and the segregation of spheres between domestic and productive did not fully impose itself in the manner that it has in other nations. Firstly, "the social cleavage between free whites and enslaved blacks minimized the imposition of the dominant class ideologies and permitted the slaves a degree of autonomy in retaining and developing distinct cultural patterns and concepts about sex roles and attributes (Sutton and Makiesky-Barrow, 1981). Capitalism did the contrary of its normal imposition, "the system demanded that their agriculturally productive roles in the cane fields took priority over biological and social reproduction (Barrow, 1993).

Women still however took on the tasks of social reproduction. Domestic tasks and child care were considered 'women's work' and men "do not generally become involved except temporarily in emergency situations. Women's social reproduction is defined to incorporate productive money-making work, be this in agriculture or another sector of the economy" (Barrow, 1993).

The legacy of slavery made its imprint on Barbadian society. It "left a cultural system of values and behaviour, which prescribed the full involvement of Afro-Caribbean women in the economy, in agricultural or other income-generating pursuits. The corollary of this is a remarkable degree of equality between men and women in access to land and other resources" (Barrow, 1993). The status of the sexes in Barbados, therefore, rests on their relatively independent access to the resources of the kinship system and the economy and on an ideology that minimizes sexual differences and emphasizes the effectiveness of the individual regardless of gender (Sutton and Makiesky-Barrow, 1981).

2.2. Water and its role in development

Development and subsequent prosperity has only been possible with the access and availability of water. Gleick (1993) highlights the importance of water for development by stating that, "the presence or absence of water can mean life or death, prosperity or poverty. Water is a necessary commodity in household and municipal activities and a critical factor in agricultural and industrial production". As such, "easy access to water is not an end in itself, but a means to other ends: health, industrial and agricultural production, generation of foreign currency" (Falkenmark and Lindh, 1993). Viessman Jr. and Hammer (1998) describe how the

provision of water facilitated the development and settlement of certain areas in the United States:

> Irrigation works helped settle the West. Waterway improvements encouraged commerce and industry in populous areas of the East, South, and Midwest. Municipal water and wastewater systems provided the basis for increasing urbanization and industrial growth in many localities.

This provision of water allowed for various sectors of the economy to emerge and furthered development and economic prosperity. Irrigated agriculture for example has been one of the main drivers to the expansion of water resources infrastructure, besides population growth and the changing standard of living (Gleick, 2000). In nations where agriculture is still the prevalent base to the economy, there is a greater likelihood that the relationship between water and development will be stronger than in industrialized nations less dependent on agriculture (Falkenmark and Lindg, 1993). This is not to mention that "universal access to basic water services is one of the most fundamental conditions of human development" (Gleick). A healthy and productive human population necessitates dependable and safe water sources, "Water supplies in most developed countries are clean and reliable, eliminating many of the water-related diseases rampant in Europe and North America in the late 1800s" (Gleick).

Adequate water resources have historically been an essential part to a nation's industrialization process. Falkenmark and Lindh (1993) continue on by stating that, "In the early phases of industrial development, water demand increases rapidly. Industry needs water for cooling, heating, processing, and transporting, as well as for drinking, air conditioning, and cleaning. There is a wide range of water needed to run industrial processes, and some use considerably larger amounts of water than others". Access to easy water leads to the hypothesis that most of the poorest and least developed nations in the world would be located in the tropics and sub-tropics. The world's poorest nations are: "(1) located where water is scarce for part of the year; (2) experience intermittent drought years; and (3) experience a high evaporative demand, which prevents much rainfall from being used in human activities since most of it returns to the atmosphere" (Falkenmark and Lindh, 1993). Brown and Lall (2006) lead to the same conclusion since they determined that in tropical areas where rainfall distribution generally follows a wet and dry season pattern, agriculture and early economic development are much more difficult to establish and have slowed the progress of development.

To diversify their economies, countries are turning to other sectors such as tourism. Tourism, however, has been well documented in its environmental degradation and excessive use of potable water that strains the local water supply (Holden, 2000; Gössling, 2001; Briassoulis, 2002; Kent, *et al.*, 2002). Holden (2002) described how tourism has an impact on water:

> Another key natural resource that is essential for tourism is water. The addition of hundreds of bed spaces in a destination, combined with the lifestyle demands of western tourists, such as daily requirement for showering, clean sheets and bath towels, means that tourism is responsible in some destinations for the consumption of copious amounts of water compared to the needs of the local people.

The importance that water plays in the role of development cannot be underestimated. Industrialized nations which constantly supply their households with water have made it so that women in these nations no longer have to spend hours upon hours fetching water. A supply of water has implied that women have been freed from these tasks and have much more available time in income generation.

2.3. Integrated water resources management

IWRM, as described in the introduction, is a holistic and all-encompassing approach to managing freshwater. At its basis is the idea that different uses of water are interdependent, and it also recognizes that various water uses have effects on each other. Furthermore, IWRM promotes the idea of the river basin as the geographic unit for its practical realisation (Cap-Net, n.d.). IWRM therefore requires cooperation not only internally between various governmental units or departments, but since water basins hardly follow jurisdictional boundaries this type of management also necessitates national cooperation when water crosses jurisdictions within a nation and international cooperation when water is shared across international political boundaries. IWRM has been accepted internationally as the way to advance efficient, equitable, and sustainable development related to water use; it is also promoted for the management of the world's limited water resources and for coping with conflicting demands. The rationale for the conception of IWRM has come about as managers in either government or private sectors have to make decisions on water allocation with difficulty. Increasingly, they have to allocate diminishing supplies between ever-increasing demands. Demographic and climatic changes are drivers which place further strain on water resources. The traditional fragmented approach is no longer viable and that is why a more holistic approach to water management, such as IWRM, is

essential (UN-Water, 2008).

The idea of managing water as part of the larger picture is, technically, not a new idea. Ecosystem-based management dates back to the earlier half of the 20th century and a much cited example can be seen with the Tennessee Valley Authority in the 1930s (Mukhtarov, 2007). However, Mukhtarov goes on to argue that adding the social and economic components to the historical definition of integrated water management makes it a relatively new idea that came about after the 1992 Dublin Conference on Water and Environment and the 1992 UN Rio Summit on Environment and Development. In the new-age of IWRM thought, Rahaman *et al.* (2004) argue that there have been four conferences that have been especially significant in furthering the concept of IWRM: the International Conference on Water and Environment Issues in the 21st century (Dublin, Ireland, 1992), the Second World Water Forum and Ministerial Conference (The Hague, Netherlands, March 2000), the International Conference on Fresh water (Bonn, Germany, 2001), and the World Summit on Sustainable Development (Johannesburg, South Africa, 2002). The International Conference on Water and Environment in Dublin in 1992 was especially significant as it gave rise to four principles that have been the foundation for much of the subsequent water sector reform, and form the basis upon which IWRM lies. These water principles are: "(1) Fresh water is a finite and vulnerable resource, essential to sustain life, development, and the environment; (2) Water development and management should be based on a participatory approach, involving users, planners, and policy makers at all levels; (3) Women play a central part in the provision, management, and safeguarding of water; and (4) Water has an economic value in all its competing uses and should be recognized as an economic good" (Cap-Net, n.d.).

At the UN Millennium Summit held in September of 2000, world leaders agreed to a set of time-bound (set to be achieved by 2015) and measurable goals and targets for combating issues of poverty, hunger, disease, illiteracy, environmental degradation, and discrimination against women. Known as the Millennium Development Goals (MDGs), they have been placed at the heart of the global agenda (UN, 2002). IWRM is a tool that can address the MDGs, as they are all either directly or indirectly linked to issues of water. For example, providing an improved water supply for women would provide them with the opportunity to use the saved time and energy for productive activities, including income-generating activities and participation in community decision-making [which both promote gender equality and empowers women (goal

3)]; better food preparation (with positive impacts on infant nutrition) [aids in eradicating extreme poverty and hunger (goal 1)]; the care and education of children; or releasing girls from domestic tasks to go to school [goal 2 – achieve universal primary education]" (Regmi and Fawcett, 1999; UN DAW, 2005).

IWRM has much potential, but there are many difficulties associated with it as well. The most common criticism, Jeffrey and Gearey (2006) argue, is that the gap between theory and practice remains extensive, and is such since there is no "recipe book, no formulae, no laws, and no blueprint". This point is furthered by Mukhtarov (2007), who claims that the definition of IWRM is stated in general terms and therefore has proven difficult to interpret for practical purposes thusly perpetuating the great deal of debate surrounding the practical value of IWRM. The example he uses highlights the lack of its implementation on the international scene,

> The World Summit on Sustainable Development [WSSD] in 2002 called for all countries to draft IWRM and water efficiency strategies by the end of 2005. At the end of 2005 only 20 of 95 countries surveyed by the Global Water Partnership produced or significantly progressed towards such plans.

Managing water on a basin-level scale, one of the principles prescribed under the umbrella of IWRM, is also a point of contention seen throughout the literature. Although McGinnis (1999) argues that at its crux integrated watershed management is not a new concept, "there is no agreement among policymakers or activists over how to develop and implement watershed-based policies and programs". Blomquist and Schlager (2005) argue that even defining a watershed is challenging, one of the reasons being that: "Once human beings have arrived on the scene [...] watershed boundaries are not defined solely by "natural" markers [...] Should one define a watershed in terms of its "natural" contours or of the way it functions today?" Where to draw the basin contour is a matter of choice, and choice involves politics. This is their preamble to the notion that integrated watershed management is very political in nature. As such, they state that "the politics of boundary drawing, decision making, and accountability offer important reasons to be skeptical of the prospects for integrated watershed management, at least as some proponents envision it".

In areas of IWRM where progress has been made, there has been greater focus on the technical portion of IWRM, "Far more attention has gone to increasing the efficiency of water use through transfers into higher value-added areas or through new technologies than to the equity and social justice central to human development" (Mukhtarov, 2007). Technical

developments alone are not enough, "There has been increasing realization over the last two decades that technical solutions alone are insufficient to ensure equitable and secure access to water resources for the world's population", and so there will be need to be a greater focus on governance and developing community-based approaches for water management (UNDAW, 2005).

2.4. Water and gender in the global context

The fundamental water principles from Dublin in 1992 and subsequently IWRM discussed in the previous section have recognized women in its principles due to the longstanding, intricate, and continued relationship they have in the management of water. Gender differs from sex, since sex is biologically determined (for example childbearing) whereas gender is socially fabricated (GWA, 2007). The term gender,

> [...] refers to the socially constructed roles and responsibilities of women and men. The concept of gender also includes the expectations held about the characteristics, aptitudes and likely behaviours of both women and men (femininity and masculinity). These roles and expectations are learned, changeable over time, and variable within and between cultures (CIDA, 1999).

In almost all rural communities in developing countries, and in general when water is not piped directly into a dwelling or within close proximity, it is primarily women and sometimes children (often girls) who bear the brunt of responsibility for collecting it and then allocating it for household use; they often spend hours a day walking, waiting in queues, carrying water, protecting water sources, maintaining water systems, and storing water (Regmi and Fawcett, 1999; Concepcion Donoso, Bakkum, and Troetsch, 2000; UNDP HDR, 2006: Ray, 2007). As providers of domestic water and food, women's actions have a direct impact upon their families' health and being the ones responsible for family health and hygiene, women are the primary stakeholders in household water and sanitation (Cap-Net, n.d; INSTRAW, 1991; Regmi and Fawcett, 1999; Manase *et al.*, 2003). This is stressed in the African situation by Buor, "in the current environmental pandemic in Africa, concomitant deterioration is evidenced in the scarcity and impurity of water; the burden of ensuring the supply of this crucial commodity rests largely on women" (2004). However, this is prevalent in much of the developing world.

2.4.1. Division of labour

Although women generally occupy the task of water collecting, this is just one task in the larger spheres of reproductive versus productive work. Women have been classified as being suitable for reproductive functions, with their roles being concentrated in the domestic sphere, dealing predominantly with unpaid, domestic work (child bearing and care and household work such as cleaning, food preparation, fetching water or gathering firewood) in comparison to men's that tend to prioritize (paid) productive work (wage employment, agricultural (ex. ploughing, herding cattle), and commercial activities) (Crow and Sultana, 2002; Upadhyay, 2005; Zwarteveen and Bennett, 2005; Peter, 2006). This division of labour in the developing world, and especially in the case of Ghana for example, is largely dictated by culture. Domestic work is perceived to be of no importance, and therefore it is relegated to women whose main functions, culturally-speaking, are to reproduce and take care of the children and the home (Buor, 2004). The unpaid work provided by females, although generally undervalued, taken for granted and then unseen by economists and policymakers for its economic and social values (INSTRAW, 1991), is arguably estimated to amount to one-third of the world's economic production (Nierenberg, 2002).

The reproductive nature of women's work has them typically working longer hours than men, through the collective tasks of nurturing children, caring for elders, maintaining homes, farming, and hauling wood and water home from distant sources (Regmi and Fawcett, 1999; Niereneberg, 2002). Fetching water is especially time consuming and can amount to significant portions of a woman's time. In developing countries, the United Nations International Research and Training Institute for the Advancement of Women (INSTRAW) suggest that "women and children often spend eight or more hours a day fetching polluted water from water supplies which, because of drought, become increasingly distant" (1991). In Africa, "it is estimated that 40 billion hours are spent each year, mostly by women, in carrying water" (Ray, 2007). The UN have quantified that in Senegal, women devote 17.5 hours per week to collect water. 15.3 hours a week is spent by women in Mozambique to collect water during the dry season (Crow and Sultana, 2002). All female respondents in a study by Upadhyay (2005) that were from villages in the North Gujarat area of India reported fetching water every day. A similar situation is seen for poorer and female-headed households in rural Bangladesh, were multiple trips must be made daily to the nearest tube well or surface water body to meet water needs, with women and girls using several

hours each day to ensure household water security (Crow and Sultana, 2002). When water is scarce, hours spent fetching water increases significantly. In the Kumasi metropolitan areas of Ghana, water fetching time increased from 0.76 hours normally to 2.5 hours in times of scarcity (Buor, 2004). The numbers may vary from nation to nation, but the same message is seen throughout: women and girls spend a lot of time collecting water.

The time spent on tasks in households can vary quite substantially among women, depending on their location and family size, among other plausible factors. Location is one of the factors that differentiates access to domestic water in rural Bangladesh, especially for poorer and female-headed households (Crow and Sultana, 2002). In a study by Upadhyay (2005) of villages in North Gujurat, India, women living in villages with access to a local water source all year round were compared with women from villages without such access to water. The latter group ("no-source") reported that they travel significantly longer distances in search of constantly changing and uncertain water sources. Family water requirements and number of trips for water were positively related: the larger the water requirement of the family implied a greater number of trips needed to be made to and from the water source. Completing this task made it common for women to walk several kilometres; men, however, were normally not involved in fetching water in the villages surveyed in the study. Similarly in Ghana, larger family size means more water and greater work for women. Men again do not assist their wives in this task as "they are not able to reconcile the need of their wives for more water with the cultural factor of women-take-all in domestic services" (Buor, 2004). The time spent by women fetching water is a loss of productive time to engage in income-generating activities (Manase *et al.*, 2003); this same time spent by young women and girls means that they may not have the opportunity to attend school in order to fetch water (Crow and Sultana, 2002).

In the same study conducted by Upadhyay (2005), although women were generally responsible for fetching water, the majority of them (89%) from both the source and no-source villages responded that they do not enjoy fetching water. Their reasons were listed as the following: "(1) Walking and queuing takes a big chunk of their time, which otherwise could have been used productively (75%); (2) It is a physically demanding job (70%); and (3) There are risks of being attacked by animals and people while traveling longer distances on foot in remote areas (60%)".

Women's work is not limited to reproductive work only. Moser (1993) describes the "triple

role of women" as encompassing reproductive work, productive work, and community managing. Reproductive work is that which has been previously described – childbearing and caring; women often involve themselves in productive work as secondary income earners such as agricultural work in rural areas and informal sector enterprises in the urban context. Community management entails working "around the provision of items of collective consumption, undertaken in the local community in both urban and rural contexts" (Moser, 1993). Women often take on two or three of these functions. In a rural Swaziland community, the main roles of male heads of households were found to be productive in nature. However, the roles that women took on as heads of households were discovered to be similar to that of their male counterparts. In these positions, women played a "double day" role where they fully undertook both productive and reproductive roles (Peter, 2006). A similar situation is described by Schreiner *et al.* (2004) in South Africa, where "women are still largely responsible for household and family chores, and if working, have to carry out these functions over and above family work hours".

Closer water sources do not necessarily reduce the burden of water work for women (UNDAW, 2005). In western Nepal, closer water sources implied that women now made a greater number of trips for more water. Before they fetched water five times a day for 80L for family consumption, but after water was supplied near their homes they made 10-15 trips per day to obtain 200-300 litres of water per day (Regmi and Fawcett, 1999). This type of situation exists because there is a need to look at changes in the gender division of labour to decrease women's work load, and not only at installing closer water supplies (Regmi and Fawcett, 1999). A similar situation exists for women in agriculture,

> In such situations [low participation of females in water users organizations despite high involvement of women in irrigated agriculture], participation of women in water users associations requires challenging accepted gender norms at the household as well as the community level. For this to occur, community members themselves – women as well as men – must be convinced that the benefits of participation outweigh the personal and social costs (Schreiner *et al.*, 2004).

Confronting deeply engrained societal norms will be a necessity if women are to ever receive full equity in the domains of water and water management.

2.4.1.1. Health burden of water collection

The ergonomics of carrying water have found that women suffer physically due to this task. Women and girls (mostly) "fetch water in pots, buckets, or ideally more modern narrow-necked

containers, which are carried either on the head or on the hips". Multiple trips for the minimal 20L per person per day implies a lot of heavy lifting over several kilometers when calculating back-and-forth trips (Ray, 2007). The task of toting water from its source to the home is an extremely energy-extensive one, sometimes amounting, according to the WHO, to one-third of a woman's daily calorie intake (Nirenberg, 2002). Not only is it energy-intensive, but damage may accumulate in the spine, the neck muscles, and the lower back, with a possible progression to early ageing of the vertebral column and potential deformities (UNDAW, 2005). Buor (2004) comments on the health hazards of fetching water in Ghana:

> There is a direct relationship between hours spent fetching water and health status. Hours spent fetching water during scarcity make a greater impact on health than during regular water supply [...] water fetching, especially during periods of scarcity, has a significant effect on the health of women who bear most of the burdens of the home". Adverse health effects are suffered during periods of scarcity.

What is problematic about this health risk to women is that it is seldom published in top public health and epidemiological journals, "as it falls outside of the conventional categories of water-borne, water-washed, and water-related ailments" (Ray, 2007).

These of course are not the only risks associated with fetching water. Chemical contamination is a possibility as well, when "women wash clothing soiled with chemicals or pesticides, or use containers contaminated with them to transport water and food" (Nierenberg, 2002). The latter activity not only puts women at risk, but their household faces the same risks in terms of consuming water or food that has been transported in contaminated containers.

2.4.2. Factors that crosscut gender

Gender cannot be looked at as a factor in isolation of other conditions surrounding women. Gender does not exist "in a vacuum" (UNDAW, 2005); it is shaped and interacts with other social relations and legal structures that crosscut it such as rights, power, class (wealth), caste, age, family and marriage relations, and ethnicity all play roles in women's access to water (Meinzen-Dick *et al.*, 1997; Zwarteveen and Bennett, 2005).

Land and property rights are one way in which women have restricted access to water. This is because often the right to land "confers the rights to other resources on the land, such as water" (Meinzen-Dick *et al.*, 1997). These rights can therefore play a "significant role in governing the patterns of natural resource management, as well as in the welfare of individuals, households,

and communities who depend on those resources" (Meinzen-Dick *et al.*, 1997). In Bangladesh, male control of property rights leads to an intense subordination of women. One way in which this manifests itself is through the implementation of "new technologies [which] involve new property rights, usually defined as the rights of men" (Crow and Sultana, 2002). Access to irrigation water is heavily dictated by land rights and on control over labour. Female irrigators are "impeded from full participation in irrigation management by their lack of entitlement to inherited or irrigated land, while poor urban women suffer parallel disadvantage in rarely having security of tenure of their dwellings, and yet being responsible for raising cash to pay for water and sanitation facilities" (UNDAW, 2005). This denial of irrigation water for agriculture perpetuates even though "women account for the bulk of food production in many countries" (UNDP HDR, 2006) and in the face of evidence that confirms that women are both productive and efficient farmers. Without official access to irrigation water, some women access it informally via unreliable ways (Ray, 2007).

Class is a factor that differentiates access to water, and Crow and Sultana (2002) document this in rural Bangladesh. It is the factor that "makes the most significant impact on the health of women during water scarcity, thus, amplifying class as a factor in health status in the metropolis [Kumasi area, Ghana]" (Buor, 2004). It is therefore a factor that needs to be taken into great consideration when discussing gender and water issues.

Marital relations are another significant element of the gender and water discussion; they "may play a large part in defining women's access to resources and ability to act autonomously, especially where they are living with the husband's family or in the husband's home village" (UNDAW, 2005). These relations may mean that a wife will put her husband's needs before her own,

> In the event of water scarcity, traditional women [in Ghana] would give priority to their husbands. They would ensure that their husbands' water needs were met before satisfying their own. It follows therefore that women are more likely to suffer the consequences of water scarcity (Buor, 2004).

Married women in countries as varied as Botswana, Chile, Namibia, and Swaziland are "under the permanent guardianship of their husbands and have no right to manage property" (Nierenberg, 2002). Women's rights to water are intertwined amongst many other conditions that need to consider when implementing water management schemes.

2.4.3. Water governance

Water management and decision making as a whole is male dominated. All four modes of social access to water (ownership of land and a pump, market access, common property access, and state-backed provision), Crow and Sultana (2002) argue, are led by men. This remains true for decisions made regarding water supply and sanitation technologies, locations of water points, and operation and maintenance systems. Though their numbers are starting to grow, the representation of women in water sector institutions is still very low (Cap-Net, n.d.). This is occurring internationally for women as well in decision-making at the community level (Schreiner *et al.*, 2004). While women play a substantial and often a ubiquitous role in the management of water and water resources, this fact is not recognized in water-related legislation, acts, and policy. In analyzing how gender issues were addressed in Zimbabwe's water reform process, Manase *et al.* (2003) highlight the shortcomings related to gender incorporation into the Zimbabwe National Water Authority (ZINWA) Act. Although attempts were made to make the new laws and policies gender-sensitive, gender, they argue, was not given enough consideration and is not addressed whatsoever in the resultant New Water Act and the ZINWA Act. One of the conclusions made by the authors unveiled the hesitation expressed by policy makers to include gender in clauses in legal acts and by-laws, although they had no problems with incorporating provision for gender in policy documents.

The arguments for women's participation in water management are numerous. It is not for the sake of adding women that they should be included; their daily experience with fetching and using water are thought to make them both knowledgeable about water sources and interested in their reliability, making them well-motivated managers and imperative in ensuring effective IWRM (Regmi and Fawcett, 1999; Manase *et al.*, 2003; UNDAW, 2005). High male labour migration in certain areas invariably makes women provide the majority of regularly available community members, so that continuity and consistency of management are ensured (UNDAW, 2005).

Women's involvement in water management is very important because the manner in which water resources are managed affects women and men in different ways. What may seem obviously beneficial to one group of people may be extremely detrimental to another group of people. An example may be illustrated in the agricultural sector, where decisions on irrigation water are predominantly made by men (Peter, 2006). Large amounts of vital irrigation water to

rich, predominantly male farmers can be provided by the installation of dams and canals; however, they prevent or divert the valuable silt that has historically enriched the fertility of floodplains where poorer, mainly women, subsistence farmers earn just enough to live on. Without consulting women, projects have proven to become ineffective "as women stopped using, or were unable to use, those sources" (Regmi and Fawcett, 1999). For example, "pump handles may be too heavy or placed too high for women and children to reach them" (INSTRAW, 1991). In a study in Nepal, all of the women made the complaint that the surveyors had not involved or consulted with them in the designing of the tap-stands or tube-wells. This led to a water-collection time that significantly increased (nearly four or five times) after they received the improved water services (Regmi and Fawcett, 1999). When men in Bangladesh converted homestead ponds for fish culture, it reduced the access of women to clean pond water. This has lead to conflict "over time and space at the ponds, and an increased presence of men at times when women seek privacy" (Crow and Sultana, 2002). Women therefore must be a part of the management regimes of water.

2.4.4. Constraints to female involvement

The conditions for female involvement in water management decision making are not always optimal. If explicit efforts are not made to include women into discussions, then there are great possibilities that they will not be present. In discussions leading up to the new water acts in Zimbabwe, Manase *et al.* (2003) state that the marginalization of the poor communal and resettlement farmers was further engrained due to the fact that no conscious efforts were made to ensure women's participation. Simply bringing women into discussion forums or increasing their numbers on committees will not guarantee increased equality either (although Agenda 21 does recommend that "governments increase the number of women involved as decision-makers, and as scientific and technical advisers" (Concepcion *et al.*, 2000)). The number of participants in South African catchment forums was a poor way of gauging the degree of participation of women in these and decision-making processes (Schreiner *et al.*, 2004). Although increasing female participation is a desirable goal, there may be hindrances to its achievement. There are often in place ingrained societal structures and norms that may allow women's participation, but they may not feel able to speak publicly, in front of men, especially if this also means going against the views and interests of men. In certain circumstances, some of these gendered norms

regarding public speaking make it so that when women speak in public forums, they speak as representatives on behalf of other women, whereas men speak as individuals representing their own interests (UNDAW, 2005). Female representation in forum meetings for catchment management in South Africa was low, and participation was not better. The poor social status of women and the greater comfort exhibited by men to discuss technical issues such as water resources both were contributing factors to why women at these forums were non-active participants in discussions and debates. Mirroring this situation were meetings held for dam development for domestic water supply. Although women were asked to sit in on these meetings, they were passive participants because tradition and custom in rural areas did "not allow women to express their views in the presence of their chiefs. The women were then addressed separately in order to get their views and concerns on the project" (Schreiner *et al.*, 2004). House (2005) documents the practical work on gender and equity carried out by the KINNAPA/KDC/Water Aid Kiteto Water, Hygiene and Sanitation Programme in northern Tanzania, a collaborative programme between WaterAid Kiteto, the Kiteto District Council, and a local NGO, KINNAPA Development Programme. A case study by Pauline Ngurumwa of the field staff of the project highlights gender constraints of involvement due to the beliefs of the society:

> When I was discussing this issue directly with women right at the meeting, so that one could stand up and give the answers to the questions I posed to them, one man told me that it is not possible for a woman to stand in front a men's gathering. This is because, according to their beliefs and traditions, if that will happen, then all the men at that meeting will die (House, 2005).

To obtain a full gender perspective on water management, in this case it was not possible to do it with both men and women together. It was necessary in this case, as House (2005) quotes Makwal, to separate the two groups and then report back discussion topics and solutions raised as one cohesive group:

> As a facilitation team we asked the meeting to split into two groups of men and women separately. Our aim was to give more chance and freer opportunity to women to discuss and give suggestions and on top of that to make their own decisions on how to solve the problems. [...] Oh, it was very interesting to see how women were very active to talk in their group. And they made very strong decisions for improvement of the scheme management.

The lack of female participation in issues of water management can also be linked with the reason that there is a severe shortage of women professionals in the water sector. Manase *et al.*

(2003) argue for gender sensitive capacity building in the water sector to help lift some of the constraints faced by women that prevent their representation in these institutions.

2.5. Water and gender in the Caribbean

Although the Caribbean is a very distinct region in itself and demonstrates much heterogeneity among its nations, the water and gender relationship in this region reverberates in some nations what is occurring globally in this domain.

2.5.1. Dominican Republic

Nirenberg (2002) repeatedly uses the example of a woman from the Dominican Republic to highlight various issues that hold gender implications. She firstly documents how a typical day for a characteristic woman in the Dominican Republic unfolds:

> Mercedes Guichardo begins her day, like many of the 4 million other women in the Dominican Republic, with one thought on her mind: water. Demand for water far outstrips supply in San Francisco de Macoris, the island's fifth most populous *pueblo* (city), Mercedes' home. Running water is a luxury few can afford, but Mercedes is considered lucky by Dominican standards because she has access to a communal faucet near her house. There, the water trickles out three to four times a week. But the half-dozen or so families who depend on it are never sure when it will come; sometimes it starts flowing at 4 a.m., other days it doesn't come until late afternoon. For women like Mercedes, who trek to the free trade zone during the week, getting enough water for bathing, cooking, housekeeping, and drinking is a constant struggle.

The situation for Dominican Republican women is consistent with those of women not only in other Caribbean countries (i.e. Trinidad), but globally as well. Having enough water is a constant thought, and one that remains a thought in the minds of the country's women. The division of labour remains blatantly contrasted in terms of the task of gathering water, with a large time allotment dedicated to this task on the shoulders of women:

> Mercedes' dependence on an erratic supply of water, for instance, means that she and other women in her *barrio*, not their husbands or sons, spend hours each week carrying water either from the tap near her home or from neighbour's water supplies (Nirenberg).

Although the ergonomics of carrying water are not discussed in this example, Nirenberg highlights some of the other health issues that arise from water collection: "In Mercedes' neighbourhood, old oil drums and plastic buckets that once held cleaning fluids or chemicals make convenient but highly toxic containers for water". Therefore, women not only put

themselves at risk but their family's health as well because of a lack of better options for water collecting.

2.5.2. Trinidad

Schneidermann and Reddock (2004) documented women's roles relating to water in the community of Jones Village, Barrackpore in Trinidad. The authors refer to the Minister of Public Utilities (Joseph's) comments when they state that in the setting of a country where only 14% of the population receives water 24 hours per day, the women and families of this village obtain their piped water only through the access of a standpipe, found a quarter mile from their homes. It is located downhill and only provides water at night when it comes out as a trickle. High population creates a line-up at the standpipe were only two buckets of water are allotted per turn. The water situation in the village leads to certain households developing friction between spouses, as "cases of women rationing water in the home and men becoming irate as a result, husbands refusing to fetch water when they come home from work" (Schneidermann and Reddock). In other areas of Trinidad, the Trinidad and Tobago Secretariat documented how villagers expressed frustrations that reiterate the same aggravations that are occurring globally – frustration due to the loss of productive time spent carrying water; fear for the safety of people, especially women and children, who must fetch water late at night; and concern for children, elderly and disabled people who had to fetch water from a standpipe and transport it up a steep hill (Schneidermann and Reddock). Water governance also echoes similarities to what many women face globally. A draft policy on national water resources management was created by the national water resources authority. Although the document acknowledges that in general women play an essential role in the provision and management of water, it does not articulate a central role for Trinidadian women (Schneidermann and Reddock).

2.6. Concluding remarks

This study was undertaken predominantly due to the gaps found in the current literature specific to water usage, access and distribution in the Caribbean region. Emphasis on the gendered nature of water is focused predominantly on areas such as sub-Saharan Africa and Southeast Asia. The Caribbean region has very little documented research in the field of gender

and natural resources management, and most especially gender and water. Greater research will need to be done in the various nations occupying this region to provide insight and strengthen water resources management, for there is great heterogeneity between and within nations. Ray (2007) argues that "gender-disaggregated data are vital for the many unresolved debates in the gender, water, and development arena". However, Wallace and Coles (2005) argue that a superficial gender disaggregation of data will not be enough,

> While the international development discourse of current water policy and practice formally acknowledges the importance of gender in water supplies, the results are, with exceptions, disappointing. There is a need to delve deeper into the gendered nature of water, and into the historical reality that gender has shaped water management over centuries, in order to understand what is required to successfully turn existing gender commitments into good practice and ensure that water systems meet the aspiration of "water for all".

Much work is left to be done in this field; and getting to the crux of why the gendered nature of water exists so profusely will aid in changing stereotypes and making water more equitable.

3. Methodology

3.1. Study approach

This study was an analysis of both the effects of development and gender on domestic water access and distribution. Conducted over four parishes with varying levels of social and economic welfare, this research attempted to quantify and class parishes measured in the study according to their level of development. Responses were compared across parishes to determine whether development had an effect on water accessibility.

A gender analysis aims at understanding the relationships between men and women and recognizing that relations between men and women are not "biologically determined differences of sex but socially shaped differences of roles and expectations that are culturally specific but can shift and change over time" (UN DAW, 2005). Many factors affect this relationship: age, class, caste, religion, ethnicity, etc. In terms of gender and water, the measurable aspects of this analysis were aimed at how men and women use water differently, how much water they each use, how much time they spend towards water-related activities, and where their sources of water come from. The deeper analysis seeks to answer the questions as to why these differences exist and where do they come from.

3.2. Study area

The area of research for this study was Barbados (Figure 3.1). It is the most easterly of the Caribbean nations. It is a small country with a land area of 430 km^2; its population is also small, approximately 260, 000 (FAO, 2000). Barbados is generally flat and low lying, though the island rises as terraces to the highest point in the central highlands in St. Andrew at an elevation of 335m, known as Mount Hillaby. The island is predominantly made up of soft marine deposits of coral limestone, with the exception of the Scotland district which is made up of clays and sandstone. This area covers around one-sixth of the island area; it is found in St. Joseph, St. John, and St. Andrew (Government of Barbados, n.d.). Jurisdictionally, the country is divided into 11 parishes. Although the country is small, its parishes are very unique and distinct from one another.

Four parishes were chosen for this study. St. James on the west coast, St. Lucy in the north, St. Joseph in the east, and St. Philip in the southeast. Table 3.1 is a summary of the parishes populations (divided into gender components) and their area and population density distributions.

Figure 3.1: Map of Barbados (BSS, 2000)

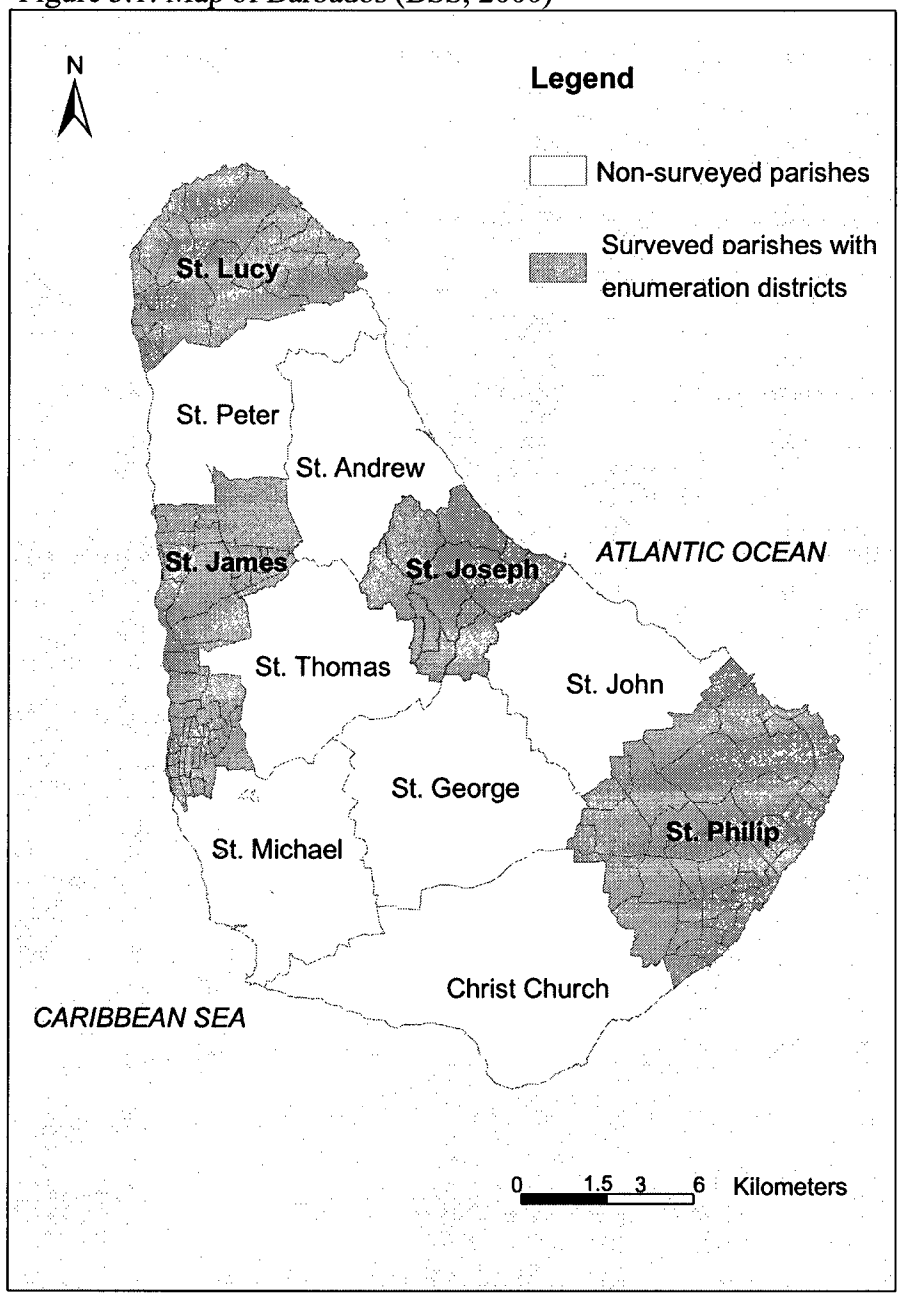


Table 3.1: General parish demographics (BSS, 2000; BSS, n.d.)

Parish	Gender Population		Total Population	Area of Parish (km^2)	Population Density (no. of people/km^2)
	Male	Female			
St. James	10669	12072	22741	80.3	1901.1
St. Lucy	4557	4771	9328	93.2	670.8
St. Joseph	3385	3420	6805	67.3	678.6
St. Philip	11063	11801	22864	155.4	986.8

3.2.1. St. James

St. James is located on the west coast of Barbados, nestled by the Caribbean Sea. St. James is one of the more populous parishes of the island: the total population of this parish is 22,741, with 10,669 male and 12,072 female occupants (BSS, 2000). The median age group of this parish is 30 to 34 years (BSS, 2000). St. James was the most densely populated parish in the study (1901.1 people/ km^2). This parish represents one of the higher population densities on the island. Only the parishes of St. Michael (where the capital Bridgetown is located) and Christ Church have greater population densities of 828.6 people per square kilometre and 335.3 people per square kilometre respectively (BSS, n.d.). Potter's study (1986) classified parishes according to the three leading factors of socioeconomic development, agriculture/rurality, and population growth. St. James was classified as highly developed/non-agriculture and touristic with some of the highest (along with St. Michael and Christ Church) social and economic welfare on the island with a concentration of economic activities.

The west coast of the island, also known as the "platinum coast" of the island, attracts much tourism development and foreign investment to this parish. Hotels, villas, restaurants, and shops litter most of the coastline in this parish. Most of St. James is classified as developed or partially developed, with some land cover scattered as evergreen needleleaf forest and dry cropland and pasture (FAO, 2008). The water supply situation in the parish is as follows:

Table 3.2: Water supply sources in St. James (BSS, 2000)

Water Supply	**Occupied Households**
Piped into Dwelling	7581
Piped into Yard	227
Public Stand Pipe	24
Friend/Relative's Pipe	80
Other	6
Not Stated	47
Total	7965

In 95% of household cases, water is piped directly into the homes. An additional three per cent of households have their water pumped directly onto their property implying that only two per cent of the parish inhabitants rely on standpipes or other sources of water. Infrastructural development in St. James is very high. Potable water from the desalination plant in St. Michael partially serves the inhabitants of St. James (Mwansa, 2008). As will be explained in the

following section, the socio-economic status of households was estimated by the enumerators since socio-economic data was unavailable from the last census. St. James was classified as the most prosperous parish with the greatest amount of socio-economic development; only 6.7% of the households classified were deemed to be of low income (lowest number between the four parishes), 75.1% of the parishes were middle income, and 18.2% were high income, which was the highest value amongst the four parishes.

3.2.2. St. Lucy

St. Lucy represents the northernmost area of the island, straddling the northern tip. It is a rural parish with a relatively small population of 4,557 male and 4,771 inhabitants for a total parish population of 9,328 (BSS, 2000). The median age group of this parish is 30 to 34 years (BSS, 2000). Development has been slower in the north: "in St. Lucy in the north of the island residential development has been slower to develop because of distance from the main city, but it was beginning in 2003" (Momsen, 2007). St. Lucy has the sparsest density of the four parishes. Potter (1986) classified St. Lucy in the category of less developed/rural.

St. Lucy is predominantly agricultural in nature. Its land cover is categorized as an expanse of dry cropland and pasture (FAO, 2008). The government had established "a land settlement project in St. Lucy and provided an irrigation system, but water costs were a problem there" (Momsen, 2007). Water supply in St. Lucy is summarized in Table 3.3.

Table 3.3: Water supply sources in St. Lucy (BSS, 2000)

Water Supply	**Occupied Households**
Piped into Dwelling	2623
Piped into Yard	291
Public Stand Pipe	32
Friend/Relative's Pipe	84
Other	5
Not Stated	35
Total	3070

The parish of St. Lucy has a piped water distribution system connecting to 85% of homes. An additional ten per cent of households have water piped into their yards, indicating that 95% of the St. Lucy parish population is connected to the public water supply system. Regarding the socio-economical status of the parish, St. Lucy was classified in the middle two of those parishes

surveyed with 11.5% of households categorized as low income, 86.2% as middle income, and 2.3% were as high income.

3.2.3. St. Joseph

St. Joseph is found on the more rugged east coast of the island, on the coast by the Atlantic Ocean. St. Joseph has the smallest population of the sample parishes, 6,805 inhabitants of which 3,385 are male, and the remaining 3,420 are female (BSS, 2000). Approximately two-thirds of St. Joseph is classified as dry cropland and pasture, with around one-third as evergreen needleleaf forest and some wooded wetland (FAO, 2008). Farming has been restricted in the Scotland District (partially found in St. Joseph) to prevent further soil erosion (Momsen, 2007). St. Joseph's topography is hilly one of the most mountainous and rugged parishes on the island. Table 3.4 presents the water supply distribution in St. Joseph.

Table 3.4: Water supply sources in St. Joseph (BSS, 2000)

Water Supply	**Occupied Households**
Piped into Dwelling	1781
Piped into Yard	220
Public Stand Pipe	42
Stream/Spring/Well	1
Friend/Relative's Pipe	75
Other	6
Not Stated	7
Total	2132

The majority (94%) of households in St. Joseph are connected to the public water supply via their property. 84% of these households receive water piped directly into their homes. St. Joseph is unique in the sense that inhabitants can access water from streams as well. St. Joseph was the poorest and the least developed parish of those surveyed in this study. Potter (1986) classified this parish similarly to that of St. Lucy as less developed/rural in nature. This parish contained the highest percentage of low income classified households at 12.1%. Middle income households occurred 80.3% of the time while high income households were made up 7.6% of the categorization.

3.2.4. St. Philip

St. Philip is situated on the south-eastern section of the island. It has a relatively large population of 22, 864 residents, of which 11,063 are male, and 11, 801 are female (BSS, 2000). The median age group of this population is 30-34 (BSS, 2000). Land cover in St. Philip is largely dry cropland and pasture, but there is also a mix of shrubland, mixed forest, wooded wetland, and partly developed areas (FAO, 2008). However, in St. Philip "land has gone into residential and tourist development for which a long dry season and proximity to the airport are locational advantages" (Momsen, 2007). Hotels such as "The Crane" (the Caribbean's oldest hotel), which also draw other tourist developments, are changing the landscape of the parish. St. Philip was described as "undergoing rapid growth" by Potter (1986) and classified in his study as intermediate on the scale of developed to less developed.

Table 3.5: Water Supply Sources in St. Philip (BSS, 2000)

Water Supply	**Occupied Households**
Piped into Dwelling	4828
Piped into Yard	443
Public Stand Pipe	59
Friend/Relative's Pipe	191
Other	7
Not Stated	34
Total	5562

Table 3.5 represents the water supply situation in St. Philip. The survey found that 86% of households receive pipe water directly into their homes, with an additional 9% of households having water piped into their yards, indicating that approximately 95% of households are serviced by water being piped directly onto their property. St. Philip, like St. Lucy, was grouped as one of the middle two parishes regarding socio-economic development. 7.7% of the households were deemed low income by the enumerators; 80.5% were determined to be medium income households, while 11.8% were classified as high income households.

3.3. Survey

A survey was developed and used to determine the significance that socio-economic development and gender had on water, as well as the amount of time and water used for various

household tasks for which water is required. Taking physical measurements to gauge water usage was not possible in this study due to the distorting factor of high levels of leakage in the piping network, thus a survey was determined to be the best survey for data collection. The questionnaire was developed following a review of the literature and discussion with locals from Barbados and included both open and close-ended questions. The open-ended questions provided clarity to the close-ended questions. Several drafts of the questionnaire were developed. After initial construction of the survey and some modifications, testing of the survey was performed in Holetown (located in the parish of St. James), and further modifications were made to it based on the responses obtained. The final survey (Appendix I) was used in conjunction with a water calculator (Appendix I) to estimate the amount of water being used per household and per gender across the four parishes when analyzing water usage. Some of the questions in the survey initially included to acquire greater demographical information on the survey respondents (i.e. age and income) had to be excluded from the survey as they were found to be culturally-sensitive. Estimates of these parameters were made by the enumerators at the completion of each survey. Based on the home of the respondent and taking note of anything indicative mentioned during the survey, a judgment call was made on the most plausible socio-economic status of the individual. Socio-economical data was extremely difficult to come by, and the author needed to get some sense of the status of the individuals within parishes.

3.4. Selection of study subjects

The aim of the study was to obtain the number of surveys equivalent to one per cent of the parish population for each parish surveyed, which produced a total sample size for this study of 617. For analytical purposes, 18 surveys were discarded due to the fact that respondents were under-aged and analyses were performed on the resultant 599 respondents. The study, however, represented more individuals and greater than one percent of the population since household practices were discussed and these were generally composed of more than one individual. This quantity of surveys was selected due to issues of feasibility and timing. The population parameters were provided by the Barbados Statistical Service. Each parish, for statistical analysis purposes, is broken up into a number of enumeration districts (EDs). One per cent of each ED was calculated and summed to produce the parish sample size. An example of calculations made

for determining survey size can be seen in an example of St. Joseph in Table 3.6.

Table 3.6: Distribution of Population per ED in St. Joseph (BSS, 2000)

ED no.	Total ED Population	1% of ED Population
476	772	**8**
477	672	**7**
478	494	**5**
479	476	**5**
480	412	**4**
481	423	**4**
482	600	**6**
483	325	**3**
484	286	**3**
485	627	**6**
487	598	**6**
488	611	**6**
490	509	**5**
Total	**6805**	**68**

Land use maps in Barbados denoting households have not been updated for many years. They do not represent the current landscape and could not be used; selecting study subjects randomly from this process was, therefore, not feasible. The selection of survey subjects was executed using the method of convenience sampling. This is a process that chooses individuals from a perspective of convenience or easy accessibility (Bailey, 1994; Statistics Canada, 2008). Although this process greatly increases the risk of bias in a study (Statistics Canada, 2008), each enumeration district was sampled in the four parishes, therefore diminishing the amount of bias. This systematic approach to proportional representation of the districts within the parish prevented a clustering of respondents in one area of the parish, and ensured that all areas were represented proportional to their population. Locating parishes and their respective EDs was completed by driving around in a car following maps provided by the BSS. The enumerators systematically conducted surveys by traveling from one district, completing the necessary number of surveys, then moving on to the next district. Door-to-door surveys conducted by the enumerators were performed focusing on individual perceptions and household practices, and no more than one survey was conducted per household. Each enumerator would take anywhere between ten to thirty minutes with the member of the household responding to the survey, generally at their home. Attitudes towards the survey were favourable since the enumerators

were very obviously not associated with the government and locals do not like government questionnaires since they view them as an intrusion to their privacy. There were limited circumstances where individuals were not surveyed at their homes.

Conditions in St. James did not always allow for optimum surveying, since in many instances people were not home. Surveying was completed solely during the day due to considerations of safety. Where one per cent could not be achieved within a particular ED, surrounding EDs with seemingly similar socioeconomic status were chosen for additional surveys.

3.5. Statistical analysis

With the segregation and categorization of the data into parishes (analyses here considered three groups: female respondents, male respondents, and total parish responses (a summation of both female and male respondents)) and genders (completed for each parish and comparing the total female versus male respondent populations), a statistical analysis was performed using the chi-square test for the analysis of a two-way contingency table (Dutilleul *et al.*, 2005).

The chi-square test is used for the interpretation of categorical, qualitative data and was therefore the most appropriate test for consideration of this type of analysis. The null hypothesis of this test assesses that each proportion of observations in each class is the same for all samples (ex. H_o: $\rho_1 = \rho_2 = \rho_3$). For each grouping of respondents, a contingency table was built with r rows, representing the classes of the parameter measured, and four columns (c) for each of the parishes or two columns for each gender (female and male). The observed frequency (0_{ij}) of each cell represented the number of responses as classified in row i and column j. The expected frequency (E_{ij}) for each cell, with n representing the total number of observations, was calculated as follows:

$$E_{ij} = R_i C_j / n$$

The χ^2 test statistic is based on the sum of squared differences between observed and expected frequencies over all cells of the table and is calculated in the following manner:

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

In certain cases, rows contained values of zero because no responses were observed in selected classes of the categories. These rows, instead of combining them with other rows,

were eliminated all together and the chi-square test was performed on the resulting rows. Row combination was not performed because "the combination of classes weakens the sensitivity of the χ^2 test" (Snedecor and Cochran, 1967). This is made evident in the various relationships explored throughout the research where the categories (either between parishes or genders) do not have the same number of classes displayed between respondent groups.

The chi-square test was performed on the resulting rows with $(r - 1)*(c - 1)$ degrees of freedom with a 95% probability level ($\alpha = 0.05$). The critical value was calculated as:

$$\chi^2_{1-\alpha}((r-1)(c-1))$$

When the test statistic was greater than the critical value, the null hypothesis was rejected; this was a rejection of the equality of all the proportions with an implication that the proportions of observations are different among classes. To validate the chi-square test, an asymptotic z-test was also performed for all pairs of proportions taken two-by-two (ex. H_o: $\rho_1 = \rho_2$; H_o: $\rho_1 = \rho_3$; H_o: $\rho_2 = \rho_3$). This test was performed with the first few relationships analyzed, and the results were the same as those being obtained in the chi-square test. The observed and expected frequencies of all of the data can be observed in Appendix III.

4. Results and discussion

4.1. Results

4.1.1. Water issues across different levels of development

As discussed in the previous section, responses comparing parishes were analyzed across three groups for each parameter measured. Table 4.1 is a synopsis of the observed χ^2 for each analyses performed and the associated critical value. The chi-square distribution is as per Thompson (as cited in Dutilleul *et al.*, 2005).

Table 4.1: Summary of observed χ^2 and critical values per parameter and respondent group measured for parish comparisons

Issues discussed with survey respondents	χ^2 test statistic per respondent group			χ^2 critical value per respondent group		
	females	males	total	females	males	total
Water availability	84.96*	33.19*	145.58*	16.9	7.81	16.9
Wet season water interruptions	33.17*	15.99	39.87*	21.0	21.0	21.0
Dry season water interruptions	23.16*	17.32	32.23*	21.0	21.0	21.0
Affect on lifestyle	1.73	1.60	0.57	7.81	7.81	7.81
Water quality	27.05*	12.95*	34.39*	12.6	12.6	12.6
Overall satisfaction with water	3.17	9.58*	9.66*	7.81	7.81	7.81
Problems with water management	6.27	6.89	11.57*	7.81	7.81	7.81
* χ^2 test statistic *greater* than critical value; i.e. statistically significant						

4.1.1.1. Water accessibility and its effects

Survey respondents were asked to rate how available they perceived their water to be or how easy it was for them to obtain water from their main source of potable water. Most individuals obtained their water through a piped system with water piped directly into their home. Domestic water supply is solely provided by the Barbados Water Authority. A small number of individuals obtained their entire water supply at a community standpipe, whereas some supplemented piped water with standpipe water. There were also a couple of households who used "other" sources to obtain their potable water, this was in the form of the BWA water system being piped into their yard, rainwater, and water stored in a tank from another source.

Out of 222 households surveyed in St. James, 218 households relied solely on water piped into their homes. Two households supplemented their piped water with rainwater, one household supplemented their piped water with water from the community standpipe, and one household solely depended on water from the community standpipe.

In the parish of St. Lucy, 90 households relied only on water distributed via piping and one household only used water from the community standpipe.

All but one (65) of the respondent households in St. Joseph had water piped directly into their home. Two of these households supplemented this water with water from the standpipe, and the one household without piped water had a large storage tank where they collected their water from a different source.

In St. Philip, all but four households (216 respondents) relied solely on water piped into their homes. One of these four households supplemented their piped water with water from the community standpipe, two households supplemented their piped water with rainwater, and the final household had access to the water distribution system but its endpoint was a pipe not in the home but in the yard.

For perceived levels of water availability across parishes, all three groups analyzed were statistically significant, females (Figure 4.1), males (Figure 4.2), and the total sample population (female and male respondents (Figure 4.3)). The chi-square (χ^2) for the respondent groups were 84.96 (critical value [c.v.] =16.9), 33.19 (c.v. =7.81), 145.58 (c.v. =16.9) respectively.

The scale from zero to ten depicted in the legend of the figures rated how available respondents observed their water to be. A scale of 8 to 10 described a situation where water was "very accessible", implying that water was virtually always delivered from their main source of water reliably (in most cases this of course implied household tapped water) with almost if no interruptions. The scale of 6 to 7 was 'accessible", implying that water was available and reliable most of the time but not always. There was a greater frequency of interruptions in this category. A scale of 5 depicted a "neutral" situation where 50% of the time water flow was reliable and the other half of the time it was not. The second to last category that was respondents replied to was that of 3 to 4 ("poor accessibility"), where water was generally unreliable in its supply and the frequency of interruptions was relatively high. A scale of 0 to 2 represents "very poor accessibility"; this is a very dire water situation in this context where delivery is highly intermittent and most times problematic. However, only one female respondent in the parish of St. Joseph categorized her water availability into this category.

Figure 4.1: Water availability as perceived by respondents on a scale of 0-10: parish comparison by female respondents

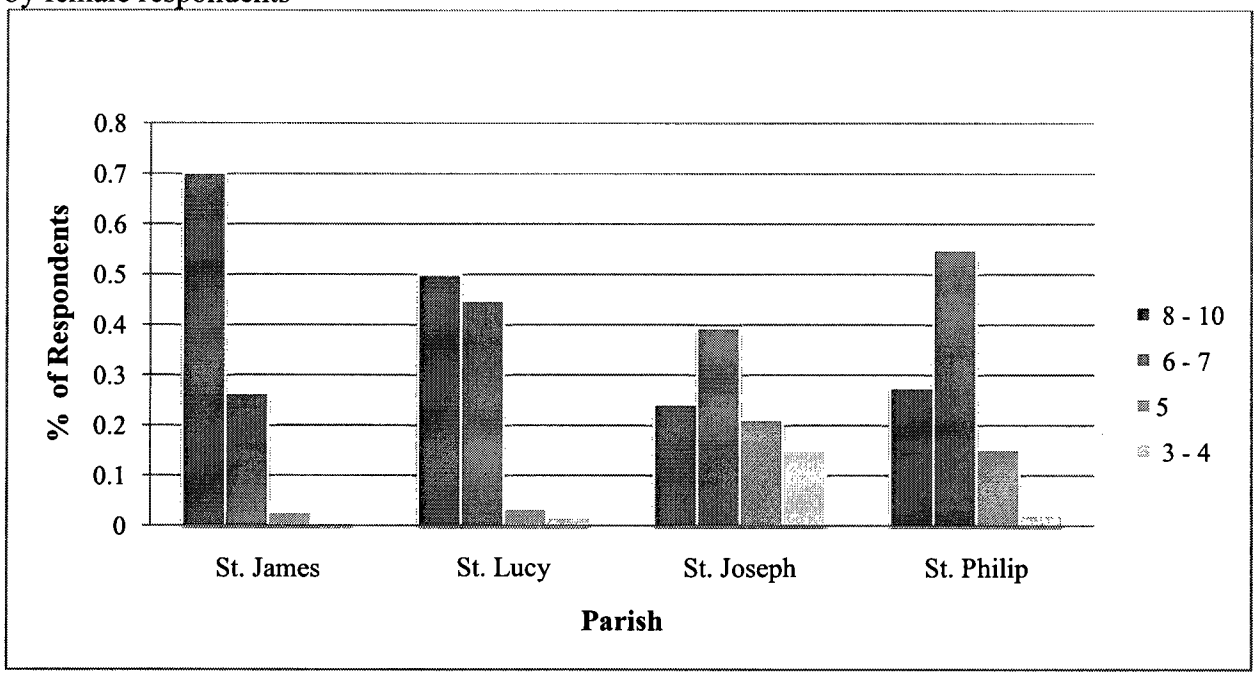


Figure 4.2: Water availability as perceived by respondents on a scale of 0-10: parish comparison by male respondents

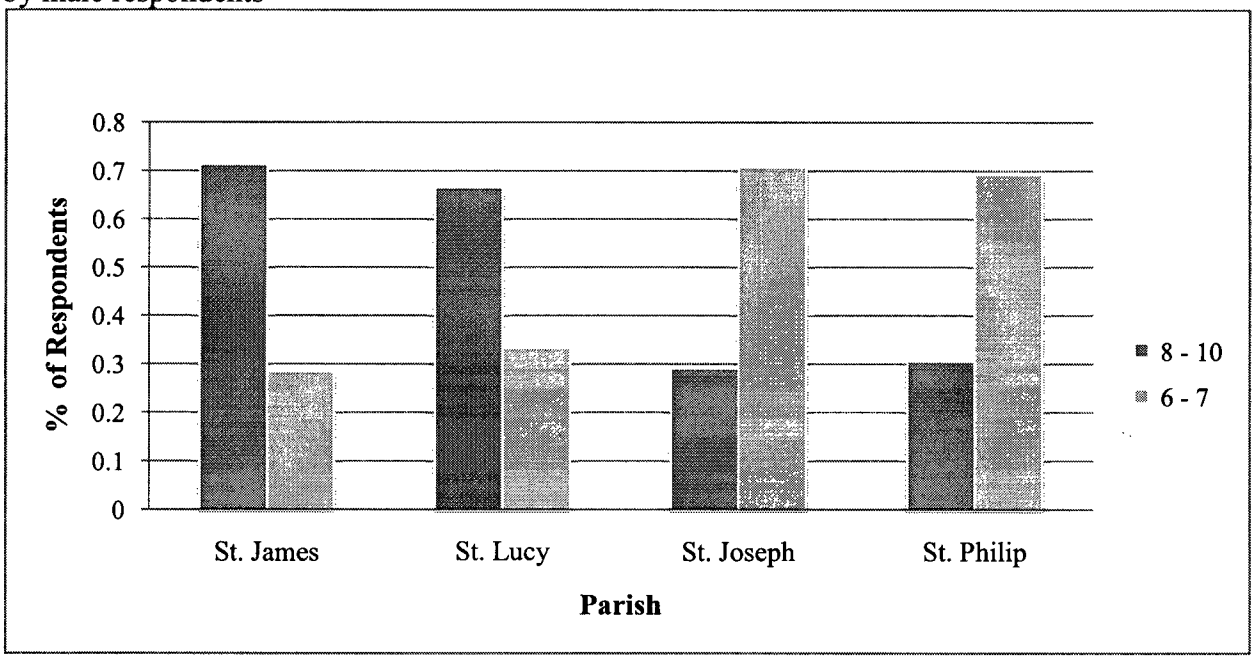
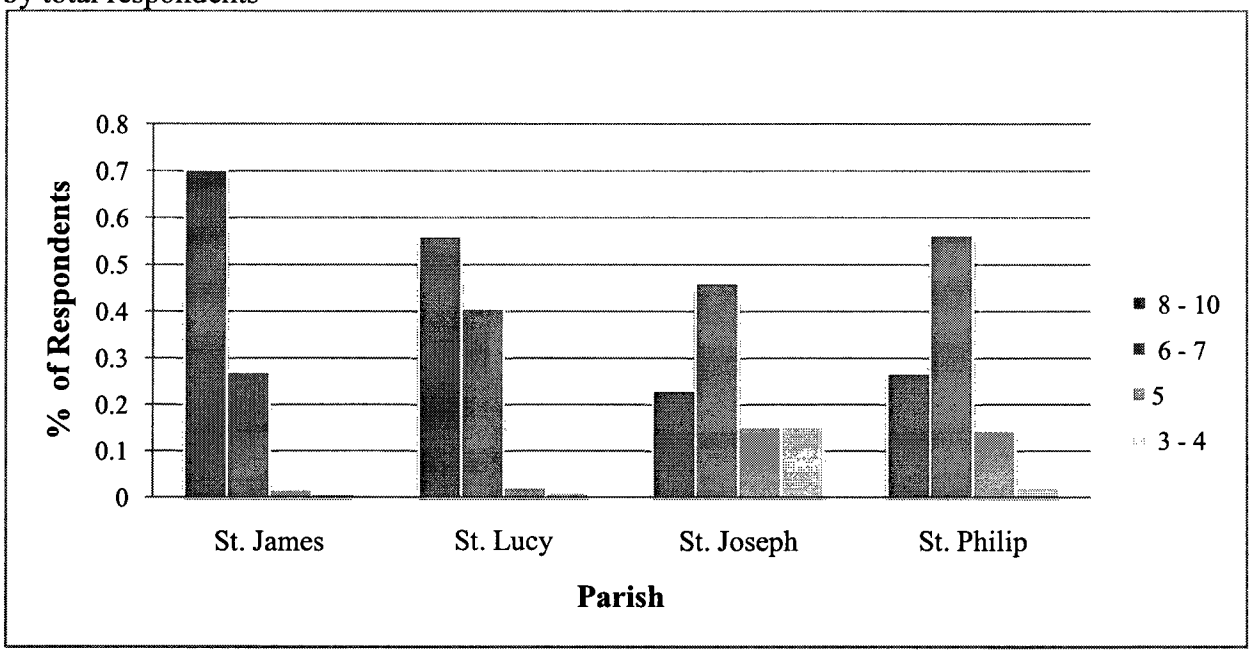


Figure 4.3: Water availability as perceived by respondents on a scale of 0-10: parish comparison by total respondents



Respondents then discussed the frequency with which they faced the occurrence of water interruptions. Interruptions were discussed with respondents as full out ceasing of water delivery through the water supply (generally household pipes) or the pressure drops to virtually unusable volumes. In the parishes of St. James and St. Lucy, frequency of interruptions ranged from every week, to every month, every few months, once a year, less than once a year, and never. The classification for St. Joseph and St. Philip was the same except for the addition of water interruptions faced every day, which certain problematic areas in these two parishes face. These two parishes also saw differences in the number of water interruptions faced over the wet and the dry season. The respondents in St. James and St. Lucy "catch water" (a local term for collecting and storing water) generally in the same pattern and amount throughout the wet and the dry seasons. In St. Joseph and St. Philip, households may collect water differently between the wet and the dry seasons, or they may collect the same amount of water between the two seasons. In the latter case, households who only answered to wet season interruptions inferred that these interruptions were faced all year round, and therefore they were kept the same for calculating dry season interruptions (this is implicit throughout the rest of the thesis).

The parish comparison of the frequency of water interruptions during the wet season yielded two significant relationships which are represented by Figures 4.4 and 4.5: females and total respondents. The critical value was 21.0, and the χ^2 for the groups was 33.17 for females and

39.87 for the total population. Table 4.2 represents the breakdown of male respondents in their categorization of frequency of water interruptions. As the relationship was not significant (χ^2 = 15.99), it is displayed in tabular format depicted by the per cent of male respondents replies across parishes in each category.

Figure 4.4: Frequency of water disruptions (wet season): parish comparison by female respondents

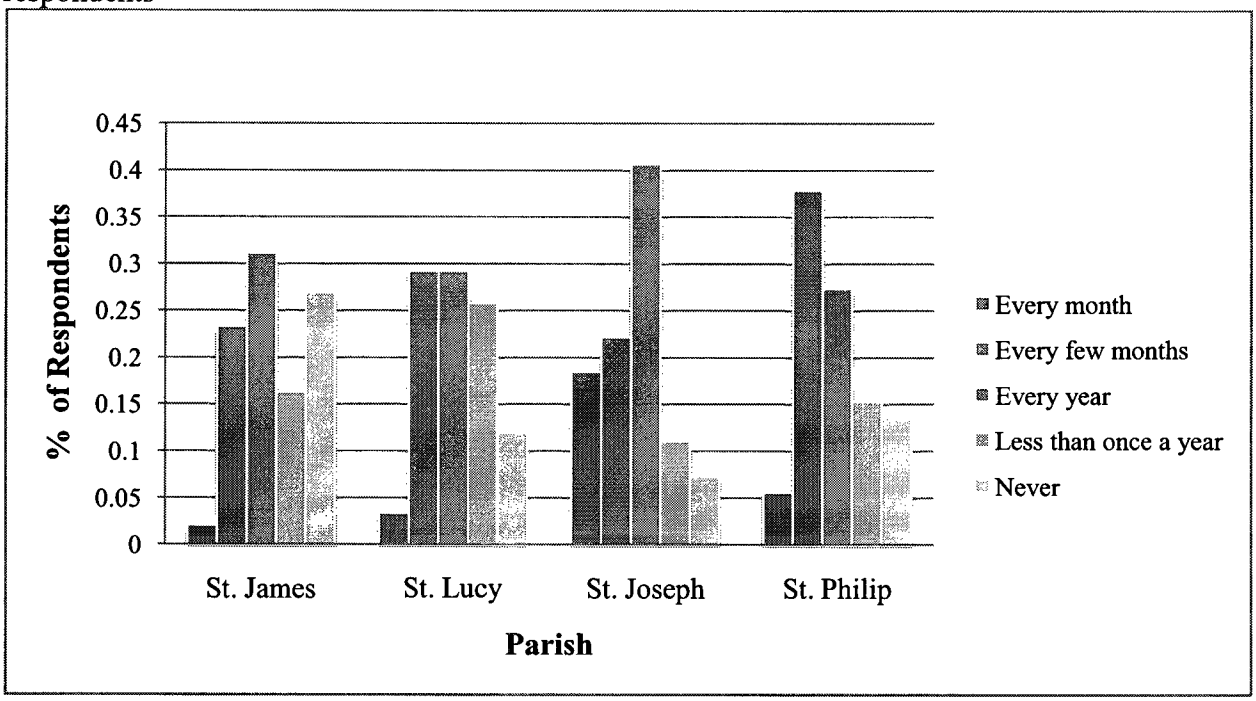


Figure 4.5: Frequency of water disruptions (wet season): parish comparison by total respondents

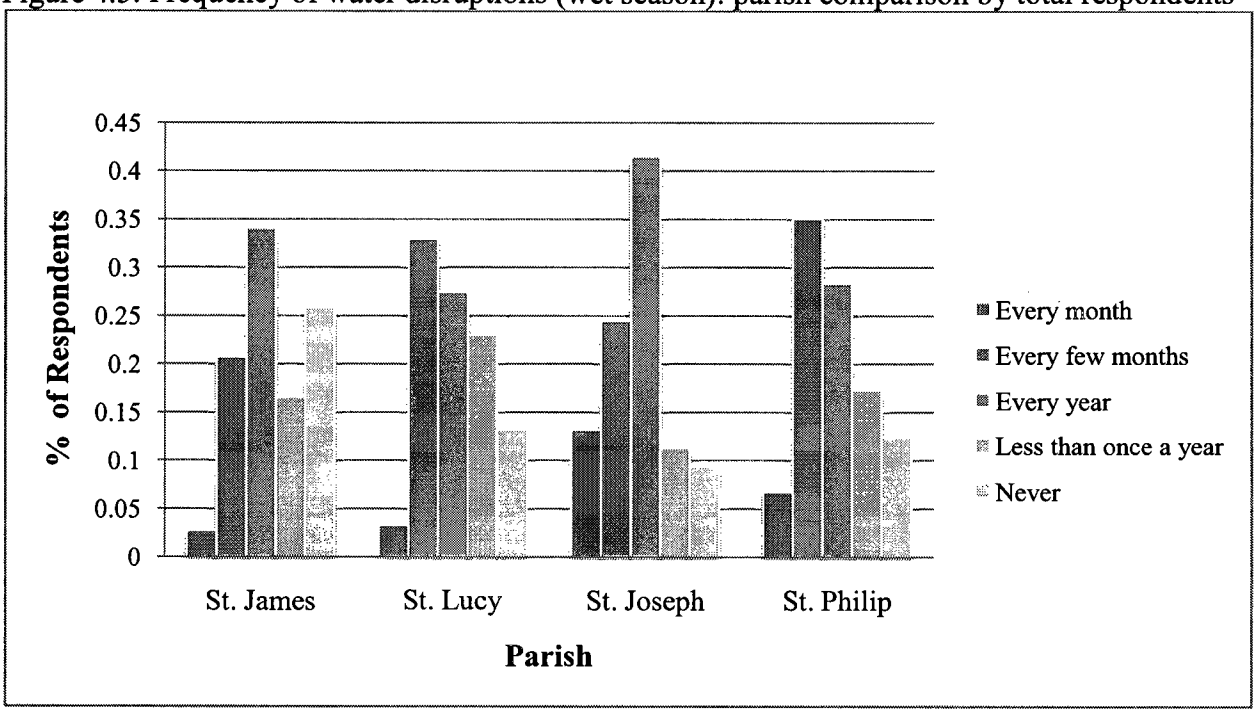


Table 4.2: Frequency of water interruptions (wet season): parish comparison by males

Frequency of water interruptions (wet season)	% male respondents of total male respondents				Total (%)
	St. James	St. Lucy	St. Joseph	St. Philip	
Every month	3.9	3.0	7.7	8.3	5.9
Every few months	15.8	39.4	26.9	31.0	26.5
Every year	39.5	24.2	42.3	29.8	33.8
Less than once a year	17.1	18.2	11.5	20.2	17.8
Never	23.7	15.2	11.5	10.7	16.0

The analysis of interruptions during the dry season produced extremely similar results with that of wet season interruptions. With an identical critical value χ^2 =21.0, the female and total population groups were significant. The observed χ^2 test statistic for both groups was 23.16 and 32.23 for females and total population, respectively. For males, the test statistic generated was χ^2 = 17.32 and therefore statistically insignificant.

There are multiple ways in which Barbadians coped with these water interruptions. For those who were actually affected by them (some households never or extremely sporadically experience interruptions), some households simply waited out the interruption and paused activities until the water comes back on. When the BWA becomes notified of water interruptions, they sometimes send a water truck (depending on the severity of the water shortage) to the district where the water outage has occurred and provide potable water to the residents. Those who did not want to depend on the BWA used a multitude of other methods to obtain water. Some used their collected and stored water reserves; if a water interruption is pre-determined and the BWA send out a notification, households generally collected water before it turned off. Households also obtained water from the community standpipe, from a public well, a spring, they go to a neighbour's or a family member's to get water or to do their household chores, or they may buy water. Many households used a combination of any of these methods. Table 4.3 is a summary of the main methods in which households obtained water from the four parishes.

Table 4.3: Coping strategies during water interruptions

Parish	Methods of obtaining water in times of interruptions						
	Wait	Collected/ stored water	Water truck	Buy water	Combination of methods	Not affected	Other
St. James	43	45	30	3	40	56	5
St. Lucy	12	12	17	1	31	12	6
St. Joseph	9	17	14	0	17	8	1
St. Philip	40	36	27	0	75	36	6

Table 4.4: Water interruptions affecting lifestyle: parish comparison by total respondents

Affect on lifestyle and other activities	% of Parish respondents				Total (%)
	St. James	St. Lucy	St. Joseph	St. Philip	
YES	29.5	27.8	32.8	31.5	30.4
NO	70.5	72.2	67.2	68.5	69.6

These water interruptions were further explored by determining whether they had a significant effect on a household's lifestyle or socioeconomic activities (such as cooking, washing, drinking water, sanitation, and irrigation). With a critical value of $\chi^2 = 7.81$, none of the categories across parishes yielded a significant relationship (females $\chi^2 = 1.73$; males $\chi^2 = 1.60$; and total population $\chi^2 = 0.57$). Table 4.4 above displays the similarity in respondents' replies (over the total population) in whether they believed that water interruptions were an important disruption in their lives.

For those respondents who felt that interruptions were not a large nuisance to their lifestyle, this was largely due to the fact that either the interruptions are too short in longevity to cause any significant difficulty, or that households are accustomed to it and adjust in relation to the interruptions. Many households know when the water will be out or when there will be low pressure, and so they plan their activities around it. One female respondent from St. James described her family's activities when faced with interruptions or shortages, "between 6h30 and 8h30 or later, low pressure and interruptions force us to bathe the children before 6h30. This is a part of our lives; we plan our activities in function of it". Others were not so optimistic about the effects of water shortages and interruptions. When the interruptions are longer or the household is not prepared for them (ie. they come about unexpectedly), shortages or interruptions impede them from completing their daily activities, chores, preparation for work and school; they also mean that households have to expend more time on household tasks and fetching water from other sources. For some, not being able to shower in the morning if the water goes out implies that they either must go to a friend or relatives, shower at work, or not go to work at all. For others water shortages imply a greater time investment in tasks either because water comes out as a trickle or because they must "go to the standpipe to get water and bring it back home" (mentioned by a female respondent from St. Lucy). For the elderly and those who are disabled, fetching water is not a possibility because it is too difficult, and so they must rely on others or wait out the interruption. The majority of individuals across parishes claimed that water interruptions were not significant detractors from their normal lives. However, many responses

were adamant for the contrary. This may be inferred due to the fact that although on an absolute term interruptions are aggravating, households have acclimatized themselves to these interruptions and can adapt their schedules around them. Those who were very affected by the interruptions were extremely vocal on the subject and may have overshadowed the majority who claimed that they were not significantly affected.

4.1.1.2. Water quality and happiness

Survey respondents were asked to describe the quality of their water. Discussions were not geared towards health related aspects of quality, but quality in terms of taste, appearance, and odour. Quality ranged from very good, good, neutral, poor, to very poor. All three classes of respondents were found to have a statistically significant relationship across parishes. At a critical value of $\chi^2 = 12.6$, females had an observed χ^2 of 27.05 (results depicted in Figure 4.6); male observed χ^2 equalled 12.95 (Figure 4.7), and the total population observed χ^2 value was calculated at 34.39 (Figure 4.8).

Figure 4.6: Water quality: parish comparison by female respondents

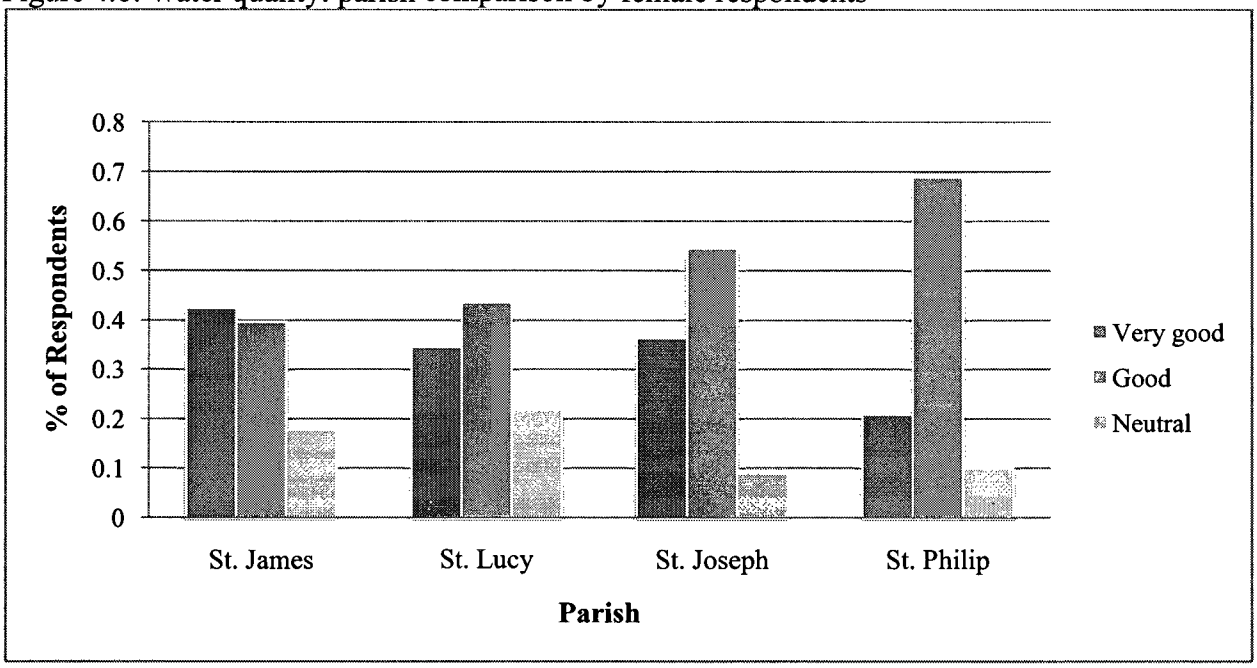


Figure 4.7: Water quality: parish comparison by male respondents

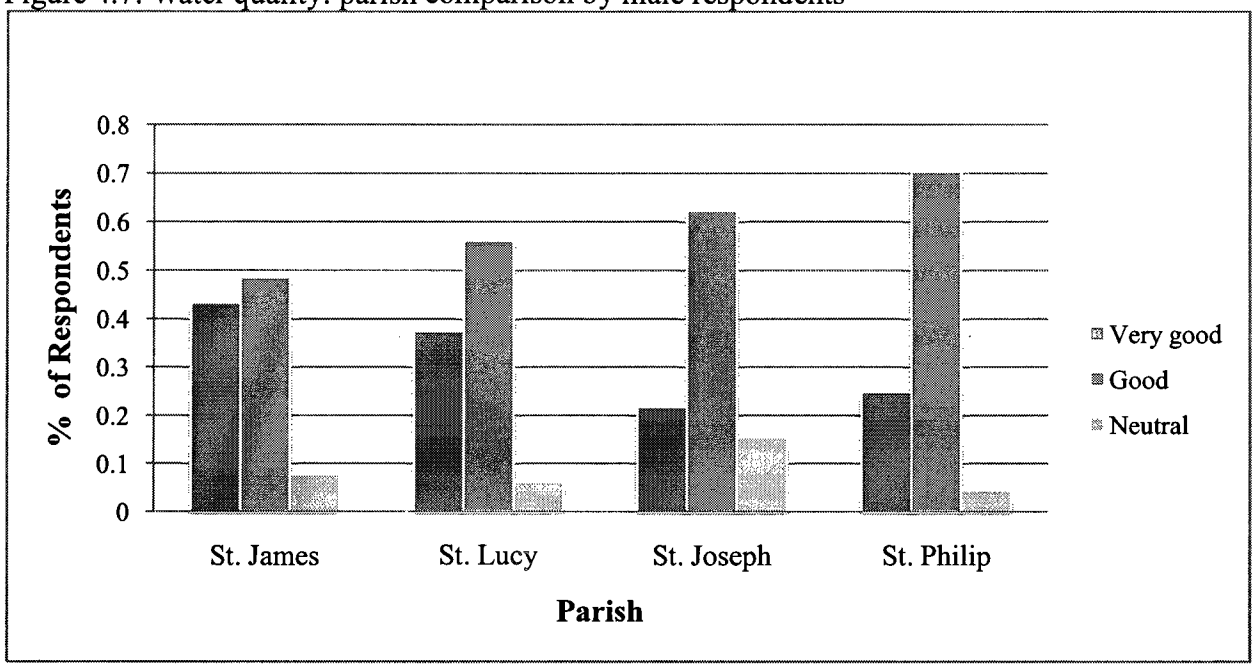
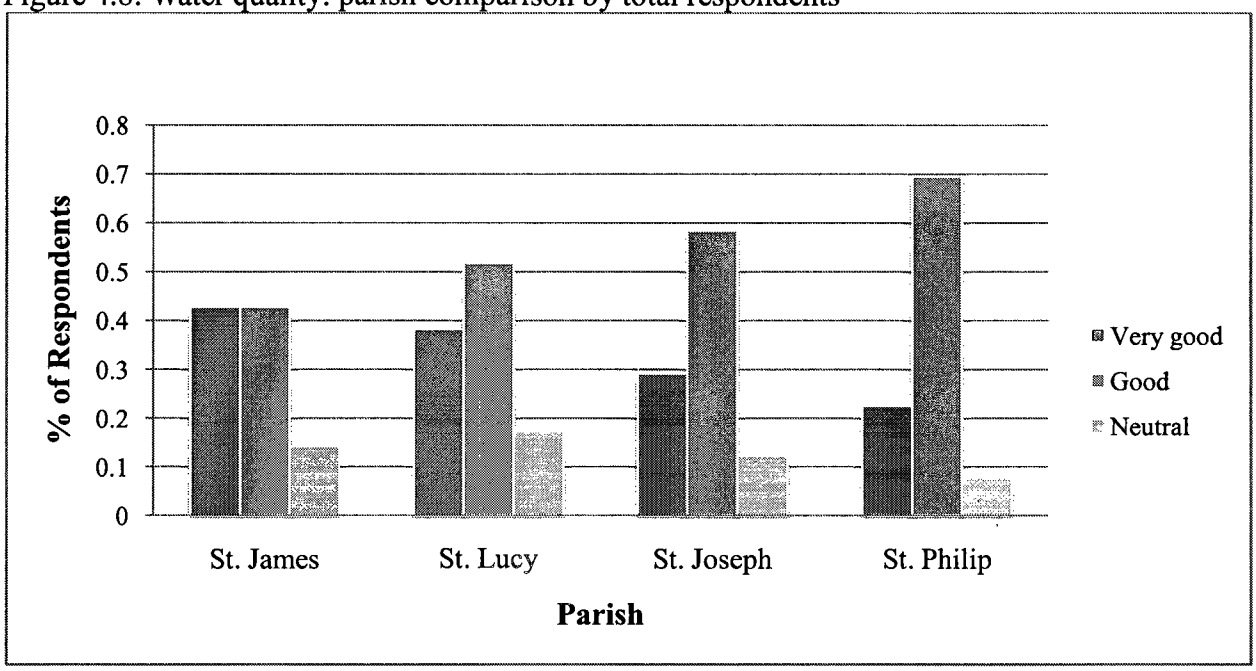


Figure 4.8: Water quality: parish comparison by total respondents



Respondents reflected on the issues surrounding the quality of their water. Domestic water sometimes comes out of the pipe too highly chlorinated; on other occasions (especially when the water has come back on after an interruption), the water is rusty and brown and of an inferior quality. Those who possess a filter on their pipes find them very useful. Many individuals commented on the taste; some inhabitants of St. James spoke about the salty taste of the water. While the previously mentioned qualities reflect those who are critical of their water, many Barbadians are exceptionally proud of it. They say that their water is "the best in the world", and that it is "110%".

Overall satisfaction of a respondent's water situation was asked to determine whether or not households were happy with the overall status of their water (i.e. frequency, quality, quantity). The critical value χ^2 for this calculation was 7.81 across all three categories between parishes (females, males, and total population), but a significant relationship existed with males (observed $\chi^2 = 9.58$), and the total population (observed $\chi^2 = 9.66$). These two categories are presented in Figures 4.9 and 4.10.

Figure 4.9: Satisfaction with water situation: parish comparison by male respondents

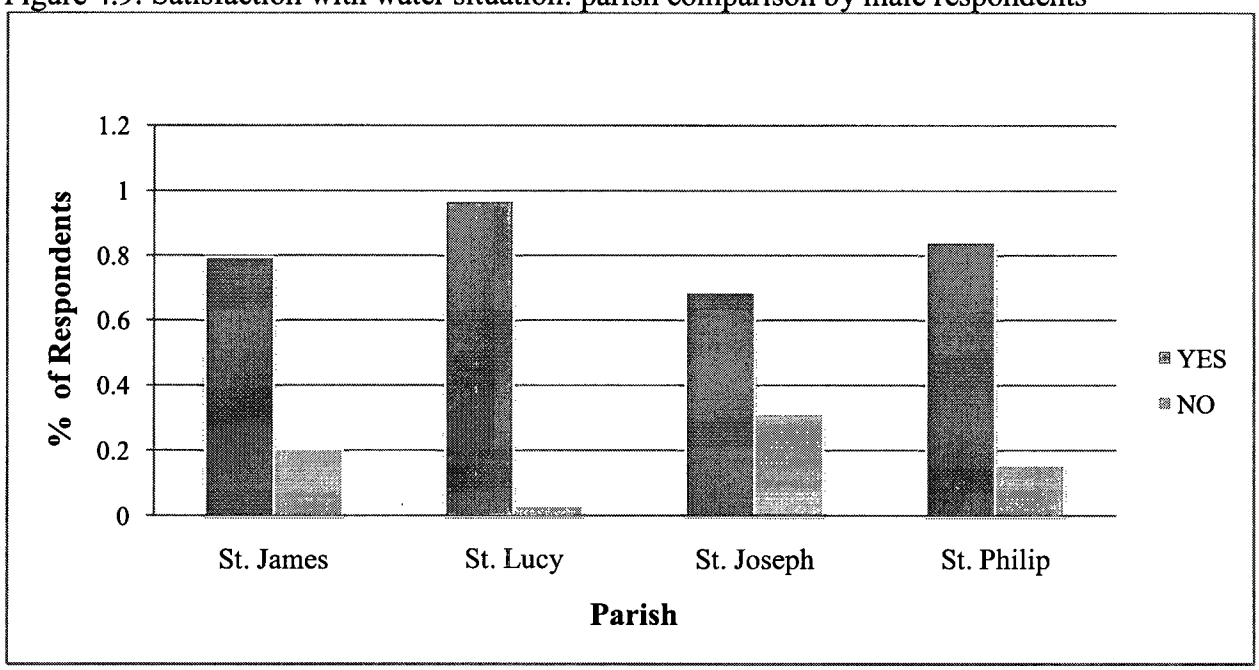


Figure 4.10: Satisfaction with water situation: parish comparison by total respondents

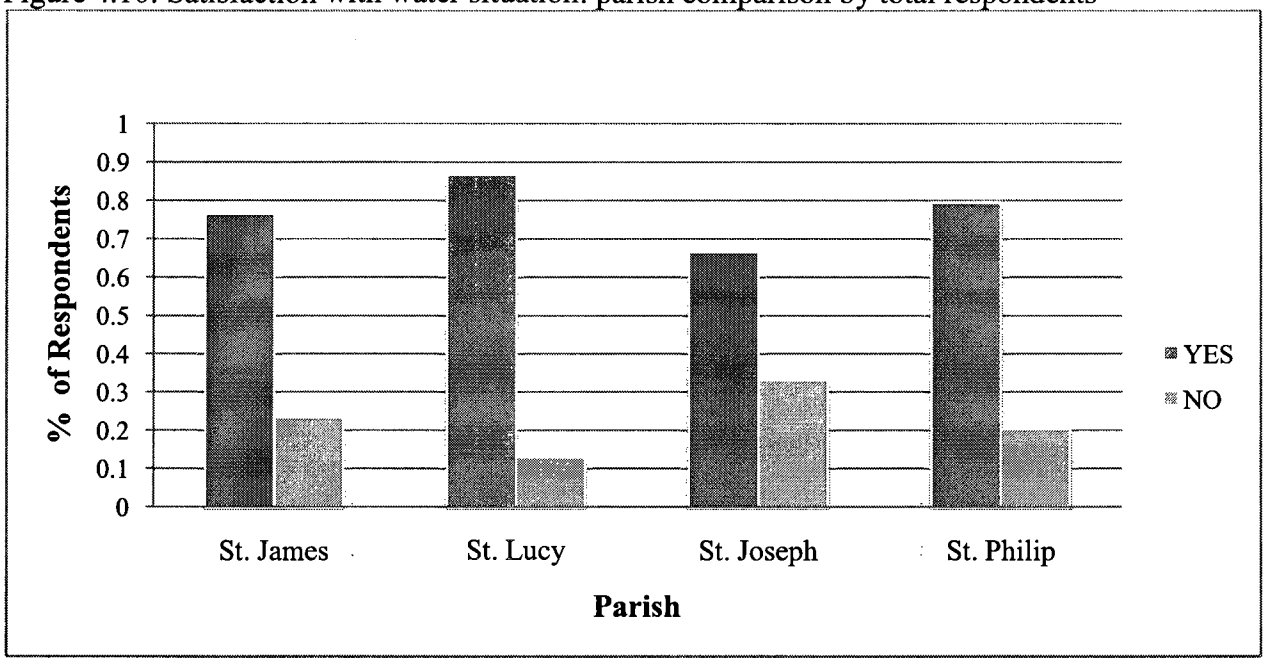


Table 4.5: Satisfaction with water situation: parish comparison by female respondents

Satisfaction with water situation	% female respondents of total female respondents				Total
	St. James	St. Lucy	St. Joseph	St. Philip	
Yes	75.0	81.0	64.7	76.3	75.5
No	25.0	19.0	35.3	23.7	24.5

Parish was not a significant factor in the case of female respondents in relation to their overall satisfaction with their water situation ($\chi^2 = 3.17$). Table 4.5 represents the percentage of female respondents in each of the four parishes who answered "yes" or "no" to whether or not they were overall satisfied with the status of their water.

In elaborating on why individuals were or were not happy with their water, replies can predominantly be divided into five categories: price, inferior quality, the BWA, water interruptions, and improvements in service. Many individuals were adamant about the price that they have to pay for water. Although water is metered and households must pay for the amount of water that they consume, many state that the price is just too high and that their water is too expensive. Some individuals commented on the fact that when pipes burst in their area, or a main bursts, it is the consumers who have to pay for it and not the BWA. Issues of water quality were discussed (but these were presented previously). Interruptions and low pressure were also topics of unhappiness for individuals. Not all that was mentioned was negative; some individuals

commented on the fact that service has increased and there is a greater quantity of water due to the desalination plant.

The final short answer question asked pertained to whether or not respondents felt that there were problems with the way that water was managed in Barbados in terms of such issues as administration and distribution. With a critical value of $\chi^2 = 7.81$, it was only the total population of respondents with an observed χ^2 of 11.57 that yielded a significant relationship between parishes. Both females and males derived insignificant relationships when compared across parishes. Females yielded an observed χ^2 of 6.27, and males an observed χ^2 of 6.89. Figure 4.11 represents the total population relationship graphically.

Tables 4.6 and 4.7 display the percentage of female and male respondents' (respectively) replies to whether or not they believed that there are problems with the way that water is managed in Barbados.

Figure 4.11: Problems with water management in Barbados: parish comparison by total respondents

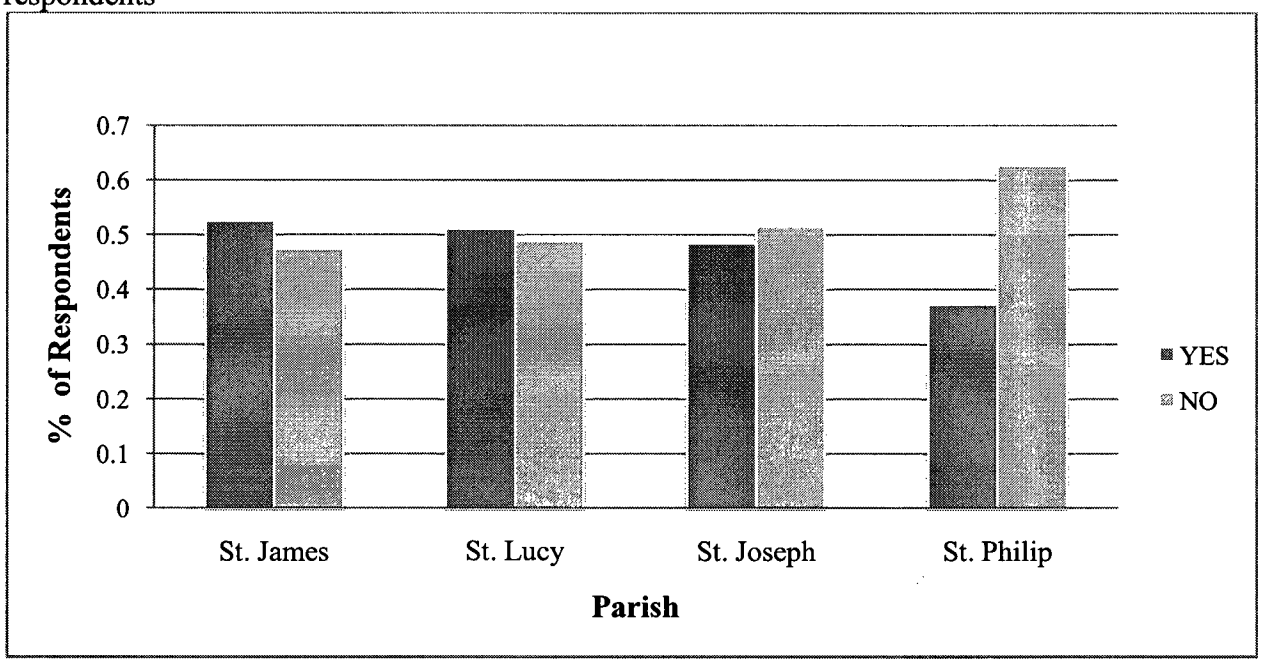


Table 4.6: Problems with water management in Barbados: parish comparison by female respondents

Problems with water management	% female respondents of total female respondents				Total
	St. James	St. Lucy	St. Joseph	St. Philip	
Yes	51.4	47.4	52.9	37.4	45.9
No	48.6	52.6	47.1	62.6	54.1

Table 4.7: Problems with water management in Barbados: parish comparison by male respondents

Problems with water management	% male respondents of total male respondents				Total
	St. James	St. Lucy	St. Joseph	St. Philip	
Yes	55.5	57.6	43.8	37.1	46.8
No	45.5	42.4	56.3	62.9	53.2

Many of the reasons behind people's perceptions of problems with water management in Barbados are issues that have already been raised: water quality problems, interruptions in the supply, low pressure, and burst pipes. Other concerns that were raised in the management of water were issues of water problems in other parishes; water interruptions during the crop season, and matters of sustainability. St. James and St. Lucy respondents enumerated multiple parishes (including St. Joseph and St. Philip) where water problems were much more stark than their own. Respondents also noted that there were greater issues of water shortage during the dry and crop seasons. Most of these respondents were from St. Lucy, as that parish is primarily agricultural in nature. Barbadians also spoke about the need for greater sustainability in their nation's water usage. Some if the comments relating to sustainability included: "there is not enough conservation of water (too much wasting; education related to water is needed)"; "people waste a lot of water [through their] hoses for car washing and garden irrigation (even for small gardens, [people] use a lot of water)"; "we are a water scarce country and between 40 and 60% of our water is unaccounted, mostly because of leakages"). Individuals would also like to see more rainwater harvesting. Although the desire to harvest rainwater is present, the economics are not. Rainwater tanks cost approximately 300 to 400 Barbadian dollars ($150-200 Canadian), and when one must consider the cost of food (which is astoundingly high due to the dependence of imported food) versus the cost of self-sufficiency for water, households are not left with a difficult decision to make. There is also a cultural barrier to the adoption of rainwater harvesting besides the economics debate.

4.1.1.3. Water pricing and use

Since water is metered in Barbados, for the most part price is proportional to consumption. The previous section highlighted commentary from respondents that would identify when this is not the case. Burst water mains and water pipes, as well as leaking connections are not charged to the BWA but rather to the consumer. Table 4.8 represents the monthly average water bill

charged to consumers on a household basis. Not all of the respondents knew how much the household paid for water, so those who answered "don't know" were not included in the tabulation of the average monthly water bill. The general trend demonstrates that as income rises, the amount of money allocated to water rises as well.

St. Lucy boasts a much greater high income monthly water bill since only two households were classified into this category, more than likely skewing the results for this category. Low income level households in St. James, St. Lucy, and St. Joseph contained individual households who did not pay for their water. The individual household in St. Joseph who did not pay for its water, for example, was on government aid. The other two households in the other two parishes mentioned also did not pay for their water, and as such they were initially removed from the average monthly water bill calculation. The following table calculates the monthly average water bill discarding those households who did not pay for their water in the low income bracket.

Table 4.8: Average monthly water bill by income and parish

Parish	Income level	Average monthly water bill (Barbados $)	Parish average (Barbados $)
St. James	Low Income	28.1	41.0
	Medium Income	38.5	
	High Income	55.8	
St. Lucy	Low Income	39.6	48.2
	Medium Income	47.9	
	High Income	70	
St. Joseph	Low Income	25.6	41.0
	Medium Income	42.4	
	High Income	43.3	
St. Philip	Low Income	52.0	39.9
	Medium Income	39.6	
	High Income	33.9	

Table 4.9: Average monthly water bill by income and parish including low income households who did not pay for water

Parish	Income level	Average monthly water bill (Barbados $)	Parish average (Barbados $)
St. James	Low income	25.5	40.8
St. Lucy	Low income	35.2	47.0
St. Joseph	Low income	21.3	40.4

Table 4.10: Number of people per household

Parish	Income Level	Average number of people per household	Parish average
St. James	Low Income	2.71	3.36
	Medium Income	3.50	
	High Income	2.97	
St. Lucy	Low Income	2.70	3.53
	Medium Income	3.44	
	High Income	4.0	
St. Joseph	Low Income	2.88	3.15
	Medium Income	3.21	
	High Income	3.20	
St. Philip	Low Income	4.53	3.19
	Medium Income	3.14	
	High Income	2.69	

The addition of the households who did not pay for their water decreased the average monthly water bills for the low income categories (Table 4.9). Decreases were in the order of 2.6$Bds, 4.4$Bds, and 4.3$Bds in St. James, St. Lucy, and St. Joseph respectively and this had a rather small effect on the parish averages. Although Table 4.8 presents a relatively direct relationship between the monthly price of water for a household and income level, St. Lucy and St. Philip exhibit directly proportional relationships with the number of people per household. Table 4.10 highlights the average number of people per household for each income bracket. The relationships seen here are not evident in the analyses conducted over the next few pages regarding the amount of water used on a task and income basis across parishes. These tables act, therefore, as a preliminary glance at what water usage could be like on a household basis and not what may be present in reality. This is due to the fact that Tables 4.8 and 4.9 show what households are charged by the BWA; and as discussed previously, there are problems with this system. Leakages are charged to the homeowner and not absorbed by the BWA and these values also do not take into account supplemental water used by households such as rainwater or standpipe water.

The following pages present the amount of water consumed per task over a period of one week, segregated by the socioeconomic classification of income by parish. In certain cases, outlier values were removed to determine what type of impact they had on the parish average. However, these outliers represent conscious decisions on water usage and management on the part of the respondents, so they form a vital component of analyzing people's responses in

regards to decision making. The standard error was also calculated for each task with and without the outliers. Table 4.11 categorizes the average water use by task and income on a per capita basis in St. James.

In the case of the medium income category, a household with a water collection storage capacity of 785.4L was removed. Removing this value changed the per capita value from an average of 4.2 L/week/person. Within the high income category, a household with a 3000L water tank with pump was removed. Removing this value changed the per capita value from an average of 28.7 L/week/person. When these two combined household values were removed from the calculation, the parish total was no longer 8.2 L/week/person and the standard error changed from 2.3 to 0.62. The total standard error decreases by a substantial amount when these large storage capacities are removed. Removing these values did not have a large affect on the grand total but it did change it from 828.3 L/week/person and the standard error decreased minutely from its 16.16 original value. Aspects such as water used for car washing was relatively standard. St. James presented the second highest total water use out of the four sample parishes. What is also noteworthy from this table is that the standard error was lowest for St. James, and so the amount of water used by an individual in this parish varies the least as compared with the three other parishes.

Table 4.11: Average Water Use by task and income level in St. James

Task	Average amount of water used per capita (L/week/person)				Standard error
	Income level			Parish total	
	Low	Medium	High		
Water collection and storage (all year)	13.9	2.8	2.2	3.2	0.62
Boiling water (to sterilize)	1.0	0.3	0.6	0.3	0.05
Cooking	6.6	6.4	4.9	6.5	1.10
Cleaning house	8.9	6.6	7.6	6.7	0.47
Cleaning dishes (hand/machine)	88.5	83.2	92.9	82.3	3.57
Bathing (including children & older family members)	603.3	681.4	579.7	655.5	13.75
Watering your animals (livestock & pets)	0.4	4.8	3.5	4.3	0.44
Washing vehicles	0.0	4.0	10.5	4.9	0.37
Washing clothes (hand/machine)	57.2	55.4	59.3	54.9	1.79
Irrigation (commercial and/or garden)	5.8	4.0	9.1	4.7	0.72
TOTAL	785.6	850.0	796.9	823.3	16.04

Table 4.12 presents the average water use by task and income level for the parish of St. Lucy. There were no outlier values observed in this parish. St. Lucy represented the lowest amount of water consumed from the four surveyed parishes. No significant water storage was observed in this parish, and other uses of water for the various tasks were standard in relation to the other parishes. Even water used for gardening and irrigation water for small scale farming was low for the amount of agriculture that occurs in St. Lucy.

Table 4.12: Average Water Use by task and income level in St. Lucy

Task	Average amount of water used per capita (L/week/person)				Standard error
	Income level			Parish total	
	Low	Medium	High		
Water collection and storage	21.0	5.5	0.0	6.7	1.14
Boling water (to sterilize)	2.2	1.1	0.0	1.2	0.25
Cooking	8.4	5.4	8.0	5.9	0.44
Cleaning house	7.5	7.4	8.5	7.4	0.64
Cleaning dishes (hand/machine)	44.9	77.3	49.0	73.5	5.96
Bathing (including children & older family members)	613.9	548.6	800.6	558.4	23.18
Watering your animals (livestock & pets)	1.6	11.2	0.0	9.9	2.09
Washing vehicles	0.0	4.0	8.5	4.0	0.52
Washing clothes (hand/machine)	77.0	50.0	42.5	53.3	2.95
Irrigation (commercial and/or garden)	3.1	10.4	0.0	9.4	1.93
TOTAL	779.5	721.0	917.1	729.9	27.48

Table 4.13 represents the average water use by task and income level in the parish of St. Joseph. In the medium income category, larger values were observed in two categories. In the task of water collection and storage (during the whole year), households that stored 1800L and 2000L at any given time were removed. Including these households increased the per capita water use for this task to 37.0 L/week/person for the medium income category. The parish total for this task was calculated to be 33.5 L/week/person and originally provided a high standard error of 8.47. St. Joseph respondents actually collected and stored the most amount of water amongst the four parishes. Two households who provided large amounts of water to their animals (amounting to 1,750L and 1,050L per week) were removed from the tabulation but originally consisted of a medium income average of 28.7 L/week/person for the task. The parish total for this task including these households reached 24.6 L/week/person and a standard error of 5.30. These households had an effect on the total weekly water use per capita for this income category which with these values was at 798.9 L/week/person. The total average weekly water use overall per capita including all of these households was 783.2 L/week/person with an original standard error of 44.5. St. Joseph actually also presented a very high water use for washing vehicles. The

value of 15.7 L/week/person on average over the parish was determined for this task in this location. Agricultural or garden water usage was also second highest in St. Joseph. In terms of overall water use, St. Joseph was ranked as third this domain with a weekly average per capita water use of 751.5L. However, the standard error associated with this value in St. Joseph was the highest, indicating the largest variation here.

Table 4.13: Average Water Use by task and income level in St. Joseph

Task	Average amount of water used per capita (L/week/person)				Standard error
	Income level			Parish average	
	Low	Medium	High		
Water collection and storage (wet)	7.3	15.1	30.0	15.6	2.77
Water collection and storage (dry)	0.0	1.0	4.4	1.1	0.44
Boiling water (to sterilize)	0.1	1.0	0.0	0.8	0.24
Cooking	6.4	4.1	2.7	4.4	0.93
Cleaning house	2.1	3.5	7.4	3.7	0.30
Cleaning dishes (hand/machine)	18.5	25.4	32.2	25.3	1.29
Bathing (including children & older family members)	682.4	626.6	582.5	613.5	35.87
Watering your animals (livestock & pets)	5.5	12.8	5.3	11.6	2.08
Washing vehicles	0.0	14.1	55.2	15.7	2.75
Washing clothes (hand/machine)	13.2	43.3	63.8	41.9	2.46
Irrigation (commercial and/or garden)	0.0	19.4	36.5	18.7	5.42
TOTAL	735.5	765.3	819.8	751.5	39.30

Table 4.14 displays the average amount of water used by task and income level in the parish of St. Philip. Both the medium and high income groups observed values which were higher than the norm. From the medium income level, an individual who irrigates with approximately 22,690L per week was removed. Originally for the medium income group the amount of water used for this task with this individual was calculated to be 75.3 L/week/person. This made the total average water use for this income category climb to 1,134.2 L/week/person. This individual had a one-half acre plot which produces okra, beans, cucumber, pumpkins, and other crops. High income households had large water collection and storage capacities in the form of water tanks (of 3,200L and 2,400L). This created average water use of 84.4 L/week/person for water

collection and storage during the wet season. One high income household irrigated with 2,178.8L per week. Including this household made the high income group for this task use 60.3 L/week/person. Without removing these mentioned individuals from the high income category, the original total water use for this socio-economic group was 1,309.1 L/week/person, the highest determined in this study. Including all of these outliers created parish totals for water collection and storage(wet season) of 14.7 L/week/person, 55.5 L/week/person for irrigation, and 941.5 L/week/person for total per capita was use and standard errors of 3.36, 22.95, and 36.83 respectively. Water used for irrigation purposes was highest in St. Philip. Water use on a weekly basis per capita was also highest in St. Philip.

Table 4.14: Average Water Use by task and income level in St. Philip

Task	Average amount of water used per capita (L/week/person)				Standard error
	Income level			Parish average	
	Low	Medium	High		
Water collection and storage (wet)	4.5	8.9	4.8	6.8	0.82
Water collection and storage (dry)	3.1	1.3	0.0	1.2	0.41
Boiling water (to sterilize)	2.1	1.0	0.1	0.9	0.15
Cooking	3.4	5.9	5.6	4.7	0.26
Cleaning house	2.1	7.6	8.0	5.9	0.62
Cleaning dishes (hand/machine)	21.7	32.4	29.4	26.2	0.67
Bathing (including children & older family members)	581.7	914.8	1,038.5	762.9	26.91
Watering your animals (livestock & pets)	6.7	15.5	8.7	11.5	2.01
Washing vehicles	2.1	12.6	19.2	10.0	0.97
Washing clothes (hand/machine)	39.1	59.0	55.1	47.9	1.31
Irrigation (commercial and/or garden)	8.9	25.4	30.5	20.2	1.98
TOTAL	675.3	1,084.2	1,198.0	898.1	27.52

The general trend observed from the water use tables for the four sample parishes demonstrate that as income rises, so does water consumption. Large tanks for water storage were observed only in medium and high income households. In all of the parishes except for St. James, greatest average household consumption of water occurred in high income households (in St.

James the medium income households on average used the greatest amount of water, followed by high income households). The price of these are very expensive (equivalent to 150-200 $Ca), and subsequently low income households cannot afford them. The one task that was consistent throughout the four parishes was that of water used for washing cars. In all four parishes, the high income categories used the most water to wash their cars or have their cars washed, followed by the medium income category. With the exception of St. Philip, the average amount of water used per week for car washing in the low income group was zero litres. Cars are a luxury that many of the low income households cannot afford.

4.1.2. Water issues across gender

As was presented similarly with Table 4.1, Table 4.15 is a synopsis of the observed χ^2 values and the associated critical values for each parameter measured comparing gendered responses. Only three relationships were statistically significant in the gender analysis. The chi-square distribution is as per Thompson (as cited in Dutilleul *et al.*, 2005).

Table 4.15: Summary of observed χ^2 and critical values per parameter and respondent group measured for gender comparisons

Issues discussed with survey respondents	**χ^2 test statistic per parish**				
	St. James	**St. Lucy**	**St. Joseph**	**St. Philip**	**Total**
Water availability	0.03	1.64	1.19	0.16	1.54
Wet season water interruptions	3.23	1.55	1.61	2.46	2.10
Dry season water interruptions	3.23	1.55	1.13	6.35	4.45
Affect on lifestyle	0.01	2.15	2.01	1.56	3.04
Water quality	4.31	4.02	1.91	2.51	8.02*
Overall satisfaction with water	0.57	4.67*	0.12	2.05	3.91*
Problems with water management	0.20	0.87	0.56	0.002	0.04
	χ^2 critical value per respondent group				
Water availability	3.84	3.84	7.81	7.81	7.81
Wet season water interruptions	11.1	9.49	12.6	12.6	12.6
Dry season water interruptions	11.1	9.49	12.6	12.6	12.6
Affect on lifestyle	3.84	3.84	3.84	3.84	3.84
Water quality	7.81	7.81	5.99	7.81	7.81
Overall satisfaction with water	3.84	3.84	3.84	3.84	3.84
Problems with water management	3.84	3.84	3.84	3.84	3.84
* χ^2 test statistic *greater** than critical value; i.e. statistically significant					

4.1.2.1. Water accessibility and its effects

The relationships analyzed across parishes presented in section 4.1. were also analyzed

across genders. The first parameter of perceived water availability on a scale of 0 to 10 was statistically insignificant across genders. The χ^2 critical values were 3.84 (for the analysis on St. James and St. Lucy) and 7.81 (total population, St. Joseph, and St. Philip) with none of these comparisons yielding significant χ^2 values. Table 4.16 represents the categorization of responses by gender across the four parishes and in total.

Table 4.16: Water availability as perceived by respondents on a scale of 0-10: gender comparison by total respondents

Perceived scale of water availability from 0-10	**% female and male respondents of total female and male respondents**								**Total (%)**	
	St. James		**St. Lucy**		**St. Joseph**		**St. Philip**			
	F	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**
8-10: "very accessible"	72.7	71.4	52.7	66.7	24.2	21.9	27.5	25.8	47.5	46.1
6-7: "accessible"	27.3	28.6	47.3	33.3	39.4	53.1	55.7	58.4	41.0	44.0
5: "neutral"	-	-	-	-	21.2	9.4	14.5	13.5	8.7	6.5
3-4: "difficult to access"	-	-	-	-	15.2	15.6	2.3	2.2	2.7	3.4

The lack of significant relationships does not indicate that disparities do not exist. Where a household did not only rely on piped water but supplemented it with either rainwater or water from the community standpipe, it was generally females or males living in female-headed households that expanded their sources of water. Five households spread over each parish (two in St. Joseph) supplemented their piped water with water from the standpipe. Four of these respondents were female, while the male respondent lived in a female-headed household. Four respondents supplemented faucet water with rainwater. They were split evenly between St. James and St. Philip, with female respondents in the former parish and one female and one male in the latter parish. In this case, the male respondent was the head of his household (but does live with his wife). Two females (inhabitants of St. James and St. Lucy) used only standpipe water as their main source of potable water, and both of these women lived on their own. The two households that only used "other" sources were both male; in St. Philip this consisted of a man living independently while in St. Joseph the head of the household lives with two female friends. There is demonstrated a subtle inference that female presence and status as a head of household may facilitate an alternate usage of water. Meanwhile, males who replied to alternatives to domestic piped water lived in the more problematic parishes in respect to water (St. Joseph and St. Philip).

Similarly to the previous question regarding perceived water availability, the frequency of

water interruptions did not have a significant gender association and the distribution of responses is presented in Table 4.17.

Table 4.17: Frequency of water interruptions (wet season): parish comparison by total respondents

Frequency of water interruptions (wet season)	% female and male respondents of total female and male respondents								Total (%)	
	St. James		St. Lucy		St. Joseph		St. Philip			
	F	M	F	M	F	M	F	M	F	M
Every day	-	-	-	-	5.9	6.3	0.8	1.1	0.8	1.3
Every week	2.1	2.6	-	-	14.7	12.5	4.6	4.5	3.8	4.3
Every month	2.1	3.8	3.4	3.0	14.7	6.3	5.3	7.9	4.6	5.6
Every few months	22.9	15.4	29.3	39.4	17.6	21.9	35.9	29.2	28.1	25.0
Every year	30.6	38.5	29.3	24.2	32.4	34.4	26.0	28.1	28.9	31.9
Less than once a year	16.0	16.7	25.9	18.2	8.8	9.4	14.5	19.1	16.3	16.8
Never	26.4	23.1	12.1	15.2	5.9	9.4	13.0	10.1	17.4	15.1

Table 4.18: Water interruptions affecting lifestyle: gender comparison by total respondents

Affects lifestyle	% female and male respondents of total female and male respondents								Total (%)	
	St. James		St. Lucy		St. Joseph		St. Philip			
	F	M	F	M	F	M	F	M	F	M
Yes	29.2	30.0	33.3	17.9	40.6	23.1	35.2	26.6	33.3	25.9
No	70.8	70.0	66.7	82.1	59.4	76.9	64.8	73.4	66.7	74.1

The scenario remained the same for the frequency of water interruptions during the dry season. None of the relationships were statistically significant and the distribution of respondents' answers resembles that of wet season/all year round responses.

The issue of determining whether water interruptions had a significant effect on a household's lifestyle or socioeconomic activities (such as cooking, washing, drinking water, sanitation, and irrigation) had no significant gender distinction. With a critical value χ^2 of 3.84, none of the gender comparisons generated a significant relationship. Table 4.18 above describes the categorization of responses by gender across the parishes and in total.

With the exception of St. James, all of the parishes had female respondents replying at least 8.6% (St. Philip), 17.5% (St. Joseph), to 15.4% (St. Lucy) more than men on the fact that water interruptions do indeed affect their lifestyle and socioeconomic activities. However, both genders were adamant to the fact that water interruptions do not allow them to complete their daily tasks.

4.1.2.2.Water quality and happiness

Water quality was described as a range from very good to very poor. With χ^2 critical values of 5.99 and 7.81, only the comparison between the total respondents was considered to be significant (χ^2 = 8.02). Figure 4.12 depicts this relationship while Table 4.19 represents the gendered difference in responses across parishes. Although the relationship was not statistically significant, women were more critical on the quality of their water over their male counterparts. 16.5 % of women claimed that their water was either neutral, poor, or very poor in quality while 9.6% male respondents claimed that their water was in this state.

Figure 4.12: Water quality: gender comparison by total respondents

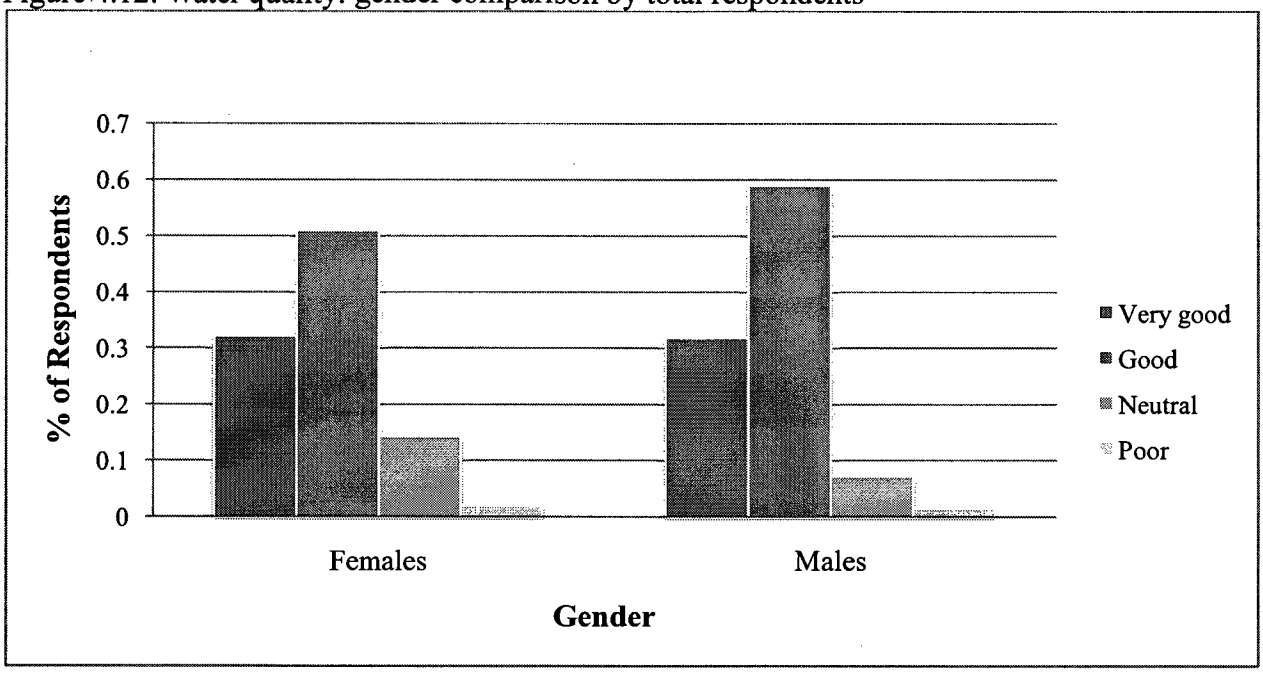


Table 4.19: Water quality: gender comparison by total respondents

Water quality	% Responses by Females (F) and Males (M) in each Parish and in Total							
	St. James		St. Lucy		St. Joseph		St. Philip	
	F	M	F	M	F	M	F	M
Very good	41.7	42.3	32.8	36.4	36.4	21.9	20.6	24.7
Good	38.9	47.4	41.4	54.5	54.5	62.5	67.9	69.7
Neutral	17.4	7.7	20.7	6.1	9.1	15.6	9.9	4.5
Poor	2.1	2.6	5.2	3.0	-	-	1.5	1.1

An overall state of happiness with regards to respondents' water situations was questioned and from this analysis two significant relationships were determined. With a critical value χ^2 of 3.84, both the comparison of the total female and male population (χ^2 =5.15) and the gender comparison of St. Lucy (χ^2 =4.12) yielded significant relationships. The results of these two relationships are demonstrated graphically in Figures 4.13 and 4.14.

Figure 4.13: Satisfaction with water situation: gender comparison by St. Lucy respondents

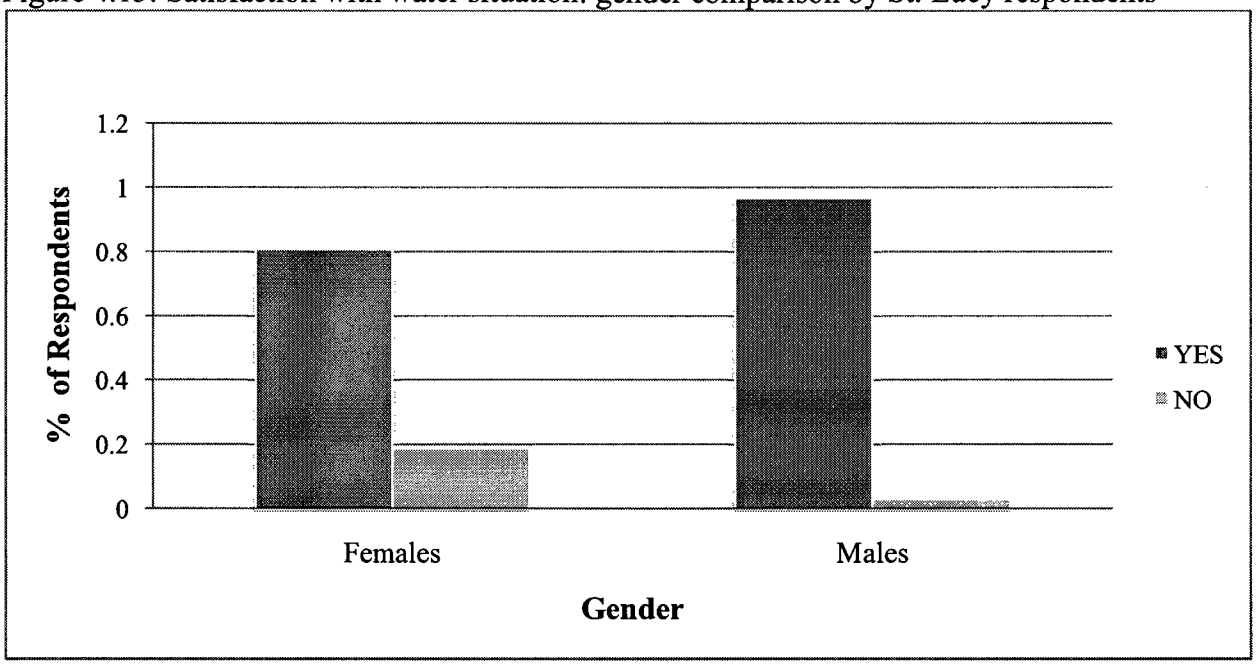
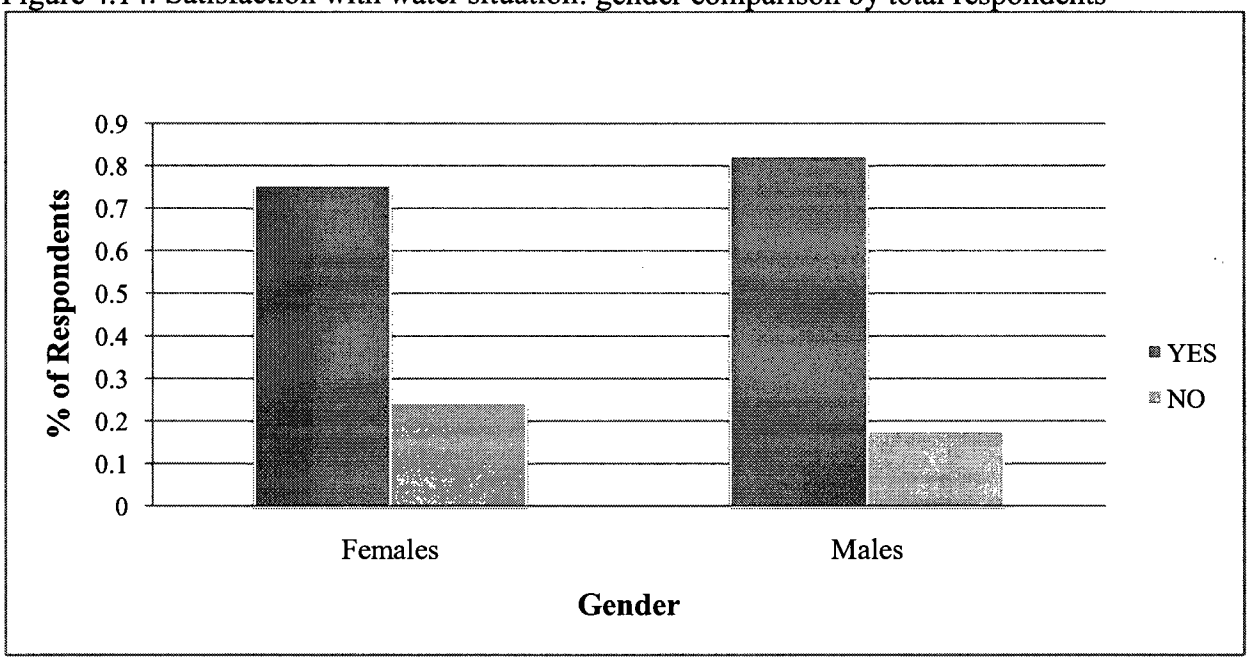


Figure 4.14: Satisfaction with water situation: gender comparison by total respondents



In St. Lucy, 82.5% of female respondents were satisfied with their water situation, as compared with 97% of their male counterparts (32 male respondents stated that they were content with their water, whereas only one male respondent was dissatisfied with his water situation). In comparing all of the female and male respondents in the sample, 75.3% of female respondents were satisfied while 83.0% of male respondents felt the same way. Results from the other three parishes, St. James, St. Joseph, and St. Philip, were all insignificant in their relationships comparing genders. The female to male ratios of water satisfaction are the following: 75%:79.5% for St. James; 64.7%:68.8% for St. Joseph; and 76.3:84.3% for St. Philip.

The final survey question looked at whether respondents' felt that there were problems with the way that water is being managed in the country by the government and the BWA. A critical value χ^2 of 3.84 was used, but none of the gender comparisons across parishes nor the total count of males and females yielded any significant results. Table 4.20 demonstrates respondents' answers in regards to the issue of difficulties with the management of water in their country.

Table 4.20: Problems with water management in Barbados: gender comparison by total respondents

Problems with water management	**% female and male respondents of total female and male respondents**								**Total (%)**	
	St. James		**St. Lucy**		**St. Joseph**		**St. Philip**			
	F	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**
Yes	51.4	54.5	47.4	57.6	52.9	43.8	37.4	37.1	45.9	46.8
No	48.6	45.5	53.6	42.4	47.1	56.3	62.6	62.9	54.1	53.2

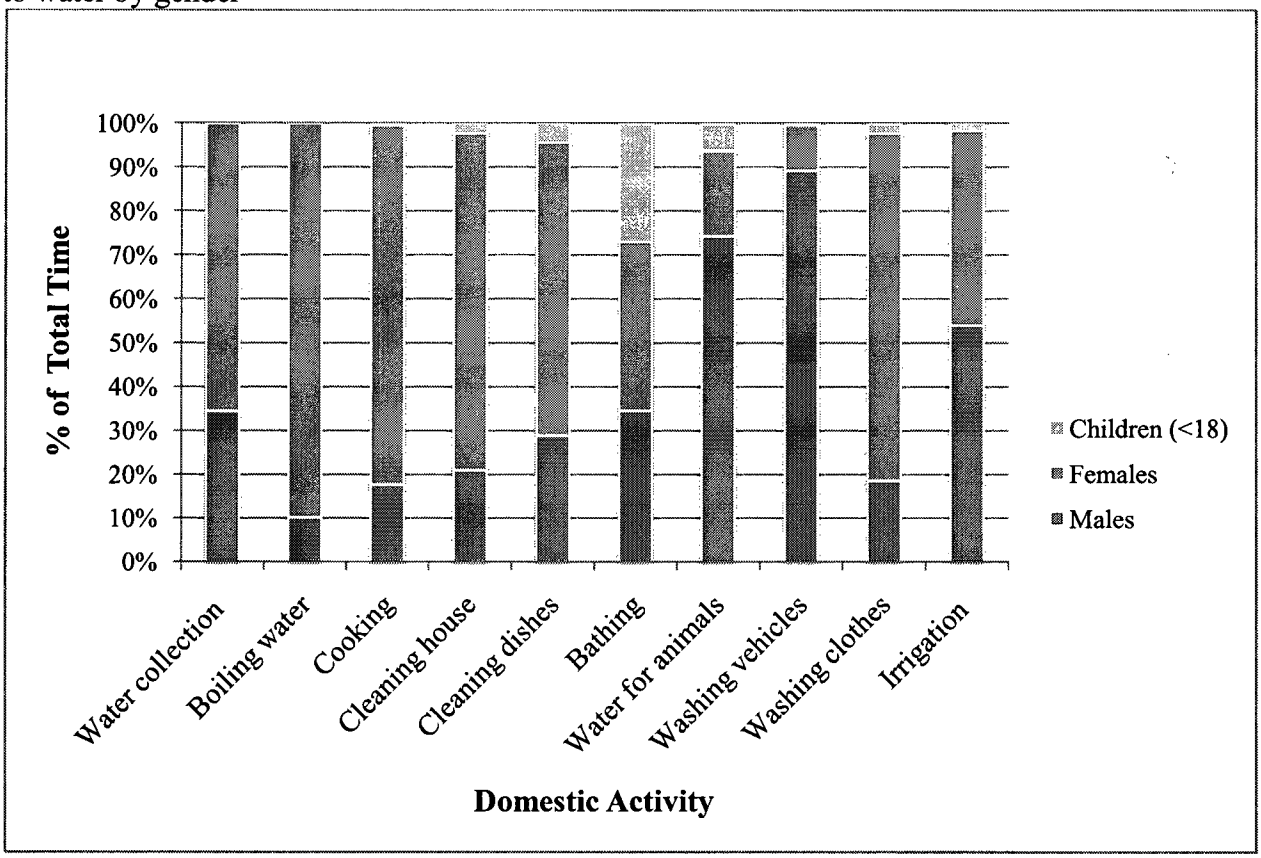
The total comparison between female and male respondents, based on the table, provided almost equal results. The largest difference between female and male answers to the question was found in St. Lucy (10.2% more males claimed that there were problems with water management in Barbados), whereas the smallest difference was in St. Philip (0.3% more females claimed that water management was problematic in Barbados). What was interesting is that in St. James and St. Lucy, there were some individuals who did feel comfortable answering this question (three females and one male). In St. Joseph and St. Philip, all respondents felt like they were capable of answering the question.

4.1.2.3. Water use patterns and water consumption

The completion of domestic chores was predominantly fulfilled by females. On average, males spend 5.6 hours per week on household tasks, whereas females spend quite a substantial time

more on tasks at 12.6 hours per week. Figure 4.15 displays the breakdown of where men, women, and children spent their time on domestic tasks relative to one another.

Figure 4.15: Time allocated per week as a proportion of the total time on domestic tasks related to water by gender



Women use more water by virtue that generally they are responsible for the majority of household tasks and chores that involve the use of water. The largest water user was bathing, which all groups shared. The next highest water-demanding tasks across parishes were cleaning dishes and washing clothes. Women had the greatest share of time spent on these tasks. Women also had a vast majority of the time share in boiling water, cooking, and cleaning the home. Men's time on a relative scale was concentrated in washing vehicles (which was one of the smallest users of water relative to the other tasks), providing water to the animals, and irrigating crops and gardens, although on an absolute level men gave a large portion of their time to cooking and cleaning dishes. Children helped in the tasks of cleaning dishes, providing water for the household's animals, washing clothes, and irrigating the garden or the lawn. Table 4.21 summarizes how much time each gender spent on each task in hours per week.

Table 4.21: Average time spent per week (in hours) on water-related household activities

PARISH / TASK	St. James			St. Lucy			St. Joseph			St. Philip			Average (total)		
	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C
Water collection & storage (wet season)	0.014	0.022	0	0.043	0.057	0.000	0.035	0.110	0	0.042	0.084	0	0.031	0.059	0
Boiling water	0.018	0.048	0	0.013	0.143	0	0.014	0.078	0	0.003	0.161	0	0.012	0.106	0
Cooking	0.936	4.69	0.035	1.07	4.83	0.083	0.816	5.02	0	0.973	3.85	0	0.957	4.43	0.028
Cleaning house	0.513	2.23	0.084	0.490	2.38	0.139	0.501	1.87	0.006	0.635	1.71	0.009	0.552	2.02	0.061
Cleaning dishes	0.737	2.31	0.147	0.945	2.32	0.176	0.589	1.97	0.113	1.14	1.79	0.105	0.897	2.08	0.135
Bathing	1.63	1.76	1.36	1.87	1.95	0.983	1.44	1.59	1.33	1.85	2.16	1.53	1.73	1.92	1.35
Water for animals	0.355	0.084	0.083	0.500	0.213	0.011	1.24	0.223	0.031	0.312	0.096	0.001	0.463	0.121	0.039
Washing vehicles	0.234	0.025	0.003	0.313	0.031	0	0.262	0.010	0	0.249	0.039	0	0.255	0.030	0.001
Washing clothes	0.471	1.85	0.023	0.546	2.14	0.119	0.194	1.23	0.008	0.271	1.30	0.051	0.379	1.62	0.047
Irrigation	0.129	0.157	0	0.153	0.245	0	0.179	0.110	0.069	0.577	0.374	0.005	0.300	0.246	0.009
TOTAL	5.04	13.17	1.74	5.94	14.31	1.51	5.30	12.20	1.60	6.10	11.60	1.70	5.57	12.64	1.67

4.1.3. Sources of bias

Although the goal was to limit the bias in the study, bias is generally unavoidable and especially so when individuals are asked to estimate the amount of water that their household uses and how much time they and the rest of the members living under the household spend doing those tasks involving water.

During the process of driving around and physically completing the surveys door-to-door, one of the biases that came out of this was that surveying was done only during the day, and so it limited the availability of individuals since many people were at work. It also focused the responses around stay-at-home mothers, retirees, and sometimes students. However, this bias was unavoidable since surveying during the day was the only option for safety precautions. Secondly, the surveys were conducted by three different individuals who had different methods and who may have provoked arguably slightly dissimilar responses. Another problem faced during fieldwork was that although the BSS provided both a listing and graphical representation of the enumeration districts in the form of a map, they were not always discernable when driving through these areas. This was only problematic in St. James, where large population densities in very small areas and an inability of locating these areas because there were no place names made it virtually impossible to survey. When this occurred and surveying was not possible, surrounding enumeration districts with similar visible socio-economic characteristics were chosen to make up for the lost enumeration district. In one instance where it was not possible to get the 1% target from remaining districts in St. James, those surveys were made up in St. Lucy (this consisted of just three surveys).

In regards to filling in the water use section of the survey, one of the first biases was that sometimes supplementary explanations and subsequently "educated guesses" had to be used since individuals would answer "I don't know" to questions asked. A number of individuals also provided their responses in gallons and not in litres, and in the process of converting the units it was much simpler to round the 1 gallon equivalency of 3.78 L equivalency to 4 litres. This therefore produced a slight overestimation for the households who answered in gallons instead of in metric. The final bias was due to the fact that some tasks related to water use (ie. water collection and storage, boiling water, car washing, etc.) were done with less frequency than was required in the study (some tasks for example were done every three months, or only when the water was shut off; however, the table in the survey demanded water used and time spent per

week, and so averaging monthly time and water would be close to negligible on a weekly basis), and consequently it was noted as zero. There were also certain tasks that were performed by non-household individuals or the task was paid for someone else to do it (ex. car washing).These tasks were often not completed at the respondent's home and so although they spent time and/or money on the task, they did not use their own domestic supply of water so it was also counted as zero.

4.2.Discussion

4.2.1. Differing development as a factor in water use and access

4.2.1.1. Socio-economic status of households

In a number of the sample parishes surveyed, households in both the medium and high income categories on numerous occasions had large water storage capacities. Due to relatively frequent interruptions in the water service in Barbados, households incorporate water storage into their decision making as a method of water security. It may be stated that certain households place a higher value on water and its security. This refers to households within the same income categories because a lack of income to purchase water storage facilities does not translate into a lesser value of water. Tanks and pumps are expensive so people in lower income brackets cannot afford them; these households are placed at greater risk and are more vulnerable during extreme environmental conditions such as droughts and hurricanes.

The only scenario where increasing water coincides completely with an increasing number of individuals per household is in the case of St. James. The strength of the socio-economic influence is arguably weaker here since individuals have better access to water within this parish. Socio-economic status plays a larger role in the other parishes; this is seen most prominently in St. Philip where income and number of people per household are indirectly proportional. As the number of individuals within a household decreases for each income bracket, the amount of water used per capita increases.

4.2.1.2. Location

Water interruptions were significant across parishes for the total population as well as for female respondents. Male respondents were not significant, and this can be due to the fact that when water interruptions occur, women may be more likely to be experiencing them, being more

often at home than their male counterparts. The temporal location of men affected their perception on water accessibility in the household regarding interruptions in the water supply. Since males spent less time in contact with water and may not have witnessed the interruptions as frequently as females, they may also have missed the deteriorated quality of the water when it returns after the interruptions that was witnessed in the gender comparison of water quality. A recurring comment connected with water quality discussions was the rusty and brownish tint and poor taste when water service is returned, and not being present for the disruption of service may also imply not seeing the poor quality as well.

Spatial location dictates the ease with which water service may be distributed. In comparison to the other three sample parishes, St. James is at least partially serviced by the new desalination plant and so it has a more reliable source supply. St. Lucy, St. Joseph, and St. Philip are physically further from the main infrastructure and so there is greater possibility of encountering water interruptions. St. Joseph, being located in the hillier region of the island, must fight topography as well as distance.

4.2.1.3. Economic and physical development

Located on the "platinum coast" of the island where one of the hub's of tourism is centered, St. James is a parish with a high volume of tourism and concentrated urban/suburban development. Potter's (1986) research on the spatial and social inequalities in Barbados due to historical developmental patterns have generated evidence that the western and southern coastal strips of the island fare better socially and economically than the rest of the island. Generally frequency and quality of water tend to be better because of the economic importance that tourism provides for the economy of Barbados. Interruptions experienced in St. James generally do not last that long so as to not inconvenience the hotels and the restaurants. Many survey respondents from the other parishes were critical on the duration of interruptions faced. The author resided in Holetown (St. James) during the collection of data, and on the final leg of the survey work a water main was breached and an interruption of water service occurred. Instead of lasting days as was the argument many made, the water was back on within hours and service was restored to full capacity. There are a multitude of hotels and tourism-related services that depend on that water in Holetown. St. Philip is also becoming an emerging centre for tourism. Proximity to the airport and beautiful coastal areas create an ideal location for tourism development, and as such

its water supply has seen improvements to increase its reliability.

The urban or rural nature of a parish may have also dictated the perceptions and responses provided by the respondents. Due to the proximity of tourism activities and services, St. James residents witness, and have access to, some of the improved services associated with such an economically important parish. The expectations of these urban dwellers who witness high service amenities can be substantially higher than their rural counterparts. These expectations may be witnessed in the male respondents of St. Lucy, who may not be as critical as male respondents in St. James but who receive a much better water delivery service than the other rural parish respondents in St. Joseph. The strong satisfaction of males in St. Lucy (98%) were significantly different from the overall lower satisfaction rates of female respondents.

The difference between urban households and rural is also noticed in the results when quantifying per capita water usage. Urban households have been documented to use 40 % more water than their rural counterparts (International Food Policy Research Institute, n.d.), and this is seen in the results with St. Philip and St. James households using a greater amount of water per capita than individuals in the rural parishes of St. Lucy and St. Joseph.

Conflicting uses of water for agriculture in the other three parishes also puts them at a disadvantage. St. Philip for example had the highest amount of household water usage partially due to very high water consumption in the category of garden and agricultural irrigation. Cash crop producers on the domestic level do not receive a special pricing for their activities from the BWA and so under their water usage for agriculture is still registered under this institution and adds to their total household water usage.

The physical landscape may also be a determinant as to how a parish develops and what its water situation may be like. St. Philip suffers from fires during the dry season on much of its shrubland terrain. This interruption in the water supply from this cause is compounded by the fact that part of the dry season coincides with the crop season which also causes either a decrease or an interruption at peak times in the water supply. St. Joseph is located on higher and rolling terrain and has greater changes in topography than the other parishes; greater topography implies that at periods of lower pressure residents in St. Joseph will likely suffer. Some do suffer shortages on a daily basis and water collection here is constant. The physical distance of St. Joseph not only from the main water supply but from the urban centres as well, coupled with the topography that makes easy bus service difficult implies that certain households place a strong

emphasis on their cars to get around. This dependence on personal transportation also invoked a need to keep the automobiles clean; St. Joseph had the highest weekly average water use for washing vehicles on a per capita basis.

At certain times, increased development actually increased hardships faced with water. An individual from the very luxurious development of Sandy Lane commented that his water shut off at least once a week. This is greater than the parish average, and occurs because perpetual development forces construction employees to shut off the water supply or induces accidental cutting of mains. Often when water goes off and then comes back on, its quality for a period of time afterwards is questionable as well.

4.2.1.4. Issues of perception

Differentiation in answers to questions such as water accessibility can be partially explained by issues of perception. For example, of the two women from St. James and St. Lucy who solely used water from community standpipes, one of these women claimed that her water was difficult to access (3-4 on the scale), while the other one stated that her water was very easily accessible (8-10 on the scale). Past water availability and preset expectations could be an underlying factor to why current access may be good or poor relative to the respondent. Origins can help explain issues of perception; there are a number of Barbadians who are not originally from Barbados. The following table presents the breakdown of Barbadian born individuals in St. James.

Table 4.22: Country of Birth by respondents in St. James (BSS, 2000)

	Gender		
Barbados Born	**Male**	**Female**	**Total**
Yes	9405	10439	19844
No	1189	1577	2766
Not Stated	75	56	131
Total	10669	12072	22741

Those individuals who did not originate from Barbados came from a wide array of regions globally; however, many came from the Caribbean (Grenada, Guyana, St. Lucia, St. Vincent and the Grenadines, Trindad and Tobago, etc.); a number immigrated from northern countries (Canada, USA, the UK), as well as other areas of the world such as Australia and India (BSS, 2000).

4.2.2. Gender influences on household water use

4.2.2.1. Current gender indicators in Barbados

Gender equality in Barbados may be measured by a number of the indices presented by the UNDP. The following facts were highlighted in the organization's Human Development report for 2007/2008. The Gender Development Index (GDI) captures inequalities in achievement between women and men. It is "simply the HDI adjusted downward for gender inequality. The greater the gender disparity in basic human development, the lower is a country's GDI relative to its HDI. Its GDI value is 99.4% of its HDI value. Out of the 156 countries with both HDI and GDI values, 60 countries have a better ratio than Barbados's" (UNDP, 2008). The next index is the Gender Empowerment Measure (GEM), which "reveals whether women take an active part in economic and political life. It tracks the share of seats in parliament held by women; of female legislators, senior officials and managers; and of female professional and technical workers- and the gender disparity in earned income, reflecting economic independence. Differing from the GDI, the GEM exposes inequality in opportunities in selected areas" (UNDP, 2008). In this category Barbados ranks 30th out of 93 countries in the GEM. The adult literacy rate (% ages 15 and older) in 2004 and the combined primary, secondary, and tertiary gross enrolment ratio 2004 perform very well. Values representing female as a percent of male provide values of 100% and 111.9% respectively. Women are given equal opportunity in Barbados regarding education, and then do excel as is demonstrated by the higher values assigned to women in the domains of literacy and educational enrolment.

4.2.2.2. *Land rights*

Land rights, which often dictate the availability of rights to water, are not a prohibitive feature in Barbadian society. Discrimination either via inheritance or purchase of land does not readily exist in Barbados (Barrow, 1993). This can be traced back to the days following emancipation, "Immediately following emancipation there was a surge of small plots of land made available to women. It is probable that this reflects planters providing land to their former slave mistresses for the support of their joint offspring" (Momsen, 2007). This remains the case in contemporary Barbados, since there are no customary or legal principles that bar women from inheriting or purchasing land, and many women do indeed own plots of land of varying size (Sutton and Makiesky-Barrow, 1981). It is actually customary for land holdings to be

"subdivided equally among all children, [and this has] generally assured that women are not discriminated against in land tenure arrangements" (Barrow, 1993).

4.2.2.3. The broader historical context

The literature review provided a narrow glimpse into some of the possible historical influences from slavery and colonialism to the current day scenario of relative gender equality. This review is a superficial undertaking into understanding how gender equality, especially in regards to natural resources such as water, has evolved in Barbados. A much more in depth analysis will be required to provide substance and not just speculation to the argument as to why the genders are relatively equal in Barbados, and is suggested as a point of further investigation in Section 6: Future Research.

5. Summary & conclusions

The research carried out in this thesis had two objectives. The first was to determine whether the degree of socio-economic and physical development of a parish influences the access and distribution of domestic water to households. The second objective was to uncover gender perceptions related to water and to determine how water use patterns and water consumption vary between genders in households. Conclusions in this chapter are divided into two sections. The first section summarizes the findings made when comparing parishes as an analysis of developmental effects, and the second section summarizes and concludes the findings made from the gender analysis.

5.1. Development

i. Survey respondents were questioned on how they perceived the status of their water regarding various characteristics (i.e. availability, quality, etc.). When comparing results from across the four parishes, it was discovered that individuals had significantly varied answers based on the parish of residence and therefore results were statistically significant for the most part with the exception of assessing whether interruptions affect lifestyle or not. What was highlighted time and time again throughout the results was that St. James almost always had the best scenario regarding whatever water feature was discussed, St. Lucy and St. Philip alternated between second and third position, and St. Joseph was the worst off pertaining to the various water issues highlighted to survey respondents. This may be demonstrated by assessing the values obtained when survey respondents discussed the frequency of their water disruptions. Respondents in St. James noted the lowest relative frequency of the occurrence of water interruption every month and the lowest relative frequency of not having any water interruptions ("never"). Alternatively, the mentioning of monthly water disruptions by the inhabitants of St. Joseph was the highest relative to the other three sample parishes, and the likelihood of never experiencing an interruption in the water service was lowest here as well.

ii. In general, the higher the income, the greater the water used by the household for domestic tasks. In the case of St. James, increasing water usage across income brackets corresponded with an increase in the number of individuals per household (the medium

income bracket in this parish had the highest number of individuals residing within a household). Water security and availability are higher and more readily available in St. James, implying that households here needed to place less emphasis on storing water and keeping it during times of scarcity. In the cases of the other three parishes socio-economic status of a household highlighted a stronger influence since household size and water usage did not correspond as blatantly as was evident in St. James. St. Philip demonstrated the strongest influence of socio-economic influence on water usage. As the number of individuals per household decreased over increasing income brackets, the amount of water used on a weekly basis per capita increased from 675.3L, 1,084.2L, to 1,198.0L. Washing vehicles was the household chore that depended on income, since water usage increased on an income level in each one of the four parishes for this task. The likelihood of owning a vehicle or multiple vehicles increased as income increased.

iii. Development as it relates to household socio-economic status, location, and especially physical and economic development within a parish all had effects on water. St. James is classified as the most developed parish, and residents struggle the least with water. Although St. Lucy is far away from much of the main water infrastructure, it still has a relatively reliable water supply although households complained quite substantially on its quality. St. Joseph and St. Philip suffer from an uneven topography, problematic land cover (e.g. the shrubland in St. Philip catches on fire during the dry season and interrupts water service and decreases quality), and competition from agriculture and other sources that predisposition them to lower reliability of water. Although water for agricultural use on a domestic level was very high in specific households in St. Philip, its booming tourism industry places it in the middle ranking of the sample parishes alongside St. Lucy regarding overall status of water reliability and availability. St. Joseph's topography and distance really place it at a disadvantage regarding reliability of water supply, and from this study it was determined that people in St. Joseph struggled the most with water. This has implications for the management of water by the BWA. The importance of a parish to the economy of the country cannot be the basis upon which the institution provides water service. Changes should be institutionalized to facilitate better water access in more remote locations. There is also a need to provide

better incentives for people to implement household water storage systems so that the lowest income households decrease their vulnerability in times of water scarcity. This should not only come from piped water but there should also be emphasis placed on increased rainwater harvesting within the country for domestic use of water.

5.2. Gender

i. The water characteristics that were analyzed across parishes were also analyzed across genders, and all but one relationship was discovered to be insignificant statistically. This was the satisfaction of households regarding their water situation in the case of the total sample respondents as well as those from the parish of St. Lucy. Gender had little influence when looking at how individuals within households perceived the various water issues. It is not surprising that this is the case in Barbados since access to a piped water supply, either within the home or just outside the home, is nearly universal. Since this is the case, the scenarios presented in the literature review of women spending many hours per day fetching water and being forced to spend most of their time completing "reproductive" tasks was not observed in Barbados. Water is generally readily available and as mentioned piped directly into the household. The gender inequalities that exist in many developing nations as well are not evident in Barbados. Women have access to everything that men have access to, including land rights (which often dictate water rights in many developing countries) and access to education at all levels.

ii. Although perceptions about the importance of water were not readily influenced by gender, household tasks were still generally performed by women. Women were not solely relegated to the domestic sphere of work; their domestic responsibilities were only part of their total responsibilities which in many circumstances also included income generation. The overall weekly time spent per person on household tasks related to water varied between the following groups; women allocated on average 12.6 hours per week per person on household tasks relating to water whereas men spent approximately 5.0 hours per week, and children spent the least by contributing 0.7 hours respectively. The differences between the tasks completed by gender exemplified the stereotypical and historical perceptions on men's work within the home versus that of

women's. The tasks that men spent more time on relative to women included washing vehicles, providing water to the animals, and irrigating gardens or crops. Women dominated in the rest of the water related domestic tasks which historically have been "typically female" such as cleaning, cooking, and washing clothes (although men did contribute their time to all of these in turn). Since women performed most of the domestic tasks, by virtue they used a greater amount of water relative to their male counterparts. These tasks were also the most water intensive (besides bathing). Using the example of St. Lucy, looking at the parish average for the weekly water consumed the aforementioned "female" tasks used 7.4L, 5.9L, and 53.3L per capita respectively. In comparison, providing water to the animals consumed 9.9L a week per capita, washing vehicles here used 4.0L, and irrigation used 9.4L. Even though men did contribute to household chores that involved the use of water, women still predominated in this facet of life. There are engrained cultural notions in Barbados and the rest of the Caribbean about domestic work and the roles and responsibilities of men and women (Barrow, 1993). These are still rooted in the mentalities of people in the current day which explain the relationships between men and women that still exist to this day.

6. Directions for future research

Throughout the duration of this research, and most notably towards the completion of the study, several subjects for future investigation were identified. Similar to the previous section, the recommendations presented in this section are divided into two parts. The first section addresses gaps and provides recommendations on the socio-economic and physical development analysis component and the second section is made up of recommendations from the gender analysis component of this research.

Development

i. This research was only conducted along coastal parishes. Although the parish distribution in the study represented the four cardinal points of the island, further research should be conducted in order to uncover the relationships and water use patterns inland to determine whether they vary in comparison to coastal parishes. Ideally, there is reason in surveying each of the parishes because they are all distinct from one another.

ii. There is a need to increase the amount of households surveyed. Since one per cent of each parish was surveyed, surveys should cover at least five per cent of each parish population to strengthen their significance statistically.

iii. Further research and data need to be collected on parameters that define development and how development affects water. Data were unavailable for economic sectors that use water in each parish and these data may help to quantify what type of priority (regarding water distribution) a parish receives. For example, knowing how much agricultural production and manufacturing exists in St. Lucy would help in quantifying water usage. A more in-depth look is required to understand the relationship in the Barbadian context between development and water, to try to understand with greater certainty why certain parishes struggle much more widely with water than others.

Gender

i. A discussion at the UN House in Barbados with members of UNIFEM, the UNDP, the Caribbean Development Bank, and various Barbadian government representatives

inferred that remnants of Barbados' development have left their imprint on household relationships. Gender relationships may be subtle, and so therefore there is a need to delve much deeper to understand this relationship. More research needs to be undertaken to understand how the historical basis of Barbados has played a role in the current day situation of relative and perceived equality between the genders. Numerous nations that were once colonies experienced slavery and yet have not resulted in similar situations to that of Barbados. Many of the other Caribbean nations were colonized in a relatively similar pattern to that of Barbados (ex. Jamaica, Dominican Republic), and yet there are strong gender relationships existing in those nations whereas they do not exist in Barbados.

References

Bailey, K. D. (1994). *Methods of Social Research* (4th Ed). New York: The Free Press.

Barbados Statistical Service (BBS). (2000). *Population and Housing Census.* Retrieved from BSS, National Insurance Building, Bridgetown, Barbados.

Barbados Tourism Investment (BTI). (2006). *About Barbados – Economy.* Retrieved November 3, 2008 from http://barbadostourisminvestment.com/economy.cfm

Barbados Water Authority. (2008). Water is Life. In *Cable and Wireless Barbados Telecommunications Service Directory 2008-2009* (pp. 433). Global Directories (Caribbean) Ltd.

Barrow, C. (1993). Small Farm Food Production & Gender in Barbados. In J. Henshall Momsen (Ed). *Women & Change in the Caribbean: A Pan-Caribbean Perspective.* (pp.181-193). Indiana: Indiana University Press.

BBC News. (2006). *Water Calculator Workings.* Retrieved September 20, 2007 from http://news.bbc.co.uk/2/hi/science/nature/5084234.stm.

BBS. (n.d.). *Census.* Retrieved November 20, 2008 from http://www.barstats.gov.bb/

Beckles, H. (1988). *Afro-Caribbean Women and Resistance to Slavery in Barbados.* Karnak House: London.

Blomquist, W & Schlager, E. (2005). Political Pitfalls of Integrated Watershed Management. *Society and Natural Resources, 18,* 101-117.

Briassoulis, H. (2002). Sustainable Tourism and the Question of the Commons. *Annals of Tourism Research, 29*(4), 1065-1085.

Buor, D. (2004). *Water* needs and women's health in the Kumasi metropolitan area, Ghana. *Health & Place. 10,* 85-103.

Cap-Net. (n.d). *Integrated Water Resources Management.* Retrieved July 9, 2008 from http://www.archive.cap-net.org/iwrm_tutorial/mainmenu.htm

Cap-Net, GWA 2006. Why Gender Matters: a tutorial for water managers. Multimedia CD and booklet. CAP-NET International network for Capacity Building in Integrated Water Resources Management, Delft. Retrieved from http://www.energyandenvironment.undp.org/undp/indexAction.cfm?module=Library&action=GetFile&DocumentAttachmentID=1869

Canadian International Development Agency (CIDA). (1999). *CIDA's Policy on Gender Equality.* Retrieved from

http://www.acdi-cida.gc.ca/INET/IMAGES.NSF/vLUImages/Policy/$file/GENDER-E.pdf

Concepcion Donoso, M., Bakkum, A., & Troetsch, M. (2000). Women and Water in Humid Tropics. In C. Tortajada (Ed.) *Women and Water Management – The Latin American Experience.* (pp.12-26). Oxford: Oxford University Press.

Crow, B. & Sultana, F. (2002). Gender, Class, and Access to Water: Three Cases in a Poor and Crowded Delta. *Society and Natural Resources, 15,* 709-724.

Distribution Department, E.S., Barbados Water Authority. (2008). Water Outages by District by BWA. Bridgetown, Barbados, West Indies: Barbados Water Authority.

Dutilleul, P., Mather, E., & Pelletier, B. (2005). Lecture Notes of the Statistical methods 1 Course (AEMA 310). Course notes. Statistical Methods 1, Plant Science, McGill University.

FAO. (1997). *FAO Corporate Document Repository – What is Gender?* Retrieved October 22, 2008 from http://www.fao.org/docrep/007/y5608e/y5608e01.htm#TopOfPage

FAO. (2000). *AQUASTAT.* Retrieved February 7, 2008 from http://www.fao.org/nr/water/aquastat/countries/barbados/print1.stm

FAO. (2008). *FAO Country Profiles and Mapping Information System: Barbados – Land cover.* Retrieved October 20, 2008 from http://www.fao.org/countryprofiles/Maps/BRB/09/lc/index.html

FAO. (2008a). *General Summary Latin America and the Caribbean.* Retrieved Novemebr10, 2008 from http://www.fao.org/nr/water/aquastat/regions/lac/index8.stm

Gössling, S. (2001). The consequences of tourism for sustainable water use on a tropical island: Zanzibar, Tanzania. *Journal of Environmental Management, 61,* 179-191.

Government of Barbados. (n.d.) *Geographic Information Service – Geography.* Retrieved October 23, 2008 from http://www.barbados.gov.bb/geography.htm.

GWA. (2007). *Chapter 2: Gender and Integrated Water Resources Management (IWRM).* Retrieved August 3, 2007 from http://www.genderandwater.org/page/2417

GWP – TAC (GWP Technical Advisory Committee). (2000). *Integrated Water resources Management.* TAC Background Papers #4. GWP, Stockholm, Sweden. Retrieved from http://www.gwpforum.org/gwp/library/Tacno4.pdfhttp://www.gwpforum.org/gwp/library/Tacno4.pdf

GWP. (n.d.) *ToolBox.* Retrieved July 7, 2008 from http://www.gwptoolbox.org/index.cfm/site/465EBFAD-C0A3-9DDA-589E7C3A28B5B62E/pageid/46F480C6-9E54-8194-64583214C91B3114/index.cfm

Holden, A. (2000). *Environment and Tourism*. London and New York: Routledge.

House, S. (2005). Easier to Say, Harder to Do: Gender, Equity and Water. In A. Coles & T. Wallace (Eds.) *Gender, Water and Development* (pp. 209-225). Oxford: Berg

Jeffrey, P. & Geary, M. (2006). Integrated water resources management: lost on the road from ambition to realisation? *Water Science & Technology, 53*(1), 1-8.

Kent, M., Newnham, R. & Essex, S. (2002). Tourism and sustainable water supply in Mallorca: a geographical analysis. *Applied geography, 22,* 351-374.

INSTRAW. (1991). Women, Water and Sanitation. In S. Sontheimer (Ed.) *Women and the Environment: A Reader – Crisis and Development in the Third World* (pp. 119 – 132). New York: Monthly Review Press.

International Food Policy Research Institute. (n.d.). *Factsheets on Water: Assessments and Projections from Global Water Outlook to 2025: Averting an Impending Crisis.* Accessed February 1, 2009 from http://www.ifpri.org/media/water_facts.htm.

ITT Industries. (n.d.). *Availability of water (in cubic metres) per capita.* Retrieved October 23, 2008 from http://www.itt.com/waterbook/per_cap_per_country.asp.

Manase, G., Ndamba, J. & Makoni, F. (2003). Mainstreaming gender in integrated water resources management: the case of Zimbabwe. *Physics and Chemistry of the Earth, 28,* 967-971.

Massiah, J. (1984). *Employed Women in Barbados: A Demographic Profile, 1946-1970.* Institute of Social and Economic Research (Eastern Caribbean): UWI, Cave Hill, Barbados

McGinnis, M. V. (1999). Making the watershed connection. *Policy Studies Journal, 27* (3), 497-501.

Ministry of Physical Development and Environment (2000). State of the Environment Report. Barbados: Government of Barbados.

Momsen, J. (2007). The Waxing and Waning of Land for the Peasantry in Barbados. In J. Besson and J. Momsen (Eds.) *Caribbean Land and Development Revisited* (pp. 175-187). New York: Palgrave Macmillan.

Moser, C. (1993). *Gender Planning and Development: Theory, Practice and Training.* London: Routledge.

Mukhatrov, F. G. (2007). Intellectual history and current status of Integrated Water Resources Management. In C. Pahl-Wostl, P. Kabat, & J. Möltgen (Eds.) *Adaptive and Integrated Water Management – Coping with Complexity and Uncertainty* (pp. 167-185). Berlin: Springer Berlin Heidelberg.

Mwansa, J. (2008). Author's Interview with chief engineer at BWA. Bridgetown, Barbados, West Indies.

Natural Resource Canada. (2003). *Caribbean.* Retrieved October 22, 2008 from http://atlas.nrcan.gc.ca/site/english/maps/reference/international/caribbean/referencemap_image_view

Nierenberg, D. (2002). *Correcting Gender Myopia: Gender Equity, Women's Welfare, and the Environment.* Danvers, MA.: Worldwatch Institute.

PAHO & WHO. (n.d.) *Health Situation Analysis and Trends Summary.* Retrieved November 10, 2008 from http://www.paho.org/English/DD/AIS/cp_052.htm

Page, B. (1996). Taking the strain – the ergonomics of water carrying. *Waterlines, 14,* 29-31.

Peter, G. (2006). Gender roles and relationships: Implications for water management. *Physics and Chemistry of the Earth, 31,* 723-730.

Potter, R. B. (1986). Spatial inequalities in Barbados, West Indies. *Transactions of the Institute of British Geographers, New Series, 11* (2), 183-198.

Rahaman, M. M., Varis, O. & Kajander, T. (2004). EU Water Framework Directive vs. Integrated Water Resources Management. *Water Resources Development, 20*(4), 565-575.

Ray, I. (2007). Women, Water, and Development. *Annual Review of Environment and Resources, 32,* 421-449.

Regmi, S. C. & Fawcett, B. (1999). Integrating gender needs into drinking water projects in Nepal. *Gender and Development, 7*(3), 62-72.

Schneidermann, J. S. & Reddock, R. (2004). Water, women and community in Trinidad, West Indies. *Natural Resources Forum, 28,* 179-188.

Schreiner, B., Mohapi, N. & van Koppen, B. (2004). Washing away poverty: Water, democracy and gendered poverty eradication in South Africa. *Natural Resources Forum, 28,* 171-178.

Statistics Canada. (2008). *Non-probability sampling.* Retrieved November 25, 2008 from http://www.statcan.gc.ca/edu/power-pouvoir/ch13/nonprob/5214898-eng.htm

Sutton, C & Makiesky-Barrow, S. (1981). Social Inequality and Sexual Status in Barbados. In F. C. Steady (Ed.) *The Black Woman Cross-Culturally* (pp. 469-498). Cambridge, Mass: Schenkman Publishing Company, Inc.

Snedecor, G. W., & Cochran, W. G. (1967). *Statistical Methods – Sixth Edition.* Ames, Iowa: The Iowa State University Press.

UN. (2004). *Freshwater Country Profile – Barbados.* Retrieved October 9, 2008 from http://un.org/esa/agenda21/natlinfo/countr/barbados/freshwater.pdf.

UN. (2002). *The Millennium Development Goals and the United Nations Role (Factsheet).* Retrieved July 21, 2008 from www.un.org./millenniumgoals/MDGs-FACTSHEET1.pdf

UNDAW. (2005). Women 2000 and beyond: Women and Water. New York: United Nations.

UNDP. (2006). Human Development Report 2006 - Beyond scarcity: Power, poverty and the global water crisis. New York: United Nations.

UNDP. (2008). *Human Development Reports – 2008 Statistical Update Barbados.* Accessed April 4, 2009 from http://hdrstats.undp.org/2008/countries/country_fact_sheets/cty_fs_BRB.html

UN-Water (2008). Status Report on IWRM and Water Efficiency Plans for CSD16. Retrieved from http://www.unwater.org/downloads/UNW_Status_Report_IWRM.pdf

Upadhyay, B. (2005). Women and natural resources management: Illustrations from India and Nepal. *Natural Resources Forum, 29,* 224-232.

Wallace, T & Coles, A. (2005). Water, Gender and Development: An Introduction. In A. Coles & T. Wallace (Eds.) *Gender, Water and Development* (pp. 1-20). Oxford: Berg.

Water-technology. Net. (2008). *St. Michael BWRO Desalination Plant, Barbados.* Retrieved October 9, 2008 from http://www.water-technology.net/projects/barbados/.

Zwarteveen, M. & Bennett, V. (2005). The Connection between Gender and Water Management. In V. Bennett, S. Dávila-Poblete, & M. Nieves Rico (Eds.) *Opposing currents – The Politics of Water and Gender in Latin America* (pp. 13-29). Pittsburg: University of Pittsburgh Press.

Appendix I: Water Calculator and Survey

Table 1: Water calculator (BBC, 2006)

APPLIANCE	CONSUMPTION	SOURCE
Bathroom		
Shower	7 litres/min	Waterwise
Power Shower	12 litres/min	Waterwise
Bath	80 litres	Waterwise
Toilet	6 litres/flush since 2001 4.5 litres/flush (average) dual flush models 7.5-9 litres/flush models before 2001 11-13 litres/flush very old models "Hippo" or other displacement device saves 1 litre/flush	British Bathroom Manufacturers Association
Running tap	6 litres/min	Thames Water
Kitchen		
Washing up	10 litres (2x5 litre bowl)	Various
Dripping tap	300 ml/hour at rate of 1 drip/second	Observation
Dishwasher	15 litres/cycle if under 10 years old 25 litres/cycle if more than 10 years old	Waterwise
Washing machine	50 litres/cycle if under 10 years old 100 litres/cycle if more than 10 years old Half load uses 55% of water of full load	Environment Agency
Garage & Garden		
Hosepipe	500 litres/hour	Waterwise
Watering can	4 litres	Various
Bucket	5 litres	Various
Pressure washer	450 litres/hour	Various

CARIWIN Gender and Water Use Survey: Barbados

Date: _____

Enumerator(s): _____

Head of Household

1. Sex: M____; F_____.
2. Parish: _____
3. a) Are you the head of your household? *(Do you make decisions on behalf of the household?)* Yes____; No_____; Shared____.

   b) If no, then who is? _____
4. a) Number of people 18 and over living in the household? ____

   b) Number of people below 18 living in the household?_____

   c) Who are they in relation to you (specify)?

   _____
   _____
   _____

Water collection/access and use

5. Where do you get your water from: (*multiple answers acceptable)*
   a) Tap (in the home)
   b) Community standpipe
   c) Public well
   d) Private well
   e) Catch water from springs
   f) Catch water using dams
   g) Other _____
6. How accessible would you define your source of water? (*circle the appropriate answer)*
   a) very accessible
   b) accessible
   c) neutral
   d) difficult to access
   e) very difficult to access
7. How often does your access to potable water get interrupted? (*circle the appropriate answer)*
   a) every week
   b) every month
   c) every few months
   d) every year
   e) less than once a year
   f) never

8. If applicable *(if answered a, b, c, d or e in Q7)*, how do you overcome with water shortages? For example, do you buy bottled water, buy from tankers, rely on some help from district neighbours, etc.?

_____
_____
_____
_____
_____
_____
_____

9. a) If applicable *(if answered a, b, c, d or e in Q7),* do water shortages affect your lifestyle and socio-economic activities (cooking, washing, drinking water, sanitation, irrigation etc.?) Yes____; No_____.

   b) If yes, how?

_____
_____
_____

10. The following table list various water-related activities. Please help us fill it by telling us who is responsible for each task, how many hours is spent on task by each responsible during dry season and during rainy season, and how many litres of water are consumed per task..

WATER-RELATED TASKS	Hours spent per task per week Rainy season			Hours spent per task per week Dry season			Litres of water used per task
	Male(s)	Female(s)	Children (<18)	Male(s)	Female(s)	Children (<18)	
1- Water collection							
2- Water storage							
3- Boiling water (to sterilise)							
4- Cooking							
5- Cleaning house							
6- Cleaning dishes (specify if hand wash or dishwasher by letter H or D)							
7- Bathing, including the children & older people who live with you *(specify if shower or bath by letter S or B)*							
8- Watering your animals (livestock and pets)							
9- Washing vehicles							
10- Washing clothes *(specify if hand wash or washing machine by letter H or M)*							
11- Irrigation (commercial and/or garden)							
TOTAL							

Legend: N/A = Non-Applicable

Note to enumerator: If not affected by dry season, only fill the rainy season section

Water quality and price

11. How would you describe the quality of your water?
    a) very good
    b) good
    c) neutral
    d) poor
    e) very poor

12. a) Do you pay for your water?
    Yes____; No_____.

    b) If yes to a), how is it paid for?

    a) Meter
    b) Flat rate
    c) Other *(tax, etc.)*_____
    d) Don't know

    c) If yes to a), how much do you pay for your water per month?_____B$

Additional comments

13. a) Are you happy with your water situation?
    Yes____; No_____.

    b) If no, why?

    _____
    _____
    _____
    _____
    _____

14. a) Do you feel that there are any problems with regards to water management in Barbados?
    Yes____; No_____.

    b) If yes, could you expand on these problems?

    _____
    _____
    _____
    _____
    _____

TO BE COMPLETED BY ENUMERATOR DURING OR AFTER SURVEY ACCORDING TO CONTEXT

Demographics

15. Age of the participant: 0-17___; 18-30___; 31-50___; 51-70___; >70___.

16. Job type(s) of the participant: _____

17. Level of income of the household:
    a) Low income
    b) Middle income
    c) High income

Additional comments

Other observations or notes to be taken by the enumerator (on income level, etc.)

Appendix II: Demographical data

The sample size for this study comprised of 1% of four parishes populations, which equated to 617 survey respondents; the removal of 18 surveys due to under-aged respondents created a final total sample size of 599 respondents. The distribution of respondents in parishes and their genders are categorized in Table 1.

Table 1: Respondents' genders and parish

	Males	**Females**	***Total***
St. James	78	144	*222*
St. Lucy	33	58	*91*
St. Joseph	32	34	*66*
St. Philip	89	131	*220*
Total	***232***	***367***	***599***

There was a predominance of female respondents overall in this study. Approximately 61% of the respondents were female. The most equal male to female ratio of respondents was in St. Joseph, where 47% of the respondents were male and 53% of the respondents were female. The least equal distribution was in St. Lucy, where approximately 34% of the respondents were male and the remaining 66% of the respondents were female. Greater female participation was due to the fact that surveying was done during the day when there was a greater likelihood that women, who take greater part in domestic roles, were the ones who were at home.

Table 2 is an estimate of the ages of the respondents per parish. It is an estimate because the age of respondents was not directly asked by the enumerators. This was due to the fact that this question was not culturally acceptable and was discouraged from the official survey after the pre-test stage. The majority of the respondents were between the ages of 31 and 70 (approximately 69% of the respondent population).

Table 2: Age of respondents

Age of Respondents/ Parish	18-30		31-50		51-70		>70		Unaccounted	
	F	M	F	M	F	M	F	M	F	M
St. James	15	9	54	24	55	29	15	14	5	2
St. Lucy	4	6	23	9	22	9	9	9	0	0
St. Joseph	6	5	13	11	10	14	5	2	0	0
St. Philip	22	12	50	23	41	38	18	14	0	0
TOTAL	**47**	**32**	**140**	**67**	**128**	**90**	**47**	**39**	**5**	**2**
	79		**207**		**218**		**86**		7	

The position of head of household was either classified as sole head of household, not the head of the home, or shared with another member of the household. The following table summarizes who fulfilled this role.

Table 3: Head of Household

GENDER	PARISH	Q: Head of Household?			When "NO", then who?		Shared w/ whom?	
		YES	NO	SHARED	F	M	F	M
Female	St. James	64	44	36	16	30	24	29
	St. Lucy	37	10	11	4	6	2	11
	St. Joseph	21	11	2	4	7	0	2
	St. Philip	78	46	7	24	22	1	7
	TOTAL	**200**	**111**	**56**	**48**	**65**	**27**	**49**
Male	St. James	51	15	12	9	7	11	2
	St. Lucy	20	9	4	8	2	2	2
	St. Joseph	25	6	1	4	2	1	0
	St. Philip	73	13	3 *	5	6	3	1
	TOTAL	**169**	**43**	**20**	**26**	**17**	**17**	**5**

In St. Philip, two individuals who are the technical heads of households (the landlord/renter of the home and the respondent's wife's cousin) do not live in the home of the respondent, and were not included in the tally of the latter columns. Males had a greater tendency of being heads of households (72.8%) rather than women (54.5%). More women also claimed that they shared the role of household head (15.3%), usually with a boyfriend or a husband, rather than men (8.6%) who usually shared the title as head with their wife or girlfriend.

Respondents were also classified based on their level of income. Like age, level of

income was not suitable in the social context of Barbados, and as such it was estimated by the enumerators. Mistakes made by the enumerators caused certain households to be missed in the socio-economic classification, and thusly were placed in a separate column.

Table 4: Income levels of respondents

Parish/ Income	**Low Income**	**Middle Income**	**High Income**	*Didn't classify*
St. James	14	157	38	13
St. Lucy	10	75	2	4
St. Joseph	8	53	5	0
St. Philip	17	177	26	0

Appendix III: Chi-Square test with observed (O) and expected (*E*) frequencies

Table 1: Level of water accessibility on a per parish basis comparing female respondents

Level of water accessibility	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
Very Accessible	101	*68.46*	29	*27.57*	8	*15.69*	36	*62.28*	$R_1 = 174$
Accessible	38	*58.62*	26	*23.61*	13	*13.43*	72	*53.33*	$R_2 = 149$
Neutral	4	*12.98*	2	*5.23*	7	*2.98*	20	*11.81*	$R_3 = 33$
Difficult to Access	1	*3.93*	1	*1.58*	5	*0.90*	3	*3.58*	$R_4 = 10$
Column totals	$C_1 = 144$		$C_2 = 58$		$C_3 = 33$		$C_4 = 131$		n = 366

Table 2: Level of water accessibility on a per parish basis comparing male respondents

Level of water accessibility	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
Very Accessible	55	*39.13*	22	*16.35*	7	*11.89*	23	*39.63*	$R_1 = 107$
Accessible	22	*37.31*	11	*15.58*	17	*11.33*	52	*37.78*	$R_2 = 102$
Column totals	$C_1 = 77$		$C_2 = 33$		$C_3 = 24$		$C_4 = 75$		n = 209

Table 3: Level of water accessibility on a per parish basis comparing total respondents

Level of water accessibility	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
Very Accessible	156	*104.32*	51	*42.76*	15	*30.54*	59	*103.38*	$R_1 = 281$
Accessible	60	*93.18*	37	*38.20*	30	*27.28*	124	*92.34*	$R_2 = 251$
Neutral	4	*17.82*	2	*7.30*	10	*5.22*	32	*17.66*	$R_3 = 48$
Difficult to Access	2	*6.68*	1	*2.74*	10	*1.96*	5	*6.62*	$R_4 = 18$
Column totals	$C_1 = 222$		$C_2 = 91$		$C_3 = 65$		$C_4 = 220$		n = 598

Table 4: Level of water accessibility on a gender basis comparing St. James respondents

Level of water accessibility	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
Very Accessible	101	*100.39*	57	*55.61*	$R_1 = 156$
Accessible	38	*38.61*	22	*21.39*	$R_2 = 60$
Column totals	$C_1 = 139$		$C_2 = 77$		n = 216

Table 5: Level of water accessibility on a gender basis comparing St. Lucy respondents

Level of water accessibility	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
Very Accessible	29	*31.88*	22	*19.12*	$R_1 = 51$
Accessible	26	*23.13*	11	*13.89*	$R_2 = 37$
Column totals	$C_1 = 55$		$C_2 = 33$		n = 88

Table 6: Level of water accessibility on a gender basis comparing St. Joseph respondents

Level of water accessibility	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
Very Accessible	8	*7.62*	7	*7.38*	$R_1 = 15$
Accessible	13	*15.23*	17	*14.77*	$R_2 = 30$
Neutral	7	*5.08*	3	*4.92*	$R_3 = 10$
Difficult to Access	5	*5.08*	5	*4.92*	$R_4 = 10$
Column totals	$C_1 = 33$		$C_2 = 32$		n = 65

Table 7: Level of water accessibility on a gender basis comparing St. Philip respondents

Level of water accessibility	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
Very Accessible	36	*35.13*	23	*23.87*	$R_1 = 59$
Accessible	73	*74.43*	52	*50.57*	$R_2 = 125$
Neutral	19	*18.46*	12	*12.54*	$R_3 = 31$
Difficult to Access	3	*2.98*	2	*2.02*	$R_4 = 5$
Column totals	$C_1 = 131$		$C_2 = 89$		n = 220

Table 8: Level of water accessibility on a gender basis comparing total parish respondents

Level of water accessibility	*Total females*		*Total males*		***Row totals***
	O	*E*	O	*E*	
Very Accessible	174	*171.98*	107	*113.46*	$R_1 = 281$
Accessible	150	*154.23*	102	*100.16*	$R_2 = 252$
Neutral	32	*28.77*	15	*19.56*	$R_3 = 47$
Difficult to Access	10	*11.02*	8	*7.82*	$R_4 = 18$
Column totals	$C_1 = 375$		$C_2 = 232$		n = 598

Table 9: Frequency of water disruptions during the wet season on a per parish basis comparing female respondents

Water Interruptions	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
Every month	3	*5.89*	2	*2.42*	3	*1.04*	6	*6.02*	$R_1 = 14$
Every few months	33	*40.71*	17	*16.74*	6	*7.22*	41	*36.49*	$R_2 = 97$
Every year	44	*42.80*	17	*17.61*	11	*7.59*	30	*37.55*	$R_3 = 102$
Less than once a year	23	*24.76*	15	*10.18*	3	*4.39*	18	*21.26*	$R_4 = 59$
Never	38	*26.86*	7	*11.05*	2	*4.76*	17	*22.67*	$R_5 = 64$
Column totals	$C_1 = 141$		$C_2 = 58$		$C_3 = 25$		$C_4 = 112$		n = 336

Table 10: Frequency of water disruptions during the wet season on a per parish basis comparing male respondents

Water Interruptions	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
Every month	3	*5.09*	1	*2.21*	2	*1.67*	8	*4.99*	$R_1 = 14$
Every few months	12	*18.55*	13	*8.05*	7	*6.10*	19	*22.25*	$R_2 = 51$
Every year	30	*26.18*	8	*11.37*	10	*8.61*	24	*28.38*	$R_3 = 72$
Less than once a year	13	*14.18*	6	*6.16*	3	*4.67*	17	*14.96*	$R_4 = 39$
Never	18	*12.00*	5	*5.21*	3	*3.95*	7	*13.42*	$R_5 = 33$
Column totals	$C_1 = 76$		$C_2 = 33$		$C_3 = 25$		$C_4 = 75$		n = 209

Table 11: Frequency of water disruptions during the wet season on a per parish basis comparing total respondents

Water Interruptions	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
Every month	6	*11.15*	3	*4.68*	5	*2.57*	14	*9.61*	$R_1 = 28$
Every few months	45	*58.93*	30	*24.71*	13	*13.58*	60	*50.78*	$R_2 = 148$
Every year	74	*69.28*	25	*29.05*	21	*15.96*	54	*59.70*	$R_3 = 174$
Less than once a year	36	*39.02*	21	*16.36*	6	*8.99*	35	*33.63*	$R_4 = 98$
Never	56	*38.62*	12	*16.20*	5	*8.90*	24	*33.28*	$R_5 = 97$
Column totals	$C_1 = 217$		$C_2 = 91$		$C_3 = 50$		$C_4 = 187$		n = 545

Table 12: Frequency of water disruptions during the wet season on a gender basis comparing St. James respondents

Water Interruptions	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
Every week	3	*3.24*	2	*1.76*	$R_1 = 5$
Every month	3	*3.89*	3	*2.11*	$R_2 = 6$
Every few months	33	*29.19*	12	*15.81*	$R_3 = 45$
Every year	44	*48.00*	30	*26.00*	$R_4 = 74$
Less than once a year	23	*23.35*	13	*12.65*	$R_5 = 36$
Never	38	*36.32*	18	*19.68*	$R_6 = 56$
Column totals	$C_1 = 144$		$C_2 = 78$		n = 222

Table 13: Frequency of water disruptions during the wet season on a gender basis comparing St. Lucy respondents

Water Interruptions	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
Every month	2	*1.91*	1	*1.09*	$R_1 = 3$
Every few months	17	*19.12*	13	*10.88*	$R_2 = 30$
Every year	17	*15.93*	8	*9.07*	$R_3 = 25$
Less than once a year	15	*13.38*	6	*7.62*	$R_4 = 21$
Never	7	*7.65*	5	*4.35*	$R_5 = 12$
Column totals	$C_1 = 58$		$C_2 = 33$		n = 91

Table 14: Frequency of water disruptions during the wet season on a gender basis comparing St. Joseph respondents

Water Interruptions	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
Every day	2	*2.06*	2	*1.94*	$R_1 = 4$
Every week	5	*4.64*	4	*4.36*	$R_2 = 9$
Every month	5	*3.61*	2	*3.39*	$R_3 = 7$
Every few months	6	*6.70*	7	*6.30*	$R_4 = 13$
Every year	11	*11.33*	11	*10.67*	$R_5 = 22$
Less than once a year	3	*3.09*	3	*2.91*	$R_6 = 6$
Never	2	*2.58*	3	*2.42*	$R_7 = 5$
Column totals	$C_1 = 34$		$C_2 = 32$		n = 66

Table 15: Frequency of water disruptions during the wet season on a gender basis comparing St. Philip respondents

Water Interruptions	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
Every day	1	*1.19*	1	*0.81*	$R_1 = 2$
Every week	6	*5.95*	4	*4.05*	$R_2 = 10$
Every month	7	*8.34*	7	*5.66*	$R_3 = 14$
Every few months	47	*43.47*	26	*29.53*	$R_4 = 73$
Every year	34	*35.13*	25	*23.87*	$R_5 = 59$
Less than once a year	19	*21.44*	17	*14.56*	$R_6 = 36$
Never	17	*15.48*	9	*10.52*	$R_7 = 26$
Column totals	$C_1 = 131$		$C_2 = 89$		n = 220

Table 16: Frequency of water disruptions during the wet season on a gender basis comparing total respondents

Water Interruptions	*Total females*		*Total males*		***Row totals***
	O	*E*	O	*E*	
Every day	3	*3.68*	3	*2.32*	$R_1 = 6$
Every week	14	*14.70*	10	*9.30*	$R_2 = 24$
Every month	17	*18.38*	13	*11.62*	$R_3 = 30$
Every few months	103	*98.64*	58	*62.36*	$R_4 = 161$
Every year	106	*110.28*	74	*69.72*	$R_5 = 180$
Less than once a year	60	*60.66*	39	*38.34*	$R_6 = 99$
Never	64	*60.66*	35	*38.34*	$R_7 = 99$
Column totals	$C_1 = 367$		$C_2 = 232$		n = 617

Table 17: Frequency of water disruptions during the dry season on a per parish basis comparing female respondents

Water Interruptions	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
Every month	3	*6.15*	2	*2.75*	4	*1.13*	6	*6.28*	$R_1 = 15$
Every few months	33	*40.58*	19	*18.13*	6	*7.48*	41	*41.44*	$R_2 = 99$
Every year	44	*43.04*	19	*19.23*	11	*7.93*	31	*43.95*	$R_3 = 105$
Less than once a year	23	*24.18*	15	*10.81*	3	*4.46*	18	*24.70*	$R_4 = 59$
Never	38	*27.05*	8	*12.09*	2	*4.99*	18	*27.63*	$R_5 = 66$
Column totals	$C_1 = 141$		$C_2 = 63$		$C_3 = 26$		$C_4 = 114$		n = 344

Table 18: Frequency of water disruptions during the dry season on a per parish basis comparing male respondents

Water Interruptions	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
Every month	3	*6.15*	2	*2.75*	4	*1.13*	6	*4.97*	$R_1 = 15$
Every few months	33	*40.58*	19	*18.13*	6	*7.48*	41	*32.81*	$R_2 = 99$
Every year	44	*43.04*	19	*19.23*	11	*7.94*	31	*34.80*	$R_3 = 105$
Less than once a year	23	*24.18*	15	*10.81*	3	*4.46*	18	*19.55*	$R_4 = 59$
Never	38	*27.05*	8	*12.09*	2	*4.99*	18	*21.87*	$R_5 = 66$
Column totals	$C_1 = 141$		$C_2 = 63$		$C_3 = 26$		$C_4 = 114$		n = 344

Table 19: Frequency of water disruptions during the dry season on a per parish basis comparing total respondents

Water Interruptions	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
Every day	0	*4.72*	0	*2.02*	7	*1.43*	6	*4.82*	$R_1 = 13$
Every week	5	*15.25*	0	*6.53*	10	*4.63*	27	*15.59*	$R_2 = 42$
Every month	6	*10.89*	3	*4.67*	6	*3.31*	15	*11.13*	$R_3 = 30$
Every few months	45	*55.18*	32	*23.65*	13	*16.75*	62	*56.41*	$R_4 = 152$
Every year	74	*64.62*	27	*27.70*	21	*19.62*	56	*66.06*	$R_5 = 178$
Less than once a year	36	*35.94*	21	*15.40*	6	*10.91*	36	*36.74*	$R_6 = 99$
Never	58	*37.39*	13	*16.02*	5	*11.35*	27	*38.23*	$R_7 = 103$
Column totals	$C_1 = 224$		$C_2 = 96$		$C_3 = 68$		$C_4 = 229$		$n = 617$

Table 20: Frequency of water disruptions during the dry season on a gender basis comparing St. James respondents

Water Interruptions	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
Every week	3	*3.24*	2	*1.76*	$R_1 = 5$
Every month	3	*3.89*	3	*2.11*	$R_2 = 6$
Every few months	33	*29.19*	12	*15.81*	$R_3 = 45$
Every year	44	*48.00*	30	*26.00*	$R_4 = 74$
Less than once a year	23	*23.35*	13	*12.65*	$R_5 = 36$
Never	38	*36.32*	18	*19.68*	$R_6 = 56$
Column totals	$C_1 = 144$		$C_2 = 78$		$n = 222$

Table 21: Frequency of water disruptions during the dry season on a gender basis comparing St. Lucy respondents

Water Interruptions	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
Every month	2	*1.91*	1	*1.09*	$R_1 = 3$
Every few months	17	*19.12*	13	*10.88*	$R_2 = 30$
Every year	17	*15.93*	8	*9.07*	$R_3 = 25$
Less than once a year	15	*13.38*	6	*7.62*	$R_4 = 21$
Never	7	*7.65*	5	*4.35*	$R_5 = 12$
Column totals	$C_1 = 58$		$C_2 = 33$		$n = 91$

Table 22: Frequency of water disruptions during the dry season on a gender basis comparing St. Joseph respondents

Water Interruptions	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
Every day	4	*3.09*	2	*2.91*	$R_1 = 6$
Every week	5	*5.15*	5	*4.85*	$R_2 = 10$
Every month	3	*2.58*	2	*2.42*	$R_3 = 5$
Every few months	6	*6.70*	7	*6.30*	$R_4 = 13$
Every year	11	*10.82*	10	*10.18*	$R_5 = 21$
Less than once a year	3	*3.09*	3	*2.91*	$R_6 = 6$
Never	2	*2.58*	3	*2.42*	$R_7 = 5$
Column totals	$C_1 = 34$		$C_2 = 32$		n = 66

Table 23: Frequency of water disruptions during the dry season on a gender basis comparing St. Philip respondents

Water Interruptions	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
Every day	3	*3.57*	3	*2.43*	$R_1 = 6$
Every week	16	*16.08*	11	*10.92*	$R_2 = 27$
Every month	6	*8.34*	8	*5.66*	$R_3 = 14$
Every few months	41	*35.73*	19	*24.27*	$R_4 = 60$
Every year	30	*32.15*	24	*21.85*	$R_5 = 54$
Less than once a year	18	*20.84*	17	*14.16*	$R_6 = 35$
Never	17	*14.29*	7	*9.71*	$R_7 = 24$
Column totals	$C_1 = 131$		$C_2 = 89$		n = 220

Table 24: Frequency of water disruptions during the dry season on a gender basis comparing total respondents

Water Interruptions	*Total females*		*Total males*		***Row totals***
	O	*E*	O	*E*	
Every day	7	*7.35*	5	*5.08*	$R_1 = 12$
Every week	24	*25.73*	18	*16.41*	$R_2 = 42$
Every month	14	*17.16*	14	*11.72*	$R_3 = 28$
Every few months	97	*90.68*	51	*59.37*	$R_4 = 148$
Every year	102	*106.61*	72	*69.53*	$R_5 = 174$
Less than once a year	59	*60.04*	39	*38.67*	$R_6 = 98$
Never	64	*59.43*	33	*40.23*	$R_7 = 97$
Column totals	$C_1 = 367$		$C_2 = 232$		n = 599

Table 25: Water shortages as they affect lifestyle on a per parish bases comparing female respondents

Affects lifestyle	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
YES	31	*35.33*	17	*17.00*	13	*10.67*	37	*35.00*	$R_1 = 98$
NO	75	*70.67*	34	*34.00*	29	*21.33*	68	*70.00*	$R_2 = 196$
Column totals	$C_1 = 106$		$C_2 = 51$		$C_3 = 32$		$C_4 = 106$		n = 294

Table 26: Water shortages as they affect lifestyle on a per parish bases comparing male respondents

Affects lifestyle	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
YES	18	*15.54*	5	*7.25*	6	*6.74*	21	*22.06*	$R_1 = 50$
NO	42	*44.46*	23	*20.75*	20	*19.26*	58	*61.94*	$R_2 = 143$
Column totals	$C_1 = 60$		$C_2 = 28$		$C_3 = 26$		$C_4 = 79$		n = 193

Table 27: Water shortages as they affect lifestyle on a per parish basis comparing total respondents

Affects lifestyle	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
YES	49	*50.45*	22	*24.01*	19	*17.63*	58	*55.92*	$R_1 = 148$
NO	117	*115.55*	57	*54.99*	39	*40.37*	126	*128.08*	$R_2 = 339$
Column totals	$C_1 = 166$		$C_2 = 79$		$C_3 = 58$		$C_4 = 184$		n = 487

Table 28: Water shortages as they affect lifestyle on a gender basis comparing St. James respondents

Affects lifestyle	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	31	*31.29*	18	*17.71*	$R_1 = 49$
NO	75	*74.71*	42	*42.29*	$R_2 = 117$
Column totals	$C_1 = 106$		$C_2 = 60$		n = 166

Table 29: Water shortages as they affect lifestyle on a gender basis comparing St. Lucy respondents

Affects lifestyle	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	17	*14.20*	5	*7.80*	$R_1 = 22$
NO	34	*36.80*	23	*20.20*	$R_2 = 57$
Column totals	$C_1 = 51$		$C_2 = 28$		n = 79

Table 30: Water shortages as they affect lifestyle on a gender basis comparing St. Joseph respondents

Affects lifestyle	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	13	*10.48*	6	*8.52*	$R_1 = 19$
NO	19	*21.52*	20	*17.48*	$R_2 = 39$
Column totals	$C_1 = 32$		$C_2 = 26$		n = 58

Table 31: Water shortages as they affect lifestyle on a gender basis comparing St. Philip respondents

Affects lifestyle	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	37	*33.10*	21	*24.90*	$R_1 = 58$
NO	68	*71.90*	58	*54.10*	$R_2 = 126$
Column totals	$C_1 = 105$		$C_2 = 79$		n = 184

Table 32: Water shortages as they affect lifestyle on a gender basis comparing total respondents

Affects lifestyle	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	98	*89.35*	50	*58.65*	$R_1 = 148$
NO	196	*204.65*	143	*134.35*	$R_2 = 339$
Column totals	$C_1 = 294$		$C_2 = 198$		n = 487

Table 33: Water quality on a per parish basis comparing female respondents

Water Quality	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row Totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
Very Good	60	*46.47*	19	*18.13*	12	*10.88*	27	*42.52*	$R_1 = 118$
Good	56	*73.65*	24	*28.73*	18	*17.24*	89	*67.38*	$R_2 = 187$
Neutral	25	*20.87*	12	*8.14*	3	*4.87*	13	*19.10*	$R_3 = 53$
Column totals	$C_1 = 141$		$C_2 = 55$		$C_3 = 33$		$C_4 = 129$		n = 358

Table 34: Water quality on a per parish basis comparing male respondents

Water Quality	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row Totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
Very Good	33	24.67	12	*10.39*	7	*10.39*	22	*28.56*	$R_1 = 74$
Good	37	45.67	18	*19.23*	20	*19.23*	62	*52.88*	$R_2 = 137$
Neutral	6	5.67	2	*2.39*	5	*2.39*	4	*6.56*	$R_3 = 17$
Column totals	$C_1 = 76$		$C_2 = 32$		$C_3 = 32$		$C_4 = 88$		n = 228

Table 35: Water quality on a per parish basis comparing total respondents

Water Quality	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row Totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
Very Good	93	*71.10*	31	*28.51*	219	*21.30*	49	*71.10*	$R_1 = 192$
Good	93	*119.98*	42	*48.10*	38	*35.94*	151	*119.98*	$R_2 = 324$
Neutral	31	*25.92*	14	*10.39*	8	*7.76*	17	*25.92*	$R_3 = 70$
Column totals	$C_1 = 217$		$C_2 = 87$		$C_3 = 65$		$C_4 = 217$		n = 586

Table 36: Water quality on a gender basis comparing St. James respondents

Water Quality	*Females*		*Males*		***Row Totals***
	O	*E*	O	*E*	
Very good	60	*60.32*	33	*32.97*	$R_1 = 93$
Good	56	*60.32*	37	*32.97*	$R_2 = 93$
Neutral	25	*20.11*	6	*10.99*	$R_3 = 31$
Poor	3	*3.24*	2	*1.77*	$R_4 = 5$
Column totals	$C_1 = 144$		$C_2 = 78$		n = 222

Table 37: Water quality on a gender basis comparing St. Lucy respondents

Water Quality	*Females*		*Males*		***Row Totals***
	O	*E*	O	*E*	
Very Good	19	*19.76*	12	*11.24*	$R_1 = 31$
Good	24	*26.77*	18	*15.23*	$R_2 = 42$
Neutral	12	*8.92*	2	*5.08*	$R_3 = 14$
Poor	3	*2.55*	1	*1.45*	$R_4 = 4$
Column totals	$C_1 = 58$		$C_2 = 33$		n = 91

Table 38: Water quality on a gender basis comparing St. Joseph respondents

Water Quality	*Females*		*Males*		***Row Totals***
	O	*E*	O	*E*	
Very Good	12	*9.65*	7	*9.35*	$R_1 = 19$
Good	18	*19.29*	20	*18.71*	$R_2 = 38$
Neutral	3	*4.06*	5	*3.93*	$R_3 = 8$
Column totals	$C_1 = 33$		$C_2 = 32$		n = 65

Table 39: Water quality on a gender basis comparing St. Philip respondents

Water Quality	*Females*		*Males*		***Row Totals***
	O	*E*	O	*E*	
Very Good	27	*29.18*	22	*19.82*	$R_1 = 49$
Good	89	*89.91*	62	*61.09*	$R_2 = 151$
Neutral	13	*10.12*	4	*6.88*	$R_3 = 17$
Poor	2	*1.79*	1	*1.21*	$R_4 = 3$
Column totals	$C_1 = 131$		$C_2 = 89$		n = 220

Table 40: Water quality on a gender basis comparing total respondents

Water Quality	*Females*		*Males*		***Row Totals***
	O	*E*	O	*E*	
Very good	118	*117.51*	74	*74.49*	$R_1 = 192$
Good	187	*198.30*	137	*125.70*	$R_2 = 324$
Neutral	53	*42.84*	17	*27.16*	$R_3 = 70$
Poor	8	*7.34*	4	*4.66*	$R_4 = 12$
Column totals	$C_1 = 366$		$C_2 = 232$		n = 598

Table 41: Satisfaction with water situation on a per parish basis comparing female respondents

Happy with water situation	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
YES	108	*108.69*	47	*43.78*	22	*25.66*	100	*98.87*	$R_1 = 277$
NO	36	*35.31*	11	*14.22*	12	*8.34*	31	*32.13*	$R_2 = 90$
Column totals	$C_1 = 144$		$C_2 = 58$		$C_3 = 34$		$C_4 = 131$		n = 367

Table 42: Satisfaction with water situation on a per parish basis comparing male respondents

Happy with water situation	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
YES	62	*64.22*	32	*27.17*	22	*26.34*	75	*73.27*	$R_1 = 191$
NO	16	*13.78*	1	*5.83*	10	*5.66*	14	*15.73*	$R_2 = 41$
Column totals	$C_1 = 78$		$C_2 = 33$		$C_3 = 32$		$C_4 = 89$		n = 232

Table 43: Satisfaction with water situation on a per parish basis comparing total respondents

Happy with water situation	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
YES	170	*173.45*	79	*71.10*	44	*51.57*	175	*171.89*	$R_1 = 468$
NO	52	*48.55*	12	*19.90*	22	*14.43*	45	*48.11*	$R_2 = 131$
Column totals	$C_1 = 222$		$C_2 = 91$		$C_3 = 66$		$C_4 = 220$		n = 599

Table 44: Satisfaction with water situation on a gender basis comparing St. James respondents

Happy with water situation	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	108	*110.27*	62	*59.73*	$R_1 = 170$
NO	36	*33.73*	16	*18.27*	$R_2 = 52$
Column totals	$C_1 = 144$		$C_2 = 78$		n = 222

Table 45: Satisfaction with water situation on a gender basis comparing St. Lucy respondents

Happy with water situation	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	47	*50.35*	32	28.65	$R_1 = 79$
NO	11	7.65	1	*4.35*	$R_2 = 12$
Column totals	$C_1 = 58$		$C_2 = 33$		n = 91

Table 46: Satisfaction with water situation on a gender basis comparing St. Joseph respondents

Happy with water situation	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	22	*22.67*	22	*21.33*	$R_1 = 44$
NO	12	*11.33*	10	*10.67*	$R_2 = 22$
Column totals	$C_1 = 34$		$C_2 = 32$		n = 66

Table 47: Satisfaction with water situation on a gender basis comparing St. Philip respondents

Happy with water situation	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	100	*104.20*	75	*70.80*	$R_1 = 175$
NO	31	*26.80*	14	*18.20*	$R_2 = 45$
Column totals	$C_1 = 131$		$C_2 = 89$		n = 220

Table 48: Satisfaction with water situation on a gender basis comparing total respondents

Happy with water situation	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	277	*286.74*	191	*181.26*	$R_1 = 468$
NO	90	*80.26*	41	*50.74*	$R_2 = 131$
Column totals	$C_1 = 367$		$C_2 = 232$		n = 599

Table 49: Management problems on a per parish basis comparing female respondents

Problems with water management	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
YES	73	*65.18*	27	*26.15*	18	*15.60*	49	*60.10*	$R_1 = 167$
NO	69	*76.85*	30	*30.85*	16	*18.40*	82	*70.90*	$R_2 = 197$
Column totals	$C_1 = 142$		$C_2 = 57$		$C_3 = 34$		$C_4 = 131$		n = 364

Table 50: Management problems on a per parish basis comparing male respondents

Problems with water management	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
YES	42	*36.00*	19	*15.43*	14	*14.96*	33	*41.61*	$R_1 = 108$
NO	35	*41.00*	14	*17.57*	18	*17.04*	56	*47.39*	$R_2 = 123$
Column totals	$C_1 = 77$		$C_2 = 33$		$C_3 = 32$		$C_4 = 89$		n = 231

Table 51: Management problems on a per parish basis comparing total respondents

Problems with water management	*St. James*		*St. Lucy*		*St. Joseph*		*St. Philip*		***Row totals***
	O	*E*	O	*E*	O	*E*	O	*E*	
YES	115	*101.22*	46	*41.60*	32	*30.50*	82	*101.68*	$R_1 = 275$
NO	104	*117.78*	44	*48.40*	34	*35.50*	138	*118.32*	$R_2 = 320$
Column totals	$C_1 = 219$		$C_2 = 90$		$C_3 = 66$		$C_4 = 220$		n = 595

Table 52: Management problems on a gender basis comparing St. James respondents

Problems with water management	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	73	*74.57*	42	*40.43*	$R_1 = 115$
NO	69	*67.43*	35	*36.57*	$R_2 = 104$
Column totals	$C_1 = 142$		$C_2 = 77$		n = 219

Table 53: Management problems on a gender basis comparing St. Lucy respondents

Problems with water management	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	27	*29.13*	19	*16.87*	$R_1 = 46$
NO	30	*27.87*	14	*16.13*	$R_2 = 44$
Column totals	$C_1 = 57$		$C_2 = 33$		n = 90

Table 54: Management problems on a gender basis comparing St. Joseph respondents

Problems with water management	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	18	*16.48*	14	*15.52*	$R_1 = 32$
NO	16	*17.52*	18	*16.48*	$R_2 = 34$
Column totals	$C_1 = 34$		$C_2 = 32$		n = 66

Table 55: Management problems on a gender basis comparing St. Philip respondents

Problems with water management	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	49	*48.83*	33	*33.17*	$R_1 = 82$
NO	82	*82.17*	56	*55.83*	$R_2 = 138$
Column totals	$C_1 = 131$		$C_2 = 89$		n = 220

Table 56: Management problems on a gender basis comparing total respondents

Problems with water management	*Females*		*Males*		***Row totals***
	O	*E*	O	*E*	
YES	167	*168.24*	108	*106.76*	$R_1 = 275$
NO	197	*195.76*	123	*124.24*	$R_2 = 320$
Column totals	$C_1 = 364$		$C_2 = 231$		n = 595