A knowledge, attitudes and practices study on water, sanitation and hygiene in Anse La Raye Village, Saint Lucia

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ABSTRACT

Anse La Raye Village is located within a coastal flood plain on the west coast of Saint Lucia. The village has had a history of problems relating to water supply, sanitation and the subsequent pollution of near-shore recreational waters. These problems when combined with inadequate hygiene could have public health implications for villagers who may be exposed to faecal pathogens from contaminated sources. The purpose of this study was to identify the current state of knowledge, attitudes and practices (KAP) of households regarding water, sanitation and hygiene (WASH) as a means of determining necessary interventions for addressing environmental and public health threats. Another aim was to determine the challenges faced in improving the state of sanitation and quality of the water supply system at the village level. The impacts which poor WASH could have on environmental and public health, were also addressed.

Both qualitative and quantitative research methods were used in this study. This qualitative component included observations during nine site visits, eight informal interviews, twelve in-depth guided interviews and one focus group discussion. The quantitative research data was gathered through conducting a questionnaire survey of 162 randomly selected households at a response rate of 100%. The results of the field observations, interviews and focus group discussion revealed that water access in the village was good in terms of quality and quantity. However there were issues with intermittency after periods of heavy rainfall due to clogging at the water intake at Venus Estate. It was also revealed that fewer individuals had access to improved sanitation and this resulted in cases of open defecation and night soil disposal on the Anse La Raye Waterfront and the two rivers bordering the village. The low depth of the water table in Anse La Raye also renders septic tank absorption systems ineffective hence further compounding environmental health issues.

The questionnaire results of the research revealed that about 42% of households did not have a household water connection and 29% had no household toilets. This was primarily due to land tenure issues and land space restrictions. Augmenting the water storage capacity of residents during prolonged water shortages may be difficult primarily because storage tanks were unaffordable for most residents. Residents were generally knowledgeable about the causes of waterborne faecal-oral disease. They also practiced good personal hygiene and engaged in point of use water treatment. Knowledge about the health effects associated with the use of polluted recreational water was lacking with regards to the infection of diarrhoea causing pathogens. However because recreational beach use is not a frequent practice by adults, this suggests that they are aware that there is a danger of contracting other categories of sanitation related diseases. Various recommendations for curbing WASH related problems were presented. These include relocating the water intake to an area which is free from high sedimentation levels as a means of reducing the intermittency of water supply. Another recommendation was to determine the current magnitude, trends and risk levels associated with faecal contamination of the Anse La Raye Bay through conducting a water quality monitoring program and a subsequent microbial risk assessment.

Keywords: water supply, sanitation, hygiene, KAP, environmental health, public health
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Citation
LIST OF ACRONYMS

CBO: Community Based Organisation

MDG: Millennium Development Goal

NEMO: National Emergency Management Organisation

SLBS: Saint Lucia Bureau of Standards

SLSWMA: Saint Lucia Solid Waste Management Authority

SIDS: Small Island Developing States

UNICEF: United Nations Children’s Fund

WASCO: Water and Sewage Company

WASH: Water, Sanitation and Hygiene

WHO: World Health Organisation

WRMA: Water Resources Management Agency
1 INTRODUCTION

1.1 Research outline and focus

This report is the output of a Knowledge, Attitudes and Practices (KAP) study, which addresses water, sanitation and hygiene (WASH) in the village of Anse La Raye, in the Caribbean island of Saint Lucia. The study focuses on WASH related issues because many households in Anse La Raye Village still lack private water access, toilet facilities and have inadequate wastewater treatment. The village is also located in a coastal flood plain where land based sources of pollution from faecal matter seem to be threatening the quality of the near-shore marine environment. This brings to the fore concerns relating to threats to public health, which may arise when individuals are in contact with faecal pathogens that are released into the environment.

Through this research project, the researcher seeks to assess KAP as they relate to WASH and by extension public and environmental health in the village setting. The information is presented under the following sections:

Section 1: The context and focus of the research are presented in this section. This is through presenting the background information, rationale and the goals and objectives of the research.

Section 2: The literature review is presented in this section and aims to review documented information from relevant secondary sources.

Section 3: Details on the methods for obtaining the data for the research are presented in this section. These methods are as follows: questionnaire survey; interviews; focus group discussions; and field observations.

Section 4: The results and findings obtained from applying the methodology are presented in this section in the form of descriptions, summaries, tables and graphical charts.

Section 5: The analysis and discussion of the results and findings are presented here. This is done by means of drawing comparisons between the various results obtained and the relevant literature on the topic. This is a means of determining how the results and findings may impinge on the life of villagers as they relate to public and environmental health.

Section 6: The conclusions of the research are presented in this section. They were derived by highlighting important points from the analysis and discussion section, in accordance with the objectives of the study.

Section 7: Recommendations for improving WASH related problems for the village are presented in this section.

Section 8: Areas of further study which could be addressed by additional research on the topic are presented.
1.2 Background

1.2.1 Overview of Saint Lucia

Saint Lucia is the second largest of the Windward Islands and is located between Martinique to the north and St. Vincent and the Grenadines to the south. It is a small island developing state (SID) located at coordinates 13º 53’N and 60º 68’W, with a mountainous terrain, covering an area of approximately 238 square miles (616 square kilometres) (Government of Saint Lucia 2006a). Saint Lucia had an estimated population of 165,595 individuals in 2010 (Government of Saint Lucia 2011).

1.2.2 Study area

The district of Anse La Raye is located on the leeward side of the island (west coast), which is characterised by rugged mountainous terrain and tropical forests extending towards the island’s interior (Walker n.d.). Geologically the rock type in Anse La Raye consists of andesitic agglomerates and ashes (Nicholsen Institute, n.d.). The district is to the south of the capital, Castries (Figure 1).

The village is within a low lying coastal area within the district of Anse La Raye. It is bordered by Petite Riviere de Anse La Raye (Petite River) to the north, Grande Riviere de Anse La Raye (Grande River) to the south and the Caribbean Sea to the west. It should be noted that a small patch of mangrove exists at the estuary of Petite River (ENCORE Project/Government of Saint Lucia 1994). According to the Population and Housing Census (2010), 1,091 individuals from 392 households reside in Anse La Raye Village (Government of Saint Lucia 2011).
1.2.3 Socioeconomic features

Traditionally Anse La Raye is a fishing village; however, in the past nothing much was done to develop the fishing sector (Government of Saint Lucia 1990). Attempts have been made in recent times to generate economic activity through heritage tourism based ventures (Vargas and Stanfield 2003). The village has been considered as one of the most economically depressed regions of Saint Lucia (ENCORE Project/Government of Saint Lucia 1994) and according to the 2010 housing census data, it still is (Government of Saint Lucia 2011).

According to the Saint Lucia Core Welfare Indicators Questionnaire Survey in 2004, Anse La Raye had youth unemployment as high as 66.7 % (35.4% for males and 43.6% for females) (Government of Saint Lucia 2006b). Also, approximately 44.4% of individuals lived below the
poverty line (Figure 2). The highest rate of indigence has been shown to exist in the Anse La Raye district, at a rate of 5.3% (Caribbean Development Bank 2006). There is also a threat of depopulation as people leave to find job opportunities in other urbanised areas such as the capital, Castries.

Figure 2 Map showing poverty head count by district between the periods of 2005 and 2006


1.2.4 Settlement pattern

The village is approximately 13.5 acres and consists of buildings used for office, commercial, institutional and residential purposes, within the urban centre. In this zone there have been reports of overcrowding, high densities and substandard accommodation (in terms of ventilation, day lighting, fire regulations and environmental quality). Land tenure has been noted as being mainly private and consists mainly of small house lots (Government of Saint Lucia 1990) (Figure 3).

On the outskirts of the village exists a “linear” type of development along the main highway from Castries to the north (West Coast Road); this zone includes more affluent settlements
primarily known as Au Tabor and Massacre. The characteristics of this area include lower density and higher quality private housing (Government of Saint Lucia 1990).

The settlement pattern which exists in the village has been governed by the steep topography around its borders (Figure 4), the availability of flat land along the coastal end and to a lesser extent the fishing industry. It has been noted that throughout the years physical growth in the village took place mainly through the process of infilling. This involved the use of open yards within the built up area for construction due to space restrictions, which resulted in unhealthy and unsightly housing conditions (Government of Saint Lucia 1990).

Historically, land ownership issues have been considered to be a major constraint to development. The village has also been subject to drainage problems because of its low altitude (some areas below sea level), a high water table and its location inside a flood plain. It has been indicated that development in Anse La Raye Village has occurred in a haphazard and unplanned manner. The ad hoc nature of land use issues and the lack of reference to a land development or proper zoning plan have resulted in land uses which have been considered to be conflicting (Government of Saint Lucia 1990).
Figure 3 Plat map (scale 1:1000) showing block divisions (lots) in Anse La Raye Village (see Appendix 1 for annotations of main streets and main infrastructure)

Source: Saint Lucia Survey and Mapping Department: Ministry of Physical Planning (Registry Map: Edition 2, Sheet 0240C)
Figure 4 Topographical map (scale 1: 1000) of Anse La Raye Village (see Appendix 1 for annotations of main streets and main infrastructure).

Source: Saint Lucia Survey and Mapping Department: Ministry of Physical Planning (Registry Map: Edition 1; Sheet 0240C; Series GOSL 1000/94; Last revision done in September 2001)
1.2.5 Water and sanitation

In 2001, the district of Anse La Raye was noted as having the second largest number of households using standpipes in Saint Lucia (21.8 %; Government of Saint Lucia 2001). This figure has since dropped to 11.5 % as of 2010 because more individuals have gained access to private household connections (Government of Saint Lucia 2011).

Statistics from 2001 also show that the percentage of households without toilet facilities in the district was 30.2 % (Government of Saint Lucia 2001). This percentage has also been reduced to 11.9 % in 2010 due to the installation of more private toilets (Government of Saint Lucia 2011).

The village has been lacking with regards to sanitation. Most notable are the inadequacy of toilet facilities, which has resulted in the two rivers and the Anse La Raye Waterfront becoming sites for night soil disposal and open defecation. This has also contributed to continued indiscriminate sewage disposal practices, which have not only impacted the environment, but raised public health concerns (Government of Saint Lucia 2001; A. Collymore, pers. comm.).

1.2.6 Environmental issues

Land based sources of pollution have been partly responsible for serious ecological changes to the marine environment in Anse La Raye. Freshwater pollution has been attributed mainly to agrochemicals, sewage, solid waste disposal and siltation from banana farms located in the upland regions in certain parts of the district such as the Roseau Valley (ENCORE Project/Government of Saint Lucia 1994; Boodram 2002). However, the extent to which chemical and bacteriological pollution occurs above the water intake for the Anse La Raye Village is not clear due to a lack of raw water quality monitoring in this region (M. Andrew, pers. comm.).

Past reports have indicated that unplanned land development in the village has also resulted in high density housing in confined areas, poor waste management, and pollution which have undermined the quality of the near shore marine environment (ENCORE Project/Government of Saint Lucia 1994).

As previously mentioned this high density housing has partly been the result of infilling. This is the process of building small houses within open yards to maximise the use of land space. As a result of this there is not enough space in many instances to install proper sewage treatment facilities such as septic tanks and soak away systems. This has left many individuals dependent on the three public toilets in the village. The lack of private toilets has also contributed to issues of open defecation and night soil disposal into the environment when the toilet facilities are closed.

Poor waste management is primarily associated with the method of wastewater (sewage) treatment. The village has a high water table and this has rendered septic tank and soak away systems infective in containing these wastes (M. Medard, pers. comm.). Also, the practice of open defecation contributes to environmental pollution and contaminant transfer due to the effects of runoff.
All these factors (high density housing and poor wastewater treatment) have impacted the environment indirectly because they facilitate pathways of faecal contaminants into the near-shore marine environment. More specifically the quality of recreational waters bordering the village has been compromised, and beach pollution exists from the presence of faecal matter deposited from night soil disposal and open defecation (D. Paul, pers. comm.) These contaminants pose public health threats because the public may be infected when frequenting the Anse La Raye Waterfront.

1.2.7 Extreme weather events


Tropical Storm Debby was reported to have caused extensive agricultural damage and flooding. There was also restricted access to potable water in the village, in the aftermath of the storm (World Bank, 2005).

The tropical wave of October 26, 1996 also resulted in serious flooding and damage in Anse La Raye (Government of Saint Lucia 2006c). These after effects brought concerns about flaws in the way natural resources and the environment were being managed in Saint Lucia (World Bank 2005). A Hazard Mitigation Plan was drafted in the aftermath of the tropical wave of October 26, 1996 (Government of Saint Lucia 2006c).

The damage from Tropical Storm Lili in 2002 also caused an evacuation order to be issued for Anse La Raye Village which was largely ignored by residents. Due to this kind of public response, an attempt has been made to include an Anse La Raye Evacuation Plan as part of a Flood Management Plan. These two plans are part of The Saint Lucia National Emergency Response Plan which was reviewed in 2002/2003 (World Bank 2005).

In 2004 operations also began under a Caribbean Development Bank (CDB) funded hazard mitigation project to conduct drainage system improvement works in Anse La Raye Village (Government of Saint Lucia 2006c). This work has since been completed, however, drainage issues still exist in some parts of the village due to factors related to topography and the proximity of the water table to the surface. For example, drains in the east of the village which border the Anse La Raye playing field have been noted as usually being backlogged with water. This area is below sea level (Figure 4; Appendix 1) therefore the water is unable to flow against gravity (W. Desir, pers. comm.).

It should also be noted that before the passage of Hurricane Dean in 2007, 71% of Anse La Raye Village residents were considered to be “technically vulnerable” and likely to be seriously impacted by vicissitudes resulting from natural disasters. This therefore, placed added challenges to recovery efforts (Kambon 2007, 12).
In the case of Hurricane Tomas in 2010, about 5,314 from a total of 6,642 residents in the district of Anse La Raye were without pipe borne water for a period of about two weeks. The hurricane also caused damages to 4.8 km of a 200 mm diameter pipeline. These damaged pipelines included the transmission treated water pipeline which connects the main water storage facility at Venus Estate to the distribution network in the village (T. James, pers. comm.). This was because joints in these pipelines became dislodged due to landslides and river erosion. The hurricane also blocked access to the intake at Venus Estate due to sediments from landslides. Power lines were also damaged hence restricting pumping (UN-ECLAC 2011).

1.2.8 Saint Lucia and the Millennium Development Goals (MDGs)

Goal 7 of the MDGs focuses on ensuring environmental sustainability (United Nations 2011). In relation to this research project, Target 7C is of particular interest. This target aims to “halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation” (United Nations 2011, 53). The indicator for progress of Goal 7, Target 7C is measured by the proportion of population with sustainable access to an improved water source and sanitation in both a rural and urban setting.

According to the World Health Organisation (WHO) World Health Statistics Report in 2011, about 98% of Saint Lucians have access to an improved water source in urban and rural areas (WHO 2011) and this value has been consistent from the year 1990 (WHO 2009). Saint Lucia is also considered to be on track for the achievement of MDG target 7C, as it relates to water supply (UNICEF 2006). However some parts of the island have been known to experience difficulties related to the weekly intermittency of supply (Caribbean Development Bank 2006).

In terms of achieving the MDG Goal 7 in Saint Lucia, attention has been placed on reforestation and coastal conservation programmes. However, there is an obstacle of limited financial, technical and human resources which hinders the achievement of Goal 7 and its targets (Caribbean Development Bank 2006). For example, the achievement of the sanitation aspect of target 7C may require that a central sewage collection system is constructed in the village. This is because the high water table may make it counterproductive to provide each household with toilets and septic tank systems. However central sewage systems may be quite expensive to construct, operate and maintain.

From the standpoint of sanitation, in 2000, 89% of Saint Lucians were reported to have access to improved sanitation both in rural and urban areas (WHO 2009). However a recent estimate has not been published in the 2011 WHO World Health Statistics Report. This has been due to issues related to the unavailability and insufficiency of data (WHO 2011). It should however be noted that sanitation access has generally been lagging behind water access in Anse La Raye Village (M. Medard, pers. comm.)

1.3 Rationale

Anse La Raye Village has been known to have problems with the quality of water supply prior to the implementation of a recent Water Supply Improvement Project in December 2009 (T. James, pers. comm.). The cost of this project amounted to approximately EC $8 million dollars
(Government of Saint Lucia Web-site). It was supposed to upgrade the water supply system through the reconstruction of the existing intake structure; the installation of a 400,000 gallon per day water treatment plant; a 200,000 gallon water storage tank; and a treated water distribution pipeline (The Voice Newspaper 2009).

Although this attempt to improve water supply in the village was a necessary step to improving access by residents, the extent to which it improves this access should be evaluated. This is because the installation of a facility may not necessarily guarantee that water is always accessible to all residents. The water supply system needs to be robust and reliable enough to maintain not just a good quality but a reliable quantity of supply. Water quantity is linked to the reliability of the water supply system to ensure that intermittent water supply does not significantly limit access.

Preventing interruptions in supply as a result of regular water shortages is a means of ensuring that enough water consistently reaches users throughout the year. This would therefore ensure that users will not resort to using other unimproved sources when pipe borne water is not available. They would also have enough water for non-drinking purposes which ensures that they are able to practice good hygiene.

In the context of the village there are some households which still lack private water connections (Government of Saint Lucia 2011). This means that they are more dependent on standpipes and the limited capacity of their water storage and collection containers. Household water management is also very important for these individuals, to ensure that the quality of stored water is not compromised before drinking. It should therefore be noted that improving water supply infrastructure should be holistic to ensure that all aspects of access are addressed, such as: water quality, water quantity, water pricing, household water storage capacity and household water management. All these components should be assessed to determine not just the supply end of the water system but the user end. This would determine whether the users are able to respond effectively to interruptions in water supply in order to limit impacts to their health.

It should be noted that when it comes to protecting public health as it relates to water related diseases, a reliable water supply is not the only factor which plays an important role. This is because these diseases usually involve the transmission of pathogens which are of faecal origin. Therefore sanitation and hygiene are also important and should not be excluded in this kind of research. Each of these components plays a role in the transmission of faecal pathogens. This is because water is a common medium for the transmission of pathogens either through direct drinking or indirect contact through the environment. Poor sanitation provides a source of faecal pathogens and poor hygiene prevents the elimination of these pathogens from vulnerable animate and inanimate surfaces.

Sanitation in the village is also known to be lacking because some residents still lack household toilets (Government of Saint Lucia 2011). This has therefore led to cases of open defecation and night soil disposal into the environment (M. Medard, pers. comm.). The extent to which this practice is done should be evaluated together with the ability for residents to protect themselves from poor sanitation through good hygiene practice. This research therefore focuses on the extent to which WASH knowledge, attitudes and practices of households may impact public and
environmental health, especially as a result of the introduction of faecal contaminants into the environment due to inadequate sanitation barriers.

1.4 Research aims and objectives

1.4.1 Aim

The aim of this research is to identify the current state of knowledge, attitudes and practices of households on water management, sanitation issues and hygiene practices in Anse La Raye Village, Saint Lucia. This contributes to the National Goal of having a needs assessment for WASH environmental and public health intervention programs at the village level.

1.4.2 Objectives

The following objectives are presented as a means of achieving the aim of this research:

- To assess the gaps in knowledge in relation to water, sanitation and public health.
- To explore challenges to good water management and sanitation practices.
- To determine the possible impacts of sanitation practices and attitudes on public and environmental health.
- To recommend ways of improving sanitation and water supply.

1.4.3 Research questions

An attempt will be made to address the following research questions, which stem from the aforementioned objectives:

- What are the main socio-economic characteristics of the village?
- What are the water supply and sanitation problems in the village?
- How are water storage and rainwater harvesting being employed in the village?
- Have there been recent impacts of water supply and sanitation on public health in the village?
- What are the environmental health interventions and educational programs which have occurred in the village?
- How have extreme weather events affected WASH practice in the village?
- What are the gender issues on water and sanitation that exist?
2 LITERATURE REVIEW

2.1 Water supply, sanitation and hygiene (WASH) and the MDG’s

Estimates from the WHO and UNICEF show that about 1.1 billion people lack access to improved water supplies and 2.6 billion people lack adequate sanitation worldwide (Gopal et. al. 2009). Goal 7, Target 7 C of the MDG’s directly refers to drinking water and sanitation and aims to reduce by half the proportion of people without these amenities (O’Hara, Hannan and Genina 2008; United Nations 2010).

2.1.1 Water supply

A safe water supply has been defined as a source which is likely to supply water which is not detrimental to health (Hamner et. al., 2006). Safe water sources include: a household piped water connection; a public stand pipe; a borehole; a protected dug well; a protected spring and a rainwater collection system (WHO/UNICEF 2000; Cairncross and Valdmanis 2006). If these sources are capable of providing 20 litres per capita per day at a distance which is no greater than one kilometre from the user’s dwelling then they are considered to be improved sources (Hamner et. al, 2006; O’Hara, Hannan and Genina 2008). Cairncross and Valdmanis (2006) refer to these as reasonable sources, which are usually house connections and public facilities. However, according to the Global Water Supply and Sanitation Assessment 2000 Report, some countries have used more stringent definitions of an improved water source than others (WHO/UNICEF 2000). Unimproved water sources are identified as: unprotected wells and springs, vendors and tanker-trucks, and bottled water (WHO/UNICEF 2000). Cairncross and Valdmanis (2006) note that what one group of consumers may consider to be a perfectly satisfactory water supply system may be unsatisfactory for another group, as this may depend on social and cultural differences between groups. They further state that “water supply is not a single, well-defined intervention… but can be provided at varying levels of service with varying benefits and differing costs” (Cairncross and Valdmanis 2006, 771).

Most of the benefits conferred by water supply revolve around access to water in quantity, and this can be based on the technology used to supply it (Cairncross and Valdmanis, 2006). However from the literature reviewed it seems that more attention is placed on the technology (for example household connections) with the assumption that the appropriate quantity will follow.

Cashman, Nurse and Charlery (2010) note that the definitions used for gauging MDG goal 7, target 7C, do not say enough regarding reliability and adequacy of potable water supply or sanitation. They also point out that not all individuals who have access may be able to use these facilities for various reasons such as aging infrastructure and increasing water demands by urbanisation and tourism. Problems resulting from hurricanes and droughts which result in damaged infrastructure and intermittency also have implications for the reliability and adequacy of supply.

Reservations about what is meant by the term “improved water source” have been acknowledged internationally (WHO/UNICEF 2000), due to arguments that it is too focused on the distance to
the source and the quantity supplied. This is important because an ample water source which is nearby does not necessarily guarantee access. It is also worth noting that increased water access does not guarantee increased water use, therefore other factors must come into play (Fewtrell and Colford 2004). These other factors include cost (affordability by users) and the reliability of supply.

Cairncross and Valdmanis (2006) have indicated that if a water supply is considered to be improved it would provide water of a better quality, convenience and reliability than traditional sources classified as not improved. Convenience would include regularity of supply, cost and the number of users per source.

Reports have indicated that although statistics may show high percentages of improved water sources, sometimes this does not reflect the situation on the ground (O'Hara, Hannan and Genina, 2008). According to WHO/UNICEF (2000), in terms of water supply and sanitation, national consolidated data may not be representative of the poorest and most vulnerable individuals because they are usually hidden in the national totals and averages.

Clasen and Cairncross (2004) have pointed out that in terms of potable water quality a greater focus needs to be placed on point of use treatment. Fewtrell and Colford (2004) also point out that there has been a tendency to focus on the provision of household connections which does not include household water storage. This therefore brings to the fore the issue of household water management as a means of addressing potential water and sanitation related health issues.

Nath (2003) agrees that although public health concerns are usually raised in the institutional setting, there is a tendency to not acknowledge the home as a setting of equal importance. It was further reported that improving health status requires an improvement in attitude concerning hygiene in the home and health education, both in tandem with community water supply and environmental sanitation programs.

A study conducted by Eshcol, Mahapatra and Keshapagu (2009) in India showed that faecal contamination of treated pipe borne water after collection was associated with water handling and hygiene practices in urban slums. They noted that the water was supplied on alternate days (intermittently), hence necessitating up to 48 hours of storage in households before subsequent supply. This resulted in dramatic increases in contamination after collection; hence it was acknowledged that until the problem of intermittent supply is resolved, the biggest impact to health must be made at the household level. As a coping strategy various household practices could be done to limit the contamination of stored water before drinking. These include: collecting water in ways which limit its contamination; storing water properly (for example completely covering containers); and treating stored water before drinking.

2.1.2 Sanitation

Cairncross and Valdmanis (2006) acknowledged that sanitation refers to excreta disposal but also includes other environmental health interventions. The term sanitation therefore also loosely falls under the broader definition of environmental sanitation, which refers to arrangements which cover issues related to drainage of storm-water and effluents, flood management, collection and
disposal of garbage and removal of human excreta (Pandve 2008; Rautanen 2010). Pandve (2008) further highlights that environmental sanitation involves not only the facilities which are provided by governmental authorities but also includes the attitude of the community. This is due to the fact that a better environment can result, if community members work towards the same goal.

In the context of goal 7, target 7C of the MDG’s; it seems that sanitation is seen principally as the removal of human excreta or the availability of appropriate facilities for its disposal. For example, in tracking progress of the MDG’s the term improved sanitation is used, and it refers to connection of households to a private or sewer septic system (with a soak away), a pour flush latrine, a simple pit latrine, or a ventilated improved pit latrine (Hamner et. al. 2006: WHO/UNICEF 2000). All sanitation technologies are deemed adequate as long they are private or shared but not public and provided that the hygienic separation of human excreta from human contact exists. Although they may be private, bucket latrines and latrines with open slab-less pits are deemed unimproved (Cairncross and Valdmanis 2006).

Public latrines fail to provide an adequate solution to the community excreta disposal needs because of problems with inadequacies in their maintenance and inaccessibility at night by the elderly, disabled and young children. It should be noted that these inadequacies sometimes lead to open defecation or inappropriate excreta disposal which sometimes reach sensitive aqueous environments or pose risks of human contact (Cairncross and Valdmanis 2006; WHO/UNICEF 2000). This therefore means that just having these public latrines constructed is not a clear cut solution to resolving sanitation problems.

The ability to engage in good sanitation depends on the availability of water which is used for cleaning and elimination of wastes. Water availability therefore influences the type and functionality of the sanitation facilities which exist (Pandve 2008) and as such it is not unusual for the two to be studied in relation to each other.

There have been differences in opinion as to the combined effect of water and sanitation services on users. According to Esrey et. al. (1991), from the public health standpoint (as it relates to diarrhoeal disease), the combined effect of water and sanitation is no greater than either component separately. However Cairncross and Valdmanis (2006) have considered the effects to be both independent and additive.

In the Caribbean it has been reported that rural sanitation gets much less attention and financial support than urban sanitation. It has also been reported that generally, only a small fraction of industrial and municipal wastewater is treated before being disposed into terrestrial and aquatic environments (Vassell 2009; Smith 2008).

Smith (2008) noted that the critical aspects of sanitation which have been identified in the Caribbean are as follows: interagency and inter-ministerial cooperation; behavioural change (cultural norms and practices); development of community sanitation programs; development of school sanitation programs; development of micro-financing enterprises and the introduction of regional and local technologies. Smith (2008) further mentioned that the absence of central
collection/treatment systems in high water table areas and the improper disposal of garbage/plastic bottles were problems.

2.1.3 Hygiene

In terms of hygiene, it may refer to a practice which is either personal or domestic. Personal hygiene refers to the use of water for cleaning parts of the body and domestic hygiene refers to water used to clean items in the home such as food, utensils and floors (Esrey et. al. 1991). In many articles reviewed, hygiene practice was usually considered as part of water and sanitation research. This is because all three components (water, sanitation and hygiene) commonly impact human health. These components also influence each other, for example, poor hygiene has been shown to be a result of low water availability and inconvenient water supply (such as low pressure, intermittence and crowding) (Karn and Harada 2002; Prüss-Üstün et. al. 2004).

Poor hygiene would also be expected to have sanitary consequences. As such, WHO and UNICEF have considered hygiene information as an important component of their work on water and sanitation issues (WHO/UNICEF 2000). In terms of the combined importance of all three components: water supply, sanitation and hygiene promotion on the reduction of diarrhoea disease have been regarded as both independent and additive to one another (Cairncross and Valdmanis 2006).

Interventions which promote hand washing with soap as a single personal hygiene practice have been shown to be most effective when compared to other behaviours (Cairncross and Valdmanis 2006). Kawata (1978) also notes that the belief that water availability for personal hygiene is of prime importance for diarrhoea control is not uniform among researchers. Other important factors such as wastewater disposal, solid waste management and human settlement issues have been shown to have implications on health (Nath 2003; Kawata 1978).

A literature review on water, sanitation and hygiene by Fewtrell and Colford (2004) found that, generally hygiene interventions which comprise hand-washing and hygiene education in child care centres significantly contribute to a reduction in diarrhoeal disease. Metwally et. al. (2007) stressed that public access to appropriate information to increase awareness and changes in hygiene patterns are important to public health. They further claimed that the result would lead to a greater tendency of the public to protect themselves from infectious diseases.

Tumwine et. al. (2002) highlighted hygiene practices as a key compliment to improved water and sanitation programs. They warned that if the hygiene component was not included, some of the environmental health benefits would be lost.

It can also be said that the adequacy of water is a necessary condition to good hygiene. This is because when there is poor sanitation, supplying enough water per capita enables residents to practice good hygiene. This in turn safeguards public health by enabling residents to protect themselves from sanitation related diseases.
2.1.4 Disease types and transmission routes

Waterborne diseases are primarily caused by human and animal faecal contamination (San Martin 2002; Eshcol, Mahapatra and Keshapagu 2009). However, these infections are usually of human origin and to a lesser extent caused by animals (Prüss-Üstün et. al. 2004). Since safe water can become contaminated with faecal matter during collection, transport and storage (Clasen and Cairncross 2004), it is important to devise ways of limiting contamination on these levels.

Water is an ideal medium for the transmission of diseases from faecal origin. Humans interact with water in different ways and as such sanitation based diseases may be transmitted through various routes. According to Clasen and Cairncross (2004) these routes have been classified by White, Bradley and White (1972) as shown below (Table 1).

Table 1 The classification of water related diseases according to White, Bradley, and White (1972)

<table>
<thead>
<tr>
<th>Transmission route</th>
<th>Description</th>
<th>Disease group</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterborne</td>
<td>The pathogen is in water that is ingested</td>
<td>Faecal-oral</td>
<td>Diarrhoeas, dysenteries, typhoid fever</td>
</tr>
<tr>
<td>Water-washed (or water-scarse)</td>
<td>Person to person transmission because of lack of water for hygiene</td>
<td>Skin and eye infections</td>
<td>Scabies, trachoma</td>
</tr>
<tr>
<td>Water-based</td>
<td>Transmission via aquatic intermediate host (for example a snail)</td>
<td>Water-based</td>
<td>Schistosomiasis, guinea worm</td>
</tr>
<tr>
<td>Water-related insect vector</td>
<td>Transmission by insects that breed in water or bite near water</td>
<td>Water related-insect vector</td>
<td>Dengue, malaria, trypanosomiasis</td>
</tr>
</tbody>
</table>

Source: Cairncross and Valdmanis (2006)

Cairncross and Valdmanis (2006), reported that most diarrhoeal diseases are transmitted through water-washed and not waterborne routes (although the most notable epidemics such as cholera and typhoid are waterborne), hence the significance of the hygiene component of WASH interventions.

In terms of the faecal-oral disease group, it should be noted that water is the ideal but not the only medium which facilitates the faecal-oral pathway (Orlando 2001). Prüss-Üstün et. al. (2004), note that the predominant pathway of infection will depend on the survival characteristics of the pathogen, the local infrastructure in place and human behaviour.

There are five main media by which faecal-oral diseases are transmitted. This is usually represented in a schematic known as the F-diagram. This diagram has been widely used as a model for the transmission of faecal-oral diseases (Bostoen, Kolsky and Hunt 2007). The F-diagram as represented by Prüss-Üstün et. al. (2004) shows the connection between the faecal pathogen sources, the environment and the individual as seen below (Figure 5):
2.2 Socioeconomic aspects

In developing countries, the consequences of poor sanitation are often greatest felt among poor residents of densely settled areas (Orlando 2001). Nath (2003) has noted that inadequate housing usually leads to poor home hygiene in poor urban areas.

In terms of WASH and health, it has been reported that the prevalence and intensity of helminth infections are influenced by certain occupations, household clustering, poverty and behaviours (Hotez et al. 2006). According to Keusch et al. (2006), a strong relationship exists between poverty, unhygienic environments and the severity of diarrhoeal episodes, especially in children less than five years of age.

Cashman, Nurse and Charlery (2010) have noted that in the Caribbean region, there has been significant progress in extending water coverage and sanitation service, however challenges such as maintaining access, coverage and quality standards still exist. These challenges have been increased by factors such as population pressures, urbanisation, economic development and the growth in tourism.

Some researchers have also concluded that the installation of water supplies and latrines should be done in parallel with improvements in housing and socio-economic status to have a marked effect on infant health (Kawata 1978). Orlando (2001) also indicated that with the implementation of sanitation projects and solutions, the factors of social change need to be considered to ensure success; hence this change should provide technologies which must be supported by the target residents.

San Martin (2002) noted that proper water resources management provides significant social effects which can be grouped into three categories namely: health, poverty alleviation and the reduction of vulnerability to natural hazards. It was also highlighted that water resources...
management infrastructure has several positive impacts on the poor, notably its effect on promoting economic growth. Hence, there is a corresponding poverty alleviation effect with any meaningful contribution to water and sanitation infrastructure.

A study by Soares et al. (2002), who investigated the inequalities in access and use of drinking water services in the Latin-American and Caribbean region, showed that the factors which determine these inequalities are related to poverty. These inequalities were reported to be directly related to family expenditures for drinking water supply services. Therefore families with a higher per capita expenditure were much more likely to have a household water connection. They also recommended that periodic surveys should be conducted in order to monitor the progress towards reducing these inequalities.

A study on water and sanitation investments in the Caribbean conducted by Martin and Sohail (2005) noted that water supply and sanitation infrastructural investments is very capital intensive and governments bear a significant amount of these costs. They noted that, attracting private investments is also a challenge because the payback of water supply and sanitation projects could take as long as 20 to 30 years.

2.3 Climate change and extreme weather events

In terms of climate change, the Caribbean which consists of small island developing states (SIDS) is highly vulnerable. Many Caribbean islands are prone to frequent damage due to their location in the hurricane belt. Natural disasters contribute to the scale and magnitude of poor water and sanitation problems in the Caribbean which usually involves infrastructural damage (destruction of toilets and water pipelines) (Vassell 2009).

The preparedness for these events is not only necessary for protecting human lives and property but for sustained economic growth and social development (San Martin 2002). It has been shown that damages from a single hurricane event can set back the socioeconomic development of a country by at least 10 years (Trotz 2008). It is also expected that climate change will have a profound effect on the socio-economic development of Caribbean islands in the long term. The impacts of climate change may even jeopardize the achievement of the MDG’s (Farrell, Nurse and Moseley 2007).

Cashman, Nurse and Charley (2010), noted that increasingly there is the realization that the degree of water availability will be vulnerable to extreme climate events. It is expected that atmospheric warming, longer seasonal dry periods and increased drought frequencies will occur. This is therefore projected to have implications for water resources availability. San Martin (2002) however notes that in comparison to floods, the region is less often affected by droughts. The impact of droughts will depend on the level of preparedness in facing these types of events.

Climate change may also lead to more intense rainstorms which in turn results in increased run-off which then leads to increased flooding (Farrell, Nurse and Moseley 2007). High precipitation, flooding and hurricanes have resulted in sanitation problems in some rural Jamaican communities. These problems included toilets which were flooded and blown away, hence directly releasing faecal matter into the environment and rivers (Vassell 2009). There is therefore
a need to supply communities with robust sanitation systems which are able to withstand the impacts of natural disasters (Harvey and Reed 2005).

San Martin (2002) further notes that increased public awareness and improved preparedness for floods and droughts are water resource management challenges in the region. In terms of the impact of climate change on water resources in the Caribbean and getting people to understand the value of water resources, Farrell, Nurse and Moseley (2007, 8) noted that:

“no policy, however well-intentioned and conceived, will achieve the desired outcome if stakeholder education is not an institutionalized element of the implementation process. This may require strategies aimed at effecting behavioural and attitudinal change, dispelling false notions…and enhancing public awareness.”

2.4 Gender

Men and women usually have different socially defined roles and responsibility in the home and community. Cairncross and Valdmanis (2006) noted that there exists a string of gender differences related to water supply and sanitation, in terms of their perception of the social benefits. They indicated that in some studies male household heads generally perceive the issue of improved sanitation as an improvement in social status. Women however place more importance on issues of security, convenience, aesthetics and the tendency to be sexually harassed when sharing public facilities.

Vassell (2009) noted in a Jamaican study that both men and women were concerned about water management although for different reasons. The concerns of women were related to water management and efficiency of use in the home because they were main water carriers. In some instances men were more concerned about water availability for washing motorbikes and cars.

Vassell (2009) further noted that water and sanitation challenges place a burden on women in relation to their productive and community management roles. On the community level, economic barriers can be created when drinking water is not available. It was shown in the Jamaican study that because of the lack of sufficient water supply, women were unable to translate ideas for food related businesses (such as jam and jelly production) into practical projects. Other water intensive activities for generating income such as hairdressing were also restricted.

2.5 Environmental implications

Some conditions which are potential indicators of high faecal-oral pathogen loads in a community are: low sanitation coverage, faecal contaminated drinking water supplies, irregular refuse collection and poor hygiene practices (Prüss-Üstün et. al. 2004). Coastal pollution due to microbiological contamination is an important issue, especially when considering that the majority of the world’s population (Griffin et. al. 2003) have settled in these areas.

A review conducted by Griffin et al. (2003) noted that human and ecosystem health are negatively impacted by a decrease in coastal marine water quality. They identified the faecal-oral
route as the means of transmission of all pathogenic viruses which pose a public health threat in the near-shore marine environment.

Factors which increase coastal pollution from inland sources include the direct or indirect disposal of wastewater into coastal waters (Griffin et. al. 2003). This is exacerbated by the density of on-site septic tanks and high precipitation. San Martin (2002) notes that when sanitation infrastructure or wastewater treatment facilities are lacking or not functioning, the quality of coastal waters can be affected and this has implications for tourism dependent Caribbean islands and communities. As a result, polluted coastal waters may pose health risks to tourists and residents alike, hence having implications for the tourism industry.

3 METHODOLOGY

The methodology for this research was geared at obtaining both primary and secondary data. Primary data were collected in the following stages: consultations; site visits/field observations; cross-sectional surveys/questionnaires (Appendix 2); interviews (Appendices 3 and 4); and a focus group (Appendix 5).

Secondary data were primarily collected from three sources: socioeconomic data sourced from the Saint Lucia 2010 population and housing census; water quality data from CEHI documentation; and maps from the survey and mapping division of the Ministry of Physical Development, Environment and Housing.

Using multiple data collection techniques facilitated triangulation and helped reduce the effects of bias during the research. According to Berg (1998) triangulation serves as a means of mutual confirmation of results and subsequent validation of findings.

3.1 Cross-sectional survey

3.1.1 Questionnaire design

The questionnaire was designed by aligning the questions to the objectives and research questions of the study and referring to questionnaire examples from various guiding documents (Appendix 2). In designing the questionnaire the WHO and UNICEF’s core questions on drinking water and sanitation for household surveys (JMP 2006) were consulted. Other principal documents which were consulted during the questionnaire design stage were authored by Billig, Bendahmane and Swindale (1999); Duncker (2001); EAWAG (2003); Sieler and Eppler (2007); and WHO (2008).

The questionnaire which was drafted was for the most part structured in nature, with some standardised open-ended questions included. This was done to give respondents an opportunity to explain why they gave certain responses to corresponding closed-ended questions. This gave greater insights into why residents had certain perceptions and attitudes, or engaged in certain practices.

After designing and drafting the questionnaire, they were revised with the assistance of the enumerators. The enumerators selected were recommended by the Saint Lucia Statistics
Department and have had recent experience in administering surveys within the Anse La Raye Village. Based on the feedback received, adjustments were made and the questionnaire was pre-tested on a small sample of 20 random residents within the study area.

3.1.2 Sample size

The total number of households in the village based on the 2010 Population and Housing Census was 392. The sample size used was calculated using a web based sample size calculator which is based on the following formula for large population sizes:

$$ss = \frac{Z^2 \times p \times (1 - p)}{c^2}.$$  

This formula has been used in previous studies for large population sizes when the confidence level, percentage of picking and confidence interval were known (Tiago Rodrigues et. al. 2010; Oldewage-Theron et. al. 2008). However, the formula was adjusted for calculating a sample size from a small population size, where the sample size exceeded 5% of the population (surveysystem.com website). This was done by dividing by: $1 + ((ss-1) / \text{pop})$. A summary of formulas and variables used are as follows:

$$ss = \frac{Z^2 \times p \times (1 - p)}{c^2}$$

Adjusted sample size for a small population size = $ss / [1 + ((ss-1) / \text{pop})]$

Where:

- $ss$ = sample size for large population (unadjusted)
- $Z$ = the z value (e.g. 1.645 for 90% confidence level)
- $p$ = percentage of picking choice (expressed as a decimal)
- $c$ = confidence interval (expressed as decimal)
- $\text{pop}$ = population size

The calculations were made based on a confidence level of 90% ($z$ value of 1.645), a confidence interval (error) of 5% or 0.05, a percentage of picking choice of 0.5 and a population size of 392. The resulting sample size used in the survey was 162 households. Systematic random sampling was then used to choose the households in the field in order to further reduce bias.

3.2 Interviews

The interviews were conducted according to various themes, which were developed from determining the information which would be required to satisfy the objectives of the research. The reviewed literature was also used as a guide for developing these themes which are as follows: socioeconomic situation; solid waste management; wastewater/drainage; water supply; and sanitation. The main types of interviews used were: informal conversational interviews and in-depth guided interviews (Appendices 3 and 4).
The informal interviews were conducted with the following individuals: Mr. Parker Ragunanan (Senior Environmental Health Officer: Environmental Health Department); Mrs. Gen Hutchinson-Reynolds (Enforcement Officer: SLSWMA); Ms. Emlyn A. Jean (Education and Public Information Manager: SLSWMA); Mr. John Smith (Member: Anse La Raye Sports Committee/Mail-man: Anse La Raye Post Office); Mrs. Felicity Labadie (Former Principal: Anse La Raye Infant School); Mr. Jonah George (village resident of Church Street); Mr. Ishmael Williams (village resident: waterfront/bay recreational user); Mr. Davis Paul (Environmental Health Officer: Environmental Health Department).

The following individuals were respondents during the in-depth guided interviews: Mr. Reeves Lawrence (President: Anse La Raye Development Foundation/Principal: Anse La Raye Primary School); Mr. Wint Desir (Chairman: Village Council); Mr. Stephen Griffith (Chairman: Disaster Preparedness Committee); Mr. Andrew Collymore (Clerk: Village Council); Ms. Juliana Arthur (Sanitation worker: Village Council); Ms. Angela Antoine (Community Nurse: Village Health Centre); Mr. Sommers St. Croix (President: Anse La Raye Vendor’s Association); Mr. Timothy James (Senior Water Distribution Technician: Water and Sewage Company – WASCO); Mr. Cyprian Yarde (Director: Bureau of Health Education); Mr. Michael Andrew (Officer Responsible: WRMA); Mr. Emerson Vitalis (Senior Environmental Health Officer: Environmental Health Department); Mr McMillan Medard (Former Senior Environmental Health Officer: Environmental Health Department).

3.3 Focus group discussion

The dual moderator focus group method was used for the focus group discussion (Appendix 5). It was held at the Anse La Raye Parish Hall with representatives from the following community-based organisations (CBO’s): All Stars Sports and Cultural Club; Anse La Raye Fishermen’s Cooperative; SDA Youth Organisation; Kiddies Hommies Day Care Centre; Youth on Fire Ministries; Mothers and Fathers Group; Lion Hearts Sports Club; Anse La Raye Seafood Vendors Association; Allez Sports and Cultural Club; Anse La Raye Development Foundation; and Anse La Raye Primary School.

3.4 Data analysis

Qualitative data from the interviews and focus group discussions were analysed by transcribing the data and reviewing the transcripts for common themes, explanations and insights using content analysis techniques (Renner and Powell 2003; Berg 1998; Silverman 1993).

The quantitative data from questionnaires were analysed using the Statistical Package for the Social Sciences (SPSS) software. Analysis was facilitated by means of descriptive statistics and cross-tabulations to assess the variables of interest and their relationships.
4 PRESENTATION OF RESULTS AND FINDINGS

4.1 Field observations

4.1.1 Housing

The houses within the village were built in very close proximity to each other, with rudimentary footpaths in between them (Figure 6). This was partly due to the construction of houses within open yard spaces. There was a mixture of small concrete and wooden houses, many of which seemed to be of aged construction and in need of upkeep. It should be noted that a few larger modern concrete houses exist on the outskirts of the main built up area.

Many low lying residential structures were found to exist along the edges the Petite and Grand River estuaries (to the north) (Figure 7). There were also damaged gabion baskets near the banks of the Petite River estuary (Figure 8). These baskets were installed to protect residents from the effects of flooding. They were installed after the passage of Tropical Storm Debby in 1994. According to a resident, these baskets were damaged due to the effects of Hurricane Tomas in 2010.

Figure 6 Rudimentary footpaths between homes and open drains channelling wastewater
Figure 7 This home together with many others were located close to the edge of the Petite River estuary.

Figure 8 Resident (Jonah George) expressing concerns about the impact of flooding near Petite River estuary and the collapse of the gabion baskets which has increased the flood risk.
4.1.2 Public toilets, showers and laundries

Three public facilities were observed; it should be noted that all toilets, showers and laundries seemed to be in working condition at the time of the investigation. The first facility is located at the northern end of Front Street where it intersects with St. Louis Street. This is a newly renovated facility and is primarily designated for tourists. There is a “payment for use” system in place in the northern facility, in order to cover its operations and maintenance costs. This is the only “pay for use” facility in the village (S. Griffith, pers. comm.) and houses four flush toilets, two urinals, two showers and two water tanks (capacities of 1,000 gallons and 500 gallons) (A. Collymore, pers. comm.).

The second facility is located on the southern end of Front Street (Figure 9) where it intersects with Bridge Street. This is an older looking facility, in need of some repairs and consists of six flush toilets, four showers, one laundry area and two water tanks (capacities of 900 and 500 gallons) (A. Collymore, pers. comm.). It is the only facility which houses a laundry area. It was observed to have the most users, especially within the laundry area, most of which were female. A door was observed to be missing in the male bathroom (Figure 10). This door faces the public beach area along the waterfront hence limiting the privacy of users. The back fence of this facility also seemed to be collapsing, bringing to the fore issues concerning the adequacy of security levels.

The third facility is located adjacent to Millet Road within the area commonly referred to as Petit Boug (Petit Boug Street is within this area). This facility consists of six toilets and four showers. It was observed that the shower areas for this facility lacked doors for regulating the access of users. This facility also houses a 900 gallon water tank.

It was observed that at least two out of the three public facilities lacked doors or shower curtains for the shower areas. All toilets and shower rooms were divided equally for male and female designated uses.

About six public standpipes were initially observed and this number was later verified by Ms. Juliana Arthur, a veteran sanitation worker who works for the village council. The standpipes are principally located at the corners of residential housing blocks and appeared to be utilised frequently by residents.

Although a laundry facility exists, many standpipes were observed being used not only for water collection, but laundry purposes as well. Most of the standpipe users who were collecting water were women and children. Only women were observed using the standpipes for laundry purposes.
4.1.3 Drainage

Drainage consists of a network of small drains which feed into two large main drains (Figure 11). These main drains empty into Petite River in the northern end of the village and Grande River in the south. The drains were clean for the most part, although stagnant water was seen in some areas. Three major areas of stagnation were observed. These were the canals along the southern and western sides of the Anse La Raye Playing Field and the final stretch of the canal.
which drains into the Petite River in the north of the Village. Some buildings were observed to lack drainage, such as Happy Josephine Pre-School in Petit Bourg. Also, during one site visit residents from Church Street complained to the community contact, Ms. Anicita Desir (due to her current tenure on the Disaster Preparedness Committee) about flooding experienced during the week. According to some residents, this was due to recent heavy rains (during the week of the site visit) coupled with the damaged gabion baskets near the banks of the Petite River estuary.

![Figure 11](image)

**Figure 11** Walking through the central drainage system with a community contact (Ms. Juliana Arthur)

4.1.4 Environmental issues

Generally, the village streets and sidewalks were clean although moderate litter was observed in some abandoned spaces (open yards and dilapidated houses) within Petit Bourg. Litter was also observed in some drains, especially those with stagnant water. Grey water enters surface water bodies (rivers) either indirectly through the drainage network or directly from homes located near the river banks (Figure 12).

The mouths of Petite and Grande Rivers were very murky and heavily silted. There were also signs of litter accumulation in these areas, especially near Petite River. A mangrove swamp was also observed inside the Petite River estuary.
There were signs of much environmental change along the Anse La Raye Waterfront due to beach erosion and beach loss. This erosion could have resulted in the collapse of the back fence of the southern public facility on Front Street and the collapse of other structures adjacent to the facility (although the cause of these damages were not subsequently confirmed).

Figure 12 Part of the central drainage system empties into the Grande River estuary

Open defecation was observed on both community walks at the mouth of Grande River and a community member was observed disposing of human excreta on the beach (Anse La Raye Waterfront) (Figure 13). These acts of human waste disposal occurred while the beach was recreationally being used by young boys from the village. Although no human waste disposal was observed near Petite River, evidence of livestock rearing was noted. At least two piggeries were observed in this area.

Figure 13: Observed excreta disposal on the waterfront and recreational beach use
In the upper reaches of Grande River near the water intake at Venus Estate (Figure 14), much sedimentation was observed on the river bed. There were also signs of river dredging due to the presence of a huge pile of silt and rock material which was placed at the edge of the intake. This silt was noted as being at risk of river re-entry from runoff.

Two pumice quarries were observed near the intake. One is operated by C.O Williams Construction Limited and is located above the intake. The other quarry is located below the intake and is operated by RG Quarry Ltd. A newly constructed water treatment plant was observed above the intake. This facility has a treatment capacity of about 400,000 gallons per day (T. James pers. comm.).

![Figure 14: Water intake at Venus Estate](image)

4.2 Results from interviews

4.2.1 Socioeconomic situation

Forms of livelihood

From the interviews conducted there was the general feeling that poverty is a problem in the village and that there has been little improvement in the socioeconomic status of villagers for many years. The village was noted as having high levels of unemployment and there were concerns about problems of indigence and teenage pregnancy. It was also noted that some individuals work outside the village and have a stable means of income. However a few of these persons have migrated to more affluent housing developments in the district such as Au Tabor and Massacre on the outskirts of the village.

The general consensus was that agriculture and fishing are the traditional means of income for villagers. However activities in these sectors have declined, especially in agriculture which has been negatively impacted by Hurricane Tomas in 2010. It should be noted that these two economic activities seem to be predominantly male-centred.
The chairman of the village council and a former farmer, Mr. Wint Desir, was of the opinion that young people are not agriculturally oriented. He further noted that this is due to their perception of farming as a tedious and long term endeavour in which the financial payoff takes too long to materialise.

Fishing has reduced due to less fishermen and lower catch. As a result of this there was an intervention within the last five years by the Ministry of Agriculture involving the introduction of fish aggregating devices (FADs) which have helped to increase catch (A. Collymore, pers. comm.). Fishing activity is still generally regarded as low due to a decline in full-time fishermen.

In recent times there has been more income generation in the tourism and construction sectors (also male-centred). Tourism has positively impacted the village by means of two heritage tourism initiatives. These are: the sale of arts and crafts throughout the week to tourists en route to Soufriere and the Anse La Raye Friday Night Fish Fry street party. The Friday night activity is a weekly mass crowd event. Both of these activities occur on Front Street near the waterfront.

The village council clerk stressed on the importance these activities, especially the mass crowd event on the livelihoods of many residents. He highlighted that most of the vendors are women, many of whom are single parents. There was a general feeling that heritage tourism is the most improved sector and that a substantial number of individuals presently depend on this for their livelihood.

The president of the Anse La Raye Vendors Association, Mr. Sommers St. Croix, noted that presently there are concerns about the sustainability of the Friday night event due to issues related to: poor management by organisers and high unregulated prices of meals. This has led to reduced sales, reduced sponsorship from the commercial sector, and poor linkages between the fishermen and the vendor association. He noted that although fishermen are supposed to benefit from the Friday night activity by selling their catch to the vendors, this does not generally happen.

There was the general consensus that in recent years many male community members have directly benefited through short term employment in the construction sector. This has been due to various construction projects which have occurred in Anse La Raye. These projects include: a new fisheries complex, a new water treatment plant and renovations to the Anse La Raye Playing Field.

The chairman of the village council indicated that millions of dollars have been injected into construction projects, many of which occurred between 2009 and 2010. Also, a significant part of this money has benefited residents directly through wages. However, others have expressed concerns about the sustainability of these short term construction jobs due to a reversion of many workers into a lengthy state of unemployment after the completion of these projects.

**Housing and Infrastructure**

There was the general consensus that housing continues to be a major problem which has led to the manifestation of other public health and environmental concerns. A shortage of housing was noted, in terms of the inadequacy of living space size per number of household members.
Congestion was also regarded as a problem with many haphazard house clusters within small house lots and yard spaces.

According to Mr. Andrew Collymore (the village council clerk), there has not been much improvement in housing since the early 1980’s. However, after the dire effects of Tropical Storm Debby in 1994 attempts were made to relocate some residents. Some individuals from flood prone areas were relocated to Au Tabor.

The general consensus among respondents was that although some individuals relocated, the housing problem still exists. This is principally due to two reasons. Firstly, the inability for some individuals to move because of unaffordable relocation costs. Secondly, many financially able individuals who relocated left their siblings, other family members, or tenants behind in their former homes. Therefore, although people did relocate, their original homes were never demolished hence perpetuating the housing issues.

Mr. McMillan Medard, a former environmental health officer who worked intimately for many years in the village, regarded infrastructure as a major issue in Anse la Raye Village. He added that this was due to poor central planning. He specified that public health and environmental issues were the result of ad hoc developments due to the lack of a clear village zoning plan. He also stressed that there had never been an effective development plan to move the village from past conditions to the modern reality. It was also firmly stated that at present “development in the village is obsolete” (M. Medard, pers. comm.).

4.2.2 Wastewater and drainage

The two main sources of wastewater are domestic and medical. However, wastewater from the village is for the most part domestic. Both medical and domestic wastewater are released into the environment untreated, via the network of open drains.

There are two main central drains, each of which empties into one of the two rivers. Sometimes the extremities of these drains need to be dredged due to the accumulation of refuse, silt and water (J. Arthur, pers. comm.). However the frequency at which this dredging was done was not specified.

Most community persons interviewed agreed that the drains which lie on the western (Figure 15) and southern edge of the playing field are problematic. The consensus was that this was due to a backlog of water, silt and refuse (such as soft drink bottles) as this part of the village is below sea level. As a result water is prevented from freely draining into the rivers from the effects of gravity. This was considered to be a major problem, which has resulted in odours, especially during high tide. It was however agreed that the drainage system is effective in the village under normal circumstances, in the absence of heavy rainfall and storm surge.

Respondents agreed that a flooding problem exists. Flooding is thought to be a consequence of the village’s location within a flood plain and having the characteristics of being bordered by water bodies on three sides (two rivers to the north and south and the Anse La Raye Bay to the west). Storm surge and high tides were also identified as further contributing to the flooding by creating a build-up of river water at the estuaries and parts of the drainage network. The
topography of the land was also identified to be a problem because some parts of the village are below sea level.

According to Mr. Reeves Lawrence, these floods were usually of short duration (2 hours) but could be longer when accompanied by storm surge. Heavy flooding from Tropical Storm Debby in 1994 and the tropical wave of October 26, 1996 were reported to generate flood waters of 1 m in height in areas such as the Anse La Raye Primary School in Petit Bourg (R. Lawrence, pers. comm.).

Grande River is thought to be the main contributor to flood waters in recent times, due to high levels of siltation which has raised the river bed. Mitigation works which were done on Petite River have reduced the magnitude of flooding to some extent in the northern end of the village.

A few flood zones were identified as follows:

- The northern end of the village near the banks of the Petite River. The flooding in this area was generally thought to be exacerbated by a mangrove swamp near the river’s mouth which is slowly encroaching landwards. The general belief is that this mangrove is pushing river water inland because of volume restrictions.

- East of the village, adjacent to the playing field (its southern edge). This is near the junction of Petit Bourg Street and Market Street. Other parts of Petit Bourg were also considered as flood prone areas.

- The centre of the village near the junction of Mole Street and St. Louis Street (near the community health centre).

Figure 15 Drain on the western edge of the Anse La Raye playing field which poses drainage problems of stagnancy, due to the low topography.
4.2.3 Village water supply

Water quality

Respondents generally thought that water supply in the village was good in terms of quality and coverage. This was primarily due to a recent upgrade to the water supply system. This upgrade was funded by the European Union through the French government. The project included the following: the construction of a 400,000 gallon per day water treatment facility with a pressurised filtration treatment system (Figure 16) and a 200,000 gallon water storage tank (Figure 17). The only problem with the upgrade was that it originally included the relocation of the intake but this could not be done due to lack of funding (T. James, pers. comm.; W. Desir, pers. comm.).

Figure 16 400,000 gallon/day water treatment facility at Venus Estate

Figure 17 200,000 gallon water storage tank at Venus Estate

Siltation was a problem at the intake before Hurricane Tomas in 2010 due to runoff from the pumice quarry above the intake and soil erosion. Although drainage mitigation works have reduced the levels of pumice reaching the intake, silt levels at the intake are still high due to the
effects of Hurricane Tomas (Figure 18). Since the passage of this hurricane, sedimentation has increased drastically. This was believed to be due to exposed soils from landslide activity further up the catchment (T. James, pers. comm.).

Figure 18 Accumulated silt deposited near the water intake after desilting efforts

Before the construction of the new treatment facility, the potable water quality in the village was considered poor (T. James, pers. comm.). The water quality has since improved, although there are a few complaints by some residents, about the presence of silt in pipe borne water. They noted that the silt was visible after it had settled at the base of water storage containers, which were used to collect water after heavy rainfall (W. Desir, pers. comm.).

From the perspective of WASCO, there have also been no complaints by customers about poor water quality, since the establishment of the new water treatment plant. Before the upgrade, customer complaints were numerous. This was not surprising because Anse La Raye was considered as one of the worst areas on the island in terms of water quality before the upgrade (T. James, pers. comm.).

The new treatment plant does not eliminate agrochemicals. This is not regarded as a problem because the intake is located away from areas of intensive agricultural activity (T. James, pers. comm.). The extent of raw water quality testing above the intake is thought to be minimal (M. Andrew; E. Vitalis; T. James, pers. comm.). However, treated water is routinely checked by officials from WASCO and the Environmental Health Department (T. James, pers. comm.; E. Vitalis, pers. comm.).

Water access

Access to water is generally thought to be good with 54.7% of households owning private connections, according to the 2010 Population and Housing Census (Appendix 7) (Government of Saint Lucia, 2010). In some cases access was hindered due to issues with the intermittence of supply.
It was generally believed that crowding at stand pipes is minimal and not a problem. However, crowding occurs occasionally not by individuals collecting drinking water but by those involved in laundry related activities. As it is more convenient and saves them the time and trouble of carrying clothes to and from the community laundry (A. Collymore, pers. comm.). It should be noted that stand pipes are supposed to be strictly used for collecting drinking water.

Intermittence in water supply was thought to be primarily due to the effects of heavy rainfall and storm events which result in heavy siltation at the intake. This causes the intake to be shut down temporarily for desilting to be done by WASCO. Water which is stored in the storage tank after leaving the treatment plant is usually unable to supply the village if the intake is closed for more than two days. Therefore intermittence in water supply usually occurs about 48 hours after a heavy rainfall event (T. James, pers. comm.).

The water storage tank at Venus Estate is fully automated and also supplies areas outside the village such as Au Tabor and Massacre (T. James, pers. comm.). It operates by shutting off when the water level has reached full capacity. The tank then restarts operations when the water level has dropped to about two thirds of the total volume. This was noted as having implications for meeting demand when the intake is closed for an extended period, because the tank may not be filled to capacity at the exact time when the intake is closed.

Stephen Griffith, the chairman of the Anse La Raye Disaster Preparedness Committee expressed concerns about the automated nature of the treatment facility and storage tank. He indicated that in the event of an approaching storm an early warning system is needed to ensure that the tank is filled to full capacity. This would ensure that when the intake is closed residents will have access to water for longer periods.

The WASCO representative, Mr. Timothy James, confirmed that there is an early warning system in place to ensure that the storage tank is filled to capacity for heavy rainfall and storm events. This is done by informing the caretaker of the facility who bypasses the automated system and activates the manual controls. He noted that there is even a backup generator at the facility to ensure pumping in the case of a power outage. However, he admitted that this early warning system is unable to meet its objective when there is flash flooding near the intake, due to time constraints.

The president of the Anse La Raye Vendors Association, Mr. Sommers St. Croix, indicated that water shortages due to siltation at the intake have adversely affected the Friday Night Fish Fry street party. This is because sometimes there is insufficient water for cleaning purposes and ensuring food hygiene. He agreed that an uninterrupted water supply is necessary for the success of the event. Mr. Sommers further indicated that in the past, closing the intake has resulted in the cancellation of the Fish Fry event. Intermittence in water supply therefore has far reaching economic ramifications in the village.

Concerns were expressed by a resident about the difficulties of acquiring a household connection from WASCO. It was indicated that the current application regulations for water connections require proof of land ownership and this restricts access to some extent. This is because although many people in the village can afford a connection they cannot access it due to the lack of
adequate property rights. The WASCO representative verified these claims. He noted that customers complain about application requirements, especially the need for proof of land ownership.

**Water storage and rainwater harvesting**

The general consensus was that the storage capacities of many households are limited because many of residents do not own water storage tanks or engage in rainwater harvesting. This is thought to be primarily because of land space and financial limitations. Water storage is usually by means of small containers such as buckets, jerry cans and drums. The few rainwater harvesting systems which exist are rudimentary. There are however concerns about the health risks of these rudimentary systems if the water is used for consumption. Efforts have been made within the last two years towards changing behaviour in relation to water conservation and household water management practices. This is done through public meetings which are usually done biannually in the village as part of disaster preparedness measures (W. Desir, pers. comm.).

Attempts are also being made by WASCO to increase public awareness on a national level. One of its ongoing initiatives is a televised program, which gives water conservation guidelines. A communications consultant was also hired to assist with public awareness issues. These measures were taken in response to the water crises experienced during the 2010 drought and Hurricane Tomas later that year (T. James, pers. comm.).

4.2.4 **Effects of extreme weather events**

**Hurricane Tomas**

The passage of Hurricane Tomas in 2010 resulted in the damage of water pipelines from the water treatment facility. These pipes originally ran along the banks of Grande River towards the village. The damage caused water supply in the village to be cut off for approximately one month. Ultimately the pipes were replaced with financial aid from the French Government. The total cost to recuperate the damaged water system was approximately EC 1.8 million dollars (T. James, pers. comm.).

In December, 2010, heavy rainfall caused repeated damage to these water pipes. This impeded water supply for two more weeks. As a mitigation measure the new transmission lines were installed in the centre of the main road as a means of protecting them from damage caused by river bank erosion and landslides (T. James, pers. comm.).

Due to the water shortage after Hurricane Tomas it was noted that many residents accessed water from the upper reaches of Petite River for domestic purposes. Petite River was generally selected for this purpose because in the aftermath of the hurricane, suspended sediments settled quickly. On the contrary, Grande River was more heavily silted and turbid in the aftermath, possibly due to a greater impact from landslides within this catchment (Figure 1). Residents were informed by the National Emergency Organisation (NEMO) through the village council representatives, of the importance of not drinking river or non-potable water (W. Desir, pers. comm.). Potable water was also made available to residents from water trucks (A. Collymore, pers. comm.)
The 2010 drought

The general consensus was that the 2010 drought did not affect Anse La Raye Village as it did in other parts of the island, which felt the full impact of this water crisis. Many individuals from other parts of the island came to Anse La Raye Village during this period to access water from the standpipes. As a result of this, there were moments of overcrowding which limited access to these standpipes by Anse La Raye residents.

4.2.5 Sanitation

Sanitation facilities

The respondents were in agreement that many residents still lack proper flush toilets and pit latrines. Many villagers therefore depend on the public facilities as their main means of sanitation. Opening hours for these facilities are from 6 am to 10 pm every day (J. Arthur, pers. comm.). Therefore many villagers also use bucket latrines after closing hours.

All of the respondents agreed that septic tanks in Anse La Raye do not function effectively because of the height of the water table. A community leader and former senior environmental health officer, Mr. McMillan Medard, noted that due to the hydrogeology of the village, it is not suited for septic tank and soak-away absorption systems. He further specified that it is difficult to manage the disposal of effluent because the water table is too high.

Many respondents thought that the public toilets were effective because without them the sanitation problems would be unbearable. Other respondents disagreed, because maintenance and management issues still pose restrictions to access.

Restrictions which were noted to exist included the lack of 24 hour access and issues of vandalism such as damaged doors which caused privacy issues. The lack of confidence in the hygienic upkeep of the facilities was also identified as a constraint. There were also concerns about inadequate regulatory control over the usage of single gender toilets by both sexes.

All respondents felt that household or domestic sanitation was a major issue which has been neglected in the village. They also felt that sanitation had not been properly integrated into the village’s overall development.

Open defecation and night soil disposal

Private toilets linked to a septic tank system are lacking in the village. According to the 2010 Population and Housing Census only 36% of households had these systems installed. There was agreement that open defecation and disposal of night soil into the environment is a practice which was traditionally done in the village. However these practices have decreased but the levels are still considered to be significant, due to the risks to public and environmental health. This is because some residents were made aware of these risks by the village council due to an advisory in 1996 from the Ministry of Health which warned against recreational beach use (A. Collymore, pers. comm.).
It was noted that although fewer individuals may be engaging in open defecation and the disposal of night soil directly into the environment, there are increasing cases of night soil disposal at curb side garbage bins. This was noted as partly responsible for the generation of odours and increased health risks to sanitation workers (J. Arthur, pers. comm.).

Most of the respondents noted that although people are aware of these practices there are not many complaints. All respondents expressed the desire that inappropriate excreta disposal practices should be completely eliminated. However this was sometimes regarded as wishful thinking. This is not only because it meant changing attitudes of some residents but surpassing barriers such as property rights; space and infrastructural restrictions; and hydro-geological constraints.

Two residents indicated that sometimes people engage in open defecation because they believe that the public toilet seats are poorly disinfected and unhygienic. They therefore believe that the open defecation is safer because it does not involve the sharing of toilet seats.

A community leader (Mr. Stephen Griffith) countered this argument by stating that the public facilities are cleaned frequently and are supplied with chemical sanitizers. He further noted that there is a better chance of getting an infection from walking barefooted on the waterfront and bathing in the rivers and the bay, than from using the public facilities.

It was noted that there is an apparent increase in the amount of human excreta on the beach (waterfront) when there is a water shortage. This is probably due to the possibility that people who usually use the public facility decide to use the beach at these times (J. Arthur, pers. comm.).

The village council clerk however gave the reassurance that whenever there is a water shortage arrangements are made with WASCO to keep the public facilities’ water tanks filled. He also indicated that during water shortages the water from these tanks is preferentially rationed for flushing toilets.

4.2.6 Environmental issues

In terms of domestic sanitation, pollution was considered to originate from the various septic tank systems in the village and the public facilities. This is due to the low retention of the soil in Anse La Raye Village and the high water table. Direct disposal of faecal matter on the waterfront and the rivers are other pollution sources which result in runoff into the fresh water and marine water bodies. All of these sources impact the integrity of the near-shore marine environment and pose risks to public health.

There are a couple of buildings along the waterfront which are relatively close to the high water mark at high tide. The proximity of these buildings to the water mark has been blamed on environmental change due to beach erosion. This has raised concerns about the integrity and effectiveness of the sewage systems of some of these buildings.
Concerns were expressed about the public facility to the southern end of Front Street. It was indicated that this facility is too close to the shore because there are issues of overflowing effluent from its septic tank at high tide (F. Labadie, pers. comm.).

The Anse La Raye Village Council is responsible for maintaining all government owned septic tanks in the village. It should be noted that there are more privately owned (household) septic tanks than those which are publicly owned. The clerk of the village council noted that there is no system in place for emptying public septic tanks but usually they are emptied every six months. He noted that due to beach erosion the village council has ordered the condemnation of at least two septic tanks near the waterfront. These are the septic tanks for the Community Centre and the Fisheries Department. He was also aware of a problem with the septic tank for the Infant School which is presently releasing effluent into the school environment and intends to act on this as soon as possible.

Most respondents believed that the Anse La Raye Bay and rivers are not suitable for bathing. This belief was founded in the advisory from the Ministry of Health which was presented to the village council on 14 October, 1994 (Appendix 6). However there is a general sense of uncertainty about the status of these water bodies due to a lack of regular water quality monitoring. Individuals are unaware of any subsequent water quality monitoring programs along the Anse La Rye Waterfront. The village council has never received a follow up public health advisory related to recreational water quality (A. Collymore, pers. comm.).

It was also noted that people have the perception that the Anse La Raye Bay is now safer for bathing because there has been a reduction in open defecation and night soil disposal along the waterfront in recent years. Another reason for this perception is the lack of any major health epidemic due to waterfront use.

Mr. Emerson Vitalis, a senior environmental health officer, noted that the two estuaries in the village are still polluted. Also, Mr Davis Paul (environmental health officer), indicated that recent sanitary inspections classified the waterfront as unsanitary according to standards. However, Mr. Emerson Vitalis, elaborated that the extent of pollution is unclear and needs to be established through a proper water quality monitoring program. Once established an advisory and a follow up information and awareness campaign can be properly put into effect. He further noted that efforts are presently underway to determine the status of near-shore waters in various parts of the island which include the Anse La Raye Bay. This is to be done as part of a recently initiated water quality monitoring initiative geared at testing microbiological and physical parameters.

4.2.7 Public health

Ms. Angela Antoine, the community nurse, noted that the only problem which she has recently observed regarding water and health is related to the use of rivers and streams. She notes that there have not been many diarrhoea related cases and no confirmed reports of intestinal worm infestations during her tenure within the last four years. However, after the passage of Hurricane Tomas in 2010 there was a marked increase in the number of female patients with superficial skin infections and rashes.
This was correlated with river uses because many of these women frequented the upper reaches of the rivers for washing and bathing, due to the prolonged water shortage. She further highlighted that complaints of skin infections were by river users and there has been no connection to the recreational use of the Anse La Raye Bay. Patients are always advised to visit the Anse La Raye Health Centre if there are any signs of rashes or skin infections after using the rivers.

She noted that public attitude toward avoiding environmentally related health risks is positive but sometimes they engage in unfavourable activities due to lack of options. For example people use the river when there is no pipe-borne water for extended periods and the quantity of water provided by alternative sources is insufficient. Therefore, river use during these desperate times is an attractive alternative.

It is her belief that the diarrhoea cases were kept low because health officials constantly inform community members about the importance of safe household water management. This was especially done after the passage of Hurricane Tomas. Water treatment tablets are made available by the health centre and residents were encouraged to use them if in doubt of the quality of water. Information is often given regarding the importance of regularly deworming adults and children. She further noted that the effort which is presently being placed on information dissemination from the standpoint of the health centre is sufficient.

She mentioned that in her professional opinion, the overall health of residents in terms of WASH related infections is good. She however noted that from her observations, there needs to be an improvement in hygiene. She emphasised the importance of having one-on-one consultations as a means of invoking positive change in residents towards WASH related issues.

She explained that the health centre presently has some effective systems in place for promoting behavioural change through education and awareness. These include: group talks, home visits and liaising with a few community based organisations.

Group talks are given at the health centre on mornings, from Monday to Friday each week. This is done before the commencement of the daily medical clinics. The community nurse gave the assurance that residents are very receptive to the information given during the group talks. She further stated that the general attitude towards engaging in good WASH practices is positive.

She noted that about every six months attempts are made to put into effect informational and awareness programs through her office. Health workers go directly to households as part of these programs. Nurses are regularly trained and updated through Ministry of Health endorsed workshops. The information gained from these workshops is integrated into the health centre’s community awareness and education initiatives.

She does admit that these awareness campaigns can be made more effective and be done more regularly. An obstacle to the effectiveness of these campaigns is the lack of personnel. However, attempts have been made to include the village council and other community-based organisations.
She also mentioned that every quarter, as part of the information dissemination strategy, talks are given to students at the various schools in the village. These talks include information on the importance of household water management, such as covering containers and water treatment.

In terms of gender issues she acknowledges that men and women are impacted in different ways by WASH issues. She noted that gender is incorporated into programs from the perspective of health.

4.2.8 Gender issues

The general consensus was that traditionally, women are the ones who frequent the stand pipes and the public laundry on Front Street. They mostly collect water, carry water and do the laundry. They are also the ones who frequent the higher reaches of the rivers for doing the laundry, especially during water shortages.

There were mixed feelings as to the importance of gender roles in the village as they relate to water and sanitation. Most of the male respondents thought that gender issues were not significant. They felt that the need for basic water and sanitation was a right which served both men and women equally. The general feeling was that it is accepted in the village that women and men both have traditional domestic roles and it would be difficult to change this.

One male respondent (Mr. McMillan Medard) who has had in-depth involvement in the village indicated that he had never seen the need for a special demarcation for gender as it relates to development. He further noted that gender has never been raised as an issue and has not been infused into the way of life of the village.

Male respondents felt that gender issues were primarily important in terms of using the public facilities. It was noted that problems were minimal because the male and females stalls were clearly labelled in all public facilities. Also, the caretakers at these facilities are meant to regulate the entry of users and ensure the privacy of both gender groups.

Female respondents generally thought that water is a basic right for both genders. However, women were mostly impacted because of their domestic roles as homemakers. A female respondent (Ms. Juliana Arthur) emphasised that gender issues are simply not addressed. She agreed that men and women both require sanitation as a human right. However she stressed that special provisions must be made to protect women and protect privacy in the public facilities, because they are more vulnerable. She drew reference to poor planning, construction, maintenance and management of these facilities from a gender standpoint.

She noted that at certain times during the day many people use the bathrooms for showering and this leads to congestion. She highlighted that as a time saving measure, men sometimes use the female showers and this causes a breach of privacy. She further mentioned that even when the female stalls are occupied, there have been several cases of men queuing to use these stalls in plain sight. This is because although the stalls are labelled by gender, there are no shower curtains and in some cases no bathroom doors.
Various respondents also indicated that women also use the male showers and toilets when they are empty. It was evident that many respondents were aware about privacy concerns in the public facilities, but were reluctant to elaborate on the topic due to its sensitive nature.

### 4.3 Focus group results

#### 4.3.1 The socioeconomic situation

Participants agreed that Anse La Raye Village is one of the poorest villages in Saint Lucia. The village has generally been in the same socioeconomic and infrastructural state for many years and has progressed to a small extent. Lack of tertiary educational opportunities was noted as being a major contributing factor to the present socioeconomic situation. It was noted that the village does not have many income generating activities.

Many individuals agreed that there is a lack of empowerment to encourage people to get out of poverty because many of the income generating activities are either short term or low paying (not sustainable). This has created a significant state of vulnerability and dependency among the village population.

The Friday Night Fish Fry street party was identified as one of the main economic activities which has been making a reasonable impact. The general feeling was that too many people depended on this event for it to fail. Fishing was seen as being on the decline. There is not a great link between the Friday Night Fish Fry activity and the fishing industry, but it was believed that a linkage of this nature was essential.

There were concerns that revenue from the Fish Fry was declining to disturbing levels due to problems with management, price regulation, marketing and cooperation of vendors. Fish Fry customers complain about high menu prices. Also, more residents are now selling more souvenirs than fish meals. There were also concerns about missed opportunities to link the Fish Fry with culture and promote a true sense of heritage tourism.

#### 4.3.2 Wastewater and drainage

Participants agreed that the drainage situation was acceptable. An issue which was highlighted was the stagnant water in the drains bordering the playing field. It was noted that these drains need to be monitored for sanitary purposes.

It was also noted that flooding is still an area of concern. Although mitigation works were done to reduce flooding in the north-eastern section of the village, flooding still occurs in other sections. For example, the vicinity of the Anse La Raye Primary School which is situated near the Grande River was identified as an area where flooding is still occurring. It was suggested that a study be conducted to determine why flooding is still a problem and how it could be mitigated.

#### 4.3.3 Village water supply

Participants agreed that when it rained prior to the construction of the new water treatment plant, access to pipe borne water was bad. It was noted that one of the few issues to be addressed is the
vulnerability of the intake to sedimentation. However they noted that relocating the intake was part of the original plan for the water system upgrade which unfortunately never materialised.

**Water storage**

Participants agreed that the village is in need of more water storage as a means of coping with water shortages. However, there are limitations of space, rendering water tanks impractical. They acknowledged that villagers have a culture of storing water but water is usually stored in buckets which limit the storage capacity of households. This also makes them more vulnerable during prolonged water shortages.

**Effects of extreme weather events**

It was noted that after Hurricane Tomas in 2010, water supply was interrupted. This resulted in many villagers resorting to the rivers as an alternative water source for bathing and washing. Residents used the upper segments of the Petite River during the water crisis. It was noted that during water crises people became desperate and resorted to obtaining water by any means. It was mentioned that many people in the village buy bottled water for drinking during these crises.

It was highlighted that the 2010 drought did not significantly impact Anse La Raye in a negative way. It was further noted that Anse La Raye was able to supply other parts of the island with water during the drought. Concerns were however raised about the present conditions of the Grande River which is now heavily silted, and its ability to meet demand during a subsequent drought was called into question.

**4.3.4 Sanitation**

There was agreement that villagers are still using the Anse La Raye Waterfront for the purpose of open defecation. This practice was noted to occur on a daily basis. However, it was admitted that the frequency of open defecation has reduced because more villagers have access to toilets. The participants indicated that a watchman was hired in the past to ensure that individuals refrained from open defecation and night soil disposal on the beach. However, this regulatory tactic is not being used anymore. They thought that some form of regulation is needed to stop open defecation and night soil disposal into the environment.

Participants agreed that the limited number of household toilets in the village is due to how the settlement was originally planned. It was noted that there is simply no space for private toilets and septic tank facilities because houses are too close to each other. They suggested that there would be more household toilets if the land space permitted this endeavour.

There were complaints that the public facilities close too early and should provide a 24 hour service. This is especially because many individuals do not have their own personal toilets and showers.

It was also mentioned that there was once a plan to construct a sewage system in the village but unfortunately this plan never made it past the draft stage due to bureaucracy issues. It was
highlighted that although education and awareness may help alleviate sanitation issues, the proper infrastructure first needs to be put in place as a precondition for changing behaviour.

4.3.5 Public health

The Anse La Raye Waterfront was identified as posing a public health risk due to pollution. They were aware of the Ministry of Health advisory in 1994 against recreational bathing in the bay. The participants noted that people still bathe in the bay and identified the jetty as an area of preference. They however noted that mainly children are the ones who frequent the beach for this purpose.

4.3.6 Gender issues

There was general consensus that there were no pressing gender issues in relation to water, sanitation and hygiene. Participants felt that these issues were minor and did not know if they were integrated into community development programs.

4.4 Results of cross-sectional survey

4.4.1 Demographics

During the questionnaire survey 162 households were interviewed of which 34% were male and 66% female. Also, 90% of the respondents were between the ages of 18 and 65 years old. Most households (65%) had no children who were under 5 years of age or elderly individuals (78%) above the age of 65. There was an average (mode) of three members per household and most respondents (73%) identified themselves as the head of the household.

4.4.2 Water supply

Access to water

Main water sources

The results indicated that as a main improved water source, most of the residents either use pipe borne water in their homes (58%), public standpipes (27.8%), yard connections (5.6%), or collect rainwater (0.6%) (Table 2). These are all regarded as improved water sources and collectively make up a total 92% of the water which residents use.

A minority of 6.2% claimed to use bottled water as their main source of drinking water. However, of those individuals, about 100% use improved sources as an alternative source for non-drinking purposes (Table 3). This indicates that in reality the true percentage of individuals who have some form of access to an improved water source is 98.2% (the sum of 92% and 6.2%). A small number of individuals (1.2%) still use untreated surface sources as a main water source.
Table 2 Main drinking water sources

<table>
<thead>
<tr>
<th>Source</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piped water into dwelling</td>
<td>58.0</td>
<td>58.0</td>
</tr>
<tr>
<td>Piped water into yard</td>
<td>5.6</td>
<td>63.6</td>
</tr>
<tr>
<td>Public standpipe</td>
<td>27.8</td>
<td>91.4</td>
</tr>
<tr>
<td>Surface water or river</td>
<td>1.2</td>
<td>92.6</td>
</tr>
<tr>
<td>Rainwater</td>
<td>0.6</td>
<td>93.2</td>
</tr>
<tr>
<td>Bottled water</td>
<td>6.2</td>
<td>99.4</td>
</tr>
<tr>
<td>Other</td>
<td>0.6</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 3 Alternative sources if primary source is bottled water

<table>
<thead>
<tr>
<th>Source</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piped water into dwelling</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>Piped water to yard</td>
<td>44.4</td>
<td>55.6</td>
</tr>
<tr>
<td>Public standpipe</td>
<td>33.3</td>
<td>88.9</td>
</tr>
<tr>
<td>Rainwater</td>
<td>11.1</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Alternative Water Sources*

Slightly less than half of residents indicated that they engage in some form of rainwater collection as an alternative water source (Figure 19). The results also indicated of those individuals who collect rainwater (49.7%), 53.3% started collecting rainwater within the last two years (Table 4).
Residents indicated that the main reasons for rainwater collection were due to water shortages (24.7%), and extreme weather events (42.4%). The extreme weather events which were mentioned were Hurricane Tomas in 2010 (26%) and the 2010 drought (16.4%) (Figure 20). The majority of residents who did not engage in rainwater collection indicated that this was mainly because they already had access to pipe borne water (38%), had insufficient land space for storage (20%) or did not have enough storage containers (18%) (Figure 21).
The majority of respondents (93.2%) believed that river water is not suitable for drinking (Figure 22). Also, 77.1% indicated that they have never used river water for this purpose (Figure 23).
Residents’ perception of the suitability of raw river water for drinking

It should be noted that from the 22.9% who have used river water for drinking only 10.4% indicated that the last time they used this source was within the last year (Figure 23). Also, of the individuals who use river water for drinking, 83.3% indicated that it was either due to water shortages (16.7%) or the effects of Hurricane Tomas (66.7%) (Figure 24).
Perception of water cost

The results indicate that residents do not generally think that water is too costly (Figure 25). The residents with household connections generally perceive that water is moderately priced (67.9%).

![Figure 25 Perception of pipe borne water rates (prices)](image)

Water shortages and overcrowding

The majority of residents (73.8%) indicated they experienced water shortages a few times yearly. It appears that intermittent water supply is not a frequent occurrence in the village. It does not seem to be a factor which frequently impacts residents (Figure 26).

![Figure 26 Frequency at which users experience water shortages](image)

Residents for the most part (95.9%) attributed intermittence in supply to heavy rainfall events (Figure 27). It should also be noted that 63.6% of individuals indicated that there is always enough water at their disposal for drinking throughout the year irrespective of whether there is a water shortage or not. This alludes to the use of alternative sources and possibly water storage. This also infers that most of the residents are satisfied in terms of water quantity. However, the reasons as to why the other 36.4% sometimes do not have enough water for drinking should be identified and addressed.
It terms of overcrowding at the standpipes and public facilities, the majority of individuals (75%) indicated that this did not hinder their access to potable water (Table 5).

### Table 5 Adequacy of potable water throughout the year and use restrictions due to overcrowding

<table>
<thead>
<tr>
<th></th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sometimes not enough water for drinking</td>
<td>36.36</td>
<td>63.64</td>
</tr>
<tr>
<td>Overcrowding hinders access</td>
<td>25.00</td>
<td>75.00</td>
</tr>
</tbody>
</table>

#### 4.4.3 Household water management

**Water collection**

The majority of residents collect water in small covered containers such as jerry cans (45.5%) and buckets (35.8%). Also, 7.6% of residents indicated that they collected water in barrels but they did not specify whether these containers were covered after collection (Figure 28).
**Household water storage**

In terms of the storage, 94.4% of households use plastic containers and most (98.1%) indicated that the containers were covered during storage. Most households also store containers indoors (82.2%) and on the ground (66.0%). Also 94.4% indicated that these containers were plastic and were for the most part (85.1%) the same containers used for collecting water. It was revealed that the preferred method (62.3%) for extracting water from storage containers was dipping one’s hand into the container with a cup.

It was also revealed that 62.1% of residents felt that their storage containers stored just enough water. Another 20.7% of residents felt that their containers stored too little water to satisfy household demand. This was probably because only 19.3% of residents owned water storage tanks.

Of the few households which own storage tanks, 57.2% indicated that they were installed as a response to an extreme weather event: 42.9% due to hurricanes and 14.3% due to droughts (Figure 29). Also, 17.8% noted that they bought a storage tank because of water shortages and 25% did so to increase storage capacity. Regarding households which did not invest in water tanks, the main reasons for not doing so were due to financial constraints (63.8%) and space limitations (25.7%) (Figure 30).

![Figure 29 Reason for purchasing a water tank](image1)

![Figure 30 Reason for not owning a water tank](image2)
It was shown that households generally wash their storage containers frequently. Regarding the frequency at which this is done: 23.2%, 27.5%, 18.1% and 17.4% indicated that they wash these containers daily, weekly, monthly and when refilling respectively (Figure 31).

![Figure 31 Frequency at which households wash storage containers](image)

**Household water treatment**

About the same number of respondents believed that pipe borne water was either safe for drinking or unsafe for drinking (48% and 52%, respectively). However, 74.8% of households do not think that they have drunk unclean water recently and 64.4% believe that household water treatment should be practiced (Table 6).

In terms of frequency of treatment, 24.8% indicated that they always treat stored water and 45.7% indicated they treat water sometimes. When these values are added it indicates that about 70.6% of households engaged in some form of water treatment measure (Figure 32). Most of the households who do not treat water (89.3%) noted that this was because pipe borne water was already treated by the water treatment plant therefore there was no need to treat stored water which came from a piped source (Figure 33).

**Table 6 Perceptions of households towards water quality and treatment practices**

<table>
<thead>
<tr>
<th>Perception</th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe borne water is safe for drinking</td>
<td>48.03</td>
<td>51.97</td>
</tr>
<tr>
<td>Water should be treated before drinking</td>
<td>64.43</td>
<td>35.57</td>
</tr>
<tr>
<td>Drank unclean water within home in the past month</td>
<td>25.24</td>
<td>74.76</td>
</tr>
</tbody>
</table>
When it came to the treatment methods which households used, it was noted that most households (85.7%) preferred boiling their water (Table 7). Very few households engaged in treatment practices such as straining water through a cloth, adding chlorine or bleach or using water filters. It is uncertain if households equated the addition of bleach/chlorine with the use of chlorine water treatment tablets.

Table 7 Treatment methods used by households

<table>
<thead>
<tr>
<th>Method</th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiling</td>
<td>85.71</td>
<td>14.29</td>
</tr>
<tr>
<td>Strained through cloth</td>
<td>1.79</td>
<td>98.21</td>
</tr>
<tr>
<td>Bleach/chlorine added</td>
<td>19.64</td>
<td>80.36</td>
</tr>
<tr>
<td>Water filter</td>
<td>11.61</td>
<td>88.39</td>
</tr>
</tbody>
</table>
4.4.4 Drainage

Most households (95.6%) saw drainage as important and indicated that their homes were connected to a drainage system (61.5%). However 71.5% indicated that they were not satisfied with the present drainage conditions (Table 8).

**Table 8 Drainage importance, practice and satisfaction**

<table>
<thead>
<tr>
<th></th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainage is important</td>
<td>95.60</td>
<td>4.40</td>
</tr>
<tr>
<td>House connected to drainage system</td>
<td>61.54</td>
<td>38.46</td>
</tr>
<tr>
<td>Satisfied with drainage system</td>
<td>28.48</td>
<td>71.52</td>
</tr>
</tbody>
</table>

From the following table it can be seen that most households (53.1%) felt that drains are in need of repairs. The same percentage of households (53.1%) felt that poor drainage contributed to mosquito breeding. Also, 71.4% of households noted that drains contributed to bad odours (Table 9).

**Table 9 Problems experienced with drainage**

<table>
<thead>
<tr>
<th></th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mosquito breeding</td>
<td>53.10</td>
<td>46.90</td>
</tr>
<tr>
<td>Spreads diseases</td>
<td>13.27</td>
<td>86.73</td>
</tr>
<tr>
<td>Bad odours</td>
<td>71.43</td>
<td>28.57</td>
</tr>
<tr>
<td>Ineffective against flooding</td>
<td>45.13</td>
<td>54.87</td>
</tr>
<tr>
<td>Drains need repairs</td>
<td>53.10</td>
<td>46.90</td>
</tr>
<tr>
<td>Clogged drains with garbage</td>
<td>37.17</td>
<td>62.83</td>
</tr>
<tr>
<td>Pollutes water bodies</td>
<td>27.43</td>
<td>72.57</td>
</tr>
</tbody>
</table>

Most households (77%) agreed that wastewater should be treated before it re-enters the environment (Table 10). It was generally indicated (100%) that wastewater should be treated to protect the environment against pollution (Figure 34). However, only 17.0% were willing to pay for treatment (Table 10). Those households which did not agree that wastewater should be treated for the most part indicated that it was either unaffordable (63.9%) or solely the responsibility of government (30.6%) (Figure 35).

**Table 10 Attitude towards wastewater treatment**

<table>
<thead>
<tr>
<th></th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agrees that wastewater should be treated</td>
<td>76.99</td>
<td>23.01</td>
</tr>
<tr>
<td>Willing to pay for wastewater treatment</td>
<td>17.02</td>
<td>82.98</td>
</tr>
</tbody>
</table>
4.4.5 Solid waste disposal

Most residents (93.7%) indicated that they use the household pickup garbage collection service (Table 11). They were also generally (64.1%) satisfied with solid waste disposal services in the village. An area which most households (70.7%) indicated was in need of addressing is the release of odours associated with solid waste (Table 12). Most households (73.2%) also engaged in some kind of reuse of cans, bottles and plastic bags.

Table 11 Solid waste management practice, satisfaction and reuse

<table>
<thead>
<tr>
<th></th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of solid waste disposal service</td>
<td>93.7</td>
<td>6.3</td>
</tr>
<tr>
<td>Satisfied with solid waste disposal services</td>
<td>64.1</td>
<td>35.9</td>
</tr>
<tr>
<td>Reuse of cans bottles and plastics bags</td>
<td>73.2</td>
<td>26.8</td>
</tr>
</tbody>
</table>
### Table 12 Areas of solid waste management which should be improved

<table>
<thead>
<tr>
<th></th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hygiene problems</td>
<td>36.3</td>
<td>63.7</td>
</tr>
<tr>
<td>Frequency of collection</td>
<td>38.9</td>
<td>61.1</td>
</tr>
<tr>
<td>Blocked drains</td>
<td>27.4</td>
<td>72.6</td>
</tr>
<tr>
<td>Water pollution</td>
<td>17.8</td>
<td>82.2</td>
</tr>
<tr>
<td>Odours</td>
<td>70.7</td>
<td>29.3</td>
</tr>
<tr>
<td>Flies</td>
<td>19.7</td>
<td>80.3</td>
</tr>
<tr>
<td>Bulk waste collection</td>
<td>43.9</td>
<td>56.1</td>
</tr>
<tr>
<td>Littering</td>
<td>19.7</td>
<td>80.3</td>
</tr>
<tr>
<td>Nothing</td>
<td>5.1</td>
<td>94.9</td>
</tr>
</tbody>
</table>

#### 4.4.6 Sanitation

The survey indicated that 71% of households own some kind of toilet facility (excluding bucket latrines) (Table 13). In terms of improved facilities: 65.4% own a flush toilet with a septic tank and 1.9% own an improved latrine (Table 14). This reveals that in all 67.3% of respondents own an improved facility. Only 26.9% of them indicated that they share toilets with other households (Figure 36).

Households generally (67.0%) indicated that they empty out septic tanks when they are full (Figure 37). It should be noted that all residents (100%) with pit latrines reported that they experienced no problems or difficulties with these facilities.

### Table 13 Household with and without toilet facilities

<table>
<thead>
<tr>
<th>Facilities owned</th>
<th>Percent</th>
<th>Improved facilities owned</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owns toilet</td>
<td>71.0</td>
<td>Owns improved facility</td>
<td>67.3</td>
</tr>
<tr>
<td>Does not own toilet</td>
<td>29.0</td>
<td>Does not own improved facility</td>
<td>32.7</td>
</tr>
</tbody>
</table>

### Table 14 Households with flush toilet and latrines

<table>
<thead>
<tr>
<th>Flush toilet linked to:</th>
<th>Percent</th>
<th>Pit latrines used:</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>septic tank</td>
<td>65.4</td>
<td>ventilated improved latrine</td>
<td>1.9</td>
</tr>
<tr>
<td>pit latrine</td>
<td>0.6</td>
<td>pit latrine with slab</td>
<td>0.6</td>
</tr>
</tbody>
</table>
Flush toilet linked to: | Percent | Pit latrines used: | Percent
---|---|---|---
elsewhere | 2.5 | bucket latrine (not classified as toilet facility in survey) | 4.3

Figure 36 Households which share their private toilets

Figure 37 When households empty septic tanks

Of those households which did not own private toilet facilities 74.5% principally used one of the three public toilets in the village (Table 15). To a lesser extent households either used a neighbour’s toilet (33.3%), rivers (23.5%) or the waterfront (7.8%). A small percentage of households (2%) also admitted to disposing of night soil at garbage collection sites.

Table 15 Disposal points of human waste by individuals who do not own toilet facilities

<table>
<thead>
<tr>
<th>Disposal points</th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In rivers</td>
<td>23.5</td>
<td>76.5</td>
</tr>
<tr>
<td>On the waterfront</td>
<td>7.8</td>
<td>92.2</td>
</tr>
<tr>
<td>In the street</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Disposal points</td>
<td>Yes (%)</td>
<td>No (%)</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td>In the field</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>At garbage collection site</td>
<td>2.0</td>
<td>98.0</td>
</tr>
<tr>
<td>Use neighbour’s toilet</td>
<td>33.3</td>
<td>66.7</td>
</tr>
<tr>
<td>In Public toilet</td>
<td>74.5</td>
<td>25.5</td>
</tr>
</tbody>
</table>

When households were asked if they were willing to borrow money to install toilets, equal amounts responded positively and negatively (50% each) (Figure 38). Those who were not willing to borrow money mainly indicated that it was due to land ownership issues (63.2%) and space restrictions (21.1%). Only a small percentage (10.5%) indicated that they were not able to afford private toilets (Figure 39).

![Figure 38 Willingness to seek finances for installing private toilets](image1)

![Figure 39 Reasons for unwillingness to borrow money for purchasing and installing toilets](image2)

Households generally (96.8%) were in agreement that open defecation and indiscriminate night soil disposal was harmful to the environment. More specifically 87.9% agreed that an effect of these practices was the pollution of surface water bodies. In terms of public health, 71.5% also agreed that these practices contributed to the spread of dangerous diseases (Table 16).
Table 16 Effects of open defecation and night soil disposal

<table>
<thead>
<tr>
<th></th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spreads dangerous diseases</td>
<td>71.5</td>
<td>28.5</td>
</tr>
<tr>
<td>Pollutes surface water bodies</td>
<td>87.9</td>
<td>12.1</td>
</tr>
<tr>
<td>Is not harmful</td>
<td>3.2</td>
<td>96.8</td>
</tr>
</tbody>
</table>

4.4.7 Hygiene

In terms of the frequency of hygiene practice it was shown that most residents wash their hands very frequently under the various conditions indicated in Table 17. From the results it was noticed that washing of hands is part of routine hygiene practice for the majority of villagers.

Table 17 Frequency of washing hands

<table>
<thead>
<tr>
<th></th>
<th>Always</th>
<th>Sometimes</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>After changing baby’s nappy</td>
<td>77.6</td>
<td>20.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Before handling of food and food preparation</td>
<td>75.5</td>
<td>24.5</td>
<td>0</td>
</tr>
<tr>
<td>Before eating</td>
<td>63.8</td>
<td>36.3</td>
<td>0</td>
</tr>
<tr>
<td>After a visit to the toilet</td>
<td>80</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>After housecleaning and/or disposing of rubbish</td>
<td>84</td>
<td>16</td>
<td>0</td>
</tr>
</tbody>
</table>

In terms of bathing in recreational waters, it was noted that more villagers frequent the rivers than the Anse La Raye Bay. However in both cases this is generally not a regular practice by most households (Figure 40 and Figure 41).

![Figure 40 Frequency of bathing in rivers](image-url)
Figure 41 Frequency of bathing in Anse La Raye Bay

It was also indicated that households principally frequented the rivers due to water shortages (70.8%), and to a lesser extent for recreation (6.8%) (Figure 42). On the contrary, more households indicated that they frequent the waterfront for recreational purposes (88.1%) (Figure 43).

Figure 42 Reasons for bathing in rivers

Figure 43 Reasons for bathing in the Anse La Raye Bay
4.4.8 Water and health

Most households (80.9%) indicated that they did not experience any diarrhoea symptoms in the last six months (Figure 44). Also, 87.5% of those who experienced these symptoms indicated that they experienced one to two incidents (Figure 45).

![Figure 44 Households which admitted to have diarrhoea cases in the last six months](image)

Respondents were well aware of the basic characteristics of diarrhoea (Table 18). Although there were still many respondents (40.2%) who were unaware of the link between the disease and recreational water pollution.

Residents for the most part were knowledgeable about diarrhoea and associated its cause with poor water quality (71.4%), poor hygiene (9.5%) and food quality (9.5%) (Figure 46). A small percentage of individuals were not knowledgeable about its causes (9.5%).

![Figure 45 Frequency of diarrhoea cases in the last six months](image)
Table 18 Household knowledge on diarrhoea

<table>
<thead>
<tr>
<th></th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhoea is a serious illness</td>
<td>93.3</td>
<td>6.7</td>
</tr>
<tr>
<td>Diarrhoea can be prevented</td>
<td>98.6</td>
<td>1.4</td>
</tr>
<tr>
<td>Diarrhoeal illness is related to the quality of drinking water</td>
<td>87.3</td>
<td>12.7</td>
</tr>
<tr>
<td>Diarrhoeal illness is related to river and beach pollution</td>
<td>59.8</td>
<td>40.2</td>
</tr>
<tr>
<td>Diarrhoeal illness is related to hygiene practices</td>
<td>90.2</td>
<td>9.8</td>
</tr>
</tbody>
</table>

Figure 46 Causes of diarrhoea which were indicated by households

4.4.9 Information, education and communication practice

Households mainly have television, radio and cellular phone devices for accessing information on WASH (Table 19). However there is low accessibility to internet services (33.1%).

The majority of households generally did not receive information on WASH in the last six months (Table 20). However those who received information indicated that information was disseminated quite frequently (Table 21).

Table 19 Household access to communication devices

<table>
<thead>
<tr>
<th></th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Television</td>
<td>93.6</td>
<td>6.4</td>
</tr>
<tr>
<td>Radio</td>
<td>79.0</td>
<td>21.0</td>
</tr>
<tr>
<td>Cellular phone</td>
<td>88.5</td>
<td>11.5</td>
</tr>
<tr>
<td>Computer with internet</td>
<td>33.1</td>
<td>66.9</td>
</tr>
<tr>
<td>Telephone landline</td>
<td>14.7</td>
<td>85.3</td>
</tr>
</tbody>
</table>
Table 20 Information received in the past six months on various WASH topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water supply</td>
<td>22.6</td>
<td>77.4</td>
</tr>
<tr>
<td>Sanitation</td>
<td>41.5</td>
<td>58.4</td>
</tr>
<tr>
<td>Wastewater</td>
<td>13.2</td>
<td>86.8</td>
</tr>
<tr>
<td>Drainage</td>
<td>16.9</td>
<td>83.1</td>
</tr>
<tr>
<td>Solid Waste</td>
<td>44.2</td>
<td>55.8</td>
</tr>
<tr>
<td>Hygiene</td>
<td>32.3</td>
<td>67.7</td>
</tr>
</tbody>
</table>

Table 21 Frequency of WASH information dissemination in the past six months

<table>
<thead>
<tr>
<th>Topic</th>
<th>Once</th>
<th>2-3 times</th>
<th>4-5 times</th>
<th>More than 5 times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water supply</td>
<td>13.3</td>
<td>26.7</td>
<td>10.0</td>
<td>50.0</td>
</tr>
<tr>
<td>Wastewater</td>
<td>5.3</td>
<td>42.1</td>
<td>0</td>
<td>52.6</td>
</tr>
<tr>
<td>Drainage</td>
<td>8.0</td>
<td>24.0</td>
<td>8.0</td>
<td>60.0</td>
</tr>
<tr>
<td>Solid Waste</td>
<td>16.4</td>
<td>27.9</td>
<td>11.5</td>
<td>44.3</td>
</tr>
<tr>
<td>Hygiene</td>
<td>15.4</td>
<td>30.8</td>
<td>5.1</td>
<td>48.7</td>
</tr>
<tr>
<td>Sanitation</td>
<td>13.3</td>
<td>25.0</td>
<td>13.3</td>
<td>48.3</td>
</tr>
</tbody>
</table>

Households also indicated that the information received was mainly from five sources, namely, health communicators (62.3%), television (77.3%), radio (77.6%), newspapers (75%) and loudspeaker (73.7%) (Table 22).

Table 22 Sources of information in the last six months

<table>
<thead>
<tr>
<th>Source</th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td>14.3</td>
<td>85.7</td>
</tr>
<tr>
<td>Church</td>
<td>10.4</td>
<td>89.6</td>
</tr>
<tr>
<td>Neighbours</td>
<td>18.2</td>
<td>81.8</td>
</tr>
<tr>
<td>Public Works Company</td>
<td>44.2</td>
<td>55.8</td>
</tr>
<tr>
<td>Health communicator</td>
<td>62.3</td>
<td>37.7</td>
</tr>
<tr>
<td>Community leaders</td>
<td>13.0</td>
<td>87.0</td>
</tr>
<tr>
<td>TV</td>
<td>77.3</td>
<td>22.7</td>
</tr>
<tr>
<td>Radio</td>
<td>77.6</td>
<td>22.4</td>
</tr>
<tr>
<td>Newspaper</td>
<td>75.0</td>
<td>25.0</td>
</tr>
<tr>
<td>Loudspeaker</td>
<td>73.7</td>
<td>26.3</td>
</tr>
</tbody>
</table>
Table 23 Household perception on effectiveness of various sources of information

<table>
<thead>
<tr>
<th>Source</th>
<th>Ineffective (%)</th>
<th>Moderately effective (%)</th>
<th>Very Effective (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home visit</td>
<td>17.5</td>
<td>46.9</td>
<td>35.7</td>
</tr>
<tr>
<td>Neighbourhood meeting</td>
<td>39.0</td>
<td>52.5</td>
<td>8.5</td>
</tr>
<tr>
<td>Loud speakers</td>
<td>19.6</td>
<td>47.6</td>
<td>32.9</td>
</tr>
<tr>
<td>Poster</td>
<td>23.0</td>
<td>65.7</td>
<td>10.5</td>
</tr>
<tr>
<td>Leaflet</td>
<td>40.4</td>
<td>52.5</td>
<td>7.1</td>
</tr>
<tr>
<td>Newsletter</td>
<td>45.8</td>
<td>49.3</td>
<td>4.9</td>
</tr>
<tr>
<td>Radio</td>
<td>9.7</td>
<td>58.6</td>
<td>31.7</td>
</tr>
<tr>
<td>TV</td>
<td>6.7</td>
<td>57.0</td>
<td>36.2</td>
</tr>
<tr>
<td>Newspaper</td>
<td>30.8</td>
<td>53.8</td>
<td>15.4</td>
</tr>
<tr>
<td>Notice Board</td>
<td>27.1</td>
<td>54.2</td>
<td>18.8</td>
</tr>
<tr>
<td>Public Campaign</td>
<td>7.6</td>
<td>35.4</td>
<td>56.9</td>
</tr>
<tr>
<td>School</td>
<td>19.4</td>
<td>59.0</td>
<td>20.8</td>
</tr>
<tr>
<td>Church</td>
<td>23.4</td>
<td>62.8</td>
<td>13.8</td>
</tr>
</tbody>
</table>

Households generally perceived that most informational sources were moderately effective with the exception of public campaigns which were generally seen as very effective (56.9%) (Table 23).

The most influential group for disseminating information on water, sanitation and hygiene was identified as the community nurses (62.1%) and to a lesser extent the village council (20.4%) (Figure 47). Households generally (92.9%) indicated that village public meetings are not held or they are not aware that they are being held (Figure 48).
Respondents also generally felt that a workshop to address water (76.7%), sanitation (75.9%) and hygiene (78.1%) was necessary in the village (Table 24). The main water issues which they indicated should be addressed at this workshop are water conservation (39.0%), water pollution issues (22%), proper water storage (17.1%) and water treatment (14.7%) (Figure 49). The sanitation issues which households indicated should be addressed were proper garbage disposal (61.1%), environmental cleanliness (22.2%) and the impacts of sanitation on the environment (16.7%) (Figure 50). The hygiene issues which were identified for addressing were personal hygiene (77.3%) and hygiene related diseases (22.7%) (Figure 51).

### Table 24 Necessity of a workshop to address WASH issues

<table>
<thead>
<tr>
<th></th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water issues</td>
<td>76.7</td>
<td>23.3</td>
</tr>
<tr>
<td>Sanitation issues</td>
<td>75.9</td>
<td>24.1</td>
</tr>
<tr>
<td>Hygiene issues</td>
<td>78.1</td>
<td>21.9</td>
</tr>
</tbody>
</table>
In terms of gender issues, households generally believed that men and women are not affected differently by water, sanitation and hygiene (Table 25). However those who thought that they were affected differently thought that women generally valued water more (66.7%) and both genders use water for different purposes (33.3%) (Figure 52). In terms of sanitation, the general thought was that men were more apathetic towards environmental issues (72.7%) (Figure 53). Also, 100% of these respondents indicated that hygiene was more important to women because they bathe more frequently.
Table 25 Perception on whether men and women are affected differently by water, sanitation and hygiene

<table>
<thead>
<tr>
<th></th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>30.2</td>
<td>69.8</td>
</tr>
<tr>
<td>Sanitation</td>
<td>28.8</td>
<td>71.2</td>
</tr>
<tr>
<td>Hygiene</td>
<td>30.4</td>
<td>69.6</td>
</tr>
</tbody>
</table>

Figure 52 Perceptions on how water affects men and women differently

Figure 53 Perceptions on how domestic sanitation affects men and women differently

5 DISCUSSION AND ANALYSIS

5.1 Challenges to good water management and sanitation practices

5.1.1 Water supply

From the perspective of most villagers, water supply is good in terms of access to improved sources (98.2%) (question 2.1 and 2.2). Pipe borne water quality was also noted as good by WASCO and environmental health officials.

Alternative sources cited by residents were rainwater, surface water and bottled water. It appears that these alternative sources were accessed primarily due to the intermittency resulting from sedimentation at the water intake (resulting from heavy rainfall). Longer water shortages were also caused by the effects of hurricane events, most recently Hurricane Tomas in 2010.
According to Cairncross and Valdmanis (2006), if a water supply is to be classified as improved it should provide not only water which is of a better quality but with greater convenience and reliability. Convenience and reliability would include regularity of supply, cost, and the number of users per source.

Regarding regularity of supply, reducing the effects of sedimentation is expected to subsequently reduce intermittency. This would also reduce the exposure of residents, especially women, to health risks when they use rivers for washing during water shortages in the rainy season. Evading the effects of hurricanes would be more challenging, because these events are generally more unpredictable and catastrophic in terms of damaged infrastructure.

Through the interviews, the main challenge to reducing intermittency was identified as financial in nature. Rectifying this problem will require the costly relocation of the intake at Venus Estate to an appropriate location further upstream. This will have to be above the pumice quarries to an area which is not significantly impacted by soil erosion and sedimentation. This endeavour, although proposed, has not been set in motion due to financial constraints from the perspective of WASCO. Therefore those villagers who are most impacted will most likely have to develop coping strategies for adapting to intermittency, through engaging in appropriate household water management and water conservation techniques.

In terms of the number of users per source, the questionnaire results revealed that generally overcrowding was not an issue at standpipes and did not hinder access to drinking water. These results were consistent with what was revealed during the interviews.

From the perspective of water pricing, the questionnaire survey indicated that the cost of pipe borne water was generally believed to be moderate. This shows that individuals may not be overburdened by water prices. This therefore poses one less barrier to access despite the fact the 2006 Saint Lucia poverty assessment report indicated that almost half of the residents from the Anse La Raye district (44.9%) were below the poverty line (Caribbean Development Bank 2006).

The interviews revealed that their lack of property rights may restrict their access to a private pipe borne water connection because it is a prerequisite for approving water connection applications by WASCO. This therefore poses another challenge to access. The 2010 Saint Lucia Population and Housing Census data indicates that only 52.2% of households own the property on which they live with 54.7% of households having private household connections (Appendix 7). This latter percentage is not significantly different from the quantitative figure generated from this research which revealed that 58% of households presently have a private household connection. This means that at least 42% of households may not have a household connection and it is most likely that this is in part attributed to land tenure restrictions.

5.2 Household water management

5.2.1 Storage capacity and rainwater harvesting

Many households collect water; it is generally stored in buckets (35.8%) and jerry cans (45.5%) (question 2.8). The volumes of these containers may not be adequate to supply water during
prolonged water shortages. The low storage capacity of most households is also reflected by the widespread (80.7%) unavailability of water storage tanks (question 3.4). This was because of three main reasons: households were unable to afford them; did not have permission from their landlords to install them; or experienced difficulties finding a suitable location to place these tanks on their small land lots. This means that the lack of finance, poor property rights and land size restrictions pose challenges to increasing the storage capacity of residents.

Slightly less than half of the households interviewed (49.7%) indicated that they engage in some form of rainwater collection as a means of increasing their resilience to prolonged water shortages (question 2.9). The majority of households who collected rainwater indicated that this was a recent practice which started within the last two years. This shows that residents are for the most part receptive to this adaptive technique and may be open to any initiative geared towards promoting best practices.

Extreme weather events and water shortages were generally regarded as the principal reasons for collecting rainwater. However, those who did not engage in rainwater harvesting noted that challenges to engaging in this practice were overcoming issues of limited land space (20%) and the inadequacy of storage containers in terms of volume (18%) (question 2.12). This again brings to the fore the challenge of overcoming limited storage capacity which seems to be connected with limited land space, the inability to afford storage tanks, and the lack of property rights.

5.2.2 Water handling

Most residents (98.1%) admitted to covering water vessels. This may have also been partly due to the recent dengue awareness campaign (June 25, 2011) which involved a degree of community participation during the clean-up phase.

One area of concern was the general practice (62.3%) of extracting stored water by dipping hands into water vessels. Care should be taken when using this water drawing technique because it has been revealed that water can easily become contaminated due to this method, if hands or small vessels are inserted into these containers in an unhygienic manner (Holt, 2009).

It should also be noted that wide neck containers such as buckets have been associated with increased water contamination in comparison to small neck containers such as jerry cans. This is because with wide neck containers there is a greater tendency to insert water drawing devices (such as cups) and a larger surface area is exposed to contaminating agents when uncovered. This poses a challenge to limiting contamination because buckets seem to be a popular container of choice in the village for both water collection and storage (42.8%) (questions 2.8 and 3.1). However these buckets may be preferable because they hold more water than narrow neck containers (such as jerry cans) which are usually smaller (Holt, 2009).

A means of reducing this challenge would be the use of proper point of use water treatment. The survey results showed that 70.6% (question 4.2) of households generally engaged in point of use treatment which was shown to be principally done by boiling. This shows that although water collection and drawing techniques may be inappropriate, households may generally be protected
from drinking contaminated water. This is not only because they are cognizant (64.4%) (question 4.1) of the importance of point of use water treatment but because they engage in this practice.

5.2.3 Domestic and environmental sanitation

**Domestic sanitation**

The household survey indicated that 32.7% of the households did not own an improved toilet facility and 29% did not own any kind of toilet (question 7.1). The latter group of individuals would therefore depend on using the public facilities for sanitary purposes. Also, due to limited opening hours of these facilities, these households are forced to resort to the use of bucket latrines. However it is difficult to ensure that they will dispose of the resulting night soil in ways which are environmentally and socially responsible, to minimise the likelihood of environmental pollution and human contact. This issue is further exacerbated by public health risks associated with open defecation which was not only mentioned during the interview session but also witnessed during site visits.

It should be noted that 50% of households which do not have toilets indicated that they were not willing to borrow money to install them (question 7.6). However the primary reasons for this response was not due to issues of finance but land ownership limitations (63.2%), and space restrictions (21.1%) (question 7.6). From the interview and focus group responses, issues of land ownership and small lot sizes were also noted as challenges to ensure improved sanitation. Septic tank systems require space which is unavailable in some settlements due to the proximity of many houses to each other.

Although 65.4% of respondents admitted to own a flush toilet linked to a septic tank system, as previously noted, the height of the water table in the village poses another challenge to curbing environmental pollution. This is because the effectiveness of these systems may be compromised by the low depth of the water table in the village. The saturated zone may facilitate a higher rate of migration of faecal contaminants towards the nearshore marine environment due to the presence of advection currents. These currents are also expected to be higher in the rainy season after periods of heavy rainfall due to peaks in groundwater flow.

**Wastewater management**

The absence of central wastewater collection and treatment systems in high water table areas significantly contribute to sanitation problems (Smith 2008). Although most households agreed that wastewater should be treated before it enters the environment, few households (17.0%) indicated that they would be willing to pay for this treatment (question 5.5). This was primarily because they thought that it would be unaffordable (63.9%) and that the government should bear any cost associated with this endeavour (30.6%) (question 5.6). Once again finance is seen as a challenge, specifically to reducing effluent (wastewater) discharge into the marine environment. Since residents are not willing to pay, this might pose an obstacle to recuperating costs for any effective centralised wastewater treatment system proposed for the village. This is especially because these treatment systems may require high capital, operational and/or maintenance costs.
This idea of centralised wastewater collection and treatment would not be limited to grey water but to domestic sewage as well. Since it has been reported that the hydrogeology of the village is a challenge to the successful operation of septic tank systems, a centralised sewer and sewage treatment system may be the most appropriate way of preventing the rapid migration of subterranean faecal contaminants within the saturation zone. This is because a central sewer and sewage treatment system will keep sewage separate from advection currents in this zone.

A downside to a centralised wastewater collection and treatment system would be the high financial cost of a project of this nature. However the future benefits derived from protecting the marine environment may justify this financial burden. Anse La Raye Village is a socio-economically depressed small urbanised centre which stands a lot to gain from environmental protection. This is because of the significant link which was found to exist between tourism and the marine environment through heritage tourism activities. For example, all major heritage tourism activities in the village were found to occur on Front Street which is adjacent to the Anse La Raye Waterfront. This area could therefore serve as a major tourist attraction if the environmental quality is improved. This in turn would increase tourism based economic activity in the village and subsequent revenue for residents. However, due to the immense costs of such a project and the uncertainty of the magnitude of these benefits, the best course of action will need to be determined after conducting a cost-benefit analysis or a feasibility study for a project of this scale.

Griffin et. al (2003) note that the pollution of coastal waters by wastewater is exacerbated by the density of on-site septic tanks and high precipitation. Although the density of septic tanks in the village appears to be moderate with only 65.4% of residents admitting to own a septic tank: the high water table poses a problem because it would decrease the migration time of subterranean contamination plumes. Hence this would increase the rate at which effluents reach the marine environment, especially during extreme rainfall events which usually result in flooding in the village.

The attitude towards wastewater treatment is also reflected by some as being an issue which is to be dealt with primarily by the government. Therefore any endeavour to implement a centralised form of wastewater treatment should entail an approach which is participatory to invoke a sense of ownership among residents.

Drainage

Most households stated that poor drainage has contributed to mosquito breeding (53.1%) and bad odours (71.4%) (question 5.4). From the interviews it was indicated that some parts of the village are below sea level and this has resulted in a backlog of water in some areas. It may be challenging to overcoming this issue because of the difficulties of overcoming topographical factors. However frequent cleaning (dredging) of drains may be necessary to keep water levels low especially due to storm surge and heavy rainfall.

These drains are relatively close to homes. Their contents are also very exposed to the environment and pose as breeding areas for mosquito vectors. This means that residents may be at increased risk of infections from mosquito-vector related pathogens such as dengue. Therefore
frequent cleaning of backed-up drains would also be necessary to maintain low mosquito breeding levels.

**Solid waste management**

Households were generally satisfied with solid waste management services (household pickup) and for the most part (93.7%) indicated that they used this service (question 6.1). An area which most households (70.7%) indicated needed addressing was odours associated with garbage at designated dumpsites (those reserved for village council sanitation workers) (question 6.3). Through the interview component it was revealed that these odours were associated with the use of garbage bins for the disposal of inappropriate matter, some of which was identified as human excreta.

Although only 2.0% of individuals who do not own toilet facilities admitted to using garbage bins to dispose of night soil, the interview component revealed that this is an emerging practice which puts residents at risk from contact with faecal matter. It may be a challenge to change behaviour regarding this practice as long as household toilets are lacking. This is because it is more inconvenient and embarrassing to travel to the public toilets for disposal of night soil. The lack of 24 hour service of public toilets also limits individuals from accessing these facilities outside opening hours (6 am to 10 pm).

5.2.4 WASH barriers to faecal-oral disease and possible public health risks

**Barriers to faecal-oral disease as a means of minimising risks**

From observing the F-diagram below (Figure 54) it can be seen that there are four main primary routes through which faecal pathogens get into the environment. These primary routes are represented by the four main arrows which emerge from the primary pathogen source (faeces) and lead to five principal media. These media are fluids, fields, flies, food and fingers, hence the name F-diagram.

The primary routes can be blocked by means placing primary barriers across them. Primary barriers are practices that prevent infectious organisms in faeces from getting into the environment. As seen in the diagram these barriers involve good sanitation and include the disposal of faeces in a manner which isolates it from all future human contact (such as the use of latrines and sewers) (Curtis, Cairncross and Yonli 2000).

Primary barriers also include practices which remove traces of faecal matter from hands after contact with excreta (Curtis, Cairncross and Yonli 2000). An effective way of doing this would be by immediately washing hands after handling any material which may be contaminated with faecal matter. This is a hygienic practice and depends more on the quantity of water available than water quality for it to be effective.

Secondary routes are routes which originate from secondary pathogen sources. These include any source which is the result of faecal contamination into the environment (from the original source) and leads to the infection of a new host. These secondary routes are represented in the F-
Figure 54 The F-Diagram showing primary and secondary barriers to the faecal-oral route (sources: Kawata 1978; Holt 2009)

diagram as arrows which connect fluids, fields, flies, food and fingers to the new host. The term secondary barriers therefore refer to hygiene practices that prevent faecal pathogens from multiplying and reaching new hosts after they have already entered the environment. These secondary barriers must include: practices such as washing hands before handing food; preventing the contamination of treated water supplies; and point of use water treatment (Curtis, Cairncross and Yonli, 2000).

The results of this study indicate that primary barriers are deficient in the village due to the lack of private toilets by 29% of households. Therefore, there may be a tendency to engage in open defecation and night soil disposal into the environment (question 7.1).

From the above diagram (Figure 54) it can be seen that hygiene practice acts at each barrier as a means of preventing disease transmission. It also acts as the final means of preventing infection when all other barriers have failed. Good hygiene therefore seems to be a determining factor in safeguarding health when sanitation barriers are weak. However the ability to engage in good hygiene depends on the quantity of water available. Water quantity may therefore limit hygiene behaviour.

Although households frequently engage in hygiene practices (washing hands) (question 8.1), implementing hygiene as primary and secondary barriers to infection may sometimes be restricted by the intermittency of water supply in the village. This is because adequate water quantity is compromised by water shortages due to heavy rainfall (which causes siltation and clogging at the intake) (question 2.5).

Most villagers do not seem to experience intermittency very often; the majority of residents (73.8%) indicated that they experienced water shortages a few times yearly (question 2.4). These shortages are most likely to be more frequent during the rainy season. It should also be noted that
if the village is not made more resilient by improving the household or community water storage capacity and rainwater harvesting projects it is likely to remain vulnerable in this regard. This state of vulnerability may have serious implications when water shortages are prolonged during the hurricane season.

It is also interesting to note that although pipe borne water quality is important, its role in preventing infection is minor in comparison to water quantity and hygiene. This means that if sanitation is unsatisfactory and water quality is good, it is water quantity which will enable hygiene behaviour as the final barrier to infection. Also, if pipe borne water quality is compromised proper household point of use water treatment will suffice.

Fortunately the results show that pipe borne water quality in the village is up to standard and hygiene practices among households are good. Therefore, regardless of the hygiene barriers in place, the biggest threats to health from faecal-oral diseases in the village are: the inadequacy of sanitation facilities and water shortages due to heavy rainfall and hurricane events.

Possible public health risks due to inappropriate practices

The results of the research have shown that two primary sources of faecal pathogens exist: namely human excreta from inadequate sanitation practices and animal excreta from small piggeries near Petite River. These faecal pathogens pose risks to public health through various transmission routes (Figure 55).

![Modified F-Diagram showing transmission pathways of faecal-oral disease, highlighting (in red) the most obvious routes which pose public health risks in the village (source: Adapted from Prüss-Üstün et. al., 2004)](image)

In the village faecal pathogens may be moved through the environment and reach human hosts through various media and pathways as highlighted in the above diagram (Figure 55). These include:
• Flies in contact with exposed night soil and excreta (the result of open defecation). These flies then contact food which may infect residents.

• Hands and feet which have been in contact with exposed excreta may ultimately contaminate food before ingestion. This may be direct contact with excreta or indirect contact through contaminated soil and sand (in the immediate environment). This especially includes public places such as the waterfront. As previously mentioned, stored pipe borne drinking water may cause infection because of the possibility of manual contact through unhygienic water drawing practices.

• Waterborne sewage which may contaminate surface and ground water. This is due to increased migration from advection currents in the saturation zone (because the water table is high). Water borne sewage therefore has a greater chance of reaching the surface water bodies bordering the village. Villagers interact with surface water through bathing and washing hence they may be at increased risk of skin infections and diarrhoeal diseases. Some villagers have admitted to drinking river water during periods of water shortage especially due to the effects of Hurricane Tomas in 2010. This means that villagers within this group are at risk of being infected through direct ingestion. Although most households admitted to infrequent use of the waterfront and rivers for bathing, at least 45% of villagers admitted to using these areas for bathing either for recreation or due to water shortages after extreme storm events. When bathing in polluted surface waters smaller volumes of contaminated water may be inadvertently ingested by users.

• Contact with animal excreta may exist. At least two small piggeries were noticed near the Petite River estuary during the site visits and the interviews. Excreta from these animals would pose as pathogen sources which could contribute to the contamination of soil and surface water. This therefore confers an added risk factor. According to Curtis, Cairncross and Yonli (2000) alternative routes of faecal-oral pathogen transmission may be facilitated by animals. These animal mediated routes include: human to animal to human via the environment and animal to human via the environment.

As previously mentioned, although these pathways exist, good hygiene practices are a sure means of preventing infection. Most households practice good hygiene which serves as effective primary and secondary barriers; however their ability to follow through with this practice may be restricted by water shortages in the rainy season.

An area of concern where good hygiene practices may not work as a barrier to infection is the use of contaminated recreational waters for bathing. According to the results, this practice although infrequent, is also associated with water shortages during the rainy season. Most residents (93.2%) seem to be aware that the rivers are polluted and also indicated that they have never used river water for drinking (question 2.13). Contrastingly, many villagers (about 56% and 45% respectively) admitted to using the rivers and bay for bathing purposes (questions 8.2 and 8.4).

Although the interview and focus group components of the research indicated that residents are aware that the Anse La Raye Bay is polluted. The questionnaire survey indicated that not many
are aware that polluted recreational waters may contribute to diarrhoeal disease (40.2%) (question 9.7). However, it should be noted that the low frequency at which residents use these water bodies may be because they are aware that polluted recreational waters may lead to other diseases which are not waterborne (Table 1). These include water washed diseases (for example skin and eye infections) as indicated by the community nurse during the interview component, and the public health advisory issued to the village council on October 14, 1994 (Appendix 6). It should also be noted that due the focus of this research on faecal-oral disease (principally diarrhoea), other sanitation related diseases were not addressed in the questionnaire survey.

From the interviews and field observations it was noted that children seem to use the waterfront and the bay more than adults especially during the summer vacation (A. Collymore, pers. comm.). This may be because these children may not be aware of the October 14, 1994 advisory. As such they may be less sensitised to the health effects of beach pollution.

From interviewing the community nurse it was revealed that the incidence of reported cases of diarrhoeal disease in the village is low. The questionnaire results also inferred this with 80.9% of residents indicating that they had not experienced diarrhoea in the last six months (question 9.1). Also, of those which did experienced diarrhoea 87.5% reported an incidence of only 1 to 2 cases within the last six months (question 9.2). It can therefore be assumed that diarrhoea cases due to WASH are kept low not only because of effective hygiene barriers but the low frequency of recreational water use by most households.

From the discussion presented it can be seen that although certain risks of infection may be present, putting in place certain barriers may be an effective means of minimising the successful transmission of faecal oral disease. It can also be said that limiting the frequency of certain risky practices, may also contribute to a lower tendency to contract water borne diarrhoeal disease.

5.3 WASH knowledge and awareness

5.3.1 Raw water use

It can be said that villagers seemed to be aware of the state of surface water quality and the dangers associated with its consumption. Approximately 93% of villagers knew that water from these sources was not suitable for drinking (question 2.13) and 77.1% denied ever engaging in this practice. These results are consistent with the results from the interviews and focus group discussions, which confirmed that rivers have been accessed for domestic uses - primarily during water shortages - which does not generally include drinking.

It should however be noted that according to the results of the interviews, the village council and NEMO have been instrumental in stressing the importance of refraining from drinking from surface water sources. These have been part of recent (post Hurricane Tomas) disaster preparedness initiatives. The health centre has also been a routine source of information through its daily group talks at clinics, biannual home visits and quarterly school outreach activities.

The health centre and NEMO personnel seem to play an important role in disseminating information to residents. They may have positively impacted the behaviour and attitudes of
residents through constant emphasis on the dangers associated with drinking water from surface sources, even during desperate times associated with extreme weather events.

5.3.2 Water treatment and quality

Residents generally (64.4%) believed that household water treatment should be practiced (question 4.1). It is interesting to note that residents were nearly equally divided on their perception of pipe borne water quality; about 48% believed it was safe and 52% believed the contrary (question 2.16). There seems to be distrust in water quality by a moderate number of households; although pipe borne potable water quality is routinely tested and found to meet water quality standards by WASCO and the environmental health officials. All community leaders interviewed are also in agreement that potable water is safe for drinking.

The difference between the sets of results (quantitative perception on pipe borne water quality and interviews) may be due to a lack of public awareness of the actual state of potable water quality in the village. This was probably because it is only recently, after the construction of the water treatment plant, that pipe borne water quality has been considered good. Many residents therefore probably still distrust the water treatment system.

It can therefore be assumed that many villagers are probably still unaware or have a lack of confidence in the reliability of the treatment system, not only due to past water quality experiences, but current issues with sedimentation. This is an area which needs to be properly communicated to residents as a means of restoring their full confidence in the new water treatment system.

This lack of confidence may have resulted in 70.6% of households admitting to engage in some form of point of use water treatment, which ironically may be a positive outcome. This is because it has been shown that faecal contamination of treated pipe borne water can occur after water collection due to inappropriate water handling and hygiene practices (Eshcol, Mahapatra and Keshapagu 2009; Holt 2009). Only 58% of residents admit to access water through a household connection. Therefore, it can be assumed that a moderate number of individuals (42.0%) still solely depend on water collection and storage in water collection vessels (buckets and jerry cans). This reinforces the need for proper water treatment and storage.

It is also worth noting that water shortages which mostly occur in the rainy season may sometimes result in periods of storage for all residents which exceed 48 hours. During this period inappropriate handling of water can introduce microbiological contaminants and encourage their proliferation (Eshcol, Mahapatra and Keshapagu 2009). Therefore, it is important that all residents are familiar with proper point of use treatment to eliminate infectious agents before water is consumed.

5.3.3 Environmental awareness

The majority of residents surveyed (77%) were aware of the importance of treating wastewater before it re-enters the environment (question 5.5). They were also generally aware that pollution related issues may arise due to untreated wastewater (question 5.6). The environmental (96.8%)
and public health (71.5%) dangers of open defecation and inappropriate night soil disposal were also acknowledged by most households (question 7.7). The connection between these indiscriminate practices and water pollution was also made by 87.9% of households (question 7.7).

It should however be noted that the urgency to limit the pollution of recreational water bodies was lacking from the interviews and focus groups. A greater concern seemed to be placed on drainage issues which resulted in stagnancy and odours within parts of the drainage system than the impacts of releasing wastewater and excreta into the environment.

Griffin et. al. (2003), noted that the direct and indirect disposal of wastewater into coastal water from inland sources lead to an increase in coastal pollution, especially if these effluents have passed threshold levels. They further mention that the impacts of concern are not only ecosystem health but human health as well. This is due to the transmission of pathogenic agents via the faecal-oral route in the near-shore marine environment (Griffin et. al. 2003). Some respondents spoke of the traditional belief that the diluting effects of the rivers and sea are great enough to keep water pollution to minimal levels. However, proper studies are needed to determine the true extent of this pollution. It also seems that the lack of recently updated information, on the state of the water quality of the marine and freshwater bodies bordering the village, has contributed to a general attitude of ambivalence on this issue.

5.3.4 Public health awareness

Residents were generally knowledgeable about the causes of diarrhoea (questions 9.3 to 9.8), with 71.4% linking it to poor water quality (question 9.3). Approximately 40.2% of respondents were still unaware about the link between recreational water use (question 9.7) and diarrhoeal disease. This is probably because of the lack of evidence that villagers have experienced diarrhoea symptoms due to the use of recreational waters. Unfortunately, this means that individuals may still inadvertently expose themselves to these waters due to ignorance on the issue.

There also seems to be a feeling that these environments have not negatively impacted the health of villagers. This is because there has not been any apparent evidence of serious illness in the community which has explicitly been linked to bathing in recreational waters, although the risks may be apparent. The only exception was the acknowledgement of the community nurse of a possible link between river use and skin rashes in women who used these rivers for laundry purposes. However this is not a normal occurrence as it is primarily related to the extensive disruptions in water supply which occurred after Hurricane Tomas in 2010.

It should be however highlighted that although people did not seem to be manifesting diarrhoea related illness through faecal-oral transmission, the risks to public health are still present. This is because whenever there are cases of open defecation and inappropriate excreta disposal in public areas there are always risks of human contact (WHO/UNICEF 2000; Cairncross and Valdmanis 2006), and this contact is a pre-condition for infection. These risks should not only be limited to diarrhoeal disease (faecal-oral) but other sanitation related diseases (water-washed and water-based) which were not of primary focus in this research (Table 1).
5.3.5 Gender relations awareness

A string of gender differences related to water supply and sanitation may exist and these differences are related to perceptions of different social benefits (Cairncross and Valdmanis 2006). It may be assumed that the importance placed on these differences may depend on the social context, such as the social norms and traditions which are present.

From the questionnaire results people were generally not aware of gender differences and considerations as they relate to WASH (question 10.10). This was also evident in the questionnaire, interview and focus group results. Those who were aware of these differences indicated that women were generally impacted more by WASH (question 10.11). There was a general feeling that gender issues were simply limited to designating gender specific rooms for the public showers and baths, however even this was shown to be an area of concern.

This was because of reported cases of cross gender sharing of public showers and toilets, according to the interviews. In the case of the showers, this was facilitated by the lack of barriers for protecting privacy. Shower curtains were lacking in all facilities and the facility in Petit Bourg lacked shower curtains and doors, which seemed to be integrated into the design of the building. This suggests the lack of sufficient gender related considerations in the infrastructural planning and conceptualisation stage of this facility. It should also be noted that the taboo nature of this issue seems to have downplayed it as an aspect of gender relations which should be addressed, although most respondents were quite aware of its existence.

Vassell (2009) notes that women and men may also be concerned about these gender issues for different reasons. This was evident from the sense of ambivalence which most male respondents had on the issues. Males seemed to address the issue of privacy limitations at the public facilities as a social taboo, and downplayed its significance. Female respondents were more forthcoming concerning the privacy limitations in the public showers. They went on to express concerns of sexual harassment due the unregulated entry of both sexes into shower rooms.

5.3.6 Information, education and communication practice

According to the questionnaire results, recent (within 6 months prior to the study) information regarding WASH has generally not been received on issues relating to water, wastewater drainage and hygiene (from any information source). However about 50% of villagers acknowledged that they have received information regarding sanitation and solid waste issues within the last six months (question 10.2). This may be due to the success of the highly publicised dengue and solid waste information and awareness campaign of June 25, 2011, which required a high level of community volunteerism. It also shows the effectiveness of these participatory endeavours in reaching large sections of the population.

Although there seemed to be problems on the receiving end of WASH information by users, those who did receive the information generally received it frequently. This shows that the ongoing efforts by the relevant authorities to provide information to the public may be frequent enough. The mechanism used to transfer this information may also be lacking due to its inability to reach a moderately large percentage of the target population. It could also mean that this group of residents is predisposed to receiving this information because they are more receptive. As such, they probably place a greater effort on accessing this information than other residents.
Five main sources of information were noted as being radio (77.6%), television (77.3%), newspapers (75%), loudspeaker (73.7%) and health communicators (62.3%) (question 10.4). This indicates that the mass media plays an important role in communicating information to villagers. It is also important to note that the role of health personnel such as the community nursing officials, are regarded as significant and they were noted as the most influential group of communicators at the community level as it relates to WASH.

It was also inferred from the interviews that community nursing personnel disseminate information quite frequently. This was done through three different strategies which primarily entailed face to face interactions. These involved targeting patients who visit the health centre for information and actually visiting households and local schools. The attitude towards health related information dissemination from the perspective of the health centre is very positive and this may have resulted in the fact that most households were aware of the causes of diarrhoeal illness (with the exception of the link to recreational water use).

Public health campaigns through workshops were also regarded by households as the most effective means of communicating WASH information, which again reflects the importance of community involvement and participation for relaying information and providing knowledge. Therefore these workshops will have to be participatory to allow residents to share knowledge and views with presenters. This will allow presenters to gain feedback, promote a sense of community involvement and allow the workshops to cater to the specific needs of participants.

Households generally thought that the following topics should be addressed at these workshops: water conservation; water pollution; water storage; water treatment; proper garbage disposal; environmental cleanliness; impacts of sanitation on the environment; and personal hygiene. The aforementioned topics should therefore be the focus of future public awareness endeavours for addressing WASH issues in the village.

It should be noted that participatory methods which make special bilingual provisions are also important in the village context because some individuals may only speak and understand the Creole dialect. The extent to which this language barrier affects the access to disseminated information in the village context was not addressed in this research. However it is possible that mass media communication may limit the access to WASH knowledge when it is principally presented in English.

6 CONCLUSIONS

From the research it was evident that of all the WASH issues discussed, sanitation problems are the most pressing. Many residents still lack private toilets and this sometimes prevents them from disposing of excreta in ways which are environmentally responsible. The lack of access to proper private toilets seems to be the result of land ownership issues and small lot sizes, which made the installation of private toilets and septic tanks less achievable for some households. Unfortunately, simply providing private toilet and septic tanks to most residents may not solve the sanitation problems. This is because even if all these households were able to install flush toilets with septic tank systems, issues relating to the height of the water table could compound the adverse environmental impacts of effluents. The high water table may facilitate the migration
of contaminants from private and public septic tanks into the near-shore environment. This in turn poses public health threats to beach users, many of which were found to be children.

Pipe borne water supply in the village is of good quality. However there are issues of intermittency during the rainy season and prolonged water shortages due to extreme storm events. This is due to heavy siltation at the water intake in Venus Estate. Although most villagers practice good personal hygiene, limited water availability at these times may affect their ability to engage in this practice. It is therefore necessary to remove the water intake at Venus Estate to an area which is not seriously affected by sedimentation.

On the household level, the lack of property rights was also shown to be a challenge to ensuring water access. This was because many households live on rented property and lack the proof of land tenure which is a requirement for securing a private household connection from WASCO. Although improving the water storage capacity of villagers will assist in improving their resilience to water shortages, there is the challenge of insufficient purchasing power of households. Water storage tanks are unaffordable to many villagers. This prevents them from significantly augmenting storage volumes. It also has an impact on the ability to store enough water from rainwater water harvesting systems. Insufficient land space for placing tanks and the absence of property rights also pose restrictions for many households.

For those households who depend on small storage and collection containers, the ability to engage in good water handling practices is limited by the nature of these containers. Many residents use buckets which have a greater likelihood of being contaminated. This is not only because these containers have a larger surface area exposed to the environment when uncovered, but since residents generally place objects into the water during the water drawing process. Although it is difficult to ensure that this practice is done in a safe and hygienic manner, villagers were generally found to engage in point of use treatment before drinking stored water.

Residents generally knew that diarrhoea could be caused by drinking water which is of poor quality. However, knowledge about the health effects associated with recreational water use was lacking with regards to waterborne (diarrhoeal) diseases. This lack of knowledge is partly due to the absence of recent updates regarding the actual state of recreational water quality in the Anse La Raye Bay and subsequent public health advisories.

Residents were quite aware that open defecation and inappropriate night soils disposal contribute to environmental pollution and public health dangers. They were also able to link these practices to the pollution of surface water bodies. It is likely that although residents were unable to associate recreational water use with diarrhoeal disease, they were probably aware that polluted surface water could contribute to other kinds of sanitation related diseases. This is because they did not frequent the Anse La Raye Bay for recreational bathing.

The attitude of residents towards WASH was positive for the most part. However there seemed to be much ambivalence regarding environmental pollution from wastewater and inappropriate excreta disposal. This is not only because there is a lack of updated water quality information on the state of the Anse La Raye Bay but due to the lack of evidence that the health of residents have been adversely impacted.
Obstacles to improving sanitation such as the lack of property rights, limited land space and hydro-geological constraints have contributed towards a sense of helplessness. This means that even if residents wanted to improve sanitation on the household level and had the money to install toilets and septic tanks systems, these obstacles may still be insurmountable on the household level.

The research also showed that men and women had different attitudes toward WASH issues. Men were ambivalent and women were more interested. This seemed to be related to the different domestic roles and vulnerabilities of these two social groups.

7 RECOMMENDATIONS

The following recommendations are proposed based on the findings of this research:

- The intake at Venus Estate must be relocated to a suitable location which is free from the effects of sedimentation. This is because clogging which occurs at the intake due to sediments from high runoff is the main obstacle to reducing the frequency of water intermittency. Also, this has implications for the ability of households to maintain good hygiene practices, due to limitations relating to the consistency of uninterrupted water supply.

- The resilience of the village to prolonged water shortages during extreme rainfall events should be improved. This must be done by improving the storage capacity of the village, as a means of ensuring that water is always available for maintaining good hygiene practice. However due to the financial burdens of purchasing private tanks, limited land space and property rights issues, it will be better to provide communal water tanks through the assistance of central government, rather than providing private water tanks. These communal tanks will have to be strategically placed and properly managed during prolonged water shortages, to ensure that water is effectively rationed throughout the duration of these periods.

- A water quality monitoring program should be implemented in Anse La Raye Bay through the Environmental Health Department. This program should be geared at determining the current magnitude and trends associated with faecal contamination of water in the bay. It should also allow the fresh and marine water bodies to be properly classified under the three recreational water classes (“primary contact recreation, secondary contact recreation and passive recreation”) specified in the 2010 national water quality standards which were drafted by the Saint Lucia Bureau of Standards (SLBS 2010). The monitoring program will give a clearer idea of the state of the environment and the extent to which public health may be impacted by recreational water use. The results from the water quality monitoring program could also be used to conduct a microbial risk assessment. This will serve as the basis to issue an updated advisory to the Anse La Raye Village Council on the present state of water quality and the dangers associated with its use. This new knowledge will provide scientific grounds for engaging the public in an awareness campaign on the dangers of recreational water use in the village. It is also recommended that as part of the information dissemination and awareness approach, signs are placed at strategic locations, in plain view,
near the water front and rivers. These signs should display the corresponding recreational water class along with an advisory which informs on the extent of permitted water use.

- One way to address the sanitation problem would be to increase access, by providing each household with a proper private toilet. This would help resolve issues of privacy and inconvenience. It would also facilitate effective barriers between excreta, the environment and the public. To resolve the issue of limitations due to land space and hydro-geological constraints, a central sewage network could be constructed. This would allow all households to directly connect to sewer lines irrespective of their lot sizes or available land space. This solution would keep sewage away from the saturation zone and limit the release of faecal contaminants into the marine environment. However, the appropriate and most cost effective central sewage transport/treatment system will have to be selected from the array of systems which are known to exist. This would ensure that residents are not overburdened by overwhelming costs while environmental and public health benefits are kept high. An ideal system for the village would ensure that operational and maintenance costs are kept low because villagers seem to be unwilling to contribute significantly to these costs. Resolving the property rights issues will have to be settled through legislative and regulatory means. This would be towards ensuring that all existing homes, private or rented are retrofitted with proper toilets as a means of ensuring that issues of human dignity are properly addressed.

- In the absence of a central sewage collection and treatment system, and full coverage of toilet facilities, the public toilets will need to be better managed to make sanitation more accessible to households. This will involve the provision of 24 hour services at these facilities. A shift system will have to be devised so that these facilities could be staffed 24 hours a day. Also, security will have to be provided at late hours as a means of protecting vulnerable users and limiting harassment. An effective system also needs to be in place to ensure that toilets are properly sanitised after each use. Sanitisation agents (disinfectants) must also be made available to users so that they have the option of disinfecting toilet seats before they use them. There is also the option of installing an automatic cleaning and hygiene system in each toilet as a means of improving user confidence regarding the hygienic state of public toilets. This may serve as a means of encouraging use rather than resorting to inappropriate forms of excreta disposal. The added costs for maintenance of these automatic systems could be covered through implementing a pay for use system during the Fish Fry Friday Night mass crowd events and implementing a small vending tax from all vendors registered under the Anse La Raye Vendors Association. This is because proper maintenance of the facilities on Front Street confers benefits to the success of these events through providing good sanitation services to customers.

- Extra garbage bins should be installed in the village. These bins must be placed in the following categories: bins designated for the disposal of green wastes; the disposal of household waste (for households who have missed the household pickup); and the disposal of waste collected by sanitation workers. This is because there is a clear conflict of use, which results in overflowing bins. Therefore, these categories will provide better direction regarding the purposes of each bin. The bins should also be colour coded and labelled according to their designated uses, so that both residents and visitors become more aware of these distinctions. This will also make it easier to reprimand unsanctioned users by both
complying residents and authorities, when disobedience has been observed. Implementing this approach will need a public information and awareness phase during which residents are sensitised regarding the importance of complying with regulations.

- More frequent public awareness and information campaigns which use participatory techniques and cater for Creole speaking residents. These campaigns should be done just before the hurricane season (disaster preparedness) since extreme rainfall events (tropical depressions, storms and hurricanes) seem to be the greatest threat to maintaining widespread water accessibility. At these times of prolonged water shortages, the public is most vulnerable to contracting faecal-oral diseases because of the lack of sufficient water to exercise good hygiene. Hence the importance of proper water storage, effective water conservation, good household water management and point of use water treatment, must be stressed, as a means of protecting public health.

- A public address system (PA system) should be provided to the village council. This will provide a means of updating residents on important WASH matters irrespective of the low turnout to public meetings. It will serve as a way of reinforcing national public service announcements which are issued via the mass media. This will also give the village council an affordable means of disseminating information which is pertinent to village specific WASH issues.

8 FURTHER STUDY

A study could be conducted to quantitatively estimate the magnitude of public health risk which results from the bacteriological contamination of recreational waters, in the nearshore marine environment. The process of determining risk involves both considering the probability that a hazard or hazardous event will occur, and the consequences if it does (National Health and Medical Research Council (Australia) 2008; SLBS 2010). This could be done via a quantitative microbial risk assessment (QMRA), epidemiological studies or a screening-level risk assessment (Howard, Pedley and Tibatemwa 2006; National Health and Medical Research Council (Australia) 2008). These methods are data intensive, so they will have to be done in tandem with an extensive water quality monitoring program as a means of collecting the necessary bacteriological data. The information generated from this study could then be used to better inform decisions about the appropriate management of the nearshore water systems in the village.

9 REFERENCES


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10 APPENDICES

Appendix 1: Aerial images of Anse La Raye Village (Source: Google Earth)

Buildings of Interest

Main Streets
Appendix 2: Questionnaire survey on WASH and the environment

SURVEY ON WATER, SANITATION, HYGIENE AND THE ENVIRONMENT

As part of the Master’s degree research project of the University of the West Indies this survey is being conducted to obtain views on water, sanitation, hygiene and the environment in the village of Anse La Raye. I would therefore appreciate if you could answer a few questions. All responses will be considered confidential for compiling the final report. You will not be identified.

Write DK (do not know) and NR (no response) as appropriate by the question where necessary.

Date: __________ Date of interview: __________
Name of interviewer: ___________________

Household block _____ Questionnaire code #: _____________

Person interviewed (sex):  o Male  o Female
Age range:  o under 18  o 18-65  o over 65

Position in household (head/daughter etc.): ______________________

Household block code: ______________

1.0. Household Information

1.1. The household consist of how many members? ________________

1.2. Number of young children in household (aged less than 5 years old)? _______

1.3. How many people in the household (aged more than 60 years old)? ______

1.4. How many females in household? __________

1.5. How many males in household? __________

2.0. Water Source

2.1. What is the main source of drinking-water for members of your household?
   o Piped water into dwelling → go to question 2.3, 2.4, and 2.5
   o Piped water to yard/plot → go to question 2.3, 2.4, and 2.5
o Public tap/standpipe → go to question 2.4 and 2.5
o Surface water (river) o Rainwater collection o Bottled water → go to question 2.2
o Other (specify) ____________________________

2.2. If bottled water is the main drinking water source, what is the main source of water used by your household for other purposes, such as laundry, cooking and hand washing?
o Piped water into dwelling  o Piped water to yard/plot  o Public tap/standpipe
o Surface water (river)  o Rainwater collection  o Other (specify) ____________________________

2.3. If water is piped into your house or yard, how do you consider the cost of piped water?
o Expensive  o Moderate  o Cheap

2.4. If piped water is your main source, how often do you experience water shortages?
o Daily  o Weekly  o Monthly  o A few times a year  o Never

2.5. If you experience water shortages, what do you think is the main reason for that?

______________________________________________________________________________

For all respondents

2.6. Does your household sometimes not get enough water for drinking?
o Yes  o No  o Don’t know

2.7. Does overcrowding hinder your access to water at the stand pipes?
o Yes  o No  o Don’t know

2.8. What container is usually used to collect water?
o Plastic jerry can with lid  o Plastic jerry can without lid  o Open bucket  o Bucket with a lid
o Other ____________________________

2.9. Do you collect rainwater (any system of rainwater collection)?
o Yes  o No → go to question 2.12

2.10. If yes, when did you start collecting rainwater this way?
o Less than a week ago  o Less than a month ago  o Less than six months ago
o Less than a year ago  o Less than two years ago  o More than two years ago

2.11. Why did you start collecting rainwater this way?

______________________________________________________________________________

2.12. If no, why don’t you collect rainwater?

______________________________________________________________________________

2.13. Do you think that water from Grande and Petite Rivers is suitable for drinking?
2.14. When was the last time that you collected water from the rivers for drinking (Petite and Grande Rivers)?

- Less than a week ago
- Less than a month ago
- Less than six months ago
- Less than a year ago
- Less than two years ago
- More than two years ago
- Never

2.15. If you have used the rivers to collect water for drinking, what was main reason for doing so?

______________________________________________________________________________

2.16. Is pipe borne water safe for drinking?

- Yes
- No

3.0. Water Storage

3.1. Tick the box corresponding to the item that best describes how the household usually stores its potable water.

- The container stores:
  - more than enough water
  - just enough water
  - too little water

- The container is made of:
  - metal
  - plastic
  - other________________

- The container is stored:
  - inside
  - outside
  - other________________

- The container is:
  - covered properly
  - uncovered
  - half covered

- The container is:
  - the same as used for collection
  - different from the one used for collection

- The container is kept:
  - on the ground
  - raised off the ground

3.2. How often do the members of the household wash the storage containers used for drinking water?

- Daily
- Weekly
- Monthly
- Never
- Don’ t know
- Other (specify) ________________________

3.3. How do members of the household usually remove water from the storage container for drinking? (Tick one box only)

- By pouring (from container without a tap)
- Using a tap on container
- Dipping hand with a cup
- Other

3.4. Do you have a water storage tank?

- Yes
- No → Go to question 3.6

3.5. If yes, what was the main reason for investing in a water storage tank?

______________________________________________________________________________
3.6. If you **don’t have a water storage tank**, what is the reason for that?

______________________________________________________________________________

**4.0. Water Treatment**

4.1. Does the household think that water which has been **stored** should generally be **treated** before drinking?
   - o Yes
   - o No

4.2. Do you **treat** your **stored** water in any way to make it safer to drink?
   - o Always → **continue with 4.3**
   - o Sometimes → **continue with 4.3**
   - o Never → **Go to question 4.4**

4.3. If you **treat** your **stored** water, what do you usually do to the water to make it safer to drink? (Tick all boxes that apply)
   - o Boil
   - o Add bleach/chlorine
   - o Strain it through cloth
   - o Use a water filter
   - o Other (specify) _________________

4.4. If the household does not use any treatment method, what is the reason for that?

______________________________________________________________________________

4.5. In the past month, do you think that you have drunk **unclean** water within your home?
   - o Yes
   - o No
   - o Don’t know / No answer

**5.0. Drainage**

5.1. Do you think that drainage is important?
   - o Yes
   - o No

5.2. Is your house connected to a drainage system?
   - o Yes
   - o No
5.3. Are you satisfied with the current drainage situation around your home/street?

o Yes → Go to question 5.5

o No → Continue with question 5.4

5.4. If no, what are some of the drainage **problems** which exist around your home/street? (Tick all boxes that apply)

- Mosquitoes breeding
- Spread diseases
- Bad odours
- Polluted water bodies
- Flooding
- Drains need repairs
- Clogged drains with garbage
- Other (specify) _________________________________

*For all respondents*

5.5. Do you agree that wastewater should be treated (cleaned) before it returns to the river or sea?

- Yes
- No
- Don’t know / No answer

5.6. Are you willing to **pay** for wastewater treatment?

- Yes, why? _________________________________
- No, why not? _________________________________
- I don’t know/ No answer
6.0. Solid Waste Disposal/Reuse

6.1. Do you use the solid waste collection service?
- Yes
- No

6.2. Are you satisfied with the current solid waste management practices in your area?
- Yes
- No
- I don’t know/ No answer

6.3. What do you suggest should be improved about the solid waste management situation? (For all respondents) (Tick all boxes that apply)
- Hygiene problems
- Frequency of collection
- Blocked drains
- Water pollution
- Smell
- Flies
- Bulk waste collection should be improved
- Reduced littering
- Nothing
- Other (specify) ___________________________

6.4. Does the household reuse cans, bottles or plastic bags?
- Yes
- No

7.0. Sanitation

7.1. What kind of toilet facility do members of your household usually use (owned by the household)?
100

* Flush toilet linked to: o Septic tank → go to question 7.2, 7.3, 7.7
  o Pit latrine  o Elsewhere  o Unknown place/not sure/don’t know

*Latrine: → go to question 7.3, 7.4, 7.7  o Ventilated improved pit latrine (VIP)
  o Pit latrine with slab (elevated seat)
  o Pit latrine without slab (elevated seat)
  o Bucket latrine
  o Other (specify) _____________

* No facilities o → go to question 7.5, 7.6, 7.7

7.2. If you have a toilet with a septic tank, how often do you empty the tank?

  o Whenever it is blocked
  o Whenever it is full
  o Never
  o Other, please specify______________________________

7.3. If you use a toilet or latrine, do you share this facility with other households?

  o Yes  o No

7.4. If you own a pit latrine, are there any problems with this latrine? (Tick all boxes that apply)

  o Flies/or Mosquitoes
  o Superstructure does not ensure privacy
  o Foul smell
  o Flooding in rainy seasons
  o Difficulties for younger children to use
  o Pit filled up
  o Slab not stable (Fear to fall)
  o No problems o other (specify) ________________________
7.5. If you **don’t own a toilet (no facilities)** where do you **most usually** dispose of human waste? (Tick all boxes that apply)

- In the river
- At the waterfront
- In the street
- In the field
- At garbage collection site
- Use neighbour’s toilet
- In Public toilet
- Other, (specify) ____________________

- I don’t know/ No answer

7.6. If you **don’t own a toilet (no facilities)** yet, are you willing to **borrow** money in order to build a sanitary household toilet?

- Yes

- No, why not? ______________________________________________________________

- I don’t know/ No answer

7.7. What do you think happens to the environment when you use the river or beach as a toilet? (Tick all boxes that apply)

- Spreads dangerous diseases?

- Pollutes the (surface) water source (bodies)?

- Is not harmful?

- Other, (specify) ____________________

- Don’t know?

**8.0. Hygiene**

8.1. How frequently do the members of the household wash their hands?

After changing baby’s nappy: o Always  o Sometimes  o Never  o Not applicable

Before handling of food and food preparation: o Always  o Sometimes  o Never

Before eating:  o Always  o Sometimes  o Never

After a visit to the toilet:  o Always  o Sometimes  o Never

After housecleaning, work and/or disposing of rubbish: o Always  o Sometimes  o Never

Other  ____________________

8.2. How often do members of the household bath in the Petite and Grande rivers?
8.3. If you bathe in the rivers, what is the main reason for doing this?

8.4. How often do members of the household bathe in the Anse La Raye Bay?

8.5. If you bathe in the bay, what is the main reason for doing this?

9.0. Diseases

9.1. Did any member of your household suffer from diarrhoea during the last six months?

9.2. If yes, how many people suffered from diarrhoea during the last six months?

9.3. What does the household believe to be the cause for the diarrhoea?

9.4. Does the household generally think that diarrhoea is a serious illness?

9.5. Does the household think it can be prevented?

9.6. Does the household believe that diarrhoea illness is related to the quality of drinking water?

9.7. Does the household believe that diarrhoea illness is related to river and beach pollution?

9.8. Does the household believe that diarrhoea illness is related to hygiene practices?

10.0. Information, Education, Communication Practice

10.1. Does your household possess one or more of the following communication devices?

(Tick all boxes that apply)

o TV   o Radio   o Cell-phone   o Computer with internet   o Telephone land line
10.2. Did you receive any information in the last six months on the following issues?

(Tick all boxes that apply)

<table>
<thead>
<tr>
<th>Information about</th>
<th>Yes</th>
<th>No</th>
<th>Don’t know/No answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water supply</td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Drainage</td>
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<td>Solid waste</td>
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</tr>
<tr>
<td>Hygiene</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10.3. If yes, how often did you receive this information in the last 6 months? (Tick all boxes that apply)

<table>
<thead>
<tr>
<th>Frequency of information receiving</th>
<th>Water supply</th>
<th>Wastewater</th>
<th>drainage</th>
<th>Solid Waste</th>
<th>Hygiene</th>
<th>Sanitation</th>
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<tr>
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<td>2-3 times</td>
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<td>4-5 times</td>
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<tr>
<td>I don’t know/No answer</td>
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<td></td>
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</tbody>
</table>
10.4. If yes, from what sources did you get the information? (Tick all boxes that apply)

- School
- Church
- Neighbours
- Public works company
- Health communicator
- Community leaders
- TV/Radio/Newspaper/Loudspeaker (please circle if applicable)
- Member of mass organization (name agency) ______________________________________
- Internet
- Other, please specify _______________________________________________________

10.5. Who do you think is the most influential group or organisation to communicate about water, sanitation and hygiene in your community? (Tick one box only)

- Village council
- Youth group
- Community nurses
- Member of women’s union
- School teachers
- Disaster preparedness committee
- Church
- Anse La Raye Development Foundation
- Other, please specify _______________________________________________________

10.6. How often public meetings are held in your community on water, sanitation or hygiene issues?

- Never
- Monthly
- Quarterly (every three months)
10.7. How do you rate the following channels for public officials to communicate with you (the households) on these issues?

1- Ineffective; 2- Moderately effective; 3- Very effective

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<th>2- Moderately effective</th>
<th>3- Very effective</th>
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<td>Neighbourhood meeting</td>
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<td>Church</td>
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<td></td>
</tr>
<tr>
<td>Other (please specify)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>_______________________</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
10.8. Do you think a **workshop** is necessary for issues related to:

- **Water**: o Yes o No
- **Sanitation (household and environmental)**: o Yes o No
- **Hygiene**: o Yes o No

10.9. **If yes**, what should be addressed in the **workshop** for the community?

- **Water**: ________________________________________________________
- **Sanitation (household and environmental)**: ___________________________
- **Hygiene**: ________________________________________________________

10.10. Do you think that **men and women** are affected **differently** by the following issues?

- **Water**: o Yes o No
- **Sanitation (household and environmental)**: o Yes o No
- **Hygiene**: o Yes o No

10.11. **If yes**, how?

- **Water**: ________________________________________________________
- **Sanitation (household and environmental)**: ___________________________
- **Hygiene**: ________________________________________________________
Appendix 3: Guided interview questions for community leaders and key informants

General information

Socioeconomic situation
What is the present socioeconomic condition of the community?
Would you say that poverty is a problem?
If yes, why is it a problem?
Would you say that housing is a problem?
If yes, why is it a problem?
Would you describe the socioeconomic condition as improving or declining (in recent years)?

Specific information

Solid Waste Management
How do you assess the infrastructure and system which is in place for solid waste management? (bins, frequency of pickups, littering, and illicit dumping)
Is the solid waste management system effective?
In terms of cleanliness, how would you describe the village? (Include: flies, rodents)
How can solid waste management be improved?

Wastewater/Drainage
How would you assess the drainage situation in the village? (Clogging, odours)
To what extent is flooding a problem? (Frequency, duration, sanitation, solid-waste dispersal).
What are the sources of wastewater in the village? (Medical, domestic, industrial, construction).

Water supply
How would you assess the access to pipe borne water supply situation in the village? (Intermittence, crowding, leakages, pipeline contamination-negative pressures)
How would you assess this situation during the hurricane season (Hurricane Tomas)?
How would you assess this situation during the dry season (2010 drought)?
What are your perspectives on the role of gender in the village? (Use of public facilities, washing, carrying water).
Are gender issues considered in community WASH projects and community meetings?
What is the general consensus on water storage and rainwater harvesting? (Are best practices taught and promoted?)

Sanitation
How would you assess household sanitation in the Village? (Septic tank connection, open defecation, open disposal of excreta, flooding and pit toilets).

How would you describe the effect of sanitation on the environment (rivers, near-shore)?

Do you consider the public facilities to be effective? (What are the problems observed or complaints reported?)

Have water related diseases (diarrhoea) been an issue in the village? (Post and pre hurricane)

Are there concerns about river water consumption due to water shortages (post hurricane or draught)? (Why?)

Are there concerns about the effects of recreational river and beach use on public health? (Why?)

Do you think that water, sanitation and hygiene information campaigns are necessary?

How often is information on WASH disseminated to the public?

What is the general public response to this information (in terms of practices)?

Is there a general feeling of disenchantment when it comes to alleviating issues?

**Recommendations**

Can you make any recommendations regarding improvements to community water and sanitation issues?
Appendix 4: Guided interview questions for government officials from regulatory agencies

Public Health/Environmental Health

Does Saint Lucia have a water policy?
Is there legislation or regulations for implementing this policy? (Enforcement)
What are the difficulties experienced in implementing these policies?

Does Saint Lucia have a sanitation policy?
Is there legislation and regulations (backed by law relating to sanitation)? (Enforcement)
What are the difficulties experienced in implementing policies and regulations (from the Anse La Raye standpoint)?

Is there a policy relating to coastal zone management?
Is there legislation or regulations for implementing this policy? (Enforcement)
What are the difficulties experienced in implementing policies and regulations (from the Anse La Raye standpoint)?

How would you evaluate the water and sanitation situation in Anse La Raye with respect to the achievement of the millennium development goals?

How would you assess the impact of land based sources of pollution on water resources (fresh water and marine) in Anse La Raye?

How would you assess the quality of fresh and marine water in Anse La Raye (for drinking and recreation)?

How are freshwater resources impacted by poor domestic and environmental sanitation in Anse La Raye?

How are marine environmental resources impacted by poor domestic and environmental sanitation in Anse La Raye? (Waterfront)

What is the extent of water quality monitoring being done in Saint Lucia? (Which agencies are responsible for this?) (Is there free information flow among agencies?)

How often is water quality testing (monitoring) done in the rivers and at the waterfront? (Is there a monitoring programme? (When did the last monitoring program take place?)

Are these waters polluted [agrochemicals and biological agents]? Are they suitable for bathing?

What are the constraints to effective water quality testing or monitoring in these areas (bay and rivers)?

Do these bodies of water (river and bay) pose a public health risk? (To what extent?)

Are agrochemical and other forms of chemical pollution a concern above or below the intake? (If so, what are the concerns regarding the effect on health?)
What are the main land based sources of pollution which affect the marine environment in Anse La Raye Village?

What is being done to curb sanitation and subsequent land based sources of pollution in Anse La Raye Village?

How often are public awareness campaigns on sanitation, public and environmental health done in Anse La Raye?

To what extent has public health been impacted by water, sanitation and environmental issues in Anse La Raye?

What disaster preparedness measures are being put in place as a means of protecting public health after natural disasters (public awareness and consistency of these measures)?

What problems or risks did Hurricane Tomas pose to water resource management in Anse La Raye?

What disaster preparedness measures are being put in place as a means of protecting the quality of water resources in the rivers and near shore (e.g. reforestation, pollution remediation)?

From the water resources stand point what public health risks were imposed by Hurricane Tomas?

How responsive is the public to information and awareness campaigns?

What improvements can be done to increase the effectiveness of awareness campaigns?

Can you make any recommendations on ways of improving the quality of water resources (fresh water and marine) in the village?

**Water and Sewage Company (WASCO)**

How would you assess the access to pipe borne water in the village? (Intermittence, crowding, leakages, pipeline contamination, negative pressures)

How would you assess this situation during the hurricane season? (Hurricane Tomas, damaged pipelines/intake, duration without water)

What has been done to prevent a repeat of the damages due to Hurricane Tomas?

What was the estimated cost of repairs due to Hurricane Tomas?

How would you assess this situation during the dry season (2010 drought)?

Why was Anse La Raye not as severely affected by the 2010 drought?

What is being done to curb the siltation problem due to deforestation and pumice mining? (Will the intake be relocated?)- (How soon and where?)

When siltation causes the intake to close down, how long does it usually take to re-start pumping?

What is being done to promote water conservation in the village? (Pricing,storage,etc.)

What is the general consensus on water storage and rainwater harvesting? (Are these practices promoted and to what extent?) (If not,why?)

110
Where is the water intake located? (Name of area)
Where does the pumice mining take place? (name of area, above/below intake)
What is the storage capacity of the tanks which supply village? (Is it sufficient?) (How long would water last during a water shortage?) (Where are they located?)
What measures have been put in place to ensure that the storage tank is filled to capacity in the event of an approaching storm?
When was the treatment facility built? (How modern is it?) (Treatment methods used?)
Have there been complaints about water quality?
Have there been complaints about water quantity (intermittence of supply)?
How effective is the treatment plant in eliminating agrochemicals?
Is chemical and biological pollution an issue at the intake? (Increased cost of treatment and to what extent?)
Are awareness campaigns on water conservation and household water management seen as necessary? (How often are they done in Anse La Raye)?
How often is water quality testing (monitoring) done near the intake (upstream)? (Is water polluted?)
Is the treatment plant fully automated? (What issues have arose due to this, in terms of ensuring the continuity of water treatment when there is a system failure?)
What arrangements are being made to ensure that the treatment plant is secured (security from vandalism, theft, interference)?
To what extent has river flow been affected by sedimentation? (Has this affected the intake?) (In what way?)
Is a water policy and subsequent legislation in full effect in Saint Lucia? (What are the legal procedures and prerequisites for acquiring a household connection?)
How would you assess household sanitation in the village? (Septic tank connection, congestion, open defecation, open disposal of excreta, flooding and pit toilets).
What are the plans for improving the sewage issues in Anse La Raye?
Is a central sewage system needed? (What are benefits and costs?)
How does geology, topography and hydrology affect sewage issues in Anse La Raye? (Water table, below sea level, base flow etc.).
What system is in place for emptying septic tanks in the village? (Has this been identified as a problem?)

**Anse La Raye Health Centre (Community Nurse)**

How would you assess the present status of WASH related diseases in the village (adults and children)? (Diarrhoea, gastroenteritis, parasitic worms, community health)
How would you describe the overall health of village residents (good, moderate, poor, improved) in terms of WASH?

Do you think that recreational and domestic use of the rivers pose a health risk and to what extent?

Do you think that recreational use of the waterfront poses a health risk and to what extent?

How would you assess public attitude and awareness in relation to WASH?

How would you assess public attitudes and awareness relating to environmentally related health risks?

Is a health status study needed for example (gastro enteritis, parasitic worms)?

Do you see water supply, sanitation and hygiene as impacting gender in different ways in Anse La Raye Village? (Is gender sufficiently incorporated into decision making, projects etc.?)

Are there gender policies which relate to these issues?

Are programs (workshops, information dissemination) relating to household WASH regularly done in the village?

Is there a need for a workshop of this nature or public intervention on the national level?

Can you make any recommendations for the improvement of WASH in the village?

**Bureau of Health Education**

How would you assess the present status of WASH related diseases in the village (adults and children)? (Diarrhoea, gastroenteritis, parasitic worms, community health)

How would you describe the overall health of village residents (good, moderate, poor, improved) in terms of WASH?

What WASH diseases are of concern in the village (pre and post Hurricane Tomas / pre and post treatment plant / water Bourne vs. water washed)?

Do you think that recreational and domestic use of the rivers pose a health risk and to what extent?

Do you think that recreational use of the waterfront poses a health risk and to what extent?

How would you assess public attitude and awareness in relation to WASH?

How would you assess public attitudes and awareness relating to environmentally related health risks?

Is a health status study needed (for example gastro enteritis, parasitic worms, and skin infections)?

What is the extent of educational programs for household water management (treatment, transport, storage, including after natural disasters)?

Do you see water supply, sanitation and hygiene as impacting gender in different ways in Anse La Raye Village? (Is gender sufficiently incorporated into decision making, projects etc.?)

Are there gender policies which relate to these issues?
Are programs (workshops, information dissemination) relating to household WASH regularly done in the village?

Is there a need for a workshop of this nature or public intervention on the national level?

Can you make any recommendations for the improvement of attitudes and awareness as they relate to WASH in the village?

**Water Resources Management Agency (WRMA)**

What is the mandate of the WRMA? (In terms of water resources?) (Is sanitation part of the mandate?)

What is the jurisdiction of the agency in terms of fresh water and near shore coastal waters?

What is the name of the catchment/watershed which serves Anse La Raye?

What is the extent of pollution in this watershed? (From which sources?) (Sedimentation from deforestation/pumice mining?) (Faecal contamination from livestock and humans?) (Chemical contamination from agrochemicals?)

What is the extent of coastal water quality testing (nearshore)?

Which agencies are responsible for the testing of water resources (raw water, pipe-borne water and coastal water)? (Is testing seen as important?)

Is there cohesion among agencies in terms of data and information sharing?

How frequently is testing done for each category i.e. (raw water, pipe borne water and coastal water)?

Are mitigation measures being implemented for existing sedimentation issues (arising from deforestation and pumice mining)?

Does a plan exist for curbing pollution and sedimentation?

How would you assess water resources in the Anse La Raye region in terms of environmental sustainability? (Sedimentation, deforestation, biological and chemical pollutants)

What recommendation would you make for improving the quality of raw water and coastal waters in the Anse la Raye area?
Appendix 5: Focus group guided questions

General information

Socioeconomic situation
Would you say that poverty is a problem? (Why?)
What would you say are the most pressing issues in terms of poverty?
Would you describe the poverty situation as improving or getting worse?

Specific information

Solid Waste Management
Is the system in place for solid waste management working to your satisfaction? (Why?) (Bins, frequency of pickups, littering, and illicit dumping)
Has it improved or worsened?
How can solid waste management be made better?

Wastewater/Drainage
Is the drainage situation in the village working to your satisfaction?
Has it improved or worsened?
Is flooding still a problem? (To what extent?)
What do you think can be done to help mitigate the impacts of flooding?

Water supply
Are there problems experienced in terms of access to pipe borne water in the village?
How did the hurricane season affect access?
How did the 2010 drought affect access?
Are gender issues adequately incorporated into community WASH projects?
Do you think that more effort needs to be placed on water storage and rainwater harvesting?
(What are the obstacles to achieving these outcomes?)

Sanitation
To what extent is sanitation a problem in the village?
Has it improved or worsened?
How do you think that sanitation is impacting the environment in the village?
Do you consider the public facilities adequate?
Is there a concern of increased health risk due to poor sanitation?
Are there concerns of river water consumption due to water shortages?
Are there concerns about the effects of recreational river and beach use on public health? (Why?)
Do you think that water, sanitation and hygiene information campaigns are necessary?
How often is information on WASH disseminated to the public?
What do you think is the general public response to this information (in terms of practices)?
Do you think that a centralised sewage system is needed?
Are individuals are generally disenchanted regarding the alleviation of sanitation issues?

**Recommendations**
Can you make any recommendations regarding improvements to community water and sanitation issues?
Appendix 6: Public health advisory on recreation water use (Anse La Raye Waterfront) with water quality data.

October 14, 1994

Dr. James St. Catherine
Chief Medical Officer
Ministry of Health
Chaussee Road
Castries

Dear Dr. St. Catherine,

The Caribbean Environmental Health Institute has been monitoring the quality of the coastal waters (including the mouth of the river) at Anse La Raye under the Environmental Monitoring component of the ENCORE project.

Five (5) tables giving the data collected during the month of July, and on August 2nd, 1994 are attached.

The results of the microbiological examinations are cause for concern. All samples were taken from the coastal waters excepting those from stations 2 and 8 which are from the mouth of the river. The findings in all cases greatly exceed internationally accepted limits. For ease of reference these are listed below.

Acceptable limits (Geometric Mean):

| [a] Faecal coliforms (UNEP) | 200/100mL |
| [b] Enterococci (US-EPA) | 35/100mL |
| [c] E. coli (US-EPA) | 62/100mL |
| [d] Faecal streptococci (UNEP) | 59/100mL |
Water quality data appended to advisory:

**TABLE 1**

Table showing coastal water quality data collected at Anse La Raye on JULY 6, 1994.

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<tr>
<th>STATION</th>
<th>pH</th>
<th>SALINITY PPT</th>
<th>TURBIDITY NTU</th>
<th>DISSOLVED OXYGEN mg/l</th>
<th>TEMP deg Celcius</th>
<th>ECOLI (US EPA)*</th>
<th>FAECAL COLIFORM (UNEP)*</th>
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<td>&gt;8000</td>
<td>&gt;8000</td>
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</table>

* All Coliform (C.F.U.) per 100 ml.
### TABLE 2

Table showing coastal water quality data at Anse La Raye on July 13, 1994

<table>
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<tr>
<th>STATION</th>
<th>pH</th>
<th>SALINITY (PPT)</th>
<th>TURBIDITY (NTU)</th>
<th>DISSOLVED OXYGEN (mg/l)</th>
<th>TEMP (deg celsius)</th>
<th>E.COLI (US EPA) *</th>
<th>FAECAL COLIFORM (UNEP) *</th>
<th>FAECAL STREPT (UPE) *</th>
<th>ENTEROCOCCI (US EPA) *</th>
</tr>
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<td>410</td>
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<td>2.96</td>
<td>5.5</td>
<td>22.2</td>
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<td>240</td>
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<td>2.42</td>
<td>5.3</td>
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<td>&gt; 66000</td>
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<td>&gt; 800000</td>
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<td>6.7</td>
<td>9.0</td>
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<td>28.1</td>
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<td>6.8</td>
<td>27.2</td>
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<td>&gt; 8000000</td>
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* All Colonies (C.F.U.) per 100 ml.

### TABLE 3

Table showing coastal water data collected at Anse La Raye on July 20, 1994

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<th>STATION</th>
<th>pH</th>
<th>SALINITY (PPT)</th>
<th>TURBIDITY (NTU)</th>
<th>DISSOLVED OXYGEN (mg/l)</th>
<th>TEMP (deg celsius)</th>
<th>E.COLI (US EPA) *</th>
<th>FAECAL COLIFORM (UNEP) *</th>
<th>ENTEROCOCCI (US EPA) *</th>
</tr>
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<td>Marine</td>
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<td>2.94</td>
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<td>23000</td>
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<td>28.8</td>
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<td>410</td>
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<td>5</td>
<td>7.8</td>
<td>3.1</td>
<td>2.94</td>
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<td>28.8</td>
<td>270</td>
<td>410</td>
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<td>7.8</td>
<td>3.1</td>
<td>2.94</td>
<td>5.5</td>
<td>28.8</td>
<td>270</td>
<td>410</td>
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<td>3.1</td>
<td>2.94</td>
<td>5.5</td>
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<td>410</td>
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<td>7.8</td>
<td>3.1</td>
<td>2.94</td>
<td>5.5</td>
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<td>270</td>
<td>410</td>
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<td>3.1</td>
<td>2.94</td>
<td>5.5</td>
<td>28.8</td>
<td>270</td>
<td>410</td>
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<td>River</td>
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<td>1.43</td>
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* All Colonies (C.F.U.) per 100 ml.

### TABLE 4

Table showing coastal water quality data collected at Anse La Raye on JULY 27, 1994

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<th>SALINITY (PPT)</th>
<th>TURBIDITY (NTU)</th>
<th>DISSOLVED OXYGEN (mg/l)</th>
<th>TEMP (deg celsius)</th>
<th>E.COLI (US EPA) *</th>
<th>FAECAL COLIFORM (UNEP) *</th>
<th>ENTEROCOCCI (US EPA) *</th>
</tr>
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<tr>
<td>1</td>
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<td>1.81</td>
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<td>27.6</td>
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<td>9000</td>
<td>140</td>
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<tr>
<td>3</td>
<td>6.9</td>
<td>3.3</td>
<td>1.81</td>
<td>5.6</td>
<td>27.6</td>
<td>8900</td>
<td>9000</td>
<td>140</td>
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<tr>
<td>4</td>
<td>6.9</td>
<td>3.3</td>
<td>1.81</td>
<td>5.6</td>
<td>27.6</td>
<td>8900</td>
<td>9000</td>
<td>140</td>
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<td>6.9</td>
<td>3.3</td>
<td>1.81</td>
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<td>27.6</td>
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<td>9000</td>
<td>140</td>
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<td>1.81</td>
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<td>27.6</td>
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<td>9000</td>
<td>140</td>
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<td>27.6</td>
<td>8900</td>
<td>9000</td>
<td>140</td>
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<td>9000</td>
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<td>1.81</td>
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<td>27.6</td>
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* All Colonies (C.F.U.) per 100 ml.
TABLE 5

Table showing coastal water quality data collected at Anse La Raye on AUGUST 2, 1984.

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<th>TURBIDITY</th>
<th>DISSOLVED OXYGEN</th>
<th>TEMP</th>
<th>E.COLI (US EPA)*</th>
<th>FASCAL COUGHER (UNEF)*</th>
<th>FASCAL STREET (UNEF)*</th>
<th>ENTEROCOCCEI (US EPA)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marine</td>
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<td></td>
<td></td>
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<td></td>
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<td>1700</td>
<td>200</td>
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<td>2800</td>
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<td>94</td>
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<td>33.5</td>
<td>1.32</td>
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<td>3000</td>
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<td>2800</td>
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<td>2800</td>
<td>550</td>
<td>340</td>
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* All Coliform (C.F.U.) per 100 ml.
## Appendix 7: 2010 Saint Lucia population and housing census data for Anse La Raye Village on land tenure and water supply

### Tenure

<table>
<thead>
<tr>
<th>Tenure</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
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<td></td>
</tr>
<tr>
<td>Owned fully</td>
<td>146</td>
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<td>52.2</td>
<td>52.2</td>
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<td>Owned with mortgage</td>
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<td>1.1</td>
<td>53.3</td>
</tr>
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<td>Rented - private</td>
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<td>34.0</td>
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<td>10.8</td>
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<td>Other</td>
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<td>.4</td>
<td>98.5</td>
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### Water supply

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<th>Valid Percent</th>
<th>Cumulative Percent</th>
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<td>Public, piped into dwelling</td>
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<td>53.4</td>
<td>54.7</td>
<td>54.7</td>
</tr>
<tr>
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<td>25</td>
<td>9.0</td>
<td>9.2</td>
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<tr>
<td>Public standpipe outside the</td>
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<td>34.9</td>
<td>98.8</td>
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<tr>
<td>dwelling unit</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Private piped into dwelling</td>
<td>2</td>
<td>.8</td>
<td>.8</td>
<td>99.6</td>
</tr>
<tr>
<td>Other</td>
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<td>.4</td>
<td>100.0</td>
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<tr>
<td>Total</td>
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<td>100.0</td>
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<tr>
<td>Not Stated</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
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</tbody>
</table>

### Toilet

<table>
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<tr>
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<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>6.4</td>
<td>6.4</td>
</tr>
<tr>
<td>sewer</td>
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</tr>
<tr>
<td>W.C. (flush toilet) linked to</td>
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<td>35.0</td>
<td>35.7</td>
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<td>Septic tank</td>
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<td>12.5</td>
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<tr>
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<td>100.0</td>
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<tr>
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120
<table>
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<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
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</thead>
<tbody>
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<td></td>
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<td></td>
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<tr>
<td>W.C. (flush toilet) linked to sewer</td>
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<td>6.3</td>
<td>6.4</td>
<td>6.4</td>
</tr>
<tr>
<td>W.C. (flush toilet) linked to Septic tank</td>
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<td>35.0</td>
<td>35.7</td>
<td>42.1</td>
</tr>
<tr>
<td>Pit-latrine/VIP</td>
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<td>12.3</td>
<td>12.5</td>
<td>54.6</td>
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<td>27.3</td>
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