Post-Earthquake Haitian Infrastructure Reconstruction

A Focus on Water & Sanitation in the Town of Leogane

Final Report

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Executive Summary

The overarching goal of this research was to inform decision-making processes concerning water and sanitation by piloting a unique participatory process in Léogâne that could be replicated elsewhere. The work included characterizing the differing perspectives of local stakeholders regarding how reconstruction funds could most efficiently and effectively improve water and sanitation conditions in Léogâne; and demonstrating a process by which the perspectives of a wide range of stakeholders could be elicited rapidly in order to inform post-disaster reconstruction.

In the report itself we describe the research context and goals (Chapter 1), the history of the water and sanitation sector in Haiti and driving concerns of the research (Chapter 2), and the research methodology (Chapter 3). This is followed by a series of chapters presenting detailed findings on the pre-earthquake water and sanitation conditions in Léogâne based on a structured survey (Chapter 4), the results of a participatory workshop (Chapter 5), and expressed preferences for management and payment for water and sanitation infrastructure services (Chapter 6). In the concluding chapter we discuss divergent models of water and sanitation planning and their implications for sustainability. In this Executive Summary we summarize the overall lessons learned from the research.

A. Structured Survey Results

The structured survey responses were used to characterize pre-earthquake water and sanitation practices, and preferences for reconstruction. It was also used to assess the stakeholder's views on who should own future water and sanitation systems in Léogâne, how they should be managed, and how water and sanitation services should be paid for.

A.1 Water sector practices and preferences

The structured survey results provided a range of insights into pre-earthquake water and sanitation practices in Léogâne. The three most common water sources accessed for daily needs were well using buckets (35%), public tap/standpipe (28%), and well using pump (12%). Approximately three quarters of the survey participants indicated that they treated water before drinking it, most frequently using Aquatabs. Commonly cited problems were "a long queue," "water is not always available" or "tastes bad or looks dirty." On average, people traveled about an hour to springs, while public taps, artesian wells and wells with pumps required about half that time. Women were more likely than men or children to be responsible for fetching water, for all sources with the exception of the artesian wells.

Residents of rural areas, younger survey participants, and the unemployed were less likely to have had access to any kind of piped water or standpipe than others.

When asked about their water system preferences, **over 80% of survey respondents indicated that they would prefer water piped to their dwelling or property**, especially for drinking, hygienic purposes, and clothes washing.

A.2 Sanitation practices and preferences

Survey participants described three different types of sanitation practices prior to the earthquake: septic and flush toilet systems, pit latrines, and open field disposal. The sanitation facilities most widely used on a daily basis were "pit latrine/open pit" (~40% of all respondents), "pit latrine with slab" (~25%), "no sanitation" (~15%) and "flush/pour system to septic tank" (6%). Amongst those from the city periphery, up to 60% used "no sanitation, bush or field". The unemployed, females under 50 years old, and individuals from the city periphery were more likely to have had "no sanitation" than other groups.

More than 64% of the structured survey respondents would prefer some kind of water carriage sanitation system to a latrine or to no sanitation. Nearly 70% would be "extremely satisfied" with a flush/pour system and 18% would be "extremely satisfied" with a pit latrine. These results were similar for all survey participants regardless of age, employment status, gender, or location.

A.3 Management of water and sanitation systems

At the time of the research, Haiti was in the midst of reorganizing governmental responsibility for water and sanitation, with water and sanitation governance responsibilities being transferred from CAMEP and SNEP to DINEPA. This transition would theoretically enable the private sector and local water committees to participate in the provision of water services. However, few study participants seemed aware or the government's plans for reorganizing the water and sanitation sector.

A plurality of survey participants (29%) approved of the national government owning and managing the water supply, followed in order of preference by local government (18%), the private sector (12%), local water committees (11%), regional government (7.6%), and individuals (4.7%). However, these results differed from the viewpoints expressed by the interviewees, over 50% of whom favored local water committees playing a role in providing these services.

A plurality of survey participants (31%) also approved of the national government owning and managing a sanitary system, followed in order of preference by the local government (18%), local water committees (11%), the private sector (11%), individuals (3.5%), and regional government (1.1%).

A.4 Management of water and sanitation systems

Because so many different entities were identified by the study participants as potentially playing a role in the management of future water and sanitation systems, general attitudes toward different

levels of governmental and toward non-governmental organization (NGOs) were assessed during the interviews.

Attitudes toward the national government were generally either unfavorable or neutral (47% each) with only 5% reporting favorable attitudes toward the central government. Local government had a much higher percentage of favorable responses (16%), although unfavorable attitudes (37%) were somewhat more frequent than neutral attitudes (32%). **Attitudes toward local organizations and committees were generally favorable (47%) to neutral (42%) with only 11% unfavorable.**

Attitudes toward foreign NGOs were categorized as 26% favorable, 52% neutral, and 16% unfavorable with 4% not addressing the issue. The reasons cited for favorable attitudes for foreign NGOs included gratitude for assistance, while unfavorable attitudes were based on a concern that qualified Haitians were not allowed to fill more senior positions, the belief that the organizations had large collected amounts of money from international donors for reconstruction yet had not brought a commensurate level of assistance to the people of Haiti, and a perception that the personnel were out of touch.

A.5 Willingness to pay for water and sanitation services

The majority of structured survey participants indicated their willingness to pay for water and sanitation services. **Nearly 70% of structured survey respondents would be willing to pay for a reliable water supply, 75.6% would pay for safe water, and 75.9% would pay for close proximity water.** These results were mirrored in the interviews, with roughly two thirds willing to pay for water. Many interviewees mentioned that they already pay for bottled water or sachets, or purchase it from private vendors.

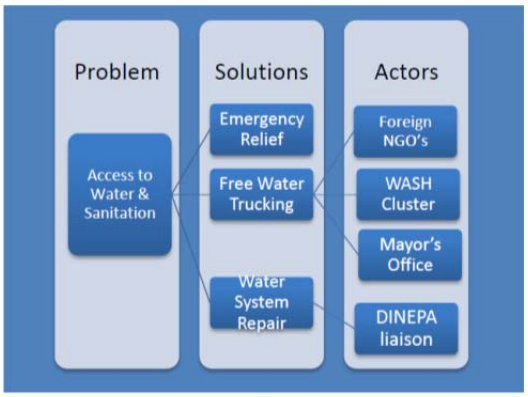
Willingness to pay for sanitation services was slightly lower. **Over half of the survey participants were willing to pay for both reliable and close sanitation facilities, with more (65%) willing to pay for reliability than for proximity (53%).** Less support for sanitation fees than for water fees was also evident in the interviews, with some suggesting that payment for sanitation services be included in water fees.

It is worth noting that while a majority of study participants expressed a willingness to pay for water and sanitation, a substantial majority did not. Some of the concerns associated with a fee-based system seemed to center about affordability among the poor, the potential for misuse or misappropriation of fees paid, and a lack of transparency regarding government decisions.

B. Governmental and Non-Governmental Approaches to Improvements in Water and Sanitation

Interviews with a wide range of representatives from governmental and non-governmental organizations were conducted. The information gleaned from these interviews was used to develop

"mental models" to describe how NGOs and governmental actors seem to see the water and sanitation problem in Leogane (Figure B1 and B2).



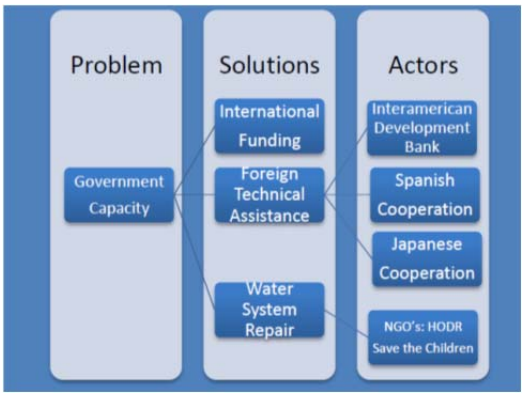


Figure B.1 The NGO "Emergency Relief" modelFigure B.2 the Government Plan

B.1 The NGO "Emergency Relief" model

The main problem is identified as immediate access to water and sanitation. This produces an emergency relief solution, centered on free water trucking and building of shallow latrines. Efforts are piecemeal and vary in terms of focus (drinking water vs. sanitation) and service area (from individual settlements to community clusters). The NGO actors generally work with others in the WASH Cluster, and have some interaction with the Mayor's Office, which is viewed as a weak actor without capacity to implement anything or even participate fully in planning processes. In most cases, installation and service are provided free of charge with no provision for long term operational costs. Some NGOs were also working closely with DINEPA to help re-build the piped-water system in Léogâne, but this has been done without any local consultation or participation. While some relief agencies planned to begin local consultation, WASH cluster meetings indicate that others simply withdrew services within a year, when their funding for free services such as water trucking ran out.

B.2 The Government Plan

DINEPA's planning focused only on provision of piped drinking water in the urban core of the City of Léogâne, and ignored sanitation for the time being. The restored system is to be publicly owned but decentralized to regional offices of DINEPA, with management gradually transferred to public or private operators under regulatory oversight on a regional and national basis. They conceptualize the main problem as one of government capacity. The solution to this problem is to gain international funding and foreign technical assistance; and to then keep the system running with payment for services to contract operators. Users would pay based on metered consumption, with revenues remaining at the regional level to implement repairs and manage the system. Current DINEPA plans

under development for sanitation seem to include payment not for use, but for the emptying of latrines.

B.3 Local Perspectives

In contrast to these two models, local interviewees and workshop participants suggested multiple solutions customized to the needs of the urban, peripheral, and outlying zones of the city. They recognized the need to address protection of source waters and the environment in general, irrigation, water treatment, public and private drinking *and* sanitation facilities. They also suggested that people are willing to pay for and co-manage services. They also noted the need for a national legal framework. They identified the main problem as being a comprehensive one of sustainable water access, sanitation and irrigation. While local stakeholders recognized the need for foreign technical assistance and NGO assistance, they also clearly identified local self-organization and the use of water committees as possible solutions, and included participatory processes in their vision of rebuilding.

C. Workshop Results

The workshop was designed to help to characterize how local stakeholders view the water and sanitation problem. It was structured around two main break-out sessions in which deliberation and voting took place, with plenary sessions following each during which a vote of the full group was recorded. The morning-sessions aimed to elicit action items to solve Léogâne's water and sanitation problems. The afternoon sessions elaborated the five top ranked action items from the morning.

The research team found it striking that the top-ranking action item ("***Protect the environment in the city and in the plains, from the mountaintops down to the valleys"***) was fundamentally an expression of the general importance of environmental protection. This outcome appears indicative of the participants' fundamental belief that the success of structural solutions is ultimately contingent upon the general integrity and general health of the local environment.

The second highest ranked action item ("***Promote Hygiene, repair and extend the quantity of pipe bringing water into people's home, dig artesian wells, public fountains with potable water, build modern bathrooms in each home"***) did encompass a very broad set of structural infrastructure improvements, but also mentioned the promotion of hygiene, a non-structural approach to improving water and sanitation outcomes.

The third ranking solution ("***It is important that each neighborhood has its own water system, build public and private bathrooms, and make sure people pay for the services"***) alludes to the need to customize solutions to the needs of different neighborhoods, but also recognizes the importance of differentiating between public and private initiatives, and suggests that fees be charged for these services. The research team interprets the emergence of this action item as among the top five as evidence that local stakeholders recognize that a "one size fits all" approach would not be appropriate

for communities within Léogâne. It also appears to outline a role for both the government and local residents, who are also expected to have to pay for water and sanitation.

The fourth ranking solution ("***Protect the water sources, treat the water and dig irrigation canals"***) makes reference to both protecting water sources and digging canals for irrigation, introducing the need for regional watershed management strategies that address water sources up in the hills and agricultural irrigation needs on the plains.

The fifth ranking solution ("***Dig more artesian wells, lay more pipes we also need a surveillance committee and to plant more trees"***) incorporates both decentralized (artesian wells) and centralized (pipes) solutions, presumably serving different populations. It also makes reference to "surveillance committees" as a community-based way of maintaining the water system, and ensuring reforestation in the hills.

D. Conclusions

The overarching goal of this research was to inform decision-making processes concerning water and sanitation by piloting a unique participatory process in Léogâne that could be replicated elsewhere. Specifically, we sought to 1) characterize the differing perspectives of local stakeholders regarding how reconstruction funds could most efficiently and effectively improve water and sanitation conditions in Léogâne; and 2) to demonstrate a process by which the perspectives of a wide range of stakeholders could be elicited rapidly in order to inform post-disaster reconstruction. The various research methods helped characterize the depth and breadth of the local water and sanitation problem in Leogane. The methods also helped to elicit a wide range of potential solutions to those problems from individuals with in-depth understanding of local conditions.

The interviewees and workshop participants appear to have a very holistic understanding of the complexity of the local water and sanitation problem. **Indeed, workshop participants identified a much wider array of potential water and sanitation initiatives than did government or NGO interviewees.** The diversity of ideas introduced by the participants during the workshop was more extensive even than those included on the structured survey or semi-structured interview questions produced by the research team.

As became evident during the workshop, **local stakeholders intimately understand the relationship between environmental protection, education, and centralized and decentralized infrastructure strategies.** Local interviewees and workshop participants suggested multiple solutions customized to the needs of the urban, peripheral, and outlying zones of the city. They recognized the need to address protection of source waters and the environment in general, irrigation, water treatment, public and private drinking and sanitation facilities. They also emphasized that people are willing to pay for and co-manage services, while underscoring the need for a national legal framework.

While recognizing the potential value of international organizations in funding and/or providing technical assistance, local stakeholders also clearly expressed that these organizations should work collaboratively with the community, and local governmental authorities. **The workshop participants indicated a strong desire to participate substantively in the reconstruction decision-making process themselves, with many expressing a willingness to attend monthly meetings to continue the dialogue begun at the meeting.**

The study team's general impression was that the comprehensive dialogue that was fostered among the participants during the workshop carries great potential for informing more sustainable water and sanitation practices in Léogâne. In a post-workshop evaluation survey, many participants expressed having truly appreciated the opportunity to discuss their ideas with others, and a desire to continue to find ways for their ideas to be heard, and to potentially be implemented.

We conclude that in Léogâne, and despite the upheavals of the earthquake:

- There is clearly a constituency at the local level who would be **willing to participate** in the conceptualization, implementation, and potential operation and maintenance of future water and sanitation systems in Léogâne.

- Moreover, this local constituency **demonstrated a deep understanding of the complex nature of the water and sanitation challenges** in Léogâne, and had specific ideas about how to custom tailor solutions to address unique local conditions.

- Our research further identified the **critical gaps in communication** between national-level planners, international NGO's, and local citizens, civil society organizations, and local government officials. These gaps reinforce divergent visions of what needs to be done, and how the recovery and reconstruction effort should proceed.

General recommendations that emerge from this research are that:

- Local stakeholders have knowledge, ideas, and energy that could be leveraged in efforts to plan and to implement reconstruction strategies in Léogâne.

- A better understanding is needed of the relationship between the desire for local knowledge and participation; and the actual capacity, means, and appropriate interactional settings for carrying it out.

- Participatory processes – including local stakeholders as well as foreign and local engineers – should be augmented and strengthened during any post-disaster emergency response, rather than replaced by foreign NGOs or government dictate in an effort at quick fixes.

- If undertaken systematically this would help generate far greater stakeholder participation in government or donor financed development efforts and hence contribute to the long-term sustainability of such efforts.

We conclude that greater attention by both engineers and social scientists to multi-stakeholder arenas, interactions amongst actors, and unfolding decision-making processes, can contribute to better post-disaster engineering. **Local participation in post-disaster engineering projects can actually provide better and more comprehensive solutions to complex problems that cut across human and natural systems, can help to build in local capacity, and ultimately can shore up the sustainability of the entire infrastructure system and thereby reduce social vulnerability when the next disaster comes along.**

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1. Introduction and Goals

The January 12th, 2010 earthquake in Haiti was one of the worst natural disasters recorded in modern history. It has been estimated that more than 230,000 people perished, another 300,000 were injured to various degrees, and 1.5 million were made homeless and the infrastructure suffered extensive damage. Total damages were estimated at US$8 billion.

The earthquake was followed by many pledges of aid. About US$2 billion was raised from individual donors immediately after the quake; approximately US$5 billion was pledged by different national governments at the Donors' Conference held in New York in late March of 2010, a number which later rose to US$9 billion (IHRC 2011). The International Monetary Fund also pledged to cancel US$268 million of Haiti's debt in July 2010 (IMF 2010).

In comparison to Haiti's 2009 Gross Domestic Product of $8.335 billion – or to the $4.8 billion in overseas development aid that Haiti received from donor countries between 1998 and 2008 rising to almost $1.48 billion in 2009 according to the Organization for Economic Cooperation and Development (OECD) – the $9 billion pledged by the international community after the earthquake raised many hopes for the reconstruction. Specifically, it initially appeared to present a significant opportunity to simultaneously promote all three pillars of sustainable development (e.g. economic, ecological, social). This opportunity was recognized explicitly in The Action Plan for National Recovery and Development produced by the Haitian government which stated:

> *"In many ways it is an opportunity to unite Haitians of all classes and origins in a shared project to rebuild the country on new foundations… [the plan] is structured in such a way as to make it possible to address the urgent, crucial problem of massive poverty and the high vulnerability of the people, and the requirement to rebuild the economy, society, and the territory on better-balanced and sustainable foundations."*

It was during this transitional phase that a team lead by Drexel University researchers, and funded by a National Science Foundation Haiti-RAPID grant, began investigating the opportunity that investments earmarked for improvements in water and sanitation could play in promoting sustainable development in Léogâne, a city situated about 30km west of Port-au-Prince and close to the epicenter of the quake (Fig 1.1). The Reconstruction Action Plan had earmarked US$160 million (or approximately 4% of its first 18 months of reconstruction expenditures) toward the goal of achieving 60% drinking water access, and 58% sanitation access in metropolitan zones. At the time, it appeared that imminent decisions were to be made about how to go about achieving these goals in Léogâne, as well as in other cities impacted by the earthquake.

The overarching goal of this research was not to track how much of the pledged money arrived and how it was spent, but rather to inform the actual decision-making processes by piloting a unique participatory process in Léogâne – one that could be replicated elsewhere. If money were made available, how could stakeholder needs be considered in decisions regarding its disbursement? Could such decisions promote social, ecological, and economic sustainability? How could local stakeholders get an opportunity to participate in these decisions? Would reconstruction fundamentally build up local capacity? To what extent would local stakeholders be able to shape the reconstruction process?

Figure 1.1 Location of Léogâne and the Earthquake Epicenter within Haiti

The team's focus on water stems from the social, economic, and environmental significance of decisions regarding "who gets what water, when and how…" (UNESCO 2006). Water is one of ten indicators used by the United Nations Development Program in computing the Multidimensional Poverty Index (Alkire and Santos 2010 as cited in UNDP 2010) and is linked to all eight of the Millennium Development Goals (Soussan 2002 as cited in UNESCO 2003.) Access to clean water and sanitation is recognized as a human right under the Universal Declaration of Human Rights, and is one of the Guiding Principles on Internal Displacement of the U.N.'s Office for Coordination of Humanitarian Affairs (OCHA 1998), which was to oversee the earthquake response.

Because of the importance of water decisions to so many different sectors of society, the research team set as its **first goal** to characterize the differing perspectives of local stakeholders regarding how reconstruction funds could most efficiently and effectively improve water and sanitation conditions in Léogâne. Although such infrastructure decisions can be made solely on technical data and expertise, in the long term more successful designs are developed with intensive stakeholder input. The participation of local stakeholders in the conceptualization and design of infrastructure projects acknowledges the "stake" that the intended beneficiaries have in the project's outcome, and increases the likelihood that these investments will directly address local needs.

Historically, public participation has been rare in policy decisions In Haiti. The top-down manner in which infrastructure and other policy decisions are typically made resulted in a wide range of unintended local consequences. For example, large-scale water projects such as the Péligre dam built in 1956 (with loans from the US Government) intended to provide hydroelectric power and irrigation in the Artibonite Valley (completed in 1976 with International Development Bank loans). The project did increase rice production, but also led to upstream deforestation, soil loss, salinization, population displacement, and "utter decimation of agriculture in the central plateau above the dam" (Howard 1997: 7). The participation of local stakeholders in project conceptualization and design can help to avoid such unintended collateral impacts (Greenwood and Levin, 1998).

The team's **second goal** was to demonstrate a process by which the perspectives of a wide range of stakeholders could be elicited rapidly in order to inform post-disaster reconstruction. In such contexts, strong countervailing forces seeking quick-fixes (Kennedy et al. 2008; Lawther 2009; Leon et al. 2009) promoted by "technical experts" often dominate decision making. Increasingly, however, the "conventional top-down approach, by governments and large relief agencies coming in with large projects" is being rejected in favor of "more involvement of local people" and community-driven projects (Fountain 2010: D1). However, practitioners are often challenged in how to rapidly obtain the input of multiple stakeholders, in a time frame commensurate with disbursement of aid.

Three years after the earthquake, the reality is that funds for reconstruction have been slow to be disbursed. Delays in disbursement have been associated with disputes over land titles, a governmental administrative structure that was weakened and decimated by the earthquake itself, and a drawn out national election process. By December 2011, according to the World Bank (Country Brief, January 2012), the international community had delivered over half of the pledges intended in the first 24 months (US$5.5 billion): but US$1 billion went immediately toward debt relief and only US$2.4 billion was spent (out of US$4.5 billion approved) on projects and programs; a large percentage of which returned to the country of origin of the organizations carrying out the projects.

A year later, according to the New York Times article (Sontag 2012) "…just a sliver of the total disbursement – $215 million – has been allocated to the most obvious need: safe permanent housing…While at least $7.5 billion in official aid and private contributions have indeed been disbursed….disbursement does not necessarily mean spent." Significant amounts were still unallocated; "…the United States has more than $1 billion allocated for Haiti sitting in the treasury, and the global Red Cross movement has more than $500 million in its coffers". Yet close to half a million people remained without adequate shelter, potable water, and sanitation three years after the disaster. Overseas development aid ultimately totaled only 3.65 billion in 2010 and 2.57 billion in 2011, according to the OECD (2013).

Though the infrastructure decisions that initially motivated the study have slowed, the study's findings remain extremely relevant. Water and sanitation issues continue to plague the Haitian population. The lack of potable water and sanitation were cited as one of the main factors in determining the spread of cholera during the epidemic that occurred after the introduction of the virus into the country by UN peace keepers from Nepal, which to date has led to more than 648,848 infections and more than

8.036 deaths (as of February 2013). Poor sanitation facilities were also cited as a factor in the lack of security for women and children in the internally displaced persons camps (Haiti Equity Collective 2010; Sheller et al. 2013).

The Haitian water sector remains, in general, in a period of intense transition, with an ongoing restructuring envisioned by a 2009 water law (described in Chapter 2) happening contemporaneously with the emergency provision of free water and sanitation by non-governmental organizations in the wake of the 2010 earthquake. Governmental and non-governmental efforts need to find ways to recover the costs of providing water and sanitation services in a manner that is both economically sustainable and meet users' expectations. Understanding the different perspectives of the various stakeholders and actors is helpful in identifying where common ground exists and where further deliberation is needed.

Stakeholder perspectives on the water and sanitation issue, and a cost-effective procedure for eliciting them, thus remain crucial to the policy and infrastructure decision making processes in Léogâne, and elsewhere in Haiti. DINEPA, the governmental entity with responsibility for water and sanitation decisions in Haiti, calls for a process described as "social engineering" (not to be confused with the meaning of this term in English, which often has negative connotations):

> *"Social engineering [l'ingénierie sociale]… rests on community participation but goes even further in the degree to which it pushes the community to take ownership of the projects in their phases of conception, realization, and implementation. Significant results have already been obtained in Haiti by the application of the philosophy and methods encompassed by Social Engineering. The application of social engineering is equally a gauge in matters of sustainability and the realization of sustainable development." (DINEPA Annual Report, 2009-10, p. 33, translation M. Sheller)*

Despite such statements, there are few indications to date that DINEPA or other international NGOs active in the water and sanitation sector have begun to engage local people in Léogâne with the rebuilding process. There remain few indications that any decisions associated with the reconstruction funds are being driven by any comprehensive planning efforts or with democratic or participatory processes.

The remainder of this report is structured as follows:

In the next section (**Chapter 2**), we provide a description of the nature and history of water and sanitation governance challenges in Haiti, and lay out the goals that drove the research effort.

In **Chapter 3**, we describe the research methodology developed by the Drexel team to investigate some of these driving research questions. This methodology included a survey of physical conditions, a structured survey of the experiences and opinions of local residents, a series of interviews and participant observations, and a full-day workshop attended by 76 local community leaders.

Chapter 4 summarizes what we learned about pre-earthquake water and sanitation conditions and reconstruction preferences, and is based on both our own physical inventory of site conditions and the results of the paper survey administered by the team to local residents.

Chapter 5 documents the results of the full-day workshop attended by the local community leaders. We present and then discuss the significance of the specific post-earthquake water and sanitation infrastructure reconstruction strategies that were formulated by participants in the full-day workshop.

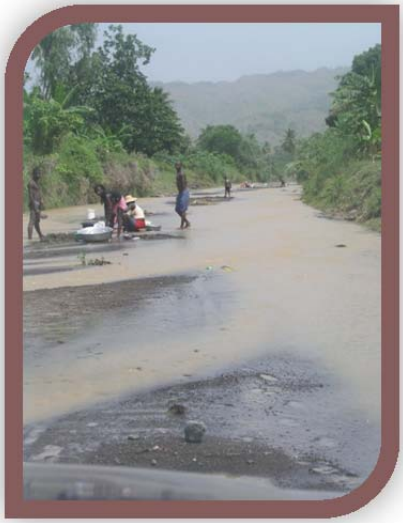
Drawing from all of the research activities, the subsequent chapters present and discuss more specific findings with respect to local preferences on:

Management structure for any new water and sanitation infrastructure strategies, specifically willingness of the community to pay for certain services, and the role of government, NGOs, residents, and the private sector in the plan (**Chapter 6**)

In **Chapter 7** we contrast what we have learned about community water and sanitation preferences with the approach being taken by the Haitian national government and the NGO community

Our conclusions and recommendations are contained in **Chapter 8**.

2. History of WASH in Haiti and Research Drivers



2.1 Site Description

Built on the site of the town of *Yaguana*, the birthplace of native Taïno leader *Anacaona* (c. 1474–c. 1503), Léogâne is historically significant. This province was the last independent holdout during the Spanish conquest of Hispaniola until *Anacaona* was captured and killed by the Spaniards. The French, securing legal access to 1/3 of the island from the Spanish crown by the treaty of Ryswick (1697) made Léogâne the administrative center of their colony of Saint-Domingue. The town was destroyed in 1770 by an earthquake and rebuilt. During the Haitian revolution Jean-Jacque Dessalines ordered his men to burn the town to the ground to force out the last of the French colonists (1803). Rebuilding after major disasters thus marks its past as well as present.

Léogâne is also very culturally significant within Haiti. The countryside of Léogâne is known for having the most traditional *Rara* bands, mobile music troops with distinctive drums and bamboo horns that play during Lent. It is also a center of traditional family Vodou practice, and of traditional familial groupings known as *lakou*, in which land is held in common. Under the sharecropping system known as *demwatye*, which arose after the Revolution, cultivators who did not own land "received 60-75 percent of the harvest and could 'interplant' food crops for themselves amidst the cash crop" (Richman 2005; Ramsey 2011, p. 173). Thus the region is shaped by both large export plantations, and small-scale food cultivation.

However, in the early twentieth century landholdings were consolidated first by regional elites, and later by the Haitian American Sugar Company, HASCO, which took over much of the land on the plain of Léogâne (mainly by leasing) to feed its sugar mills and rum exports, and the small cultivators, known in Haiti as *peyizan*, were expelled. Anthropologist Karen Richman observed that HASCO's operations were still strongly resented by many of her informants in Léogâne, even decades later. As the largest foreign business in Haiti, HASCO operated for 75 years (1912-1987) and displaced small cultivators across the region causing widespread disruption of rural life.

2.2 Background on Water and Sanitation Issues in Haiti

With 12.11 km^3 of internal renewable water resources and an inflow of 0.9 km^3 from neighboring Dominican Republic through the Artibonite River, the physical nature of water sector challenges in

Haiti stems not from resource availability, but from difficulties associated with its distribution. The country receives approximately 1500 mm of rainfall per year, but its mountainous terrain and associated irregular exposure to the dominant winds create strong seasonal, interannual and spatial variability. With extensive deforestation and erosion at higher elevations in the mountains, the irregular rainfall causes both droughts and floods, presenting significant challenges for rain fed agriculture. The nation is hit, on average, by one cyclone (defined as a climatic event with wind speed over 250 km/h) with devastating effects every five years (Aquastat 2000).

As a result of these conditions, only 7.5% of the nation's renewable water resources are utilized (Aquastat 2000), ranking Haiti 138th (between Ethiopia and Eritrea) of all countries in terms of water availability per person per year (UNESCO 2006). Only 70% of the country's urban population had access to improved drinking water as of 2008, with access to piped water having actually declined over the previous decade from 27% to 21%; and only 55% of the rural population had access to improved water (WHO 2010 – Progress on Sanitation and Drinking Water, p.43).

Sanitation has been equally challenging. Until recently, there was no centralized wastewater treatment facility anywhere in the country. In 2006, only 52% of the urban population had access to sanitation (Glieck 2006). Haiti is the only country in which access to improved sanitation has significantly decreased over the past decade as indicated by the sanitation report by the World Health Organization/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (WHO/UNICEF JMP 2008: 15). Until 2009, there was no governmental organization with the responsibility to improve sanitation (Varma et al 2008). The percentage of the urban population with access to sanitation had also fallen over the last decade from 44% in 1990 to only 24% in 2008, and in rural areas from 19% to only 10% (WHO/UNICEF JMP 2010: 47). A report by a French hydraulic engineer in November 2011 noted that:

> *"The outlook for sanitation is… worrisome. There is no sewerage at present in Port-au-Prince. There are no rules in place. Bringing sanitation to an existing urban area requires a completely innovative and unconventional approach. The timelines for achieving a working sanitation system are certainly too long, and costs are hard to estimate when you haven't settled on a specific solution. But building a sanitation system also raises the issue of funding to cover operating costs, on top of the present socio-economic constraints."*[3]

2.3 Water and Sanitation Governance Challenges

A number of factors have undermined the ability of government agencies to manage water and sanitation services in Haiti (both before and immediately following the earthquake). Governance

[3] **http://www.iadb.org/en/news/webstories/2011-11-03/haiti-fixing-port-au-princes-water-service,9640.html**

challenges stem from a history of dysfunctional land tenure systems, the absence of comprehensive infrastructure planning, and haphazard and failed development strategies. Historical political instability and a lack of financial resources also certainly both play a role, but these factors have also been exacerbated by the actions of foreign governments and institutions. In 2001, the United States, for example, successfully blocked disbursements of a $54 million Inter-American Development Bank loan aimed at improving potable water and sanitation services. The US justification for this position was allegedly to limit support for President Jean-Bertrand Aristide (according to internal documents obtained under the Freedom of Information Act), but in reality by blocking this loan, the US significantly handicapped the Haitian government in its efforts to improve access to water and sanitation for the entire population.

Governance of water has also been hindered by a suite of internal institutional complexities. Until 2009, the provision of potable water was under the auspices of two national agencies, CAMEP (*Centrale Autonome Métropolitaine d'Eau Potable*) which operated in Port-au-Prince, and SNEP (*Service National d'Eau Potable*), which operated throughout the rest of the country, assisted by POCHEP (*Poste Communautaire d'Hygiene et d'Eau Potable*) in rural areas. Both CAMEP and SNEP were largely ineffective bodies (PBS 2004) with minimal operating budgets, insufficient to sustain day-to-day operations, or to make investments in providing for future needs. Both bodies were impacted by the ambient disregard for the rule of law that was one of the hallmarks of the Duvalier dynasty (1957-1986) as public administration became politicized and powerful individuals disregarded custom and law in constructing their homes and tapping into the existing water system. This chaotic practice further undermined the existing infrastructure. The few remaining qualified personnel were often hired away by international NGO's offering higher wages and better working conditions. Filling the management void in many communities were hundreds of small water committees, called CAEPs (*Comités d'Aprovisionnement en Eau Potable*) also known simply as *Comités d'Eau* (*Komite dlo*, in Kreyòl), which are still active in many urban neighborhoods, rural areas and small towns (see, e.g., GRET 2010).

In March 2009, a reform process known as *Unité Réforme du Sector d'Eau Potable* (URSEP) created a new law, the *Loi Cadre Portant Organisation du Secteur de l'Eau Potable et de l'Assanissment,* that transferred control of the water sector to a new government organization *Direction Nationale de l'Eau Potable et de l'Assainissementor* (DINEPA), which officially replaced CAMEP and SNEP during the summer of 2009, (although the process of integration of CAMEP into DINEPA was ongoing at the time of this research). The earthquake hit during this period of transition in official water and sanitation governance, during which DINEPA was attempting to establish regional offices, staff its new structure, and establish connections to localities.

As if these institutional challenges were not enough, DINEPA and CAMEP were further laden with fairly ambitious water sector goals written into the Reconstruction Action Plan. These called for 60% drinking water coverage in metropolitan zones, 73% in other urban and rural areas, while simultaneously setting goals of 58% sanitation coverage in metropolitan zones and 50% in other urban and rural areas. To achieve these goals, the Haitian government earmarked only $160 million (or

approximately 4% of its first 18 months of expected reconstruction budget) for this purpose. DINEPA initially appeared to have successfully secured a $40 million third party grant from the Spanish Cooperation Fund for Water and Sanitation in Latin American and the Caribbean (in partnership with the Inter-American Development Bank) (IDB 2013) to provide water supply for intermediate cities, such as St. Marc and Jacmel. It also appeared to have secured a $10 million grant for rural water supply (IDB 2013), and a $35 million grant for a potable water system for Port-au-Prince (IDB 2013). However, as of the end of 2012, only about $300,000, $1.5 million, and $5.5 million, respectively, of these grants had been disbursed.

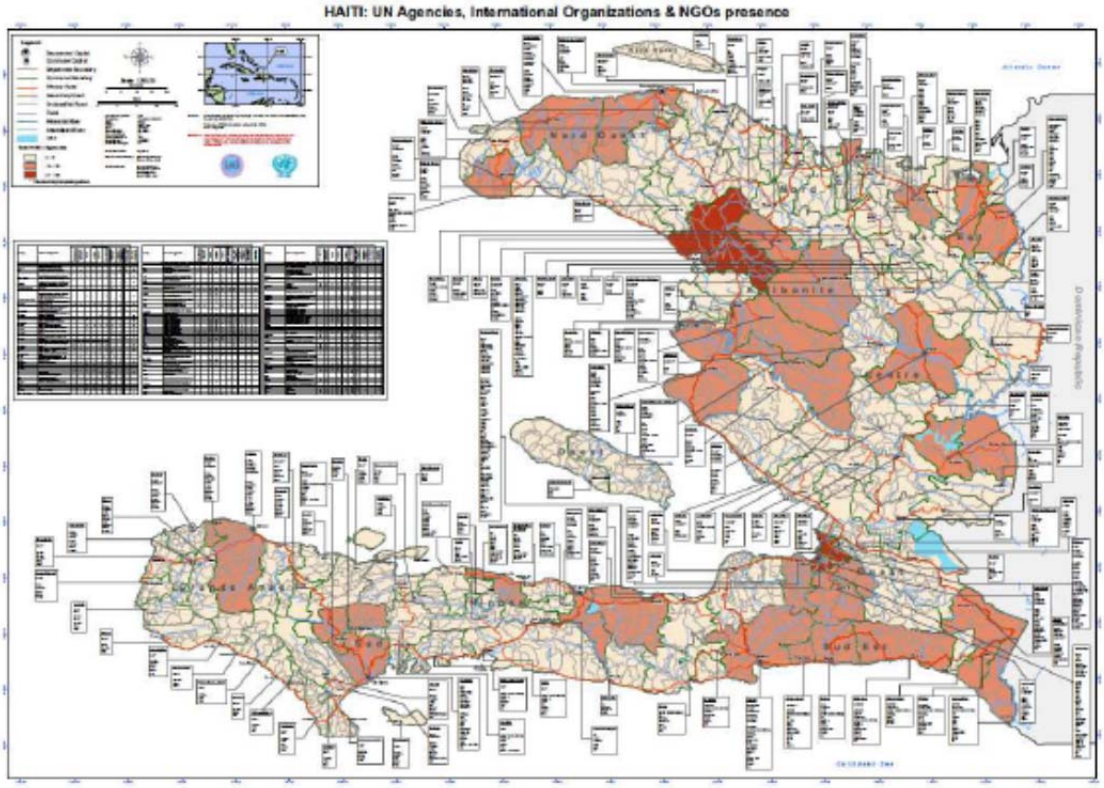


Figure 2.1 Complex web of international NGOs in Haiti (Verella 2010)

A complex web of international NGO's (Figure 2.1) further complicates governance of water and sanitation in Haiti. Some localities, such as *Gressier* near Léogâne, have very elaborate water systems, including piping into homes, kiosks, treatment points, filtering and local management with financing from international donors; other international NGO's dig wells; yet others cap springs and offer either hand or solar powered pumps. In addition some local churches benefit from support of congregations from other countries and have dug wells or developed local water systems. All of these activities generally occur outside of the purview or knowledge of the local authorities. The piecemeal and haphazard implementation of uncoordinated projects contributed to undermining the ability of SNEP to set national water and sanitation priorities, or to use international aid to address community needs.

In its 2006 Strategic Plan, SNEP did encourage NGOs active in the water sector to partner with it. Unfortunately, it had no ability to enforce this coordination (Varma et al 2008). The same remains true of DINEPA today (Nouvellon 2010a). Since the earthquake, many of the international organizations active in Haiti have been loosely organized through the UN Office of Coordination and Humanitarian Affairs (OCHA) "cluster system", including the Water, Sanitation and Hygiene cluster (WASH). This framework, however, operates largely independent of local or national government.

Last but not least, governance of water in Haiti has been made more challenging due to the activities of unregulated private water vendors. Beginning in the 1970's, without government oversight of prices or quality, a number of private water trucking companies began providing drinking water throughout the country (Varma et al 2008). Since that time, water trucking has become big business, providing water to private homes, institutions, and individuals who resell it, often at exorbitant prices, and reportedly at great profit (PBS 2004). Verdeil (1995) found that 10% of the population of the slums of Port-au-Prince purchased water from street vendors. Varma et al (2008) report, for example, that approximately 80% of the population of Port-de-Paix, a port town and capital of the northwestern province, rely on private vendors. In addition, there are many private potable water treatment centers using either reverse osmosis or ultraviolet light or both. These enterprises are not licensed or regulated and there is no testing of the water as to purity or inspection of the treatment facilities to ensure the prevention of cross contamination.

Within this unregulated and disparate context of chaotic water and sanitation systems, despite the rejuvenation of the national water authority and the construction of an excreta treatment center, there exists no overt, sustained effort to involve the stakeholders in the planning and construction of sustainable systems.

3. Research Methodology

3.1 Methods

The overall goal of the research plan was to better understand water and sanitation practices and preferences through an in-depth study in one of the communities hit hardest by the earthquake. Our intention was to use this case study to formulate useful recommendations that might guide decisions about how reconstruction funds earmarked specifically for water and sanitation projects could be most appropriately invested in Haiti, but also in other settings. A parallel goal was to pilot a methodology that can be used to rapidly infuse local knowledge into governmental decisions regarding infrastructure.

Accordingly, the Drexel team developed a multi-pronged research plan with discreet activities designed to survey, rapidly and comprehensively, post-earthquake physical conditions, as well as the perspectives of a wide range of stakeholders about how to improve the situation on the ground. The team included four Drexel professors (three engineers and one social scientist), three community planners from Léogâne, six trained Haitian enumerators, five trained Haitian workshop facilitators, and a base team of Drexel staff and researchers. The plan included a physical survey of water, sanitation, and drainage conditions (n=95 features), a paper survey implemented on the streets of Léogâne using the Kreyòl-speaking enumerators (n=171), a series of interviews (semi-structured, n=19, and in-depth open-ended, n=6) as well as more general participant observations made at two different WASH cluster meetings. The field research culminated with a full-day participatory workshop attended by 76 local community leaders. All field work was conducted over a five month period, during which two, one-week trips to Léogâne were performed. Each of these individual activities is described in detail below.

3.2 Physical survey of water, sanitation and flood conditions in Léogâne

During the first trip, the team performed a physical survey to better understand baseline water, sanitation, and drainage infrastructure conditions to provide context to all the other research activities. During this physical assessment, the team did not distinguish between pre- and post-earthquake status except when it was clear that the earthquake had caused a measurable change from pre- to post-earthquake situation. To this end, the team spent considerable time visiting the Léogâne town center, periphery, and more outlying areas (Figure 3.1).

To select survey locations, the team considered both the administrative structure of Léogâne and its gradient in population density. The commune of Léogâne is situated 30km to the west of Port-au-Prince and consists of 13 administrative units known as sections (Figure 3.1). Approximately one-third of the commune's 300,000 people live in the three sections including and adjacent to its urbanized center, which is also its economic and political base. A grid was superimposed on top of these three sections (Figure 3.1), and within that grid, the team performed half day field visits in each of seven of the grid squares (Figure 3.2). Table 3.1 classifies each of these grid squares as belonging to the "city core", "city periphery" or "outlying areas", and also lists the local place names used to identify those locations.

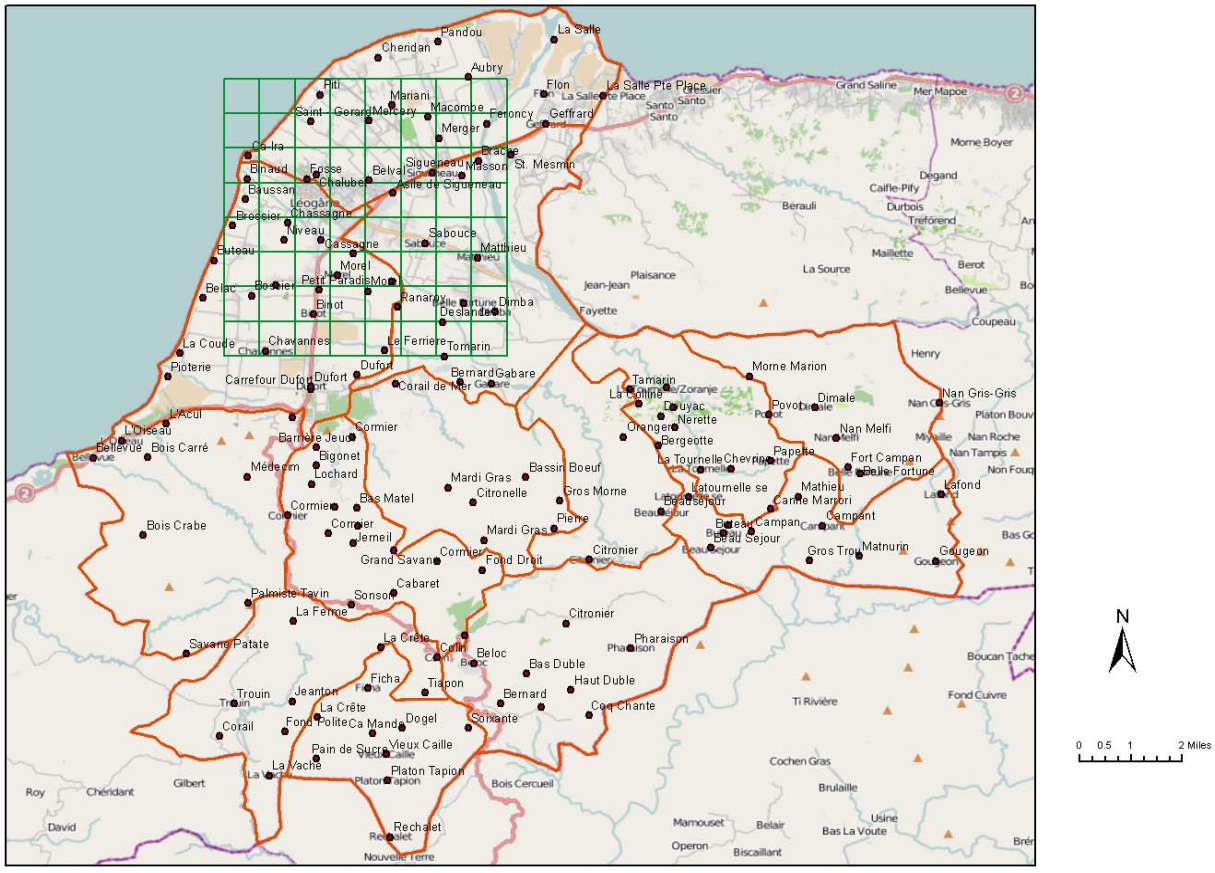


Figure 3.1 Administrative units of Léogâne with grid used to develop research design

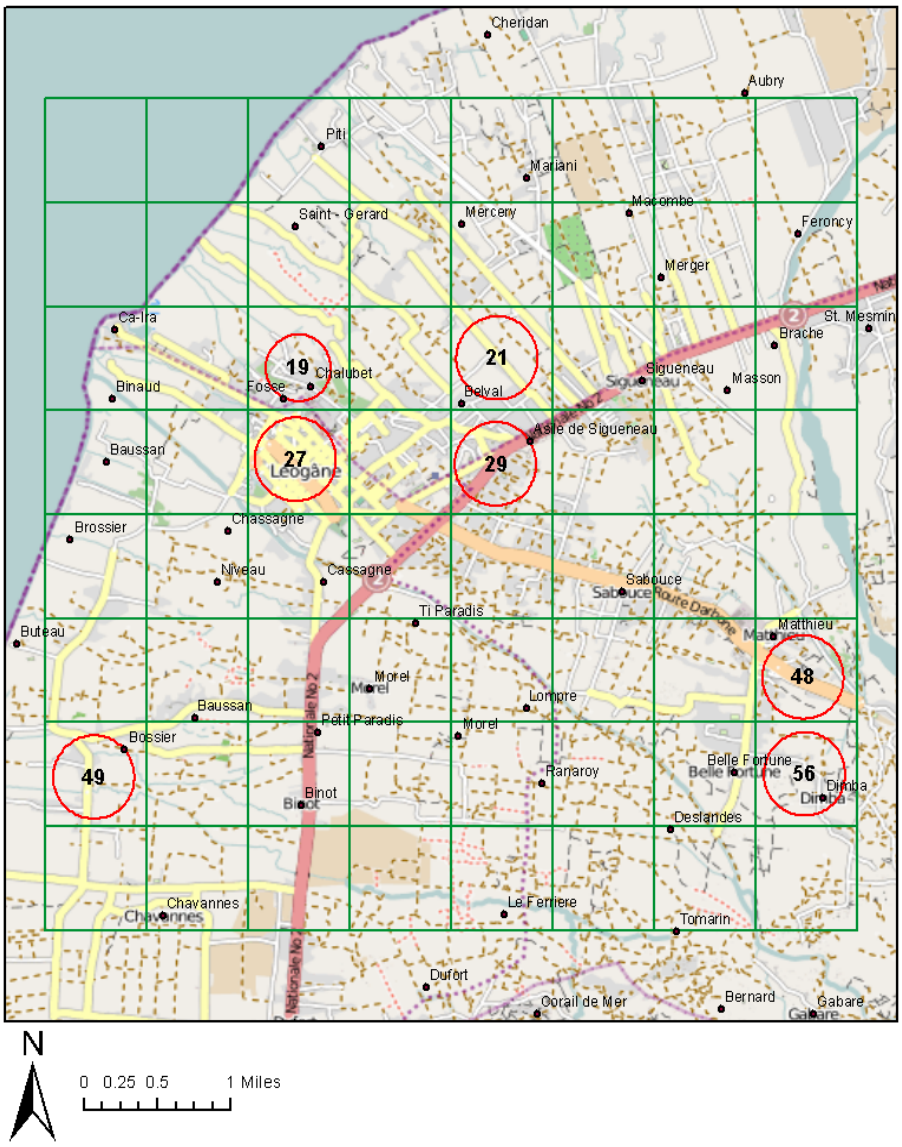


Figure 3.2 Locations of half day visits by Drexel researchers

Throughout the study area, the team used geo-mapping devices to record and take images of water, sanitation, and drainage features in addition to their respective status, i.e. whether they were dysfunctional, somewhat impaired, functional with limitations, or well maintained and fully operational. A total of 95 features were mapped. While time constraints limited the geographic area that could be covered, the final sample appeared representative of physical conditions throughout Léogâne.

Table 3.1 Place names of research locations

Location Classification	Grid ID	Place / Street Names surveyed
City Core	27	Bas Grand Rue, Georges Kernizan, Grand Rue, Rue Chatelain, Rue Danjous, Rue de la Liberte, Rue des Rampas, Rue La Goix, Rue Lavandye, Rue Lopital, Rue Noir, Rue St Catherine, Rue St Lawrent, Ruelle Pandou
City Periphery	19	Fosse, Chalubet
Outlying Areas	21	Belval
	29	Chatule
	48	Mathieu
	49	Degay, Beloque
	56	La Colline, Mapou, Mapou Bussonniere

3.3 Structured surveys

Also during the first trip, the team trained six Haitian enumerators to administer a structured survey in Kreyòl in the same geographic regions covered in the physical conditions survey. The survey consisted of 42 questions about pre- and post-earthquake water and sanitation conditions, practices, and problems, including the "core questions" used by UNICEF and WHO for quantifying the percentage of a population that has reasonable access to water and sanitation and those at risk from flooding.

In each of the survey locations, the enumerators circulated on foot, approaching would-be participants by convenience. While there was no formal protocol to ensure a random sample, the enumerators were instructed to try and balance those whom they approached in order to achieve a representative sampling in terms of age, gender, occupation and other readily identifiable factors. In total, 171 individuals were surveyed, with just over half originating in the outlying areas, and just under a third from the city center (Table 3.2).

Additional details on the gender, employment and displacement status of the survey participants are shown in Figures 3.3, 3.4, and 3.5. Roughly 40% of the subjects were interviewed on the street while occupied in a task. Just over 35% were residing in a residence for displaced persons, while just over 31% were residing in the same location as before the earthquake. Approximately 70% of the participants were categorized as "unemployed" (which can mean informal sector work). Of 81 women interviewed, 84% were unemployed, while of the 90 men interviewed, only 56% were unemployed.

For general reference, Figure 3.6 graphically depicts how participants from each of the geographic areas characterized the level of damage the earthquake caused to their place of residence. More than half of the participants from the outlying areas reported their place of residence "completely destroyed", while the degree of damage to residences in the city center varied more considerably. In all three geographic regions, less than 10% of the participants reported "no significant damage". Figure 3.7 describes where the participants were living at the time of the survey.

Table 3.2 Number and percentage of respondents from different regions of Léogâne

	Number of Respondents	Percentage of Respondents
Location		
City Center	58	33.9
City Periphery	17	9.9
Outlying Areas	95	55.6
Didn't Answer	1	0.6

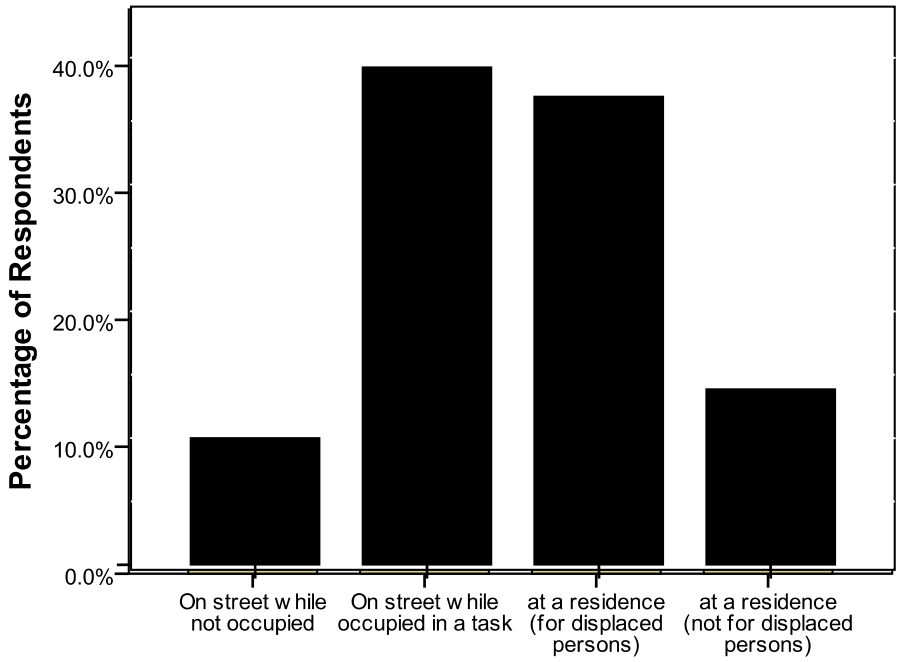


Figure 3.3 Location of inverviewees

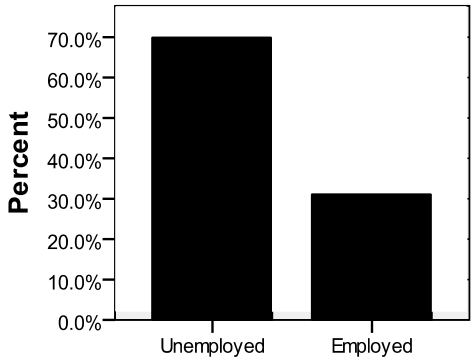


Figure 3.4 Employment status of interviewees

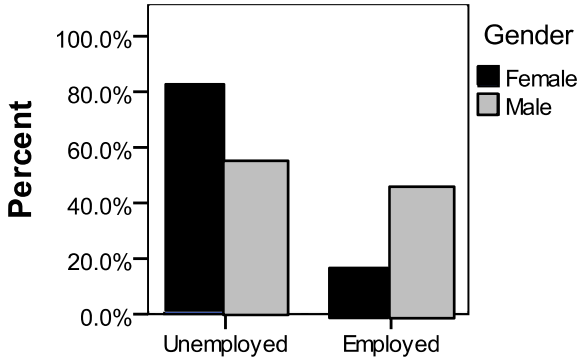


Figure 3.5 Gender and employment status

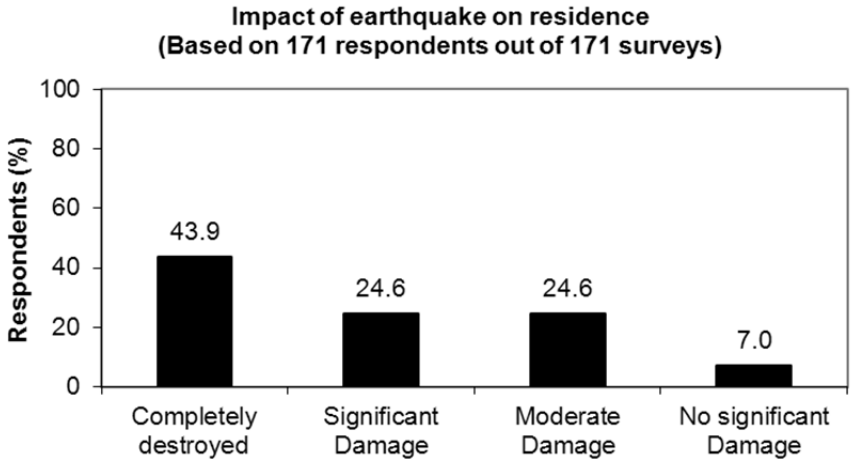


Figure 3.6 Impact of earthquake on residence

The survey results were analyzed by creating contingency plots developed using Microsoft Excel and PASW 19 (formerly SPSS), breaking down the results based on gender, geographic origin, and employment status. Graduate research assistants performed t-tests, Chi-Square tests, and Logistic Regression to test the statistical significance of different responses by these groupings.

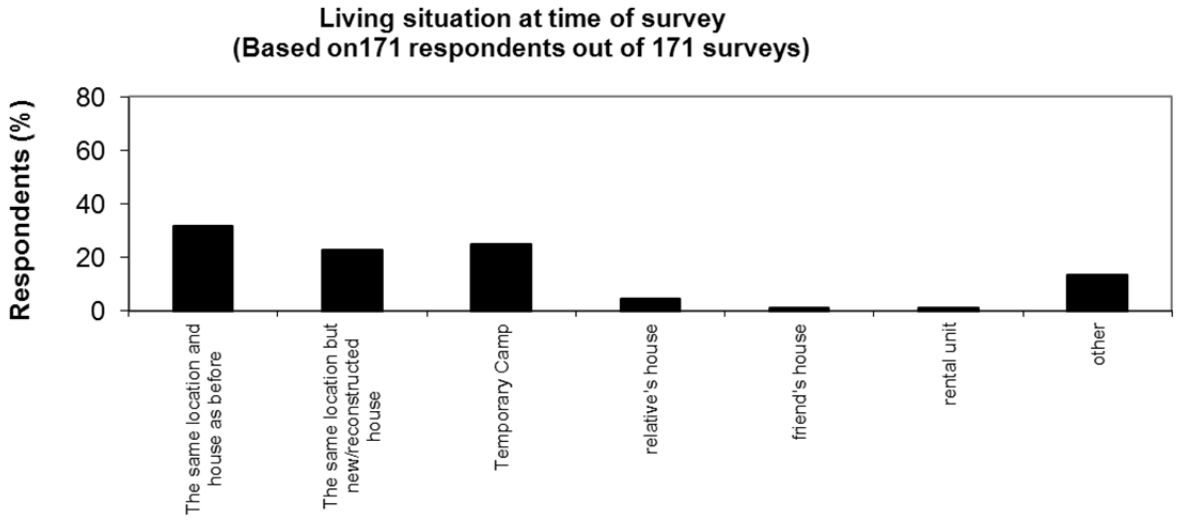


Figure 3.7 Living situation at time of survey

3.4 Interviews

Interviews were carried out during both trips, and also by telephone at other times from the United States. These interviews are classified as semi-structured (n=19), in-depth and open-ended (n=6), and more generally as participant observations (n=2 performed at two different WASH cluster meetings.) The protocol guiding each type of interview is described below.

Semi-Structured Interviews:

Nineteen semi-structured interviews were conducted with a convenience sample, consisting of current residents of Léogâne, expatriate former residents of Léogâne, and non-governmental organization (NGO) representatives. These interviews were conducted by one or two team members (with a Kreyòl translator when required,) and digitally recorded. To guide the process, a set of "discussion points" was initially developed. During the interview, follow up questions were posed both to elaborate participants' answers and to probe for the reasons why particular statements or proposals were made. Each interview lasted approximately 45 minutes. The recorded interviews were transcribed in English and coded for analysis with ATLAS.ti, a software package that allows for the qualitative analysis of large bodies of data. This was used to identify broad patterns of types of responses, common themes, actors mentioned, linkages between problems identified and solutions suggested, and to compare differing groups of interviewees. A separate protocol was also used to check for the presence or absence of certain basic ideas and concepts.

In-depth, Open-Ended Interviews:

Six in-depth open-ended interviews were also conducted (3 in English, 3 in French/Kreyòl) in meetings with representatives of DINEPA, the Ministry of the Environment, and foreign NGO's active in the area. These interviews lasted between 30 minutes to one hour each. Notes taken by hand were later transcribed into ATLAS.ti for coding, using the same categories used for coding the semi-structured

interviews (common themes, actors mentioned, linkages between problems identified and solutions suggested). The in-depth interviews offered a more nuanced perspective on governmental and non-governmental organization views of the water and sanitation issues in Léogâne.

Participant-Observation:

Participant-observation was conducted by the team's social scientist during two different WASH Cluster meetings in Léogâne (both held on 1 June 2010). Observations were also made of notes, comments, and documents posted by WASH cluster members on a Google Group website. Together, these activities provided the team with a general overview of the key participants and activities of the Cluster, and an ongoing sense of how their communication structures worked from April through December 2010. Online participant-observation also extended to the creation of a Twitter account (@HaitiWater) and actual participation in communications amongst Haitian and foreign NGO members, journalists, researchers, and Haitians in Haiti and the diaspora involved in the reconstruction efforts (@HaitiWater had 663 followers as of March 2013.)

3.5 Workshop

During the second trip in July/August 2010, the team trained 10 Haitian facilitators to conduct a full-day participatory workshop, in Kreyòl, attended by 76 community stakeholders identified during the first trip. Invited participants included representatives of youth associations, women's organizations, professional organizations, and small farmer's organizations identified during the first trip.

The overall goal of the workshop was to create a forum for brainstorming, prioritization, and elaboration of solutions to Léogâne's water and sanitation problems. The workshop was specifically designed to focus discussion *only on solutions proposed by the workshop participants themselves*. Drexel team members refrained from introducing any opinions or pre-conceived "solutions" during the workshop process.

The workshop was structured as follows: during an introductory plenary session the purpose of the workshop and a brief overview of the daily agenda were presented to the assembly in Kreyòl by one of the Haitian team members (the workshop MC). Next, the five breakout groups, composed of two of the trained Haitian facilitators (1 facilitator, and 1 scribe) and 10-15 participants each (including two groups composed primarily of residents of the city center), were formed. The facilitator for each breakout group asked each participant to introduce her/himself and, at the same time, to offer an "action item," i.e. an idea for how to improve water supply and sanitation conditions in Léogâne. After the facilitator repeated back and clarified each action item response (without expressing any opinion as to its merit), the scribe transcribed the item onto a flip chart. After all participants in the breakout group had provided their action item ideas, the facilitator led a group discussion to determine whether any of the ideas could be combined, or needed further clarification. Combinations and revisions were only made where consensus was achieved. The aim was to make sure that each action item was unique.

At the conclusion of this process, voting slips were distributed on which each participant was asked to anonymously identify her/his three favorite action items. The votes were tallied by the scribe and the top three action items from each breakout group (i.e. those receiving the greatest number of votes) announced.

Next, in plenary, the top three or four action item ideas identified from each of the five breakout groups (i.e. total of sixteen ideas) were transcribed onto another set of flip charts. The workshop MC facilitated a discussion to determine whether any clarifications were required or if any ideas had been repeated, and could therefore be combined. (No combinations were actually made.) Each action item was assigned a number, and individuals were asked to anonymously cast three votes on voting slips for the action items that they think are the most promising. The top five action items (of the group of 16) were announced to the plenary.




Léogâne Workshop Photos, July 2010 (credit: by M. Sheller)

During a second round of five breakout sessions, pairs of facilitators lead self-selected groups of participants through a second set of activities designed to elaborate the five action items that received the most votes from the plenary. Pairs of facilitators were assigned to each of the top five action

items, and all participants were asked to attend the session associated with the idea they were most interested in. The facilitator of each session asked members of the group specifically to brainstorm a) how the action items from the first round should be implemented, and b) who, specifically would need to be involved. The scribe transcribed individual responses, as they were made, onto a flip chart. After all the "how's" and "who's" were transcribed, the facilitator asked for proposals from the group regarding how to reformulate the action item. Each reformulation was transcribed by the scribe on a flip chart, and again by anonymous ballot, participants were asked to vote for the top three reformulations.

Finally, during a second plenary session, representatives of each plenary session reported back the top ranking reformulation of their particular action item. The entire assembly was asked, once again, to anonymously vote for "the top three," and a concluding discussion was facilitated by the workshop MC once the results were tabulated.

A pre- and post- workshop paper survey consisting of 30 questions was conducted to profile the workshop participants, measure the degree to which their opinions changed as a result of their participation in the event, and to gage their degree of satisfaction and agreement with the workshop outcome. Due to the late arrival and early departure of some participants, an unequal number of pre- and post-workshop survey forms were completed. Sixty-one of the 76 participants filled out the pre-workshop survey. Sixty-nine filled out the post-workshop survey. Of those participants who filled out the post-workshop survey, 79% of the participants strongly agreed with the workshop results.

Table 3.3 Geographic origin, age, and gender of workshop participants

Location			Age					Gender		
City	Plain	Hills	18-20	20-29	30-39	40-49	50-59	M	F	N.R.
24%	61%	15%	3%	42%	27%	22%	5%	54%	19%	27%

As shown in Table 3.3, the majority (close to 60%) of the participants came from City periphery (i.e. "plains"), with about a quarter originating in the City center (i.e. "city"), and the remainder from the outlying areas (i.e. "hills"). A total of 69% were 20-39 years of age, and 54% were male. This latter statistic is indicative of the prevalence of men in leadership and public positions in Haiti, and suggests that efforts at full social inclusion in participatory processes would have to make specific outreach to women and women's organizations in order to ensure more equal representation (Sheller et al. 2013). Over half of the participants characterized themselves as either members or leaders of civic associations (Figure 3.8). Roughly 11% were employed by a foreign organization, and about 6% were elected government officials. Of the 76 participants, only 4% have never offered input into a public decision making process, while 52% previously voted and 50% have spoken with officials (Figure 3.9).

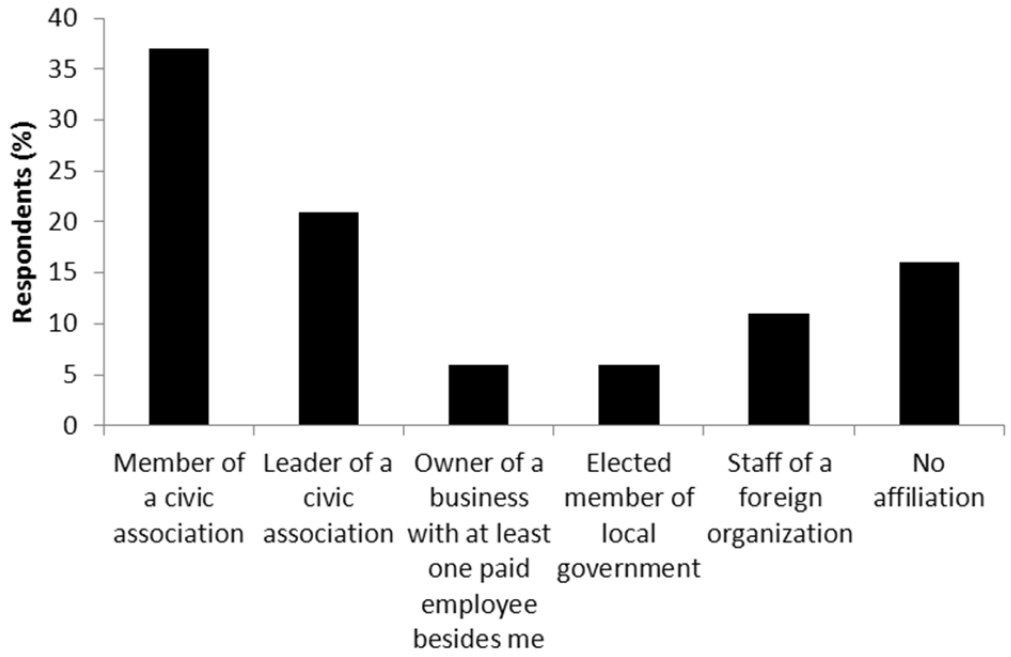


Figure 3.8 Leadership history of workshop participants

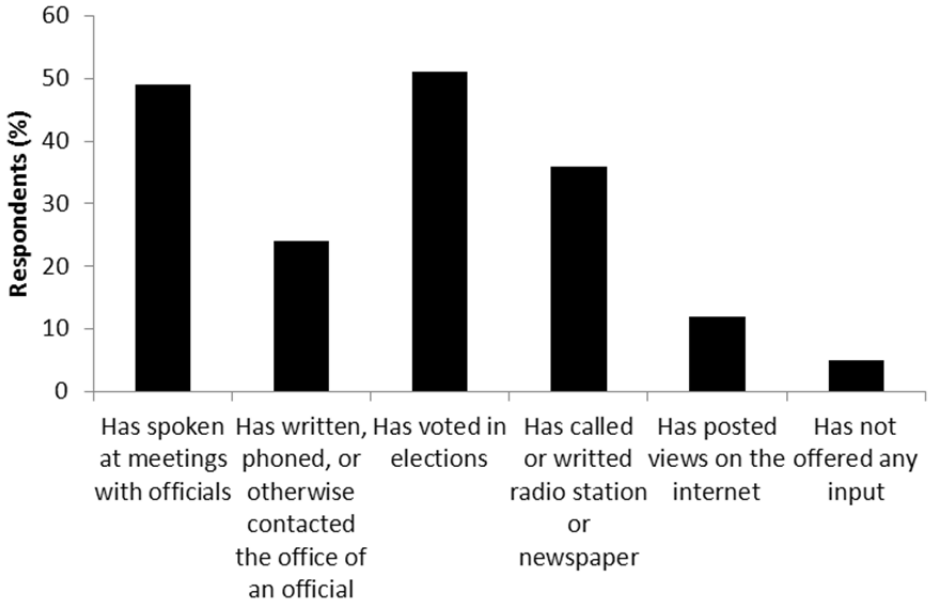


Figure 3.9 Civic engagement history of workshop participants

4. Pre-Earthquake Water and Sanitation Conditions and Preferences for Reconstruction

This chapter summarizes what was learned about pre-earthquake water and sanitation practices in Léogâne, and preferences for reconstruction. It draws heavily from the structured survey, and includes a contingency analysis that breaks down the results based on age group, gender, employment status, and geographic location.

Overview of Pre-Earthquake Water Practices

Portions of the city of Léogâne were, at one time, supplied with drinking water by a centralized gravity-driven distribution system built with international aid money in the early 1980s. The system was fed by an artesian spring on the eastern side of the Momance River. A main distribution line was buried in the river bed and resurfaced on the western side before continuing under the main road to Léogâne's urban center, where it subdivided into a gridded distribution system covering about a 1km by 1km square region. Two smaller lines branched off the main line, one going to the north (the Matthieu branch) and one to the south (the Belle Fortune branch). Another small line branched off the downtown service area to serve Ca Ira in the northwest. In addition to this centralized distribution system, a smaller subsidiary system fed by another artesian spring supplied drinking water to an unknown service area.

While these distribution pipes may have sustained additional damage due to the earthquake, the system had actually been rendered inoperable during the 2008 hurricane season when floods washed out the river bed and destroyed the piping buried in the bed. As a result, even residents of central Léogâne relied on a number of other kinds of water sources prior to the earthquake. Residents from most of the outlying areas never had access to a piped water supply.

Figure 4.1 depicts the percentage of respondents who indicated that they accessed different sources of water at different levels of frequency. The three most common water sources accessed for daily needs were well using bucket (35%), public tap/standpipe (28%), and well using pump (12%). Figure 4.2 is a bar chart depicting the different sources of water accessed by the participants for different uses prior to the earthquake. The bars break down the responses for each use by source. Overall, the top two sources for cooking, clothes washing, hygienic needs, and drinking were "well using bucket", and "public tap/standpipe". Prior to the earthquake, approximately 40% of all respondents relied on "public tap/standpipes" for cooking, clothes washing, hygienic purposes, and drinking. For this same set of uses, the second most frequent source was "well using bucket", but it is noteworthy that the percentage of respondents who relied on "well using bucket" for drinking purposes (<20%), was significantly lower than for the other uses (30-40%). Stated differently, groundwater accessed using wells and buckets was used for nonpotable purposes more frequently than for drinking. Water that was intended for ingestion was more frequently accessed from the "public tap/standpipe" (which may actually have originated in a local borehole).

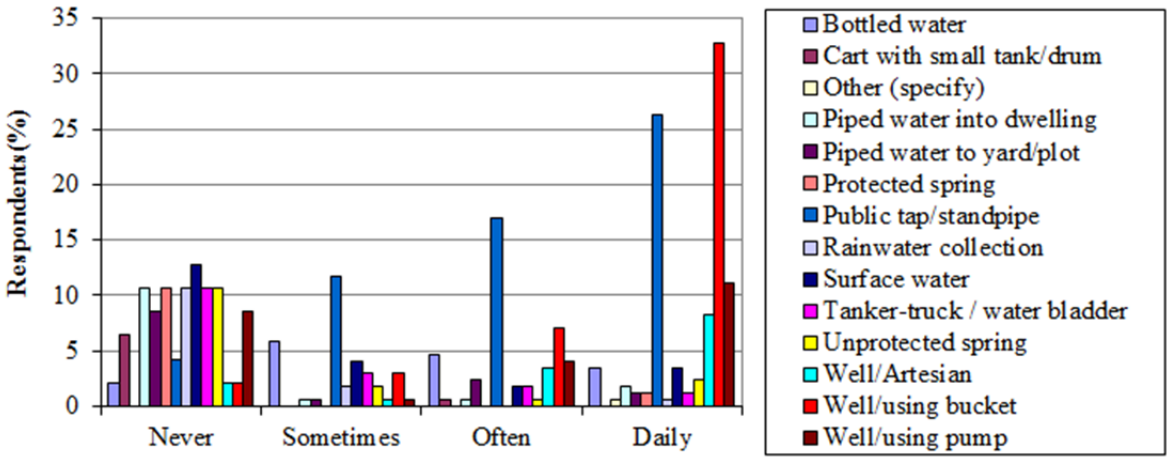


Figure 4.1 Frequency of water source use

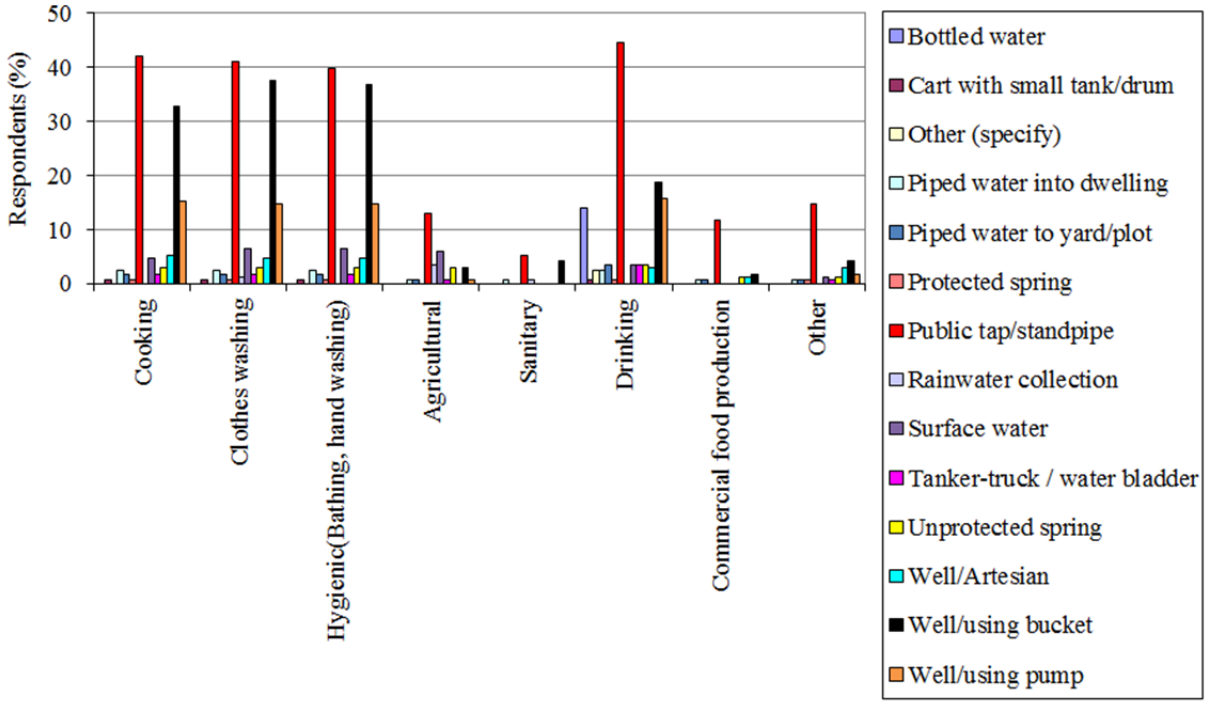


Figure 4.2 Water sources used prior to the earthquake

Of 170 respondents, 74.1% said they treated water before drinking it (Figure 4.3), and the most common form of household treatment was a locally available bleach tablet, known as Aquatab (Figure 4.4). Perhaps because they treated water before drinking, very few respondents listed “sickness” or “death” as among the problem with their pre-earthquake water source. More commonly cited problems were “a long queue,” “water is not always available” or “tastes bad or looks dirty.” (Figure 4.5). Figure 4.6 displays the average number of minutes required to access different water sources,

(includes travel to and from the source, waiting and extraction time, but excludes all socializing time). On average, springs require about an hour, while public taps, artesian wells and wells with pumps require about half that time. Based on travel time, wells accessed using buckets appear to have been most readily accessed at 11 minutes. Women were more likely than men or children to be responsible for fetching water, for all sources with the exception of the artesian wells (Figure 4.7).

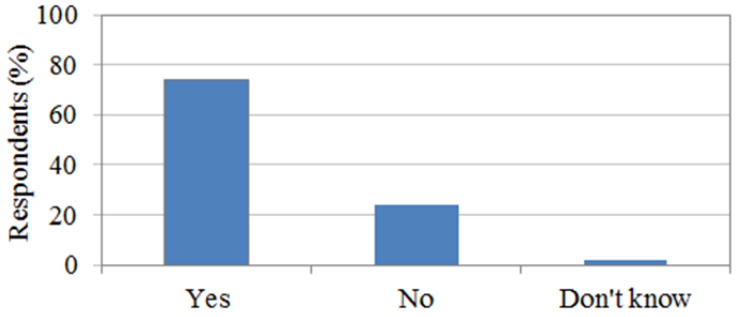


Figure 4.3 Treatment of water before drinking

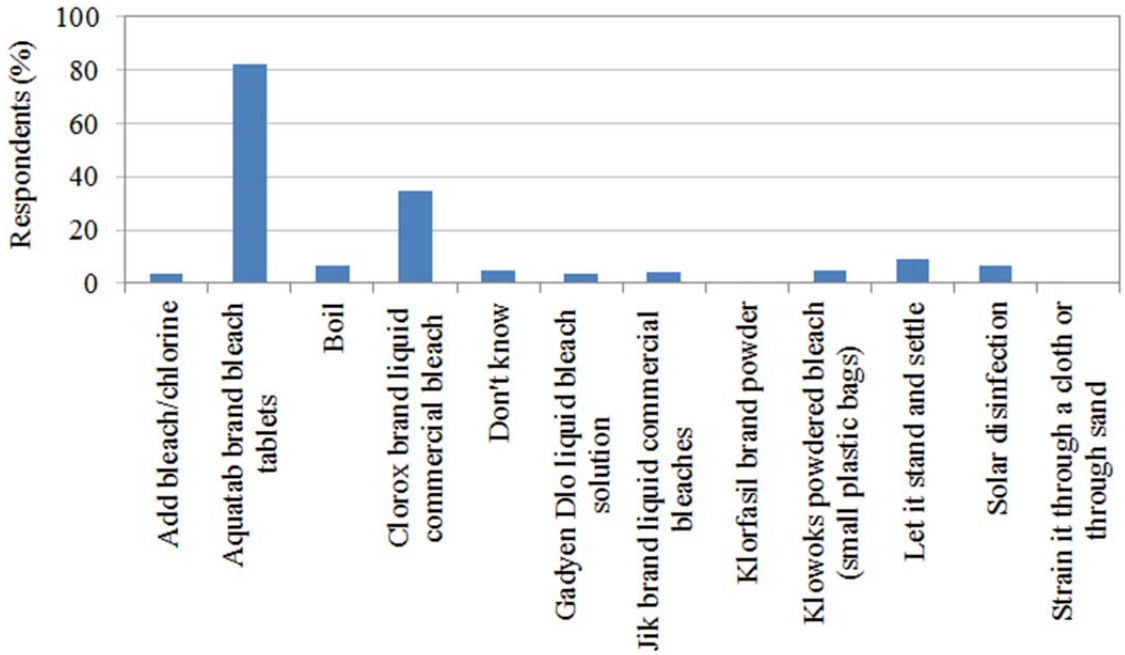


Figure 4.4 Type of water treatment

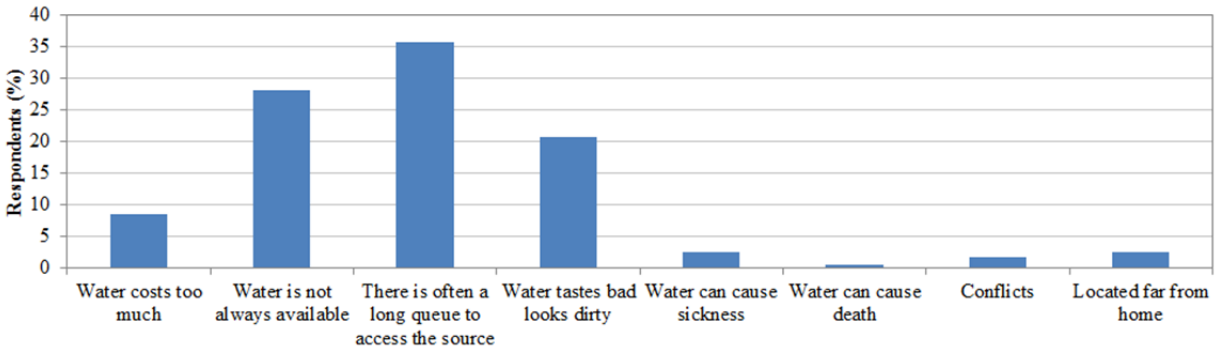


Figure 4.5 Problems associated with accessing different water sources

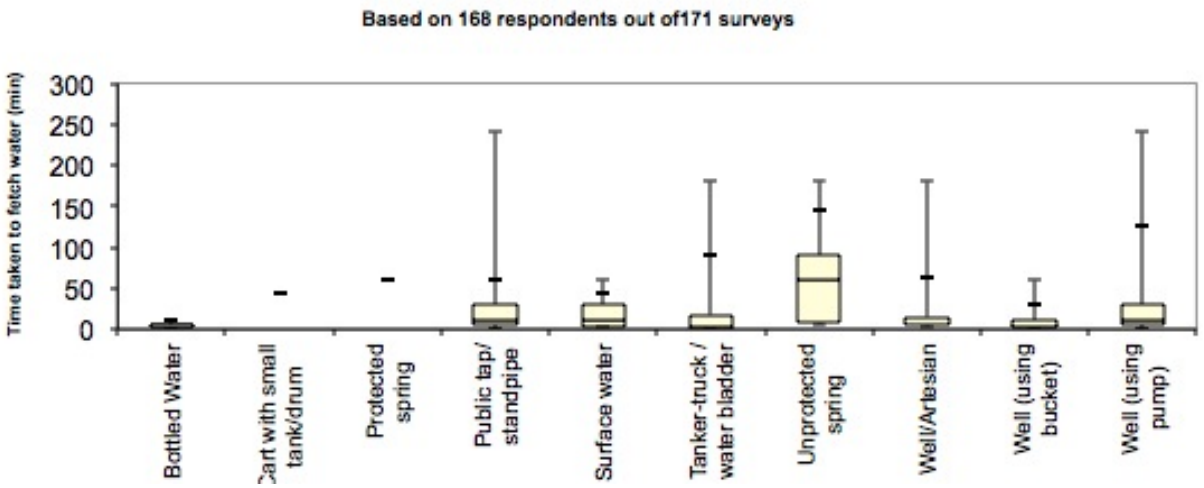


Figure 4.6 Time needed to access different water sources

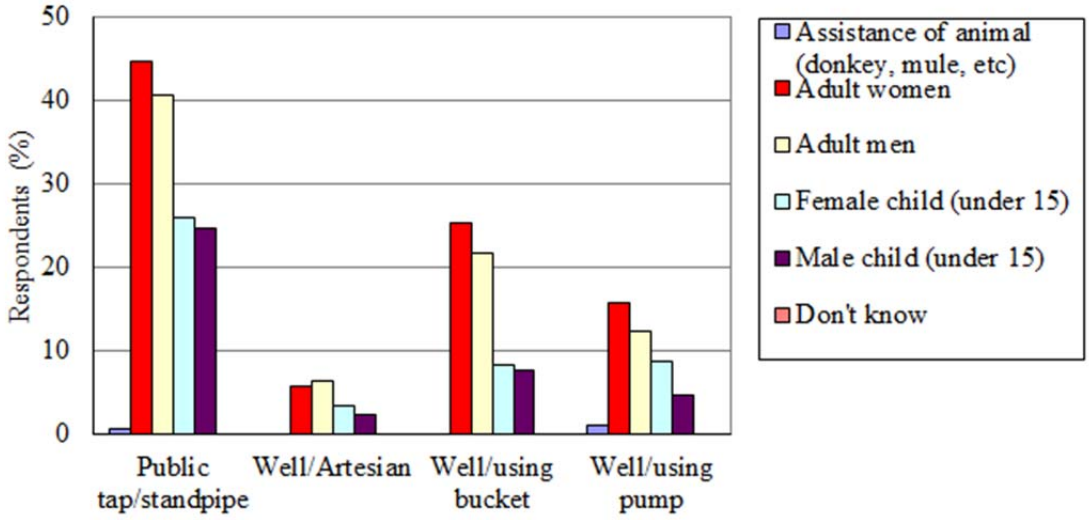


Figure 4.7 Household member responsible for collecting water

A classification system was established to categorize survey responses (and later reconstruction preferences) as referring to either a "centralized" or "decentralized" approach (Table 4.1). For reference, "decentralized" water systems are assumed to include wells, surface water sources, harvested rainwater, springs, water bladders, tanker-trucks, the use of a cart and tank or drum, and bottled water. For the purposes of this report, "centralized" water systems are assumed to include piped water (into the dwelling or yard/plot) and public taps or standpipes. In general, public standpipes may be fed by wells or by a piped supply. In Léogâne, all functioning taps were fed by wells since the public water supply was not functioning at the time of the study. While public taps are hydrologically "decentralized" when fed by local wells, they nevertheless require institutional arrangements to apportion costs among users and for this reason are classified as "centralized" in this study.

Table 4.1 Classification of centralized and decentralized water options

Water Source	**Centralized**	**Piped (Into Dwelling)**
		Piped (Into Yard)
		Public tap/standpipe
	Decentralized	**Well (Artesian)**
		Well (Using Bucket)
		Well (Using Pump)
		Surface Water
		Rainwater Collection
		Unprotected Spring
		Protected Spring
		Cart with Small Tank/Drum
		Tanker-truck/Water Bladder
		Bottled Water

In Figure 4.8 the various reported sources are classified as either centralized or decentralized. With the exception of water used for sanitary purposes and water used for commercial food production, decentralized sources were more frequently used than centralized ones. Table 4.2 is a comparison of pre-earthquake drinking water sources used with the source type that the respondents would prefer to use after the rebuilding process. More than half (53%) of those surveyed stated that they used a decentralized water source to obtain drinking water prior to the earthquake. However, when asked, "As Léogâne is rebuilt after the earthquake, which source of water would you prefer to be available to you?" 83% said they would prefer a centralized one. More detail is provided in Figure 4.9, which shows that for cooking, clothes washing, hygienic purposes and drinking, survey respondents expressed a preference for "piped water to yard/plot" and "piped water into dwelling" above all other sources.

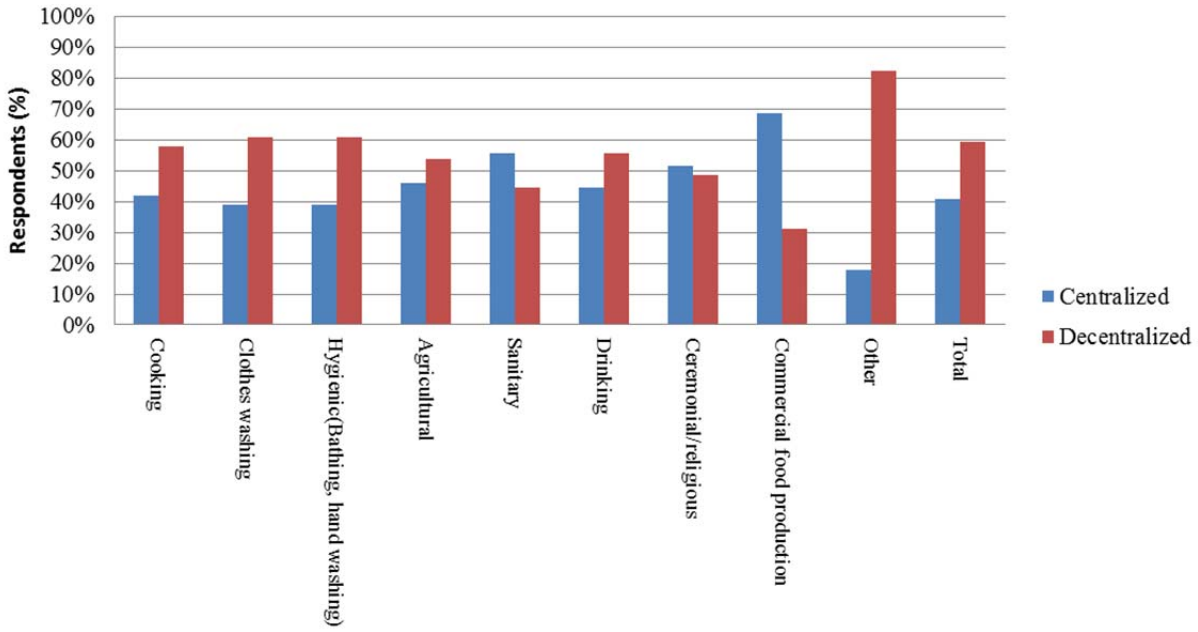


Figure 4.8 Water sources classified as centralized or decentralized

Table 4.2 Comparison of pre-earthquake water sources usage with reconstruction preferences

Water Source	# Using before earthquake	% Using before earthquake	# Who would prefer this source/system	% Who would prefer this source/system
Centralized	59	36.0%	137	83.0%
Decentralized	87	53.0%	28	17.0%
Combination	18	11%	0	0.0%

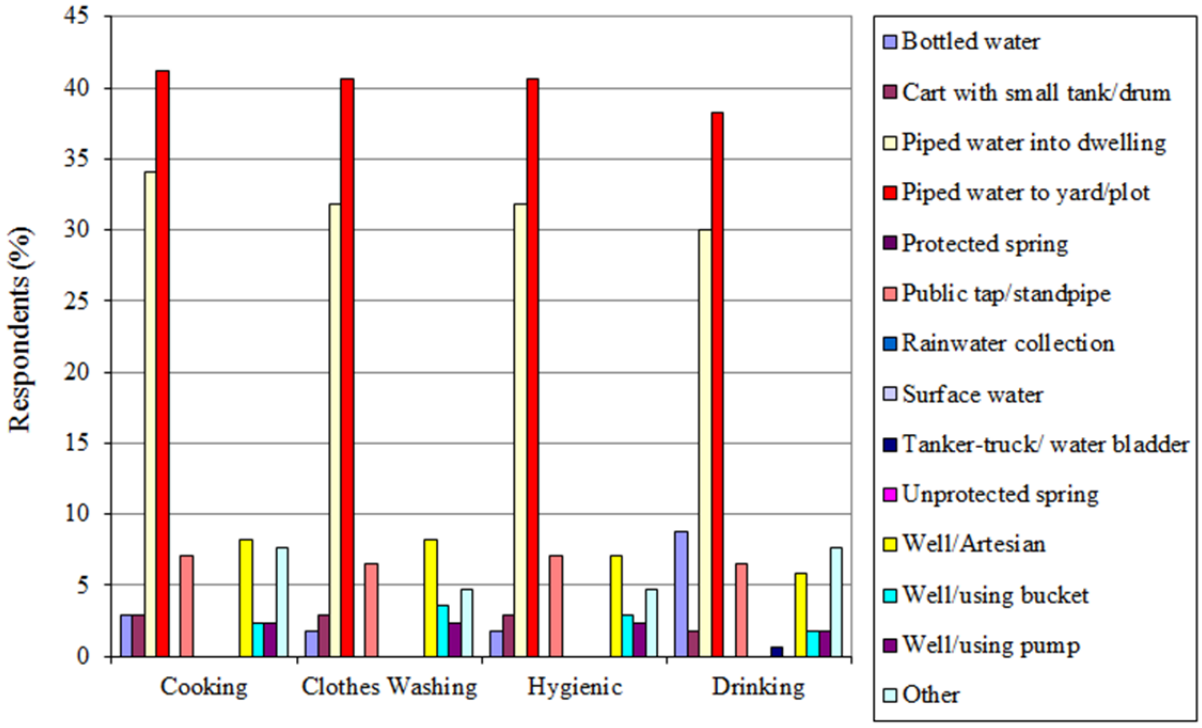


Figure 4.9 Reported preferences for water sources

4.1 Contingency analysis on pre-earthquake water practices and reconstruction preferences

The survey results indicate that before the earthquake the majority of all survey participants obtained drinking water from decentralized sources. In Table 4.3, these results are broken down by age group, employment status, gender, and location, and the significance of the differences in responses tested using a Pearson's chi-square test. Reliance on decentralized sources varied significantly (p=0.027) only by employment status. Of those unemployed, 58.4% relied on a decentralized water system, compared to only 41.2% of employed participants. A small difference was also observed between geographic areas. The city periphery relied less heavily (e.g. 35.3% of respondents) on decentralized water sources than did the city core (53.8%) or outlying areas (55.8%), though these results were not statistically significant (p=0.356). Assuming that centralized water sources are generally more costly to build, operate, and maintain than decentralized ones, the contingency analyses suggest that participants from two specific groups, (e.g. residents of rural areas and younger survey participants), had less access to capital intensive technologies than the rest of the sample.

Overall, the paper survey suggests a general preference for centralized, and specifically piped, water systems. Over 80% of participants in all age groups preferred a centralized water source; as did 100% of participants from the city periphery, and more than 80% of those from the city core and outlying areas. Contingency analyses were used to test for significant differences among the responses of

participants from different groups. Differences between individuals of different age groups, employment status, gender and location were found to be insignificant.

Table 4.3 Number and percentage of structured survey participants using different water sources before the earthquake and preferences for rebuilding, divided by age group, employment, gender and location

	Centralized		Decentralized		Combination	
	Pre-earthquake (n=59)	Preference (n=137)	Pre-earthquake (n=87)	Preference (n=28)	Pre-earthquake (n=18)	Preference (n=0)
Age Group						
0 to 30 years (n=57)	42.1%	83.6%	45.6%	16.4%	12.3%	0
31 to 50 years (n=54)	35.8%	82.0%	50.9%	18.0%	13.2%	0
51 years and over (n=46)	33.3%	87.0%	57.8%	13.0%	8.9%	0
Employment						
Employed (n=53)	39.2%	80.4%	41.2%	19.6%	19.6%	0
Unemployed (n=118)	34.5%	84.2%	58.4%	15.8%	7.1%	0
Gender						
Male (n=90)	37.6%	81.4%	54.1%	18.6%	8.2%	0
Female (n=81)	34.2%	84.8%	51.9%	15.2%	13.9%	0
Location						
City Core (n=58)	34.6%	80.4%	53.8%	19.6%	11.5%	0
City Periphery (n=17)	58.8%	100.0%	35.3%	0.0%	5.9%	0
Outlying Areas (n=95)	32.6%	81.7%	55.8%	19.3%	11.6%	0

4.2 Overview of Pre-Earthquake Sanitation Practices

As in the rest of Haiti, Léogâne never had any centralized wastewater collection or treatment facilities, so people have coped with informal decentralized sanitation measures for some time. There is no collection network that would collect and direct sewerage into adjacent waterbodies, i.e. there is no built outfall at the coastline. Rather, sanitation infrastructure can be grouped into three general types: septic and flush toilet systems, pit latrines, and open field disposal, all of which are elements of a completely decentralized (and privately managed) sanitation system. In the discussion that follows,

we generally classify sanitation infrastructure as either “water carriage” or “dry decentralized” Water carriage systems included the options of using a flush/pour system to a septic tank, an unknown place or somewhere else. Dry sanitation systems included using a bucket, composting toilet, and pit latrine with slab or an open pit, as well as use of an open field.

The survey data presented a base-line portrait of pre-earthquake sanitation measures amongst different populations in the area. Figure 4.10 represents the frequency with which survey respondents used different types of sanitation facilities. The sanitation facilities most widely used on a daily basis were “pit latrine/open pit” (~40% of all respondents), “pit latrine with slab” (~25%), “no sanitation” (~15%) and “flush/pour system to septic tank” (6%). Amongst those from the city periphery, up to 60% used “no sanitation, bush or field”.

Figure 4.11 depicts the types of problems typically associated with different types of sanitation facilities. “Bad odors” and “harassment by animals” were indicated more frequently than other choices for the two different types of latrines. A “lack of privacy” topped the list of complaints for respondents who had “no sanitation.” A significantly greater number of respondents who had no sanitation or used a latrine indicated that they had to share these facilities with other households.

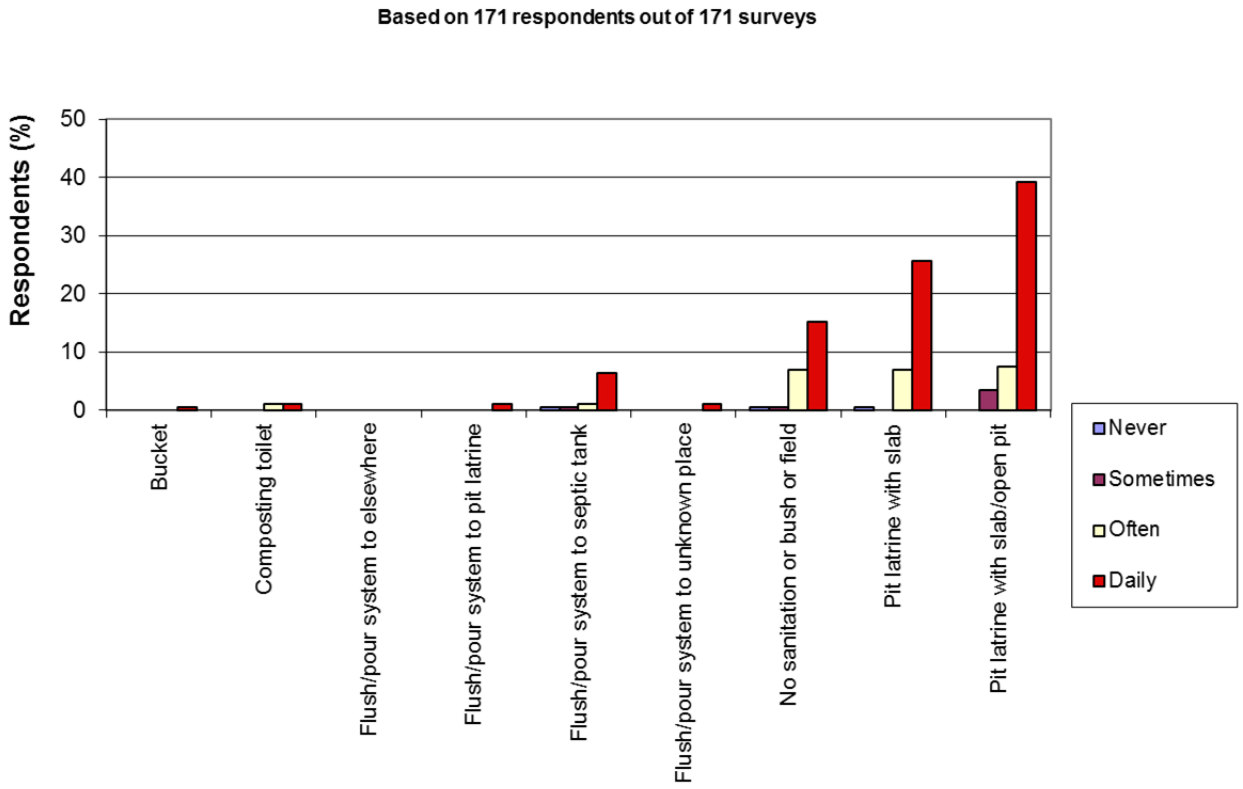


Figure 4.10 Survey response showing frequency of use of different forms of sanitation

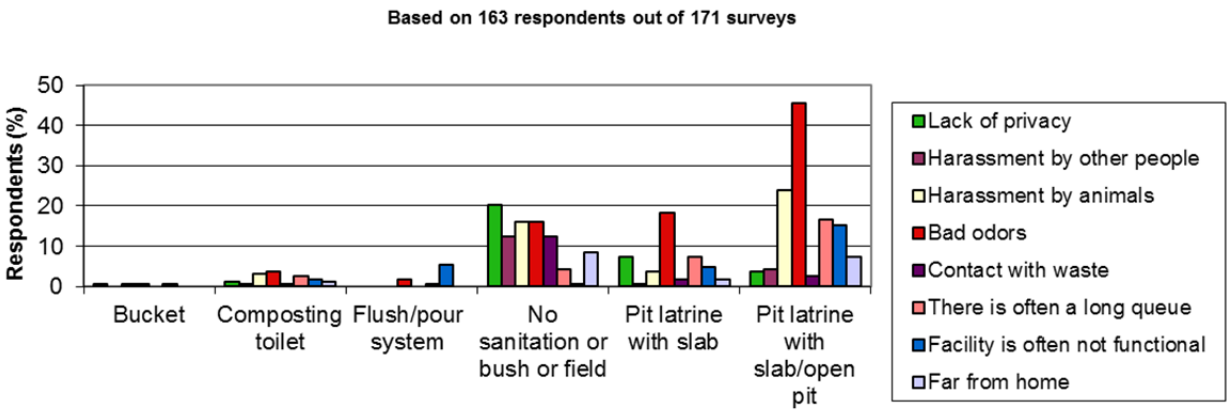


Figure 4.11 Problems cited with different types of sanitation

4.3 Contingency analysis on pre-earthquake sanitation practices and reconstruction preferences

The contingency analysis on pre-earthquake sanitation conditions (Table 4.4) revealed significantly different levels of access to water carriage sanitation by gender, geography, employment status, and age. Of males, 14.4% had a water carriage sanitation system before the earthquake, compared to only 3.7% of females. Of those in the city core, 16.9% had a water carriage system, compared to only 6.3% of the outlying areas, and none in the city periphery. At 15.1%, the employed were more than doubly likely to have had water carriage systems than the unemployed. It was also doubly likely that survey participants under 50 years had access to water carriage than older participants, of whom only 4.3% had access. Unemployed females and rural residents were more likely than employed males in the urban core to rely on dry decentralized systems before the earthquake. Differences were also observed between groups in the percentage who lacked sanitation. While slightly more than one in five of participants 50 and below had no sanitation, only 13% of those over 50 reported this pre-earthquake condition. More females (25.9%) lacked sanitation system than males (16.7%). Of the employed, 15% did not have a sanitation system, compared to 23.7% of the unemployed. Over half of participants from the city periphery (64.7%) did not have a sanitation system, while only 16.9% of the city core and 15.8% of the outlying areas lacked sanitation systems. Together this analysis suggests that the unemployed, females under 50 years old, and individuals from the city periphery were the most likely group to have not had any sanitation prior to the earthquake.

In response to a question about their preferred future form of sanitation, 64.6% of the structured survey respondents prefer a water carriage system. None of the respondents would prefer “no sanitation” (even though nearly 20% had no form of sanitation before the earthquake). Of the respondents selecting preferred sanitation options, 69% would be “extremely satisfied” with a flush/pour system and 18% would be “extremely satisfied” with a pit latrine. A contingency analysis on sanitation preferences found that participants preferred water carriage sanitation systems, regardless of age, employment, gender, or location.

Table 4.4 Number and percentage of structured survey participants using different sanitation sources before the earthquake and preferences for rebuilding, divided by age group, employment, gender and location

	Water Carriage		Dry		Hybrid		No Sanitation	
	Pre-quake (n=16)	Preference (n=117)	Pre-quake (n=117)	Preference (n=39)	Pre-quake (n=2)	Preference (n=11)	Pre-quake (n=36)	Preference (n=0)
TOTAL	8.8%	64.6%	64.6%	21.5%	1.1%	6.1%	19.9%	0.0%
Age Group								
0 to 30 years (n=57)	12.3%	80.0%	64.9%	18.2%	1.8%	1.8%	21.1%	0.0%
31 to 50 years (n=54)	11.1%	75.5%	64.8%	18.9%	1.9%	5.70%	22.2%	0.0%
51 years and over (n=46)	4.3%	53.3%	82.6%	33.3%	0.0%	13.30%	13.0%	0.0%
Employment								
Employed (n=53)	15.1%	66.7%	66.0%	21.6%	3.8%	11.80%	15.1%	0.0%
Unemployed (n=118)	6.8%	71.6%	69.5%	24.1%	0.0%	4.30%	23.7%	0.0%
Gender								
Male (n=90)	14.4%	70.5%	66.7%	22.7%	2.2%	6.8%	16.7%	0.0%
Female (n=81)	3.7%	69.6%	70.4%	24.1%	0.0%	6.30%	25.9%	0.0%
Location								
City Core (n=58)	16.9%	72.4%	64.4%	17.2%	1.7%	10.30%	16.9%	0.0%
City Periphery (n=17)	0.0%	82.4%	35.3%	11.8%	0.0%	5.90%	64.7%	0.0%
Outlying Areas (n=95)	6.3%	66.3%	76.8%	29.3%	1.1%	4.30%	15.8%	0.0%

5. Workshop Results

This chapter summarizes the results of the stakeholder workshop organized in Léogâne by the project team. Following Lynam (2007), the team designed the workshop principally to acquire knowledge about the values and preferences of local stakeholders regarding water and sanitation reconstruction options for Léogâne. However, interactive activities such as this one can also create opportunities for co-learning, through which the perspectives of all participants change as a result of the process, eventually informing future decision-making processes and creating new opportunities for "co-management". In this chapter, the preferences and values expressed by the workshop participants are presented. The results of a survey distributed to the participants at the beginning and end of the workshop are also presented, and show some evidence of co-learning. The ultimate participation of stakeholders in decisions regarding water and sanitation is a stated objective of DINEPA, and was a desired long-term outcome of this project.

5.1 Workshop overview

The workshop was structured around two main break-out sessions in which deliberation and voting took place, with plenary sessions following each during which a vote of the full group was recorded. The morning-sessions aimed to elicit action items to solve Léogâne's water and sanitation problems, followed by a plenary session in which each group's top three solutions were ranked by all participants through a voting exercise. The afternoon sessions each took one of the five winning action items, and were asked to deliberate on how it could be achieved and by whom, focusing on actors and implementation scenarios. A full description of the workshop methods is included in Chapter 3. This chapter presents and broadly discusses the results.

5.2 Morning Breakout Groups and Plenary Voting

The goal of the morning breakout session was to brainstorm potential solutions to the water and sanitation challenges faced by Léogâne. After significant deliberation, the five morning breakout groups brought a total of sixteen action items to the plenary session for voting. Two rounds of voting were required to break ties. The final votes were tallied by the project team during the lunch break and the five top water and sanitation action items were announced to the participants after lunch. Table 5.1 summarizes the original 16 ideas generated during the morning breakout session, the number of votes each solution received, and the percentage of the group that identified each as among "the top three". When the winning action items were announced, participants seemed generally satisfied with the process and outcome. The five ideas receiving the greatest number of votes are indicated with bold type in Table 5.1.

Table 5.1 Sixteen action items for resolving Léogâne's water and sanitation problems, as generated during morning breakout groups with votes received during plenary session

ID	Action items derived during the morning session	Total number of votes received during plenary	% of participants identifying solution as among "top 3"
1	**Protect the environment in the city and in the plains from the mountaintops down to the valleys**	**25**	**12%**
2	Build a potable water system for all the people whether in the town or outside of town	14	6%
3	Build solidarity among organizations in Léogane to dig artesian wells in Léogane.	6	3%
4	Run pipes into every home and build public bathrooms in public areas	14	7%
5	Educate people about sanitation and provide water	15	7%
6	Build a huge reservoir so that everyone can get water piped into their home	9	4%
7	Build bathrooms in each home and place a home based water treatment system to make drinking water potable	11	6%
8	Cap water sources, treat the water and pipe the water into each home	4	2%
9	Build public fountains, dig canals for drainage, and do not build latrines near water sources	6	3%
10	**Dig more artesian wells, lay more pipes, and we need a surveillance committee and to plant more trees**	**16**	**7%**
11	**Protect the water sources, treat water and dig canals for irrigation purposes**	**17**	**7%**
12	**Promote hygiene, repair and extend the piped water system to more homes, build artesian wells, public fountains with potable water, and modern bathrooms in every home**	**23**	**12%**
13	**It is important that each neighborhood have its own water system, build public and private bathrooms, and make sure people pay for the services**	**21**	**10%**
14	Protect all water sources in our area	7	4%
15	Build reservoir in areas where people reside	10	5%
16	Cap water sources and collect rain water, build cisterns to treat them and dig artesian wells to make the water potable	15	7%
	Total	**213**	**100%**

5.3 Interpretation of morning votes

As demonstrated by the voting results, the workshop participants appear to have a very holistic understanding of the complexity of the local water and sanitation problem. As an example, Table 5.2 lists the spectrum of concepts mentioned in the morning session and the number of times that each one was mentioned (as analyzed using Atlast TI).

Table 5.2 Number of times different concepts were mentioned in morning session

Topic	No. of times mentioned	Topic	No. of times mentioned
Agriculture	2	Manage garbage	1
Artesian wells	15	Management by the people	3
Avoid water contamination	4	Point of use water treatment	1
Build canals	7	Promote hygiene	3
Build cistern	3	Protect environment	3
Build home bathrooms	10	Public fountains	4
Build latrines	3	Rainwater capture	2
Build public bathrooms	11	Reforestation	1
Build shared bathrooms	1	Repair piped water system	4
Cap water sources	10	Water catchment system	5
Clean rivers	1	Water committees	2
Distribute water	1	Water fee payment	3
Extend piped water system	11	Water system urban and rural	4
Irrigation	5	Water treatment	14
Manage flooding	1		

Given that many discussions within the breakout groups had revolved around which structural infrastructure systems should be built, the research team found it striking that the top-ranking action item (#1) was fundamentally an expression of the general importance of environmental protection. This outcome may be indicative of the participants' understanding that the success of structural solutions is ultimately contingent upon the general integrity and general health of the local environment. The second highest ranked action item (#12) did encompass a very broad set of structural infrastructure improvements, but also mentioned the promotion of hygiene, a non-structural approach to improving water and sanitation outcomes.

The third ranking solution (#13) alludes to the need to customize solutions to the needs of different neighborhoods, but also recognizes the importance of differentiating between public and private initiatives, and suggests that fees be charged for these services. The research team interprets the emergence of this action item as among the top five as evidence that local stakeholders recognize that a "one size fits all" approach would not be appropriate for communities within Léogâne. It also appears to outline a role for both the government and local residents, who are also expected to have

to pay for water and sanitation. The fourth ranking solution (#11) makes reference to both protecting water sources and digging canals for irrigation, introducing the need for regional watershed management strategies that address water sources up in the hills and agricultural irrigation needs on the plains. The fifth ranking solution (#10) incorporates both decentralized (artesian wells) and centralized (pipes) solutions, presumably serving different populations. It also makes reference to "surveillance committees" as a community-based way of maintaining the water system, and ensuring reforestation in the hills.

Table 5.3 Morning Plenary Session- First Choice vote based on geographic origin of voter.

ID	Location							
	City		Country or plains		Hills		Not Answered	
	Count	%	Count	%	Count	%	Count	%
1	6	40%	2	6%	3	38%	5	38%
2	2	13%	4	11%	1	13%	0	0%
3	0	0%	2	6%	0	0%	0	0%
4	1	7%	1	3%	0	0%	2	15%
5	2	13%	3	8%	1	13%	0	0%
6	0	0%	2	6%	0	0%	0	0%
7	1	7%	0	0%	1	13%	0	0%
8	0	0%	2	6%	0	0%	0	0%
9	0	0%	2	6%	1	13%	1	8%
10	1	7%	5	14%	0	0%	0	0%
11	1	7%	3	8%	0	0%	0	0%
12	0	0%	7	19%	0	0%	2	15%
13	0	0%	1	3%	0	0%	0	0%
14	0	0%	1	3%	1	13%	3	23%
15	0	0%	0	0%	0	0%	0	0%
16	1	7%	1	3%	0	0%	0	0%
Total	15	100%	36	100%	8	100%	13	100%

Some geographic differentiation in water and sanitation preferences was detected. Participants residing in the outlying areas (identified as the plains) generally showed a preference for structural projects (44%) that included not only DINEPA's plan to repair the existing piped-water system, but also more artesian wells, building of public fountains, and extension of the piped water systems to more households. This correlation may be due to the dearth of water and sanitation infrastructure in many areas on the plains even before the earthquake. Participants from the city center, however, seemed to

show greater concern for environmental issues (53%) and for addressing educational gaps (Table 5.3). This observation may be an artifact of the particular community organizations that were represented at the workshop, or be simply due to individual preferences amongst a relatively small group. It may also reflect strategic alignment that took place within the smaller deliberative sessions, in which each geographically-based group may have moved toward a consensus around particular issues.

5.4 Results from Afternoon Breakout group

While the morning breakout groups elicited specific action items that the participants thought should be implemented, the afternoon sessions focused attention on who should implement each of these ideas and how. The goal was to iterate on more specific reformulations of the action items introduced in the morning. Another five breakout groups were created, and each group was given one of the finalist action items from the morning plenary to elaborate. As in the morning session, each group collaborated to generate ideas for how the action item could be implemented and by which actors, and then voted on specific proposals to bring forward to a second plenary vote. Internally, each group created five to nine ideas, reformulated and voted on them, moving three to the general vote. Table 5.4 lists the 15 proposals from the afternoon groups that advanced to the afternoon plenary, and the number and percentage of votes that each reformulation ultimately received by the larger group. In most cases, the reformulation is meant to be read with the general action item statement, and represents an attempt to elaborate it.

In the afternoon plenary, the participants were once again asked to vote on which three reformulations of the original action items they thought were best. Although the original intention of the exercise was to focus the top-ranking morning action items, the discussion was more generally about how to implement any of the action items. As reflected in the votes, the top four ranking strategies for implementation of the action items are listed in Table 5.5. The ID references the action item number with which the implementation strategy was originally associated.

Table 5.4: Afternoon Breakout and Plenary Results

By whom, and how, should the action generated in the morning be implemented?	# votes	% of participants voting
#1*: Protect the environment in the city and in the plains, from the mountaintops down to the valleys*		
a) The population with the government to carry out reforestation, stop throwing garbage everywhere, stop building latrines near water sources and dig canals in order to manage the rivers.	13	6%

b) The local population working with appropriate authorities to plant trees, pass laws prohibiting the cutting of trees and offer an alternative to charcoal and wood fire.	12	6%
c) Reforest the mountaintops with trees native to the area	10	5%
#12: Promote Hygiene, repair and extend the quantity of pipe bringing water into people's home, dig artesian wells, public fountains with potable water, build modern bathrooms in each home		
a) It is a well thought out agreement between the state (national government), local and international organizations with international financing	28	13%
b) Contact international organization and the Haitian state to work together	14	6%
c) It is with funds from international organizations	6	3%
#13: It is important that each neighborhood has its own water system, build public and private bathrooms, and make sure people pay for the services		
a) International organizations, with local communal officials should implement the projects	16	7%
b) It is the national government or international organizations	13	6%
c) We will need the national government, international and local organizations and people should pay for the service	12	6%
#11: Protect the water sources, treat the water and dig irrigation canals		
a) Drexel University, community participation with funds from the international community.	27	13%
b) National government and the local elected officials should implement the project.	10	5%
c) It is the international community which can help us to execute these projects	30	14%
#10: Dig more artesian wells, lay more pipes we also need a surveillance committee and to plant more trees.		
a) We want to begin with a monitoring committee to work with the farmers and planters so we have more trees to help in soil preservation.	14	6%
b) We, the population, need to organize ourselves and we will be able to secure all the resources we need.	7	3%
c) We need to organize ourselves first and then the NGO's can do the follow up because we do not have enough resources	4	2%
Total	216	100%

Table 5.5 Top four strategies for implementation of the action items, from afternoon vote

ID	Strategy
11c	It is the international community which can help us to execute these projects
12a	A well thought out agreement between the state, local and international organizations with international funding.
11a	Drexel University together with ourselves in the community, plus funding from the international community
13a	It is the international organizations along with the communal authorities [of Léogâne], who should implement these projects

5.5 Interpretation of afternoon votes

As evidenced by the number of implementation strategies that received 12-14 votes, it was more difficult to declare implementation strategy winners than it was to identify top-ranked action items. It became clear during the discussion that further progress could not be made during this workshop without more details on technical specifications, costs, and project precedents. The results shown in Table 5.5 should thus only be interpreted as a first cut into how a deliberative process on this topic might unfold, if it were democratically implemented in Léogâne on a larger scale.

With this caveat, it is interesting to note that international organizations were mentioned as having a role to play in implementation. In all cases, however, the international organization was mentioned as a partner to a local body. It appears that the participants view international organizations as playing a critical role in funding and/or providing technical assistance, but would prefer that they act in collaboration with the community, the communal authorities, or other local partners. This observation is noteworthy given the proliferation of independently-acting international organizations throughout the region, as described in Chapter 2.

5.6 Results of pre- and post-workshop survey

The pre- and post- workshop survey results provide further evidence of the integrated manner with which local stakeholders view Léogâne's water and sanitation problem. Figure 5.1 below depicts the number of times that different concepts were mentioned in the pre- and post- workshop survey. Table 5.6 shows shifts in mean Likert-scale responses (1=not important, 5=very important) to paired questions which appeared in both the pre- and post-workshop surveys. The numbers in parentheses

are the question identification number addressing the topic in the pre- and post- surveys, respectively. By comparing the number of times different concepts were mentioned in each survey, and their mean Likert scores, the extent to which the workshop may have precipitated a co-learning process can be discussed. The shifts in opinion were small, but indicative of overall directions of opinion formation, several of which are described below.

Structural improvements in a larger environmental context

Participants seemed to have assigned greater value to structural improvements as a result of the workshop. In questions 8 and 37, the percentage of people who believed that it was important to repair the piped water system (4%), shifted such that 100% of the respondents believed it was important after the workshop. Similarly with questions 9 and 38, support for extending the existing water distribution system increased from 88% to 100%. The participants also shifted their views about the importance of constructing public restrooms with shower facilities. In the pre survey, 82% believed it was very important, and the post survey revealed an increase by 14%. In total, 98% of the stakeholders acknowledge that constructing public restrooms is very important.

However, participants appear to have gradually recognized that the many physical infrastructure projects they initially desired would only be sustainable within a wider context of environmental protection. While artesian wells, pipes and latrines were the prevailing areas identified for action in the pre-survey, by the post-workshop survey this had shifted to a prevailing emphasis on the environment, and especially reforestation.

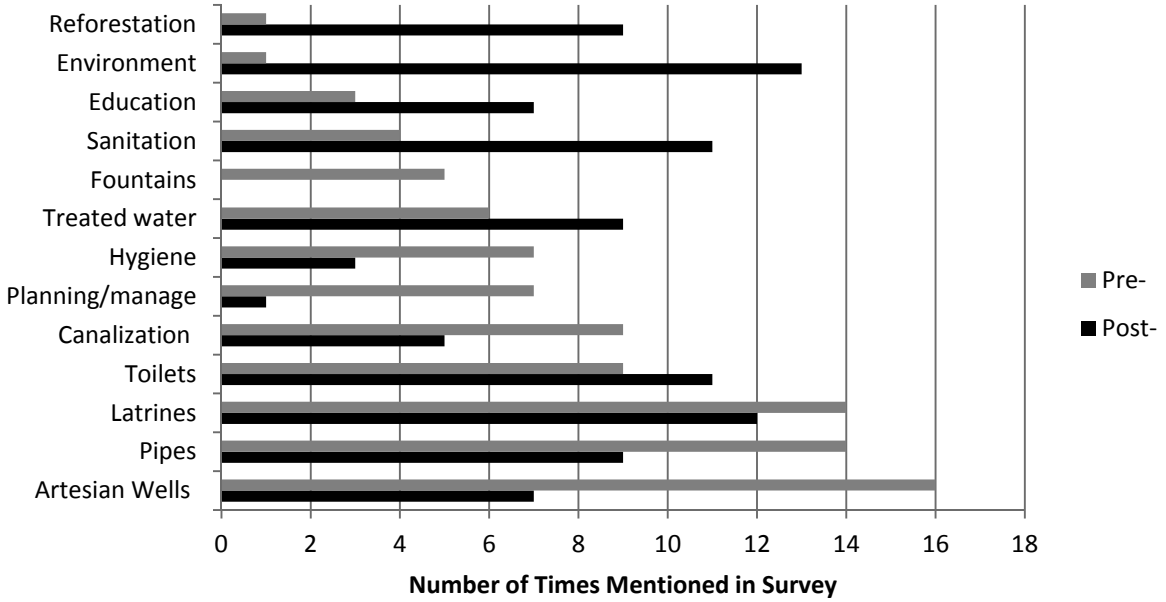


Figure 5.1 Number of times different concepts were mentioned in pre- and post- survey

Table 5.6: Comparative results from pre and post- workshop surveys

Question	Pre Mean	Post Mean	St. Dev.	Trend (up/down)
Repairing the EXISTING piped drinking water distribution system (8/37)	4.8	4.94	0.25	U
Extending the EXISTING piped drinking water distribution system (9/38)	4.35	4.97	0.177	U
Constructing more borehole (lined and protected) wells that tap a deep, high quality source of water (10/39)	4.47	4.35	1.199	D
Training and support for people to treat their water at home so it is safe to drink (11/40)	4.86	3.87	0.562	D
Constructing more high-quality household latrines (12/41)	4.81	4.9	0.396	U
Constructing public restrooms with shower facilities (13/42)	4.78	4.87	0.718	U
Removing dirt and garbage in the canals (14/43)	4.95	5	0	U
Addressing deforestation (15/44)	4.9	4.97	0.183	U
Improve access to irrigation for farming (16/45)	4.95	4.89	0.416	D
More neighborhood meetings with elected officials (17/46)	4.73	4.55	0.888	D
Improve capacity of elected officials to respond to constituents by telephone (18/47)	4.67	4.83	0.592	U
Improvements to the election process (19/48)	4.88	4.67	0.884	D
More opportunity to meet with neighbors and discuss common issues (20/49)	4.7	4.87	0.346	U
More radio call in shows with elected officials (21/50)	4.63	4.62	0.728	NC
More education so people understand how to participate (22/51)	4.92	4.9	0.305	D
More education so people understand more about different water and sanitation options (23/52)	4.86	4.97	0.186	U
Reduce fear of reprisals if people express their opinions (24/53)	4.58	4.83	0.384	U
How important is it that new efforts to improve water and sanitation include committees of neighborhood residents to help manage the project? (25/54)	4.81	4.87	0.423	U

The importance of non-structural measures

The respondents also showed an increase in the importance of developing new efforts to improve public participation, specifically advocating for more education to help citizens to understand different water and sanitation options. In questions 22 and 51, there was a 4% increase—to unanimity—in support for this kind of education. The survey also suggested that neighborhood committees should be initiated along with new improvement projects to help manage the projects. The pre survey

showed that 84% believed it was very important to have these committees and this increased to 98% in the post survey.

Willingness to pay

The pre- and post- survey demonstrated an increase in the number of participants who believe that residents should pay for a portion of the cost of construction. The pre survey demonstrated that 63% agree with paying for some of the cost and the post survey shows an increase to 68%. The people that were unsure about paying for the construction also increased from 8% to 18%, while the people who did not support funding the construction process decreased from 24% before the workshop to 14% in the post survey.

Ability to affect change

The survey measured the stakeholders' beliefs about the extent to which Léogânais themselves can drive significant changes. According to the post survey, 93% believe that the Léogânais can create significant change, an increase from 84% in the pre survey. It is important to note that both in the pre and post survey, the stakeholders acknowledge the need for assistance from the Haitian central government and the international community in order to facilitate the change. The survey remained consistent, with 85% of the participants advocating support from outside agencies.

Readiness to act

Though not shown in Table 5.5, one of the more important findings is the division between the stakeholders when asked about the amount of time that should be dedicated to deciding which water and sanitation projects should be implemented. The pre and post survey results both indicated that the majority of the stakeholders wanted more time to consider their options. However, in both cases, a large minority believe that projects should be implemented immediately. The pre survey showed that 58% thought they needed more time, 9% were unsure at the time, and 33% were ready to act. The post survey showed 54% (a 4 % decrease) wanting more time while 7% were unsure and 39% thought that projects should be implemented immediately. In this regard, it is possible that the workshop itself played a small part in increasing at least a few people's sense of collective efficacy.

Community Participation

The workshop also determined the stakeholders' willingness to provide input into future water projects, including whether the participants thought they were ready to implement projects immediately or wanted more time to consider future projects. The stakeholders recognize they need assistance from outside, but clearly indicated a desire to participate in the process. They identified the need for education on how they can participate in the rebuilding process, questioned what options may be available for water projects, and suggested developing neighborhood committees to manage future projects.

The stakeholders identified the need for neighborhood residents to manage any future projects. The pre-workshop survey showed that 95% of the respondents believe that these committees must exist

and should be called together by the neighborhood residents or the local governments. The post-workshop survey showed little change, with the exception of who should be responsible for calling the committees together. Responses indicating that the people from the neighborhood should facilitate the committees increased from 51% to 68%, while the option of them being organized by the local government decreased from 49% to 34%. This indicates that the stakeholders themselves are willing to implement and manage future water projects. Insofar as current DINEPA plans call for decentralization of water management through the formation of regional offices (OREPA), and cooperation with local stakeholders through the formation of water committees with a full participatory role (which DINEPA calls "social engineering"), there is the possibility for alignment with local preferences as expressed at this workshop.

Critique of the workshop

The post-workshop survey included two open-ended questions on what worked well at the workshop (Qn. 35), and what could be done to improve the workshop (Qn. 36). In general, impressions of the workshop seemed overwhelmingly positive. A sampling of the 76 comments citing aspects of the workshop that went well is listed in Table 5.7. Table 5.8 is a sampling of the 75 comments citing areas for improvement.

Table 5.7: Positively viewed aspects of the workshop

Question 35 responses – What worked well?
-Everything that happened in the seminar is good, it is a day well spent
-Because we put our heads together to think
-The welcome we received and the great ideas that we shared
-It was about sharing ideas with one another, working together for Léogâne to move forward
-What I found to be good in the seminar is the way they made it that we could work together (the atelier system [i.e., breakout sessions])
-We sat together and shared ideas so we can come up with a solution

Table 5.8: Areas for improvement in the workshop

Question 36 responses – what could be improved?
-For me, the seminar lacked nothing, couldn't be any better
-We would need more time to discuss the topic, we should meet every month
-What we should do is plan for another meeting soon
-If the majority participates in the votes of the workshop and that so many good ideas gathered are not lost and that their dream can turn into reality
-We would need more time to debate the subject, at least every month
-The workshop was so good I would like to ask for another

Tables 5.7 and 5.8 indicate the extent to which the participants truly appreciated having an opportunity to discuss their ideas with each other. It appears to have been a rare experience, but one that was highly valued. The responses indicate the degree to which many of the participants would be willing to continue this process, and valued it as a way to potentially have real input into decision-making. They truly wanted their ideas to be heard, and potentially implemented. Many were willing to commit to monthly meetings if that would lead to real results. Thus, despite the upheavals of the earthquake, there is clearly a constituency at the local level who would be willing to participate in planning and rebuilding efforts.

5.7 Discussion

Workshop participants identified, overall, a much wider array of water and sanitation initiatives than did government or NGO interviewees. These ranged from piped water and flush toilets to irrigation canals and digging artesian wells and reforestation in rural areas. They took a comprehensive approach that seemed to recognize the interaction between different elements of the water system. For example, they noted that water sources would be polluted if latrines were built too close to them; that upstream watersheds needed to be protected and reforested, if people on the plain were going to have clean water; and that flooding would need to be prevented. Thus they recognized not only the interaction between potable water and sanitation systems, but also the interaction between human and natural systems.

Based on the categories of actors cited by the workshop participants, and the types of action items that were cited during the morning session, a mental model describing how workshop participants seemed to view the water/sanitation sector and its ideal management was constructed (Figure 5.2).

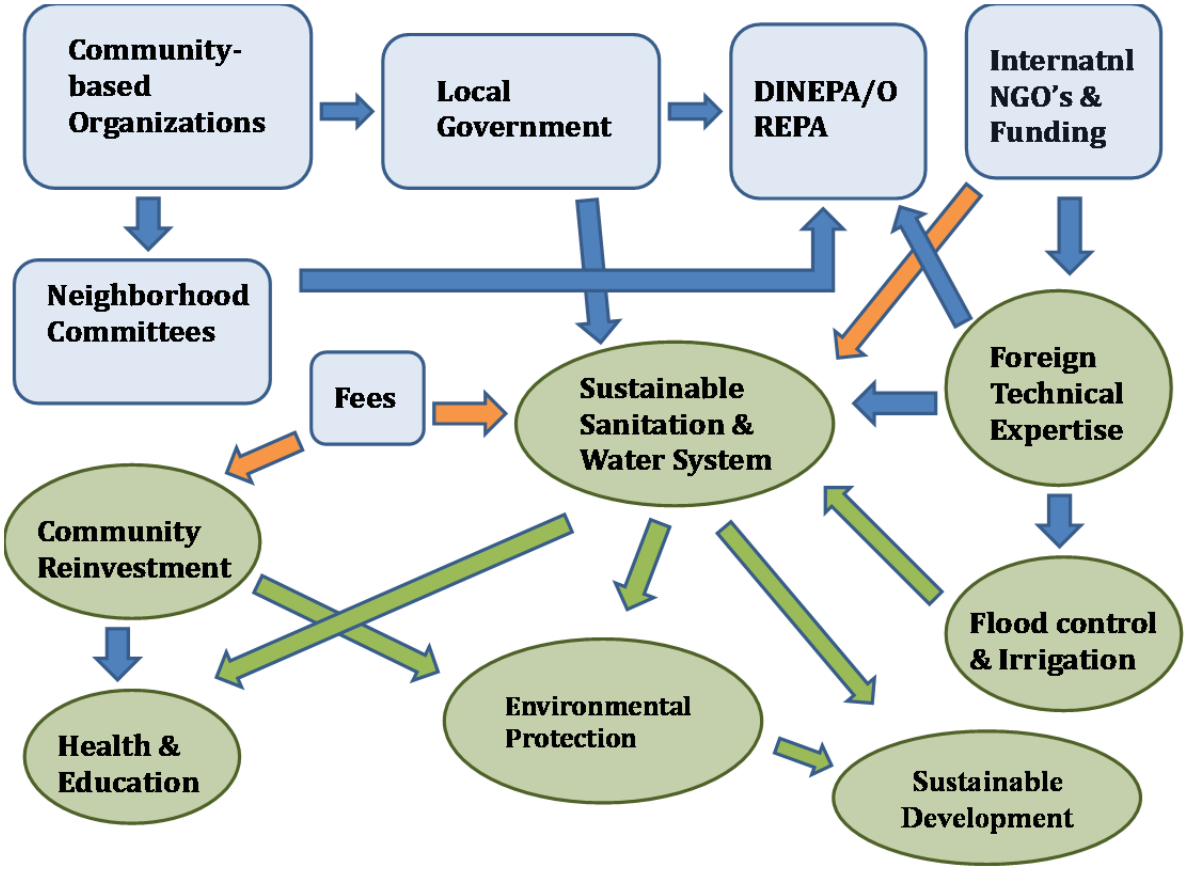


Figure 5.2 Mental model of workshop participants' view of Léogâne's water and sanitation sector

In the figure, blue boxes represent specific actors, and blue arrows represent human interactions. Green ovals represent outcomes, and green arrows represent environmental processes. Orange arrows represent financial flows. The only actor included in this figure that was not specifically discussed by the workshop participants is DINEPA, since the establishment of local DINEPA offices was a new initiative emerging from recent policy reform, and it seemed that many participants were still not entirely aware of this change. However, it seemed to be implicit in the discussions that there would be some kind of management entity involved in water and sanitation, with which local neighborhood committees and local government would interact.

5.8 Conclusion

The ARDI method for participatory modeling used by Etienne et al. (2011) is an acronym of the four French words, "Acteurs", "Ressources", "Dynamiques", and "Interactions". It identifies the four steps the method uses to elicit stakeholder mental models of the system they are working or living in. It is designed to allow the progressive emergence of a shared representation of the components and dynamics of the system by describing the stakeholders/actors, the resources present, the processes in

play, and the interactions between them. This workshop began to implement such a process, but was not designed to fully enact it.

Instead, it allowed the research team to begin to see the emergence of various shared representations of the actors and dynamics. Clearly the participants in the workshop envisioned themselves as central actors in the rebuilding process, calling for local participation along with various governmental actors and international actors. They did not yet have a full chance to deliberate on resources and interactional factors, however they did begin to generate a mental model of the water system that was quite comprehensive (including natural and man-made elements, urban and rural) and complex (including a wide range of potential actors and power relations between them).

The pre-workshop survey indicated that stakeholders were unsure whether they were ready to act now or needed more time to consider possible options. The pre survey question 30, "When it comes to making a decision about choosing future water and sanitation projects for Léogâne, Léogânais are…" showed that, overall, participants are neutral with a mean score of 3.55. After the completion of the workshop, this shifted marginally to a mean score of 3.27, which still shows that taking more time to consider possible future projects is slightly favored. This also aligns with the numerous post-survey suggestions that more workshops should be held. This could be interpreted as a wise recognition that further deliberation is needed to identify the actors, resources, and dynamics at play, and how they all interact with each other.

Both the NGO's acting in the WASH sector and the public water authority represented by DINEPA were not, at the time, adequately planning their interventions. Instead they were rushing to implement water and sanitation projects as quickly as possible (the NGO's largely to meet immediate needs such as building latrines and trucking in potable water; and DINEPA to meet medium-term needs such as repairing the broken piped water system in the town center). In contrast, the stakeholders engaged in this workshop seem to have taken a longer-term view of their future. This long-term view includes environmental protection, education, building both centralized and decentralized systems, and addressing both rural and urban concerns. The progressive emergence of this kind of comprehensive model, and its incorporation into participatory learning and decision-making processes, has the greatest chance of supporting a sustainable water and sanitation solution for Léogâne.

6. Management and Payment for Water and Sanitation Infrastructure Services

This chapter summarizes what the research team learned about stakeholder preferences with regard to management and payment for water and sanitation services. These perspectives were elicited during May-August 2010, through both the semi-structured interviews and the structured survey. The results presented in this chapter are a snapshot of stakeholder values, and it is recognized that these values and preferences may evolve over time. Nonetheless, understanding local perspectives at this critical juncture can help to identify where consensus exists and where additional deliberation is needed to arrive at socially acceptable policies.

6.1 Background

At the time of this research, Haiti was in the midst of reorganizing governmental responsibility for water and sanitation. In March 2009, the *Loi Cadre Portant Organisation du Secteur de l'Eau Potable et de l'Assainissement* [Law on the Organization of the Water and Sanitation Sector] was passed, which reorganized the Haitian water supply sector to enable both private contract operations and local water committee involvement in water supply. The law established the *Direction Nationale de l'Eau Potable et de l'Assainissement* (DINEPA) [National Drinking Water and Sanitation Directorate] and provided it with regulatory authority for water supply and sanitation. Within DINEPA, a number of regional authorities (*Offices Régionaux d'Eau Potable et d'Assainissement*) [Regional Drinking Water and Sanitation Offices] became responsible for water supply, although these regional agencies may use private contractors or local water committees to administer water supplies.

The premise of the new arrangement is that the provision of water and sanitation services can be self-financing on a local level through the levying of user fees that are subject to regulation by higher levels of government. There is some precedent for this in Haiti. In lower-income areas of Port-au-Prince, local water committees, known as *komité dlo*, were created in the 1990's that sold water at public standpipes (Snell, 1998). Revenues were used to 1) cover the cost of the service, 2) pay salaries to water committee members, and 3) reinvest in community projects with the amount used for each subject to regulation. Thus, the water committees are incentivized to collect revenue by the prospect of being able to retain a portion, yet a portion of the revenue must be reinvested in projects for the good of the community (GRET 2010a).

An alternate view would be to provide at least a minimal level of publicly-funded access to water, free of charge at the point of use, with the justification being that all human beings have a right for such a basic need to be met, regardless of ability to pay (Palaniapan et al., 2004; McCaffrey, 1992). Requirements for payment may also be met with resistance if users do not have confidence in water management institutions to use these revenues appropriately (Whittington et al., 1990). In Léogâne

there is a large proportion of the population who have little or no ability to pay for services. Creative rate structures may help to balance the objectives of providing service for all while recovering costs in a sustainable manner. The less affluent may be offered some support either by explicit subsidies or through a fee structure that charges minimal amounts for a basic water allotment and then increasing amounts for larger usage volumes that are generally associated with the activities of higher income users (use of automatic washers, landscape irrigation, etc.) (Whittington et al. 1990).

In post-earthquake Léogâne, the practice of providing water and sanitation free as a basic service became widespread as an interim measure in the many camps for internally displaced persons. Efforts by the organizations running these camps to transition away from directly providing these services were in the planning stage at the time of this research. The Haitian water sector was at a critical moment with the decentralization cost recovery from user fees envisioned by the 2009 water law happening contemporaneously with the emergency provision of free water and sanitation by non-governmental organizations in the wake of the 2010 earthquake.

6.2 Willingness to Pay for New and/or Improved Water Supply Sources

Survey Results

The survey asked three sets of questions to identify if Léogânais are willing to pay for new and/or improved water services. The results (Table 6.1) suggest that the majority of the participants are willing to pay, consistent with many views expressed at the workshop. Specifically 67.3% were willing to pay for a reliable water supply, 75.6% for safe water, and 75.9% for close access/proximity to water.

An analysis was carried out to test for a significant difference in willingness to pay for close access to water based on geographic locations (Table 6.2). There is a significant difference among geographic groups (Fisher's Exact Test = 6.46, p= 0.04) with participants in the city periphery (100%) more willing to pay for close access to water than participants in the city core (75.4%) and participants in outlying areas (72.7%). No significance differences were found between genders or between employed and unemployed participants.

Table 6.1 Questions about willingness to pay for and manage new and/or improved water services

Payment
Are you willing to pay for a reliable water supply?
Are you willing to pay for safe water?
Are you willing to pay for close access/proximity to water?
Are you willing to pay for a reliable sanitary system?
Are you willing to pay for close access/proximity to sanitary facilities?

Management
In the future, who do you think should be responsible for owning and managing the Léogâne water system?
In the future, who do you think should be responsible for owning and managing the sanitary system?

Table 6.2. Number and percent of respondents who are willing to pay for water.

Question	Respondents who answered "yes" (% in group)			
		Location		
	Overall	City Core	City Periphery	Outlying Area
Are you willing to pay for **reliable** water supply?	66.9%	63.8%	94.1%	63.8%
Are you willing to pay for **safe** water?	75.1%	79.3%	94.1%	69.1%
Are you willing to pay for **close proximity** to water?	76.2%	81.0%	100%	68.8%

When the test was repeated for willingness to pay for reliable water, a significant difference was found among geographic groups again (chi-square with two degrees of freedom = 6.19, p= 0.045) with participants in the city periphery (94.1%) more willing to pay than participants in the city core (62.7%) and outlying areas (65.6%). No significance difference was found among geographic groups when the test was repeated for willingness to pay for safe water.

Semi-structured interviews

Willingness to pay for water was addressed in 79% of the semi-structured interviews and when the subject was addressed, a similar proportion of participants supported payment (roughly two-thirds) as was found in the structured survey. Reasons for not supporting payment included a concern that due to lack of employment opportunities many would be unable to pay. In addition, there was a lack of confidence in local institutions to appropriately manage the funds. One participant thought that this lack of confidence meant that payment could only be collected on an as-needed basis to make specified repairs. Many participants indicated that they currently did pay for water, including water provided in bottles or sachets (plastic bags), water purchased from kiosks (small privately owned water treatment units where the user supplies the container), and in one case additional payment for water to be hauled from a kiosk by motorcycle due the lack of a local supply. Treated water from the kiosks was reported to cost 25 gourdes per 5 gallon, or US$25 per cubic meter (US$1=40 Gourdes).

6.4 Operation and Maintenance of Water systems

Preferences for ownership and management are shown in Figure 6.1. This question was not posed to five subjects due to an error in survey administration. Thus sample size for this question is 166. The results indicate that a plurality, 29% of respondents, prefer that the national government own and manage the water supply, followed by local government (18%), the private sector (12%), local water committees (11%), regional government (7.6%),and individuals (4.7%) (19% did not provide a response).

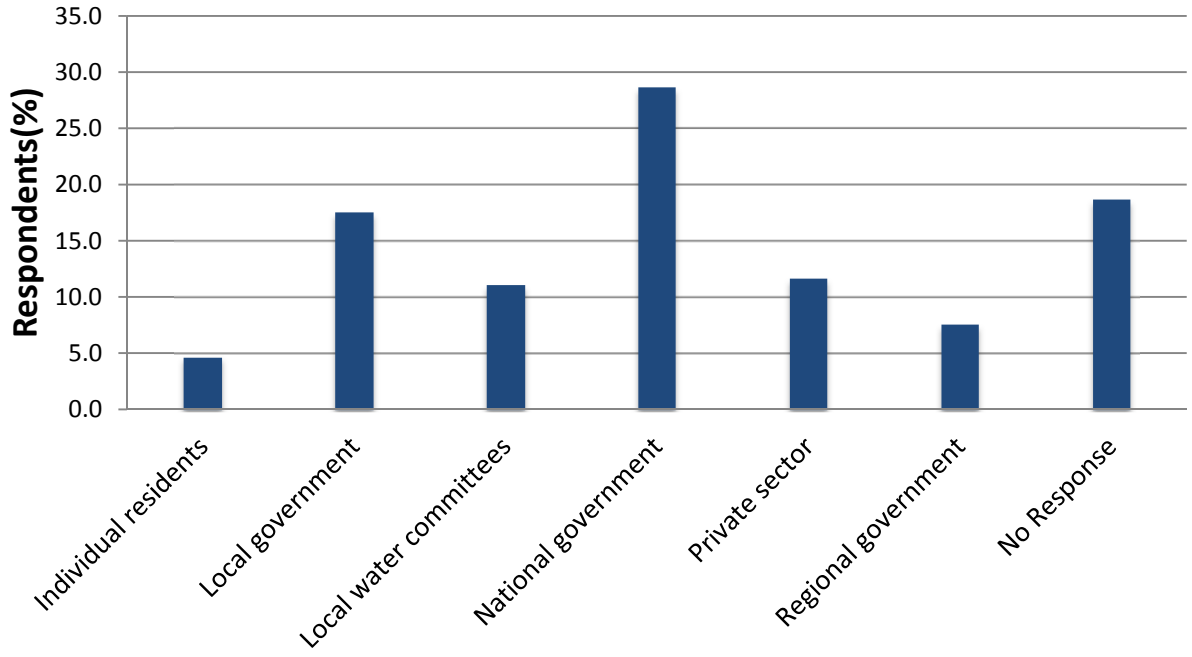


Figure 6.1 Percentage of participants who would like different groups to own, manage and operate the water supply system (n=166)

The results of the semi-structured interviews appear to differ from the structured survey. Ten of the 19 participants saw some role for local water committees. This is just over 50% or far higher than the percentage who favored local water committees on the structured survey questions. Most respondents who saw a role for local water committees (seven of the 10 who favored local committee involvement) envisioned a tiered system consisting of either: 1) local government and committees (two respondents), or 2) the central government, local government, and committees (five respondents). The small sample size means that one cannot draw definitive conclusions, but it may be that the greater time for reflection allowed by the semi-structured interviews resulted in more favourable views of local committees. In addition, the open-ended format allowed more elaborate approaches to be described.

6.4 Willingness to pay for sanitation facilities

Structured survey

Two sets of structured survey questions were asked to determine if survey participants were willing to pay for new and/or improved sanitation facilities (Table 6.3). Over half of the participants were willing to pay for both reliable and close sanitation facilities, with more (65%) willing to pay for reliability than for proximity (53%). These values are lower than the percentages willing to pay for water (67% for a reliable supply, 76% for safe water, and 76% for close proximity to water).

Table 6.3. Percentage of participants willing to pay for sanitation, divided by location, gender, and employment status

Question	Respondents who answered "yes" (% in group)			
	Location			
	Total	City Core	City Periphery	Outlying Area
Are you willing to pay for **close access/proximity** to sanitary facilities?	53.3%	45.8%	94.1%	50.5%
Are you willing to pay for a **reliable** sanitary system?	65.3%	66.1%	82.4%	61.5%

A statistical test showed a significant difference among geographic groups (Chi-Square with two degrees of freedom = 13.002, p=0.002) with participants in the city periphery (94.1%) more willing to pay for close access to sanitation facility than participants in the city core (45.8%) and participants in outlying areas (50.5%). When a similar test was performed on willingness to pay for reliable sanitation facilities, no significant differences were found among the participants from different locations.

Semi-structured interviews

Payment for sanitation systems was raised in only eight of the semi-structured interviews. While results from such a small sample cannot be reliably interpreted, participants were less likely to favor payment for sanitation that water, as three of the eight favored payment for sanitation compared to 10 of 15 for water. Those favoring payment considered examples such as a centrally located facility for toilets and showers at the market. Some of those not favoring payment for sanitation suggested that payment for sanitation might be included in payment for water, as people would be more favorably disposed to paying for water.

6.5 Operation and Management of Sanitation Services

The structured survey also addressed management of sanitation services. The question was not posed to five participants due to an error in survey administration, which resulted in a sample size of 166. Figure 6.2 shows participants' preferences regarding who should own and manage the system. As was

the case with water supply, a plurality (31%) prefer that the national government own and manage the sanitary system. The local government is second (18%), followed by local water committees (11%), the private sector (11%), individuals (3.5%), and regional government (1.1%) (in addition 5.9% of respondents identified multiple preferred options and 19% did not provide any response.

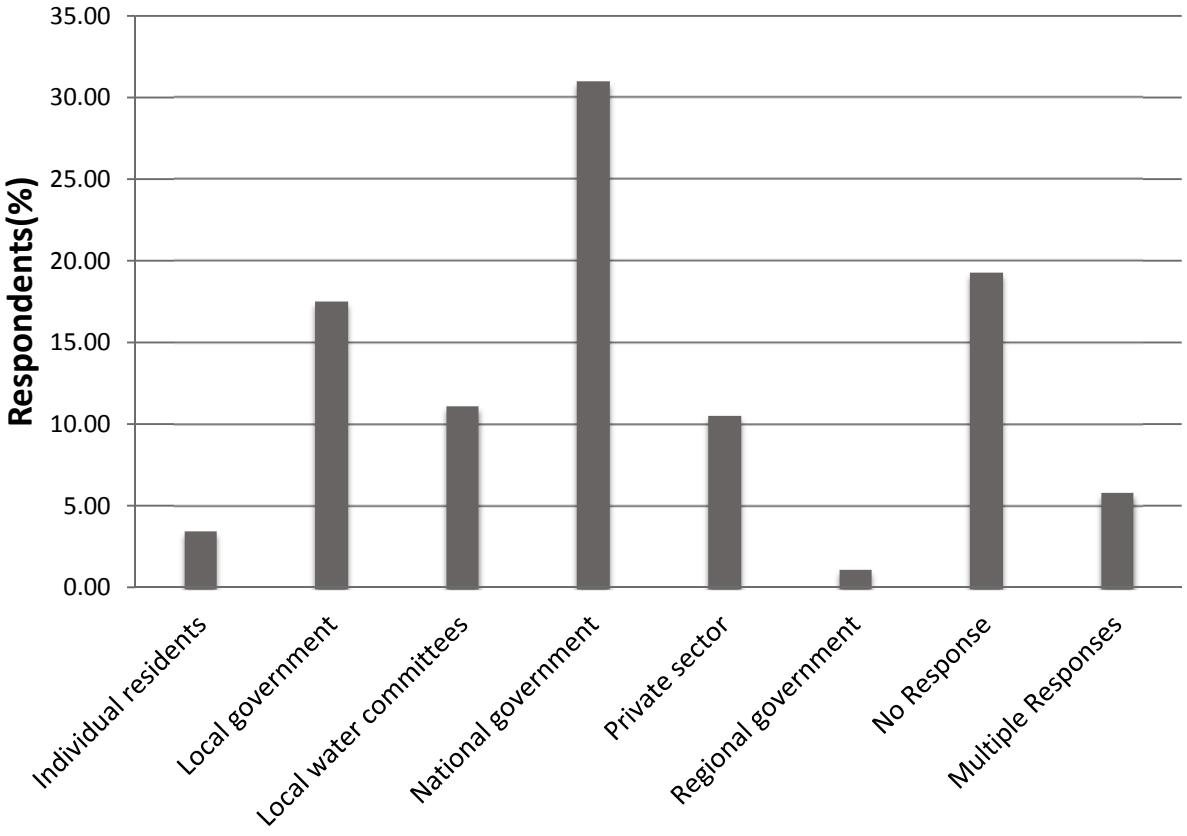


Figure 6.2 Percentage of respondents who would like different groups to own, manage and operate the sanitation system (n=166)

The management of sanitation systems was not raised in most of the interviews (11 of 19). In cases where it was raised responses were scattered among the central government (2), the local government (2), local committees (2), NGOs (1), and individual households (1).

6.6 General attitudes toward different organizations

As part of the semi-structured interviews, general attitudes were assessed towards the national government, local government, foreign non-governmental organizations (NGOs), and local organizations and committees (Figure 6.3). Attitudes toward the central government were generally either unfavorable or neutral (47% each) with only 5% reporting favorable attitudes toward the central government. Local government had a much higher percentage of favorable responses (16%), although unfavorable attitudes (37%) were somewhat more frequent than neutral attitudes (32%). In 16% of interviews the subject did not express an evaluation of the local government. Attitudes toward

foreign non-governmental organizations were categorized as 26% favorable, 52% neutral, and 16% unfavorable with 4% not addressing the issue. Favorable attitudes included gratitude for foreign assistance, while unfavorable attitudes included, concern that qualified Haitians were not allowed to fill more senior positions, the belief that the organizations had large collected amounts of money from international donors for reconstruction yet had not brought a commensurate level of assistance to the people of Haiti, and a perception that the personnel were out of touch, driving around in sport utility vehicles and spending time at the beach, rather than dedicating themselves to reconstruction. Attitudes toward local organizations and committees were generally favorable (47%) to neutral (42%) with only 11% unfavorable. One respondent mentioned that committees had been active in managing local water resources but that they had become inactive over time. Of the 11 respondents who addressed the issue of whether committee members should be paid for their time 8 favored payment, while 2 felt committee service should be done as a voluntary service.

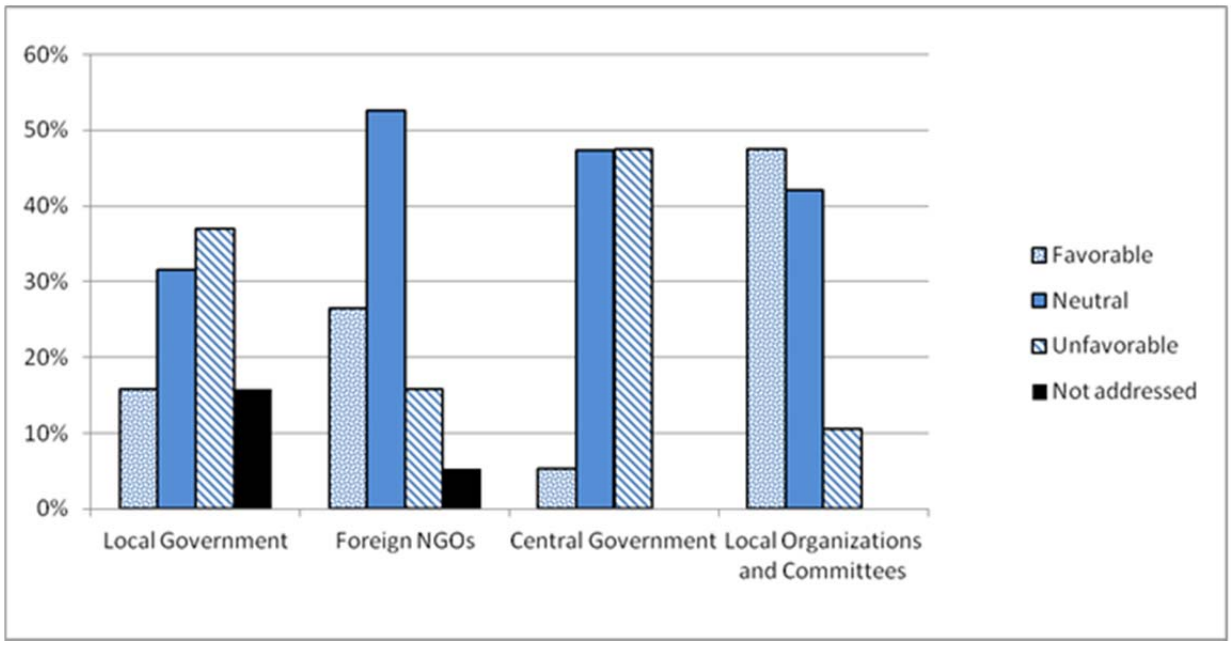


Figure 6.3. Attitudes towards institutions among semi-structured interview participants

6.7 Discussion

In some respects attitudes observed in this study matched well with the governmental policies being pursued under the 2009 reorganization of the water sector. The 2009 water law envisions water supply as being largely fee-based, and a majority of participants expressed a willingness to pay for both water supply and sanitation. The 2009 water law decentralizes water supply, and given that only 5% of semi-structured interview respondents had a favourable view of the central government, this may be viewed favourably by many. The law envisions a greater role for water committees, a view shared by a majority of semi-structured interview participants.

However, there are also some areas where the 2009 law does not appear to match the attitudes found in this study. While administration of contracts and supervision of local committees from regional offices is the basis of the new organization of the water supply sector, few participants favoured any role for regional government for either water supply or sanitation. Instead participants in the structured survey preferred central government ownership and management for both water supply and sanitation infrastructure. This finding was unexpected given that centralized administration of the water system in Léogâne had failed (the system had not been operational since 2008) and also because many semi-structured interview participants viewed the central government negatively. As a partial explanation, we note that in one semi-structured interview a participant stated that he was not comfortable talking critically about the central government. Another factor expressed by a different interview subject was that authority and responsibility lie with the central government. Thus responses may reflect participants' assessments of what ought to be, rather than pragmatic considerations as to the effectiveness of different institutions.

It is worth noting that while a majority of participants express a willingness to pay for water and sanitation, a substantial minority do not. If the overall economic situation improves, it is possible that concerns over ability to pay could be reduced. Concerns over the misappropriation of funds might be addressed by institution building efforts to improve the transparency and accountably of financial management by the relevant agencies or committees. Given that many participants are currently paying for water, it may be appropriate to note that when provided in an efficient manner, water can be sustainably supplied at rates much lower than are currently paid by many participants. For example, in Port-au-Prince neighbourhood water committees sold water for from the piped distribution system for 0.2 Gourde (U.S. $0.005) per gallon (GRET 2010a) which is far below the 5 Gourdes (U.S. $0.13) per gallon (see Results section) reported by for the private water kiosks in Léogâne. [The committees purchased the water from the utility at 0.05 Gourdes per gallon; the committees' mark-up covered both the committees' operating costs and provided a profit that was reinvested in the community following the "social privatization" approach of these committees (GRET 2010b).] Similarly, in 2009 DINEPA implemented payment for a piped water supply service in the city of St. Marc at a cost of 0.24 Gourdes per gallon (Nouvellon, 2010) which is comparable to the water committees' price and dramatically lower than the price for water from kiosks in Léogâne. [Fees in St. Marc also include a connection fee of 104 gourdes per month over three years. Ideally such fees would be shared among groups of lower income users. Even if such fees cannot be shared the piped supply cost would remain substantially lower than the kiosk water for any reasonable household water consumption rate.]

Overall these results may suggest some items for public engagement, in order to help make the reorganization envisioned by the 2009 law successful. Few participants appeared aware of the on-going reorganization of the water sector or the recently established regional offices of DINEPA (Offices Régionaux d'Eau Potable et d'Assainissement) and efforts to explain the new institutional structure appear warranted. This may include an explanation of the regionalization strategy as a means for the central government to meet its obligation to provide needed infrastructure, not an abandonment of

the central government's responsibility to provide for its citizens. While the public largely supports payment for infrastructure services, public engagement efforts should also address transparency in financial management and mechanisms to provide affordable service for those with limited ability to pay. This is not to suggest that gaining public support for cost-recovery efforts is simply a matter of obtaining a majority of favourable responses on a hypothetical question. However, the statistically significant regional differences on this basic question may be just one of many neighbourhood-level differences in attitudes toward such cost-recovery efforts. This would argue for a fine-grained approach to building support in which attitudes and the economic situation of the residents of different neighbourhoods are addressed in the design of management and payment programs.

6.8 Conclusions

The following points may merit consideration as Léogâne develops plans for water and sanitation services:

- Most Léogânais appear willing to pay for water and sanitation services, but there are concerns about whether the poor could afford to pay.

- Public water systems can provide treated drinking water at a fraction of the cost of water in bottles, in sachets, or from water kiosks. There were examples of functioning public water systems providing low-priced water in Port-au-Prince before the earthquake and in St. Marc after the earthquake. Explaining to people in Léogâne that water from public systems is inexpensive may help address concerns over whether the poor can pay. These concerns can also be addressed by different pricing strategies that allow people to obtain some limited amount of water at low or no cost.

- The Haitian government's reorganization of the water sector can allow people to be involved in the provision of water and sanitation in new ways, such as serving on local water committees. These water committees might be involved in activities such as collecting fees and maintaining local water infrastructure.

- People in different parts of Léogâne may feel differently about how water and sanitation should be managed. It may be possible to allow different areas to use somewhat different approaches towards pricing and service delivery, while in other aspects it may be necessary for compromises among different areas to be reached so that the efficiencies that come with sharing a common system can be realized.

7 Divergent Models of Water and Sanitation Planning

By involving multiple stakeholders in collectively constructing a social learning process through community workshops and democratic processes, participatory approaches to post-disaster engineering seek to generate collective mental models of the issues or problems in a specific local context. Mental models are the cognitive representations of the world that frame how people interact with the world; learning implies changing these mental models (Mathevet et al. 2011). Based on ATLAS.ti network maps from the interviews, along with notes from meetings with various officials and the coding of opinions gathered during the workshop, the research team developed three comprehensive ideal-type mental models. The schematic models below identify the main problems, solutions, and actors that various types of respondents referred to when prompted to address the water and sanitation problems in Léogâne.

7.1 The Emergency Relief approach (Fig. 7.1)

The main problem is identified as immediate access to water and sanitation. This produces an emergency relief solution, centered on free water trucking and building of shallow latrines. Efforts are piecemeal and vary in terms of focus (drinking water vs. sanitation) and service area (from individual settlements to community clusters). The NGO actors generally work with others in the WASH Cluster, and have some interaction with the Mayor's Office, which is viewed as a weak actor without capacity to implement anything or even participate fully in planning processes. In most cases, installation and service are provided free of charge with no provision for long term operational costs. Some NGOs were also working closely with DINEPA to help re-build the piped-water system in Léogâne, but this has been done without any local consultation or participation. While some relief agencies planned to begin local consultation, WASH cluster meetings indicate that others simply withdrew services within a year, when their funding for free services such as water trucking ran out.

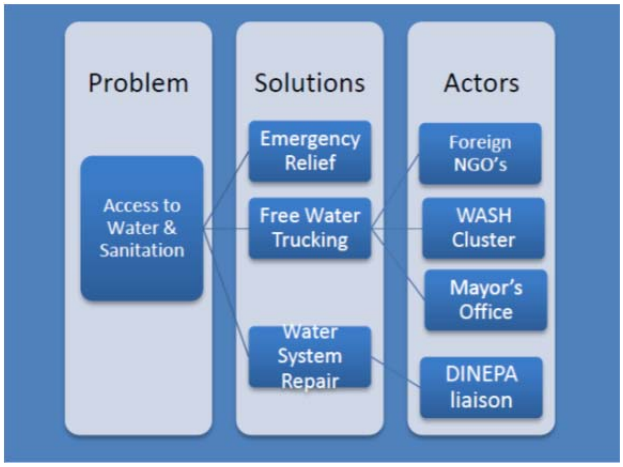


Figure 7.1: The "Emergency Relief" NGO Model

7.2 The Government Plan (Fig. 7.2):

DINEPA's planning focuses only on provision of piped drinking water in the urban core of the City of Léogâne, and ignores sanitation for the time being. The restored system is to be publicly owned but decentralized to regional offices of DINEPA, with management gradually transferred to public or private operators under regulatory oversight on a regional and national basis. They conceptualizes the main problem as one of government capacity. The solution to this problem is to gain international funding and foreign technical assistance; and to then keep the system running with payment for services to contract operators. Users would pay based on metered consumption, with revenues remaining at the regional level to implement repairs and manage the system. Current DINEPA plans under development for sanitation seem to include payment not for use, but for the emptying of latrines.

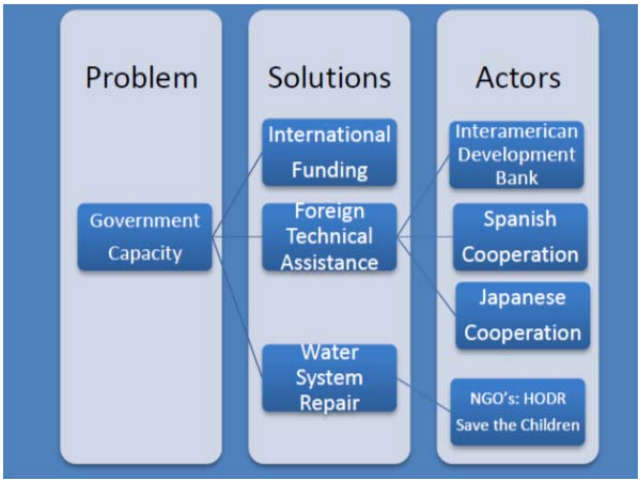


Figure 7.2 DINEPA "Water Management" Model

7.3 Local stakeholders (Fig. 7.3)

Finally, local interviewees and workshop participants suggested multiple solutions customized to the needs of the urban, peripheral, and outlying zones of the city. They recognized the need to address protection of source waters and the environment in general, irrigation, water treatment, public and private drinking *and* sanitation facilities. They also suggested that people are willing to pay for and co-manage services. They also noted the need for a national legal framework. They identified the main problem as being a comprehensive one of sustainable water access, sanitation and irrigation. While local stakeholders recognized the need for foreign technical assistance and NGO assistance, they also clearly identified local self-organization and the use of water committees as possible solutions, and included participatory processes in their vision of rebuilding.

Figure 7.3: The Community "Participatory" Model

7.4 Summary

Our research identified the important gaps in communication between national-level planners, international NGO's, and local citizens, civil society organizations, and local government officials. This gap reinforced divergent visions of what needed to be done, and how the recovery and reconstruction effort should proceed. It suggests that a better understanding is needed of the relationship between the desire for local knowledge and participation; and the actual capacity, means, and appropriate interactional settings for carrying it out. NGOs generally offered piecemeal interventions, to the best of their ability, in whatever small area they worked. Because of a lack of coordination with the government and finite availability of resources, NGO strategies, while helpful during the immediate phase of post-disaster response are often criticized for creating dependencies that cannot be supported in the long term. Even more importantly, however, in their ignorance of local histories of participation and community organization, they may actually be undermining local social organization

and “social capital” that exists amongst CBOs as well as bypassing existing national legal frameworks and policy directives.

To the extent that sustainable development strategies are informed by local participation, the current governmental and non-governmental water and sanitation strategies are fundamentally problematic. Although DINEPA was supposedly created to implement long term sustainable and participatory approaches, and has much of the paper infrastructure for this, it has not done much along these lines yet and is instead acting within a mentality of quick disaster response. This mission creep is bypassing participatory processes at exactly the point in time when they are most necessary to determining the longterm direction of infrastructure decisions in Haiti. While the government plan may provide drinking water to some of the urban dwellers in Léogâne, it will not address the broader set of water and sanitation needs articulated by local stakeholders. Such quick-fix solutions circumvent precisely those social learning processes that might engage multiple stakeholders and take into account complex system interactions (Grin, Rotmans and Schot 2010).

While the community-based participatory model is in line with the national legal framework that DINEPA is pursuing, our workshop participants placed stronger emphasis on community participation (and demonstrated a willingness to participate). Our interactions with stakeholders indicate that local understanding of the nature of the water and sanitation problem is comprehensive, as are the breadth and extent of locally proposed solutions. This integrated vision of actors, resources, and dynamics (Etienne et al. 2011) is in stark contrast to the government plan that more than a year and a half after the earthquake was just beginning to address urgent sanitation needs. Public sanitation facilities are one option identified by the stakeholder participants that could be, but are not, included in the government’s plan. In sum, we would represent the local stakeholders’ mental model of a sustainable sanitation and water system as shown in Figure 7.4.

The rectangles represent participatory processes – including foreign and local engineers – which we suggest should be augmented and strengthened during any post-disaster emergency response, rather than replaced by foreign NGOs or government dictat. The ovals represent elements connecting to emerging sustainability, which we suggest is the ultimate outcome of post-disaster participatory engineering that aims to reduce future risk and vulnerability.

These results are, of course, limited by our use of convenience sampling techniques that may not have been representative of the entire population. The paper survey included a significantly higher percentage of participants from the outlying areas that from the city center or its periphery. The study also required us to make interpretations of the various results, which may differ somewhat from the actual viewpoints of the study participants (e.g. with respect to the definition of a “modern toilet”). Nonetheless, this multi-method approach by an interdisciplinary team of both engineers and social scientists gives detailed insight into the types of participatory processes that infrastructure planners and engineers could use first to elicit and document local knowledge and preferences, and then use as a template for participatory planning and management of infrastructure systems. This kind of a process is currently not taking place in the effort to rebuild Haiti, but if undertaken systematically it

would help generate far greater stakeholder participation in government or donor financed development efforts and hence contribute to the long-term sustainability of such efforts.

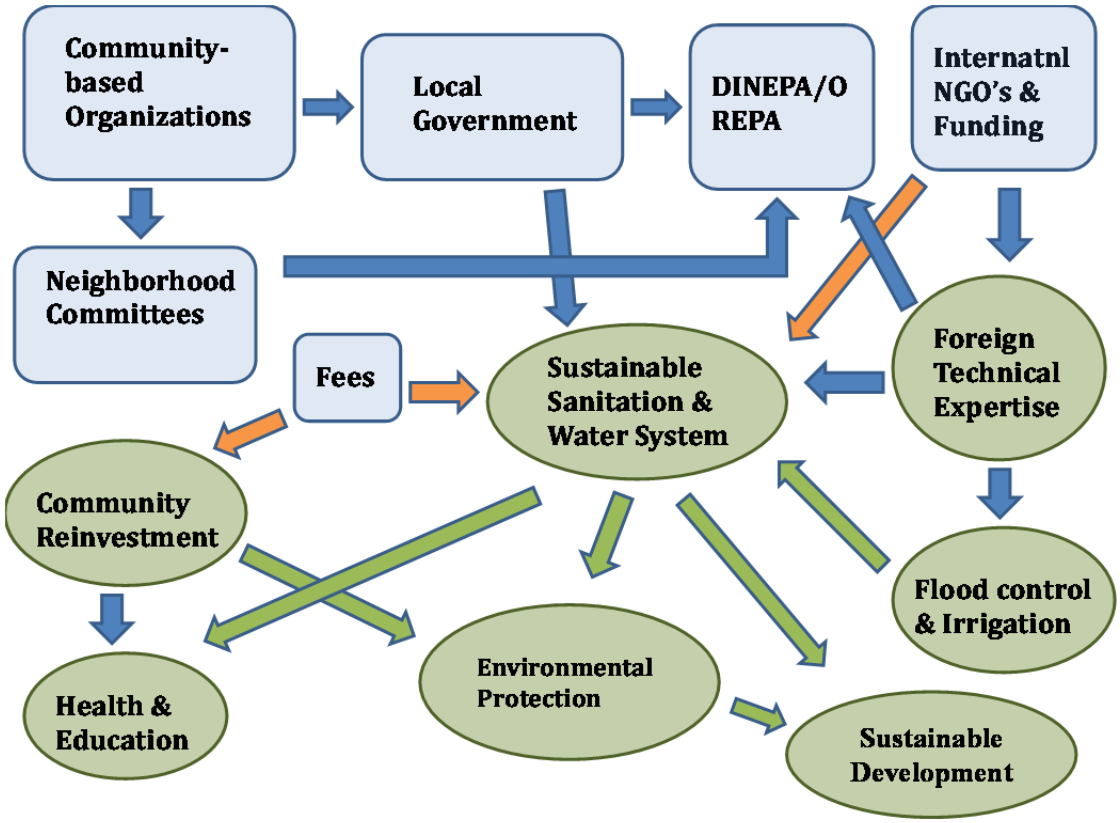


FIGURE 7.4 : Community Vision of a Sustainable Water & Sanitation System for Haiti

Modeling the complex post-disaster coordination of participatory processes in contexts like post-earthquake Haiti is crucial to understanding potential pathways for sustainable engineering. Participatory approaches that engage local stakeholders are increasingly viewed as necessary elements of transnational engineering projects, yet there are substantial gaps in the achievement of such laudatory goals. We conclude that greater attention by both engineers and social scientists to multi-stakeholder arenas, interactions amongst actors, and unfolding decision-making processes, can contribute to better post-disaster engineering.[ii] As a Haitian workshop participant stated, "The important thing is to work together and continue to work towards a common goal." Local participation in post-disaster engineering projects is important not merely as window dressing for projects driven by outside decision-makers and planners (whether governmental or non-governmental), but we argue can actually provide better and more comprehensive solutions to complex problems that cut across human and natural systems, can help to build in local capacity, and ultimately can shore up the sustainability of the entire infrastructure system and thereby reduce social vulnerability when the next disaster comes along.

8.0 Acknowledgements

This project was supported by a National Science Foundation Haiti-RAPID grant via the Sustainability program (Bruce Hamilton) in the ENG Directorate (grant ENG 1032184). The authors would like to thank Jean D. Vernet II, Lavaud Vernet, Yves Rebecca, Tibebu Ayalew, Steve O'Connor, Heather Galada and Adam Zahn for their work and contribution to this project. Thanks to Campbell Soup Corp. for donating laptop computers to the project; and to ATLAS.ti for donating a software license, and to Contech Engineered Solutions for a $1000 grant in support of this research. We also thank Marie Yoleine Gateau and all the staff of the Neges Foundation for hospitality; and we are very grateful to our team of enumerators from the Université de Notre Dame, and the group of facilitators who helped run the workshop. For lending us their time and willingly sharing their ideas we especially thank members of Hands on Disaster Response; the staff of DINEPA; and inhabitants of the municipality of Léogâne.

References

"Action Plan for Reconstruction." Haitian Government (2010): n. pag. Web.

Country Brief (2012) "Haiti - Population." Haiti - Population. US Library of Congress Country Studies, 2010. Web. 15 Mar. 2013. <http://countrystudies.us/haiti/21.htm>.

DINEPA (2010) Rapport Annuel 2009-2010. Pétion-Ville, Haiti

Etienne M, Du Toit D, Pollard S (2011) ARDI: A Co-construction method for Participatory Modeling in Natural Resource Management. *Ecology and Society* 16 (1): 44. [online] URL: http://www.ecologyandsociety.org/vol16/iss1/art44/

FAO (2013) "Haiti Fact Sheet." Aquastat. N.p., 2000. Web. 15 Mar. 2013. <http://www.fao.org/nr/water/aquastat/countries/haiti/index.stm>.

Fountain, H. "Managing Disasters with Small Steps." The New York Times 18 Jan. 2010: n. pag. Print.

GRET (2010). CAMEP and Komite dlo dans le cadre du projet Rezodlo. Rapport de diagnostic: Situation dans les quartiers défavorisés de Port au Prince 4 mois apres le séisme de 12 janvier 2010. [CAMEP and Water Committees in the framework of the Water Resources Project]. Diagnostic report: Situation in disadvantaged neighborhoods of Port au Prince 4 months after the January 12, 2010 earthquake] GRET, Port au Prince, Haiti.

GRET, CAMEP and Komite dlo dans le cadre du projet Rezodlo (2010) Rapport de diagnostic: “Situation dans les quartiers défavorisés de Port au Prince 4 mois apres le séisme de 12 janvier 2010” (June 2010), Port au Prince: GRET

Grin J, Rotmans J, Schot J (2010) *Transitions to Sustainable Development: New Directions in the Study of Long Term Transformative Change*. New York and London: Routledge.

Howard, Philip (1997) "Development-induced Displacement in Haiti", Refuge, Vol. 16, No. 3 (August 1997), pp. 4-11.

IDB (2013) Website of the International Development Bank, Haiti Page, accessed March 15, 2013 @ http://www.iadb.org/en/countries/haiti/hope-for-haiti,1001.html

IHRC (2011) Interim Haiti Recovery Commission. Accessed online at http://www.state.gov/p/wha/rls/fs/2011/154141.htm

IMF (2010) "Press Release: IMF Executive Board Cancels Haiti's Debt and Approves New Three-Year Program to Support Reconstruction and Economic Growth." Press Release: IMF Executive Board Cancels Haiti's Debt and Approves New Three-Year Program to Support Reconstruction and Economic Growth. IMF, 2010. Web. 15 Mar. 2013. <http://www.imf.org/external/np/sec/pr/2010/pr10299.htm>.

Kennedy, J., J. Ashmore, E. Babister, and I. Kelman. ""The Meaning of 'Build Back Better': Evidence from Post-tsunami Aceh and Sri Lanka."." Journal of Contingencies and Crisis Management 16.1 (2008): 24-36. Print.

Lawther, P.M. "Community involvement in post disaster re-construction – Case study of the British Red Cross Maldives recovery program." International Journal of Strategic Property Management 13.2 (2009): 153–169. Print.

Leon E, Kelman I, Kennedy J, Ashmore J. Capacity building lessons from a decade of transitional settlement and shelter. International Journal of Strategic Property Management 13 (2009): 247–265. Print.

Mathevet, R., M. Etienne, T. Lynam, C. Calvet (2011) "Water Management in the Camargue Bioshpere Reserve: Insights from Comparative Mental Models Analysis", Ecology and Society 16 (1): 43 http://www.ecologyandsociety.org/vol16/iss1/art43/

McCaffrey, S.C. (1992) A human right to water: Domestic and international implications, *Georgetown International Environmental Law Review,* V(1), pp. 1-24.

Nouvellon, Alban. (2010) Direction National de l'Eau Potable et de l'Assainissement, personal communication, Port-au-Prince, Haiti, June 1, 2010.

OCHA (1998) United Nations Office for the Coordination of Humanitarian Affairs. Guiding Principles on Internal Displacement. Accessed online on 3/15/13 at http://reliefweb.int/sites/reliefweb.int/files/resources/AB752ABEA5C1EFFCC1256C33002A8510-idp.html

OECD (2013) "Net ODA Receipts, 1998-2008", Organisation for Economic Co-operation and Development accessed online at http://stats.oecd.org/

Palaniappan, M., Gleick, P.H., Hunt, C. & Srinivasan, V. (2004) Water Privatization Principles and Practices. In P.H. Gleick (Ed) *The World's Water 2004-2005: The Biennial Report on Freshwater Resources* (pp. 45-78). Washington D.C.: Island Press.

PBS (2004) "Haiti: The Struggle For Water." Web. 15 Mar. 2013. <http://www.pbs.org/frontlineworld/fellows/haiti/watersystem.html>.

"Progress in Drinking-water and Sanitation: Special Focus on Sanitation." World Health Organization (WHO)/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) (2008): n. pag. Web.

"Progress in Drinking-water and Sanitation: Special Focus on Sanitation." World Health Organization (WHO)/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) (2010): n. pag. Web.

Ramsey, Kate (2011). The Spirits and the Law: Vodou and Power in Haiti. Chicago: University of Chicago Press.

Richman, Karen (2005). Migration and Vodou. Gainesville: University of Florida Press.

Snell, S. (1998) Water and Sanitation Services for the Urban Poor: Small-Scale Providers: Typology and Profiles. *World Bank Water and Sanitation Program*, Working Paper. http://www.wsp.org/wsp/sites/wsp.org/files/publications/global_typology.pdf Last accessed: June 2011.

Sontag, D "In aiding quake-battered haiti, lofty hopes and hard truths" *The New York Times*. 22 Dec. 2012. Print.

UNDP, 2010. Web. 15 Mar. 2013. <http://hdr.undp.org/en/media/HDR_2010_EN_Complete_reprint.pdf>.

UNESCO (2003) 1st World Water Development Report. Rep. N.p.: UNESCO, 2003. Web. http://www.unesco.org/water/wwap/wwdr/wwdr1/tableofcontents.shtml

UNESCO (2006) 2nd World Water Development Report. Rep. N.p.: UNESCO, 2006. Web. http://www.unesco.org/water/wwap/wwdr/wwdr2/tableofcontents.shtml

UNESCO (2009) 3rd World Water Development Report. Rep. N.p.: UNESCO, 2009. Web. http://www.unesco.org/water/wwap/wwdr/wwdr3/tableofcontents.shtml

Varma, MK; Satterthwaite, ML; Klasing, AM; Shoranick, T; Jean, J; Barry, D; Fawzi, MCS; McKeever, J and E. Lyon. "Woch Nan Soley: The Denial of the Right to Water in Haiti."Health and Human Rights in Practice. Vol 10, No. 2. Hhrjournal. Web. 8 March 2013.

Verella, F. "Building Resilience in Haiti: Equity, Information, Growth and Sustainibility."Haiti RAPIDS and Research Needs Workshop. Haiti Earthquake Clearinghouse. 30 September 2012. Web. 8 March 2013.

Whittington, D.,Briscoe, J., Mu, X. & Baron, W. (1990). Estimating the willingness to pay for water services in developing countries: A case study of the use of contingent valuation surveys in Southern Haiti. *Economic Development and Cultural Change,* 38, 293-311.

WHO (2013) "Water, Health and Human Rights." WHO. N.p., n.d. Web. 15 Mar. 2013. <http://who.int/water_sanitation_health/humanrights/en/>.