MINISTRY OF HEALTH AND SANITATION

GOVERNMENT OF SIERRA LEONE

Household Water Treatment and Safe Storage

A National Study on Market Opportunities, Barriers and Steps to Scale Up Household Water Treatment and Safe Storage in Sierra Leone

Undertaken by NestBuilders International, on behalf of the Government of Sierra Leone Ministry of Health and Sanitation, funded by the UK Government, through the WASH Facility.

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Market Opportunities, Barriers and Steps to Scale Up Household Water Treatment and Safe Storage in Sierra Leone

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Foreword

The MoHS has commissioned a national market study to establish the current situation with respect to household water treatment and safe storage (HWTS) practices and attitudes, as well as baseline information on household demand for, and supply of HWTS products throughout the country. To this end, NestBuilders International (NBI) was contracted to carry out the 'National Study on Market Opportunities, Barriers and Steps to Scale-Up Household Water Treatment and Storage (HWTS) in Sierra Leone'.

The study is action orientated, seen as the first key step to implementing and scaling-up HWTS in Sierra Leone. Therefore the deliverables of the study are based around providing guidance on strategies for nationwide scale-up. As such, the following documents have been prepared as part of this study:

1) **National Study on Market Opportunities, Barriers and Steps to Scale-Up HWTS in Sierra Leone**: The current document serves as a baseline study on HWTS and is the first of its kind in Sierra Leone. Comprehensive baseline indicators related to HWTS demand, supply and policy have been included in the report. The document is intended for use by programme managers who require evidence-based research to establish baseline levels and develop detailed HWTS programming.

2) **National Study Brief**: Summarises the key results of the national study, suitable for general consumption.

3) **HWTS Programme Implementation Plan:** The 'Programme Implementation Plan' (PIP) builds on the findings of the national market study. It has been prepared for use by the Government of Sierra Leone Ministry of Health and Sanitation, and other relevant national programme managers and organizations that would be involved in implementing a HWTS programme in Sierra Leone. The PIP is designed to take readers through the necessary steps to plan and implement a national HWTS programme.

4) **Recommendations for the National Action Plan for HWTS:** Includes a set of defined recommendations to support the drafting of the National Action Plan for HWTS for use by policy makers at the Ministry of Health and Sanitation.

Acknowledgements

NestBuilders International (NBI) is grateful to all those collaborators, stakeholders and consultants who provided invaluable input throughout the various stages of this study. This includes the guidance and support provided by the Ministry of Health and Sanitation. Tribute also goes to the WASH Facility for providing support and advice throughout the study.

Gratitude is extended to our energetic and conscientious office and field staff whose tireless efforts contributed significantly to the success of the study.

Lastly, we would like to extend our sincere gratitude to all of the survey respondents and study participants for the generous contribution of their time and input.

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Acronyms and Abbreviations

ACF	Action Contre la Faim
BCC	Behaviour Change Communication
BSF	Biosand Filter
CBO	Community-Based Organisation
CDC	Centers for Disease Control and Prevention
CLTS	Community Led Total Sanitation
DfID	Department for International Development
DHMT	District Health Management Team
DPD	Diethyl Paraphenylene Diamine
EA	Enumeration Area
EHD	Environmental Health Department
EHP	Environmental Health Policy
FGD	Focus Group Discussion
FCR	Free Chlorine Residual
GDP	Gross Domestic Product
GoSL	Government of Sierra Leone
GVWC	Guma Valley Water Company
HDPE	High-Density Polyethylene (for plastics)
HHWT	Household Water Treatment
HWTS	Household Water Treatment and Safe Storage
INGO	International Non-Governmental Organisation
LGA	Local Government Act
MANCO	Mano Manufacturing Company
MFI	Microfinance Institution
MGD	Millennium Development Goal
MLGRD	Local Government and Rural Development
MoHS	Ministry of Health and Sanitation
MOU	Memorandum Of Understanding
MoWR	Ministry of Water Resources
NGO	Non-Governmental Organisation
NWP	National Water Policy
ODF	Open Defecation Free
PHU	Peripheral Health Unit
PRSP	Poverty Reduction Strategy Paper
PSI	Population Services International
PUR	PUR Purifier of Water ™
PVI	Polyvinyl Chloride
SALWACO	Sierra Leone Water Company
SODIS	Solar Water Disinfection
SWS	Safe Water System
US	United States Dollar
USAID	United States Agency for International Development
VIP	Ventilated Improved Pit Latrine
WASH	Water, Sanitation and Hygiene
WHO	World Health Organisation
WSD	Water Supply Division
WSP	Water Safety Plan
WTP	Willingness to pay

Executive Summary

Background

The recent cholera outbreak in Sierra Leone is a clear indicator of the challenges of access to safe drinking water in the country. While the population depends on a wide range of water sources, an estimated 43% rely on unimproved sources which are likely to be prone to contamination. To date, efforts to improve the quality of water have focused solely on the source. However, a recent study of improved water sources (i.e. utility piped supply, borehole, protected dug well, and protected spring) throughout Sierra Leone found that faecal coliform was detected in 51% of sampled water sources (UNICEF, 2010). The study also found a dramatic decline in residual chlorine with time, suggesting that the effectiveness of the source chlorination protocol followed in Sierra Leone decreases as the frequency of water use increases, particularly in shallow dug wells. Across the country, poor hygiene practices relating to collection, transport and storage of water pose additional risks to the contamination of drinking water in households.

Household water treatment and safe storage (HWTS) is an appropriate intervention in response to the issues highlighted above, as it both treats source contaminated drinking water and prevents contamination during collection, transport and use in the home. HWTS has also been shown to be one of the most effective and cost-effective interventions for preventing water borne disease. A growing body of evidence demonstrates that the use of HWTS methods improves the microbiological quality of household water and reduces the burden of diarrhoeal disease in users at a lower up-front cost when compared to source-based interventions.

As HWTS has been relatively limited in Sierra Leone, the Ministry of Health and Sanitation (MoHS) commissioned a national market study to establish the current situation with respect to HWTS, as part of its wider preventative health activities to reduce WASH related diseases in the country. This study is seen as the first key step, or foundation upon which to develop a national programme on HWTS in Sierra Leone.

Study Objectives and Methods

The overall goal of the study is to provide comprehensive research and analysis for a nationwide market feasibility study on HWTS which will allow the MoHS and its partners to 1) develop a national social marketing campaign for the range of existing and proposed HWTS products; and 2) inform demand and supply strategies. In safe drinking water marketing it is essential to have a clear understanding of both the demand and supply side of the market. Thus, the national study comprised three separate, yet interrelated tasks: a study of consumer demand, a study of HWTS supply chains, and a review of legal and policy issues influencing HWTS uptake.

In total, 2,000 household level surveys and 24 focus group discussions/taster sessions were conducted in all 14 districts of Sierra Leone, comprising of both urban and rural areas. Semi-structured interviews were conducted with 90 supply chain actors to collect information on current market conditions. In addition, four relevant large scale manufacturers were surveyed to assess their capacity to produce high-quality household water treatment and safe storage products. The research team also conducted site visits with organisations implementing HWTS projects throughout Sierra Leone, in addition to interviewing micro-finance lenders to assess the potential for financing HWTS options. Finally, a policy review was undertaken with the objective

of identifying and describing key policies, operational issues and regulations relating to HWTS in Sierra Leone.

Key Findings

Treatment

Survey findings revealed that very few households reported to treat their drinking water. Primarily, this is due to the misperception of current water sources safety (i.e. water is perceived to be safe or already treated at its source). This directly negates the perceived necessity for water to be treated before drinking. Nonetheless, when questioned on the perceptions of individuals who do treat their drinking water, respondents suggested that such individuals care about their health and wellbeing, and therefore have an elevated social standing.

When presented with a range of water treatment products and asked to indicate a preference, consumers were found to favour consumable, rather than durable, products. This was largely based on cost, as consumers were less likely to prefer a HWTS product as its cost rises. Therefore, the large upfront cost of durable products largely reduced the likelihood of consumer's preferences for these products. Rather, there was a preference for paying smaller ongoing costs – which consumable products allow.

Overall, liquid chlorine was the most preferred water treatment product among the surveyed consumers across both urban and rural areas. The study also noted equilibrium between consumer's willingness and ability to pay for the liquid chlorine product. Furthermore, the reported willingness to pay for liquid chlorine was significantly higher than the projected retail cost.

Taster sessions of community water samples treated with a range of treatment products revealed that participants had a high tolerance for the taste and smell of chlorine. Interestingly, many people liked to sense chlorine (often referred to as 'medicine') in the water as assurance that the water was purified and subsequently safe to drink.

Market scans across rural and urban areas revealed that virtually no water treatment products are currently available in retail outlets. This is largely due to a general unavailability of treatment products in country. The limited presence of treatment products on the market creates a major barrier to the uptake of effective and consistent point of use water treatment. Nevertheless, supply-side assessments across the region found that the production of quality liquid chlorine in neighbouring Liberia does present opportunities for low cost importation. Furthermore, an assessment of national manufacturers provided indication that the current production of chlorine in-country has potential to be scaled-up, but requires capacity building and technical support to ensure that quality control measures are implemented.

Meanwhile, an examination of past and existing HWTS projects in Sierra Leone revealed that communities have a demand for, and enjoy using a liquid chlorine product to treat their household drinking water. Nonetheless these projects have been implemented on a small scale basis, and there has been minimal progress in translating these initiatives to a large scale to ensure long-term sustainability. Nevertheless, experiences with safe water systems in Liberia and Guinea suggest that HWTS projects can be implemented in the region with great success and lead to lasting behavioural change.

Storage

The majority of survey respondents were observed storing drinking water in the home, primarily for convenience and to ensure a regular supply of drinking water. However, *safe* storage of water was observed within very few households, often due to the limited access to safe storage containers which encourages unhygienic storage and handling of drinking water.

Survey findings revealed that respondents' most preferred option for storage was a plastic bucket with lid and tap. Nearly half of all respondents also suggested that they would be willing to pay the retail price for the product. From market scans across the country, a range of covered plastic buckets were found to be available within urban areas, chiefdom headquarter towns and rural Loma market trade fairs. Manufacturing assessments also revealed that such products are produced in-country. Local manufacturers expressed willingness to modify their current products to be marketed as 'safe' storage options (e.g. retrofitting plastic buckets with taps).

Key Recommendations

Based on the study findings, a series of recommendations can be made to promote the uptake of HWTS practices throughout Sierra Leone:

- A liquid chlorine product targeted at both urban and rural areas is recommended for Sierra Leone. While there is national capacity to manufacture a liquid chlorine product, technical support and guidance will be needed to assist manufacturers to effectively produce a quality product for wider distribution. Therefore, it is recommended that the liquid chlorine programme begins with importation of a regional product (manufactured in Liberia and approved by the CDC) with the ultimate goal of developing a locally manufactured product, assuming funding is in place.
- The recommended product for safe water storage is a plastic bucket with lid and tap, which has the potential to be produced locally and modified to ensure safe storage.
- Cost is a significant constraint for the majority of households in Sierra Leone, thus, potential consumers will need to see value in what they are purchasing. Based on income data, the majority of the surveyed population would be able to pay for a liquid chlorine product; however, the lack of perceived need for water treatment must be addressed in order for households to be willing to make any HWTS related expenditure.
- It is recommended that the national HWTS programme be scaled up according to a two-tier approach: First, through the development of a national 'mothership' HWTS strategy focused on promoting public-private partnerships and behaviour change communication for demand creation. Second, opportunities for mainstreaming HWTS into ongoing WASH and health-related programs should also be encouraged. This includes linkages with antenatal care clinics, PHUs, NGOs active in the WASH sector, etc.
- The 'mothership' programme should initially be rolled out across major urban cities (Freetown, Bo, Makeni and Kenema) in the first year of the program mainly through the commercial sector (e.g. pharmacies, local shops, etc.) and government infrastructure (e.g. clinics, hospitals and pharmacies). This approach is most likely to achieve economies of scale and ensure sustainable supply chains. Once promotional messages have trickled into rural areas and HWTS products are known and demand is created, entry into rural areas (through partnerships and mainstreaming activities) will be properly supported.

- As part of this approach, and to overcome problems of water treatment accessibility to rural areas while encouraging community-based approaches, it is recommended to investigate the possibility of distributing drinking water treatment products through Peripheral Health Units (PHUs) and development partners active in the WASH sector. Health facilities are well placed throughout the country and accessible even in rural areas, while the opinions of health workers are also valued by consumers. NGOs could also be instrumental in the distribution of HWTS products through existing programmes.
- As radio is commonly used and widely trusted in Sierra Leone, jingles and discussions should be developed to promote HWTS messaging and products. Motivational messaging could also be carried out by community health workers conducting outreach activities. A social marketing campaign to promote the uptake of water treatment practices throughout the country should involve high profile community leaders and NGOs, leveraging the inspirational motivations of consumers. It will also be important to ensure that educational and promotional materials are available at points of sale.
- Finally, efforts need to be made at the central government level to integrate HWTS into national policies.

1. Introduction

This report summarises the rationale, methodology and results from an assessment of the market opportunities, barriers and steps to scale up household water treatment and safe storage (HWTS) in Sierra Leone. The study was undertaken by NestBuilders International, on behalf of the Government of Sierra Leone Ministry of Health and Sanitation, funded by the UK Government, through the WASH Facility.

This national study is envisioned as the first key step to implementing and scaling-up HWTS in Sierra Leone. It is expected that outputs from this study will support the development of a national social marketing campaign to improve demand for clean drinking water and HWTS products, and stimulate private sector engagement and strategies to achieve scale-up.

1.1. Context: Water, Sanitation and Hygiene (WASH) in Sierra Leone

The recent cholera outbreak in Sierra Leone is a clear indicator of the challenges of access to safe drinking water in the country. While the population of Sierra Leone depends on a wide range of water sources, an estimated 43% (SSL & UNICEF, 2011) rely on 'unimproved' sources, which are likely to be prone to contamination.[1] This figure masks the high coverage disparities evident throughout the country: rural coverage has consistently been much lower than urban coverage, with over half (52%) of the rural population relying on unimproved sources for drinking water (SSL & UNICEF, 2011). These figures are alarming as an estimated 60% of Sierra Leone's population reside in rural areas.

Nonetheless, even those served by 'improved' sources, such as a public tap or protected well, may not always receive water of acceptable quality. It may be that the water is not treated at all or is not treated properly (e.g. interrupted or irregular chlorination) or that the source is not bacteriologically safe due to groundwater contamination. In fact, a recent study of improved water sources (i.e. utility piped supply, borehole, protected dug well, and protected spring) throughout Sierra Leone found that faecal coliform was detected in 51% of sampled water sources (UNICEF, 2010). The study also found a dramatic decline in residual chlorine with time, suggesting that the effectiveness of the source chlorination protocol followed in Sierra Leone decreases as the frequency of water use increases, particularly in shallow dug wells. Poor hygiene practices relating to collection, transport and storage of water poses additional risks to the contamination of drinking water in households. This is consistent with a large body of research that has shown that even drinking water which is safe at the source is subject to frequent and extensive faecal contamination during collection, storage and use in the home (Wright et al., 2003).

1.2. Why Household Water Treatment and Safe Storage?[2]

While Sierra Leone works to provide universal access to safe, reliable, piped-in water, it is important to consider interim approaches that will accelerate the health gains associated with safe drinking water. Household water treatment and safe storage (HWTS) is an appropriate intervention in response to the issues highlighted above, as it both treats source contaminated drinking water and prevents contamination during

[1] These include: unprotected well (9.2%); unprotected spring (5.5%); tanker truck (0.1%); push cart vendor (0.1%); surface water (27.8%); bottled water (0.1%); other (0.2%).

[2] Adapted from: UNICEF (January 2008). *"Promotion of Household Water Treatment and Safe Storage in UNICEF WASH Programmes".*

collection, transport and use in the home. A growing body of evidence demonstrates that the use of HWTS methods improves the microbiological quality of household water and reduces the burden of diarrhoeal disease in users.

Treating water at the household level can be more effective than conventional improvements in water supplies because it prevents recontamination of water in the home – thereby ensuring the microbiological quality of drinking water at the point of consumption (Sobsey, 2002). This translates into improved health outcomes. In a systematic review of 15 intervention studies for the World Bank, Fewtrell and colleagues (2005) reported that HWTS was associated with a 35% reduction in diarrhoeal disease compared to a statistically insignificant 11% for conventional source-based interventions. A more recent and comprehensive Cochrane review covering more than 38 randomised, controlled trials and 53,000 people in 19 countries found that household-based interventions were about twice as effective in preventing diarrhoeal disease (47%) than improved wells, boreholes and communal stand pipes (27%) (Clasen et al., 2006). While the exact amount that HWTS reduces disease varies across studies, the research indicates that HWTS can be an effective way to reduce the disease burden in appropriate contexts.

Household water treatment not only provides exceptional health gains, the up-front cost of providing household water treatment is about half that of conventional source-based interventions (Clasen et al., 2007). In fact, a WHO-sponsored analysis (Hutton, 2007) concluded that household-based chlorination was among the most cost-beneficial of the various options for pursuing the MDG water and sanitation targets, yielding high returns on every dollar invested mainly from lower health care costs but also increased productivity and value of school attendance (UNICEF, 2008).

Promoting HWTS helps vulnerable populations to take charge of their own water security by providing them with the knowledge and tools they need to treat their own drinking water. This approach has been shown to reduce diarrhoeal disease, contribute to greater productivity and other associated benefits from improved health. Household treatment can often provide these benefits to underserved populations in a more cost-effective and timely manner than it will take to design, install and deliver piped community water supplies.

1.3. Household Water Treatment and Safe Storage in Sierra Leone

The practice of HWTS has historically been relatively limited in Sierra Leone. In fact, nationwide data from the MICS4 (SSL & UNICEF, 2011) suggests that very few households in Sierra Leone practice household drinking water treatment: only 11% of households use some type of water treatment (15% in urban areas and 9% in rural areas); while only 2% of households using unimproved water sources use an appropriate water treatment method (4% in urban areas and 2% in rural areas). Furthermore, previous national surveys indicate that post collection contamination of safe water is a considerable problem in the country. This includes contamination risks during collection, transportation and storage of drinking water.

While the practice of HWTS is relatively limited, and pilots to date in the country have not been widely scaled-up, shock chlorination of wells is becoming a common practice across the country. Practiced initially for emergency response activities, well chlorination is now perceived by some as a long term option – regardless of it being highly inefficient and effective for only a matter of days. This practice gives a false message to communities regarding the ongoing quality of the water (even after the chlorine has dissipated).

Interestingly, there is an apparent desire of urban and peri-urban communities to consume ‘safe’ water, and a willingness to pay high prices for it, as demonstrated by the flourishing packaged water industry in Sierra

Leone. While the packaged water industry is a booming business across urban and peri-urban areas, there are a number of concerns and shortcomings which pose significant threats to the sector: the on-going cost of packaged water is high; the industry produces significant volumes of waste from the packaging; and the relative lack of quality monitoring does not guarantee that the packaged water is safe.

1.4. Why Conduct a Market Study?[3]

A marketing approach to safe drinking water shares the responsibility for water quality by engaging and stimulating local markets, instead of directly providing the facilities and services. The ultimate goal of safe water marketing is to create a sustainable safe water industry whereby HWTS products are needed and the market provides them under a supportive government regulatory framework.

As marketing involves satisfying people's needs and wants through an exchange process, marketers offer the consumer something they want and are prepared to pay for. Thus the heart of the marketing task is to determine what consumers want and offer it to them in an attractive and accessible way. In other words, in safe drinking water marketing it is essential to have a clear understanding of both the demand and supply side of the market. From the demand side, it is important to gather data on current practices, barriers and preferences for drinking water treatment and safe storage. On the supply side, all aspects of existing household water treatment supply schemes need to be clearly understood, including existing products and technologies and their service providers. Furthermore, the information collected on the supply side provides insight about current market prices, products, costs, and available services, in addition to gaps that remain to increase accessibility of these facilities and services.

The central pillars to a marketing approach are Product, Price, Place, Promotion and Policy. An understanding of these concepts allows for the development of appropriate products at the right prices that are easily available through strategic sales placement and known about through the use of promotional activities that enhance product awareness and demand.

Table 1: The Marketing Mix*

Product	In the marketing of behaviour change, to have a viable product consumers must first believe that they have a problem and that this can be addressed by the product. Offering a range of product choices can prove instrumental in meeting this aim.
Price	Behaviour change itself may have no price tag; however associated products that make it easier can come at a price. These products need to be available at an affordable price to the target audience.
Place	The products required for behaviour change need to be available at outlets accessible to the target audience in order to make behaviour change truly possible.
Promotion	Having a product available in the right place, for the right price creates an enabling environment for behaviour change to occur. However, challenging social norms and promoting a new behaviour remains difficult. Awareness needs to be raised, and a desire to adopt the new behaviour created. This is done via promotion based upon an understanding of the motivations of the target audience and knowledge of their primary and trusted channels of communication.
Policy	Policy can be used to make the desired behaviour easier, by including supportive language in key policy documents and creating a supportive regulatory environment for market growth of services. Providing an enabling policy environment is vital for sustaining behaviour change in the longer term.

*Adapted from: Scott (January 2005). WELL Factsheet. *"Social Marketing: A Consumer-based approach to promoting safe hygiene behaviours."*

[3] Adapted from the Terms of Reference (ToR) for the study issues by the WASH Facility and the Ministry of Health and Sanitation.

1.5. Objectives and Scope

As part of a move to look at HWTS as a key component in the prevention of water related diseases, the Ministry of Health and Sanitation (MoHS) commissioned a national market study. This study aims to establish the current situation with respect to HWTS attitudes and practices, as well as baseline levels of coverage and behavioural indicators, and information about household demand for HWTS products throughout the country. The national study is seen as the first key step in developing a national programme on HWTS.

Research Objectives of the Study

The aim of this study is to understand consumer demand for HWTS, supply chains for HWTS and policies relating to HWTS in order to inform marketing campaigns (See Table 2 below). In doing so, the right interventions can be chosen to overcome barriers, promote consumer demand and stimulate supply side actors to develop and produce appropriate HWTS products.

The overall goal of the study is to provide comprehensive research and analysis for a nationwide market feasibility study on HWTS, which will allow the MoHS and its partners to 1) develop a national social marketing campaign for the range of existing and proposed HWTS products; and 2) inform demand and supply strategies.

Table 2: Research Tasks

Consumer Demand Study	Supply Study	Policy Review
Main Objective: To describe consumers' perceptions, attitudes, knowledge and practices related to adoption and consistent use of HWTS. More specifically, the demand study identified: • Current attitudes and perceptions underpinning behaviour in relation to drinking water; • Barriers to demand; • Awareness of the availability and effectiveness of HWTS products; • Perceptions of the effectiveness of well chlorination; • Consumer preferences between different HWTS product types and willingness to pay; and • Effective messages and interventions to stimulate demand.	**Main Objective**: To gain in-depth insight of local HWTS markets. More specifically, the supply study identified: • Barriers and opportunities for market entry / expansion; • Lessons from past HWTS projects; • Existing products on the market and national availability; • Opportunities for production and sale of HWTS products nationally and regionally; and • Barriers and opportunities for supply chains.	**Main Objective**: To assess the current regulatory framework for HWTS in Sierra Leone. More specifically, the policy review identified: • Key government policies and regulations relating to provision of safe water and HWTS; • Opportunities for the development of a supportive regulatory framework for HWTS.

2. Methodology

A combination of qualitative and quantitative methodologies were employed to address the research objectives of the national market study. Table 3 highlights the mix of data collection tools that were developed, as well as the related target groups.

Table 3: Data Collection Instruments and Target Groups

Research Method	Target Group
Demand Side Research	
Household Survey	Primary caregivers and household heads
Consumer Demand FGDs, Taster Sessions and Product Displays	Community men and women
Supply Side Research	
Market Scan	Pharmacies, general stores, road side kiosks, supermarkets, market traders, etc.
Manufacturing Assessment	Local clay producers, bleach manufacturers, plastics producers
Project Visits and Review	Site visits with organisation engaged in HWTS programmes in Sierra Leone, and a review of relevant HWTS programmes in the region
Financing Assessment	Micro-finance lenders, venture capital programmes and banks
Semi-structured Interviews	Key supply chain actors and providers of HWTS products (e.g. manufacturers, wholesaler/importers, retailers, clay producers, etc.)
Policy Side Research	
Key Informant Semi-structured Interviews	Government ministries, departments and agencies (MDAs) and NGOs active in the WASH sector
In-depth Literature Review	Review of key policy documents

2.1. Survey Tools

Demand-Side Assessment

Household Survey

The household survey collected data on current water sources, collection, storage and treatment practices; knowledge of, perceptions about and experience using water treatment methods; perceptions of water quality; HWTS preferences, willingness to pay and demand for HWTS products. Data on barriers, constraints and motivating factors to uptake HWTS was also collected, along with additional consumer information on ability to pay, access to markets and communication channels.

After conducting the household survey, respondents were asked to provide a glass of their own drinking water. Observations were made of water clarity and in 20% of the sampled households, free chlorine residual (FCR) was measured.

Sampling and sample size:

The sample for the household survey was designed to provide estimates of key research indicators at the national level, for urban and rural areas across the 14 districts of Sierra Leone. The sample was selected in two stages using a stratified cluster sampling methodology. In the first stage, 200 enumeration areas (EAs) were selected, using probability proportional to size methodology, through systematic sampling from a sample frame of all EAs in Sierra Leone that was ordered by province and, within provinces, by district. Household selection in the second stage was an equal probability systematic selection of fixed size: 10 households per cluster, yielding an overall sample of 2,000 households.

Focus Group Discussions, Taster Sessions and Product Display

Combined focus group discussions (FGDs), taster sessions and product displays were conducted to gain in-depth qualitative data on consumers' perceptions, attitudes, knowledge and practices related to the adoption and consistent use of HWTS. During the taster session participants were provided with their own source water in the community treated with four domestic water treatment options (including Aquatabs,

PUR, WaterGuard and Ceramic filtered water). The options were blinded and taste and smell perception were recorded. The product display session presented various HWTS products to participants (see below) in order to gauge preferences and the willingness to pay for the different products.

Table 4: HWTS Products Displayed

Treatment Products	Storage Products
Aquatabs	Plastic bucket with lid and retrofitted tap
PUR Purifier of Water ™	Jerry can with retrofitted tap
WaterGuard	Modified clay/country pot with tap and cover
Ceramic Filter	Concrete/clay storage container with lid and tap
	Indie Group and co. (storage container and treatment option)

24 FGDs were carried out, with six organised in each of the four regions, three with men and three with women, divided by urban, peri-urban and rural sampled communities. Each group discussion had an average of nine participants. All discussions were led by one moderator and recorded by two long-hand note-takers.

Supply-Side Assessment

Market Scan

Vendors in the geography likely to sell water treatment products and water storage containers were visited to investigate the availability and current prices of HWTS related products. Vendors were also asked questions about their knowledge on, and current stock of, household water treatment products and/or water storage products.

A total of 70 market scans were carried out at the nearest main market to each of the sampled EAs. The following vendors were specifically targeted: pharmacies, general stores, road side kiosks, market traders, supermarkets, building materials and speciality stores.

Manufacturing assessment

Local (micro-industry) and national firms producing bleach products and plastics were identified and site visits were conducted to assess their capacity to produce high-quality household water treatment and safe storage products.

Market actors were identified in study sites where the demand survey was being undertaken through snowball sampling methods. Through this approach four relevant large scale manufacturers were surveyed. The study also surveyed producers of local water storage containers (i.e. ceramic 'country pots') to assess the suitability and quality of storage options on the market.

Project visits

Site visits were arranged with each of the organisations identified as implementing HWTS programmes in Sierra Leone. At each site visit, the project team met with key staff to discuss the history, successes and lessons learned of the project. In addition, the project team met with a maximum of ten randomly selected users of the products and conducted informal interviews with household recipients that addressed use of, and payment for the HWTS product.

Site visits were arranged in country with three organisations: (1) Inter Aide, who is implementing a chlorine product in the North; (2) GOAL, who has implemented a biosand project in the South; and (3) ACF, who is implementing a chlorine production project in the West.

Financing Assessment

The project team identified existing programmes in Sierra Leone that work with individuals to provide financing for health products to determine what strategies have been successful and what potentials exist for HWTS financing options. In total seven micro-finance lenders, venture capital programmes and banks were surveyed.

Semi-structured interviews with Supply-Chain Actors

Semi-structured interviews with key market actors in the HWTS supply chain were carried out to explore market conditions and existing supply chains. Information was gathered on market access, customer base, product development and quality, business management, finance and regulatory and policy environment.

Market actors (manufacturers, retailers, clay producers, industry wholesalers/importers, etc.) were identified throughout the project and interviewed. From this sample frame, a total of 90 supply chain actors were selected for semi-structured interviews.

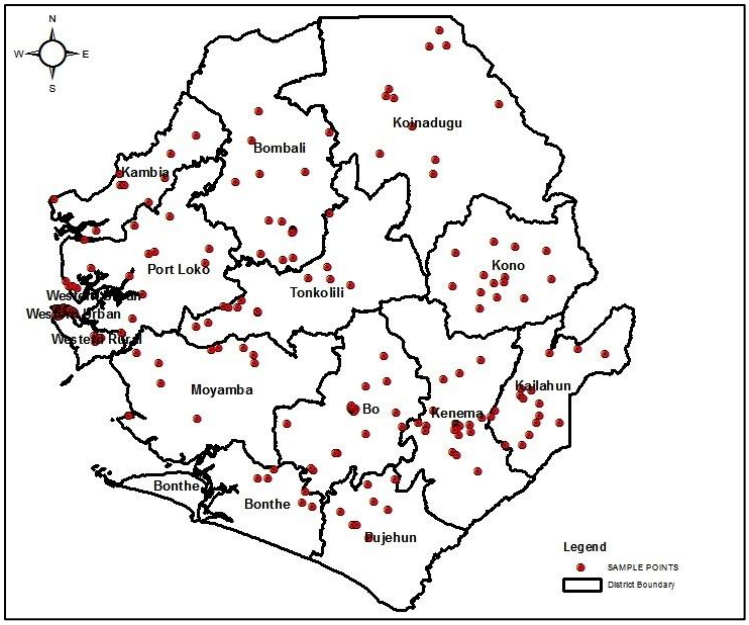
Policy Review

A policy review was undertaken with the objective of identifying and describing key policies, operational issues and regulations relating to HWTS in Sierra Leone. Semi-structured interviews with key informants at government ministries, departments and agencies (MDAs) and NGOs were also carried out. Purposive sampling was used to obtain policy documents and identify key actors in the water sector in Sierra Leone.

2.2. Study Locations

The map below illustrates the location of the 200 enumeration areas that were surveyed during the study.

Figure 1: Location of Sampled Enumeration Areas



3. Results: Consumer Demand Study

The demand-side assessment investigated respondents' current knowledge, attitudes, and practices around water and sanitation; access to water, sanitation, and hygiene; knowledge of, perceptions about, and experience using water treatment methods; access to markets for HWTS products; willingness to pay for water treatment and storage products; main communication channels for health information; and, questions about, and testing of, stored household drinking water at the time of the unannounced survey visit.

The survey population was stratified to identify trends between urban and rural populations. Results have also been disaggregated by region and socio-economic groups where relevant.

3.1. Household Profile and Demographics

The household survey captured summary descriptive statistics on a total of 1994[4] households, among them, 1264 (63.4%) were from rural areas and 730 (36.6%) from urban areas.[5] The main target of the household survey was the primary caregiver, as they are traditionally more involved in managing the household's WASH practices and behaviours. Select questions relating to household socioeconomics, willingness to pay for HWTS products and access to markets were also asked to household heads in each sampled household (as they are traditionally the main economic decision makers).

The average household size was 6.4 members, with households tending to be slightly larger in rural areas (Table 5). Over two-thirds (68.4%) of the sampled households reported having children under the age of five, with an average of 1.3 children under five per household. A higher proportion of rural households had at least one child under the age five (73.0%) compared to households in urban areas (60.4%).

Table 5: Household Descriptors

	Rural (N=1264)*	Urban (N=730)*	Total (N=1994)*
Average Number of People in Household	6.7	5.9	6.4
Percentage of households with children <5	73.0%	60.4%	68.4%

* Unless noted otherwise, sample sizes (n) for total survey populations are as indicated here.

The majority of household heads were men (96.4%), though female-headed households were more common in urban areas (See Table 6). The age of household heads ranged from 20 to 96 years old, with the average age being 45.6 years old. While household heads in urban areas were far more likely to have completed some level of education, seven in ten (69.9%) of rural household heads had not completed primary school. Furthermore, household heads in rural areas were most likely to be engaged in agriculture (76.4%), while urban household heads occupied a larger range of occupations.

[4] A total of six surveys out of the 2000 surveys were not included in the analysis as they contained a high number of incomplete responses.

[5] According to the 2004 Sierra Leone national census framework, 35.8% of the household population in Sierra Leone lives in urban areas; in the current study sample frame 36.6% of the surveyed households were sampled from urban areas. The statistics obtained from the sampling frame are thus representative of the urban-rural split at the national level. Statistics Sierra Leone census data EA identifications of rural and urban areas were applied.

Table 6: Household Heads Background Characteristics

		Rural	Urban	Total
Gender of Household Head	Male	97.4%	94.5%	96.4%
	Female	2.6%	5.5%	3.6%
Average Age of Household Head		45.9 years	45.0 years	45.6 years
Highest level of education completed by Household Head	No education	69.9%	34.0%	57.8%
	Primary education	19.5%	24.3%	21.1%
	Secondary education or higher	10.6%	41.6%	21.1%
Occupation of Household Head	Agriculture/Farming	76.4%	11.5%	54.5%
	Sales/Trading	4.8%	25.3%	11.7%
	Skilled manual	6.1%	16.1%	9.4%
	Professional/Managerial	2.1%	17.5%	7.3%
	Middle professional (e.g. forces, teacher, nurse, etc.)	4.7%	10.6%	6.7%
	Services	1.7%	8.6%	4.0%
	Other	4.2%	10.4%	6.4%

As shown in Table 7 below, primary caregivers tended to be overwhelmingly female (96.6%). Ages of primary caregivers ranged from 16 to 87 years old, with an average of 36.2 years. Levels of education of primary caregivers were lower than those of household heads, with two-thirds (63.9%) reporting that they had not completed any level of schooling. Urban caregivers were far more likely to have completed any level of education. In both urban and rural areas, the most common sources of income were agricultural work in rural areas, or self-employment which involved trading or vending in urban areas. Again, a wider range of occupations were reported in urban areas.

Table 7: Primary Caregiver Background Characteristics

		Rural	Urban	Total
Gender of Primary Caregiver	Male	3.2%	3.7%	3.4%
	Female	96.8%	96.3%	96.6%
Average Age of Primary Caregiver		36.1 years	36.5 years	36.2 years
Highest level of education completed by Primary Caregiver	No education	76.1%	42.5%	63.9%
	Primary education	17.3%	31.6%	22.5%
	Secondary education or higher	6.6%	25.9%	13.6%
Occupation of Primary Caregiver	Agriculture/Farming	66.2%	8.2%	44.9%
	Sales/Trading	21.8%	44.7%	30.2%
	Professional/Managerial	0.5%	4.2%	1.9%
	Middle professional (e.g. forces, teacher, nurse, etc.)	4.6%	13.7%	7.9%
	Housework	3.8%	14.1%	7.6%
	Services	1.3%	6.0%	3.0%
	Other	1.8%	9.1%	4.5%

Household Socioeconomics: Wealth Quintiles

A wealth index was developed to represent a composite measure of the surveyed households' cumulative living standard. The wealth index was calculated using data on a household's ownership of selected assets, such as radios and bicycles; materials used for housing construction; and types of water access and sanitation facilities. Table 8 shows the percent distribution of the surveyed households by wealth quintiles, according to residence and region. It is not surprising that more than half of urban residents (52.2%) live in households that are in the highest wealth quintile, compared with only 1.4% percent of the rural population. Nearly six out of ten (59.2%) surveyed households in the rural area were in the two lowest quintiles. The data also shows that households in the Western region (which includes the capital city, Freetown) are predominately in the richest quintile, while the majority of households in the other regions are in the two lowest quintiles.

Table 8: Wealth Quintiles, by region and area

		Poorest	Second	Middle	Fourth	Richest
Region	South	36.1%	21.4%	22.7%	12.5%	7.3%
	North	18.0%	30.6%	27.9%	21.4%	2.2%
	East	24.0%	20.8%	20.0%	25.4%	9.8%
	West	-	0.8%	4.5%	19.0%	75.7%
Area	Rural	30.0%	29.2%	27.0%	12.4%	1.4%
	Urban	2.6%	4.1%	7.9%	33.2%	52.2%
Total		**20.0%**	**20.0%**	**20.0%**	**20.0%**	**20.0%**

3.2. Current Household Sanitation and Hygiene Practices

As the benefits of a water quality intervention depend on overall sanitation and hygiene conditions, the survey collected data on the surveyed population's existing access to sanitation and current hygiene habits. When sanitation and hygiene conditions are poor, water quality improvements may have minimal impact, regardless of the amount of water contamination.

Use of Improved Sanitation Facilities

Current sanitation practices were assessed by measuring the percentage of surveyed households using an improved sanitation facility. An *improved* facility was defined as one of the following: flush latrine, ventilated improved pit (VIP) latrine and pit latrine with slab.[6]

Overall, 68.4% of the survey population – 87.9% in urban areas and 57.1% in rural areas – live in households using improved sanitation facilities (Table 9).[7] The findings indicate that use of improved sanitation facilities is strongly correlated with higher levels of wealth and education of household head and is higher in urban than in rural areas. Notably, nearly three out of ten households (28.9%) in the poorest quintile report practicing open defecation. Regionally, respondents in the South (42.5%) were least likely to report using an improved facility.

[6] Categories of improved and unimproved sanitation are based on the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) guidelines. See World Health Organisation and UNICEF (2006). *"Core Questions on Drinking-water and Sanitation for Household Surveys."* WHO Library Cataloguing-in-Publication Data.

[7] These figures do suggest major improvements from the 2010 Sierra Leone Multiple Indicator Cluster Survey (SSL & UNICEF, 2011), where only 40.5% of the population of Sierra Leone – 57.5% in urban areas and 32.3% in rural areas – were found to be using an improved source. The interventions of government, donors and NGOs in CLTS and other sanitation initiatives over the last three years may have contributed to some of the measured increase.

The most common type of latrine facility was a pit latrine with slab (56.8%), although there were noted variations based on location and area. For instance, urban dwellers, specifically in the West, were more likely to use an improved flush latrine, whereas a higher proportion of rural dwellers reportedly access an unimproved pit latrine without slab.

Table 9: Improved and Unimproved Sanitation Facilities

		Type of Toilet Facility Used by Household							
		Improved Sanitation Facility (%) N=1364				Unimproved Sanitation Facility (%) N=630			
		Flush latrine	VIP	Pit latrine w/ slab	**Total Improved**	Pit latrine w/o slab	Open Defecation	Hanging Latrine	**Total Un-Improved**
Region	South	2.3%	0.9%	39.3%	**42.5%**	48.2%	9.3%	0.0%	**57.5%**
	North	2.0%	2.2%	68.3%	**72.5%**	24.2%	3.3%	0.0%	**27.5%**
	East	6.2%	4.6%	53.4%	**64.2%**	13.3%	22.5%	0.0%	**35.8%**
	West	28.3%	5.2%	62.2%	**95.7%**	3.5%	0.5%	0.3%	**4.3%**
Area	Rural	1.1%	2.0%	54.0%	**57.1%**	30.0%	12.9%	0.0%	**42.9%**
	Urban	21.1%	5.2%	61.6%	**87.9%**	9.5%	2.5%	0.1%	**12.1%**
Wealth Quintile	Poorest	0.3%	0.5%	28.1%	**28.9%**	42.2%	28.9%	0.0%	**71.1%**
	Second	0.0%	0.5%	58.5%	**59.0%**	31.5%	9.5%	0.0%	**41.0%**
	Middle	0.5%	0.5%	69.9%	**70.9%**	23.3%	5.8%	0.0%	**29.1%**
	Fourth	4.8%	7.5%	73.4%	**85.7%**	12.7%	1.3%	0.3%	**14.3%**
	Richest	36.6%	6.8%	53.8%	**97.2%**	2.8%	0.0%	0.0%	**2.8%**
HH Head Education	No education	2.1%	1.3%	55.1%	**58.5%**	27.6%	13.8%	0.1%	**41.5%**
	Primary	6.3%	2.0%	63.3%	**71.6%**	20.8%	7.6%	0.0%	**28.4%**
	Secondary or higher	25.1%	5.3%	56.1%	**86.5%**	11.5%	2.0%	0.0%	**13.5%**
Total		**8.4%**	**3.2%**	**56.8%**	**68.4%**	**22.4%**	**9.1%**	**0.1%**	**31.6%**

Sharing of sanitation facilities was found to be quite prevalent in the surveyed areas. Nearly equal proportions of households reported using a private latrine (48.0%) or a shared latrine (42.8%). Private latrines were more common among urban households (53.7%) compared to those in rural areas (44.3%).

Disposal of Child Faeces

While overall, the majority of respondents (81.1%) reported practicing safe disposal of child faeces[8] there were significant variations between the areas; for instance, in urban areas, over nine in ten respondents (92.6%) indicated that they practiced safe disposal, however in rural areas, only three-quarters (75.6%) of respondents reported the same. Respondents most commonly reported safely rinsing children's faeces into a latrine (73.3% in rural areas and 89.3% in urban areas).

Current Handwashing Practices

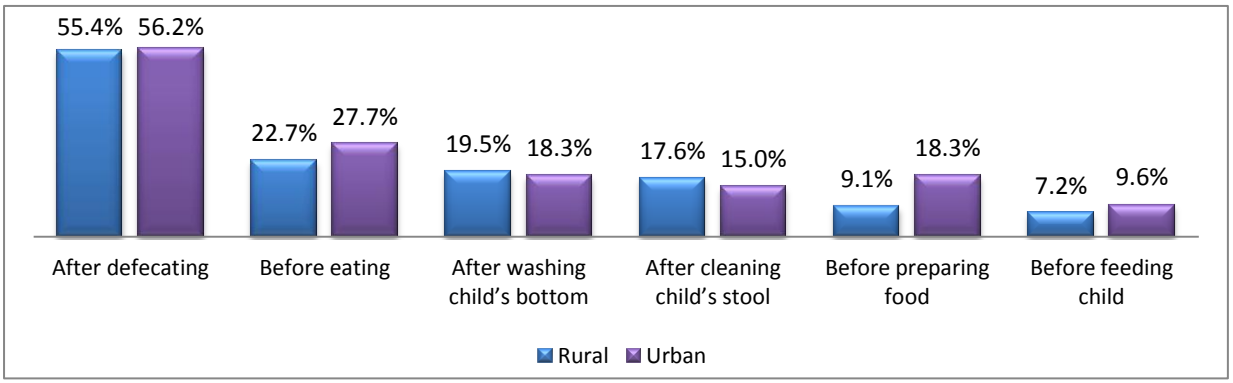
Handwashing with soap at critical junctures is a key hygiene practice which can lead to the reduction of diarrhoeal disease.[9] Since self-reporting of handwashing behaviour is often over-stated and requires time consuming observations to verify, the survey asked respondents what they used soap for the day before or

[8] Safe disposal means either defecating or throwing feces in a latrine.
[9] Critical junctures related to a reduced risk of diarrhoea: washing hand with soap (i) after defecation, (ii) after handling child's faeces, (iii) after cleaning a child's bottom, (iv) before preparing food, (v) before feeding children and (vi) before eating.

the day of the survey. This is an effective way to solicit a more accurate answer about handwashing practices without actually observing the behaviour. All surveyed respondents indicated that they had used soap the day before or the day of the survey; however the vast majority reported using soap mainly for cleaning (87.1%) and bathing (85.5%).

Overall, the use of soap for handwashing was reported among a smaller proportion of respondents. Only five in ten primary caregivers reported handwashing with soap after defecation (55.4% rural and 56.4% urban), and handwashing at the other critical junctures was far less common. In fact, less than one-quarter reported handwashing with soap after handling children's faeces, before eating, before preparing food and before feeding a child (See Figure 2). This was similar among both rural and urban primary caregivers, with the exception of more urban dwellers reporting handwashing with soap before preparing food.

Figure 2: Reported Practice of Handwashing with Soap at Critical Junctures



Overall, only 15.2% of respondents reported washing their hands with soap at least three critical times the day before or the day of the survey. There was little variation between rural and urban primary caregivers on this measure (15.6% rural compared to 14.6% urban respondents).

Knowledge of Critical Times for Handwashing with Soap

Overall, caregivers' knowledge of critical times for handwashing with soap was low to moderate. While the need to handwash with soap after defecation was identified as an important juncture by nearly all survey respondents (95.0%), knowledge of the importance of other important handwashing times was comparatively low among both rural and urban respondents. Less than four in ten primary caregivers mentioned the need to handwash with soap after cleaning a child's bottom, before eating and before preparing food. Self-reporting of handwashing with soap reflected these priorities.

Particularly relevant for this study is the low proportion of respondents that noted the importance of handwashing with soap before handling water for storage (only 4.8% of rural and 9.1% of urban respondents), which raises concerns over the high potential for contamination during the water storage and handling process.

Reported Motivations for Handwashing with Soap

Respondents were asked about the reasons why it is important to wash one's hands with soap. Both urban (86.9%) and rural (88.6%) respondents were most likely to report removal of dirt as the main driver for washing hands with soap. The next most common motivation for washing hands with soap was to be healthy (61.2% rural and 73.8% urban). Only four in ten primary caregivers reported removal of germs/bacteria as a motivation for handwashing with soap (38.5% in rural areas and 46.8% in urban areas).

Summary of Sanitation and Hygiene Behaviours

The data presented in this section suggests that the surveyed population's sanitation and hygiene behaviours are poor to moderate at best. With nearly one-third (31.6%) of households using unimproved sanitation facilities (more so in the rural areas), and very few primary caregivers washing their hands with soap at critical junctures, it can be hypothesised that the success of any HWTS intervention will be partially dependent on improvements made in the sanitation and hygiene practices of beneficiaries.

3.3. Household Health Status

Incidence of Diarrhoea

Primary caregivers were asked about the health status of all members of their household in the two weeks prior to the day of the survey, specifically about the incidence of diarrhoea. When taken as a proportion of the total population of all the sampled household members (N=12,736), 4.6% had a case of diarrhoea in the two weeks prior to the survey. Table 10 presents the data on surveyed households' incidence of diarrhoea according to selected background characteristics. Household members under five years of age were most likely to have a reported case of diarrhoea in the two weeks preceding the survey (10.2%, 178 cases out of a total <5 household population of 1,739). The incidence of diarrhoea was highest in the Southern region (6.8%), while both rural and urban households reported similar proportions of diarrhoea cases in the previous two weeks. Interestingly, households in the richest wealth quintile were the least likely to report a case of diarrhoea (3.2%). Diarrhoea prevalence was higher than average among households using an unimproved source of drinking water or type of sanitation facility.

Table 10: Household Incidence of Diarrhoea

Background Characteristics		Had diarrhoea in the last 2 weeks
Age	<5	10.2%
	5-17	5.0%
	18+	2.8%
Sex	Male	4.8%
	Female	4.5%
Region	South	6.8%
	North	4.9%
	East	3.3%
	West	3.5%
Area	Rural	4.2%
	Urban	4.9%
Wealth Quintile	Poorest	4.5%
	Second	5.4%
	Middle	5.0%
	Fourth	4.9%
	Richest	3.2%
Water Source	Improved	4.3%
	Unimproved	5.7%
Sanitation Facility	Improved	4.0%
	Unimproved	6.2%
	Total	**4.6%**

3.4. Household Water Supply

Households reported having an average of 3.5 drinking water sources available in their community – three in rural areas and five in urban areas. Nonetheless, respondents in both areas only reported *ever* using two (28.6%) or three (24.3%) of the available sources for drinking water.

Access to an Improved Drinking Water Source

The distribution of surveyed households by source of drinking water is presented in Table 11. *Improved sources* of drinking water include the following: piped water (into dwelling, compound, yard or plot), public tap, borehole, protected dug well, protected spring and rainwater collection.[10]

Overall, three quarters of surveyed households (75.6%) reported using an improved source of drinking water – 79.9% in urban areas and 73.1% in rural areas.[11] However, it is important to reiterate that the use of an improved water sources does not guarantee that users actually consume safe water. Protected water sources have been found to deliver contaminated water.[12] Furthermore, piped water supplies across the country have challenges in guaranteeing the quality of the water delivered to customers, through haphazard treatment practices and contamination risks in the distribution system.

Access to an improved water source varied strongly by region. In the Eastern region, 83.8% of surveyed respondents used an improved source for their drinking water, compared to 69.0% in the Northern region. Furthermore, the data indicates that use of an improved drinking water source is strongly correlated with higher levels of wealth. For instance, respondents in the two poorest wealth quintiles had below average access to an improved water source.

The most commonly reported source for drinking water in both urban and rural areas was protected dug well (27.4% and 38.1% respectively), nonetheless variations were observed. Households in urban areas had far greater access to piped water, public taps and packaged water; whereas rural areas overwhelming relied on wells and boreholes. Regional differences were also noted with households in the West being most likely to have access to a piped water connection (23.5%) and public taps (35.1%) compared to other regions. Packaged water was also most prevalent in the West (22.3%), while in the other regions this was reported by less than 1.0% of respondents. Surface water and unprotected wells and springs were the most commonly used unprotected sources of drinking water outside of the Western region.

[10] Categories of improved and unimproved water sources are based on the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) guidelines. See World Health Organisation and UNICEF (2006). *"Core Questions on Drinking-water and Sanitation for Household Surveys."* WHO Library Cataloguing-in-Publication Data. Note: For the current study, packaged water is not considered as an improved water source due to concerns about the quantity of supplied water, in addition to the lack of conclusive water quality testing and standards in the packaged water industry in Sierra Leone.

[11] These figures do suggest an increase in access to improved water sources from the 2010 Sierra Leone Multiple Indicator Cluster Survey (SSL & UNICEF, 2011), where 57.1% of the population of Sierra Leone – 76.2 % in urban areas and 48.2% in rural areas – were found to be using an improved source. More specifically, the largest improvement has been in the decrease in the proportion of households reporting to access *surface water* as their main drinking water source. This difference may arise from the increasing WASH activities of the Government of Sierra Leone and various NGOs over the past 3 years. For instance, the Sierra Leone Water Company (SALWACO) has been involved in providing pipe-borne water for urban and peri-urban settlement, digging hand-dug wells and drilling boreholes in rural communities, in addition to building public taps in urban and peri-urban areas.

[12] According to data collected by the WHO through 'Rapid Assessments of Drinking Water Quality', a high proportion of improved water sources in various countries do not comply with WHO micro guidelines. For instance, of the improved water sources assessed in Nigeria and Nicaragua, 24.3% and 53.3% respectively did not comply with WHO micro guidelines. WHO (2005-6) "Rapid Assessment of Drinking Water Quality".

Table 11: Access to Water Source

		Improved Sources of Drinking Water						Unimproved Sources of Drinking Water					
		Piped water into dwelling	Piped water into yard	Public tap	Borehole	Protected dug well	Protected spring	Unprotected well	Unprotected spring	Bottled water	Sachet water	Surface water	**% using improved source of drinking water**
Region	South	0.0%	0.2%	0.0%	47.7%	26.3%	0.9%	2.1%	10.7%	0.0%	0.2%	11.9%	**75.1%**
	North	0.2%	0.3%	7.2%	15.4%	45.4%	0.5%	8.7%	6.6%	0.2%	0.3%	15.3%	**69.0%**
	East	4.4%	9.4%	7.7%	15.0%	43.3%	4.0%	6.9%	2.1%	0.0%	1.0%	6.2%	**83.8%**
	West	4.0%	19.5%	35.1%	2.8%	13.3%	1.3%	1.0%	0.5%	3.0%	19.3%	0.3%	**75.9%**
Area	Rural	0.6%	2.6%	4.8%	24.9%	38.1%	2.1%	5.4%	7.1%	0.1%	0.2%	14.1%	**73.1%**
	Urban	4.4%	13.3%	22.7%	11.2%	27.4%	0.8%	4.9%	1.8%	1.6%	11.3%	0.5%	**79.9%**
Wealth index quintiles	Poorest	0.0%	0.0%	0.5%	30.7%	35.0%	1.8%	5.3%	12.6%	0.0%	0.0%	14.1%	**68.0%**
	Second	0.3%	0.8%	2.0%	26.1%	38.9%	2.5%	7.8%	6.3%	0.0%	0.0%	15.3%	**70.6%**
	Middle	0.3%	2.8%	6.5%	25.3%	40.4%	2.5%	6.3%	3.3%	0.3%	0.0%	12.5%	**77.7%**
	Fourth	2.3%	6.5%	18.3%	13.3%	44.9%	0.3%	6.3%	3.3%	0.0%	1.3%	3.8%	**85.5%**
	Richest	7.3%	22.6%	29.3%	4.0%	11.8%	1.3%	0.5%	0.3%	3.0%	20.0%	0.0%	**76.2%**
Household Head Education	No education	0.5%	3.3%	8.3%	20.5%	37.7%	2.5%	7.1%	7.5%	0.2%	0.7%	11.6%	**72.8%**
	Primary	1.0%	7.3%	13.9%	22.8%	29.4%	1.3%	7.3%	4.6%	0.0%	2.3%	10.6%	**75.6%**
	Secondary or Higher	4.6%	12.2%	16.8%	10.6%	28.4%	1.3%	1.7%	3.0%	3.3%	14.5%	3.6%	**73.9%**
Total		**2.0%**	**6.5%**	**11.3%**	**19.9%**	**34.2%**	**1.7%**	**5.2%**	**5.1%**	**0.7%**	**4.3%**	**9.1%**	**75.6%**

Differences in Main Drinking Water Source in the Dry versus the Rainy Season

As the majority of respondents (84.2%) reported relying on the same *main* source of drinking water in the dry and rainy season, summary data on main water source in Table 11 is largely representative for both dry and rainy season source of drinking water. Of those households that reported use of a different source for drinking water in the rainy season, 54.8% switched to rainwater collection, 11.8% switched to a protected dug well and 8.9% switched to borehole.

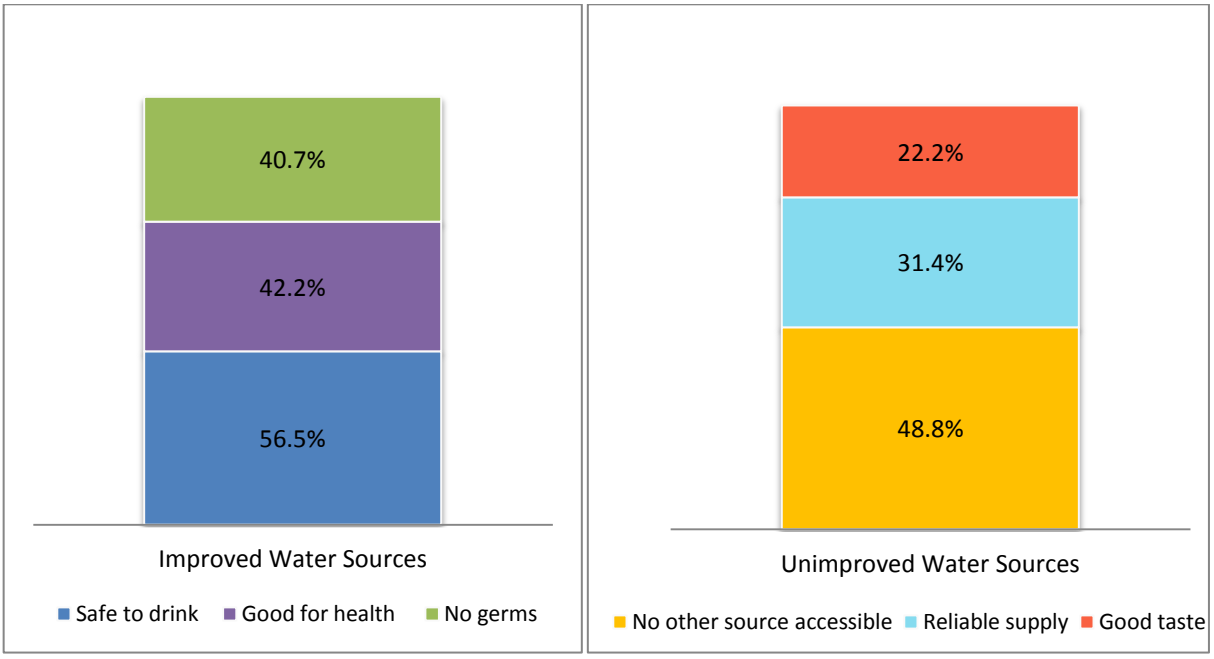
While only 15.8% of households reported using a different main drinking water source in the rainy season, it is likely that many use rainwater collection as a secondary source. In fact, asked if their households ever collect rainwater to use for drinking, 85.6% of rural and 53.7% of urban respondents stated that they did. Households reported that they would use existing buckets, bowls or pots to collect rainwater –suggesting that products are not readily available to support safe rainwater harvesting.

Key Considerations in Choosing a Main Drinking Water Source

As previously mentioned, the majority of surveyed communities had an average of 3.5 water sources available, however households relied on only one main source for drinking water. The reasons why they use their main source can provide insight into the drinking water attributes valued by households.

The survey found that users of improved and unimproved sources differ greatly in their reasons for choosing their main source of drinking water. Users of improved water sources selected their source of drinking water based on its perceived safety (56.5%), health benefits (42.2%) and protection from germs (40.7%). Conversely, the majority of respondents accessing unimproved sources reported that they choose their main source because no other source is accessible to them (48.8%), followed by the reliability of the supply (31.4%) and the good taste (22.2%).

Figure 3: Reasons for Choosing Main Drinking Water Source



Main Drinking Water Source when Away from Home

Survey respondents were asked to report on the source of their drinking water when away from home. Less than one in ten respondents reported taking drinking water from home in a container. While half of urban respondents (52.1%) reported purchasing packaged water, eight in ten (83.7%) rural respondents reported drinking 'whatever water source is available' when away from home. As was highlighted in Section 3.1, the majority of rural households are engaged in agriculture, which infers that significant periods of time are spent away from the home, and presumably, away from safer community water points. Taken together, these findings may imply that marketing of storage containers should include storage options which can be easily transported.

Continuity of Drinking Water Supply

Seasonal changes in the availability of water were noted throughout the research. According to FGD participants in both rural and urban areas, water is generally abundant in the rainy season, while during the dry season, it is difficult for most households to find sufficient quality water close by. In many cases, households are forced to collect water from more distant sources where water remains available; however there are concerns over its quality.

"In the rainy season, we get water from the rain, in the dry season we get water from the swamps or from the dry well, which has very small amounts of water and is usually dirty." (Male respondent, Peri-Urban, Southern region)

"Water is the biggest problem especially during the dry season when we get shortages of water, unless we walk for more than a mile and the water is dark." (Female respondent, Urban, Northern region)

"The water from the well is contaminated during the dry season and we have to wait until dirt settles at the bottom of the bucket before drinking." (Female respondent, Rural, Western region)

Payment for Drinking Water

Payment for drinking water is highly correlated with geography, wealth and main source of drinking water. The majority of households that pay for drinking water are located in urban areas, live in the Western region, are from the richest wealth quintile and rely on packaged or piped water. Among those that reported paying for drinking water, the median monthly payment for rural households was nearly one-tenth of the average amount paid my urban dwellers.

Table 12: Payment for Drinking Water

Background Characteristics		% of HHs paying for drinking water	Median monthly payment, per HH (1 US = 4,360 Le.)
Region	South	1.6%	US$3.44
	North	8.4%	US$1.15
	East	15.2%	US$0.70
	West	63.9%	US$5.75
Area	Rural	5.7%	US$0.65
	Urban	43.8%	US$5.75
Wealth Quintile	Poorest	2.0%	US$0.25
	Second	5.0%	US$0.70
	Middle	7.5%	US$0.45
	Fourth	21.7%	US$2.65
	Richest	62.6%	US$5.75
Main Water Source Used By HH For Drinking	Bottled water	100.0%	US$68.80
	Packaged water	100.0%	US$8.00
	Piped into yard	74.2%	US$3.45
	Piped into dwelling	72.5%	US$5.75
	Public tap	35.6%	US$3.45
	Protected spring	12.1%	US$0.70
	Protected dug well	10.3%	US$0.70
	Unprotected well	6.7%	US$0.45
	Borehole	3.3%	US$0.60
	Unprotected spring	0.0%	N/A
	Surface water	0.0%	N/A
Total		**19.5%**	**US$4.50 (Le. 19,600)**

3.5. Packaged Water

As the packaged water industry is increasingly gaining traction into new areas of the country, the survey sought to collect data from households on their consumption and perceptions of packaged water. This is particularly relevant as it will provide insight on the motivations of those households that are currently willing to spend money on drinking water and the reasons why others are not.

Overall, nearly half of all respondents reported that their household had *ever* purchased packaged water (48.4%).[13] Findings show significant variation between urban and rural respondents. For instance, while eight in ten urban respondents (80.6%) indicated that their households had ever purchased packaged water, less than three in ten rural respondents (29.8%) said the same. Disaggregation by wealth quintile also revealed that those in the richest quintile were most likely to have ever purchased packaged water (94.4%), while those in the poorest were least likely (22.3%).

Table 13: Packaged Water Purchasing Practices

Does your household ever buy packaged water?		Have *ever* purchased packaged water
Region	South	49.4%
	North	34.3%
	East	29.8%
	West	94.1%
Area	Rural	29.8%
	Urban	80.6%
Wealth index quintiles	Poorest	22.3%
	Second	25.0%
	Middle	31.8%
	Fourth	68.7%
	Richest	94.4%
	Total	**48.4%**

Among households that reported having ever purchased packaged water, sachet water was the most common (95.1%) in both rural and urban areas. Asked about the frequency of purchase, rural respondents were most likely to report doing so only when away from the home (36.4%), while urban respondents most commonly reported at least once a week (31.2%). Nonetheless, a significant proportion of both urban and rural respondents reported purchasing packaged water rarely (26.5% and 35.6% respectively).

FGDs in areas across all four regions of Sierra Leone revealed that respondents generally purchase packaged water during the dry season/when water is scarce (e.g. when wells are dry/pumps are locked) and for special occasions (e.g. marriage and burial ceremonies). Issues of wealth were also directly linked to the frequency packaged water is purchased, exemplified by one respondent who reported only buying packaged water when money is available.

Motivations for Purchasing Packaged Water

Consumers of packaged water reported a high level of trust in the quality of the water as it is believed to be treated and pure. In fact, when asked why they purchase packaged water, nearly five in ten respondents reported 'because it is treated' (53.6% in urban areas and 42.5% in rural areas). A significant proportion also reported that they purchase packaged water because it is convenient when away from the home (48.8%

[13] Packaged water includes bottled, sachet and plastic bags of water.

urban and 46.0% rural). Thus, despite the reported high levels of confidence in the safety of water sources, certain segments of the population (specifically within urban areas) purchase packaged water as it is a convenient and safe water source when away from the home. Furthermore, the belief that packaged water is treated and safe from germs (34.7%) and good for health (33.5%) was also commonly reported.

Trust in packaged water quality, and the belief that it is treated and safe are problematic when viewed within the context of preliminary findings from a recent report about the packaged water industry in Sierra Leone. The report findings suggest that the packaged water industry in Sierra Leone is not appropriately regulated to protect public health and without strong regulations and oversight, packaged water may be contaminated with faecal coliform.[14] While these findings will need to undergo further testing to determine the exact level of contamination, they are cause for concern.

Focus group discussions revealed similar consumer motivations for buying packaged water. Respondents suggested that they purchase packaged water, as it is pure and therefore lessens the likelihood of the spread of disease. Additionally, awareness of their own unsafe household water source was reported, as respondents suggested that they purchase packaged water for family members and guests who will not drink from their main water points.

"Yes, I buy as my father does not drink pump water and in case strangers come to my house and do not want to drink pump water." (Male respondent, Urban, Eastern region)

"Yes, it is pure to drink and prevents diseases." (Male respondent, Urban, Southern region)

"Yes, because it is more safe than other alternative water sources." (Male respondent, Peri-Urban, Northern region)

Reasons for Not Purchasing Packaged Water

Those who reported that their household had *not* purchased packaged water were asked about their reasons for not doing so. Reasons for not purchasing packaged water varied greatly among rural and urban respondents. For rural respondents, the most commonly reported reason for not purchasing packaged water was that it is not available (52.0%); while for urban respondents cost was the biggest deterrent, with 62.5% reporting it was too expensive. Very few respondents had problems with the taste or smell of packaged water (3.7% urban and 2.1% rural) and only 2.1% of rural and no urban respondents had concerns about the safety of packaged water. Data from FGDs also highlighted issues of affordability and accessibility, along with the habitual practices of respondents as influencing factors of whether respondents would purchase packaged water.

"We buy when the pockets are full." (Male respondent, Rural, Northern region)

"We don't have the money. We are not used to drinking it." (Male respondent, Rural, Eastern region)

"No, it costs a lot of money. I have a big family to buy water for all." (Male respondent, Peri-Urban, Eastern region)

[14] See Focus 1000 and The Water Institute at UNC (2013). "*Improving the regulation, monitoring, and quality of the packaged (sachet and bottled) water industry in Sierra Leone; and sensitising the customer base".*

"I don't even think to buy it." (Female respondent, Peri-Urban, Easter region)

"No, it is not available. I don't want it because I am used to my current source of water." (Female respondent, Rural, Southern region)

Perceptions of Packaged Water Safety

Nearly all respondents reported that they believed packaged water is safe to drink (95.6% urban and 98.0% rural). When asked *why* they believed it was safe, many respondents reported that the 'water is treated at the place of production'. Numerous respondents felt that because packaged water is clear, it must be clean. Overall, reasons for believing that packaged water is safe centred among the following three themes:

- If rich, educated and prominent people with prestige drink packaged water, it must be safe
- A belief in the regulation of the industry: "If it was not safe, government would have stopped [vendors] from selling it, so it is safe"
- Perceptions of health benefits from drinking packaged water: "I don't know of anyone who got cholera/sick from drinking it"

A small percentage of respondents reported that they did not believe packaged water is safe (1.9% rural and 4.4% urban). One frequently mentioned reason for this was the occasional appearance of particles in previously bought packages of water. Also reported was a lack of trust that the water was free from germs and dirt.

FGDs revealed that those respondents who reported that packaged water is safe to drink primarily based this belief on the messages spread through the product's advertisements. Additionally, a few respondents related the taste of the water to measure its safety.

"Yes, it is written on the packet that it is safe to drink." (Male respondent, Rural, Eastern region)

"Yes, it is pure water- the name says it is. The adverts say it is pure." (Female respondent, Peri-Urban, Eastern region)

"Yes, they tell us on the radio it is safe to drink." (Female respondent, Urban, Southern region)

"Yes, it is treated, it is purified, because it tastes good." (Male respondent, Urban, Southern region)

Of the FGD participants who reported that packaged water is not safe for drinking, the majority suggested that this was due to perceptions of taste and smell which indicate that water is contaminated.

"We are not sure despite we are told so because some smell and taste bad." (Female respondent, Peri-Urban, Northern region)

"No, because it has bad smells." (Female respondent, Urban, Northern region)

Survey findings on the motivations and barriers for purchasing packaged water suggest that urban consumers (most specifically in the Western region) in higher wealth quintiles are willing to spend money on packaged water for the convenience it affords and for reasons of perceived safety. On the other hand, the inaccessibility of packaged water in rural areas, coupled with the higher costs, are barriers for rural consumers, who also consider the practice of purchasing water to be foreign. Nonetheless, the majority of consumers across both urban and rural areas believe packaged water is safe to drink.

3.6. Perceptions of Drinking Water Quality and Safety

Satisfaction with Water Source

Primary caregivers were asked about their overall levels of satisfaction with their main source of drinking water. If levels of satisfaction with current water source are viewed as a driver of behaviour, it can be hypothesised that households with high levels of satisfaction are least likely to be motivated to treat their drinking water at home.

Overall, respondents reported exceptionally high levels of satisfaction with their main water source. In fact, eight out of ten (83.5%) reported that they were satisfied - with over half (55.5%) reporting that they were *very* satisfied, while a further 28.0% were *somewhat* satisfied with their main water source. Only 9.7% reported any level of dissatisfaction.

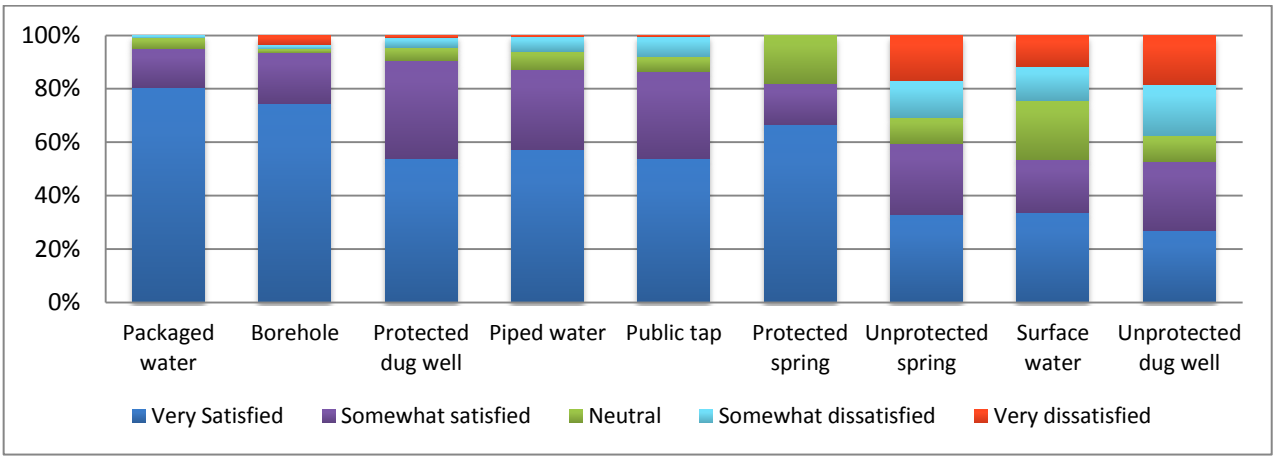
The lowest levels of satisfaction were found in rural areas among users of unimproved sources. More than one in four (28.7%) of all rural users of an unimproved source reported being somewhat dissatisfied or very dissatisfied with their current source of drinking water. The majority of respondents in this group were relying on surface water, with the remainder mostly using either an unprotected well or spring.

Table 14: Level of Satisfaction with Main Source of Drinking Water, by type and area

How satisfied are you with your current source of drinking water?	Unimproved Water Source			Improved Water Source			TOTAL
	Rural	Urban	**TOTAL UNIMPROVED**	Rural	Urban	**TOTAL IMPROVED**	
Very satisfied	30.6%	66.7%	**41.5%**	62.5%	56.0%	**60.0%**	**55.5%**
Somewhat satisfied	23.4%	17.0%	**21.5%**	29.8%	30.5%	**30.1%**	**28.0%**
Neutral	17.2%	4.1%	**13.2%**	3.9%	6.0%	**4.7%**	**6.8%**
Somewhat dissatisfied	14.2%	6.8%	**12.0%**	2.8%	5.2%	**3.7%**	**5.7%**
Very dissatisfied	14.5%	5.4%	**11.8%**	1.0%	2.2%	**1.5%**	**4.0%**

Figure 4 below presents levels of satisfaction by type of water source. The highest levels of satisfaction were reported among users of packaged water, borehole, protected well, piped water and public tap. On the other hand, while users of surface water, unprotected spring and unprotected dug well recorded the highest levels of dissatisfaction, nearly half of the respondents in this group still reported that they were very or somewhat satisfied with their source.

Figure 4: Level of Satisfaction with Main Source of Drinking Water, by source



Data gathered through FGDs provided further insight into the possible rationale for such high levels of satisfaction. A common theme was found among FGD participants who rely on *both* improved and unimproved water sources: a general sense of satisfaction based on their acceptance of their water source as the only option which is available to them.

"We are happy with our water because it is what we have." (Female respondent, Rural, Northern region)

"Yes we are happy because there is no other alternative." (Male respondent, Peri-Urban, Northern region)

In fact, acceptance of drinking water source was also implied when FGD participants were asked to comment on what they believed to be the main problems in their community. Generally, participants in all sampled areas cited the absence of key amenities, such as sanitation facilities, electricity, schools and hospitals as the main problems they are concerned about. While some discussed issues and concerns over water access, they were not the top priority for the majority of community members. The FGD data suggests that high levels of satisfaction may be based on acceptance of current water source simply by its virtue of being available within the context of so many competing priorities (where there is an absence of infrastructure for other amenities).

"The toilet facilities are not good because people defecate in the bushes." (Female respondent, Rural, Western region)

"Lack of job opportunities." (Male respondent, Peri-Urban, Western region)

"No electricity, school or hospital in this village." (Male respondent, Rural, Western region)

"The road network is terrible and only ocadas are used as transportation. Only one hospital, which is located about one and half mile from the community.. No police station around here to protect us from thieves. Toilets are very close to the dwelling homes, which creates bad hygiene." (Female respondent, Urban, Western region)

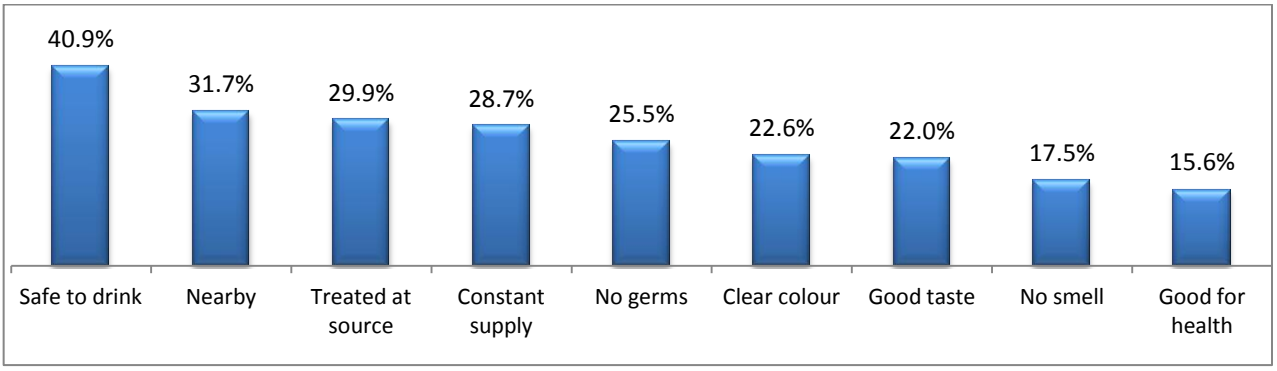
"Refuse disposal is a problem, we don't have a dustbin." (Female respondent, Urban, Northern region)

The FGD data suggests that high levels of satisfaction may be based on acceptance of current water source simply by its virtue of being available within the context of so many competing priorities (where there is an absence of infrastructure for other amenities).

Perception of Key Drinking Water Attributes

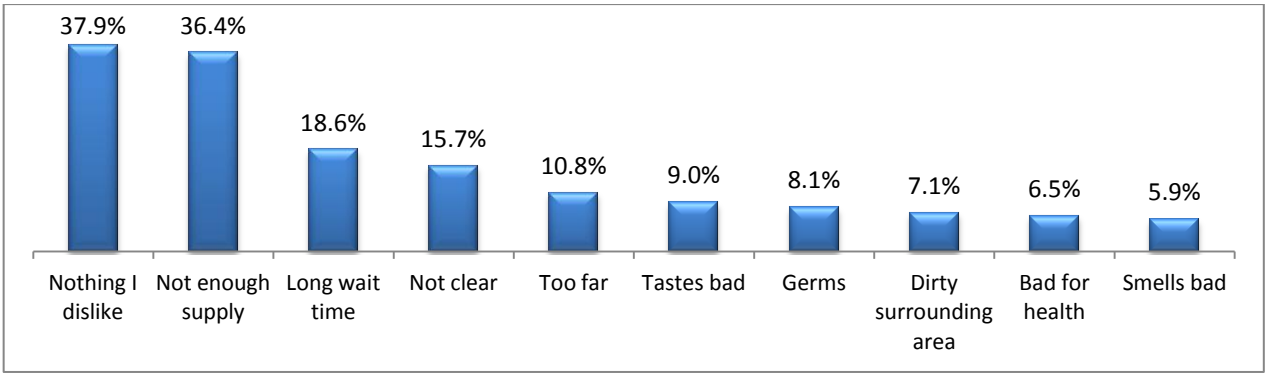
In terms of favourable attributes of drinking water sources, respondents value water safety, proximity, treatment at the source and constant supply (in that order). Other characteristics that respondents favour include a perceived lack of germs/bacteria, clear colour and good taste. Few respondents mentioned health benefits as a characteristic they like about their water source, suggesting that health issues are less important than perceived safety of the water, a belief that it is treated (mainly among users of improved sources), constant supply and aesthetics. These findings were fairly consistent among urban and rural dwellers and for both users of improved and unimproved sources.

Figure 5: Most Favourable Attributes of Main Drinking Water Source



When asked to name the least preferred characteristic of their drinking water source, three out of ten respondents claimed that they liked everything about their source (37.9%). This supports the previous finding regarding the high levels of satisfaction with the main drinking water source. Among the main attributes they disliked, respondents were most likely to report supply shortages (36.4%), long wait times to collect water (18.6%), and water turbidity (15.7%).

Figure 6: Least Favourable Attributes of Main Drinking Water Source



FGD participants were more likely to discuss their least favoured feature in terms of poor health outcomes. In fact, the majority of participants who rely on unimproved sources expressed dissatisfaction with their main source, due to its susceptibility to contamination and the sickness experienced from consuming water from such sources.

Users of Improved Sources

"Yes it is good. Nobody has died from drinking it." (Female respondent, Urban, Eastern region)

"Yes, we like our water because we don't get sick. It is very close to home." (Female respondent, Rural, Eastern Region)

Users of Unimproved Sources

"No [we are not happy] because it is not good, it has germs. Children get sick often. We think it is caused by the water because it is not pure." (Male respondent, Rural, Southern region)

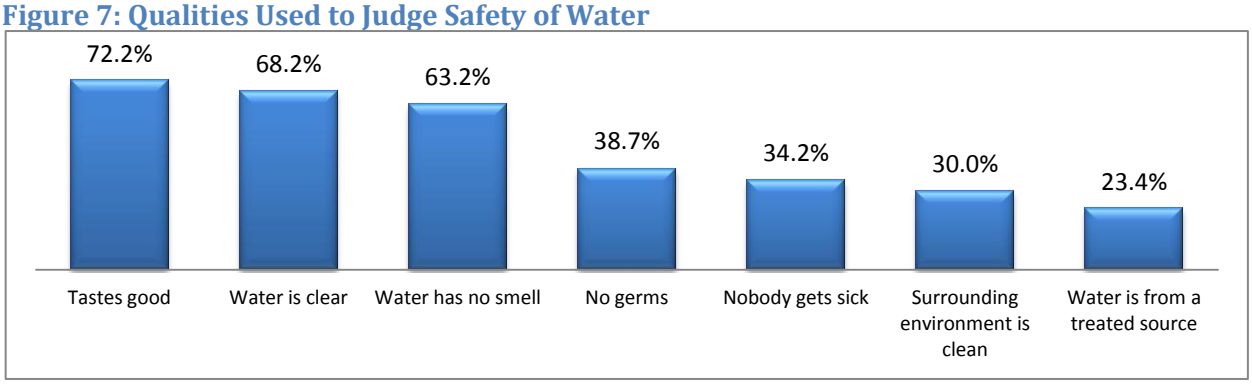
"The water is not covered and we don't know what gets into it." (Female respondent, Rural, Southern region)

"We get sick from drinking from some water wells." (Male respondent, Peri-Urban, Northern region)

Perceptions of 'Safe Water'

Overall, eight out of ten (80.4%) primary caregivers believed that their main source of drinking water was safe. In order to better understand how 'water safety' is understood among surveyed caregivers, they were asked: 'How do you know that water is safe to drink?' According to their responses, people judge the quality of water based on its taste (72.2%), colour (68.2%) and smell (63.2%). These findings were similar for both urban and rural respondents.

Figure 7: Qualities Used to Judge Safety of Water



Qualitative data also revealed that almost unanimously, respondents believed water sources were safe if they had no taste, smell or colour. Furthermore, FGD respondents suggested that turbid/cloudy water with a poor taste and smell would not be safe for drinking (indicating contamination). Respondents also reported that their water would be unsafe if they regularly suffer from diarrhoea or sickness after drinking from it.

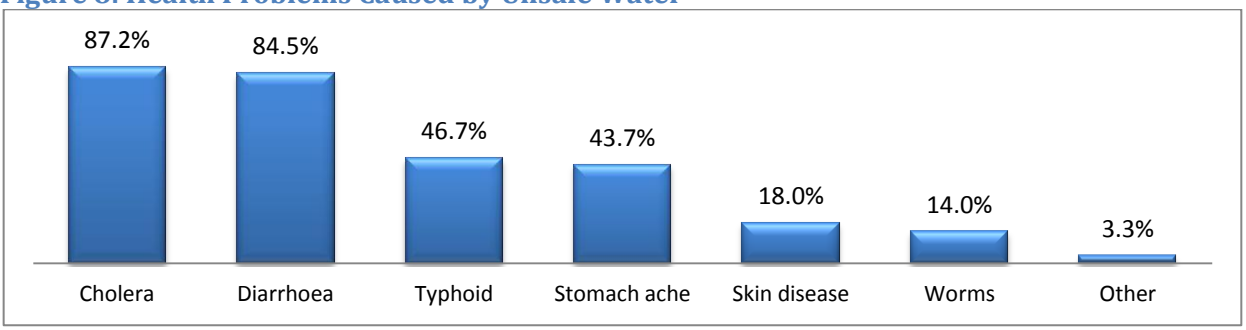
"The water is safe if it has no colour, water has no smell and it does not give us sickness." (Male respondent, Urban, Eastern region)

"When water does not have a rusty taste, smell and no particles in it." (Male respondent, Peri-Urban, Western region)

Understanding the Link between Water Quality and Health

Almost all respondents (99.4%) believed that the consumption of unsafe water caused health problems. When asked what health problems can be caused by drinking unsafe water, the majority of primary caregivers in both rural and urban areas cited diarrhoea (84.5%) and cholera (87.2%).

Figure 8: Health Problems Caused by Unsafe Water

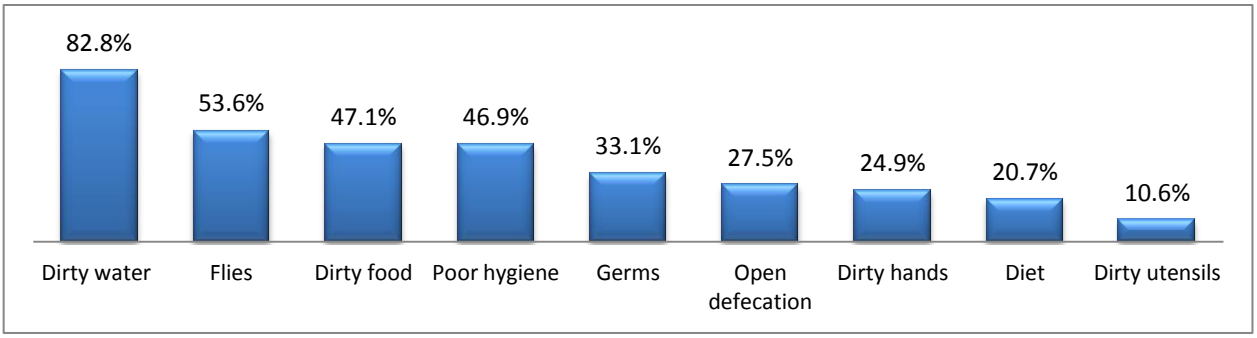


The link between water quality and health was also widely expressed in FGDs among both women and men across all sampled regions. While diarrhoea and cholera were the most commonly cited water-related illnesses, many participants mistakenly believed that unsafe water can also cause malaria.

Knowledge of Diarrhoea Causes and Prevention

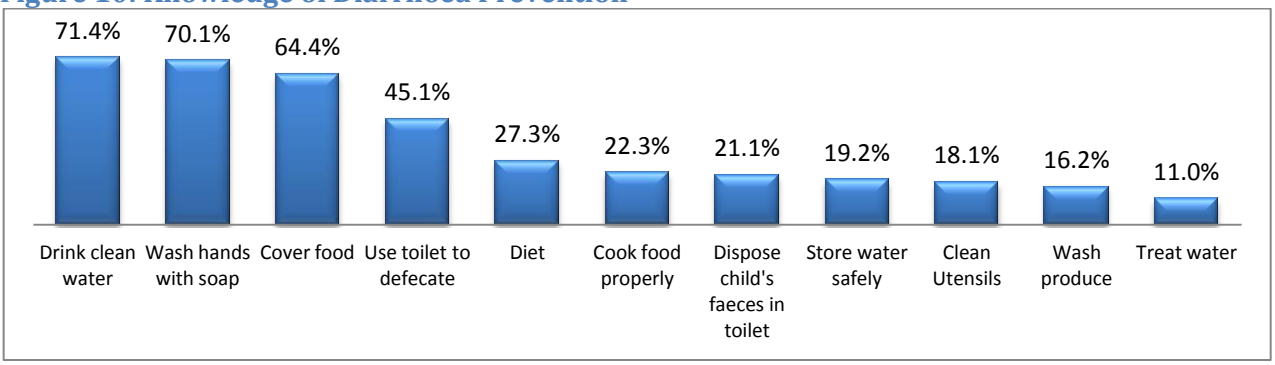
Survey results suggest a high level of awareness of the link between dirty water and diarrhoea as over eight in ten respondents identified bad or dirty water (82.8%) as the leading cause of diarrhoea. There was substantially less knowledge on the faecal-oral transmission of diarrhoea as far fewer respondents identified open defecation or dirty hands as a major cause of diarrhoea. Knowledge of diarrhoea causes was similar among both rural and urban respondents.

Figure 9: Reported Causes of Diarrhoea



The majority of all respondents knew that diarrhoea can be prevented (96.6%). The top three preventative measures reported included: drinking clean water (71.4%), washing hands with soap (70.1%) and covering food (64.4%). While drinking clean water was the most commonly reported method for preventing the transmission of diarrhoea, very few respondents reported proper storage of water (19.2%) or water treatment (11.0%) as preventative measures. These findings suggest that while many respondents have correct knowledge of the connection between contaminated water and diarrhoea, this knowledge is often not translating into knowledge of practical diarrhoea prevention methods such as water treatment and storage.

Figure 10: Knowledge of Diarrhoea Prevention

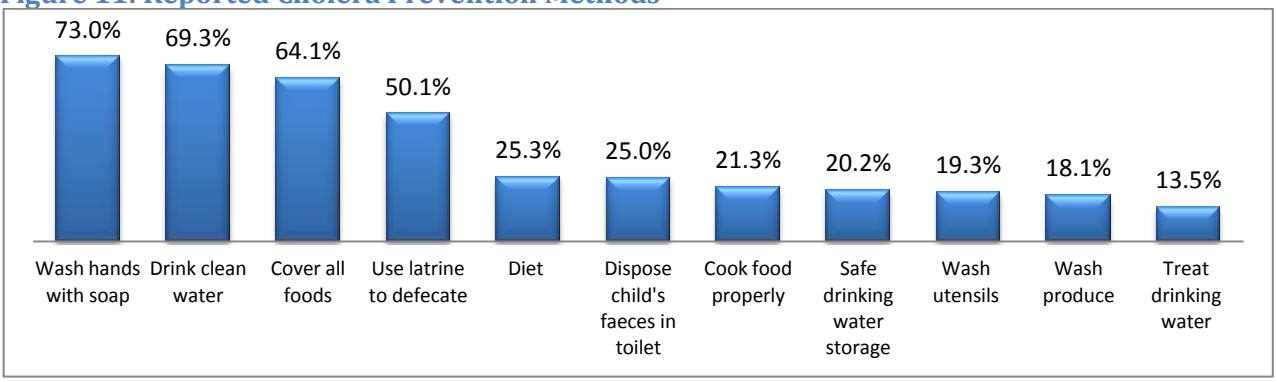


Knowledge of Cholera Causes and Prevention

Respondents were also questioned about the causes of cholera. The most commonly reported cause, in both rural and urban areas, was drinking unsafe water (81.4% rural and 77.3% urban respectively).

Nearly all respondents indicated that they thought that cholera is a serious health problem (99.6% rural and 99.4% urban). Furthermore, the great majority of respondents accurately reported that there are actions to be taken to effectively prevent the transmission of cholera (95.9% rural and 97.4% urban). The most commonly reported prevention method was to wash one's hands with soap (73.0%), followed by to drink clean water (69.3%) and to cover all foods (64.1%). Similar to knowledge of diarrhoea prevention methods, only 12.3% rural and 15.6% of urban respondents knew that treatment of drinking water could be a cholera prevention method, despite the increased sensitisation after the cholera outbreak and the promotion of water treatment options such as Aquatabs. A more sustained intervention, coupled with increased availability of water treatment options may be required to encourage effective knowledge retention.

Figure 11: Reported Cholera Prevention Methods



3.7. Household Drinking Water Collection, Storage and Handling Practices

Water Collection

Overall, only 16.0% of households reported having access to drinking water on their premises or delivered to the home – the majority of which were located in the Western region (43.9%) and urban areas (34.9%). Furthermore, over half of all respondents in the richest quintile (52.7%) had water on premises or delivered, compared with 2.1% and 1.9% in the poorest and second quintiles.

Among the remaining households which reported collecting drinking water, primary caregivers were asked to estimate the amount of time required for water collection (including round trip, queuing, and filling). The distance one must travel to a water point and the time it takes to collect water are two major factors that determine access to potable water. For the survey, improved access was defined as 30 minutes or less for drinking water collection, including queuing time. According to survey findings, access to potable water is fairly high among the sampled households with over three-quarters (76.3%) requiring 30 minutes or less to collect drinking water. Very few primary caregivers (7.7%) reported taking more than 30 minutes to collect water.

Table 15: Drinking Water Collection Time

		Water on premises/ delivered	30 minutes or less	More than 30 minutes
Region	South	6.5%	85.4%	8.2%
	North	2.3%	89.5%	8.2%
	East	19.4%	76.0%	4.6%
	West	43.9%	45.5%	10.5%
Area	Urban	34.9%	56.0%	9.1%
	Rural	5.0%	88.1%	6.9%
Wealth index quintiles	Poorest	2.1%	92.2%	5.7%
	Second	1.9%	90.5%	7.7%
	Middle	7.1%	85.8%	7.1%
	Fourth	15.7%	74.7%	9.6%
	Richest	52.7%	38.8%	8.5%
Water source	Improved	15.4%	78.1%	6.5%
	Unimproved	17.9%	70.6%	11.4%
	Total	**16.0%**	**76.3%**	**7.7%**

Despite access to potable water being quite high among the survey population, findings also revealed that the majority (85.7%) of households collect water every day, making an average of 2.5 trips in a day. The frequency of water collection was highest outside of the Western region, in rural areas and among households in the poorest wealth quintiles.

Table 16: Drinking Water Collection Practices

		Person Responsible for Collecting Water				Frequency of Collection	
		Adult woman (age 15+ years)	Adult man (age 15+ years)	Female child (under 15 years)	Male child (under 15 years)	% of households that collect water everyday	Average trips in a Day
Region	South	68.4%	15.0%	8.8%	7.8%	96.3%	3.0
	North	48.0%	20.6%	22.9%	8.5%	87.5%	2.1
	East	65.5%	13.4%	16.4%	4.6%	88.2%	2.4
	West	48.8%	20.0%	20.0%	11.2%	58.4%	2.8
Area	Rural	58.5%	17.3%	17.2%	7.0%	92.7%	2.4
	Urban	55.3%	17.5%	17.7%	9.4%	69.8%	2.8
Wealth index quintiles	Poorest	68.4%	15.2%	10.6%	5.8%	95.2%	2.3
	Second	55.1%	17.6%	19.9%	7.4%	93.1%	2.4
	Middle	55.4%	18.8%	18.0%	7.7%	89.9%	2.4
	Fourth	60.3%	12.5%	19.0%	8.2%	83.6%	2.7
	Richest	41.7%	26.0%	21.1%	11.2%	52.0%	2.7
	Total	**57.6%**	**17.3%**	**17.3%**	**7.8%**	**85.7%**	**2.5**

Drinking Water Storage and Handling

Even if a household has easy access to a safe water source, they could be at risk if the water is not properly stored and the storage container is not properly maintained. This is especially true in the context of Sierra Leone where the majority of households must collect water on a daily basis.

Households that practice safe water management are assessed against the following practices:

- Use covered and use narrow mouthed containers
- Limit access of children/animals to the drinking water by raising the water containers above ground
- Use a utensil/cup reserved solely for retrieving water that has a long handle
- Regularly cleaning water storage containers

In order to assess household water management practices, the survey included a series of questions and a 'rapid household observation' which allowed enumerators to observe drinking water storage and handling.

Overview of Water Storage and Handling Practices

In total, almost nine in ten households (88.7%) reported to store drinking water in the home. Within these households, enumerators observed that three in ten (30.6%) storage containers were elevated above the ground and over half (57.8%) had a cover, while a very small proportion (14.9%) had a narrow mouth. Respondents were also asked to demonstrate how they remove water from the storage container to drink. Almost three quarters (72.5%) removed water by dipping (i.e. a cup or scoop is used and immersed into the container by hand to retrieve water from their container). Just over half (56.3%) of the surveyed households reported that they clean their water container with soap and water daily. Lastly, primary caregivers noted that water was often stored in the same container for an average of 1.8 days.

Figure 12: Household Water Storing Practices

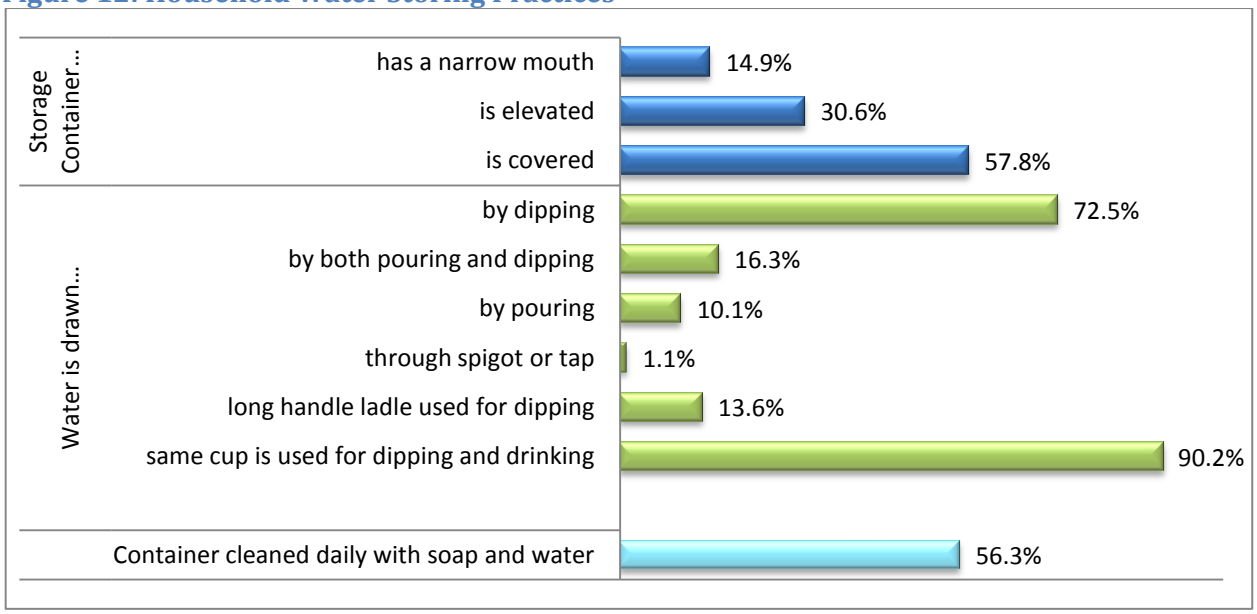


Table 17 presents summary data on household storing practices according to key background characteristics. While there is no clear trend in the safe water management across regions, area and wealth quintile, households in urban areas were the most likely to have storage containers with a narrow mouth, that are covered, elevated and cleaned with soap and water daily.

Table 17: Drinking Water Storage Practices

		Household stores drinking water	Storage containers have narrow mouth	Storage containers covered	Storage container elevated	Storage containers cleaned w/ soap & water daily
Region	South	82.0%	11.1%	52.0%	35.1%	60.6%
	North	85.8%	20.3%	32.1%	17.3%	44.8%
	East	97.1%	7.9%	76.3%	41.2%	65.8%
	West	89.5%	20.2%	77.3%	31.3%	56.4%
Area	Rural	88.9%	13.5%	51.8%	27.8%	56.1%
	Urban	88.2%	17.3%	68.4%	35.4%	56.8%
Wealth index quintiles	Poorest	85.2%	12.7%	53.6%	27.1%	56.4%
	Second	88.5%	15.6%	49.9%	23.8%	51.7%
	Middle	88.2%	12.9%	46.6%	30.6%	61.6%
	Fourth	94.5%	12.7%	62.8%	38.4%	58.7%
	Richest	87.0%	20.5%	76.1%	32.0%	52.7%
Total		**88.7%**	**14.9%**	**57.8%**	**30.6%**	**56.3%**

Drinking Water Handling

Safe water handling is practiced when stored water is dispensed by pouring, through a tap or if a utensil reserved for retrieving water is used when dipping. In order to collect information on drinking water handling in the home, respondents were asked to demonstrate how they remove water from the storage container to drink. Overall, the majority of respondents were observed dipping (72.5%) to retrieve water.

Table 18: Observed Water Handling Practices, by area

	Rural	Urban	Total
Can you please show me how you take water to drink out of the container?			
Pouring: Water is poured from mouth opening	8.4%	13.2%	10.1%
Dipping: A cup or a dipper is used and immersed into the container	76.7%	65.1%	72.5%
Both pouring and dipping	14.3%	19.8%	16.3%
Tap: There is a tap/spigot to dispense drinking from the container	0.6%	0.7%	1.1%

Among those respondents 'dipping' to retrieve water, observations were made of their possession and use of a reserved transferring vessel (i.e. utensil or cup) that allows the water to be transferred to another vessel for drinking (as opposed to using the same utensil/cup for drinking). Overall, only 9.8% of respondents were observed transferring water using a utensil reserved solely for retrieving water, with households in urban areas being more likely to follow this practice (15.7% compared to 6.7% in rural areas). The majority (86.4%) of households used a short handle to retrieve water. This has an impact on the potential for the contamination of water as hands can be dipped into the water, resulting in the transfer of bacteria.

Table 19: Use of a Reserved Utensil for Retrieving Water, by area

	Rural	Urban	Total
What was used to remove water from the drinking water containers?*			
Same utensil/cup used to drink from	93.3%	84.3%	90.2%
Utensil/cup reserved for retrieving water	6.7%	15.7%	9.8%
Does the receptacle to retrieve water have a long or short handle*			
Long handle (e.g. ladle)	14.2%	12.4%	13.6%
Short handle (e.g. cup)	85.8%	87.6%	86.4%

*Expressed as a percentage of all respondents who removed water by dipping, or pouring and dipping, N=1558 (out of the 1768 households who report storing drinking water in the house)

Safe Water Storage and Handling

When the key indicators on safe water storage and handling are combined, we see that only 4.3% of sampled households effectively practice safe water storage and handling.[15] The practice of safe water storage and handling was nearly twice as likely to be observed in urban areas – albeit, the practice was still quite low at 6.0%.

Table 20: Proportion of Households Practicing Safe Water Storage and Handling, by area

	Rural	Urban	Total
% of households safely storing drinking water in a covered and clean container and practicing safe water handling*	3.3%	6.0%	4.3%

***** Expressed as a percentage of households where all of the water storage containers were observed to be covered and cleaned at least once a week with soap and water and stored water is properly handled (i.e. pouring, using a tap, or using a Utensil/cup reserved for retrieving water that has a long handle). Expressed as a percentage of households that reported storing drinking water (n=1558)

Despite these survey observations, FGD respondents showed awareness of safe water storage and handling practices. For example, the importance of using a covered water storage container was recognised by FGD participants as a means of preventing contamination. Furthermore, the cleanliness of water storage containers and utensils, and the number of days water is stored were also mentioned as potential avenues for contamination of stored water.

"If you keep your water without covering it, when left open, it can easily be contaminated." (Female respondent, Urban, Northern region)

"By storing water without a cover, water can get infected by bugs and insects." (Female respondent, Peri-Urban, Southern region)

"Don't put your hands into drinking water and the cup is to be clean. The container is also supposed to be clean." (Male respondent, Rural, Northern region)

"If a dirty cup is used to drink from the stored water, it contaminates the drinking water." (Male respondent, Rural, Western region)

"Stored water kept in the house for too long gets fungi and other particles in it. It turns the water red and dirty." (Male respondent, Peri-Urban, Southern region)

"Storing water for days makes it slippery, it shouldn't be left for over three days." (Male respondent, Peri-Urban, Western region)

"If water is stored for two or three days, the dirt settles at the bottom of the storage unit." (Female respondent, Rural, Western region)

Outside of the home, FGD respondents reported that during the collection of drinking water, stepping around the water source and the instruments used for collection can also increase the risk of water contamination.

[15] Safe water storage and handling is defined as: households which store drinking water do so in a covered, regularly and properly washed, storage container and retrieve water either by using a tap, pouring or dipping with a utensil/cup that has a long handle which is reserved solely for retrieving water.

"Wearing shoes on top of unprotected wells contaminates the water." (Female respondent, Urban, Northern region)

"If you fetch water from the well and you step your feet by the top of the well [this can contaminate the water]." (Female respondent, Urban, Northern region)

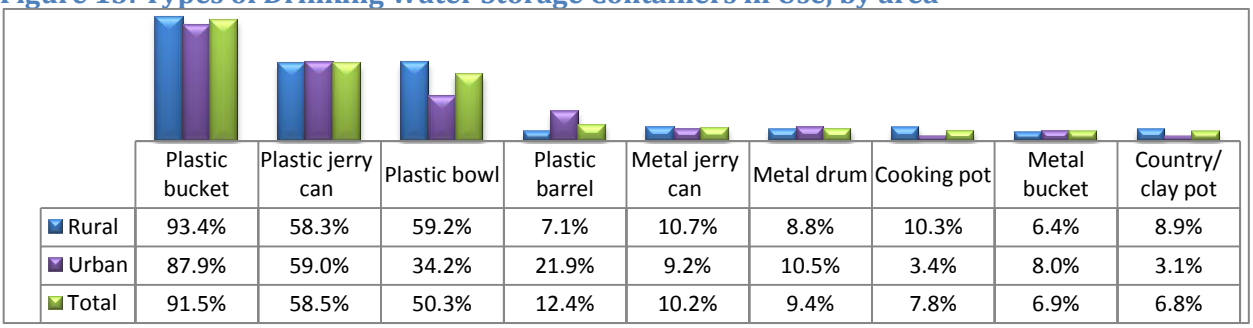
"The rope and rubber that we use to collect from the well may also be used to spoil water." (Female respondent, Rural, Northern region)

"If you wash your feet near the well water, it contaminates the water. The drainage water sips into the water well and contaminates the water." (Male respondent, Rural, Western region)

Types of Drinking Water Storage Containers Currently Used

Observations of storage containers revealed that, on average, households had 2.6 different types of storage containers in use. The majority of households' were found to use similar containers across the country. The most common type of storage containers observed included: plastic bucket (91.5%), plastic jerry can (58.5%) and plastic bowl (50.3%). Nonetheless, there were slight variations in the storage containers used between area type – with a greater proportion of rural households reporting to use a plastic bowl for storage (59.2%), compared to urban households (34.2%), whereas urban households were more likely to use a large plastic barrel (21.9%, compared to 7.1% of rural households). Primary caregivers in both rural and urban areas reported high levels of satisfaction with their current storage containers (92.5% and 96.7% respectively). Among those who reported dissatisfaction with their containers, the majority cited issues with the small volume of water that can be stored, lack of a cover and leakages.

Figure 13: Types of Drinking Water Storage Containers in Use, by area



	Plastic bucket	Plastic jerry can	Plastic bowl	Plastic barrel	Metal jerry can	Metal drum	Cooking pot	Metal bucket	Country/ clay pot
Rural	93.4%	58.3%	59.2%	7.1%	10.7%	8.8%	10.3%	6.4%	8.9%
Urban	87.9%	59.0%	34.2%	21.9%	9.2%	10.5%	3.4%	8.0%	3.1%
Total	91.5%	58.5%	50.3%	12.4%	10.2%	9.4%	7.8%	6.9%	6.8%

When asked to report on the reasons they choose the storage containers they use, the top valued attributes included: it has cover (75.5%), easy to clean (47.0%), prevents contamination (34.0%) and durability (30.9%). Urban respondents were more likely to report the prevention of contamination, the large volume of water and the nice appearance of a storage container as being a motivation for choosing a container when compared to households in rural areas; whereas rural primary caregivers were more likely to cite 'it keeps the water cool'.

The survey found that the majority of households use their containers exclusively for the storage of drinking water – as only 5.3% of primary caregivers reported that drinking water storage containers are also used to store other things (such as rice). Nonetheless, six out of ten households (63.3%) did report that they use the same container to collect, transport and store drinking water (60.8% in urban areas and 64.8% in urban areas). This practice has serious implications in terms of the potential for drinking water to be contaminated during collection, transport and storage.

3.8. Drinking Water Storage Motivations and Barriers

Motivations

Motivations for storing drinking water were identified through FGDs across all regions of Sierra Leone. Participants noted that drinking water is primarily stored for convenience and to ensure continued access during periods of water scarcity. For instance, FGD participants indicated that once water is collected, it is stored to avoid frequent trips to the water point. It was also emphasised that water collection and storage is especially imperative during the dry season, when water shortages are frequently experienced. Thus, in order to ensure a readily available and adequate supply of water, it is stored within the home.

"It is difficult to fetch and haul water every day because our hands hurt." (Female respondent, Rural, Western region)

"We store water because of shortage of water in the community." (Male respondent, Rural, Western region)

"We store water because the tap can lock for seven days." (Female respondent, Peri-Urban, Western region)

"It is good to store water in the house for emergency issues." (Male respondent, Rural, Western region)

Barriers

Nonetheless, barriers exist that restrict the storage of drinking water. The most common barriers discussed related to the availability, access and affordability of proper water storage containers. FGD respondents noted that they cannot always afford to buy new, or repair broken, storage containers. It was further reported that households often use the same container for water storage and collection, primarily due to financial constraints restricting the number of containers that can be purchased. Additionally, respondents spoke of habit influencing their water storage practices whereby storage within the same container used for collection is practiced, as it is something that has always been carried out.

"Yes, we don't have another. We don't have money to buy any more." (Female respondent, Rural, Southern region)

"Yes [we collect and store drinking water in the same container], because of habit. It is what we have always done." (Female respondent, Urban, Southern region)

3.9. Drinking Water Storage Preferences

In order to gain insight into consumer preferences for drinking water storage containers, both primary caregivers *and* household heads were shown a series of flashcards which displayed five shortlisted containers for consideration. The flashcards included coloured pictures of each of the storage products, and a pre-developed script describing the product's features was printed on the back for enumerators to read out to respondents (see Table 21 below).

Household water storage containers were selected based on the following criteria:

1. Identified as 'safe' storage options by the Centers for Disease Control and Prevention (CDC)[16]
2. Storage containers are locally available (however lack the minor modifications to make them safe)

[16] See: CDC. "*Safe Water System: Safe Storage of Drinking Water*". Available at: http://www.cdc.gov/safewater/storage.html

Table 21: Drinking Water Storage Containers

Storage Container	Description
5 Gallon Jerry Can with Tap 	• 5 gallon (20 litre) jerry can with tap • It is lightweight and has a handle which makes it easy to carry • It has a small opening at the top that is covered with a lid • The jerry can has been modified to include a tap at the bottom so water can be easily dispensed • The narrow, covered top and the tap at the bottom help to prevent contamination of the water • **Price: US $8.02 (Le. 35,000)**
Modified Country (Clay) Pot 	• 5 gallon (20 litre) country (clay) pot which has been modified • The modified country pot can be made in Sierra Leone • It has been modified to have a narrow opening at the top with a lid so the opening is too small to allow hands or objects into the water which can cause contamination • It also includes a tap at the bottom so water can be easily dispensed – this also helps to prevent contamination of the water • The country (clay) pot keeps stored water cool • **Price: US $18.34 (Le. 80,000)**
Bucket with Lid and Tap 	• 5 gallon (20 litre) plastic bucket • It is lightweight and easy to carry • It has a fitted lid at the top to prevent entry of the hands or objects into the container which can cause contamination • The bucket has been modified to include a tap at the bottom so water can be easily dispensed – this also helps to prevent contamination of the water • **Price: US $10.32 (Le. 45,000)**
Concrete Storage Containers with Lid and Tap 	• 12.5 gallon (50 litre) concrete water storage container that can be made in Sierra Leone[17] • It is very durable and will last a long time • It can store a large amount of water safely • It has a fitted lid at the top to prevent entry of the hands or objects into the container which can cause contamination • There is a tap at the bottom so water can be easily dispensed – this also helps to prevent contamination of the water • **Price: US $16.05 (Le. 70,000)**
Metal Tap & Plastic Tap  	• The picture is of two different taps: (a) a metal tap and (b) plastic tap • These taps can be bought and added to <u>existing</u> storage containers that already have a narrow mouth and a lid/cover. This helps to make the storage container safe: • The taps allow you to easily dispense water and prevent entry of the hands or objects into the container to get water which can cause contamination • **Prices:** Metal tap is **US $5.73 (Le. 25,000)** Plastic tap is **US $3.44 (Le. 15,000)**

[17] WHH is currently producing these storage containers at a warehouse in Grafton, Western region.

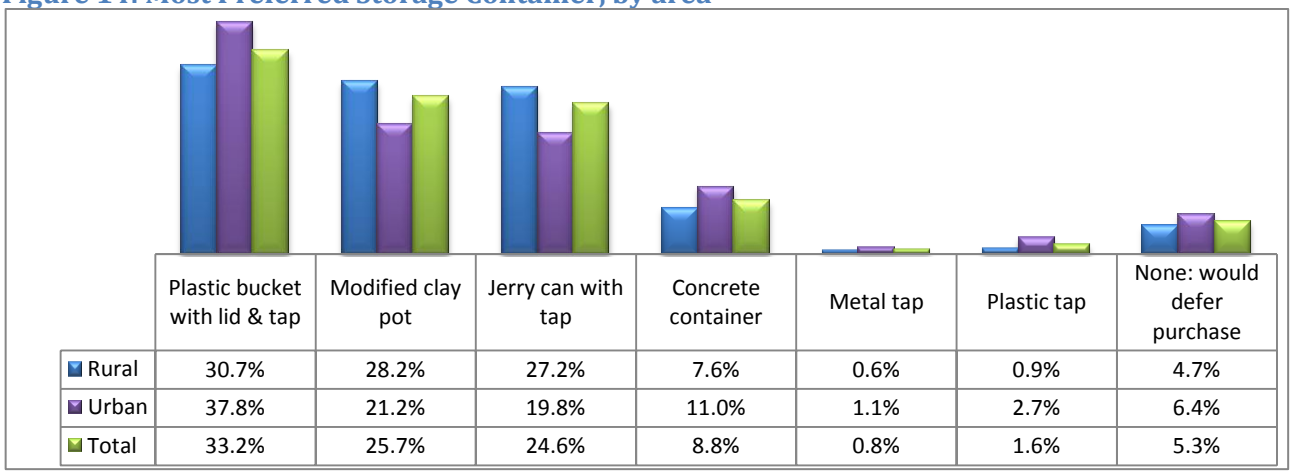
Most Preferred Storage Container

Once flashcards were presented and discussed with respondents, they were asked: *"If you were in the market to buy a water storage container today, and these were your only options, which one would you prefer?"* Following their choice, they were asked to list the top three features they like about their preferred storage container. This approach allowed the team to collect practical data on consumer preferences for storage containers, which can be incorporated into product development to ensure a sustainable, effective and locally available drinking water storage product is marketed to consumers.

Overall, the most preferred storage product was the plastic bucket with lid and tap (33.2%), followed by the modified clay pot (25.7%) and five gallon jerry can with tap (24.6%). Interestingly, there were no discernible differences between the preferences of primary caregivers and household heads preferences for storage products.

Analysis by area revealed slight differences in the relative preferences of urban and rural households (see Figure 14). For instance, a higher proportion of urban respondents preferred the plastic bucket with lid and tap, whereas rural respondents indicated a higher preference for the modified clay pot and five gallon jerry can. Nonetheless, both urban and rural households most preferred the plastic bucket, modified clay pot and jerry can (in that order).

Figure 14: Most Preferred Storage Container, by area



	Plastic bucket with lid & tap	Modified clay pot	Jerry can with tap	Concrete container	Metal tap	Plastic tap	None: would defer purchase
Rural	30.7%	28.2%	27.2%	7.6%	0.6%	0.9%	4.7%
Urban	37.8%	21.2%	19.8%	11.0%	1.1%	2.7%	6.4%
Total	33.2%	25.7%	24.6%	8.8%	0.8%	1.6%	5.3%

Findings also revealed interesting trends by wealth quintile:

- The poorest households were significantly more likely than those in the richest quintile to prefer the five gallon jerry can with tap (32.7%, compared to 18.9%) and modified country pot (29.0%, compared to 21.3%).
- Conversely, respondents in the richest quintile were more likely than those in the poorest households to prefer the plastic bucket with lid (37.6%, compared to 26.8%).

Table 22 below presents the preferred water storage products by area, along with the top three product features mentioned by respondents. The data suggests that urban and rural households are very similar in their preferences for storage containers and the product features they value. For instance, both groups indicated that the existence of cover and tap, along with the features that make a container easy to clean and safe from contamination were important considerations when purchasing a water storage container.

Interestingly, those that preferred the modified clay pot overwhelming preferred the product for its ability to keep water cool.

Table 22: Most Preferred Storage Containers, by area

	Rural	Urban
MOST PREFERRED 	**Preferred Features** • Has a cover (82.9%) • Has a tap (70.6%) • Easy to clean (33.2%) • Keeps water safe from contamination (33.2%)	**Preferred Features** • Has a cover (78.0%) • Has a tap (65.4%) • Easy to clean (35.7%)
SECOND PREFERRED 	**Preferred Features** • Keeps water cool (76.2%) • Has a cover (70.5%) • Has a tap (66.8%)	**Preferred Features** • Keeps water cool (70.5%) • Has a tap (68.5%) • Has a cover (55.5%)
THIRD PREFERRED 	**Preferred Features** • Has a tap (68.1%) • Has a cover (67.1%) • Keeps water safe from contamination (34.9%)	**Preferred Features** • Has a cover (71.3%) • Has a tap (63.7%) • Keeps water safe from contamination (51.5%)

Looking at the data across each of the wealth quintiles, a few variations were noted:

- Respondents from the poorest households were most likely to value a storage containers' durability (richest: 18.0%, poorest: 29.0%) and capacity to keep water cool (richest: 16.9%, poorest: 26.7%).
- Meanwhile, households from the richest wealth quintile were most likely to be concerned about the product's aesthetic appearance (richest: 34.9%, poorest: 17.9%).

Again, little variation was noted between primary caregivers and household heads. Indeed, despite the slight differences reported by area type and wealth index quintiles, no major difference between the top products preferred, or their features, were found across consumer groups. The implications of this suggest that varying groups share the same concerns regarding water storage product attributes. Therefore, strategies aimed at the promotion of water storage containers can be marketed in a similar way to different groups of the population.

Product Display Feedback on Preferred Storage Containers

Follow up FGDs (where shortlisted storage products were displayed to FGD participants) revealed that participants preferred the plastic bucket with tap due to its availability, ease of use, light weight and aesthetic appearance.

"It is easy to obtain and will be available at all times. We can also lift it because it is not heavy. It is easy to carry and keep clean." (Female respondent, Peri-Urban, Southern region)

"The rubber bucket is easy to use and nice looking." (Male respondent, Peri-Urban, Western region)

The ability to keep water cool was cited by respondents to be the most preferred feature of the modified clay pot. Focus group discussions revealed that the traditional appearance of the storage container was also highly valued by community members who have memories of using a similar product in their childhood. Interestingly, many participants noted that the clay pot is most suitable for the 'village' – not for the city.

"It makes water cool." (Female respondent, Urban, Eastern region)

"It reminds me of my grandmother and of when I was a child." (Female respondent, Rural, Northern region)

"It is easy to carry and easy to clean. It is traditional." (Female respondent, Rural, Eastern region)

"*The country pot is for the village, but the concrete container is good for in the town.*" (Male respondent, Urban, Southern region)

Feedback on the five gallon jerry can with tap revealed that the tap and cover were the most preferred features of the container. In fact, the protective attributes of the container which keep water safe from contamination were identified by all participants as the most valued feature of the jerry can with retrofitted tap.

"Children cannot put their hands in the water." (Female respondent, Rural, Eastern region)

"I would buy a batta [jerry can] because it is more protected and easy to carry." (Male respondent, Peri-Urban, Northern region)

"It has a cover and a tap and it is safe to store water." (Male respondent, Urban, Southern region)

3.10. Willingness to Pay for Safe Storage Containers

To determine the amount that respondents were willing to pay for the shortlisted storage products, primary caregivers and household heads were first presented with the flashcards and informed of the attributes of each water storage container. Prior to informing them of the product price, respondents were asked what they would be willing to pay for each storage container.

Findings on the median price respondents were willing to pay for each product are presented in Table 23 below.[18] The summary table shows some interesting trends by area, region, wealth quintile and position within the household. Not surprisingly given their socioeconomic background, respondents from urban areas were willing to pay more for storage containers than those in rural areas, as were respondents in the Western region. Furthermore, survey respondents from the richest households were willing to pay the most for each of the water storage products. Perhaps most interesting, household heads were willing to pay more than primary caregivers for the jerry can with tap, modified clay pot and concrete container with lid and tap.

[18] Data on willingness to pay was highly skewed as a wide range of prices were reported. This makes reporting on the *average* willingness to pay price problematic. The best measure of central tendency (average) for asymmetrical or very skewed data is the median. In this situation, the median is a more representative value than the mean, and has thus been presented.

Table 23: Willingness to Pay for Water Storage Containers – Median Price

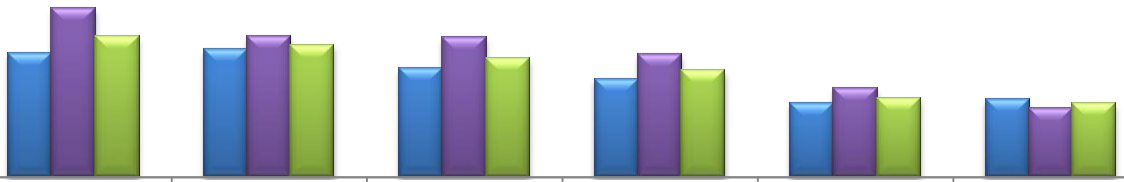
		Willingness to Pay for Product Median Price (1US$ = 4,360 Le.)					
		5 gallon jerry can with tap	Modified clay pot	Plastic bucket with tap	Concrete container	Metal tap	Plastic tap
Region	South	US $3.45	US $6.90	US $4.10	US $6.90	US $2.30	US $2.30
	North	US $4.10	US $6.90	US $4.60	US $6.90	US $2.30	US $1.40
	East	US $3.45	US $4.60	US $4.60	US $5.75	US $2.30	US $1.60
	West	US $4.60	US $6.90	US $5.75	US $9.20	US $3.45	US $2.30
Area	Rural	US $3.45	US $5.75	US $4.60	US $6.90	US $2.30	US $1.85
	Urban	US $4.60	US $6.90	US $4.60	US $9.20	US $3.10	US $2.30
Wealth index quintiles	Poorest	US $3.45	US $5.75	US $4.10	US $6.90	US $2.30	US $1.15
	Second	US $3.45	US $5.75	US $4.60	US $6.90	US $2.30	US $1.60
	Middle	US $3.45	US $5.05	US $4.60	US $6.90	US $2.30	US $1.85
	Fourth	US $3.45	US $5.75	US $4.60	US $8.00	US $2.30	US $1.95
	Richest	US $4.60	US $6.90	US $5.75	US $9.20	US $3.45	US $2.30
Position in HH	Primary Caregiver	US $3.45	US $5.75	US $4.60	US $6.90	US $2.30	US $2.30
	HH Head	US $4.60	US $6.90	US $4.60	US $8.00	US $2.30	US $2.30
Total Median Price		**US $3.90 (Le. 17,000)**	**US $5.75 (Le. 25,000)**	**US $4.60 (Le. 20,000)**	**US $6.90 (Le. 30,000)**	**US $2.30 (Le. 10,000)**	**US $2.30 (Le. 10,000)**

Willingness to Pay Estimated Retail Price

Once respondents reported their willingness to pay for the storage products, the price for each product was revealed and respondents were asked if they would be willing to pay the full retail price.[19] Findings indicate that approximately half of the respondents were most willing to pay the full retail price for the plastic tap (52.3%), 5 gallon jerry can with tap (49.3%) and the plastic bucket with lid and tap (44.6%). There was less willingness to pay for the more expensive concrete storage container (29.6%) and modified clay pot (27.7%).

Disaggregation by area type revealed that urban consumers were generally more likely to report willingness to pay the full retail price of each water storage product when compared to rural consumers (except in the case of the modified country pot). In the case of household status, findings revealed that household heads were slightly more likely to report a willingness to pay for each storage container's specified retail price.

Figure 15: Willingness to Pay Retail Price for Water Storage Containers, by area



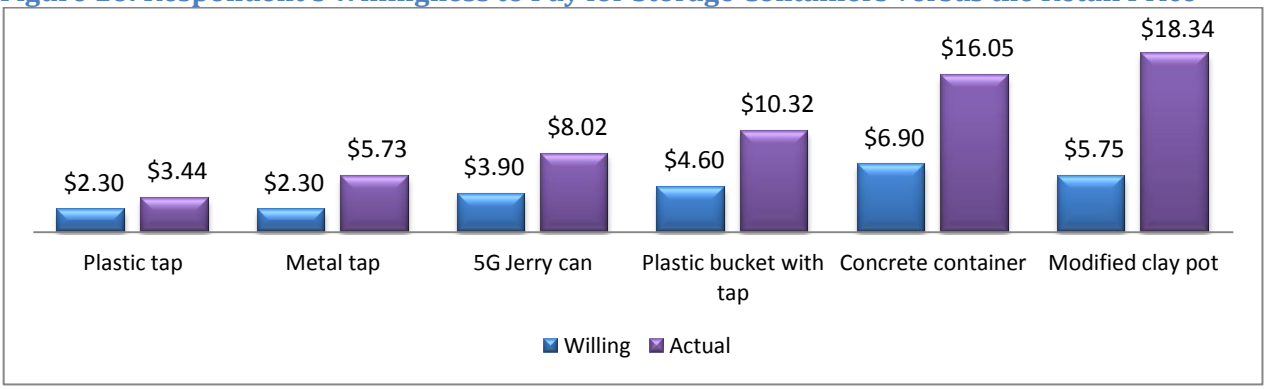
	$3.44 - Plastic tap	$8.02 - 5 gallon jerry can	$10.32 - Bucket with lid & tap	$5.73 - Metal tap	$16.05 - Concrete container	$18.34 - Modified clay pot
Rural	46.4%	47.7%	40.5%	36.6%	27.7%	29.0%
Urban	63.0%	52.3%	52.1%	45.8%	33.1%	25.4%
Total	52.3%	49.3%	44.6%	39.9%	29.6%	27.7%

When the amount that respondents are willing to pay is compared to the actual retail price, we see that the products with the most price parity between the willingness to pay price and actual cost are the less costly plastic and metal taps, followed by the 5 gallon jerry can and plastic bucket with tap. As these last two

[19] The retail price of each product was based on the findings of the national market scan. The modified clay pot was purchased from clay producers in Lunsar (in Northern Sierra Leone) and includes the cost of the PVC pipe and tap added to the container.

products were also among the most preferred, the data suggests that these two products may be the most suitable for safe storage promotion in Sierra Leone.

Figure 16: Respondent's Willingness to Pay for Storage Containers versus the Retail Price



3.11. Current Household Drinking Water Treatment

The practice of in-house water treatment in Sierra Leone is described in Table 24 below. Overall, only two out of ten (19.5%) households reported using *any* type of water treatment— among them, straining through a cloth (8.5%), boiling (5.7%) and Aquatabs (4.5%)[20] were the most commonly used methods.

When the data on current treatment practices is reviewed within the context of *appropriate* methods, we see that only 12.3% of households reported use of an appropriate treatment method. Appropriate methods of drinking water treatment include boiling, adding bleach or chlorine, using a water filter and using solar disinfection. The data indicates that use of appropriate water treatment methods is strongly correlated with higher levels of wealth and education among primary caregivers and is higher in urban than in rural areas.

As illustrated below, only 7.6% of households using unimproved water sources are using an appropriate water treatment method. Whilst this figure is notably low, recent national statistics suggest that in fact, the percentage of households using unimproved water sources and an appropriate water treatment method may be lower. For instance, in the recent MICS4, it was found that only 1.9% of households using an unimproved water source treat their water using an appropriate method (SSL & UNICEF, 2011).

[20] There was a free distribution of Aquatabs during the 2012 cholera outbreak in Sierra Leone. Many of the households reporting use of Aquatabs indicated that they have kept any extra tablets they received for use when the need arises (e.g. turbid water, sickness in the community, etc.).

Table 24: Household Drinking Water Treatment

		Water Treatment Method Used*								% households using appropriate water treatment**	% household using unimproved water source & appropriate water treatment
		None	Boil	Add bleach/ chlorine	Aquatabs	Strain through cloth	SODIS	Let stand & settle	Alum or Camphor		
Region	South	77.0%	3.6%	6.8%	5.0%	10.5%	0.0%	8.2%	7.5%	13.2%	13.8%
	North	84.3%	4.6%	3.1%	5.0%	4.6%	0.0%	0.5%	2.2%	10.9%	5.1%
	East	85.8%	1.3%	2.3%	2.7%	5.2%	0.2%	2.3%	5.6%	5.8%	3.6%
	West	71.7%	15.5%	5.3%	5.3%	16.8%	0.3%	9.8%	2.8%	22.3%	9.4%
Area	Rural	84.7%	3.3%	2.8%	3.9%	6.3%	0.1%	3.0%	4.4%	8.8%	7.1%
	Urban	73.4%	9.9%	6.6%	5.5%	12.2%	0.1%	7.1%	4.4%	18.5%	8.8%
Wealth index quintiles	Poorest	91.0%	1.8%	1.5%	1.0%	5.0%	0.0%	2.5%	2.5%	4.0%	5.5%
	Second	84.7%	2.8%	2.3%	3.8%	6.3%	0.0%	2.8%	3.8%	8.3%	6.0%
	Middle	82.7%	4.3%	2.5%	4.8%	7.5%	0.3%	3.3%	6.3%	10.0%	7.9%
	Fourth	78.9%	5.0%	6.8%	6.3%	5.5%	0.0%	3.3%	5.0%	14.8%	13.8%
	Richest	65.4%	14.8%	7.8%	6.5%	18.0%	0.3%	10.8%	4.3%	24.6%	8.4%
Primary caregiver's education	No education	85.9%	3.5%	2.9%	3.5%	6.1%	0.2%	3.1%	3.8%	8.5%	5.9%
	Primary	74.1%	6.7%	4.5%	5.8%	11.6%	0.0%	6.9%	5.1%	15.0%	13.4%
	Secondary or higher	66.1%	14.8%	9.2%	7.0%	14.0%	0.0%	7.4%	5.9%	25.8%	9.0%
	Total	**80.5%**	**5.7%**	**4.2%**	**4.5%**	**8.5%**	**0.1%**	**4.5%**	**4.4%**	**12.3%**	**7.6%**

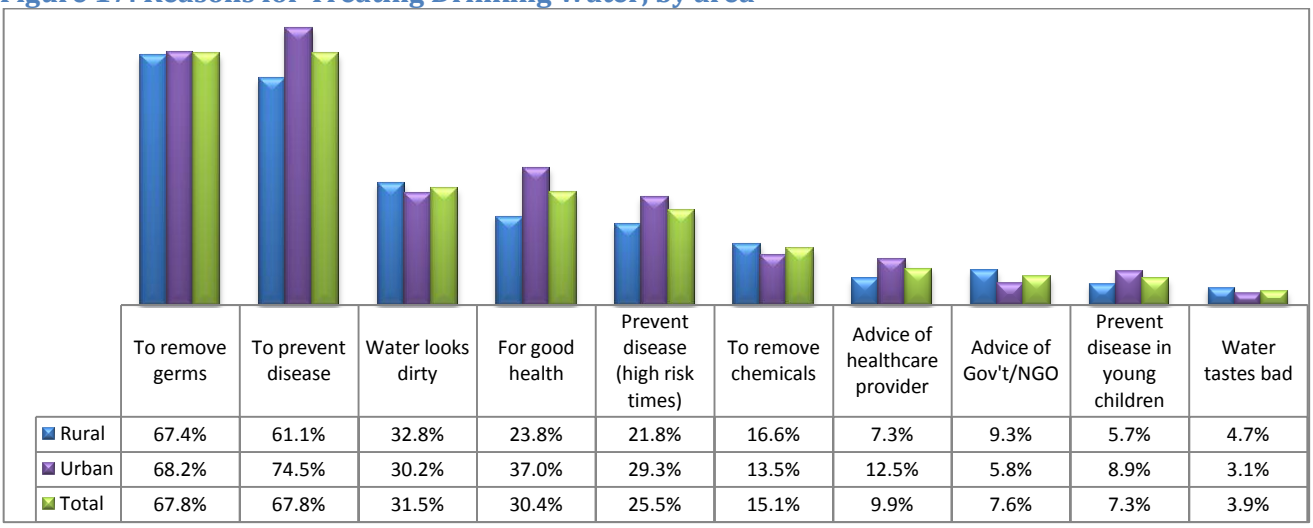
*Respondents may report multiple treatment methods so the sum of treatment may exceed 100 percent.
**Appropriate water treatment methods include boiling, bleaching, Aquatabs, filtering, and solar disinfecting. Taken as a proportion of all sampled households (N=1994)

Motivations for Current Household Water Treatment

Among those households practicing any form of water treatment, primary caregivers were asked to report on their motivations for doing so. The main drivers for water treatment reported were: to remove germs, prevent disease and as a response to turbid or dirty looking water (See Figure 17 below). Urban respondents were more likely to cite disease prevention and good health as drivers for water treatment when compared to rural respondents.

As previously discussed (see Section 3.6), the surveyed population had a high level of understanding of the link between water and disease. This understanding is an obvious motivation for households that currently treat their drinking water as germ removal and disease prevention were reported as their top two reasons for treating water. While these motivations were reported as the most common among all respondents, primary caregivers in urban areas were more likely to report the prevention of disease (74.5%) and good health (37.0%) compared to those in rural areas (61.1% and 23.8% respectively). Furthermore, water treatment to improve water clarity (31.5%) was also reported to be a driver for water treatment – which we have seen to be highly correlated with perceptions of water safety.

Figure 17: Reasons for Treating Drinking Water, by area



	To remove germs	To prevent disease	Water looks dirty	For good health	Prevent disease (high risk times)	To remove chemicals	Advice of healthcare provider	Advice of Gov't/NGO	Prevent disease in young children	Water tastes bad
Rural	67.4%	61.1%	32.8%	23.8%	21.8%	16.6%	7.3%	9.3%	5.7%	4.7%
Urban	68.2%	74.5%	30.2%	37.0%	29.3%	13.5%	12.5%	5.8%	8.9%	3.1%
Total	67.8%	67.8%	31.5%	30.4%	25.5%	15.1%	9.9%	7.6%	7.3%	3.9%

Uses and Frequency of Household Water Treatment

The majority of households use treated water exclusively for drinking (69.4%). Less commonly reported uses included preparation of infant food (18.4%), to cook (16.8%) and to mix medicine (16.0%), which were all more likely to be reported in urban rather than rural areas.

Less than half of the surveyed primary caregivers reported they treat their water *every* time before drinking (46.8%). Among the remaining households it was reported that they only treat water when it looks dirty (53.2%) or when diseases, such as cholera, are in the community (46.8%). These findings were similar across both rural and urban areas. This suggests that data on the proportion of households currently treating water must be viewed with caution as it does not appear to be a sustained habit among nearly half of the households.

Reasons for Using Current Treatment Method

Ease of use (75.1%), minimal time required (31.1%) and affordability (27.4%) were the most commonly reported reasons that households have chosen their current treatment method.

Intention to Treat Among Non-Treaters

Very few primary caregivers reported that they had ever considered or discussed treating their family's drinking water (9.3%). This low percentage should be considered within the context of the nearly non-existent culture of water treatment habits and practices throughout Sierra Leone. Among the 9.3% of households which have considered adopting household water treatment, the top driver which leads them to the consideration for water treatment was the "fear of getting cholera" (63.9% rural 56.9% urban), followed by "for the good health of my family" (14.5% rural and 27.6% urban).

3.12. Experience with Previous HWTS Initiatives – Cholera Response

During the 2012 cholera outbreak the Presidential Task Force on Cholera, along with the Ministry of Health and Sanitation and key development partners carried out, among other response activities, a free distribution of household water treatment products. As the most commonly distributed products included Aquatabs and chlorine solution (in addition to kits containing soap and safe storage containers), the current

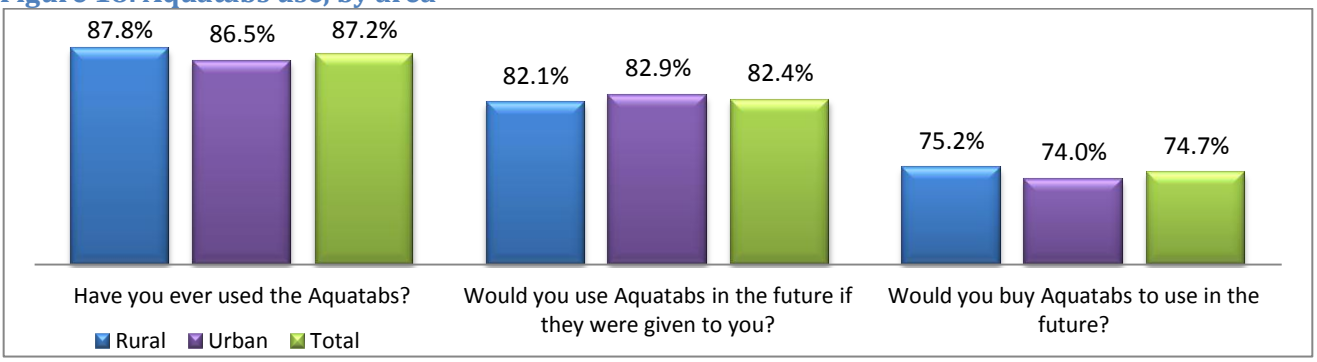
study is interested to gain insight from the study population on their experience with emergency response household water treatment activities.

Overall, few respondents (17.6%) reported receiving any household water treatment products during the cholera response – although it was slightly higher in urban (21.4%) compared to rural areas (15.3%). Of those who received a water treatment product, Aquatabs were far more common (71.2%) than chlorine (36.0%).

Household Experience with Aquatabs

Among those respondents who received Aquatabs, a very high proportion reported using them to treat their drinking water (87.2%) and would use them again in the future if they were *given* to them (82.4%). A slightly lower proportion indicated that they would *purchase* Aquatabs in the future (74.7%).

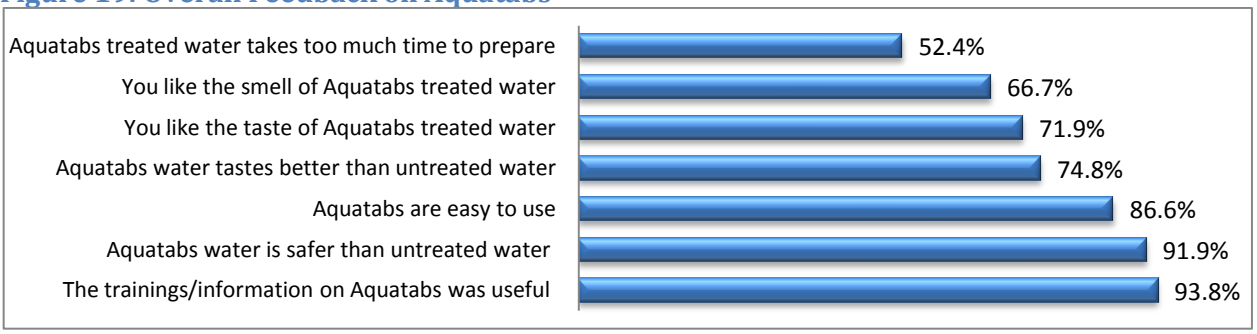
Figure 18: Aquatabs use, by area*



*Expressed as a percentage who received and used Aquatabs, n=212 (multiple response)

Respondents were asked about their opinions regarding the different qualities of the Aquatabs product. There were very few differences reported between urban and rural respondents. Overall, most users believed that Aquatabs treated water is safer than untreated water (89.9% urban and 93.4% rural). Notably, seven out of ten respondents suggested that Aquatabs treated water tastes better than untreated water (74.8%) and that they in fact like the taste (71.9%).

Figure 19: Overall Feedback on Aquatabs*



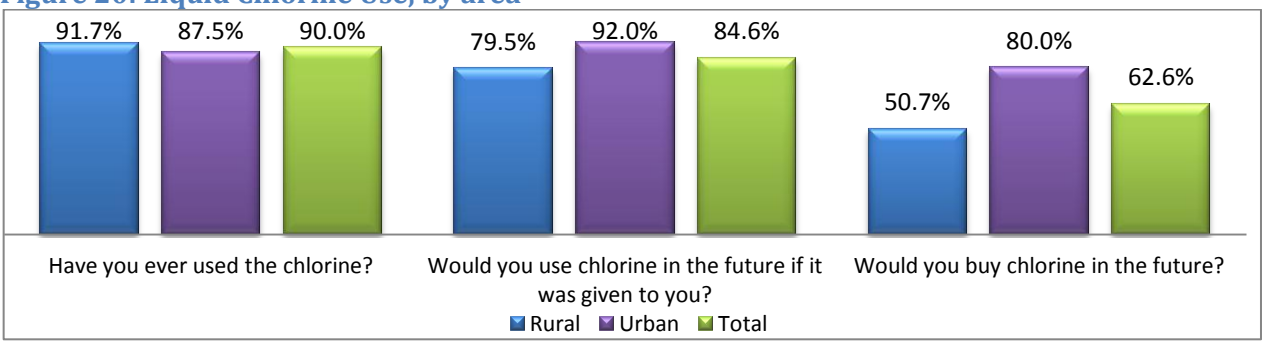
*Expressed as a percentage who received and used Aquatabs, n=212 (multiple response)

Household Experience with Liquid Chlorine

Nine out of ten primary caregivers who received liquid chlorine reported ever using it. Overall, urban respondents were much more likely than rural respondents to indicate that they would use chlorine in the future if they were *given* it (92.0%), and also that they would *buy* chlorine for future usage (80.0%). The findings related to future usage and purchase must be viewed with caution as anecdotal evidence suggests

that the liquid chlorine distributed during the cholera response required households to measure the proper dosage using a syringe, a reportedly tedious and difficult task according to some respondents.

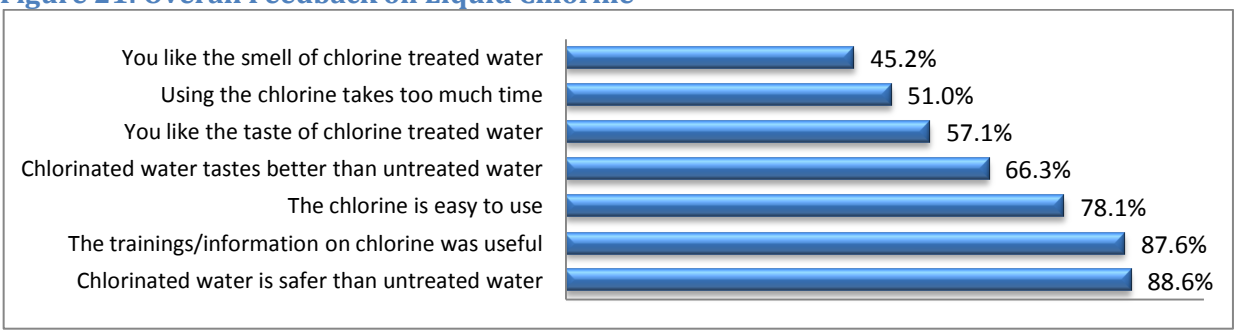
Figure 20: Liquid Chlorine Use, by area*



*Expressed as a percentage of respondents who reported they received chlorine, n=125 (multiple response)

The majority of respondents reported that they believed chlorinated water is safer than untreated water - although the proportion was higher in urban (100.0%) versus rural areas (81.5%). In fact, there were a number of noted differences between area types in regards to their experience with using the chlorine. For instance, urban respondents were more likely to report that they found the chlorine easy to use (90.0% compared to 70.8% in rural areas). Furthermore, urban respondents were more likely to report that they liked the taste of chlorine treated water *more than untreated water* (77.5% compared to 59.4% in rural areas) and that they liked the taste of chlorine treated water (65.0% compared to 52.3%).

Figure 21: Overall Feedback on Liquid Chlorine*



*Expressed as a percentage of those who used chlorine, n=108 (multiple response)

3.13. Drinking Water Treatment Motivations and Barriers

Motivations

Understanding motivations for treating drinking water in Sierra Leone is difficult since very few respondents reported the practice. Nevertheless, valuable themes have emerged, which enable a more nuanced understanding of drivers for drinking water treatment specific to Sierra Leone. Motivations for treating drinking water fall into five categories: (1) *Safety*, the removal of bacteria and germs; (2) *Fear*, the prevention of disease at times of high risk; (3) *Health promotion*, health and prevention of disease; (4) *Turbidity*, the removal of the appearance of dirt; and (5) *Social acceptance,* perceptions of people who treat water as "wise" and "prestigious".

Safety

Safety related themes – such as the removal of invisible bacteria and germs - emerged as key motivations for treating drinking water. As highlighted in Figure 17, seven out of ten respondents reported that their main

reason for treating drinking water was the 'removal of germs'. Further, when asked if it was necessary to treat drinking water, many FGD respondents suggested that it was for the purpose of germ removal.

"Yes, it is necessary to kill the germs in the water." (Male respondent, Urban, Eastern region)

"Some water wells are close to toilets, which can cause contamination." (Male respondent, Peri-Urban, Southern region)

This high level of knowledge regarding the link between invisible germs in the water and benefits of treating water might be attributed to respondents' inundation with WASH-related sensitisation campaigns over the years. As was previously shown, while respondents are aware that drinking clean water is a way to prevent diarrhoea, very few report the *practice* of water treatment as one of the top measures one can take to prevent diarrhoeal disease (see Figure 10). As such, the understanding is likely to be more theoretical, and less aligned with practical realities.

Fear

A significant motivation for treating drinking water was the *fear* of disease during high risk times – mainly during the rainy season when there can be elevated risk of exposure to cholera. Perceptions of risk associated with water are often a motivation that can serve as an impetus for water treatment. In fact, the top driver among all primary caregivers who do not treat their household's drinking water, but had considered doing so, was the fear of getting cholera (61.0%). This suggests that emergency cholera relief health promotion messaging is effective insofar as knowledge of the link between disease and water treatment is fairly high. Unfortunately, this does not always translate into a sustained behaviour resulting in long term treatment. For instance, while respondents often reported using the distributed Aquatabs and chlorine, their water treatment efforts usually concluded once the perceived risk was over or when the product supply had run out. Some respondents even reported that they saved water treatment products for future use – presumably another cholera outbreak.

This theme of 'fear' was also discussed during FGDs, as many participants agreed that water should be treated to prevent diseases in times of emergency: *"Yes, we want to treat water so we do not get Cholera."* (Male respondent, Urban, Southern region)

Health Promotion

Quantitative and qualitative findings suggest that health and disease prevention are significant motivators for water treatment in Sierra Leone. When all surveyed primary caregivers were asked for their opinion on the main benefits of water treatment, nearly seven out of ten indicated disease prevention (68.9%) and good health (69.9%). The majority of FGD respondents also reported health gains as the main benefit of treating drinking water.

"Yes, you should treat for water to be pure, for good health and to remove dirt." (Female respondent, Urban, Southern region)

"It is necessary to treat water to prevent diseases and maintain good health." (Female Respondent, Urban, Western region)

"Yes, treating water will protect us from sickness. Most of the pipes have gone rusty so it is necessary to treat the water." (Female Respondent, Urban, Eastern region)

While respondents commonly reported health related motivations for treating water, caution should be taken in developing promotional messages centred solely on these findings as perceived health benefits are not always grounded in knowledge of waterborne disease transmission, but can be based on cultural beliefs of water safety – for instance, the definition of 'safe water' being related to the physical properties of water (i.e. smell, taste and colour). Promotional messaging must be focused on altering the population's perceptions of safe water – clear, tastes good and odourless – to a definition of safety that encompasses other elements such as free of invisible contaminants, which can be damaging to health.

Additionally, while findings pertaining to knowledge of diarrhoea prevention reveal drinking clean water was the most commonly cited method for diarrhoea prevention, as of yet this has not translated into improved treatment practice with only 12.3% of all respondents treating water with an appropriate method. Therefore promotional messaging based solely on health will not be sufficient to bring about positive behaviour change in relation to household water treatment practices.

Turbidity

Making turbid water clear was mentioned by respondents as one of the key benefits for treating drinking water (43.9%). This was also one of the top motivations for those that are currently treating their drinking water (see Figure 17, 31.5%). This may explain why the most commonly reported method of water treatment was to strain it through a cloth. This finding is in line with respondents' definition of "safe" water, which is closely linked to water clarity. However, this definition is problematic as the treatment methods used to address turbidity (a major driver of water treatment) do not remove bacteria or other contaminants that cause disease.

Focus group participants also viewed turbid water as un-safe, thus warranting water treatment.

"Yes, water treatment purifies water and removes dirt. It makes water good for drinking." (Female respondent, Rural, Southern region)

"Water from the tap should be treated, you cannot trust the water pipes because they are rusty and carry dirt." (Male respondent, Peri-Urban, Southern region)

"The water from the well is contaminated during the dry season and we have to wait until dirt settles at the bottom of the bucket before drinking." (Female respondent, Rural, Western region)

Social Acceptance

Although a pervasive culture of water treatment does not currently exist in Sierra Leone, social acceptance and prestige can still be considered a motivation as people who treat drinking water were perceived favourably by respondents.

When FGD participants were asked about their perceptions of people who treat their drinking water, the overwhelming response was that people who treat drinking water are health-aware and value their wellbeing. Issues of prestige were also raised, as respondents indicated that those who treat their drinking water have greater access to opportunities and wealth.

"People who treat their drinking water care for their health." (Male respondent, Urban, Eastern region)

"They come from a decent home." (Male respondent, Urban, Eastern region)

"People who treat their drinking water do not want to get sick and they have the money." (Female respondent, Urban, Southern region)

"They are people who value life." (Female respondent, Urban, Northern region)

On the other hand, individuals that are not treating their drinking water were viewed as careless and risk takers, though many respondents could sympathise with their inability to treat their household drinking water, due to financial constraints.

"They don't care for their health." (Female respondent, Urban, Eastern region)

"We don't think anything of them [people who do not treat] because maybe they don't have money to buy the treatment products." (Female respondent, Urban, Western region)

"Those who don't treat are poor and end up with sickness." (Male respondent, Rural, Northern region)

"People who do not treat their drinking water will become sick at any time." (Female respondent, Peri-Urban, Eastern region)

"People who do not treat their drinking water are careless." (Male respondent, Rural, Southern region)

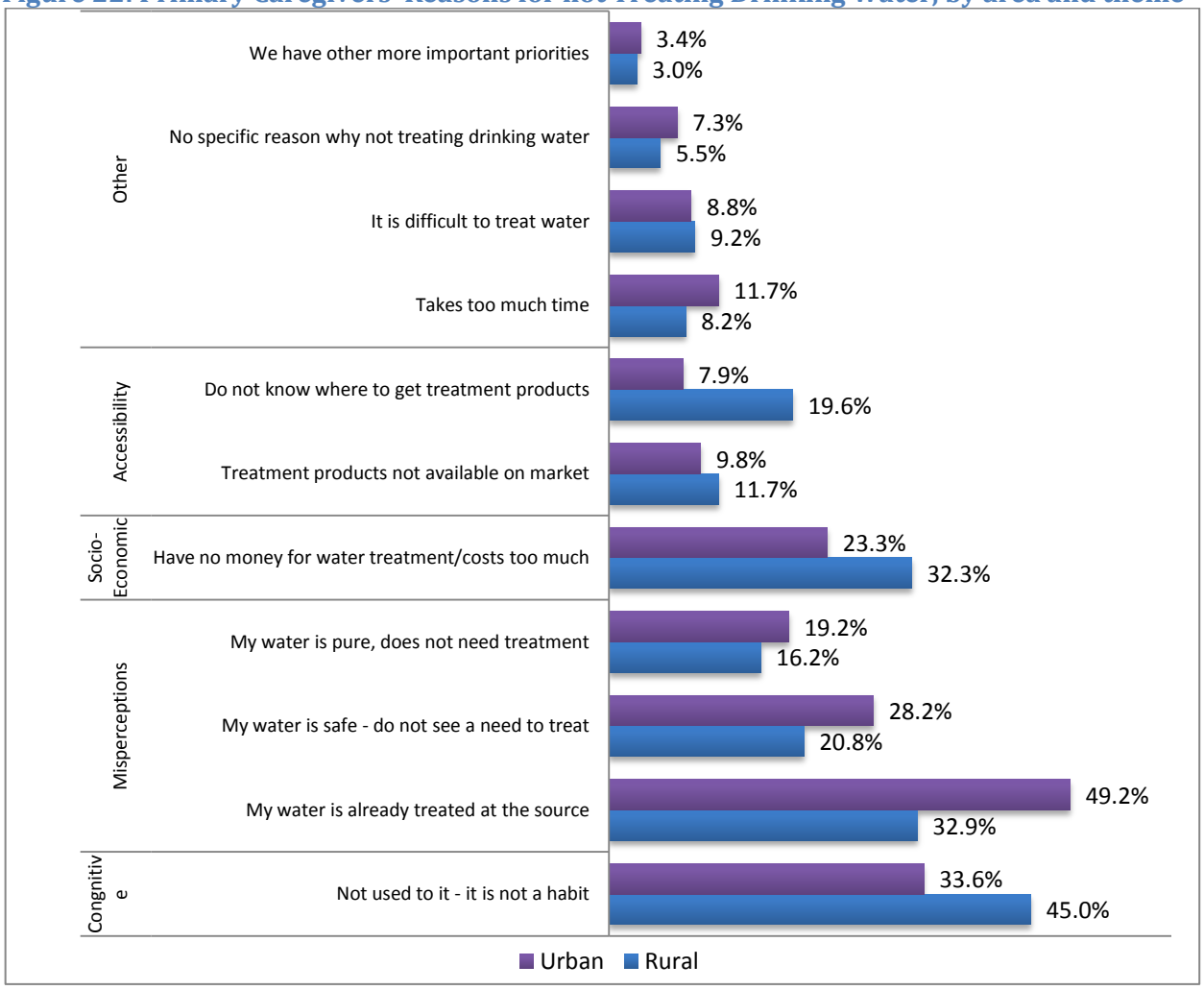
Currently, the motivating factor of social acceptance is not a particularly strong driver of drinking water treatment; however, the potential may exist if water treatment, and the related products, can be marketed as a vital indicator of a person's wisdom, prestige and awareness of health.

Barriers

Respondents who do not treat their household drinking water were asked to identify the reasons for not doing so. FGD participants were also encouraged to discuss the factors that prevented them from treating their water. Data from these sources was analysed to identify barriers to household drinking water treatment in Sierra Leone. Ultimately, four factors that inhibit or prevent the treatment of drinking water were identified through the study: (1) *cognitive*, the habit of water treatment**;** (2) *socio-economic*, the affordability of water treatment products; (3) *awareness and accessibility*, the awareness of treatment methods/products and the availability of drinking water treatment products and (4) *misperceptions*, about the safety of drinking water sources.

Figure 22 presents survey findings on primary caregivers' reported reasoning for not treating drinking water, which are themed by the barriers identified.

Figure 22: Primary Caregivers' Reasons for not Treating Drinking Water, by area and theme*

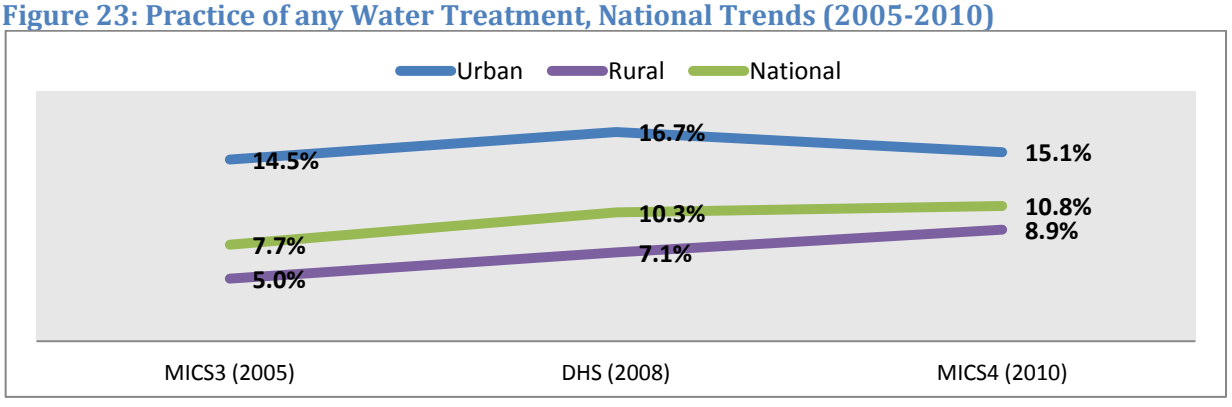


*Expressed as percentage of respondents who do not treat their water, n=1606 (multiple response possible)

Cognitive

That water treatment is not an established habit was cited by the majority of primary caregivers (33.6% of urban and 45.0% of rural respondents respectively) as a key factor which inhibits their practice of household water treatment. Historically, the treatment of drinking water has not been habitually practiced by households within Sierra Leone. In fact, a review of available national level data suggests that water treatment (in any form) has not been widespread (See Figure 23).

Figure 23: Practice of any Water Treatment, National Trends (2005-2010)



In the absence of a 'culture' of water treatment, households are not used to applying treatment methods to their drinking water before consumption. Therefore, despite an awareness of the health problems that can result from the consumption of untreated (unsafe) drinking sources, the adoption of this unfamiliar habit, which is very rarely observed within households, does not occur. This was exemplified by FGD participants, who suggested that the treatment of drinking water was a novel idea, which they had not considered previously.

"No one has ever shown us how to treat water, you are the first." (Male respondent, Peri-Urban, Western region)

"We don't have the idea." (Female respondent, Urban, Eastern region)

Existing research suggests that even when widely available, households do not immediately use new water treatment products consistently, as this requires substantial behaviour change[21]. The norms of water treatment and consumption are therefore a major barrier to overcome in order to achieve the widespread adoption of water treatment. In this, change in everyday behaviours is required to encourage sustained practice.

Socio-Economic

Primary caregivers reported that they do not treat their drinking water, due to the high cost of water treatment products (32.3% of rural and 23.3% of urban primary caregivers). The majority of participants in FGDs also emphasised poverty as the main barrier to the uptake of water treatment practices.

"No money to buy these things. The price of items is too high." (Female respondent, Urban, Southern region)

"Please try to bring the treatment products for a cheap price." (Female respondent, Peri-Urban, Western region)

"They are not available and are expensive and some can easily spoil." (Male respondent, Rural, Western region)

Furthermore, when asked what types of problems someone who does treat their water will face, nearly half (45.3%) of all primary caregivers reported that they would experience difficulties because of the cost of the products. Thus, while many respondents reported that the habit of drinking water treatment was something they would like to adopt, the additional cost for the products necessary to do this was perceived as being too prohibitive.

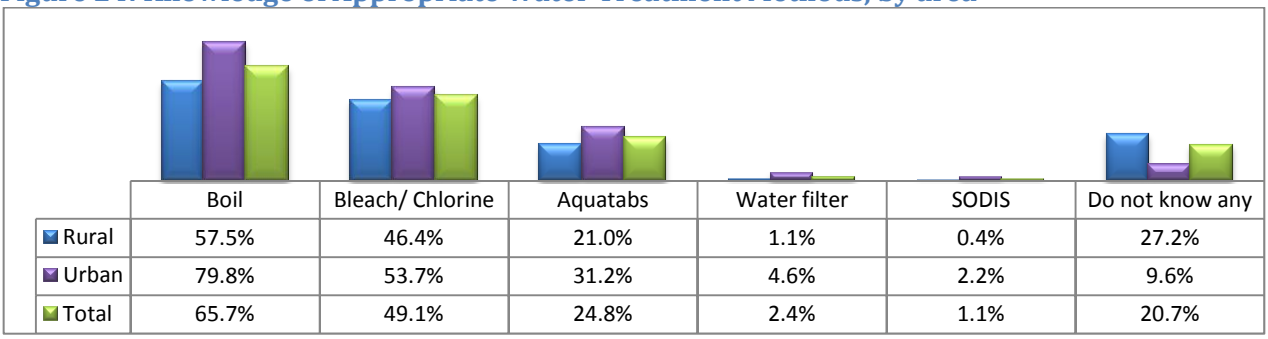
Awareness and Accessibility of Water Treatment Products

When asked to list the water treatment methods they were aware of, boiling was the most commonly reported by six out of 10 (65.7%) primary caregivers. In fact, awareness of alternative treatment methods and products was quite low among primary caregivers. For instance, less than half of surveyed primary caregivers were aware of chlorination (49.1%); approximately one in five (24.8%) were aware of Aquatabs; and very few mentioned water filter or solar disinfection (SODIS). Overall, one-fifth (20.7%) of primary caregivers were not aware of any water treatment method – the majority of which were in rural areas. This

[21] See Figueroa and Kincaid (2010). **"***Social, Cultural and Behavioral Correlates of Household Water Treatment and Storage".*

lack of awareness of water treatment methods and products is a barrier to households in Sierra Leone taking up the practice of HWTS, and will need to be addressed at the initial stages of any HWTS programme.

Figure 24: Knowledge of Appropriate Water Treatment Methods, by area



	Boil	Bleach/ Chlorine	Aquatabs	Water filter	SODIS	Do not know any
Rural	57.5%	46.4%	21.0%	1.1%	0.4%	27.2%
Urban	79.8%	53.7%	31.2%	4.6%	2.2%	9.6%
Total	65.7%	49.1%	24.8%	2.4%	1.1%	20.7%

There is also a lack of accessibility to household water treatment methods and products. In fact, when asked what problems a person who treats their drinking water may encounter, 46.1% of all primary caregivers indicated that it would be difficult to get the products required for treatment. In fact, findings from the market scan (see Section 4) highlight the barrier of accessibility as very few treatment products (aside from bleach which is produced and marketed as a cleaning agent) were readily available in the market.

FGD respondents also reported that products are not available, implying that lack of access to affordable and appropriate HWTS products is a major barrier faced by households.

"It is difficult to see these products so we can't access them… Not available to buy and sometimes expensive." (Male respondent, Urban, Northern region)

"Not enough money, the products are too expensive and are not seen." (Female respondent, Urban, Eastern region)

"No one has brought us medicines." (Female respondent, Rural, Southern region)

Misperceptions

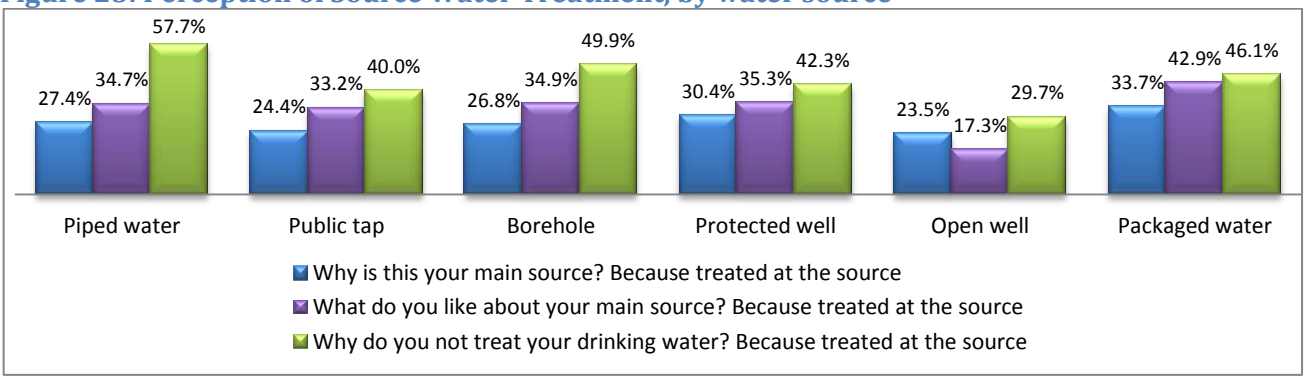
Most primary caregivers reported that they do not treat their drinking water, as their water is already treated at the source (38.4%), is already safe (23.3%) or that treatment is not required, as their drinking water is already pure (17.2%). The belief that current water sources are already safe or have been treated reduces the perceived need to treat drinking water and was a central theme throughout the study. As highlighted in Table 25, a large proportion of primary caregivers reported a perception of current water source safety and/or treatment at the source when asked a series of questions.

Table 25: Perceptions of Water Safety and Treatment at the Source

	..water is safe to drink	**...water is treated at the source**
Why did you choose your main drinking water source?	48.7%	24.3%
What do you like about your main drinking water source?	40.8%	28.9%
For those not currently treating: Why are you not treating your drinking water?	23.3%	38.4%

Figure 25 presents the data by water source for the proportion of primary caregivers who reported that their 'water is treated at the source' in response to the aforementioned questions. These findings suggest a very high belief in the existence, and safety, of source water treatment across the sampled communities.

Figure 25: Perception of Source Water Treatment, by water source



Primary caregivers' perceptions of existing source treatment are understood as a barrier to household water treatment when put into context of the current water source treatment practices in Sierra Leone. Shock chlorination of wells, practiced initially for emergency response activities,[22] is now perceived by some as a long term option – regardless of it being highly inefficient (volume of chlorine required), and effective for only a matter of days. [23] The issue, when viewed in context of respondents' perceptions of source treatment, is that it conveys the false message to the user that the water is safe well beyond the time the chlorine residual wears off.

Furthermore, a lack of follow up and monitoring data on the treatment of piped water, including public tap supplies across the country pose challenges in guaranteeing the effectiveness of source treated water delivered to customers.

Discussions with FGD respondents also revealed that many believed that treatment is unnecessary, as drinking water is pure or has already been treated at its source.

"We do not treat our water out of fear of double treatment because it is treated by SALWACO." (Male respondent, Urban, Easter region)

"No we do not [need to] treat our water; it is treated at the source." (Female respondent, Urban, Eastern region)

The belief that water is being consistently and properly treated at the source negates concerns over safety as communities have a false sense of security that their water is being treated, which incites a perception that the treatment of household water is unnecessary. Nonetheless, sampling on 420 households' drinking water

[22] In response to the continued threat of the annual cholera epidemic a district level Shock Chlorination strategy was put in place by UNICEF in collaboration with the District Health Management Team (DHMT) and the Directorate of Disease Prevention and Control. (UNICEF Sierra Leone. 2010. *"Evaluation of Shock Chlorination Intervention and Water Quality Assessment in Cholera Hot Spots In Sierra Leone"*.)

[23] According to the 2010 UNICEF evaluation findings: "Shock chlorination cannot be a sustainable means of controlling or preventing outbreaks of cholera and other diarrhoeal diseases. The dramatic decline in residual chlorine with time measured through the study clearly shows that the effectiveness of the chlorination protocol decreases as the frequency of water use increases, particularly in shallow dug wells". (UNICEF Sierra Leone. 2010)

at the time of the survey revealed that only 9.8% (n=41) of water samples had tested positive for free chlorine residual (7.7% were sourced from a borehole and 2.1% were sourced from a protected dug well).[24]

3.14. Drinking Water Treatment Preferences

Prior to asking respondents about their water treatment product preferences, the research team recognised that it was important to ensure that respondents were provided with a foundational understanding of the different water treatment features in order to support an informed choice for product preference. This was a key consideration in the approach as water treatment products are currently not widely available or used in Sierra Leone (unlike the storage containers) and respondents had limited awareness of treatment products. Enumerators presented the following details from a pre-developed script flashcard:

Table 26: Features of Household Water Treatment Products

Product Feature	Description
Health impact/ Water problems addressed	Household water treatment products and practices mainly address three types of water quality problems. While some products and practices only address one of these problems, others can address two or even all three. The possibilities are: a) Product removes invisible germs, which can make your family healthier/reduce sickness – BUT it does not make water clear or remove invisible chemicals b) Product removes invisible germs and makes water clear, but does not remove invisible chemicals c) Product removes invisible germs and chemicals and makes water clear
Amount of time it takes to treat water	Water treatment products and practices vary in the amount of time it takes to treat water. For some products, a material is added to the water and it takes only a few minutes for all the water to be treated. For some other products, the water may be treated through different steps and it will take longer to treat the water.
Taste and smell of treated water	Some water treatment products and practices have no effect on water taste or smell. Other water treatment products and practices use materials that make water taste or smell different. Even though the water tastes or smells different, it is safe to drink.
Length of product usefulness	Some water treatment products are solutions or tablets that are used up when water is treated. These products have to be re-purchased by households if they use them up and want to continue treating water. Other products, like filters, can be used over and over again. These products do not need to be replaced frequently.
Price of water treatment	Every water treatment product has its own cost. Some water treatment products cost less than others. Paying the cost of water treatment products may mean that you will have to reduce what you spend on other things by the same amount.

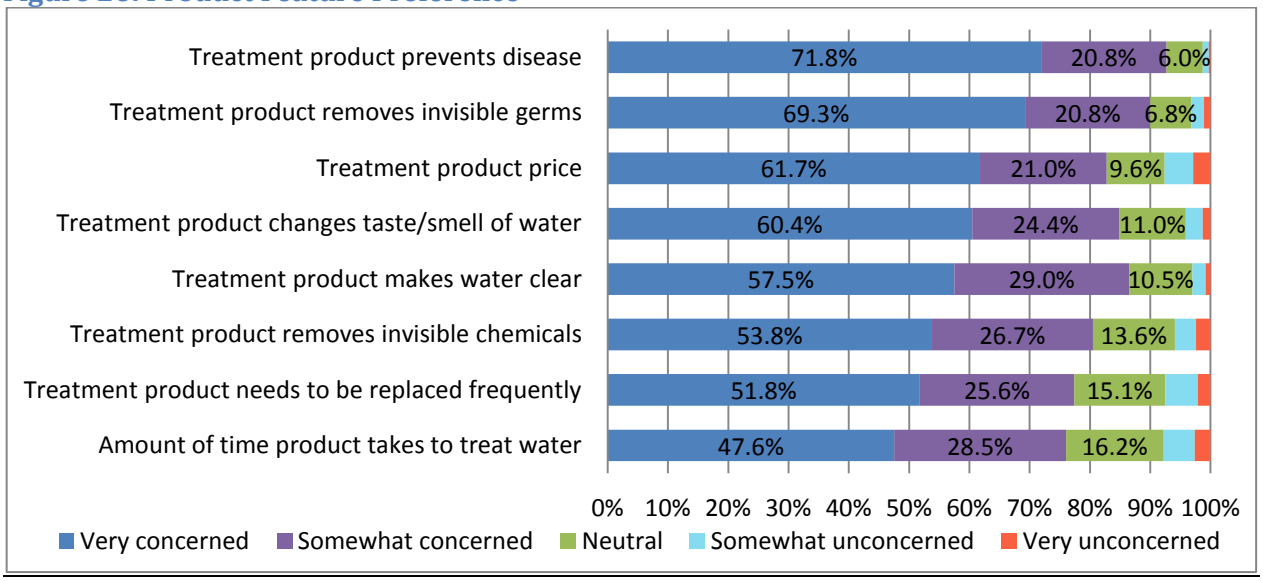
The objective of sharing this information was two-fold: (1) to provide respondents with the information they needed to be able to make an informed choice for their preferred treatment product, and (2) to measure the level of importance of each product feature. To this end, respondents were asked a series of questions relating to treatment product features and asked to answer according to a Likert scale: (1) very concerned, (2) somewhat concerned, (3) neutral, (4) somewhat unconcerned and (5) very unconcerned.[25] A review of the data on those features that respondents reported being *'very concerned'* about allows for conclusions to be drawn regarding the most important treatment product features among consumers.

In total, the majority of respondents reported that they were most concerned about a treatment product preventing diarrhoea and other water related diseases (71.8%), removing invisible germs in the water (69.3%) and the product price (61.7%). The time it takes for a product to treat water was the least important

[24] Among the water samples testing positive from a borehole, 0.8% were reportedly treated in the home with bleach or chlorine.
[25] A visual tool was also added to the questionnaire to assist respondents. The visual was designed as a ladder with increasing numbers from top to bottom to correspond with the Likert scale values. At the bottom of the ladder a sad face was displayed to depict a poor rating (i.e. 5=very unsatisfied). A smiling face was displayed at the top of the ladder to depict a good rating (i.e. 1= very satisfied)

feature to all respondents (47.6%), followed by need to replace the product frequently (51.8%), and ability to remove chemicals (53.8%).

Figure 26: Product Feature Preference



Treatment Product Preferences

In order to gain insight into consumer preferences for drinking water treatment products, both primary caregivers and household heads were shown a series of flashcards which displayed five shortlisted treatment products for consideration. These five products – liquid chlorination, ceramic filtration, biosand filtration, Aquatabs and PUR Purifier of Water ™ – were selected due to their proven ability to reduce diarrhoea and improve the microbiological quality of stored household water.[26]

Much like the approach followed in ascertaining consumer preferences for storage containers, flashcards with coloured pictures of each treatment product and a pre-developed script describing the product's features was presented to respondents (Table 27 below).

Table 27: Shortlisted Water Treatment Products

Treatment Product	Description
150ml bottle liquid chlorine 	• A liquid chlorine solution that can be used to treat household drinking water. To use, one cap of solution is added to water in a storage container. • **Water/Health problems addressed:** It can remove invisible germs, helping to prevent disease. It does not remove dirt/particles. It does not remove invisible chemicals. • **Water taste/smell**: Chlorine treated water may have a strong chlorine taste and smell at first, but it fades in a few hours. • **Product type/lifespan:** One 150ml bottle of liquid chlorine can be used to treat 250 gallons of water. • **Treatment speed:** Treating 5 gallons of water takes 30 minutes. • **Price: US$0.69 (Le. 3,000)**

[26] See CDC and USAID (2010). *"Preventing Diarrheal Disease in Developing Countries: Proven Household Water Treatment Options".*

Slow Sand Filter 	• The slow sand filter (SSF) has layers of sand and gravel that water passes through. As it passes through, contaminates are removed. To use, water is poured into the filter and collected out of the outlet pipe. • **Water/Health problems addressed:** It can remove invisible germs, helping to prevent disease. It removes dirt/particles making water clear. It does not remove invisible chemicals. • **Water taste/smell:** The SSF does not change the taste or smell of water. • **Product type/lifespan:** Can last over 10 years. • **Treatment speed:** Treating 5 gallons of water can take 30 minutes. • **Price: US$57.34 (Le. 250,000)**
Ceramic Filter 	• The clay filter is a pot that is made of clay which has many tiny holes in it that removes contaminates as the water flows through. To use the ceramic filter: you fill the top clay pot with water, the water flows into the container at the bottom until you need it. • **Water/Health problems addressed:** It can remove invisible germs, helping to prevent disease. It removes dirt/particles making water clear. It does not remove invisible chemicals. • **Water taste/smell:** The ceramic filter does not change the taste or smell of water. • **Product type/lifespan:** It can last 1-3 years (if the filter remains unbroken). • **Treatment speed:** Treating 5 gallons of water can take 6 hours. • **Price: US$18.34 (Le. 100,000)**
Aquatabs 	• Aquatabs are a chlorine tablet that can be used to treat water. To use, one tablet is added to water in a storage container and left for 30 minutes. • **Water/Health problems addressed:** It can remove invisible germs, helping to prevent disease. It does not remove dirt/particles. It does not remove invisible chemicals. • **Water taste/smell**: Aquatabs treated water may have a strong chlorine taste and smell at first, but it fades in a few hours. • **Product type/lifespan:** One tablet can be used to treat 5 gallons of water. • **Treatment speed:** Treating 5 gallons of water takes 30 minutes. • **Price: US$0.11 (Le. 500)**
PUR Purifier of Water ™ (flocculant/disinfectant) 	• PUR is a powder which can both disinfect water and remove particles. To use, PUR is added to 2.5 gallons of water. Water is then stirred, left to settle and strained through a cloth and then left for 20 minutes. • **Water/Health problems addressed:** It can remove invisible germs, helping to prevent disease. It removes dirt/particles making water clear. It removes invisible chemicals. • **Water taste/smell:** PUR treated water may have a strong chlorine taste and smell at first, but it fades in a few hours. • **Product type/lifespan:** One sachet of PUR can treat 2.5 gallons of water. • **Treatment speed:** Treatment takes 30 minutes. • **Price: US$0.11 (Le. 500)**

Most Preferred Water Treatment Product

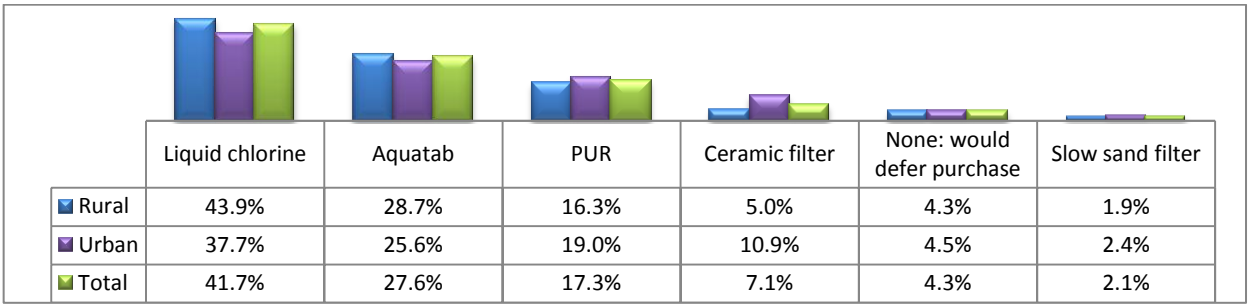
Once the participants were clear on the various features of water treatment products, the product flashcards were presented and respondents were asked to indicate which treatment product they would want to buy if they were in the market today.

Overall, the most preferred water treatment products were the consumables - liquid chlorine (41.7%), Aquatabs (27.6%) and PUR (17.3%). The durable water treatment products were significantly less preferred by respondents (7.0% for the ceramic filter and 2.0% for the slow sand filter respectively).

When the data is disaggregated by area type, we see that both urban and rural respondents overwhelmingly preferred the consumable treatment products – liquid chlorine, Aquatabs and PUR. However, there were slight differences in their relative preferences for certain products. For instance, liquid chlorine and

Aquatabs were slightly more preferred by rural respondents, while PUR and the ceramic filter were slightly more preferred by urban respondents.

Figure 27: Preferred Water Treatment Product, by area



	Liquid chlorine	Aquatab	PUR	Ceramic filter	None: would defer purchase	Slow sand filter
Rural	43.9%	28.7%	16.3%	5.0%	4.3%	1.9%
Urban	37.7%	25.6%	19.0%	10.9%	4.5%	2.4%
Total	41.7%	27.6%	17.3%	7.1%	4.3%	2.1%

While there were no discernible differences between the product preferences of primary caregivers and household heads, there were some noted differences between wealth quintiles:

- While all wealth groups preferred liquid chlorine, those in the poorest households had a relatively higher preference for the product (42.3% compared to 36.2% in the richest household).
- Respondents from the richest households were the most likely to prefer the ceramic filter (15.4% compared to 4.5% in the poorest household).

Nonetheless, all data disaggregations indicated that respondents reported the highest preference for liquid chlorine, Aquatabs and PUR (in that order), whereas durable water treatment products (i.e. the ceramic and slow sand filters) were least preferred.

Why the Preference for Consumables?

As discussed, respondents reported that (i) disease prevention, (ii) germ removal and (iii) cost were the most important water treatment product attributes (see Figure 26). It can thus be hypothesised that since the consumable products address each of these concerns, the higher cost of the durable products may be the main factor preventing more consumers from preferring the ceramic and slow filters. Furthermore, respondents indicated that they were not as concerned about a treatment product having to be replaced frequently – indicating less of a preference for a durable product. The consumable products thus more closely align with consumers most valued product attributes.

In fact, FGDs revealed that the significant difference between respondents' reported preference for consumables was in large part related to product price. In reference to the slow sand filter (the least popular water treatment product), FGD participants suggested that the cost was too high, and therefore households could not afford to purchase the water treatment product. Additionally, a few FGD participants suggested that the treatment process for the slow sand filter was too complicated and time consuming.

"How can I afford that? It costs too much." (Female respondent, Rural, Eastern region)

"If you said that price to me, I will run from the shop." (Male respondent, Peri-Urban, Eastern region)

"No we cannot pay that amount, we in this community are poor and have no jobs." (Male respondent, Peri-Urban, Northern region)

"No I would not buy- it is difficult to use." (Male respondent, Peri-Urban, Southern region)

Similarly, FGD respondents reported that the cost of the ceramic filter (the second least preferred water treatment product) was too high. During product demonstrations, FGD participants were also deterred by the filter's slow flow rate.

"No not at all, it is too much. We cannot afford it. It is too expensive and very difficult to maintain." (Male respondent, Peri-Urban, Southern region)

"Jesus Christ! It is too much money." (Female respondent, Urban, Eastern region)

"No not at all, it is too much. We cannot afford it. It is too expensive and very difficult to maintain." (Male respondent, Peri-Urban, Northern region)

"This product takes too long to treat the water. We will not be able to wait for it." (Female respondent, Urban, Western region)

Table 28 below presents the top three preferred water treatment products by area, along with the three preferred product features mentioned by respondents. The data suggests that urban and rural households are very similar in their preferences for treatment products and the attributes they value. For instance, both groups indicated that the product's affordability, ability to remove germs and health benefits were the most valued features of their preferred products. Interestingly, the one noted difference was among rural respondents who valued liquid chlorine's ability to treat a large volume of water – this feature is very closely linked to its affordability as it is seen as being more value for money.

Table 28: Most Preferred Water Treatment Products, by area

	Rural	Urban
MOST PREFERRED PRODUCT 	**Preferred Features** • It doesn't cost a lot of money (69.1%) • It can treat a large volume of water (67.4%) • It removes invisible germs (58.8%)	**Preferred Features** • It doesn't cost a lot of money (71.3%) • It removes invisible germs (56.6%) • It is good for health (54.6%)
SECOND PREFERRED PRODUCT 	**Preferred Features** • It doesn't cost a lot of money (57.1%) • It removes invisible germs (46.5%) • It is good for health (45.2%)	**Preferred Features** • It doesn't cost a lot of money (24.8%) • It is good for health (23.1%) • It removes invisible germs (20.1%)
THIRD PREFERRED PRODUCT 	**Preferred Features** • It doesn't cost a lot of money (85.2%) • It removes invisible germs (69.3%) • It is good for health (67.4%)	**Preferred Features** • It doesn't cost a lot of money (75.4%) • It is good for health (70.2%) • It removes invisible germs (61.2%)

Looking at data across each of the wealth quintiles, few variations were noted:

- Respondents from the poorest households were more likely to value a water treatment's ability to remove invisible germs (richest: 46.8%, poorest: 60.9%), cost (richest: 61.7%, poorest: 77.0%) and capacity to treat large volumes of water (richest: 16.1%, poorest: 32.4%).
- Households from the richest wealth quintile were most likely to be concerned about the length of time water treatment takes (poorest: 15.2%, richest: 29.0%).

Examining data by the respondent's role in the household (primary caregiver versus household head) and gender revealed very little variation in the reported water treatment product preferences. The implications of this suggest that varying groups share the same concerns regarding a new HWTS product's attributes. Indeed, despite the slight variance reported across urban and rural areas and wealth index quintiles, no major differences between the top products preferred (or their features) were found. Strategies aimed at the promotion of a new water treatment product can therefore market the product in a similar way to different groups of the population.

Follow up FGDs (where products were demonstrated to groups) revealed that respondents identified liquid chlorine's ease of use and ability to treat large quantities of water as preferred features of the product. This included simplicity in terms of how to measure out the correct dosage of chlorine, along with the straightforward process required to treat water.

"Oh yes, I would definitely buy WaterGuard. It helps to purify the water easily." (Female respondent, Peri-Urban, Southern region)

"It treats fifty battas, it is cheap and effective." (Female respondent, Peri-Urban, Northern region)

"It lasts longer. I can put it inside my 5 gallon, and it will last long." (Male respondent, Peri-Urban, Eastern region)

"It purifies plenty water." (Female respondent, Urban, Eastern region)

"It is quick and easy to use. We hope and pray that God will buy it for us." (Female respondent, Rural, Eastern region)

Again, the low cost of Aquatabs was reported by both urban and rural respondents to be the most preferred feature of this water treatment product. After observing how Aquatabs are used, FGD participants highlighted Aquatabs' ease of use and cost as their preferred features of this product.

"The Aquatabs are simple to use and cheap." (Female respondent, Urban, Western region)

"We will buy because it will help us live longer." (Male respondent, Peri-Urban, Southern region)

"Aquatabs prevent diseases like Cholera." (Female respondent, Urban, Southern region)

"They are cheap, easy to use and effective." (Female respondent, Peri-Urban, Northern region)

After observing a demonstration of PUR Purifier of Water ™ water treatment process, where turbid water is made clear by PUR, FGD participants cited the product's cost and effectiveness in removing dirt and germs as desirable features of this product.

"It makes water clean to drink. Changes the water from brown to white." (Male respondent, Urban, Eastern region)

"We prefer the PUR because it can clean the water and also kills the germs in the water, and it is less expensive." (Male respondent, Peri-Urban, Northern region)

"It gathers all the germs and kills them. It is more reasonable." (Male respondent, Urban, Southern region)

Interestingly, FGD respondents consistently referred to the liquid chlorine, Aquatabs and PUR as 'medicine' throughout the discussions. This suggests that these treatment products were perceived as a health remedy or commodity. These perceptions can be effectively leveraged in the context of the aforementioned motivations of disease prevention and germ removal.

3.15. Willingness to Pay for Treatment Products

To determine the amount that respondents were willing to pay for the shortlisted treatment products, primary caregivers and household heads were first presented with flashcards providing information on the attributes of each treatment product. Prior to informing them on the price of the products, respondents were asked what they would be willing to pay for each.

Findings on the median price respondents were willing to pay for each product is presented in Table 29.[27] The summary table shows some interesting trends by area, region, wealth quintile and position within the household. Not surprisingly given their socioeconomic background, respondents from urban areas were willing to pay more for treatment products than those in rural communities, as were respondents in the Western region. When the data is reviewed by wealth, there were no significant differences between the groups willingness to pay for consumable treatment products; however respondents in the richest quintiles were willing to pay markedly higher prices for the durables relative to those in the lower wealth quintiles.

Table 29: Willingness to Pay for Water Treatment Products – Median Price

		Willingness to Pay for Product Median Price (1 US$ = 4,360 Le.)				
		150ml bottle liquid chlorine	Ceramic filter	Slow sand filter	Sachet PUR	One Aquatabs tablet
Region	South	US $1.15	US $5.70	US $6.90	US $0.25	US $0.25
	North	US $1.15	US $4.60	US $6.90	US $0.25	US $0.25
	East	US $0.90	US $4.60	US $5.75	US $0.25	US $0.10
	West	US $1.15	US $9.15	US $11.45	US $0.45	US $0.45
Area	Rural	US $1.15	US $4.60	US $5.75	US $0.25	US $0.25
	Urban	US $1.15	US $6.90	US $9.15	US $0.25	US $0.25
Wealth index quintiles	Poorest	US 0.90	US $4.60	US $5.75	US $0.25	US $0.25
	Second	US $1.15	US $4.60	US $5.75	US $0.25	US $0.25
	Middle	US $1.15	US $4.60	US $5.75	US $0.25	US $0.25
	Fourth	US $1.15	US $5.75	US $6.90	US $0.25	US $0.25
	Richest	US $1.15	US $9.15	US $11.50	US $0.25	US $0.25
Position in HH	Primary Caregiver	US $1.15	US $4.60	US $6.90	US $0.25	US $0.25
	HH Head	US $1.15	US $5.75	US $6.90	US $0.25	US $0.25
Total Median Price		**US$1.15 (Le. 5,000)**	**US$5.70 (Le.25,000)**	**US$9.35 (Le. 40,703)**	**US$0.25 (Le. 1,000)**	**US$0.25 (Le. 1,000)**

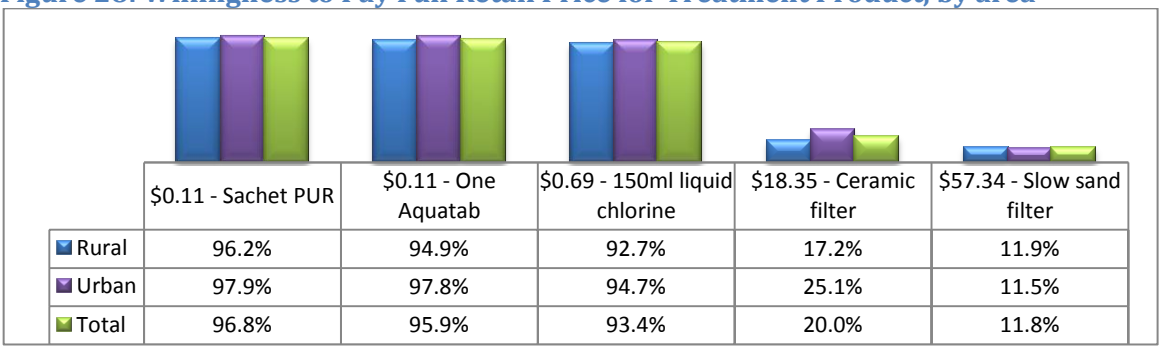
[27] Data on willingness to pay was highly skewed as a wide range of prices were reported. This makes reporting on the average willingness to pay price problematic. The best measure of central tendency (average) for asymmetrical or very skewed data is the median. In this situation, the median is a more representative value than the mean, and has thus been presented.

Willingness to Pay Estimated Retail Price for Treatment Products

Once respondents reported on their willingness to pay for the treatment products, the price for each product was reported and respondents were asked if they would be willing to pay the full retail price. [28] Findings indicate that nine out of ten respondents were most willing to pay for the PUR, Aquatabs and liquid chlorine. One the other hand, very few respondents were willing to pay for the more expensive durable treatment products.

Disaggregation by area type revealed that urban and rural respondents were equally willing to pay the retail price for the treatment products though urban respondents reported a higher willingness to pay for the ceramic filter (25.1%), compared to rural respondents (17.2%). Furthermore, minimal differences were found between primary caregivers' and household heads' reported willingness to pay retail price for the water treatment products.

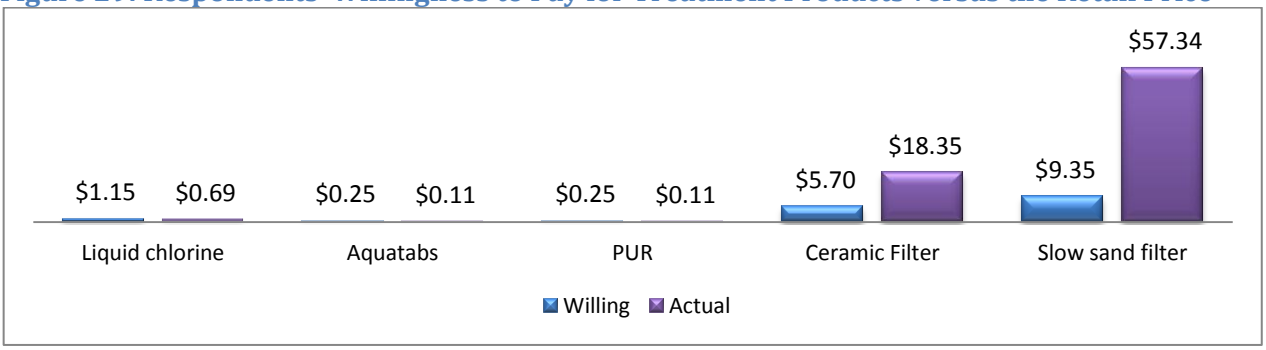
Figure 28: Willingness to Pay Full Retail Price for Treatment Product, by area



	$0.11 - Sachet PUR	$0.11 - One Aquatab	$0.69 - 150ml liquid chlorine	$18.35 - Ceramic filter	$57.34 - Slow sand filter
Rural	96.2%	94.9%	92.7%	17.2%	11.9%
Urban	97.9%	97.8%	94.7%	25.1%	11.5%
Total	96.8%	95.9%	93.4%	20.0%	11.8%

When the amount that respondents were willing to pay is compared to the actual retail price of each treatment product, we see that the products with the most price parity between the willingness to pay price and actual cost are the consumables. In fact, respondents were willing to pay more than the retail price for liquid chlorine, Aquatabs and PUR. As these products were also among the most preferred, the data suggests that they may be the most suitable for water treatment promotion in Sierra Leone.

Figure 29: Respondents' Willingness to Pay for Treatment Products versus the Retail Price



3.16. Taster Session Results

A total of 12 taster sessions were conducted with male and female FGD participants in urban, rural and peri-urban areas in each of the four regions of the country. Participants tasted water collected from their usual

[28] The retail price of each product was assigned based on their current retail cost, gathered during a review of international prices (with a focus on regional prices and Centers for Disease Control and Prevention data sheets).

community source filtered through a ceramic filter, and treated with PUR, WaterGuard and Aquatabs. The following treated water samples were prepared for each taster session:

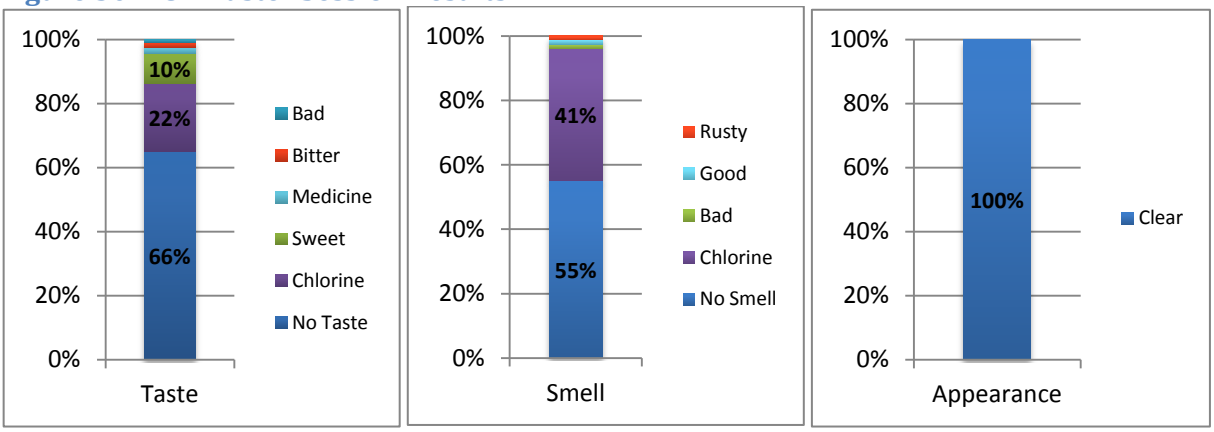
With Aquatabs (67 mg) 2 mg/L for 20 Litres Bucket 1: 1/4 tablet in 20 Litres: dosage 0.5 mg/L Bucket 2: 1/2 tablet in 20 Litres: dosage 1.0 mg/L Bucket 3: 1 tablet in 20 Litres: dosage 2.0 mg/L Bucket 4: 2 tablet in 20 Litres: dosage 4.0 mg/L	**With WaterGuard** Bucket 1: 1/4 cap in 20 Litres (0.75 mL): dosage 0.5 mg/L Bucket 2: 1/2 cap in 20 Litres (1.5 mL): dosage 1.0 mg/L Bucket 3: 1 cap in 20 Litres (3 mL): dosage 2.0 mg/L Bucket 4: 2 cap in 20 Litres (6 mL): dosage 4.0 mg/L
With PUR As instructed: Dosage 2 mg/L.	**Through Ceramic Filter** As instructed. Due to uncertainty surrounding the effectiveness of the procured ceramic filter (*Kosim Filter* from Ghana) to remove contaminants, previously boiled water was used for filtration and tasting

A demonstration of how to use each water treatment product was provided to participants at the beginning of each taster session. Following this demonstration, respondents were invited to sample the treated water. The session was organised as a blind tasting and participants were unaware of which water treatment product they were tasting. After each sample was tested, respondents were questioned about their perceptions of taste, smell, appearance and whether they would consider drinking the treated water in the sample on a regular basis (i.e. not during a cholera outbreak). Results from the taster sessions have been presented below by product type.

PUR Purifier of Water ™

Overall, the response to PUR was favourable with most respondents indicating no taste associated with water treated with the product (65.5%). Of those who indicated there was a taste, it was most commonly reported to be chlorine (21.5%), followed by sweet (9.5%). When asked about the smell of PUR treated water, over half reported no smell (55.0%), with approximately four in ten suggesting that it smelled of chlorine (41.0%). All respondents reported that PUR treated water was clear in colour. Overall, 90.5% of respondents indicated they would drink PUR treated water daily.

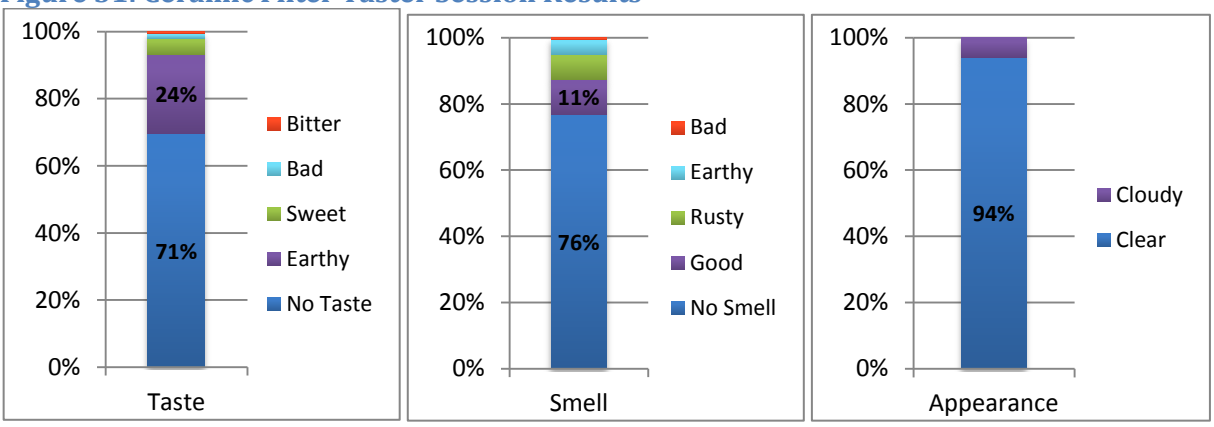
Figure 30: PUR Taster Session Results



Ceramic Filter

While most commonly, participants indicated that ceramic filter water had no taste (71.4%); nearly one-quarter felt that the filtered water tasted earthy (24.1%). Three-quarters of respondents suggested that there was no smell associated with ceramic filtered water (76.4%). While the great majority of respondents perceived the filtered water to be clear, 6.0% felt that it was cloudy. Overall, 96.0% of respondents reported willingness to drink ceramic filtered water daily.

Figure 31: Ceramic Filter Taster Session Results



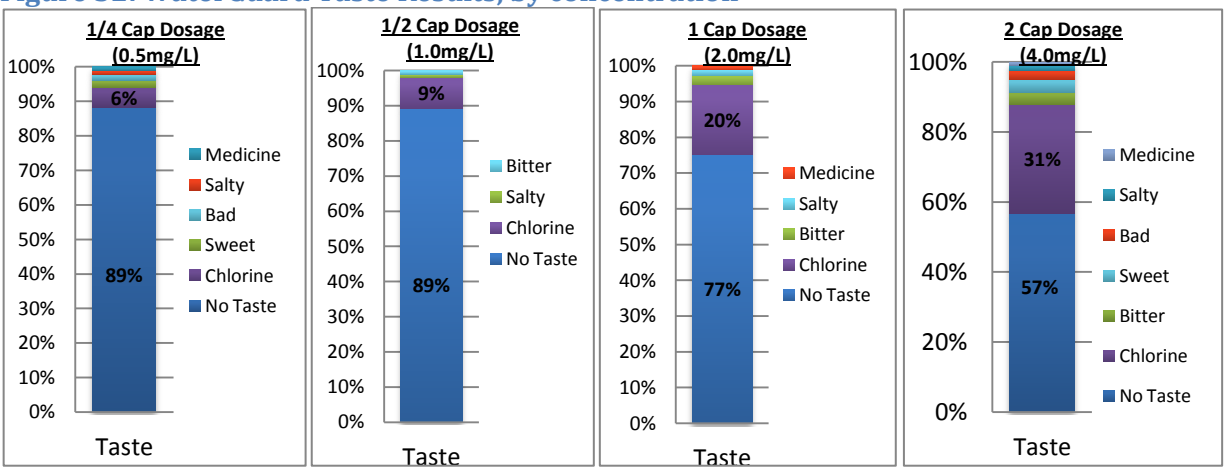
WaterGuard

Taste

Respondents tasted four different concentrations of WaterGuard treated water, added to a five gallon jerry can (and left for 30 minutes before tasting). The results show that at the lowest dosage of a ¼ cap (0.5 mg/L), nearly nine in ten (88.0%) participants reported that the water had no taste at all. This perception of 'no taste' steadily decreased as the dosage increased and participants began to sense the taste at the 2.0mg/L dosage (19.8%) and at 4.0mg/L (31.0%). Nonetheless, the majority of participants indicated a high tolerance for the taste of liquid chlorine as more than half (56.9%) reported that the water had no taste at the highest dosage (4.0mg/L).

Interestingly, some participants indicated that they did not like the fact that they could not taste the chlorine in the lower dosages, as it was perceived that the 'medicine' had not worked. That is, participants wanted to be able to taste the chlorine as a sign that the treatment was working.

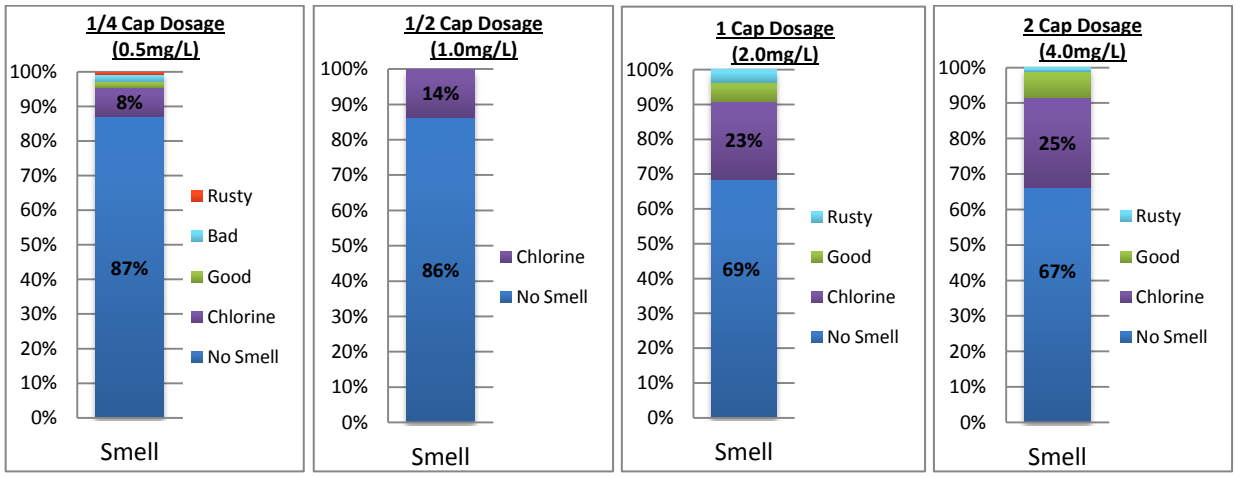
Figure 32: WaterGuard Taste Results, by concentration



Smell

Questioned about the smell, the majority of participants reported that the WaterGuard treated water was odourless, especially at the lower concentrations. Results from the 2.0mg/L and 4.0mg/L samples revealed that the smell of chlorine was detectable to two out of ten respondents at these higher concentrations (22.5% and 25.4% respectively).

Figure 33: WaterGuard Smell Results, by concentration



Overall, nine in ten participants reported that they would drink WaterGuard treated water on a regular basis across each of the four concentrations.

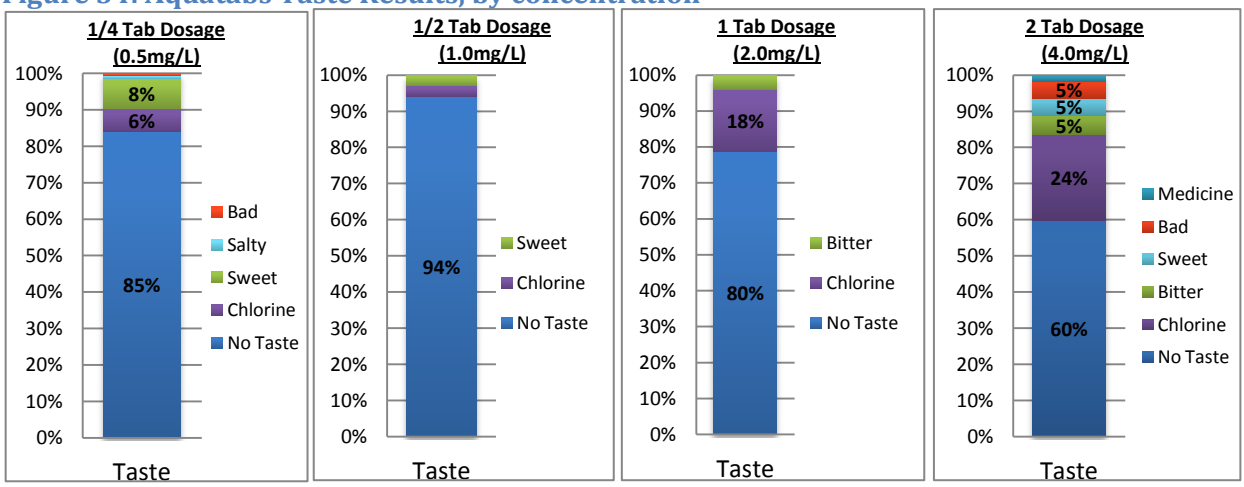
	0.5mg/L	1.0mg/L	2.0mg/L	4.0mg/L
Would you drink this water every day?	92.7%	97.1%	96.4%	92.4%

Aquatabs

Taste

Respondents tasted four different concentrations of Aquatabs treated water, added to a five gallon jerry can (and left for 30 minutes before tasting). The results show that from 0.5mg/L to 2.0mg/L the majority of respondents detected 'no taste' in the water. There was a dramatic increase in the taste perception of chlorine for the two tab dosage of Aquatabs treated water (4.0mg/L). Again, participants demonstrated a high tolerance for the Aquatabs treated water, with only four out of ten reporting a chlorine taste at the highest dosage (4.0mg/L).

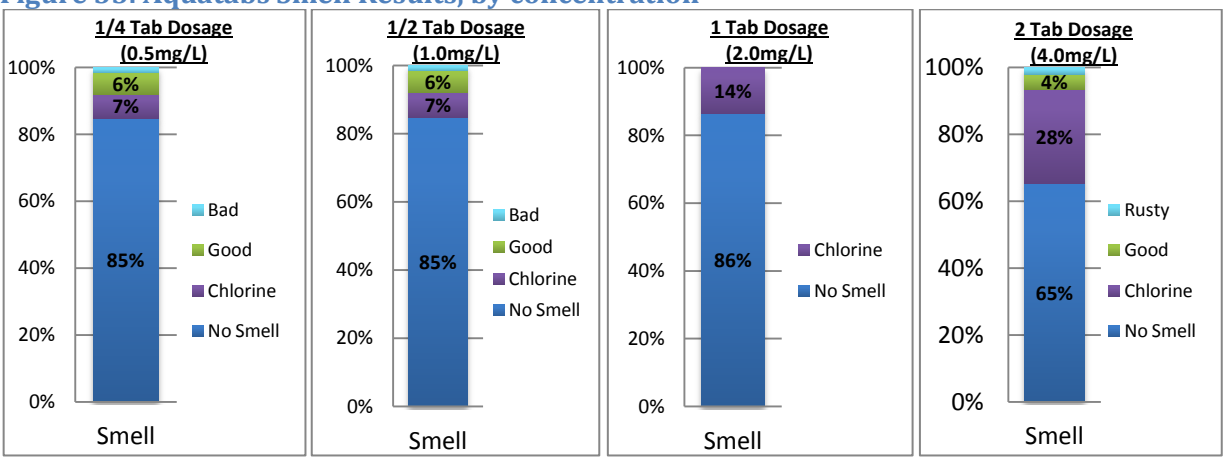
Figure 34: Aquatabs Taste Results, by concentration



Smell

The majority reported that the Aquatabs treated water was odourless, especially at the lower concentrations. Results from the highest dosage (4.0mg/L) revealed that the smell of chlorine was detectable to slightly more than a quarter of respondents (28.3%).

Figure 35: Aquatabs Smell Results, by concentration



Overall, nine in ten participants reported that they would drink Aquatabs treated water on a regular basis across each of the four concentrations.

	0.5mg/L	1.0mg/L	2.0mg/L	4.0mg/L
Would you drink this water every day?	99.0%	100%	100%	94.1%

Summary of Taster Session Results

As the concentration/dosage of chlorine increased in both Aquatabs and WaterGuard samples, findings revealed that participants were more likely to sense both the taste and smell of chlorine within the water. Interestingly, for some participants in the taster sessions, this was a positive contributor to the overall taste/smell of water, as it indicated that the water had been treated. Frequent reference to the sensing of 'medicine' was reported, which was directly correlated to the detection of chlorine within the water samples. If fact, in some instances, higher concentrations of chlorine were preferred by respondents as this provided a reassurance that the water has been treated. Nevertheless, this inclination depended solely on personal preference, as some people's tolerance of chlorine within water was less, and therefore higher dosages/concentrations of chlorine were less preferred by respondents.

Overall, an acceptance and enjoyment of the taste of chlorine was found amongst taster session participants. Across each of the treatment products, at least nine out of ten respondents reported that they would want to drink the treated water every day. Table 30 presents a summary of this data by area and respondent sex.

Table 30: Would you Drink Water Treated with this Product every day?

		Ceramic Filter	PUR	Aquatabs (1/4 Tab)	Aquatabs (1/2 Tab)	Aquatabs (1 Tab)	Aquatabs (2 Tab)	WaterGuard (1/4 Cap)	WaterGuard (1/2 Cap)	WaterGuard (1 Cap)	WaterGuard (2 Caps)
Area	Rural	98.3%	92.9%	98.2%	100%	100%	100%	98.2%	100%	100%	100%
	Urban	95.9%	93.3%	100.0%	100%	100%	98.5%	100%	97.5%	100%	98.8%
	Peri-Urban	94.0%	85.5%	98.5%	100%	100%	84.8%	81.8%	93.8%	90.0%	75.4%
Sex	Male	96.0%	86.0%	98.0%	100%	100%	87.8%	90.0%	96.1%	92.2%	86.2%
	Female	96.0%	95.0%	100%	100%	100%	100%	95.5%	98.1%	100%	100%
Total		**96.0%**	**90.5%**	**99.0%**	**100%**	**100%**	**94.1%**	**92.7%**	**97.1%**	**96.4%**	**92.4%**

3.17. Ability to Pay for HWTS Products

The survey collected data on monthly household income to determine households' ability to pay for HWTS products. The data revealed that 76.2% of respondents earned less than US $80.30 monthly. Nearly half of all rural households (44.6%) and two in ten urban households (21.1%) earned a monthly income of less than US $34.40.

To estimate the amount of income that could be allotted for water treatment products, the "5% rule", which states that households can afford 5% of total monthly income for water management costs, was modified. Recognising that water management refers to all household water costs (storage, connection fees, drinking water treatment, etc.); the percentage has been reduced to 3.5% to provide an estimate as to what households would be able to pay for *drinking water treatment.* The ability to pay for the most preferred drinking water treatment products, WaterGuard and Aquatabs, has been calculated using the 3.5% standard and monthly income data (See Table 31).

The projected retail cost for one Aquatabs tablet is US $0.11, which can treat approximately 20 litres of water. Considering that the average household size is six people, and according to the Sphere Standards, three litres of water are needed per person for cooking and drinking for daily survival,[29] the average household would thus require 27 tablets to treat one month's drinking and cooking water (540 litres). The estimated monthly Aquatabs expenditure for the average family is therefore US $3.10; an amount that could serve as a barrier to the majority of the sampled population, especially those in rural areas. In fact, it can be estimated that less than one-quarter of the sampled households would be able to pay the monthly cost for Aquatabs. Nonetheless, as previously shown, 95.9% of respondents surveyed indicated they would be *willing* to pay for Aquatabs.

Using the same process, the average household's ability to pay for WaterGuard has been calculated. The estimated retail cost for one bottle of WaterGuard is US $0.69 and it can treat approximately 1000 litres of water. The average household would require 0.54 bottles of WaterGuard per month. Therefore, the estimated monthly WaterGuard expenditure for an average household is US $0.37, which households in every income bracket have the ability to pay for the product. Furthermore, the study has shown that 93.4% of the sample would be *willing* to pay for WaterGuard.

[29] The Sphere Standards recommend 2.5- 3 litres per day per person for cooking and drinking. See Sphere Handbook (2011 Edition). *"Humanitarian Charter and Minimum Standards in Humanitarian Response".*

Table 31: Self-Reported Monthly Income and Ability to Pay for Treatment Products, by area

How much money does your household make in a general month (from all sources)?	3.5% of income for water treatment	Rural	Urban	Total	Ability to purchase Aquatabs	Ability to purchase WaterGuard
Less than US$34.40	≥ US $1.20	44.6%	21.1%	36.9%	X	✓
US$34.60 – 57.30	US $1.20 – 2.00	24.6%	20.8%	23.4%	X	✓
US$57.60 – 80.30	US$2.00 – 2.80	16.6%	14.4%	15.9%	X	✓
US$80.50 – 103.20	US$2.80 – 3.60	4.3%	9.1%	5.9%	✓	✓
US$103.45 – 126.15	US$3.60 – 4.40	3.3%	11.1%	5.8%	✓	✓
US$126.40 – 149.10	US $4.40 – 5.20	2.2%	3.8%	2.7%	✓	✓
US$149.30 – 172.00	US $5.20 – 6.00	1.3%	5.3%	2.6%	✓	✓
Over US $172.00	≥US$6.00	3.1%	14.4%	6.8%	✓	✓

Furthermore, earlier findings revealed respondents from the Western region (63.9%) and those in the richest wealth quintile (62.6%) were most likely to report paying for drinking water. All packaged water was paid for, followed by piped water into yard (74.2%), piped water into dwelling (72.5%), and public tap (35.6%). Of those who reported paying for drinking water, the median expenditure in urban areas was US $5.75 and in rural areas was US $0.65. In both areas, those who paid for drinking water were already paying well over the amount required for a monthly supply of WaterGuard. Therefore, these households could be targeted to serve as early-adopters in future drinking water treatment initiatives.

Financial Practices

To measure households' ability to save for more expensive HWTS products such as durable treatment options or water storage containers, information was collected on respondents' financial practices. Overall, only three in ten respondents reported having a bank account (30.2%). Disaggregation by area revealed large variations between urban and rural respondents with a higher proportion of bank account holders located in urban areas (53.7%) and significantly less in rural areas (16.6%). Furthermore, the practice of saving was not widespread among the survey population. In rural areas, nearly half of the households reported to have never saved; conversely, in urban areas, 42.8% reported putting savings aside monthly.

Potential Savings for HWTS Products

Surveyed respondents were asked whether they currently had any money saved that could be used to purchase a drinking water *storage* container. Overall, less than two out of ten (18.0%) respondents reported that they did. Respondents in urban areas were more likely to have savings that could be used to purchase a storage container when compared to rural respondents (18.0% compared to 14.8%).

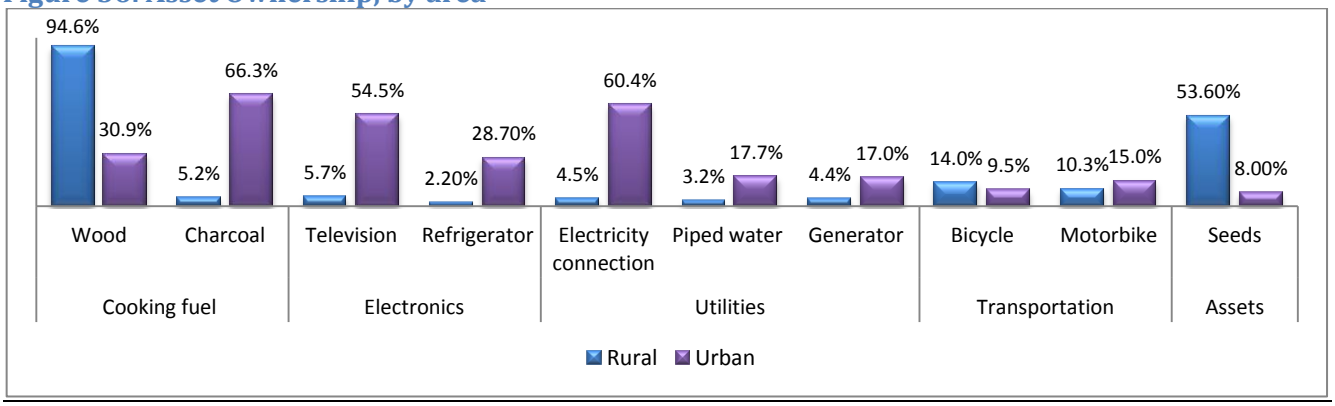
When asked if they had any money saved that could be used to purchase a water *treatment* product, one in four (25.3%) respondents reported that they had money saved. This was more common among urban households (33.7%) compared to rural households (20.7%).

Household Asset Ownership

Details about ownership of common household items were collected to complement the income data as ability to pay for other assets may be indicative of a households' ability to pay for treatment and storage products. Findings revealed that overall respondents have limited ability for investment in household assets (see Figure 36).

Wood and charcoal were the most common cooking fuels, while more expensive options such as liquefied petroleum gas were not common. Ownership of other household items such as a television, refrigerator or means of transportation, while more common in urban areas, were also quite low. Additionally, utilities such as electricity and piped water were also not common among the survey population, especially in rural areas. Furthermore, when asked about productive assets such as seeds, while the majority of rural respondents indicated that they were employed in agriculture for a living, only 53.6% reported ownership.

Figure 36: Asset Ownership, by area



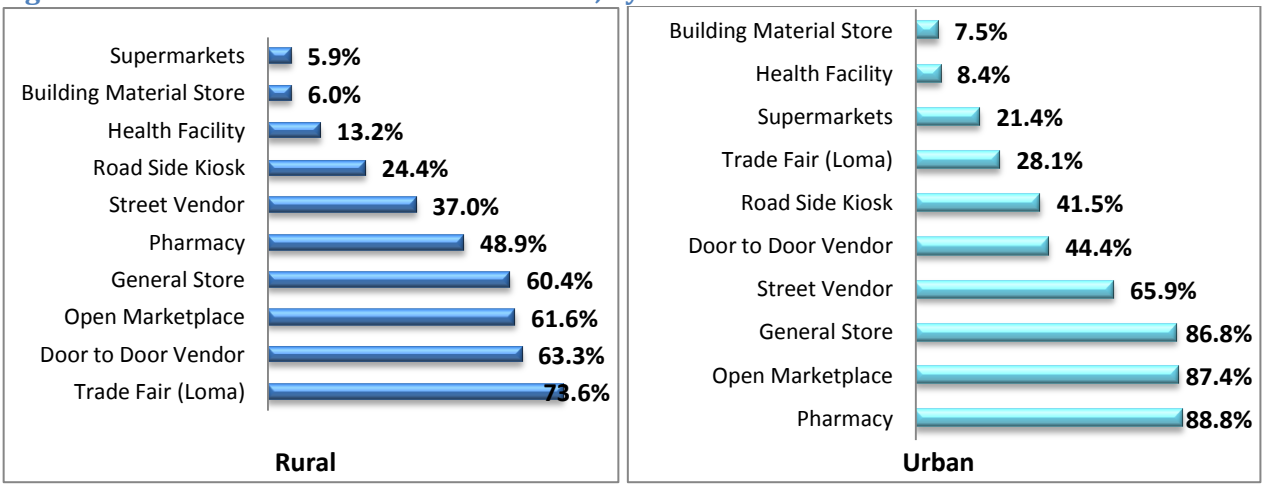
3.18. Purchasing Decision Drivers and Behaviours

Both primary caregivers and household heads were questioned on their purchasing decision drivers and behaviours. This data will help match HWTS marketing efforts with the people and areas that are most likely to have the greatest impact on stimulating product sales.

Current Purchase Place

Primary caregivers and household heads were asked where health items, consumables (including food, soap, detergent and bleach), large household purchases and water storage products (such as plastic storage containers) were generally purchased. Findings indicate that rural households access very different purchasing places compared to urban households. For instance, rural respondents reported that they most often purchase goods from Loma trade fair (market days), door-to-door vendors and open marketplaces. On the other hand, urban respondents are more likely to purchase goods from pharmacies, open marketplaces and general stores.

Figure 37: Purchase Place for General Goods, by area



The majority of rural dwellers indicated that they mostly purchase goods from local sources such as Lomas/trade fairs and door-to-door vendors. However, for the majority of larger household purchases, rural respondents reported having to travel to larger cities or the nearest headquarter town. On the rare occasion that these products were available within rural areas, it was reported that there was not much variety and prices are inflated to account for the cost of transportation.

Purchase Place for HWTS Products

Respondents were asked if they would be interested in purchasing HWTS products through their local health facility (including Peripheral Health Units), community health workers and door-to-door vendors. The overwhelming majority of both urban and rural respondents voiced an interest in purchasing HWTS goods through health facilities (95.2%) and community health workers (89.9%). There was slightly less interest in purchasing these goods from door-to-door vendors (74.7%) – especially among urban respondents.

Buying Decision Influences

Respondents were also asked whose opinion they considered before purchasing health items, consumables and larger household goods. At an aggregate level, health professionals were reported to have the most influence on purchasing decisions (especially in the case of health items), followed by the respondent's spouse (55.1%). Interestingly, six out of ten (60.5%) household heads reported that they seek out their spouse's opinion before making a purchase, compared to 47.5% of primary caregivers who reported the same.

Primary Purchaser

The individual that makes the final decision about household expenditure is likely to affect the regularity in which HWTS products are purchased and thus, the practice of sustained water treatment. Overall, almost seven in ten (69.7%) primary caregivers reported that the household head controls the money within their household, followed by the household head and spouse/primary caregiver jointly (17.5%).

Asked who is primarily responsible for purchases, respondents reported that while the household head is more empowered to make large household purchases on their own, primary caregivers are often involved in the purchase of daily household needs (this includes soap, cleaning solutions and plastic buckets). For instance, in 57.2% of the households, either the primary caregiver alone, or the primary caregiver along with the household head makes daily purchasing decisions.

Table 32: Primary Purchaser of Household Goods

	Major household purchases*	Daily household purchases**
Who makes the final decision to purchase household items?		
Household head	59.3%	37.8%
Spouse/Primary Caregiver	11.4%	36.0%
Household head and Spouse/Primary Caregiver	24.1%	21.2%
All household members	4.4%	3.9%
Other	0.9%	1.1%

*For instance, items such as a bed, radio, television, car, motorbike, etc.
** For instance, items such as food items, soap, kerosene, bleach, plastic buckets, etc.

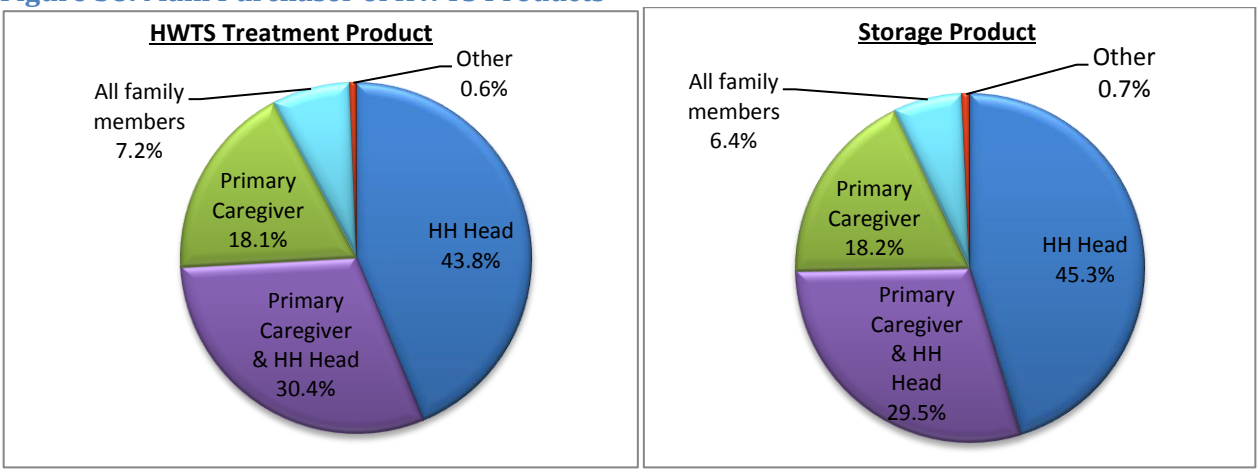
FGDs also revealed that the female/primary caregiver in the household usually makes the final decision for daily household purchases, whereas household heads more commonly make the final decision for major household purchases.

"My wife, because she is the primary caregiver. She can take care most of the time on the little things in the house." (Male respondent, Peri-Urban, Northern region)

"Men make the decision and provide the funds." (Male respondent, Peri-Urban, Southern region)

Primary caregivers were also asked to report on who would make the final decision in their household to buy a HWTS product. The majority reported that the household head would make the final decision, followed by primary caregiver and household head jointly (See Figure 38).

Figure 38: Main Purchaser of HWTS Products



3.19. Communication

Sources of Information

The household survey investigated the main sources of information primary caregivers rely on and trust. Overall, radio was the most commonly used source of general information in both urban and rural areas, followed by friends and family members or relatives. Community-based sources tended to be more popular in rural areas (such as churches/mosques or community leaders), whereas commercially-produced media (such as mobile phones and radio) were more popular in urban areas.

Table 33: Sources of General Information

Description	Rural	Urban	Total
Main sources of general information*			
Radio	74.0%	89.7%	**79.7%**
Friends	64.3%	66.9%	**65.3%**
Family members / relatives	57.5%	61.0%	**58.8%**
Market/traders	38.8%	48.1%	**42.2%**
Community leaders/elders	48.2%	15.2%	**36.1%**
Church / Mosque	30.3%	21.9%	**27.2%**
Household elders	26.2%	15.5%	**22.3%**
Health professional	23.1%	20.7%	**22.2%**
Health facility	21.4%	20.9%	**21.2%**
NGO/CBO	25.6%	11.4%	**20.4%**
Women's groups	17.3%	12.8%	**15.6%**
Mobile phone	11.2%	21.9%	**15.1%**

*Multiple responses possible

Health Information

While health facilities and health professionals were the most frequently named main sources of information on health and hygiene, radio was seen by the majority of respondents as the most trusted source (50.0% rural and 53.2% urban).

When FGD participants were asked which methods they use to gain information on health and hygiene products, the radio, newspapers, mobile phone communications, posters, word of mouth (i.e. through friends, family and work colleagues), schools and health centres were most commonly reported. This was generally reasoned to the ease of access to such communication methods.

"Everybody can listen to the radio." (Male respondent, Urban, Northern region)

"They can teach our children at school and then bring the information home." (Male respondent, Peri-Urban, Eastern region)

Table 34: Sources of Information on Health & Hygiene

Description	Rural	Urban	Total
Main sources of information about personal and household health and hygiene*			
Health professional	66.3%	57.6%	**63.1%**
Health facility	66.1%	58.0%	**63.1%**
Radio	54.5%	75.8%	**62.3%**
Family members / relatives	21.4%	31.6%	**25.1%**
Friends	19.9%	28.0%	**22.9%**
Market/traders	14.1%	17.9%	**15.5%**
NGO/CBO	17.4%	8.9%	**14.3%**
Community leaders/elders	15.8%	8.5%	**13.1%**
Pharmacist/ Chemist	9.8%	15.1%	**11.7%**
TV	0.8%	28.7%	**11.0%**
Community mega-phone	10.9%	8.8%	**10.1%**
Household elders	10.3%	7.8%	**9.4%**
School/Teacher/Students	10.8%	6.7%	**9.3%**
Church / Mosque	8.0%	6.9%	**7.6%**
Women's groups	6.4%	5.6%	**6.1%**
Mobile phone	3.2%	9.9%	**5.6%**
Youth groups	4.6%	4.5%	**4.6%**
Government official	4.1%	4.7%	**4.3%**
Posters/Books/Brochures	2.4%	6.2%	**3.8%**
Community festivals/events	3.3%	2.2%	**2.9%**
Newspaper/Magazine	0.6%	5.2%	**2.3%**
Other	2.1%	1.8%	**2.0%**
Internet	0.2%	3.4%	**1.4%**

		FIRST most trusted	SECOND most trusted	THIRD most trusted
Top three most-trusted sources of health & hygiene information	**Rural**	Radio (50.0%)	Health professional (14.8%)	Health facility (8.8%)
	Urban	Radio (53.2%)	Television (14.9%)	Health professional (13.3%)

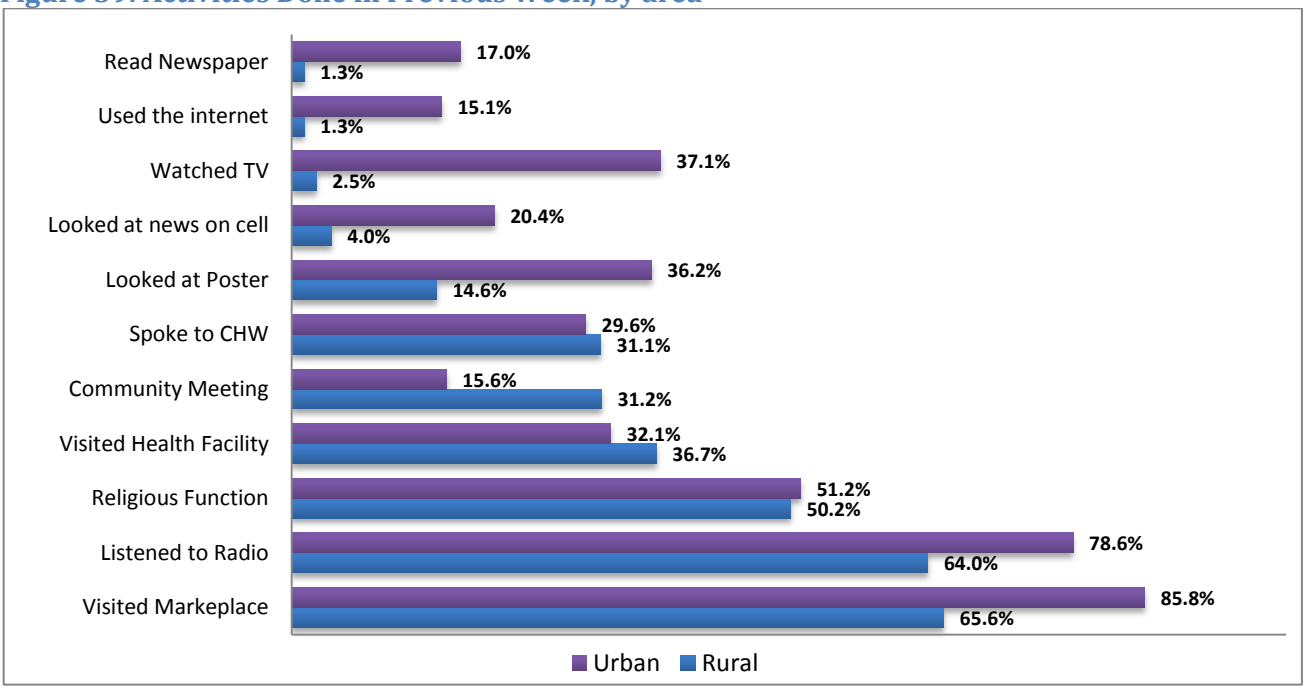
*Multiple responses possible

Habitual Activities

A series of activities were read out to surveyed primary caregivers, to which they were asked to respond if they had done any of them in the past week. Data on habitual activities provides some insight into the most appropriate media channels and information distribution points for different segments of the market – namely between urban and rural respondents.

According to their responses, the most common activities were: having visited a marketplace, listened to a radio and attended a religious function. Rural residents were more likely than urban residents to have attended a community meeting and slightly more likely to have visited a health facility. Urban residents were more likely to have used the internet (though only 15.1% of urban residents had done this); they were also more likely to have read a newspaper or a magazine, watched TV or looked at a poster, though none of those activities were very popular.

Figure 39: Activities Done in Previous Week, by area



4. Results: Supply Side Study

4.1. Market Scan

A nationwide market scan was conducted to determine the availability of HWTS products in Sierra Leone. A total of 70 retail outlets in each region were visited in both urban and rural areas. The market scans revealed that, aside from plastic storage containers, HWTS products were not widely available for purchase, especially in rural areas. The poor road network and lack of supply chains presents a major constraint to the supply of goods and services to rural areas. As we have seen, the majority of rural dwellers reported having to travel to urban centres or chiefdom headquarter towns to purchase goods.

As described in Table 35, household water *storage* products were quite common in the retail outlets scanned (including plastic buckets, jerry cans and taps). The only water treatment products available on the market were a selection of imported and locally produced bleaches. While locally produced bleaches like Cloral were common in roadside kiosks and shops, imported bleaches like Clorox were more likely to be found in supermarkets, which are common in urban areas such as Makeni, Bo, Kenema and Freetown.

The Western urban region had the widest array of HWTS products. It was most difficult to find HWTS products in the Eastern region of the country. While the *range* of prices for brand new products was fairly similar throughout the four regions of Sierra Leone, there were vast variations in pricing per product, due to a lack of price control.

Table 35: HWTS Market Scan

Product	Details	Price Range
Storage		
Extra-large plastic bucket (over 50 L, with or without cover)	Found in all regions. Usually found in roadside kiosks, occasionally found in shops and market kiosks.	US $ 8.00 – 17.20 (Le. 35,000 – 75,000)
Large plastic bucket (20 – 49 L, with or without cover)	Found in all regions. Usually found in roadside kiosks, occasionally found in shops and market kiosks.	US $ 1.55 – 8.85 (Le. 6,666 – 38,500)
Medium plastic bucket (under 20 L, with or without cover)	Found in all regions. Usually found in roadside kiosks, occasionally found in shops and market kiosks.	US$ 1.05 – 3.45 (Le. 4,500 – 15,000)
Extra-large bowl (over 60 L, with or without cover)	Found in all regions. Usually found in roadside kiosks, occasionally found in shops and market kiosks.	US $ 6.90 – 11.45 (Le. 30,000 – 50,000)
Large bowl (40 – 60 L, with or without cover)	Found in all regions. Usually found in roadside kiosks, occasionally found in shops and market kiosks.	US $ 2.75 – 8.05 (Le. 12,000 – 35,000)
Medium bowl (under 40 L, with or without cover)	Found in all regions. Usually found in roadside kiosks, occasionally found in shops and market kiosks.	US $ 0.85 – 4.15 (Le. 3,800 – 18,000)
Jerry can (1 L – 5 L)	Found in all regions. Most commonly found in roadside kiosks.	US $ 0.25 – 1.85 (Le. 1,000 – 8,000)
Plastic drum (120 L)	Found in all regions. Usually found in roadside kiosks. Found occasionally in market kiosks.	US $10.30-11.45 (Le. 45,000 – 50,000)
Metal tap	Found in all regions. Commonly found in roadside kiosks and shops.	US $ 1.15 – 2.30 (Le. 5,000 – 10,000)
Plastic tap	Found in all regions. Commonly found in roadside kiosks that sell hardware products.	US $ 3.45 – 8.05 (Le. 15,000 – 35,000)
Modified country (clay) pot	Available upon request at local potters.	US$22.95 (Le. 100,000)
Treatment		
Imported bleach (0.5 – 4.5 L)	Found in all regions. Most commonly found in supermarkets. Sometimes found in roadside kiosks.	US $1.40-12.60 (Le. 6,000 – 55,000)
Locally produced bleach (0.5 – 1 L)	Found in all regions. Commonly found in roadside kiosks, market kiosks, shops and supermarkets.	US $ 0.45 – 3.45 (Le. 2,000 – 15,000)

Retailers' Profile

The majority of retailers found to carry related HWTS products were roadside kiosks and small scale general shops. Over half of surveyed retailers reported that they were formally registered with the government. With a few exceptions, most retailers owned and operated only one shop or kiosk. Smaller retailers often carried a wide assortment of products (plastic buckets, bowls/tubs) that can be used for water storage, but are not made exclusively for such a purpose. Additionally, bleach and cleaning agents were commonly found in kiosks and shops. Supermarkets were found to carry multiple types of bleach, both imported and produced locally. Findings revealed that with the exception of large supermarkets (such as those found in Bo, Makeni and Freetown), there was no price control at retail outlets.

Inventory and Monthly Sales

In nearly half of all outlets, there were ten or less items in stock as retailers held minimal inventory due to a lack of capital. This speaks to the relatively small nature of the most common retail outlets across the country – often kiosks and shops with little storage space. Furthermore, in some retail outlets where sales of HWTS products were slow, retailers preferred to keep small inventories. Supermarkets and wholesalers were more likely to report keeping larger inventories of HWTS products. Many retailers were either unable or unwilling to report the sales of their HWTS products in the past month. The reasons for this could be twofold: either due to a reluctance to reveal such information or a lack of proper record keeping.

Product Demand and Shortages

While few retailers reported the highest demand for storage products occurred in the dry season, the majority indicated that sales of storage containers and bleach were the same in both seasons.

For the majority of HWTS products, retailers indicated that there were no shortages experienced. In the case of those products that did have occasional shortages, the reasons given were generally due to political problems and instability in Guinea (in the case of plastic storage containers), followed by high demand for the product.

Knowledge of HWTS Products

In general, retailers' knowledge of HWTS products was minimal. Often, retailers were unaware that their treatment products (i.e. bleach) could be used for any purpose other than laundry or other household tasks. When asked to name HWTS products, many retailers focused exclusively on water storage containers (usually those products that they currently sell). A small number of retailers reported knowledge of Aquatabs, likely due to past cholera relief efforts.

When asked why they did not sell other HWTS products, the most common response was because they focused on the sale of other products, followed by perceptions of low demand and unavailability of HWTS products.

Customer Base

When questioned about HWTS product customers, it was most commonly reported that sales are predominantly to households and specifically women who carry out daily purchases (this may be because many of the current HWTS products are also used for laundry). Several retailers also reported that they sold their HWTS products to private businesses, NGOs and community based organisations.

Marketing and Communication

While most retailers reported some method of marketing their products, there was very little in the way of formal advertising. The most commonly reported methods consisted of display of products from their shop or kiosk, and radio; while several retailers indicated that they did not advertise at all.

Retailers reported learning about new products through a variety of informal means, including: word of mouth such as speaking with other sales people, client requirements and friends. Others reported their main source for product information was through product displays. Some respondents indicated that they gathered information on new products when they went to Freetown. A few respondents received information on new products through the radio.

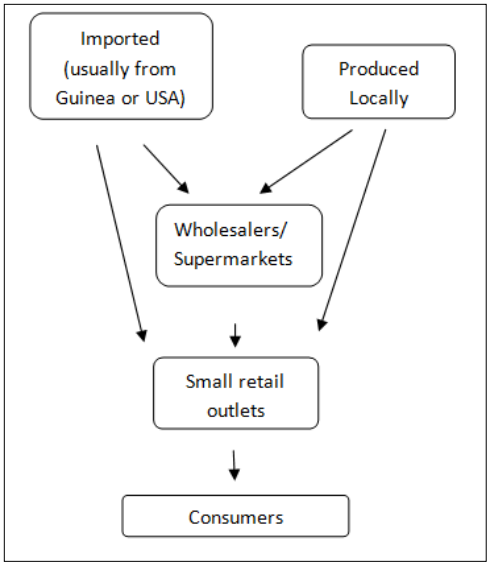
Sources of market information were also informal as many retailers reported that they often look at other retailers' displays to gather information about what products are in demand. Radio and telephone calls were also noted as sources for market information.

Existing HWTS Market Channels

Most retailers reported purchasing HWTS products from multiple sources, both domestic and sourced from other countries. In the case of small-scale retailers, Guinea was the most common source of imported goods' whereas larger retailers such as supermarkets reportedly import goods from a wider range of countries. Approximately one-third of the retailers interviewed reported that they procured their HWTS products from Freetown at least some of the time. Another commonly reported source for HWTS goods was the "Loma" (trade fair). While many retailers reported that they acquired HWTS goods in Freetown or domestically, only a small minority of products were locally produced.

In Freetown, supermarkets often imported goods and then served as wholesalers. Roadside kiosks regularly bought directly from the factory (locally produced goods) and then wholesaled to other kiosks and shops. Certain traders reported that they go to trade fairs to purchase goods from Guinea. While there is no direct supply channel from urban centres to rural areas, sometimes vendors in the interior travel to Freetown or other market centres to purchase goods from wholesalers or kiosks at a lower price and then add a small profit margin when they return to sell the goods upcountry.

Figure 40: Market Distribution Channel



Transportation of Products

The most common mode of transporting HWTS products to retail outlets was by vehicle. Retailers reported various problems associated with vehicle transport – primarily cost and time taken. While most retailers reported satisfaction with the delivery of their products, issues highlighted included theft and breakage during transportation.

Constraints and Opportunities

Many vendors noted that lack of capital was a key inhibiting factor to business expansion. Often, sales were required before retailers could invest in inventory, which was reportedly a significant barrier to the expansion of business.

Several retailers referenced the Operation on Waste Management, Improved road access and Decongestion –"Operation WID" as an obstacle to the growth of their business.[30] Many retailers reported that taxes and licensing fees were a hindrance for their business and indicated that they believed the government should be doing more to assist them in their business efforts. Potential solutions mentioned included having improved access to micro-finance and loans.

Several retailers seemed eager to expand their business in order to meet demand if it were to grow substantially. Some retailers voiced concern about the lack of capital required to accommodate an increased market for goods.

4.2. Bleach Producers

To determine the existing national capacity to make a liquid chlorine water treatment product, site visits were conducted with domestic bleach producers. Currently, there are two bleach producers in Sierra Leone, both of which have formally registered factories in Freetown.

Table 36: Local Bleach Producers

Producer	Product Name	Description	Carton Size/Price (wholesale)	Quantity produced (monthly)
Hudroge Enterprises	Cloral	Bleach 	12 x 1/2L = US $ 6.90 (Le. 30,000) 12 x 1L= US $ 13.75 (Le. 60,000)	15,000 Litres*
Meta Engineering Services	Original Whitex	Bleach 	12 x 1L = US $ 11.45 (Le. 50,000)	960 Litres**

*Can be increased according to demand

**Monthly production levels vary substantially; can be increased according to demand

[30] As part of "Operation WID", many traders have been removed from the streets with the intention of future relocation to a permanent market. See: http://www.statehouse.gov.sl/index.php/component/content/article/34-news-articles/676-operation-wid-revival

Hudroge Enterprises

Hudroge Enterprises, located in Freetown, produces Cloral bleach, which is commonly found in shops around the country. The company has been operating in Sierra Leone for over 50 years and manufactures a wide assortment of products including sachet mineral water. The bleach product is sold to wholesalers and supermarkets and also exported to Liberia. At the time of the study, 15,000 bottles of Cloral are produced monthly with a reported ability to increase production.

The water used to produce Cloral is from Guma Valley Water Company and it goes through a filtration process twice (nine filters) and is then deionised. The ingredients used to produce Cloral are purchased locally (caustic soda) and imported directly from China (calcium hypochlorite). The calcium hypochlorite usually takes one month to five weeks to get to Freetown and comes by ship. The producer expressed satisfaction with the importation process as shortages of raw materials are not experienced.

While there was a high level of knowledge demonstrated about the process for producing chlorine, no clear explanation was provided regarding the chemical processes involved in checking and raising pH levels. Each batch is made with the exact same proportions of water, caustic soda and calcium hypochlorite. One area of concern is the reported lack of quality control during the production of the bleach as Hudroge does not perform any testing to ensure an exact concentration of chlorine.

Filling and labelling of the bleach bottles is done manually and Hudroge Enterprises produces the bottles used for Cloral. The company also has the capacity to produce bottles of any size, given the required moulds.

Hudroge Enterprises expressed eagerness to become involved with chlorine production to be used for household water treatment and stated the possibility of lowering the chlorine concentration of its bleach to an appropriate level. Asked about how to increase and improve to production of quality chlorine for household drinking water and storage in Sierra Leone, the CEO said “We will need to create a *new* market because the market for drinking water treatment is currently very small, to do this we will need more public support”.

Meta Engineering Services

Meta Engineering Services, located in Freetown, manufactures bleach (Original Whitex) and has been in operation since 1998. The company also produces a variety of products including car battery acid and ‘Crystal’ bottled water.

Meta Engineering Services filters and deionises water sourced from Guma Valley Water Company in the production of its bleach. Both the water and each batch of bleach produced are reportedly tested to ensure there is no contamination and that the chlorine concentration is at the correct level. Chlorine granules are used in the production of Original Whitex Bleach. They are purchased from an importer located in Freetown. Caustic soda is produced domestically and its place of purchase is determined by availability. Meta Engineering Services indicated that there are occasionally shortages of raw materials.

The company uses a manual process called “gravitational filling” to fill bleach bottles. The labels are also applied manually. As was the case for Hudroge Enterprises, Meta Engineering Services seemed very informed about the process for making bleach, but less about the chemical components of the product.

Original Whitex Bleach is sold mainly to wholesalers and supermarkets in Freetown. Occasionally, customers and retailers purchase directly from the factory to benefit from wholesale prices. The company produces the

bottles used for the bleach and sells fifteen to twenty cases of bleach (12x1L) per week. It has capacity to produce up to 500 dozen bottles of bleach per month and could increase production based on demand.

The General Manager of Meta Engineering Services expressed eagerness to become involved with chlorine production to be used for household water treatment. He also expressed interest in a partnership with another company to produce household water treatment options for consumers in Sierra Leone.

Summary of Bleach Producers Potential to Produce Domestic Liquid Chlorine for HWTS

In order to identify a suitable solutions company to produce liquid chlorine, the following key factors must be in place:

1. Capacity to make 'clean' water
2. Capacity to test chlorine solution to ensure it is the correct concentration (some type of laboratory facility)
3. Capacity to use chemicals (sodium or calcium hypochlorite and sodium hydroxide)

Both national manufacturers surveyed are assessed as currently being partially suitable for domestic production of liquid chlorine. While they have the capacity to make clean water and use chemicals, there is room for capacity building in the ability to test chlorine solutions to ensure it is the correct concentration, and to ensure quality control measures and procedures are put in place. Both producers are keen to work with partners in the development of a domestically produced product to respond to consumer demand. Nonetheless, more detailed factory visits will be required to fully assess capacity.

4.3. Plastic Manufacturers

Domestic plastic manufacturers were visited to better understand the local market for (1) water storage products and (2) to determine whether there was in-country capacity to produce high-density polyethylene (HDPE) bottles for a liquid chlorine drinking water treatment product.

Currently, two major large-scale plastic producers operate in Sierra Leone, both of which are national companies that have formally-registered factories located in Freetown: G. Shankerdas & Sons (S.L.) Ltd. and Milla Group (S.L.) Ltd.. Both manufactures produce items that are frequently used for household drinking water storage, namely, a variety of sizes of plastic buckets with covers. Shankerdas & Sons (S.L.) Ltd. also produces cans and plastic tubs. Select storage containers produced by these national manufacturers are presented in the table below.

Table 37: HWTS Products Manufactured by Domestic Plastic Companies

Description	Price (wholesale)	Product picture
G. Shankerdas & Sons (S.L.) Ltd.		
Gallon Jerry Can	1 G = US $1.10 (Le. 4,800) 5 G = US $5.05 (Le. 22,000)	
Bucket with cover	5 L = US $0.80 (Le. 3,417) 10 L = US $1.40 (Le. 6,167) 16 L = US $1.80 (Le. 7,917) 18 L = US $2.10 (Le. 9,250) 20 L = US $2.45 (Le. 10,666)	

	22 L = US $2.65 (Le. 11,583)	
Plastic bowl / Tub	US $1.40 – 2.30 (Le. 6,067 – 10,000)	
Milla Group (S.L.) Ltd.		
Bucket with cover	12 L = US $1.95 (Le. 8,500) 16 L = US $2.45 (Le. 10,600) 20 L = US $2.80 (Le. 12,300)	

Both companies have warehouses located throughout the country to house their products. G. Shankerdas & Sons (S.L.) Ltd. indicated that there would be warehouses located in each of the districts in the near future. Both manufacturers reported that they only sell their products to domestic wholesalers.

The plastic manufacturers were asked whether they would be willing to produce a storage option for household drinking water which consisted of a plastic bucket with a tap pre-assembled. Both indicated that this was possible, reliant on the availability of taps. Milla Group (S.L.) Ltd. suggested use of a plastic tap as a metal tap would likely be too heavy. Shankerdas & Sons (S.L.) Ltd. reported that there is in house capacity to produce plastic taps, dependent on the volume of the order.

In regards to the potential to manufacture HDPE bottles for a liquid chlorine treatment product only Shankerdas & Sons (S.L.) Ltd. currently produces HDPE plastics. The manufacturer has the capacity to produce a HDPE plastic bottle between 50 and 300 millilitres and a cap between two and ten millilitres, which could be used to dose liquid chlorine. With one mould, 3000 HDPE bottles could be produced per week. This amount could be increased with the purchase of more moulds. Shankerdas & Sons (S.L.) Ltd. expressed willingness to produce the bottles. According to the CEO, an appropriately sized mould can be purchased for approximately US $3,000 (more expensive than other moulds because it is HDPE plastic).

Summary of Plastics Producers Potential to Produce Domestic Safe Storage Containers, and Plastic Bottles for Liquid Chlorine

Both plastics manufacturers have blow-moulding capacities and are already producing many of the plastic storage containers currently in use in Sierra Leone. However, as these products are not being produced or marketed as *safe water* storage containers, they lack some of the necessary features to make them truly safe storage options (such as the addition of a tap for water retrieval). Further engagement with these producers and the proof of consumer demand will be necessary to encourage production of exclusive safe water storage products. Nonetheless, domestic production capacity does exist.

In order to identify a suitable plastics company to produce bottles for liquid chlorine, the following key factors must be in place:

1. Capacity to make HDPE plastic bottles
2. Capacity to make blow moulded bottles of 150 mL size
3. Capacity to make a 3-millimeter dosing cap fit to the bottle

Both national manufacturers surveyed are assessed as currently being fairly suitable for domestic production of the bottle and cap for liquid chlorine. One of the manufacturers has the capacity to make HDPE plastic bottles of 150mL size, along with a 3-millilitre dosing cap to fit the bottle (although this may require the purchase of a new mould, the capacity exists). Both producers are keen to work with partners in the development of a domestically produced product to respond to consumer demand. Nonetheless, more detailed factory visits will be required to fully assess capacity.

4.4. Storage and Treated Water Product: Indie Group and Co.

Indie Group and Co promotes itself as a sustainable water innovative solution for low-income communities in Freetown by giving access to affordable, quality drinking water. Indie Group and Co purifies water obtained from underground and from the Guma Valley Water Company through a UV water box system. Water is then filled into the safe container pictured below. After the initial purchase of the filled storage container (US$ 16.05), consumers can return for refills of purified water (US$1.60).

Table 38: Indie Group and Co Household Water Treatment and Safe Storage Option

Indie Group and Co	
Container US $16.05 (Le.70,000) Refill US $1.60 (Le. 7,000)	

The project is now being piloted and has been in operation in Sierra Leone since early 2013 aiming for completion in 2017. Indie Group and Co is planning on launching several water shops in addition to the kiosk that is already in operation in Central Freetown. The targeted beneficiaries are residents of low-income communities within Freetown. The ultimate goal is to reach 330,000 people by the end of 2025.

This product was displayed in focus group discussion sessions held around the country. Rural respondents were less receptive to the product due to initial costs for the storage containers (US $16.05/Le. 70,000) as well as challenges associated with reaching an outlet to refill. Urban respondents also voiced concern over the initial cost and expense of transport for refill.

"Bucket costs too much. How would we go to get the water each time?" (Female respondent, Urban, Northern region)

4.5. Ceramic Producers

Businesses that specialise in manufacturing ceramic products were also surveyed in order to ascertain the potential for the modified clay pot to be produced within Sierra Leone. Both ceramic producers identified to participate in semi-structured interviews were found to operate in Lunsar (Northern region), but distribute their products throughout the country. Neither currently produce the modified (clay) pot on a regular basis, but prefer to manufacture them according to demand.

While both ceramic manufacturers interviewed reported to work full-time in the clay industry, neither are formally registered. One manufacturer solely relies on the production of clay goods for income, while the second sells vegetables to supplement their business earnings. Both respondents indicated that their trade

had been passed down through generations, and they used earnings from this initial work to start their business. Both producers indicated that a local abundance of clay (found in local swamps) also influenced their decision to start ceramic production.

Other than clay, very few inputs/materials are required to manufacture products. Both ceramic producers follow a relatively simple method to manufacture their products, relying on basic moulds (from old/broken pots), whereby clay is applied and left to dry. One ceramic producer has also constructed a potter's wheel and uses a kiln (requiring wood to fuel it). Ceramic producers most often make pots for boiling incense and flower pots, as well as clay bricks and plates/bowls.

The minimum number of employees recruited by ceramic producers interviewed was five and a maximum of up to 40. Neither producer could provide accurate information on the cost of production of goods, nor quantity produced per month.

The manufacturers interviewed suggested that to expand their business and produce the modified (clay) country pots on a commercial scale, capital investment would be required to employ more people and subsequently produce greater quantities of products.

Both ceramic producers were positive regarding the potential of clay production in Sierra Leone:

"Clay has huge potential across Sierra Leone, the product is widely available and can be used for many purposes." (Clay producer, Northern region)

Specifically concerning country pot manufacture, the ceramic producers both reported to be willing to produce the product, provided it is demanded by customers. Thus, to ensure the successful establishment of the clay pot industry within Sierra Leone, both manufacturers reported that promotion of the product is required.

4.6. District Health Management Teams

District Health Management Teams (DHMT) across Sierra Leone were interviewed to gain information on current HWTS activities across the country and to seek their input and suggestions on the national study. The majority of DHMT representatives reported that well chlorination is carried out throughout communities within their districts; however, this is inconsistently practised, due to irregular supplies of chlorine. In fact, none of the DHMT respondents could provide an accurate account of the frequency and coverage of well chlorination within their district. A mixed response regarding the effectiveness of well chlorination was reported by the DHMTs. For example, it was suggested that well chlorination is effective as it is easy to conduct and can target a significant population; however, there was some acknowledgement of the potential for contamination during transport and storage of drinking water.

"It depends on the users, as chlorinated wells can still get contaminated by users after the water has been collected".

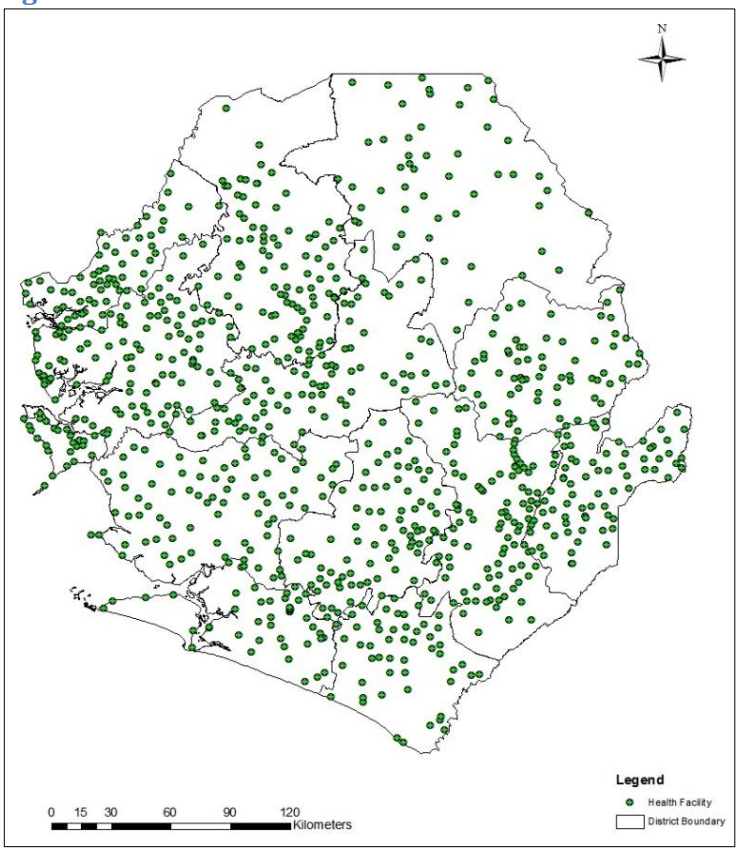
When questioned on the frequency in which wells should be chlorinated, responses varied significantly between DHMT respondents, from every week to monthly. It is therefore questionable whether wells are being treated regularly enough.

The possibility for PHUs to act as a distribution channel in the circulation of water treatment products was also discussed with DHMT members. From this, it was revealed that in a number of districts, chlorine for the treatment of wells is being distributed by PHU staff. While the foregoing discussion highlighted that this distribution is often inconsistently practiced, PHUs were identified by DHMT representatives as the best dispenser of water treatment products to the hard-to-reach communities in their district.

"In our district there are 95 catchment communities. PHUs provide easy access as they are closer to catchment communities."

In fact, as the map below illustrates, PHUs and health facilities across the country are well distributed, and could very well make up for the lack of supply chains to rural areas.

Figure 41: Location of Health Facilities in Sierra Leone



As systems are already in place whereby PHUs have, in the past, distributed chlorine for the treatment of wells under the guidance of the DHMT, they appear to be a good candidate for linking HWTS distribution with district health actors, under the direction of the MoHS. Furthermore, as highlighted in Section 3.19, health facilities and health professionals were the most frequently named main sources of information on health and hygiene.

Additionally, some DHMT respondents suggested that lactating mothers/families with children under 5 could be used as a pilot in the promotion of water treatment – perhaps through antenatal visits. In fact, recent evidence from a pilot initiative aimed at linking HWTS and maternal health care through community health

facilities, suggest that there may be potential to replicate the model in the Sierra Leonean context under the National Free health Care Imitative for Mothers and Children under Five. [31]

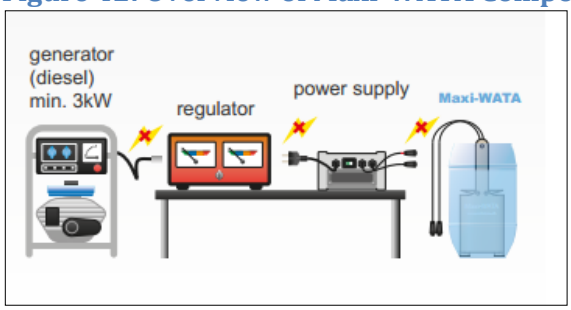
4.7. HWTS Initiatives in Sierra Leone

Project visits were organized with three NGOs who have implemented HWTS initiatives in Sierra Leone. The objective of the site visits was to assess past and current initiatives and to gather lessons learned which may influence future HWTS programming.

ACF: Maxi-WATA

In April 2013, ACF began implementing a community-led chlorine production initiative, known as Maxi-WATA. The Maxi-WATA project is a community-led production of sodium hypochlorite with a corresponding concentration of six grams per litre active chlorine. The Maxi-Wata systems allows for small-scale production of chlorine using very simple tools and technology. In essence, the Maxi-Wata system includes a small machine connected to a generator which creates a small electrical current. When water and salt are added, the Maxi-Wata creates a chlorine concentrate.[32]

Figure 42: Overview of Maxi-WATA Components



This results in a local, easy to produce water treatment product, which can be sold to the community. There are currently two Maxi-WATA projects being carried out: one in Bottom Oku and another in Pamuronko (both city sections in Eastern Freetown). In each beneficiary community, the projects are led by a Maxi-WATA production group, which consists of community members and includes a chairman/production manager.

The treatment product was launched accompanied by a comprehensive community marketing campaign. Five batches of Maxi-WATA were sold in two weeks between April and May 2013. Maxi-WATA was sold for US $0.25 (Le. 1,000) for 250 millilitres. Quality control was conducted by checking each batch of product and all batches met and exceeded WHO standards for liquid chlorine (seven grams per litre and WHO standard is six).

[31] For instance, a recent pilot in Malawi distributed a free hygiene kit, including WaterGuard, to pregnant women using antenatal and postnatal services in health facilities. Follow-up surveys documented a sustained increase in WaterGuard use three years after the initial intervention (at which point, women had to pay for the WaterGuard). In fact, programme participants were found to be more likely to know correct water treatment procedures, chlorinate drinking water, demonstrate correct handwashing practices, and purchase water treatment solution after free distribution. Furthermore, there was also a noted increase in the utilization of maternal health services among participants. Another recent pilot in Vietnam demonstrated that WASH education and Aquatab distribution through local health collaborators can have a positive impact on the community. While the project was able to recover the product cost, it was not able to recover the additional marketing or distribution costs. Nonetheless, there may be potential to carry this model forward with assistance from the public sector.

[32] See Antenna Technologies product guide at: http://www.antenna.ch/en/medias/maxi_wata_EN.pdf

An interview was held with ACF staff, followed by a FGD with seven members of the Bottom Oku "Maxi-WATA production group" and four community members who had purchased the treatment product.

Strengths of the Maxi-WATA Project

FGD participants reported that the Maxi-WATA production had taught them about the necessity of water treatment and that they were able to see a reduction in waterborne disease within the community. Respondents were noticeably excited about having the ability to produce such an effective and popular product. Consumers were eager to highlight the health related benefits of Maxi-WATA, even referring to it as "medicine" on multiple occasions. The promotional activities for Maxi-WATA were also a success. To inform the community about the purpose and benefits of the product, the Maxi-WATA production group did a musical performance to advertise the product. Reportedly, after the promotions, the product was so popular that producers had a difficult time meeting demand. People came from other communities to purchase the product.

"Before the water had no taste. It tastes fine now. Now it tastes like chlorine." (Maxi-WATA consumer, Bottom Oku)

"We would like to continue producing [Maxi-WATA] forever!" (Maxi-WATA producer, Bottom Oku)

Weaknesses/Constraints of the Maxi-WATA Project

The major obstacle facing the Maxi-WATA project was that the bottles used to package the treatment product were meant to be re-used so as to make the project more sustainable and affordable, but in practice, consumers did not return their bottles. This resulted in all of the bottles running out, which halted the production of Maxi-WATA. Consumers stated that they were no longer consistently treating their water as they were unable to obtain the product. ACF reported that more bottles have been ordered, but this additional cost means that the project is unsustainable at its current price point without additional assistance.

Additionally, the production of Maxi-WATA requires significant oversight in order to ensure quality control measures are adhered to and proper maintenance of the Maxi-WATA machine – which may prove difficult in the long term. Furthermore, due to the localised nature of production, there are serious implications for cost efficiency which may restrict the project's potential to be scaled up.

GOAL: Biosand Filters

Between 2009 and 2011, GOAL provided 564 biosand filters (BSFs) to households across eight of the sixteen chiefdoms in Kenema district, Southern region. GOAL identified the communities for BSF provision (rather than well construction) from their baseline survey, on the following conditions:

1. Remote/rural location: Difficult to access markets for consumable water treatment products.
2. Do not meet criteria for a well to be dug within the community (i.e. less than 250-500 users per hand pump well).
3. Open Defecation Free (ODF).
4. Vulnerability of communities due to their key water point (i.e. predominantly use surface water).

Initial training on the BSF was provided by GOAL for four days, where information on how to use and maintain the BSF (including how to wash the sand and stone), along with sensitisation on the necessity to treat drinking water was presented. Each community also had to recommend a representative for the

training ('Natural Leader'), who oversaw the usage of BSFs within each household. Each Natural Leader also monitored BSF handling by households at different times (one week, one month, 6 months and a year) after the filter was initially installed. Further monitoring of BSF usage after one year was not conducted.

Strengths of the BSF Project

GOAL assessments revealed a reduced incidence of diarrhoea within households using the BSF. Satisfaction with the temperature and taste of the treated water was also reported.

Weaknesses/Constraints of the BSF Project

A few individuals provided with a BSF suggested that they would prefer a well, primarily as this would directly reduce the time it takes to collect water. Reduced usage of the BSF during the rainy season was also reported, where the collection of rain water reduced the need to treat water from unclean sources (e.g. surface water). A reduction in the use of filters was also reported by GOAL due to a shortage in storage containers needed to store the treated water. GOAL subsequently provided households with two jerry cans: one for fetching water and one for storage.

Problems in maintenance were not reported, aside from the replacement of the initially installed diffusion place (which overtime became rusty), to a plastic substitute.

Of the four houses which were habitable and accessible during the site visit, none were found to be using their biosand filter (i.e. the area around the diffusion plate was very dry, indicating disuse for a significant period) while other BSFs were being used for the storage of bananas and local herbs.

Reasoning for not using their BSF was explored further with households. Most notable in this case, the process of using the BSF was reported to be too lengthy and strenuous. Community members still have to walk to collect water from their key water point (a nearby stream), wait for the water to settle, before pouring it into the BSF. This process was cited by interviewees as being too "labour intensive". The slow flow rate of the BSF and lengthy treatment speed also deterred the use of this water treatment product, exemplified by one female:

> *"I have to collect water, bring it to the home, wait for the sedimentation to settle, and then wait for the water to pass through the biosand filter."* (BSF user, Kenema district)

Interviewees also reported that despite using the BSF for a number of months, they have not noticed any difference in their health status or reduction of diarrhoea. Thus, the lengthy water treatment process, along with no observed change in user's health has resulted in non-usage of BSFs.

Implications

The BSF technology was not widely accepted by beneficiaries. The treatment process and time required to use the BSF were major barriers to the uptake of the treatment product. Any future promotion of BSFs in Sierra Leone will need to seriously consider the experience of the GOAL project. GOAL has suggested that an in-depth review of the apparent disuse of BSFs is now required to evaluate the issues in provision of the filter.

Inter Aide: Household Chlorine

Since 2011, eight communities (reaching approximately 576 people) across Bombali district, Northern region, were targeted by Inter Aide to participate in a household chlorination project. This involved communities

purchasing chlorine collectively at a subsidised rate from identified vendors, in order to treat their drinking water at the household level. Still in its pilot phase, the project has been scaled up to reach thirteen villages (843 people). Through the project, households are provided with a kit which includes a five gallon plastic container, cloth, syringe and cup which are used to treat their drinking water. Households are required to contribute 40% to the overall cost of these items.

A survey before the implementation of the project identified rural communities where well construction and/or regular chlorination would be difficult due to issues of access. Such communities therefore qualified for the household chlorination pilot.

The chlorine (Cloral) is produced in Freetown, and then transported to a shop in Makeni. From there, subsidised vendors purchase the chlorine and distribute the product to their rural catchment communities (costing US $1.40/Le.6,000 for 1 litre and US $0.70/Le. 3,000 for ½ litre). Practical training was provided by Inter Aide on how to use the syringe (measuring the required quantity of chlorine; relevant to the pH value in each water source). General education through animations showing the 'contamination cycle' also educated households on how water can be contaminated.

Strengths of the Chlorine Project

Interviews with the primary caregiver practising household water chlorination as part of the Inter Aide project revealed that users could correctly identify the steps needed to treat their water:

"We wash the container with soda soap, wash my hands, filter the water through a white cloth and put the medicine in it. I wait until the evening and then the water is safe." (Household chorine user, Bombali district)

All beneficiaries reported problems of diarrhoea when they initially started to treat their water with chlorine. However, within a few weeks, households reported that this eased significantly. Now, the majority of villagers discussed the positive impact that water treatment has had on their health, exemplified below:

"I love enjoying good health by using this medicine." (Household chorine user, Bombali district)

"Since the coming of the medicine, we obtain better health. We could no longer drink any other water." (Household chorine user, Bombali district)

"Inter Aide brought us cups, rubber buckets and some medicine which they taught us to use with the water and it caused us a lot of diarrhoea, but now we are free from most of the illness that used to affect us. We no longer go to hospital easily." (Household chorine user, Bombali district)

Inter Aide evaluations also reported a reduction in the incidence of diarrhoea in households using the Cloral, encompassing up to a 30-45% improvement in health (i.e. reduced sickness and diarrhoea). The mobility and affordability of chlorine is also regarded to be particularly successful in promoting the treatment of water in communities that are difficult to access. Initially piloted with only four villages, households from thirteen communities are now treating water using chlorine, with households from outside the targeted areas also purchasing chlorine from Inter Aide vendors.

Shortages in chlorine were not reported, and the majority of households stated that they purchase more Cloral as soon as they run out. Of the households interviewed, none reported problems with the payment

scheme, and found it convenient to pay an elected secretary each month in order to receive chlorine when required. Households contributed different amounts with a range of US $0.45 – 1.60 (Le. 2,000 - Le. 7,000) per month, depending on the number of individuals per household.

Lastly, DPD (diethyl paraphenylene diamine) indicator tests on water samples (treated on the day of the site visit) in five households in Masonkarie village provided readings from 0.3 mg/L to 5 mg/L, with a mean of 2.36 mg/L. As the chlorine residual should generally range from 0.2 to 0.5 mg/L, the readings indicate that households are over-treating their water with chlorine.

Weaknesses/Constraints of the Chlorine Project

Two respondents complained of the lengthy process required to filter the water; finding it both time consuming and difficult. One respondent even suggested that they may stop filtering the water as it is too demanding on a daily basis:

"I think I will not be able to continue filtering this medicine as it is time consuming." (Household chorine user, Bombali district)

"It is not easy to use as you have to filter the water." (Household chorine user, Bombali district)

Further to this, general practice in the implementation of the Inter Aide project endorses two women within each community to be trained to treat the community member's water using chlorine (usually at an agreed space close to the water source). However, when these women are unavailable to treat water, and the products are locked away, community members cannot access the chlorine to ensure consistent water treatment. Therefore, a number of households have bought their own kit, reducing the emphasis of community co-operation in the project.

Issues with the use of syringes were also reported, as previously, a specific quantity of chlorine had to be extracted by users. However, due to the high incidence of illiteracy within some communities, incorrect dosages of chlorine were being mixed with untreated water. Therefore, Inter Aide sought a new manufacturer of smaller syringes, whereby it can be completely filled with Cloral to get the correct dosage of chlorine.

Finally, the project has been implemented with a very limited scope across few communities. This has implications for the potential of programme scale up. Furthermore, the long-term sustainability of the community approach has not been thoroughly assessed.

Implications

Despite a few reported complaints of household water chlorination being time consuming, findings reveal that generally, respondents are satisfied with this water treatment method. Interestingly, none of the respondents complained of the taste or smell of chlorine within their water sources, indicating that they are satisfied with the concentrated dosage. Based on the experience of Inter Aide's chlorination project, liquid chlorine appears to be an easy to use and widely acceptable treatment product.

4.8. Regional HWTS Initiatives

Liberia Safe Water System Programme

With funding from UNICEF, PSI studied household water treatment practices in Liberia and determined the most suitable dosage and formulation for using WaterGuard (a domestically produced liquid chlorine product), which was officially launched in 2009 by Liberia's president. PSI distributes WaterGuard year round using local wholesaler and retailer networks. A 2011 mapping exercise found that the WaterGuard product is available in a quarter of all census enumeration areas.

According to a 2010 evaluation of households water treatment using WaterGuard, about 75% of households in project communities treated their drinking water with WaterGuard as a result of education received through programme activities. This is over and above the programme target of 30%. About 60% (307) of the project communities were also found to be storing their drinking water in recommended safe storage containers. As of April 2012, a total of 324,961,000 litres of water has been treated using WaterGuard.

A similar project has been implemented in Guinea since 2006, which has also been largely successful. As of April 2012, a total of 1,520,628,000 litres of water has been treated using Sûr'Eau (the local liquid chlorine product).

Production of the liquid chlorine product for both regional programmes is carried in Liberia by Mano Manufacturing Company (MANCO). MANCO's 'WaterGuard' and 'Sûr'Eau' products are developed exclusively for PSI and are regularly tested by CDC to guarantee quality assurance.

4.9. Microfinance

A final task of the supply-side research included a review of access to and use of microfinance to support the manufacturing and purchase of HWTS products. More specifically, the research examined options for consumers to overcome barriers to meet capital costs of HWTS products and potential financing for private sector actors interested in expanding their activities into HWTS product production or distribution.

A number of questions asked to the surveyed household head provided an indication of the access and use of MFIs throughout Sierra Leone. Survey findings revealed that in total, 34.8% of respondents reported that their community had access to a microfinance institution (more likely in urban areas 56.7%, compared to rural areas 22.1%). Fewer (23.3%) respondents reported having access to a village savings and loan scheme within their communities. Finally, almost three quarters (72.8%) of respondents indicated that their community has access to Osusu.[33]

Overall, very few respondents reported ever taking a microfinance loan (6.0%), or using a village savings and loan scheme (3.6%). The most commonly used lending system reported was Osusu (20.0%). The most common use for Osusu funds included: business loans, purchasing building materials for home construction or repair, school fees, medicine and to purchase household goods such as food.

Can microfinance or forced saving be applied to HWTS to increase/encourage more widespread use of HWTS products in poor and rural areas?[34]

[33] Osusu is a system of savings whereby community members agree to contribute a set amount of money, which is distributed out to the members on a rotational basis and repaid for redistribution.

[34] The promotion of microfinance/forced saving to encourage the purchase of HWTS products has experienced limited success internationally. For instance, the provision of lending schemes to promote the purchase of water filters in India did initially increase the uptake of water treatment practices (and create a demand for filters), however, continued use was low as the subsidised price

Household heads were asked whether they would use loan funds to purchase HWTS products. Overwhelmingly, respondents reported that they would not use microfinance (77.5%) or village savings and loan schemes (82.7%) to finance the purchase HWTS products. However, one third (33.9%) of household heads reported that they would use money from Osusu for the purchase of HWTS products. This is not particularly promising, as finance from Osusu sources has to compete with the priorities such as school fees, business loans, medicine, etc., as individuals are free to choose how to spend the Osusu funds.

Can microfinance help manufacturers market and distribute their products in a profitable and sustainable manner?[35]

A rapid appraisal was conducted with seven MFIs and other lending institutions in Sierra Leone to gauge their interest or willingness to support HWTS producers or entrepreneurs. The findings of the appraisal reveal that financial assistance (consisting of individual or group loans ranging from US $114.70 – 10,321.10/Le. 500,000 to Le. 45,000,000) is primarily provided to business entrepreneurs and petty traders, and used for the growth of existing businesses. The majority of MFIs reported that they provide loans to individuals with an established business, whereas only one MFI indicated that they would provide financial assistance to start-up businesses. MFIs were hesitant when discussing the possibility of providing loans to help HWTS manufactures. Their willingness to consider such a loan was generally based on the condition that businesses are already established and can make the case for the successful marketing and distribution of their products in a profitable and sustainable manner.

undermined the perceived health benefits of the filter and deterred salespeople from communicating the benefits of safe drinking water. See PATH (2012). *"Microfinancing boots uptake of water filters".*

[35] To date, there has been limited success linking microfinance institutions (MFIs) with producers of HWTS products. Two case studies reviewed suggest that it is very difficult to develop microenterprises within rural areas of a developing country that can produce and market a quality HWTS product effectively. For example, the production of slow sand filters in the Dominican Republic resulted in 10 of the 14 technicians trained to leave the programme, due to poor workmanship. Meanwhile, an evaluation of chlorine (WATA) production initiatives in Haiti revealed that the product did not meet quality standards.
See DINEPA (2012). *"Evaluation de project de traitment d'eau à domicile"* and Jan Tollefson (2004). *"History of the Dominican Republic Biosand Project, 1998-2004".*

5. Results: Policy Review

5.1. National Policy and Institutional Framework

The Government of Sierra Leone (GoSL) policy on water and sanitation is laid out in the second generation Poverty Reduction Strategy Paper: Agenda for Change 2008-2012 (GoSL, PRSP-II) which includes its overarching policy objectives in relation to WASH. However, there is no mention of household water treatment and safe storage or regulatory priorities in the PRSP-II for ensuring proper treatment of the preferred pipe-borne water supply.

The National Water Policy (NWP) document (July 2008) aligns water and sanitation policy objectives with Sierra Leone's Development Vision 2025, the PRSP objectives and the commitments to attaining the MDGs. Much like the Agenda for Change, the NWP does not explicitly recognise the role of HWTS in fulfilling the human right to safe and clean drinking water.

Various interviews with key stakeholders and a secondary review of relevant policy documents revealed a number of constraints and public sector deficiencies with the current policy and institutional framework.

First and foremost, HWTS is at its infancy in Sierra Leone and it is addressed to a limited extent in national policies. While, HWTS is declared as part of a package of WASH interventions that will be considered standard of care at all levels of health services delivery, there is nothing in the way of specific strategy development to encourage HWTS as a priority in the fight against diarrhoeal disease. In fact, current policies make little mention of, or support for, the integration of drinking water treatment and safe storage within different environmental health interventions.

Second, responsibilities for water provision have been decentralised, with Local Councils becoming the focal entities at the district level of implementation of water delivery (officials work through District Water and Sanitation Committees). This process of decentralisation has resulted in loss of authority and control over local sector technical staff. The issue becomes particularly problematic in the context of weak human resources, especially at local levels. Local government bodies have limited technical capacity and financial resources to fulfil their statutory responsibilities.

Third, the review found that there is weak coordination and lack of harmonisation within and among the various ministries for water in Sierra Leone. These include: the MoHS and the Ministry of Water Resources (MoWR), two Government agencies - Environment Protection Agency and Office of National Security - local governments, the two state owned enterprises - Guma Valley Water Company (GVWC) and Sierra Leone Water Company (SALWACO). However, there is little in the way of ensuring harmonisation of each entities responsibilities and objectives. This situation creates ineffective communication among ministries and sector institutions and an inequitable distribution of resources, duplication of programmes and a lack of effective monitoring and evaluation of WASH activities at the national, district and local level.

5.2. Planned Policy Reforms in Relation to HWTS

The Environmental Health Department (EHD) of the MoHS is currently working on revising the National Environmental Health and Sanitation Policy to include a strategic implementation plan and a revised public health ordinance (PHO, 1961). Through interviews with the relevant actors in the EHD there is a serious

interest to include HWTS in the revised policy. In carrying this out, it is very important that MoHS collaborates with the Standards Bureau to ensure their involvement in the approval, testing, certification and product labelling of all HWTS products. The Standards Bureau also has a major role to play in ensuring national standards for HWTS products and technologies.

In May 2013, a delegation from Sierra Leone including officials from MoHS, MoWR, WHO (World Health Organisation)s, UNICEF and NBI participated in the West Africa Region Household Water Treatment and Safe Storage Workshop in Accra, Ghana . The conference was organised by the Ghana Technical Working Group on HWTS in collaboration with The International Network on Household Water Treatment and Safe Storage (the "Network").

The workshop provided an opportunity to identify and strengthen national policies and strategies that support HWTS as one of the interventions for reducing diarrhoeal diseases. The overall goal of the workshop was to support participating countries to identify existing policies and develop and strengthen strategies and regulations on HWTS to support effective implementation and integration with other household environmental health interventions.

The workshop culminated into the development of key milestones for the integration of HWTS into national policy. A firm commitment to the following milestones was made by the Sierra Leonean delegation:

Table 39: Planned National Policy HWTS Milestones

Activity	Milestone
WASH National Indicators	National indicators harmonised among WASH stakeholders
Multi-Sectoral Multi-Year Emergency Preparedness Plan	HWTS indicators and action plan in emergency incorporated
Water Safety Plan	HWTS action plan harmonised with WSP
HWTS Market Research	HWTS Baseline-Demand, Supply, Policy
EHS Policy and Public Health Ordinance revision	HWTS indicators and action plan incorporated into the national policy

Achieving tangible results in the scaling-up of household water treatment and safe storage depends, in large part, on national enabling environment and policies and strategies. In-depth interviews with key MoHS staff expressed commitment to developing realistic short, medium and long-term HWTS policies and strategies. To this end, the MoHS has developed a draft National Action Plan for HWTS. Moving forward, it is also important that donors and NGOs respond to government plans with a willingness to support HWTS programmes and develop national, district and local HWTS programmes that ensure sustainability.

6. Summary of Key Findings

6.1. Summary of Key Findings

Water Treatment

Current Context

- Overall, very few households currently treat their drinking water; exemplifying the non-existent treatment culture currently present within Sierra Leone.
- Often people perceived their water to be safe based on physical cues such as taste, smell and appearance; or treated at the source and therefore did not see a need for treatment.
- Nonetheless, the surveyed population had a high level of understanding of the link between water and disease.
- When questioned on the perceptions of individuals who do treat their drinking water, respondents suggested that such individuals care about their health and wellbeing, and therefore have an elevated social standing.

Motivations and Barriers to Water Treatment

- Motivations for treating drinking water fall into five categories: (1) *Safety*, the removal of bacteria and germs; (2) *Fear*, the prevention of disease at times of high risk; (3) *Health promotion*, health and prevention of disease; (4) *Turbidity*, the removal of the appearance of dirt; and (5) *Social acceptance,* perceptions of people who treat water as "wise" and "prestigious".
- Ultimately, four factors that inhibit or prevent the treatment of drinking water were identified through the study: (1) *cognitive*, the habit of water treatment**;** (2) *socio-economic*, the affordability of water treatment products; (3) *awareness and accessibility*, the awareness of treatment methods/products and the availability of drinking water treatment products and (4) *misperceptions*, about the safety of drinking water sources.

Preferred Water Treatment products

- Liquid chlorine was the most preferred water treatment product among the surveyed consumers across both urban and rural areas. The study also noted equilibrium between consumer's willingness and ability to pay for the liquid chlorine product. Furthermore, the reported willingness to pay for liquid chlorine was significantly higher than the projected retail cost.
- Taster sessions of community water samples treated with a range of treatment products revealed that participants had a high tolerance for the taste and smell of chlorine. Interestingly, many people liked to sense chlorine (often referred to as 'medicine') in the water as assurance that the water was purified and subsequently safe to drink.

Willingness and Ability to Pay for Water Treatment Products

- The estimated monthly cost of liquid chlorine to treat enough water for an average household is US $0.37. The study found that households in every income bracket have the ability to pay for the product at this price. Furthermore, 93.4% of the sample would be willing to pay for liquid chlorine.

Water Storage

Current Context

- The majority of survey respondents were observed storing drinking water in the home, primarily for convenience and to ensure a regular supply of drinking water.
- *Safe* storage of water was observed within very few households, often due to the limited access to safe storage containers which encourages unhygienic storage and handling of drinking water.
- The majority of households' were found to use similar containers across the country. The most common type of storage containers observed included: plastic bucket, plastic jerry can and plastic bowl.

Preferred Water Storage containers

- Respondents' most preferred option for a safe water storage container was a plastic bucket with lid and tap.

Willingness to Pay for Safe Water Storage Products

- Findings indicate that approximately half of the respondents were most willing to pay the full retail price for preferred plastic bucket with lid and tap. There was less willingness to pay for the more expensive concrete storage container and modified clay pot.

Supply-Side Findings

Availability of Products

The poor road network and lack of supply chains presents a major constraint to the supply of goods and services to rural areas. The majority of rural dwellers reported having to travel to urban centres or chiefdom headquarter towns to purchase goods.

Market scans across rural and urban areas revealed that virtually no water *treatment* products are currently available in retail outlets. This is largely due to a general unavailability of treatment products in country. The limited presence of treatment products on the market creates a major barrier to the uptake of effective and consistent point of use water treatment. Nevertheless, supply-side assessments across the region found that the production of quality liquid chlorine in neighbouring Liberia does present opportunities for low cost importation. Furthermore, an assessment of national manufacturers provided indication that the current production of chlorine in-country has potential to be scaled-up, but requires capacity building and technical support to ensure that quality control measures are implemented.

On the other hand, the market scan and manufacturing assessment both revealed that *storage* products such as covered plastic buckets are currently manufactured and sold throughout the country (including urban commercial centres and rural Loma market trade fairs). Local manufacturers also expressed willingness to modify their current products to be marketed as 'safe' storage options (e.g. retrofitting plastic buckets with taps).

Past and Existing HWTS Initiatives

Meanwhile, an examination of past and existing HWTS projects in Sierra Leone revealed that communities have a demand for, and enjoy using a liquid chlorine product to treat their household drinking water. Nonetheless these projects have been implemented on a small scale basis, and there has been minimal

progress in translating these initiatives to a large scale to ensure long-term sustainability. Nevertheless, experiences with safe water systems in Liberia and Guinea suggest that HWTS projects can be implemented in the region with great success and lead to lasting behavioural change.

Policy Findings

HWTS is at its infancy in Sierra Leone and is addressed to a limited extent in national policies. While, HWTS is declared as part of a package of WASH interventions that will be considered standard of care at all levels of health services delivery, current policies make little mention of, or support for, the integration of drinking water treatment and safe storage within different environmental health interventions. Moving forward, a number of policy reforms are planned to elevate HWTS as a strategy to support the reduction in diarrhoeal disease. To this end, the MoHS has developed a draft National Action Plan for HWTS.

6.2. Market Segmentation

As survey findings have shown, the greatest variations exist between urban and rural populations, therefore, market segmentation (used to divide consumers to ensure that products are most appropriate according to identified trends) has been carried out along these lines.

Water Treatment Products Market Segmentation

Findings in the table below indicate that respondents were more willing to pay for consumable water treatment products, i.e. liquid chlorine, Aquatabs and PUR. Very few consumers reported a preference or a willingness to pay for the durable products. Both urban and rural respondents reported to most prefer the liquid chlorine, as it is affordable, good for health and removes invisible germs. Encouragingly, there is considerable evidence that the target population is willing and able to pay for some or all of the cost of chlorine household water treatment. In fact, respondents in both rural and urban areas voiced a willingness to pay well above the retail price. Additionally, taster sessions provided indication that participants had a high tolerance for the taste and smell of chlorine. Indeed, many people liked to sense chlorine in the water as assurance that the water was purified.

Table 40: Household Water Treatment Product Market Segmentation

Rural Respondents		Urban Respondents
Willing to Pay		
US $1.15	**Liquid Chlorine (150ml)**	US $1.15
US $0.25	**Aquatabs (one tab)**	US $0.25
US $0.25	**PUR (sachet)**	US $0.25
US $4.60	**Ceramic Filter**	US $6.90
US $5.75	**Slow Sand Filter**	US $9.15
Preferred Treatment Product		
Liquid Chlorine		Liquid Chlorine
Willing to Pay Full Retail Price of Preferred Product (US $0.69)		
92.7%		94.7%
Most Valued Storage Treatment Product's Attributes		
• It doesn't cost a lot of money • It can treat a large volume of water • It removes invisible germs		• It doesn't cost a lot of money • It removes invisible germs • It is good for health

Water Storage Product Market Segmentation

According to the findings presented in the table below, rural and urban dwellers share many of the same values and preferences for water storage containers. While the majority of respondents preferred the plastic bucket with lid and tap, only 40.5% of rural respondents and 52.1% of urban respondents were willing to pay the full suggested retail price of the product. Given the current use and ownership of various water storage containers across the surveyed areas, the motivation to purchase new storage products at the current market costs is quite unlikely, more so among rural households. A safe water storage container that responds to these groups' needs (while keeping costs down) will be important to meet the demand for water storage products in both rural and urban areas.

Table 41: Household Water Storage Container Market Segmentation

Rural Respondents		Urban Respondents
Willing to Pay		
US $4.60	**Bucket with Lid and Tap**	US $4.60
US $3.45	**Jerry Can with Tap**	US $4.60
US $5.75	**Modified Clay Pot**	US $6.90
US $2.30	**Metal Tap**	US $3.10
US $1.85	**Plastic Tap**	US $2.30
Preferred Storage Container		
Bucket with lid and tap		Bucket with lid and tap
Willing to Pay Full Retail Price of Preferred Container (US $10.32)		
40.5%		52.1%
Most Valued Storage Container Attributes		
• Has a cover • Has a tap • Easy to clean / keeps water safe from contamination		• Has a cover • Has a tap • Easy to clean

7. Conclusions and Recommendations

7.1. Scaling Up a National HWTS Programme

Moving forward, it is recommended that the HWTS programme in Sierra Leone take the form of a Safe Water System (SWS). The Safe Water System is a water quality intervention that employs simple, inexpensive and robust technologies appropriate for the developing world. The strategy is to make water safe through disinfection at the point of use and safe storage.

Based on study findings, the most appropriate safe water system entails (1) a low cost liquid chlorine treatment option, imported from the region or produced locally, and (2) a bucket with lid and tap to prevent contamination. The availability of HWTS products must be coupled with behaviour change techniques, including social marketing, community mobilization, interpersonal communication, and education, to increase awareness of the link between contaminated water and disease and the benefits of safe water, and to influence hygiene behaviours including the purchase and proper use of the water storage vessel and disinfectant.

It is recommended that the scaling up of a HWTS programme in Sierra Leone follow a two-tier approach:

1) The GoSL through the MoHS promotes public-private partnership through an enabling environment and supportive policies for the development of a nation-wide HWTS programme. This 'mothership' programme should initially be rolled out across major urban centres in the country. This approach is most likely to achieve economies of scale and ensure sustainable supply chains. Once promotional messages have trickled into rural areas and HWTS products are known and demand is created, entry into rural areas (through partnerships and mainstreaming activities) will be properly supported.

2) In order to ensure scalability across the country (including into rural areas), opportunities for mainstreaming HWTS into ongoing WASH and health-related programs should be encouraged. This includes, integrating HWTS into training of community health workers, engaging health workers and PHU staff to promote HWTS into the wider national policy on maternal and child health. This also includes working with partners in the sector to encourage opportunities for mainstreaming HWTS into the Rural Water Supply Strategy, Urban WASH Consortium and UNICEF Rural WASH programs.

Lessons learned from countries implementing similar safe water systems demonstrate that there is the potential for full cost recovery of the HWTS products once the initiative is taken to scale. It is anticipated that, at the outset, institutional sales will be a greater percentage of sales than commercial sales, until demand is created, and free distribution in cholera and other emergencies stimulates the commercial sales network in the post-cholera, post-emergency environment (as has happened in other countries).

7.2. Revisiting the Marketing Mix

The study's findings have been used to identify strategies to encourage the scaling up of a HWTS programme in Sierra Leone. To ascertain clear objectives and goals, recommendations are presented below according to the 5 P's of Marketing (Product, Price, Place, Promotion and Policy).

Product

Safe Storage Products:

Based on study results, the most preferred, and thus, recommended product for safe water storage is a plastic bucket with lid and tap. While this product is currently available in-country, it will require assemblage.

Recognising that the cost of a plastic bucket with lid and tap may present a barrier to certain segments of the population, an alternative safe storage option is to promote the retrofitting of existing narrow-mouthed containers (such as jerry cans) with newly purchased taps. These taps are easily accessible and will prevent contamination of drinking water as households will be able to easily dispense water. Additionally, consumers reported high levels of willingness to pay for taps to be retrofitted to their existing storage containers.

As household water storage containers are already widely used, albeit requiring adjustments to make them truly 'safe', efforts should focus on encouraging local manufacturers to modify containers which can subsequently be retailed as a safe storage option specifically for household drinking water. As items used for storage already enjoy penetration of the local market, this should be a fairly natural and intuitive transition.

Treatment Products:

A liquid chlorine product targeted at both urban and rural areas is recommended for Sierra Leone. In

addition to being the most preferred among consumers, it is also the most cost effective and can be imported from regional suppliers and/or produced locally (see Table 42 below).

Table 42: Preferred Household Water Treatment Comparison

	Chlorine (liquid)	Chlorine (Aquatabs)	PUR
Lab	Bacteria, Viruses	Bacteria, Viruses	Bacteria, Viruses, Protozoa
Produced	**Locally**: Freetown **Regionally**: Liberia & Guinea	Ireland	Pakistan
Health	Proven	Not proven	Proven
Scale	>30 countries	>10 countries	Emergency
Cost (consumer)	US$0.69 / 1000 L	US$0.11 / 20 L	US$0.11 / 10 L

Liquid chlorine can be imported from suppliers in other countries within the region that are already manufacturing the product. For instance, Mano Manufacturing Company (MANCO) (located in Liberia) is currently producing liquid chlorine for SWS programmes in Liberia and Guinea, and is in negotiations to supply the Côte d'Ivoire. The cost of regional importation is approximately US$0.50 per bottle, including freight, which is well within the cost respondents reported willingness to pay for the product (the reported median price reported was US$1.15 retail).

Alternatively, liquid chlorine could be produced by domestic bleach manufacturers; however, the costs associated with starting a domestic liquid chlorine product would likely be inhibitive and delay the implementation of the programme substantially. Considerable technical support and guidance would be needed to assist domestic manufacturers to effectively produce a quality product for distribution. Furthermore, bleach producers and plastics producers may need to partner to ensure that a suitable HDPE bottle is developed with a cap that will allow for simple and proper dosage of chlorine. For existing local manufacturers to set up production, an initial investment of approximately US$15,000 – $25,000 would be required based on projected costs associated with moulds, quality control and technical assistance.

Based on the above, it is recommended that the liquid chlorine programme begins with importation of a regional product with the ultimate goal of developing a locally manufactured product, assuming sufficient demand and funding are in place. This approach could help to create sustained market demand for the treatment products and as such, create an enabling environment for local production.

Emergency Response

Given the recent cholera outbreak in Sierra Leone, it is necessary to consider water treatment products currently used for emergency response and their potential impact on commercial water treatment products. Thus, a mechanism must be provided to ensure differentiation between emergency response and everyday treatment products. The following strategies, which have been used successfully in other countries, should be considered:

- Reserving one treatment product, such as Aquatabs, dedicated solely for emergency response, while another product, such as liquid chlorine, is marketed for everyday use.
- A voucher system implemented in times of emergency: whereby vouchers are distributed instead of free product, preventing market distortion and the perception that water treatment products should be provided for free.

- Use of different coloured bottles for packaging of liquid chlorine: one for times of emergency and another for everyday water treatment.

Other Treatment Product Considerations

Several considerations must be reviewed in the process of product development:

- Dosage needs to fall within the WHO guidelines for chlorine residual, taking into consideration the level of turbidity in the water.[36]
- It is necessary that approval from the Standards Bureau is obtained prior to the launching of any water treatment product. Internal and external quality assurance must be secured - this needs to include the Standards Bureau's development of guidelines (that meet international standards). Additionally, regular testing must be conducted to ensure the proper concentration of liquid chlorine (meeting both consumer taste preferences and safe dosages of chlorine).
- The product must be user friendly and accommodate the high illiteracy rates present within Sierra Leone. Products must clearly label their use, through animations/illustrations, including information on correct dosing.
- HWTS products must also be safe for consumers: i.e. product development must consider children/the elderly to ensure that accidental harm will not arise from the presence of these goods within the household.[37]
- The product must also include a brand name and logo that is easily identifiable. To achieve this, branding must be simple, catchy and promote aspirational/healthy images of water treaters.
- It is recommended that the label on the chlorination product include pictures of both the plastic bucket with lid and tap and the jerry can to promote safe storage.
- A standardised bottle and cap must be manufactured to ensure consistency in the concentration of chlorine used at point of use.
- The product must be packaged for easy distribution/avoid leakage, reducing problems of transportation on Sierra Leone's poor road network.
- A system must be established whereby training on how to use the treatment/storage products correctly is passed onto consumers. This must also include monitoring activities to ensure that products are properly used over a sustained period of time.

Price

Cost is a significant constraint for the majority of households, thus, potential consumers will need to see value in what they are purchasing. As mentioned in the foregoing discussion, respondents reported high levels of willingness to pay for consumable treatment options; in fact, in the case of liquid chlorine the reported willingness to pay was higher than the projected retail cost of the product. Additionally, based on income data, the study found that the majority of the surveyed population would be able to pay for a liquid chlorine product on a monthly basis. Given these findings, there is strong potential for the introduction of liquid chlorine into the Sierra Leonean market chain to be profitable. This provides scope for more affluent

[36] A study done in over 25 countries (Lantagne, 2008) showed that 91.7% of turbid waters between 10-100 NTU require a 3.75 mg/L (2 caps) dose of WaterGuard.

[37] The CDC considers the sodium hypochlorite solution "safe" for the following reasons: An extensive review of Poison Control Center data in Europe found that "All evidence presented confirms the normal safety profile of hypochlorite-based bleaches to be similar to that of other 'generally recognized as safe' household products." (Racioppi, 1994). Use of the SWS solution in drinking water meets WHO Guidelines for Drinking-Water Quality. Lastly, there has been no health effects from SWS solution reported to CDC in the 15 years the program has operated.

consumers to purchase the liquid chlorine at a higher price, generating profit. This can be used to subsidise those households who would otherwise be unable to afford the product.

As the estimated price of the plastic bucket with lid and tap may be a barrier to certain segments of the population, an alternative safe storage option is to promote the retrofitting of existing containers with newly purchased taps – which are easily accessible throughout the country, and are also affordable.

In Sierra Leone, consumers have little in the way of savings and there are limited opportunities for microfinance and/or forced savings schemes to help assist with the uptake of HWTS initiatives; therefore, the utmost importance must be placed on the availability of inexpensive options. Nonetheless, limitations of the small scale HWTS initiatives described in section 4.7 (which have neither attracted private sector interest nor developed sustainable supply chains) demonstrates the necessity for this HWTS pilot in Sierra Leone to reach a significant scale in order to be commercially viable.

Further issues that must be considered during the process in which the price of liquid chlorine in Sierra Leone is determined include:

- The seasonality of incomes for households engaged in agricultural activities
- Prioritised expenditures- i.e. the probability that households would prefer to spend earnings on diarrhoea prevention, compared to school fees, medicines etc.
- The costs that need to be recovered by sales
- Coverage versus cost- the targeting of urban areas initially allows for a higher price to be set, before promotion increases demand

Place

To ensure the uptake of HWTS practices, products must be easily accessible to households, requiring capable networks of storage and distribution that are currently lacking in Sierra Leone. It is recommended that a liquid chlorine product, with a complementary safe storage container, is developed, branded and distributed to meet consumer needs, beginning with the major urban cities (Freetown, Bo, Makeni and Kenema) in the first year of the programme mainly through the commercial sector (e.g. pharmacies, local shops, etc.) and government infrastructure (e.g. clinics, hospitals and pharmacies). The major urban cities are a good point of entry for the 'mothership' programme, as it will provide a large market that is also relatively easy to reach. Households within urban areas are also more likely to have the disposable income available for the purchase of HWTS products. Once the programme is launched, beginning in the main urban cities, the product and messages will spread into rural areas and then behavior change communications can be extended into these areas.

Scaled-up distribution will be best achieved through a combined approach, including:

1. Government/community structures (e.g. Peripheral Health Units)
2. Existing NGO systems
3. Commercial sector

To overcome problems of product accessibility to rural areas, it is recommended to investigate the possibility of distributing drinking water treatment products through PHUs. Health facilities are well placed throughout the country, accessible even in rural areas and could therefore make up for the lack of rural supply chains. Furthermore, respondents value the opinions of health workers and visit them often. Interpersonal

communication and promotional activities can thus be supported through health facilities acting as a major distribution channel. Indeed, HWTS initiatives can be integrated with existing health care/hygiene programmes that go beyond diarrhoeal disease reduction. In the context of Sierra Leone, integration with maternal and child health may be an ideal opportunity to integrate HWTS with a wider nationwide policy.

Secondly, NGOs can be instrumental in the distribution of HWTS products. As outlined above, a two-tier approach emphasizing a 'mothership' national programme, alongside the mainstreaming of HWTS into existing programs is most suitable to ensure the scalability of the national programme. NGO's operating at the regional and community level have a great potential to provide supplemental support as implementers. NGOs already implementing or with plans to implement a HWTS project should be streamlined into the national Safe Water System programme.

NGOs can also be effective in distribution, as they have established working mechanisms/existing networks which can be used to supply areas with HWTS products. These existing networks can be used to help penetrate rural areas. However, care must be taken to ensure sustainability of distribution channels in the absence of donor support. NGOs must also be sensitised and convinced of the effectiveness of point of use chlorine, rather than well chlorination (a commonly promoted activity conducted by donors). Additionally, it is important that caution is taken with any NGO-provided free distribution of products so as not to disrupt the commercial viability of HWTS products.

The combined approach of using both government/community structures and NGO systems is common in the distribution of health products, and thus, the transition to HWTS products may be easily achieved. Meanwhile, an involvement with the commercial sector will promote the sustainability of distribution channels in the absence of donor support. The three-tiered system also has the potential to reach areas which are not served by commercial channels and is also less costly. The merits of using these distribution channels are summarised in the table below:

Table 43: HWTS Product Distribution Channels

Possible Distribution Methods	Project Cost	Demand Creation	Project Recognition	Effectiveness of Distribution	Accessibility of Products for Consumers	Potential for Sustainability
NGO	High	Moderate	Moderate	Dependent on NGO activity	Dependent on NGO activity: Potential to reach rural/poorer areas	Low
Community Structures-PHUs	High to moderate	High	High	Good	High	Moderate to high
Commercial Sector	High	High	High	Good	High, but may not reach rural/poorer areas	Moderate to high

*Adapted from CDC: "Safe Water Systems for the Developing World: A Handbook for Implementing Household-Based Water Treatment and Safe Storage Projects".

Nonetheless, the provision of stock to a retailer is not sufficient to ensure the widespread distribution of HWTS products to households across Sierra Leone. Assistance must also be provided to retailers, to ensure healthy product sales. For example, 'uplifting teams' (i.e. dedicated staff that transport stock from wholesalers to local outlets) help to ensure the supply of goods in areas that are difficult to reach/targeted

for sales. [38] "Free trials" could also be used, whereby outlets are provided with initial stock at no cost, which in turn can encourage the retailer to use money from initial sales of the product to purchase additional inventory.

The ability of PHUs and further retailers to manage inventories and funds should also be taken into consideration. Training may be beneficial in order to establish set roles, promote procedures to control money handling and demonstrate how the funds generated can be effectively used to distribute new supplies. Additionally, retailers must also be provided with assistance to ensure that products are promoted. Promotional materials (including branded sales flags, sales signs and product imagery) would help to draw the attention of potential purchasers to HWTS products.

Promotion

The lack of perceived need for water treatment will need to be addressed in order for households to be willing to make any HWTS related expenditure – this must be through a comprehensive messaging campaign. As survey findings revealed, a treatment culture does not exist within Sierra Leone. Comprehensive campaigns are therefore required to promote the desirability of water treatment products, which in turn can ensure behaviour change in households, resulting in the consistent treatment of drinking water. On the other hand, as survey findings revealed, the storage of water is commonly practiced throughout Sierra Leone. However, very few sampled households (4.3%) stored water *safely*. Therefore, promotional activities should focus on altering perceptions of the *treatment* of water, in conjunction with its *safe* storage.

As study findings revealed, the household head generally makes the majority of purchasing decisions for the home, however, primary caregivers are often involved within this process. Successful marketing therefore must appeal to both actors. Here, household heads should be targeted to promote the likelihood that the product is purchased, while primary caregivers must want to use the product in the household.

The timing of a product launch will also affect consumer demand. It is recommended that water treatment products are first introduced into markets just before the beginning of rainy season. During this period, awareness to the outbreak of cholera is high, and consumers are therefore responsive to initiatives to reduce the transmission of water borne diseases. However, messaging must differentiate between emergency response efforts and purchased goods for everyday use.

Channels

As radio is commonly used and widely trusted in Sierra Leone, jingles and discussions should be developed to promote HWTS messaging and products. Furthermore, interpersonal communication should also be promoted through health professional and facilities. For instance, motivational messaging could be carried out by community health workers conducting outreach or by health workers interacting with mothers of young children as part of the National Free Health Care for Mothers and Children under Five Initiative.

As mentioned above, demand will need to be created for HWTS products. To achieve this, a comprehensive social marketing campaign is required. This can encompass many stakeholders. For instance, existing community platforms (e.g. school hygiene clubs) could be used to help promote awareness of HWTS benefits. HWTS promotion within learning environments, such as schools, would also be a beneficial channel

[38] See USAID (2007). *"Best practices in social marketing safe water solution for household water treatment: Lessons learned from population services international field programs".*

in which information could be disseminated to the household. Additionally, the involvement of local leaders, relevant ministry officials and high profile community members (respected spokespersons) could help to promote the uptake of water treatment practices throughout the country and act as profiled users of water treatment products, leveraging the inspirational motivations of consumers. Partnerships with established NGOs should also be encouraged to assist with message dissemination along with product distribution.

In the first year, promotional blitzes should be prioritised in urban centres such as Freetown, Makeni, Bo and Kenema. Messages can then be disseminated to rural areas through NGOs and PHUs as HWTS is mainstreamed into ongoing WASH and health-related programmes. It will also be important to ensure that educational and promotional materials are available at the point of sale. This may include posters, face-to-face communication and promotional videos/music.

Messages

Messaging used to encourage the need for the treatment of drinking water and safe storage must be positive, in order to be effective in promotion. Promotional material should be presented in both picture and word format, to accommodate the high levels of illiteracy experienced throughout Sierra Leone. Promotional messaging must encompass a number of considerations:

- The wording of messages, accommodating local languages and terms
- Current knowledge about diarrhoea
- Address the motivations and barriers related to the uptake of HWTS
- Messaging must be easy to understand and remember, encourage use and be specific to the cause, while maintaining sensitivity to cultural beliefs

Table 44: Promotional Messaging Methods*

Logo	**Flyers**
• Simple • Explicit: immediately understandable • Positive, uplifting: conveys the idea of results • Easily reproducible • Works in different sizes and settings • Dramatises the overall tone of the behavior change strategy	• Carries the information most likely to be forgotten • Uses visuals to tell the story, not just words • Shows people performing key behaviours • Concise • Designed for easy use as a visual aid
Poster	**Radio**
• Dramatises a single idea • Attracts attention from at least ten meters away • Uses visuals to carry the message • Memorable • Shows how the product benefits people	• Presents one idea • Begins with an attention getter • Direct and explicit • Repeats the key idea at least two or three times • Asks listeners to take action • Makes the audience feel part of the situation

*Adapted from CDC: "Safe Water Systems for the Developing World: A Handbook for Implementing Household-Based Water Treatment and Safe Storage Projects".

More specifically, sensitisation campaigns must address reported misperceptions that water is already treated and safe to drink (and thus, treatment is unnecessary). Any behaviour change campaign will need to address this – and use messages such as *"Trust your water is safe; treat your own at home!"* Increased awareness of actual water quality may in turn stimulate the demand for a treatment product.

The sporadic treatment of household drinking water in reaction to the fear of diseases at high-risk times, should be leveraged into sustained water treatment practices by promoting messages such as *"Your water must be safe at all times – not just in times at risk for cholera – use liquid chlorine every day."*

While respondents commonly reported health related motivations for treating water, caution should be taken in developing promotional messages centred solely on these findings as perceived health benefits are not always grounded in knowledge of waterborne disease transmission, but can be based on traditionally based beliefs – for instance, on the definition of 'safe water' being related to the physical properties of water (i.e. smell, taste and colour). Promotional messaging must be focused on altering the population's perceptions of safe water to a definition of safety that encompasses other elements such as free of invisible contaminants, which can be damaging to health. For example: *"Remove dangerous invisible germs for good health with the Safe Water System!"*

Messages to consumers of packaged water should promote the cost-effectiveness of liquid chlorine over packaged water. Messages should be developed around a theme of: *"it is cheaper to treat water yourself."* As the majority of reported purchases of packaged water occur in urban areas, this specific promotion should be concentrated within these areas.

Table 45: Possible Promotional Messages*

Health related messaging:	"Your water must be safe at all times – not just in times at risk for cholera – use liquid chlorine everyday"
	"Remove dangerous invisible germs for good health with the Safe Water System!"
	"Trust your water is safe; treat your own at home!"
Aspirational messaging:	"For healthier, beautiful children, use the Safe Water System"
	"Smart mothers use the Safe Water System"
	"Be the first in your neighbourhood to use the Safe Water System!"
Messaging about correct product usage:	"Clean your safe storage container weekly with soap to your drinking water pure"
	"Do not put or let anyone put hands or other utensils into water"
	"Add appropriate amount of disinfectant to each container of water"

*Adapted from CDC: "Safe Water Systems for the Developing World: A Handbook for Implementing Household-Based Water Treatment and Safe Storage Projects".

While the necessity of water treatment must be prioritised in promotional campaigns, messaging on water treatment products must be accompanied with campaigns for the safe storage of water. Recommended water storage containers distributed across the country should be promoted with accompanying messages about safe water handling, for instance, an info graphic depicting dipping with an instrument, rather than hands. Such messaging should also inform users of the necessity to regularly clean storage containers.

Furthermore, behavior change communications must also focus on topics of regular handwashing, improved sanitation and improved hygiene – all of which are crucial to ensuring the sustainability of the SWS.

Policy

Achieving tangible results in the scaling-up of household water treatment and safe storage depends, in large part, on national enabling environment and policies and strategies. As part of its commitment to integrate HWTS into national policies it is important that the MoHS is supported in its achievement of the following milestones:

- MoHS should make it a priority to have the draft National Action Plan for HWTS finalized and approved.
- As part of its commitment to integrate HWTS into national policies it is important that the MoHS pursues the achievement of the milestones established at the regional policy workshop in Ghana. Efforts should be made to adhere to the following key milestones: Development of WASH National Indicators harmonised to include HWTS-specific indicators; HWTS indicators and action plan incorporated into the Multi-Sectoral Multi-Year Emergency Preparedness Plan; HWTS action plan harmonised with Water Safety Plan; Environmental Health Policy and Public Health Ordinance revision to include HWTS indicators and action plan.
- Increase the profile of HWTS within the relevant ministries to enhance full governmental support at all levels, and secure necessary funding.
- MoHS should establish an inter-ministerial group including, but not limited to: MoWR, Ministry of Trade and Industry (Standards Bureau), Ministry of Internal Affairs, Local Government and Rural Development (MLGRD) and build institutional capacity to ensure the overall coordination of HWTS activities and highlight the cost-effective means of delivering the health gains associated with safe water in furtherance of national priorities and the MDGs.
- Establish a coordinating committee representing MoHS, other line ministries, UN agencies, private sector, NGOs, other HWTS programme implementers and encourage pursuit of synergistic opportunities with other interventions (for example, the prevention and care of HIV/AIDS, immunisations, scaling up of maternal and neonatal health care and malaria control).
- MoHS to collaborate with the Standards Bureau to develop a certification and product labelling system so that consumers can understand and trust the performance of current/new HWTS products.
- Establish the policy support for developing IEC /BCC materials on HWTS technology options and delivery models, launching pilot projects, monitoring and assessing results and scaling up successful initiatives.
- Explore the potential for reducing the tariffs, taxes and other costs on both local and imported HWTS products in order to encourage the entry of appropriate technologies not currently present in Sierra Leone and to improve their affordability by the target population.
- Develop a comprehensive, professional training in HWTS technologies, selection criteria and strategies for optimising uptake and use to MoHS, MoWR, MLGRD staff and support for them to train district, local officials.
- MoHS should increase the profile of HWTS as a cost-effective intervention among public leaders, health personnel, and other change agents; use schools, hospitals, PHUs, religious institutions to promote awareness of HWTS.
- Explore creative supply channels and distribution systems to ensure that effective HWTS options reach rural communities and vulnerable populations (such as through government pharmacies and PHUs).

7.3. Key Roles and Responsibilities

The scaling up of a HWTS programme in Sierra Leone will require input from a range of key stakeholders. Partnerships between government ministries, NGOs, donors, private sector retailers/manufacturers and community organisations are imperative to ensure the success of any HWTS programme in Sierra Leone. In

this, clearly defined roles and responsibilities of each stakeholder group must be established to scale up HWTS.

As part of the recommended two-tier approach to implementing the national HWTS programme, the overall 'mothership' programme would be promoted by the GoSL, through the MoHS who would be responsible for implementing national level activities, such as HWTS product approval and certification (with the Standard's Bureau), behaviour change communication strategies, mass media campaigns, training and technical assistance and monitoring and evaluation. According to the proposed approach, the roll-out at community level would potentially be undertaken (and partially funded) by development partners and NGOs.

Suggested roles and responsibilities have been outlined in Table 46 below (note: the illustrative list is not exhaustive).

Table 46: Stakeholder's Key Roles in the Rolling out of a HWTS Programme

Key Stakeholders	Key Roles	Illustrative List of Key Actors
Government *Create an enabling environment for introduction and scaling up HWTS as detailed in HWTS programme implementation plan and national action plan. Key responsibilities include stakeholder coordination and policy/guidance formation.*	• Create an enabling environment for a HWTS pilot to be rolled out; encompassing domestic policy creation, regulation of involved stakeholders and explore the potential for reducing the tariffs, taxes and other costs on both local and imported HWTS products. • Regulate the quality control of products (i.e. standards are in place to ensure that products are safe for human consumption). • Support the development and dissemination of behavior change communication and mass media campaigns. • Conduct timely monitoring and evaluation of programme activities. • Establish a coordinating committee with HWTS programme implementers to encourage partnerships and coordination of HWTS activities. • Provide training and capacity building to programme partners on HWTS. • Support PHUs in the distribution of HWTS products.	• Ministry of Health and Sanitation • District Health Management Teams • Ministry of Water Resources • Standards Bureau • Ministry of Finance • Central Medical Stores • District-level authorities.
NGOs *Programme implementation: Advocacy and awareness, capacity building and service delivery.*	• Mainstream HWTS into their ongoing WASH programs. • Build demand for HWTS products through sensitisation programmes and by leveraging existing relationships with communities. • Help in the distribution of HWTS products either through existing distribution schemes or HWTS projects. • Assist with message dissemination/product promotion. • Help to build linkages between stakeholders- i.e. public and private sectors. • Complementing and expanding the reach of the commercial sector.	• Oxfam • ACF • Inter Aide • Urban WASH Consortium • DIP • CORD • Safer Future

Community Health Promoters *Raise awareness and educate households about the need for safe water and HWTS solutions.*	• Create demand for HWTS products. • Serve as primary information source on HWTS at the community level. • Potential to be incorporated into the distribution channel.	• Community health workers • PHU staff • Blue Flag Volunteers • Community mobilizers
Private Sector *Provision of HWTS products and services: Product innovation and manufacturing, marketing and supply chain management.*	• Supply the market with affordable and quality HWTS products- i.e. liquid chlorine and safe storage containers. • Contribute to the building of an effective supply chain reaching both urban and rural areas of Sierra Leone. • Advertise products.	• Local firms (e.g. Meta Engineering Services, Hudroge Enterprises, G.Shankerdas & Sons Ltd. and Milla Group Ltd.) • Larger international firms (e.g.: MANCO)
International Organisations *Financial support and technical guidance on best practices and product performance standards.*	• Assist with policy development. • Influence and co-ordinate stakeholders. • Mobilise funds. • Contribute to service delivery, capacity-building and advocacy.	• WHO • UNICEF • US Centers for Disease Control and Prevention
Academia/Consultants *Generating evidence to inform decision making.*	• Conduct independent, rigorous research, monitoring and evaluation of the National HWTS Programme. • Provide training and capacity building for programme staff and stakeholders.	• Local and international consultants • Njala University • Fourah Bay College
Donors *Funding, guidance, and local capacity development.*	• Provide financial support, guidance on programme implementation, and local capacity development.	• USAID • DfID • World Bank Group • CDC • African Development Bank • Rotary Foundation

7.4. The Way Forward

Building on the findings presented in this report, two key documents have been produced to support the development and implementation of the recommended strategies. First, a HWTS 'Programme Implementation Plan' (PIP) has been prepared for use by the Government of Sierra Leone Ministry of Health and Sanitation, and other relevant national programme managers technical staff and organizations that would be involved in implementing a HWTS programme in Sierra Leone. The PIP is designed to take readers through the necessary steps to plan and implement a national HWTS programme in Sierra Leone. This document is available from the Ministry of Health and Sanitation. Second, a set of defined recommendations have been developed to support the drafting of the National Action Plan for HWTS for use by policy makers at the Ministry of Health and Sanitation.

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