



*A Study of Water Access and  
Health Issues in Sierra Leone's  
Bombali, Kambia, and Koinadugu  
Districts*

This report is a part a broader project which is focused on providing improved water access at the community level across three Sierra Leonean districts. The overall project is being financed by the Department of International Development (DFID), United Kingdom.

The contents of this report are the sole responsibility of ENFO and can in no way be taken to reflect the views DFID.

This report provides an analysis of the research conducted in the Kambia, Bombali, and Koinadugu Districts during June and July 2012

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# ACRONYMS AND ABBREVIATIONS

BADEA	Arab Bank for Economic Development in Africa
ENFO	Energy For Opportunity
DHMT	District Health Management Team
DFID	[United Kingdom's] Department for International Development
JICA	Japan International Cooperation Agency
MEWR	Ministry of Energy and Water Resources
MOHS	Ministry of Health and Sanitation
NGO	Non-Government Organisation
RWSSB	Rokupr Water Supply Facility
SALWACO	Sierra Leone Water Company
STEWARD	Sustainable and Thriving Environments for West Africa Regional Development
UNICEF	United Nations Children's Fund
WASH	Water Sanitation and Hygiene

# 1

## Introduction

This report presents the data and analysis from a research project conducted by Energy For Opportunity (ENFO) on water access and utilisation within 18 communities across Sierra Leone’s Kambia, Koinadugu, and Bombali Districts (see Table 1). The study is part of ENFO’s broader project: “Solar Powered Water Purification,” and Sierra Leone’s Water Sanitation and Hygiene (WASH) programme.. The research for this report involved the collection of data on typical water sources, water collection methods, water transportation, water storage, water distribution methods, the prevalence of water borne diseases, and any current or recent initiative to improve water access in the surveyed communities. The collected data has subsequently been analysed and presented in this report with three main objectives in mind: first, to assist in the selection of the nine initial target communities that will receive solar powered water purification systems; second, to help inform how the solar power water purification systems will be implemented in each community; and third, to provide baseline data which can be used to measure the impact of the project over time.

Town	Chiefdom	District	Pop (approx.)	HQ	DC
Kambia	Magbema	Kambia	13,000	Y	Y
Rokupr	Magbema	Kambia	11,000		
Kassirie	Samu	Kambia	5,500		
Mambolo	Mambolo	Kambia	5,500	Y	
Tawuya	Gbinle Dixing	Kambia	3,500	Y	
Madina	Tonko Limba	Kambia	3,500	Y	
Kamabai	Biriwa	Bombali	4,000	Y	
Kamakwie	Sella Limba	Bombali	17,500	Y	
Gbendembu	Gbendembu Ngowahun	Bombali	5,000		
Fintonia	Tambakha	Bombali	4,600	Y	
Kabala	Sengbe	Koinadugu	16,000	Y	Y
Fadugu	Kasunko	Koinadugu	5,600	Y	
Sinkunia	Dembelia Sinkunia	Koinadugu	2,700	Y	
Musaia	Folasaba Dembelia	Koinadugu	2,300	Y	
Bafodia	Wara-Wara Bafodia	Koinadugu	5,800	Y	
Yiffin	Nieni	Koinadugu	8,400	Y	
Bendugu	Mongo	Koinadugu	3,458	Y	
Falaba	Sulima	Koinadugu	4,300	Y	
HQ = Chiefdom headquarter town; DC = District Capital Town					

Figure 1 - Summary of Towns Surveyed

Sourcing decent health statistics and data in Sierra Leone is a major challenge. Sierra Leone, like many other West African countries, does not yet have the technical infrastructure, local research

capacity, or even a culture of accurate account keeping, which are needed to produce reliable health statistics.<sup>1</sup> In rural areas, where this research project is focused, the problem is even more acute. As Okonjo-Iweala and Osafo-Kwaako note, “The absence of [health] statistics in many African countries is both a symptom and a cause of underdevelopment.”<sup>2</sup> For this project, the only source of rigorously collected water-borne disease data was provided by the Kamakwie Wesleyan Hospital in the north of Bombali District. For the other areas surveyed (at the District, Chiefdom, or Village level) there were no rigorously recorded official health statistics,<sup>3</sup> while more general information about water and health issues in the area was in a piecemeal and incomplete fashion. This meant that this project had to initiate a ‘bring your own data’ approach to inform and measure its intervention and subsequently a research methodology was designed.

Three specific research methods were used in this project: interviews, household surveys, and participant observation. Interviews were conducted with health clinic staff, hospital workers, district water supply engineers, district health officers, and water shop owners; each interview was specifically designed for its context, however, the overall objective of each interview was to extract any relevant information in relation to water supply and water-borne disease related health issues at each of the targeted villages. Household surveys were conducted at each of the 18 targeted villages, with sample sizes large enough to produce data with a 5% margin of error at a 95% confidence level; questions in the surveys related to household issues in regards to health, water sourcing, and water consumption. Participant observation was conducted in regards to water collection points and consumption utensils, with extensive photographs taken to provide a qualitative picture of the waterscape in these different communities. Finally, a review of existing relevant literature on water and health issues in the three districts was conducted, to provide a broader context in which to situate the analysed data.

One of the greatest challenges of the exercise was to source quality data on village level water-borne rates; such data being needed to inform which villages should be prioritised for improved water facilities, as well as to help measure any long-term impacts of the project. Given the country’s dearth of health statistics, this project adopted a triangulation approach to securing such data in a relatively rigorous manner. Every village surveyed contained a health clinic (serving both the village and surrounding smaller hamlets), or in the case of the larger centres (i.e., Kambia, Kabala, and Kamakwie), hospitals that served large catchment areas. At each of these health facilities, as the formal recording of patient ailments generally did not exist, staff were asked to provide general estimates on the percentage of patients admitted due to illnesses related to water-borne diseases. To complement this, for the household surveys, one of the questions asked was in relation to the monthly frequency of stomach illness (e.g., diarrhoea) in each household. Results produced from these two data collection methods correlated significantly (i.e., the towns whose health clinics reported a high incidence of water-borne disease related infections, also generally had its households reporting high levels of stomach illness), suggesting that, although the data might not be

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<sup>1</sup> C. J. L. Murray, ‘Towards good practice for health statistics: lessons from the Millennium Development Goal health indicators’ *The Lancet*, 369 (2007): 862-87.

<sup>2</sup> N. Okonjo-Iweala and P. Osafo-Kwaako, ‘Improving health statistics in Africa,’ *The Lancet*, 370 (2007): 1527.

<sup>3</sup> When official statistics do exist there is also a great risk that they have been just fabricated. This is something that ENFO discovered in a recent study on forestry in Sierra Leone; see P G Munro and G van der Horst, *The Domestic Trade in Timber and Fuelwood Products in Sierra Leone: current dynamics and issues* (EFO/FAO/EU 2012; in particular Chapter 3.

exact in terms of its numerical value, it is at least reflective in relative terms of how serious water-borne diseases are in each of the communities.

In terms of measuring the long-term impacts of the project there are a number of data that can be used. Evidently the water-borne disease data will be important, with the objective of witnessing a relatively reduction in the current rates recorded. Nevertheless, it would be beneficial to the project if a more rigorous patient data collection system was implemented at each of the health clinics. A second, complementary, area for measuring impacts would be to calculate the population percentage in each town that is accessing purified water as a result of the project. The data from the surveys has helped to produce calculation for overall litres water of drunk on a daily basis in each of the targeted villages. This data, in conjunction with measurements of daily water kiosk sales at each of the towns, will provide a percentage value in regards to the size of the population in each town sourcing purified water from the kiosk. A final important piece of data at the household level, is the data on water collection times, which one would hope to see reduced as a result of the project intervention; although overall this is likely to be a relatively modest reduction, as this project specifically targets 'drinking water,' which on average makes up only around 10% of a household's overall water consumption.

The rest of this report provides an analysis of the data on a district-by-district basis, followed by an overall conclusion. Each district section provides a general district background, district level water supply information and analysis of water issues at each of the targeted villages. The final chapter provides an overall summary of the results.

# 2

## Kambia District

**K**ambia District is located within the Northern Province of Sierra Leone. Its capital, and largest city, is also called Kambia. As of 2010, the district had an approximate population of around 313,765. It borders the Republic of Guinea to the north, Port Loko District to the south, and Bombali District to the east; and acts as an important trade route between Freetown and Conakry. The district occupies a total area of 3,108 km<sup>2</sup> and is divided into seven Chiefdoms: Bramaia, Gbinle Dixing, Magbema, Mambolo, Masungbola, Samu and Tonko-Limba.

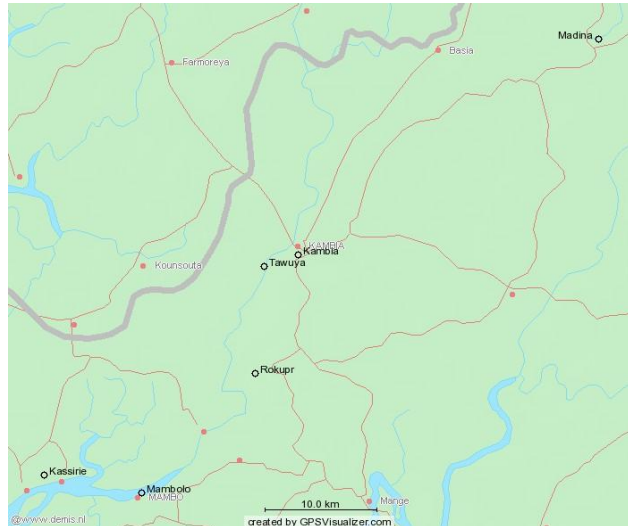


Figure 2 - Map of Towns surveyed in Kambia

Six towns in the Kambia District were surveyed as a part of this project (see Figure 2). This included Kambia, the district capital, which is also the headquarter town for the Magbema Chiefdom; Madina, Tawuya, and Mambolo, which are the headquarter towns for the Tonko Limba, Gbinle Dixing, and Mambolo Chiefdoms respectively; and finally Kassirie and Rokupr, which although they are not chiefdom headquarter towns, they are still nevertheless important urban centres in the district. All of the towns have community health centres, which serve broad catchment areas.

The supply of accessible and potable water in the Kambia District is a major issue. The water-borne diseases of dysentery and typhoid are common in the district; however, the disease that has caused the greatest amount of concern in recent times has been cholera.<sup>4</sup> Kambia in particular has been noted as being one of the most cholera affected districts in Sierra Leone; this is namely due to its vast coastline, which is prone to flooding, causing the contamination of water sources.<sup>5</sup> Cholera outbreaks are most common towards the end of the country's dry season (March to May), when water supply is scarce, and residents are forced to source drinking water from nearby streams, instead of the safer source points of public taps and wells. The most recent cholera outbreak in the Kambia District was in March 2012, with 490 reported cases and 17 fatalities across 18

<sup>4</sup> Personal Communication with Francis Kamara, Kambia District Rural Water Services Supervisor. July 2012

<sup>5</sup> IFRC 'Disaster relief emergency fund (DREF) Sierra Leone: Cholera Outbreak', IFRC Newsletter, 20 March, 2012



communities.<sup>6</sup> The Samu Chiefdom, along with some parts of the Mambolo Chiefdom, was the worst affected area; although cases were also reported in the Magbema and Gbinle Dixing Chiefdoms.<sup>7</sup> Overall, reliable statistics on health are hard to come by in Kambia, nevertheless estimates by professional health staff are that usually between 20% and 40% of cases at their health clinics are related to infections from water borne diseases;<sup>8</sup> the figure generally being highest at the end of the dry season when water sources are scarce.

The main sources of water for the people in the district are local wells, hand pumps, public taps, and streams. During the dry season, hand pumps, public taps, and wells often lose their supply of water and as a result people have to depend mainly on streams and unprotected local wells for water.<sup>9</sup> In all of the surveyed towns, households generally collected water from source points (e.g., wells, taps, pumps, streams, etc.) by using five gallon [22.7 litre] plastic containers (see Figure 6); however some households also occasionally used plastic buckets, notably in Tawuya. In all of the households water was drunk from a designated plastic 'country cup,' which was usually 0.5, 1, or 2 litres in size (see Figures 3 to 6).

There is some commercialisation of drinking water in the district, mainly in the larger urban centres of Kambia Town, Rokupr, and Mambolo, with people buying packets of water or, as is the case of Rokupr, paying to source water from public taps. For the most part, however, it is only a minority of the population in these towns that actually purchases this safe drinking water. The Kambia District Water Coordinator also noted that patients who are ill from water borne diseases at hospitals will often buy the packet (purified) water during their stay, however, when they leave the hospital they generally return to drinking untreated water.<sup>10</sup>



**Figure 3 - Two Litre Drinking Cup – Kassirie**



**Figure 4 - One Litre Drinking Cup – Tawuya**

<sup>6</sup> *Ibid.*

<sup>7</sup> Personal Communication with Francis Kamara, Kambia District Rural Water Services Supervisor. July 2012

<sup>8</sup> Personal Communication, Kambia District Medical Officer, June 2012; Personal Communication Richard Kargbo, Chief Health Officer, Tonko Wesleyan Health Centre, Madina. July 2012

<sup>9</sup> Personal Communication, Chief Health Officer, Tawuya Community Health Centre, July 2012.

<sup>10</sup> Personal Communication, Kambia District Water Coordinator, June 2012.



**Figure 5 - 0.5 and 1 litre drinking cup with water container- Kambia**



**Figure 6 - Five gallon container with drinking cup – Tawuya**

There have been a number of initiatives in recent times to improve water access and management in the district. Non-Government Organisations (NGOs), such as Africa for Jesus and Action Aid,<sup>11</sup> have been involved in digging wells, chlorinating water supplies, and installing hand pumps in communities across the district.<sup>12</sup> At the government level, the district council has been involved in installing hand pumps in all seven chiefdoms through a project funded by the World Bank, it is also currently involved in installing piped water systems in Mambolo and Madina. While the Ministry of Energy and Water Resources (MEWR), in collaboration with UNICEF, currently has a project underway to identify and map all water points or sources in the district.<sup>13</sup> The largest water supply initiatives in the district, however, are being implemented by the Japan International Cooperation Agency (JICA).



**Figure 7 - An unprotected well in Kasserri**



**Figure 8 - A water pump in Tawuya**

<sup>11</sup> Piers Cross, Alastair Morrison, Jane Fulton, Andrew Hudson, *Country Sector Assessments, UNDP GoAL WaSH Programme: Governance, Advocacy and Leadership for Water, Sanitation and Hygiene. Volume 1 – Sierra Leone* (UNDP New York 2009)

<sup>12</sup> Kambia District Wash Meeting – 25 June 2012.

<sup>13</sup> Personal Communication with Francis Kamara, Supervisor, Kambia District Rural Water Services, July 2012.



**Figure 9 - Transporting water from a stream during the dry season – Madina**



**Figure 10 - Collecting water from the stream - Madina Stream**

JICA was first involved in improving the district’s water supply during the 1980s, when it built a piped water supply system in the town of Rokupr. This system, however, was heavily damaged during the war and subsequently ceased to function. JICA returned to Rokupr in 2006, and spent three years rebuilding the water supply system, using a “slow sand filtration system” for the purification of the water. After completing this project in 2009, JICA conducted a survey of 37 existing water supply facilities in rural towns and examined the feasibility for disseminating the Rokupr system to other towns. Based on the survey, MEWR recommended Kambia, the district capital, as the most urgent site in need of improved water supplies, and since 2010 JICA has been installing a water supply system the district capital. The project is expected to be completed by 2016.<sup>14</sup>

These initiatives by JICA unfortunately have come up against some significant implementation hurdles. The most major issue is related to the costs and technical knowledge needed to ensure the continual maintenance of the water systems after the project cycle.<sup>15</sup> Even the project leader of the Rokupr installation, Kazumi Matsuda, noted the major limitations of a sand filtration water purification system is that it requires technical personnel for maintenance and constant input of treatment chemicals.<sup>16</sup> Thus, there is a need for a steady source of income to fund its continual operation. JICA, along with the local district Government, have attempted to instigate fee collection systems for water use to cover the costs of on-going operations.<sup>17</sup> And despite reported wide-spread community support for the idea of paying for clean water,<sup>18</sup> the non-payment of the fees has been an on-going issue for the project.<sup>19</sup>

<sup>14</sup> ‘Water Supply Management for Rural Towns’ *JICA Newsletter* 1 (2010): 1-2

<sup>15</sup> JICA, Project for Establishment of Water Supply Management System in Kambia District’ *Activities in Sierra Leone*, <http://www.jica.go.jp/ghana/english/activities/activity10.html>

<sup>16</sup> JICA, *Sierra Leone: working with JICA*, video documentary 2008

<sup>17</sup> JICA, Project for Establishment of Water Supply Management System in Kambia District’

<sup>18</sup> JICA, *Sierra Leone: working with JICA*, video documentary 2008

<sup>19</sup> Wash meeting – 25 July 2012



**Figure 11 - Rokupr Water Works**



**Figure 12 - Water supply swamp for the Rokupr Water Works**

The completed water works system at Rokupr exemplifies the problem of JICA's approach. The overall objective of the project was to provide "reliable and sustainable water services to about 14,000 residents of Rokupr."<sup>20</sup> Only three years after its completion, however, the project has run into numerous difficulties. As a part of the project, the monthly water bill was supposed to be Le 20,000 for a household connection; and Le 5,000 per household for public tap access; yet by end of December 2008, only around 50% of households were paying this bill.<sup>21</sup> By 2012, the formal bill collection system had completely ceased to function, and staff from the of Rokupr Water Supply Facility (RWSSB) have since resorted to only opening the standing taps once a week, collecting fees – 200 Leones per five gallon container – *in situ* at the taps.<sup>22</sup> Furthermore, the financial sustainability of the system has not yet been achieved, as the materials for the ongoing operation of the water works system are currently being supplied by an NGO, rather than being purchased by RWSSB as originally planned. Finally, the project has encountered technical problems, as the water source area for the system, a nearby swamp, is no longer deep enough to provide enough water and therefore new strategies (and costs) are needed ensure to continual functioning of the water works.<sup>23</sup>

It is not clear if JICA has addressed these major issues for its subsequent installation in Kambia (which is supposed to be based on the same model as Rokupr). It could potentially have greater success though; as Kambia is a larger and more prominent urban centre, meaning that it should be more straightforward to source technical expertise and implement more sophisticated fee collection systems. Nevertheless, given the major issues that have been reported with the project Rokupr, the efficacy of such an approach to providing improved water for the district can certainly be questioned.

<sup>20</sup> 'Water Supply Management for Rural Towns' *JICA Newsletter* 1 (2010): 1-2

<sup>21</sup> JICA, *The Project for Establishment of Water Supply Management System in Kambia District Republic of Sierra Leone*, 2009

<sup>22</sup> Personal Communication, Deputy Chief Health Officer, Rokupr, July 2012.

<sup>23</sup> Personal Communication with Rokupr water works staff, July 2012.

## Town Profiles

### Kambia

**Population:** 13,000

**Chiefdom:** Sengbe

**Survey Sample Size:** 525

**Margin of Error:** 4.19%

**Hospital Catchment:** 22,152

Item	Unit	#	
Stomach Sickness in household	Per month	1.0	
Hospital Visits per household	Per month	1.8	
Health cases with water borne related illness	%	20 - 30	
Water Consumption (Drinking)	Individual Average per day	Litres	4.32
	Town Total per day	Litres	56,160
Water Consumption (Total)	Per Day	Litres	39
	Town per day	Litres	507,000
Water Collection	Amount per day	Litres	591
	Time per day	Hours	2.1

Figure 13 - Survey data results for Kambia

The urban centre of Kambia previously had a functioning piped water supply system, however, during the country's recent civil war (1991-2001) the system was destroyed, leaving the town with poor systems of water supply. This has been a concern as Kambia, along with the surrounding chiefdom of Magbema, has regularly suffered from cholera outbreaks;<sup>24</sup> the most recent one occurring in March 2012.<sup>25</sup> As noted above, in response to this situation, JICA is in the process of rehabilitating and expanding Kambia's old water supply system.<sup>26</sup> The project, titled "Establishment of Rural Water Supply System in Kambia Town" plans to supply piped water to Kambia's existing town ('Old Town') and newly developed area ('New town'); and is expected to be completed by 2016.<sup>27</sup>

In terms of health, the frequency of stomach sickness and water-borne diseases Kambia has one of the lowest levels out of the household's surveyed in the district; however there is a spike in water-borne disease infections at the end of the dry season. The average amount of time that each household spends collecting water per day (2.4 hours) is one of the longest in the district; although after the completion of the JICA project water collection times should be reduced. Interestingly, Kambia was the only town surveyed where men (in 12.5% of households) were also occasionally involved in collecting water; in all of the other villages surveyed it was specifically a chore for women and children.<sup>28</sup> Most households sourced their water from wells or public taps; however a minority sourced their water from private taps and other sources. During the end of the dry season there is a scarcity of water in the urban centre and all households need to travel to nearby streams for the collection of water; this is the same time period that cholera outbreaks are common in Kambia.

Kambia is one of the few towns surveyed in the district where there are commercial sales of purified water; both by the bundle (containing 20, '500ml' sachets of water) and by the bottle. There are two shops selling this water, and the owners noted that their main customers are passengers travelling between Freetown and Guinea, and local offices; during the survey some households also reported

<sup>24</sup> Personal Communication with Francis Kamara, Kambia District Rural Water Services Supervisor. July 2012

<sup>25</sup> A. R. Bedor 'Cholera Outbreak Hits Kambia' *Sierra Leone Media Express*, 19 June 2012

<sup>26</sup> Awoko, JICA to supply Kambia water soon', 5 February 2008 Oswald Hanciles, Sierra Leone: In Kambia, Koloto Says - 'Petito Is Most Humane' *Concords Time*, 7 June 2012 Awoko, 'Japanese conclude survey on Kambia Water supply project, 30 April 2008 Awoko, 'For Kambia Water project...Energy Minister signs MOU with Japan' 5 May 2010.

<sup>27</sup> JICA "Preparatory Survey on the Project for the Establishment of Rural Water Supply System in Kambia Town in the Republic of Sierra Leone" Summary of Preparatory Study; Water Supply Management for Rural Towns' *JICA Newsletter* 1 (2010): 1-2

<sup>28</sup> Indeed, the gendered division of water collection is common across all of Sierra Leone: J. Thompson (2011): 'Picturing gendered water spaces: A textual approach to water in rural Sierra Leone,' *Agenda*, 25 (2011): 43-53.

that they did occasionally purchase these packets of water. A bundle of water, which is supposed to contain ten litres of water (although independent testing indicates the amount is usually closer to 8.5 litres), is sold for Le 5,000, while a one litre bottle of water is sold for Le 1,000. The shop owners reported selling around six bundles and five bottles of water per day.

## Rokupr

**Population:** 11,000

**Chiefdom:** Magbema

**Survey Sample Size:** 560

**Margin of Error:** 4.03%

**Health Clinic Catchment:** 13,430

Item	Unit	#	
Stomach sickness in household	Per month	1.5	
Hospital visits per household	Per month	1.7	
Health cases with water borne related illness	%	40.0	
Water Consumption (Drinking)	Individual average per day	Litres	3.1
	Town total per day	Litres	34,100
Water Consumption (Total)	Per day	Litres	57
	Town per day	Litres	630,300
Water Collection	Amount per day	Litres	177
	Time per day	Hours	2.5

Figure 14 - Survey data results for Rokupr

Rokupr was an important centre for agricultural research during the colonial era, and the Rokupr Agricultural Research Station, which was set up in 1934, has recently been re-opened by the Sierra Leonean Government.<sup>29</sup> The town previously had a functioning piped water supply system installed by JICA in the late 1980s. This system, however, like the one in Kambia was damaged during the country's civil war. JICA returned to Rokupr in 2006 and rebuilt the water supply system and a local governance body to manage it.<sup>30</sup> The installation has encountered numerous problems, and public water taps are generally only opened one day a week.

Access to clean water is certainly still a major concern in Rokupr, and, with the exception of Kassirie and Mambolo, Rokupr had the highest recorded stomach sickness per household; and, health cases related to water-borne disease.<sup>31</sup> Rokupr was also one of the sites affected by the Kambia District's recent cholera outbreak.<sup>32</sup> This is in spite of the installation of an improved water supply system three years ago. Thus there appears to still be great problems with water delivery in the community with households spending on average 2.5 hours a day collecting water; the highest amount of time out all of the villages surveyed in the Kambia District. This is likely a result of the RWSSB only opening the public taps once a week, which causes large queues for water collection as well as forcing people to travel further afield to source their water. This is evident from the data collected, where all households stated that they needed to source water from public wells in addition to the RWSSB controlled water tap. Like all of the other towns surveyed, during the end of the dry season there is a scarcity of water and households either have to travel to the wells early in the morning or to nearby streams for the collection of water. There are some positives with the JICA installation, when the tap is open all households reported that they sourced water from it, paying the fee of Le 200 per five gallons [22.7 litres] of water. This suggests that the commercial selling of water in the community is certainly feasible if suitable fee collection mechanisms are put in place.

<sup>29</sup> Essa Thaim Kurugba 'The Forgotten Rokupr Agricultural Research Station: Which way forward?' *Awareness Times* May 4 2009

<sup>30</sup>; 'Water Supply Management for Rural Towns' *JICA Newsletter* 1 (2010): 1-2; JICA, *The Project for Establishment of Water Supply Management System in Kambia District Republic of Sierra Leone*, 2009

<sup>31</sup> Personal Communication Deputy Chief Health Officer, Rokupr Health Clinic, July 2012.

<sup>32</sup> Personal Communication with Francis Kamara, Kambia District Rural Water Services Supervisor. July 2012

## Kassirie

**Population:** 5,500  
**Chiefdom:** Samu  
**Survey Sample Size:** 514  
**Margin of Error:** 4.12%  
**Health Clinic Catchment:** 6,847

Item	Unit	#	
Stomach sickness in household	Per month	1.6	
Hospital visits per household	Per month	1.5	
Health cases with water borne related illness	%	50.0	
Water Consumption (Drinking)	Average per day	Litres	3.8
	Town total per day	Litres	20,900
Water Consumption (Total)	Per day	Litres	45.9
	Town per day	Litres	252,450
Water Collection	Amount per day	Litres	591
	Time per day	Hours	2.1

Figure 15 - Survey data results for Kassirie

Kassirie is a major town situated on the Great Scaries River, and is an important port for trade along the river and coast. The town has never had a previous piped water system installed, however in recent years an NGO called Africa For Jesus has been present in the community digging wells.<sup>33</sup> Water is scarce in the surrounding area, and nearby communities will often travel by boat to Kassirie in search of drinking water.<sup>34</sup>

Kassirie appears to be one of the towns most affected by water-borne diseases. Staff at the local health centre estimate that 50% of their patients are brought in due to water borne disease related issues;<sup>35</sup> this was the equal highest percentage of all of towns visited; while its stomach sickness rate of 1.5 people per household per month, was the second equal highest. Kassirie and the surrounding area was also one of the most severely affected areas during the district's recent cholera outbreak.<sup>36</sup> Water sourcing problems appear to be acute in the community. When water is more plentiful the majority of residents source their water from wells or public taps, however there is still a sizeable minority of the community that have to travel to nearby swamps and streams for water supply during this time. Towards the end of the dry season households either have to stockpile water, travel to other villages, or travel to further away swamps and streams to fulfil their water needs. Some households also reported occasionally purchasing water during this period.

## Mambolo

**Population:** 5,500  
**Chiefdom:** Mambolo  
**Survey Sample Size:** 523  
**Margin of Error:** 4.08%  
**Health Clinic Catchment:** 15,958

Item	Unit	#	
Stomach sickness in household	Per month	1.9	
Hospital visits per household	Per month	1.6	
Health cases with water borne related illness	%	50	
Water Consumption (Drinking)	Individual average per day	Litres	4
	Town total per day	Litres	14,000
Water Consumption (Total)	Per Day	Litres	57
	Town per day	Litres	200,200
Water Collection	Amount per day	Litres	750
	Time per day	Hours	1.9

Figure 16 - Survey data results for Mambolo

The Kambia District Council, with funding from the World Bank, is in the process of constructing a pipe-borne water supply system for the Mambolo community.<sup>37</sup> Such a project is certainly needed, as Mambolo appears to have some of the worst cases of water-borne disease issues in the district.

<sup>33</sup> Personal Communication with the Chief Health Officer, Kassirie Community Health Centre, June 2012.

<sup>34</sup> *Ibid.*

<sup>35</sup> *Ibid.*

<sup>36</sup> Personal Communication with Francis Kamara, Kambia District Rural Water Services Supervisor, July 2012.

<sup>37</sup> *Ibid.*

The estimate by local staff that 50% of their patients have water-borne related illness was equal highest among the surveyed towns, as was the stomach sickness rate per household. The town and its surrounding area was also a focal area of the district's recent cholera outbreak.<sup>38</sup> For most of the year people use public taps or wells for their water supply, however during the end of the dry season households either travel to streams or pay to use privately owned wells (paying Le 200 for five gallons of water). There also one shop in Mambolo that sells bundles of water (8 to 10 litres in total) for Le 5,000; or packets of water (500 ml) for Le 500; 7.5% of the households surveyed noted that they occasionally purchased these packets of water.

## Tawuya

**Population:** 3,500

**Chiefdom:** Gbinle Dixing

**Survey Sample Size:** 418

**Margin of Error:** 4.5%

**Health Clinic Catchment:** 4,602

Item	Unit	#	
Stomach sickness in household	Per month	1.0	
Hospital visits per household	Per month	1.0	
Health cases with water borne related illness	%	20.0	
Water Consumption (Drinking)	Individual average per day	Litres	3.61
	Town total per day	Litres	12,635
Water Consumption (Total)	Per Day	Litres	42
	Town per day	Litres	146,300
Water Collection	Amount per day	Litres	173
	Time per day	Hours	2.1

Figure 17 - Survey data results for Tawuya

Tawuya is a medium size town located on the Great Scaries River. There has never been a piped water system installed in Tawuya. Out of all of the towns surveyed in the Kambia District, Tawuya appears to have to least problems with water-borne diseases. On average one person per household suffers from a stomach sickness per month, while the staff at the health clinic estimate that around 20% of patients come in with water-borne related illness,<sup>39</sup> the equal lowest of all of the towns surveyed. It is important to note, however, that this is a relevant comparison, and certainly does not mean that water-borne disease is not an issue. Indeed, Tawuya was one of the towns affected by the recent cholera outbreak in Kambia.<sup>40</sup> Households collect water from both public wells and taps, and, like the other towns, they generally have to find other sources during the dry season with all houses reported that they went to the nearby river during this period (see Figures 9 and 10). There are no shops selling water in Tawuya, however, during the dry season, a few households occasionally travel to Kambia to purchase packets or bundles of water.

## Madina

**Population:** 3,500

**Chiefdom:** Tonko Limba

**Survey Sample Size:** 580

**Margin of Error:** 3.75%

**Health Clinic Catchment:** 5,585

Item	Unit	#	
Stomach sickness in household	Per month	1.4	
Hospital visits per household	Per month	1.6	
Health cases with water borne related illness	%	10 - 30	
Water Consumption (Drinking)	Individual average per day	Litres	3.9
	Town total per day	Litres	13,650
Water Consumption (Total)	Per day	Litres	51
	Town per day	Litres	178,500
Water Collection	Amount per day	Litres	741
	Time per day	Hours	2.0

Figure 18 - Survey data results for Madina

<sup>38</sup> *Ibid.*

<sup>39</sup> Personal Communication, Chief Health Officer, Tawuya Community Health Centre, July 2012.

<sup>40</sup> Personal Communication with Francis Kamara, Kambia District Rural Water Services Supervisor, July 2012.



A piped water system was installed in Madina during the 1980s; however it has not functioned for about 15 years, as it was damaged severely during the country's civil war.<sup>41</sup> The Kambia District Council, with funding from the World Bank, is now rehabilitating this water supply system. They plan on creating a water management structure similar to what is being used at Rokupr, and officials claim that the system will start supplying water in the very near future (although no specific date was given).<sup>42</sup> Madina was the only town surveyed that was not affected by the recent cholera outbreak. Nevertheless, water-borne diseases are still an issue, with a relatively high level of stomach sickness per household and a water-borne disease infection rate of hospital patients rising to 30% during the end of dry season.<sup>43</sup> The majority of households collect their water from public wells; and while there is some water scarcity during the end of the dry season, they noted that they were still able to collect water from most wells (sometimes they travel to the wells earlier in the morning to help guarantee this). A very small minority of households also collect their water from private taps; however these cease to function during the end of the dry season, and therefore sourcing water from wells becomes the only option.<sup>44</sup> There is currently a fee in place for the collection of water – Le 200 for 5 gallons – which appears to be enforced at both the wells and public taps, likely a part of the management system for the water works that is currently being rehabilitated.

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<sup>41</sup> JICA, *The Project for Establishment of Water Supply Management System in Kambia District Republic of Sierra Leone*, 2009; Personal Communication, Chief Health Officer Madina Health Clinic, Madina. July 2012.

<sup>42</sup> Personal Communication with Francis Kamara, Kambia District Rural Water Services Supervisor, July 2012.

<sup>43</sup> Personal Communication Richard Kargbo, Chief Health Officer, Tonko Wesleyan Health Centre, Madina, July 2012.

<sup>44</sup> *Ibid.*

# 3

## Bombali District

**B**ombali District is located in the Northern Province of Sierra Leone. Its capital and largest town is Makeni. In 2010 the district had an approximate population of 434,319. It borders the Republic of Guinea to the north, Port Loko and Kambia Districts to the west, Tonkolili District to the south, and Koinadugu District to the east. It is the second largest district in Sierra Leone in terms of geographical area, occupying a region of 7,985 km<sup>2</sup>. The district is divided into thirteen chiefdoms: Bombali Shebora, Makari Gbanti, Sanda Tenraren, Biriwa, Magbaiamba Ndowahun, Sanda Loko, Safroko Limba, Sella Limba, Tambakha, Gbanti Kamaranka, Gbendembu Ngowahun, Paki Massabong, and Libeisaygahun.

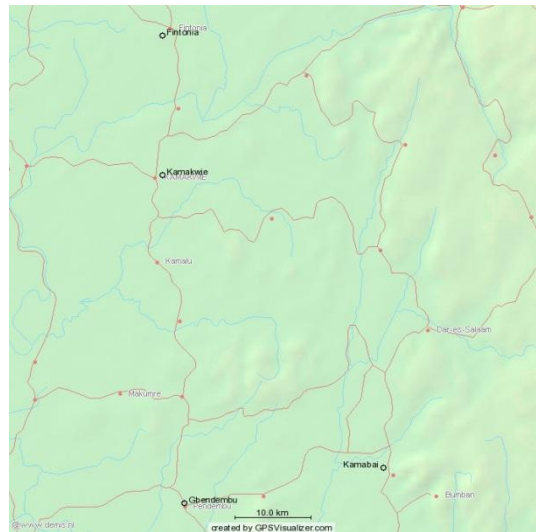


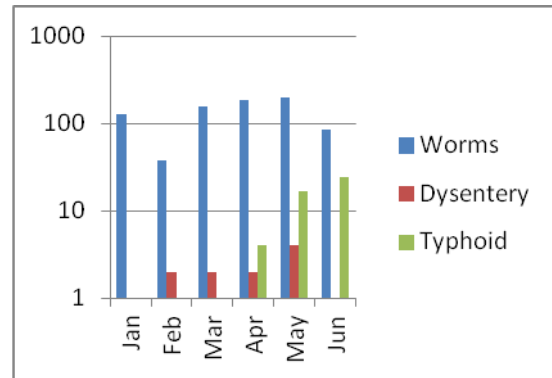
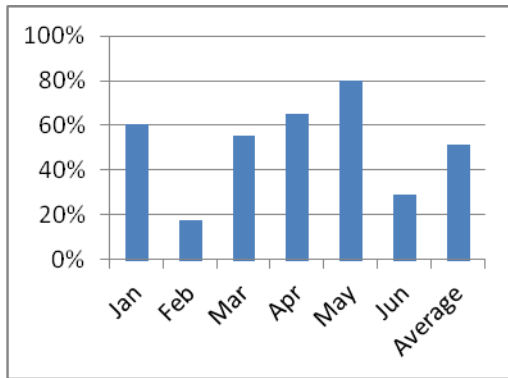
Figure 19 - Map of surveyed towns in Bombali District

Four towns in the Bombali District were surveyed as a part of this project (see Figure 19). This included Kamakwie, the district's second largest urban centre, which is the headquarter town for the Sella Limba Chiefdom; along with Kamabai, Fintonia, and Gbendembu, which are the respective headquarter towns for the Biriwa, Tambakha, and Gbendembu Ngowahun Chiefdoms.

Water supply and access is a major issue in the Bombali District, as it is in most of Sierra Leone. People regularly suffer from typhoid, dysentery, and diarrhoea, while Schistosomiasis is common in many of the district's waterways, presenting a risk to those collecting water from streams.<sup>45</sup> Cholera outbreaks also occasionally occur across the district, although there have been no major ones in the last couple of years.<sup>46</sup> The Kamakwie Wesleyan Hospital was the only medical facility visited during the research that rigorously collected data on its patients. It is a large hospital that has a population catchment of 200,000 (equivalent nearly 50% of Bombali District's total population – patients come to the hospital from neighbouring districts and even Guinea), and therefore the data collected provides a good snapshot of water-borne disease in the broader area.

<sup>45</sup> Personal Communication, District Health Sister and Monitoring and Evaluation Officer, Bombali District Primary Health Care Unit.

<sup>46</sup> Personal Communication, District Health Sister and Monitoring and Evaluation Officer, Bombali District Primary Health Care Unit; Personal Communication, Andrew Moseray, Supervisor of the Bombali District Water Supply Divisions, July 2012.



Figures 20 and 21 - Water-borne related diseases among patients at Kamakwie Wesleyan Hospital between January and June, 2012. Figure 20 (left) shows water-borne diseases as a percentage of hospital cases; Figure 21 (right) shows the number of cases to each specific water-borne disease type (note that the value axis is logarithmic).<sup>47</sup>

As can be seen in Figure 20, during the first six months of 2012, around 50% of cases at the hospital were related to water-borne diseases. However, there are great variations in this percentage, with it being as low as 18% in February and as high as 80% in May. This correlates with the more anecdotal data provided by other health facilities across the three districts, whereby the last few months of the dry season (March to May/June) tend to be the worse for water-borne diseases due to scarcity of water.<sup>48</sup> The specific data on water-borne disease type is also interesting, showing that worm related infections are by far the most common, and, although they are prominent all year around, have a notable peak between March and May. Dysentery infections have a slight peak in May 2012; while typhoid infections become prominent between April and June, 2012. Once again, this information correlates with anecdotal data from other health clinics; that March to May/June is the worst period for water-borne infections.



Figure 22 - Public water tap in Fintonia



Figure 23 - Water tank in Gbendembu

The majority of the people in the Bombali District access water through hand dug wells, public taps, and streams. However, most of these sources dry up during the end of the dry season (December to May) and as a result, most people rely on streams and other unprotected sources for water. Even

<sup>47</sup> Data supplied by Kamakwie Wesleyan Hospital via email.

<sup>48</sup> Given that all other clinics say that February to June are the peak for water-borne disease, it is therefore reasonable to assume that Kamakwie's Wesleyan Hospital's water-borne infection rate is likely to be relatively lower during the second half of the calendar year.

the main dam in the district struggles to provide the capital Makeni with water for more than five months a year.<sup>49</sup> Water is generally collected by households using five gallon containers, although plastic tubs and buckets are also common. Similar to Kambia District, water is usually drunk in the household from ‘country cups’ that are between 0.5 and 2 litres in size. There is some degree of water commercialisation in the surveyed towns, with Kamakwie, Gbendembu, and Kamabai all having shops that sold packets and bundles of water; water sales are generally being highest during the dry season.

There have been a number of initiatives in recent times to improve water supply and management in the district. The Bombali District Health Management Team (DHMT), with funding from UNICEF, is engaged in the monitoring and supervision of well construction, as well as being involved in the training of WASH committees, chlorinators, and hand pump mechanics in all thirteen chiefdoms across the district. World Hope International is engaged in Borehole Drilling in four chiefdoms (i.e., Makarie, Gbanti, Safroko Limba and Gbendembu Ngowahun).<sup>50</sup> While the NGO Inter Aide, with funding from the European Union, is involved in constructing wells, latrines and hand pumps in six of the district’s chiefdoms. Similar to Kambia, the MEWR in partnership with UNICEF, is identifying and mapping all sources of water across the district.<sup>51</sup>



**Figure 24 – Drinking cup and water container in Gbendembu**



**Figure 25 – Drinking cup and water container in Fintonia.**

<sup>49</sup> Personal Communication, Andrew Moseray, Supervisor of the Bombali District Water Supply Divisions. July 2012; Personal Communication, District Health Sister and Monitoring and Evaluation Officer, Bomabli District Primary Health Care Unit.

<sup>50</sup> Personal Communication, Andrew Moseray, Supervisor of the Bombali District Water Supply Divisions, July 2012.

<sup>51</sup> Personal Communication, District Health Sister and Monitoring and Evaluation Officer, Bomabli District Primary Health Care Unit; Personal Communication Mohame Sesay, Water Engineer at the Bombali District Water Supply Division.

There are also the major pipe water-supply projects being implemented in the district by the Sierra Leonean Government: at the villages of Kamakwie (with assistance from a Korean organisation), Gbendembu, and Kamabai, all target villages in this research. In Kamakwie, the project involved the drilling of a 98 metre bore-hole and the installation of a concrete tank with solar powered water pump.<sup>52</sup> In Gbendembu, the project involved the drilling of three bore holes (57, 59, and 66 metres in depth) and the installation of a concrete tank with solar powered water pump (see Figure 23).<sup>53</sup> The installation at Gbendembu has never function, and parts of the water pumping system are now missing, while the system at Kamakwie has a number of technical issues (and requires the use of a generator) and ultimately it struggles to supply water during the end of the dry season. The system at Kamabai is yet to be installed.

## Town Profiles

### Fintonia

**Population:** 4,600

**Chiefdom:** Tambakha

**Survey Sample Size:** 471

**Margin of Error:** 4.28%

**Health Clinic Catchment:** 7,714

Item	Unit	#	
Stomach sickness in household	Per month	1.2	
Hospital visits per household	Per month	1.3	
Health cases with water borne related illness	%	10 - 30	
Water Consumption (Drinking)	Individual average per day	Litres	4.19
	Town total per day	Litres	19,274
Water Consumption (Total)	Per day	Litres	31
	Town per day	Litres	140,760
Water Collection	Amount per day	Litres	360
	Time per day	Hours	3.4

Figure 26 - Survey data results for Fintonia

Fintonia is situated in between the two main sections of the Outamba-Kilimi National Park, and is only a few kilometres away from the National Park's main tourist camp. It also hosts the office for the USAID and US Forestry Service funded Sustainable and Thriving Environments for West Africa Regional Development (STEWARD) programme, which is working towards the improved management of Outamba-Kilimi National Park, along with the Madina Oula forest area across the border in Guinea.

Water accessibility is a major issue in Fintonia; when water is plentiful it can be sourced from swamps, hand pumps and taps, the latter two, however, providing a greatly reduced supply at the end of the dry season. During this period people sometimes need to wake up at 5am and collect water from stream that is further away from the town; with the average household spending around 3.4 hours a day collecting water. Local health staff estimate that 10% of patients that come into the health clinic are suffering from water-borne related infections; the percentage rises to 30% towards the end of the dry season;<sup>54</sup> cholera outbreaks have also occurred in parts of the local catchment area in the past. No household in the community purchases purified water; however, the town's health clinic does regularly buy packets of purified water from Kamakwie.

<sup>52</sup> Government of Sierra Leone, Ministry of Finance and Economic Development Monitoring and evaluation report MFED, February 22-27, 2010.

<sup>53</sup> A. M. Sesay "Is Richard Conteh A Loko Hero?" *The Torchlight*, 29 January 2012.

<sup>54</sup> Personal Communication, John Gbla, Chief Health Officer, Fintonia Community Health Centre, July 2012.

## Gbendembu

**Population:** 5,000

**Chiefdom:** Gbendembu Ngowahun

**Survey Sample Size:** 441

**Margin of Error:** 4.46%

**Health Clinic Catchment:** 5,252

Item	Unit	#	
Stomach sickness in household	Per month	1.2	
Hospital visits per household	Per month	1.2	
Health cases with water borne related illness	%	10.0	
Water Consumption (Drinking)	Individual average per day	Litres	4.32
	Town total per day	Litres	21,600
Water Consumption (Total)	Per day	Litres	38
	Town per day	Litres	190,000
Water Collection	Amount per day	Litres	424
	Time per day	Hours	3.1

Figure 27 - Survey data results for Gbendembu

Gbendembu is situated on the Kamakwie-Makeni highway, an important port for trade route in the Northern Province. It hosts one of only three Senior Secondary Schools that are present in district of Bombali, outside of the district capital of Makeni; meaning that it acts as a broad catchment for students in the chiefdom.

The town recently had a pipe water supply system installed by the Sierra Leone Government, however the system has never properly functioned and access to water is still a major issue in Gbendembu. There are public hand pumps and taps present across the town; however they only function during the wet season (July to early December). For the rest of the year, people have to source water from unprotected wells, streams and local swamps. The end of the dry season tends to be the worst for water-borne disease, with children in particularly regularly suffering from vomiting and diarrhoea.<sup>55</sup> Many households, when they can afford it will purchase water from the local shop, especially during the dry season.<sup>56</sup> This was confirmed by the shop owner, who said she sells around 25 to 40 (500ml) packets, along with 5 to 8 bundles (20 packets), of water each day during the dry season; with her sales dropping by about 75% during the wet season. She sources her bundles of water from Freetown and sometimes from Makeni. A bundle in Freetown costs Le 3,000 (plus Le 1,500 for transportation), while a bundle of water in Makeni costs Le 4,000 (plus Le 1,000 for transportation). She sells packets of water for Le 300 (or Le 500 if they are cold) and bundles for Le 7,000.<sup>57</sup> Curiously, it is cheaper to purchase by the packet, rather than by the bundle (i.e., 20 packets of water = Le 6,000 = the equivalent of one bundle of water).

## Kamabai

**Population:** 4,000

**Chiefdom:** Biriwa

**Survey Sample Size:** 474

**Margin of Error:** 4.23%

**Health Clinic Catchment:** 5,567

Item	Unit	#	
Stomach sickness in household	Per month	1.0	
Hospital visits per household	Per month	1.2	
Health cases with water borne related illness	%	10.0	
Water Consumption (Drinking)	Individual average per day	Litres	4.49
	Town total per day	Litres	17,960
Water Consumption (Total)	Per day	Litres	43
	Town per day	Litres	170,800
Water Collection	Amount per day	Litres	505
	Time per day	Hours	1.8

Figure 28 - Survey data results for Kamabai

<sup>55</sup> Personal Communication with Susan Conteh, Gbendembu Community Health Centre, July 2012.

<sup>56</sup> *Ibid.*

<sup>57</sup> Personal Communication, Margaret Albert, Water Shop, Gbendembu, July 2012.

Kamabai also hosts one of only three Senior Secondary Schools that are present in district of Bombali outside of the district capital of Makeni; meaning that, like Gbendembu, it acts as a broad catchment for students in the chiefdom. People from the community of Kamabai generally source their water from a well, public taps and public hand pumps. However, like other towns in the Bombali District, during the end of the dry season water become scarcer, and people have to travel to the pumps and wells early in the morning, or to a nearby stream to fulfil their water needs. The local health clinic reports that water-borne illnesses are most common during the end of the dry season, with around 10% of cases in the health clinic being related to water-borne infections. Many households, when they can afford it, purchase water from local shops in Kamabai, paying Le 500 for a packet of water and Le 5,000 for a bundle.

## Kamakwie

**Population:** 17,000

**Chiefdom:** Sella Limba

**Survey Sample Size:** 401

**Margin of Error:** 4.84%

**Hospital Catchment:** 200,000

Item	Unit	#	
Stomach sickness in household	Per month	1.7	
Hospital visits per household	Per month	1.6	
Health cases with water borne related illness	%	51	
Water Consumption (Drinking)	Individual average per day	Litres	4.4
	Town total per day	Litres	77,000
Water Consumption (Total)	Per day	Litres	60
	Town per day	Litres	1,048,250
	Amount per day	Litres	599
Water Collection	Amount per day	Litres	599
	Time per day	Hours	2.1

Figure 29 - Survey data results for Kamakwie

Kamakwie is a major trading centre which is situated on an important transport route between Sierra Leone and Guinea. It is also often used as a base for trips into the nearby Outamba-Kilimi National Park, and has a hotel and restaurant/nightclub, along with a wide variety of small shops and businesses. The Kamakwie Wesleyan Hospital is a major health post, serving over 200,000 people in northern Sierra Leone and southern Guinea. There is also a small Maternal Health Clinic in Kamakwie. Along with Kamabai and Gbendembu, it hosts one of only three Senior Secondary Schools that are present in district of Bombali outside of the district capital of Makeni; it is the largest of these three schools.

Water-borne diseases appear to be a major issue in Kamakwie, its household stomach sickness rate is the highest out of the surveyed towns in the Bombali District (although this could be a reflection of the higher quality of the data collected). The water-borne infection rate at the Kamakwie Hospital is also dramatically higher than other towns (see Figures 20 and 21). It is important to note, however, that the hospital serves a catchment well beyond Kamakwie (and therefore is not a direct snapshot of the town). The population of Kamakwie generally collect water from public wells or public taps, the latter being linked to the town's piped water system which was recently rehabilitated by the Sierra Leonean Government and a Korean Organisation. During the end of the dry season, however, the public taps cease to operate and most household are forced to go to the public wells early in the morning to source their water supplies; some households even travel to the nearby stream to collect water. People are suppose pay between Le 100 to Le 200 to fill their five gallon [22.7 litres] containers at the public taps and wells; although these fees are inconsistently collected. There are least three shops that sell water in Kamakwie, along with some bars and restaurants around the town. Packets (~500ml) are sold for Le 500, while bundles are sold for Le 7,000 (20 packets).

# 4

## Koinadugu District

**K**oinadugu District is located in the Northern Province of Sierra Leone. Its capital and largest city is Kabala. It is by far the largest district in Sierra Leone, with a geographical of 12,121 km<sup>2</sup>. It had a recorded population of 265,765 in the 2004 census. It borders Bombali District to the west, Tonkolili District to the south-west, Kono District to the south and the Republic of Guinea to north-east. The district is made up of 11 chiefdoms: Diang, Nieni, Sengbe, Sulima, Wara-Wara Bafodia, Wara Wara Yagala, Mongo, Dembelia Sinkunia, Kasunko, Folasaba, and Neya.

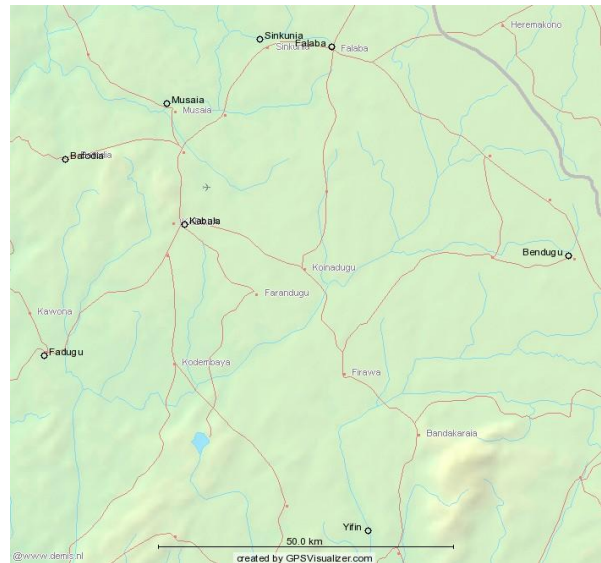


Figure 30 - Map of Surveyed Towns in Koinadugu

Eight towns in the Koinadugu District were surveyed as a part of this project. This included Kabala, the district capital, which is also the headquarter town for the Sengbe Chiefdom, along with the town Fadugu, Sinkunia, Musaia, Bafodia, Yifin, Bendugu, and Falaba, which are all the headquarters of their respective chiefdoms of Kasunko, Dembelia Sinkunia, Folasaba Dembelia, Wara-Wara Bafodia, Nieni, Mongo, and Sulima. All of the towns have community health centres, which serve broad catchment areas.



Figure 31 - Public Tap in Yifin



Figure 32 - Public Tap in Fadugu



Water access is a major issue in Koinadugu. Water-borne diseases (e.g., typhoid, dysentery) are prevalent in all communities;<sup>58</sup> however, there have been no reported cholera outbreaks in recent times. Water scarcity is a major issue, especially during the dry season, and households often have to travel long distances and spend many hours collecting enough water for their daily needs. The majority of the people in the district access water through hand dug wells, local and improved wells, streams and rivers. Very few communities have public taps, and those that do, they tend to struggle to supply decent water during the end of the dry season.<sup>59</sup> In contrast to the other districts, swamp wells are quite common, and tend to be the most reliable year-round source for water. Like Bombali and Kambia District, water is generally collected using five gallon containers, plastic bowls or buckets, while water is drunk in the household with plastic cups (between 0.5 and 2 litres in size).



**Figure 33 - Dirty water from tap in Fadugu**



**Figure 34 - Public Well in Bendugu**

There are a few projects currently underway to try and improve water access in the district. The largest is a plan for a US\$16 million overhaul of Kabala’s water supply system. This initiative is being co-funded by the Islamic Development Bank (US\$12 million) and the Arab Bank for Economic Development in Africa (BADEA) (US\$4 million), and is being managed by the Sierra Leone Water Company (SALWACO).<sup>60</sup> Tenders were received from potential contractors in May 2012 for the construction of a brand new 8.5 meters reinforced concrete reservoir and the construction of pipe lines into Kabala. A second phase of the project will involve constructing a treatment plant at Musaia, from which water will be pumped across to Kabala.<sup>61</sup> The MEWR is also reportedly involved in constructing and rehabilitating wells across the district, while the Ministry of Health and Sanitation (MOHS) is reportedly involved in WASH trainings and well chlorination. There are also a number of smaller-scale projects being conducted by Oxfam, Cause Canada and other smaller NGOs across the district. These usually related to the formation of Chiefdom and Village level WASH

<sup>58</sup> Personal Communication, Abdulai Jalloh, Koinadugu District Environmental and Sanitation Coordinator, July 2012; Personal Communication CA, Koinadugu District Council, July 2012.

<sup>59</sup> Personal Communication, Abdulai Jalloh, Koinadugu District Environmental and Sanitation Coordinator

<sup>60</sup> Saidu Bah, ‘SALWACO engage stakeholders on Kabala water supply project,’ *Expatimes*, 9 November 2011.

<sup>61</sup> *Awareness Time* ‘SALWACO to Rehabilitate Kabala Water Supplies’ 23 February 2012; *Sierra Express Media* “SALWACO takes Contractors to Kabala Water Supply project site”, February 23, 2012.

communities, health education programmes, and the construction and rehabilitation of wells in some communities within the District.<sup>62</sup>

## Town Profiles

### Kabala

**Population:** 16,000

**Chiefdom:** Sengbe

**Survey Sample Size:** 521

**Margin of Error:** 4.22%

**Hospital Catchment:** 266,000

Item	Unit	#	
Stomach sickness in household	Per month	1.0	
Hospital visits per household	Per month	1.2	
Health cases with water borne related illness	%	10.0	
Water Consumption (Drinking)	Individual average per day	Litres	4.46
	Town total per day	Litres	71,360
Water Consumption (Total)	Per day	Litres	38
	Town per day	Litres	612,800
Water Collection	Amount per day	Litres	500
	Time per day	Hours	2.5

Figure 35 - Survey data results for Kabala

Kabala, the district capital of Koinadugu District, acts as an important agricultural centre in Sierra Leone. Estimates by health local staff is that 10% of their patients are admitted due to water-borne diseases, one of the lowest rates out of the towns surveyed; the household stomach infection rate was also low. As noted above, there are currently plans to conduct a massive overhaul of Kabala's water supply system project. Currently, the residents of Kabala source the majority of their water needs from a variety of wells and hand pumps that are situated across the town. During the end of the dry season some of these dry up, causing extra-long queues at the remaining pumps and wells that are still functioning. Most households also occasionally purchase bundles or packets from local shops; with packets of water costing Le 500 and bundles of water costing Le 5,000. As noted above, there are currently plans to introduce a piped water system into Kabala Town, which would dramatically change the current dynamic of water collection; however it appears that such an installation would not be completed for a number of years.

### Fadugu

**Population:** 5,600

**Chiefdom:** Kasunko

**Survey Sample Size:** 554

**Margin of Error:** 3.95%

**Health Clinic Catchment:** 8,677

Item	Unit	#	
Stomach sickness in household	Per month	1.0	
Hospital visits per household	Per month	1.2	
Health cases with water borne related illness	%	20-30	
Water Consumption (Drinking)	Individual average per day	Litres	4.58
	Town total per day	Litres	25,648
Water Consumption (Total)	Per day	Litres	29
	Town per day	Litres	161,840
Water Collection	Amount per day	Litres	401
	Time per day	Hours	4.7

Figure 36 - Survey data results for Fadugu

The exploits of Fadugu, prior to and during, the country's recent civil war, are recounted in the recently published book *Black Man's Grave: Letters From Sierra Leone*.<sup>63</sup>

According to the data, Fadugu has some of the greatest issues with water-borne disease out of the towns surveyed in Koinadugu District. Health staff estimate that around 20% of their patients have water-borne related infections, and the percentage rises to around 30% during the end of the dry

<sup>62</sup> Personal Communication, Abdulai Jalloh, Koinadugu District Environmental and Sanitation Coordinator

<sup>63</sup> G. Stewart and J. Amman - *Black Man's Grave: Letters From Sierra Leone* (Cold Run Books, 2007)

season, with children being especially affected.<sup>64</sup> During the wet season, the community generally sources water from public taps and wells located in the village; however almost all of these do not function most of the year, and therefore people are forced to leave their houses at 5am and walk about 5.5 kilometres to fetch water from a stream. Each household spends on average 4.7 hours every day collecting water – the longest amount of time out of all the villages that were surveyed as a part of this project. There is a considerable amount of water commercialisation in Fadugu, with 95% of the population reporting that they occasionally buying packets of water; these cost Le 500 per packet, or Le 5,000 per bundle from local water shops (the shops source their water bundles from Freetown).

## Sinkunia

**Population:** 2,700

**Chiefdom:** Dembelia Sinkunia

**Survey Sample Size:** 497

**Margin of Error:** 3.97%

**Health Clinic Catchment:** 4,949

	Item	Unit	#
	Stomach sickness in household	Per month	1.1
	Hospital visits per household	Per month	1.2
	Health cases with water borne related illness	%	20-30
Water Consumption (Drinking)	Individual average per day	Litres	4.34
	Town total per day	Litres	11,718
Water Consumption (Total)	Per day	Litres	35.7
	Town per day	Litres	96,390
Water Collection	Amount per day	Litres	444
	Time per day	Hours	3.7

Figure 37 - Survey data results for Sinkunia

There have been some recent initiatives to improve the supply of water in Sinkunia. Between 2007 and 2009, the Canadian-based Sinkunia Community Development Organisation (SCDO), installed two wells in the community with a US\$5,000 grant from the Manitoba Council Community Solidarity Fund. More recently, since 2010, the NGO Change for Children has reportedly been involved in installing an additional five wells in the community. Improved water access is certainly needed in Sinkunia, as the town has one the highest incidents of water-borne disease infections out of the towns surveyed in the Koinadugu District. The local health clinic estimates that around 20% of its patients come to the health clinic due to water-borne infections, the percentage rising to 30% between May and June at the end of the dry season, with children being especially affected.<sup>65</sup> Households source their water from wells, pumps, taps, swamps and streams; the latter two being the least safe sources of water but often the most reliable sources for water during the dry season. There is some commercialisation of water in the town, as during the dry season the majority of households (82.5%) stated that occasionally buy bundles of water from the capital Kabala (for Le 5,000 + transportation costs) or from local shops (for Le 7,000).

## Musaia

**Population:** 2,300

**Chiefdom:** Folasaba Dembelia

**Survey Sample size:** 504

**Margin of Error:** 3.86%

	Item	Unit	#
	Stomach sickness in household	Per month	1.2
	Hospital visits per household	Per month	1.2
	Health cases with water borne related illness	%	10 - 20
Water Consumption (Drinking)	Individual average per day	Litres	4.64
	Town total per day	Litres	10,672
Water Consumption (Total)	Per day	Litres	28.4
	Town per day	Litres	65,320
Water Collection	Amount per day	Litres	358
	Time per day	Hours	2.4

<sup>64</sup> Personal Communication, Senesie Roger, Chief Health Officer, Fadugu Community Health Centre, July 2012.

<sup>65</sup> Personal Communication, Anthony Lansanah Sesay, Chief Health Officer, Sinkunia Health Clinic, July 2012.

**Health Clinic Catchment:** 3,574

**Figure 38 - Survey data results for Musaia**

During the late colonial era an animal husbandry station was set up in Musaia, and the town subsequently became an important site for experimenting with milk production in Sierra Leone. While the livestock industry is still important in Musaia, the husbandry station has ceased to function for a number of years now.

As a part of the major water supply project for Kabala there are plans to install a water treatment plant at Musaia. It is not clear, however, if this plant will supply piped water to Musaia as well, or if it will just provide water for Kabala. The trend in water-borne infections in Musaia is similar to many other towns in Koinadugu districts, being present in about 10% of health clinic case for most of the year, rising to 20% towards the end of the dry season.<sup>66</sup> Water is sourced from a variety of wells, streams and hand pumps; however during the dry season water is more commonly sourced from streams. There are no shops selling water in Musaia; however, a small proportion of households (7.5%) occasionally travel to Kabala to purchase bundles of water.

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## Bafodia

**Population:** 5,800

**Chiefdom:** Wara-Wara Bafodia

**Survey Sample Size:** 554

**Margin of Error:** 3.96%

**Health Clinic Catchment:** 9,777

Item		Unit	#
Stomach sickness in household		Per month	1.1
Hospital visits per household		Per month	1.2
Health cases with water borne related illness		%	10 - 20
Water Consumption (Drinking)	Individual average per day	Litres	4.58
	Town total per day	Litres	26,564
Water Consumption (Total)	Per day	Litres	28
	Town per day	Litres	162,400
Water Collection	Amount per day	Litres	387
	Time per day	Hours	1.7

**Figure 39 - Survey data results for Bafodia**

Situated at the base of the Wara-Wara Mountains, Bafodia was the old capital of a Limba Kingdom that prospered during the 15<sup>th</sup> and 16<sup>th</sup> centuries.<sup>67</sup>

In Bafodia water is sourced from a mixture of public taps, wells, hand pumps and streams; however during the end of the dry season decent water can generally only be sourced from the latter. The town's water well was constructed by the Sierra Leone Government in 2010, while the pipe water supply for the town was constructed by CARITAS in 2008. Water from streams is the most likely to be contaminated, and health care workers say they experience a spike in water-borne related illness during this end of the dry season.<sup>68</sup> There is some commercialisation of drinking water in the town, with around 20% of households occasionally travelling to Kabala to purchase bundles of water.

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<sup>66</sup> Personal Communication, Juliet Jawara, Chief Health Officer, Musaia Health Clinic, July 2012.

<sup>67</sup> C. Magbaily Fyle *Historical Dictionary of Sierra Leone* (Scarecrow Press: Toronto: 2006); Susanne LeVert *Cultures of the World: Sierra Leone* (Marshall Cavendish 2007).

<sup>68</sup> Personal Communication, Neneh Koroma, Chief Health Officer, Bafodia Health Clinic, July 2012.

## Yiffin

**Population:** 8,400

**Chiefdom:** Nieni

**Survey Sample Size:** 555

**Margin of Error:** 4.02%

**Health Clinic Catchment:** 12,950

	Item	Unit	#
	Stomach sickness in household	Per month	1.1
	Hospital visits per household	Per month	1.1
	Health cases with water borne related illness	%	20
Water Consumption (Drinking)	Individual average per day	Litres	4.61
	Town total per day	Litres	38,724
Water Consumption (Total)	Per day	Litres	29.1
	Town per day	Litres	244,440
Water Collection	Amount per day	Litres	404
	Time per day	Hours	2.5

Figure 40 - Survey data results for Yiffin

Yiffin is one the starting point towns for hikes into the Loma Forest Reserve and up Mount Bintumani – Sierra Leone’s highest peak.

The Makeni Trust Fund, with funding from ‘Water for Kids,’ recently repaired the old pipe system that used to bring water from an old reservoir to the centre of the town, using the system to provide water for Yiffin’s school. Overall, water is sourced in Yiffin from a variety of public taps, hand pumps, wells and streams. During the dry season the public taps and hand pumps are unable provide water, meaning that households have to travel early to wells or the streams to fulfil their water needs.<sup>69</sup> There is currently no commercialisation of water in Yiffin. In the (perhaps very distant) future, when tourism has expanded in Sierra Leone, there could be a market for Yiffin to see water to passing hikers who are heading into the Loma Mountains.

## Bendugu

**Population:** 3,800

**Chiefdom:** Mongo

**Survey Sample Size:** 449

**Margin of Error:** 4.34%

**Health Clinic Catchment:** 7,872

	Item	Unit	#
	Stomach sickness in household	Per month	1.0
	Hospital visits per household	Per month	1.2
	Health cases with water borne related illness	%	30.0
Water Consumption (Drinking)	Individual average per day	Litres	4.34
	Town total per day	Litres	16,492
Water Consumption (Total)	Per day	Litres	42.1
	Town per day	Litres	159,980
Water Collection	Amount per day	Litres	472
	Time per day	Hours	3.5

Figure 41 - Survey data results for Bendugu

The extent of water issues is somewhat contested in Bendugu. The Acting Paramount Chief in Bendugu recently stated that “we have no problems with water supply [in Bendugu] at present.”<sup>70</sup> This statement, however, contradicts information from the local health clinic and the household surveys. According to the local health clinic staff, Bendugu has some of the high rates of water borne infections, with around 30% of patients coming to the clinic with such issues.<sup>71</sup> The main sources for water are wells, hand pumps, and streams; however, like other towns in the district, streams become the main water source towards the end of the dry season. Around 75% of households also occasionally buy bundles and packets of water from Kabala.

<sup>69</sup> Personal Communication, Alieu Mansaray, Chief Health Officer, Yiffin Health Clinic, July 2012

<sup>70</sup> A. Kargbo “Paramount Chiefs condemn witch hunting of African Minerals” *Sierra Leone Express Media* - October 26, 2011

<sup>71</sup> Personal Communication, Susan Mansaray, Nurse, Bendugu Health Clinic, July 2012.

## Falaba

**Population:** 4,400

**Chieftdom:** Sulima

**Survey Sample Size:** 573

**Margin of Error:** 3.8%

**Health Clinic Catchment:** 7,621

Item	Unit	#	
Stomach sickness in household	Per month	1.0	
Hospital visits per household	Per month	1.1	
Health cases with water borne related illness	%	20	
Water Consumption (Drinking)	Individual average per day	Litres	4.4
	Town total per day	Litres	18,480
Water Consumption (Total)	Per day	Litres	33
	Town per day	Litres	138,600
Water Collection	Amount per day	Litres	485
	Time per day	Hours	3.9

Figure 42 - Survey data results for Falaba

Falaba was the fortified capital of the old Sulima Yalunka kingdom (also known as Solimana), which prospered during the 18<sup>th</sup> and 19<sup>th</sup> centuries.<sup>72</sup> It was visited by the early British explorers Alexander Gordon Laing (in 1822) and William Winwood Reade (in 1868); the latter being imprisoned in Falaba by the Sulima Yalunka king, Kind Seedwa, for a period of three months.<sup>73</sup>

The people of Falaba mainly rely of streams and swamps for their water supply, although there are a few hand pumps that function in the community during the wet season.<sup>74</sup> Distances to these swamps and streams are relatively far; the overall result is that households in Falaba spend some on the longest time collecting water – 3.9 hours per day – out of all of the villages surveyed. Those that can afford it, sometime hire motor bikes to fetch water from the other surrounding villages, where they often also have to pay around Le 200 per five gallon drum of water for the privilege of using these source points. Most households (82.5%) also occasionally source bundles and packets of water from Kabala.

<sup>72</sup> C M Fyle, *The Solima Yalunk Kingdom*, (Nyakon Publishers, 1979)

<sup>73</sup> A G Laing *Travels in the Timanee, Kooranko and Soolima Countries, in Western Africa* (J. Murray, 1825); W W Reade, *The African Sketch-Book* (Smith, Elder & Co, 1873).

<sup>74</sup> Personal Communication, Rebecca Koroma, Chief Health Officer, Falaba Health Clinic, July 2012.

# 5

## Conclusions

### Flaws in Current Initiatives

In terms of water improvement projects, there appears to be two broad types of initiatives commonly implemented across the three districts. The first are large scale piped-water projects that have been, or are the process of being, implemented in a number of the larger urban centres (i.e., Rokupr, Kambia, Mambolo, Madina, Kabala, Kamakwie, Gbendembu), which are being financed by large donors (i.e., JICA, World Bank, BADEA, the IDB). The second are small-scale projects, implemented mainly by international and local NGOs, which have a focus on well construction and community water pumps. Both of these types of projects have considerable limitations.

The completed piped installation at Rokupr, as shown in the analysis above, has already encountered significant technical and managerial difficulties. Technical water improvement projects with high inputs are not practical in most of Sierra Leone at this time, as even at the district capital level, technical and managerial capacity is still limited;<sup>75</sup> district councils were only re-introduced in Sierra Leone 2004, after being disbanded by Sierra Leone's former-President Siaka Stevens in the 1970s, and although their governance capacity is improving, it is still a relatively slow process.

A major problem of the above project approach is that it contains a homogenous perspective of water supply – using large-scale infrastructure to purify the town's *entire* water-supply. According to this research, on average, just over 10% of the water collected by a household is actually used for 'drinking water,' the rest being used for bathing, cleaning, and other household needs. It is this 10% of water that is the most likely to spread diseases and infections. While attempts to purify the entire town supply of water is admirable, it is not the most practical or cost-efficient method to effectively reduce water-borne related diseases in communities. Indeed, in most middle-income countries (e.g., Mexico, Brazil, South Africa, etc.) and many low-income countries, there is generally a distinction between water that is used for bathing and general household use (which generally comes from taps) and water that is drunk (which usually sourced from bottles of water); the former water therefore requiring lower levels of treatment.<sup>76</sup> A similar trend can also be witnessed in Sierra Leone,

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<sup>75</sup> Y Zhou, *Decentralization, Democracy and Development: Recent Experience from Sierra Leone*, World Bank Country Series, 2009).

<sup>76</sup> Even in high-income countries it is becoming increasingly common for households to drink water only from bottle sources, however this perhaps more a reflection of the successful marketing by bottled-water manufacturers than it is of poor quality piped water sources: B. Rani, R. Maheshwari, A. Garg, and M. Prasad, 'Bottled Water – A Global Market

where middle-to-high income families in Freetown and other urban centres will regularly purchase purified water in the form of bundles and plastic bags. Most of this water is purified and produced by companies based on the Freetown Peninsula (e.g., Magram, Grafton, etc.). Interestingly, in this research, it was observed that it was relatively common for rural households, especially in Koinadugu District, to also occasionally purchase purified bundles of water, often travelling some distance to nearby urban centres to source these bundles. This is despite the bundles being dramatically higher in price in rural areas: a bundle of water costs Le 2,000 to Le 2500 in Freetown; Le 4,000 in Makeni; Le 5,000 in Kabala; and up to Le 7,000 in Kamakwie and rural villages in Bombali and Koinadugu Districts. This indicates that there are already markets at the village level for the selling of purified water. There is just mainly a need to remove access barrier and supply such water in a cost-effective manner.

The installation of hand pumps and protected wells in communities, while also being venerable work, also has severe limitations. The most obvious being that in all of the communities surveyed, these systems almost always failed to provide water during the end of the dry season, causing communities to source water from streams and unprotected wells, which in turn dramatically increase their chances of catching water-borne diseases; they ultimately fail to provide improved water access at the most critical time of year. This is certainly something that the current project needs to take into account, there needs to be a guarantee that the water kiosks can supply water all year around.

## **District Overviews**

The table below provides a comparative of the town level statistics gathered at all of the towns surveyed as a part of this project. Marked in green are the lowest values for each category, while marked in red are the highest.

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Overview' *Bulletin of Environment, Pharmacology and Life Sciences*, 1 (2012): 1-4; R. Wilk 'Bottled Water: The pure commodity in the age of branding' *Journal of Consumer Culture* 6 (2006): 303-325



District	Town	Town Population	Average Household Size	Survey Sample Size	Data Margin of Error	# of stomach sickness per household per month	# of hospital visits, per household per month	% of cases with water borne related illness	Hours spent per day collecting water	Litres of water collected per day	Amount of water drunk per day	Total water consumed per day per person
Kambia	Kambia	13,000	13.1	525	4.19	1.0	1.8	25	2.4	514	4.32	39.0
	Rokupr	11,000	14.0	560	4.03	1.5	1.7	40	2.5	802	3.10	57.3
	Kassirie	5,500	12.8	514	4.12	1.5	1.6	50	2.1	591	3.80	45.9
	Mambolo	5,500	13.0	523	4.08	1.9	1.5	50	1.9	750	4.00	57.2
	Madina	3,500	15.0	580	3.75	1.4	1.6	20	2	765	3.90	51.0
Tawuya	3,500	19.0	418	4.50	1.0	1.0	20	2.1	640	3.61	41.8	
Bombali	Fintonia	4,600	11.8	471	4.28	1.2	1.3	20	3.4	360	4.19	30.6
	Kamabai	4,000	11.9	474	4.23	1.0	1.2	10	1.8	505	4.49	42.7
	Gbendembu	5,000	11.0	441	4.46	1.2	1.2	10	3.1	424	4.23	39.0
	Kamakwie	17,000	10.0	401	4.84	1.7	1.6	51	2.1	599	4.40	59.9
Koinadugu	Bafodia	5,800	13.9	554	3.96	1.1	1.2	15	1.7	387	4.58	28.0
	Fadugu	5,600	13.9	554	3.95	1.0	1.2	25	4.7	401	4.58	28.9
	Falaba	4,200	14.3	573	3.80	1.0	1.1	20	3.9	485	4.4	33.9
	Musaia	2,300	12.6	504	3.86	1.2	1.2	15	2.4	358	4.64	28.4
	Sinkunia	2,700	12.4	497	3.97	1.1	1.2	25	3.7	444	4.34	35.7
	Bendugu	3,800	11.2	449	4.34	1.0	1.2	30	3.5	472	4.34	42.1
	Yiffin	8,400	13.9	555	4.02	1.1	1.1	20	2.5	404	4.61	29.1
	Kabala	16,000	13.0	521	4.22	1.0	1.2	10	2.5	500	4.46	38.3
Kambia Average		7,000	14.5	520	4.11	1.4	1.5	34	2.2	677	3.79	48.7
Bombali Average		7,650	11.2	447	4.45	1.3	1.3	23	2.6	472	4.33	43.1
Koinadugu Average		6,100	13.2	526	4.02	1.1	1.2	20	3.1	431	4.49	33.1
OVERALL AVERAGE		6,744	13.2	506	4.14	1.2	1.3	25	2.7	522	4.22	40.5

Figure 43 – Comparative Table of the Different Towns and District

Across the three surveyed districts, some important contrasts can be noted. Households in Kambia District on average collect more and consume more water (in total) per day than the other two districts (See Figures 43 and 44);<sup>77</sup> Bombali District collects and consumes the second highest; while Koinadugu the least. This trend likely related to climatic conditions, as in Sierra Leone precipitation is heaviest on the coast, and gradually reduces as one moves further inland. This is reflected in vegetation types, with Kambia District being located in the country's moist semi-deciduous forest zone, while Koinadugu District is located with the drier woodland savannah zone; the Bombali District straddles the border of these two vegetation zones. Interestingly, in terms of water drunk (rather than water consumed as a whole) the positions are reversed, with Koinadugu District the highest and Kambia District the lowest; this is probably a reflection of Koinadugu's drier climate inducing people to drink more. The drier climate also evidently has an impact on the accessibility of water, with households in Koinadugu on average spending a lot more time collecting water (3.1 hours) than their counterparts in Bombali and Kambia Districts (2.6 and 2.2 hours respectively).

According to the data, wetter Kambia District has a higher prevalence of water-borne diseases than the other two districts. This correlates with conclusions in other publications, which describe Kambia as being the worst affected district in Sierra Leone in terms of water-borne diseases. This is due to its extensive coastline making the district vulnerable to flooding, which causes the contamination of water supplies.<sup>78</sup> Data from all three districts indicated that the end of the dry season was the time when water-borne diseases are most prevalent, due to the need to source water from potentially contaminated streams and unprotected wells.

<sup>77</sup> To put this in perspective though, households in the Kambia District still consume less than one third per person than the international average of 150 litres.

<sup>78</sup> IFRC 'Disaster relief emergency fund (DREF) Sierra Leone: Cholera Outbreak', IFRC Newsletter, 20 March, 2012

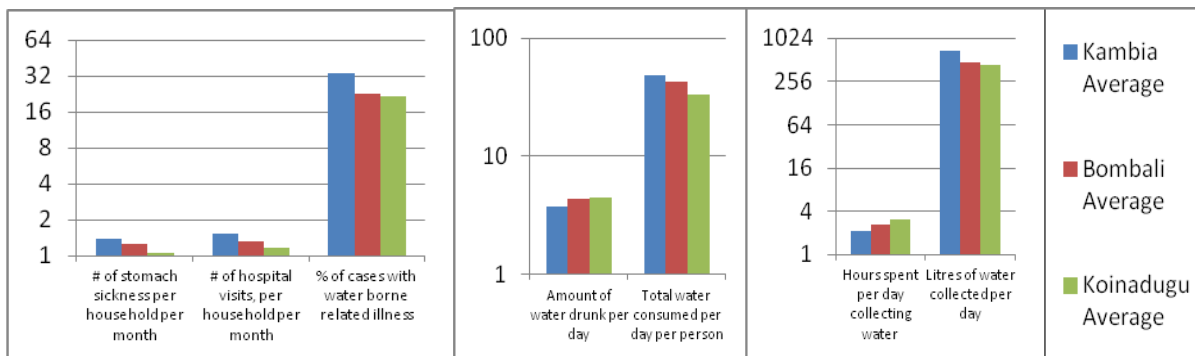


Figure 34 - Comparative Graphs from the three Districts

The commercial sale of drinking water was surprisingly common in all three districts, although each with a slightly different geography. With the exception of Yiffin, all of the surveyed towns in the Koinadugu District had households that occasionally purchased bundles of purified drinking water. Usually households had to travel to Kabala to purchase these bundles; however Fadugu and Sinkunia had had shops that stocked these bundles. In the Bombali District, Kamabai, Gbendembu and Kamakwie all have shops regularly selling bundles of water; however there was no water commercialisation in Fintonia. Finally, in Kambia District, the selling of bundles of water was restricted to Kambia and Mambolo; however it was common at all towns to pay (usually Le200 for five gallons) for the use of public taps and wells. Tawuya was the only town where water commercialisation did not exist in the district.

### Viability of Water Kiosks?

The data and analysis from this research strongly indicates the viability for installing water kiosks at each of the communities, using solar power technology for water purification. Water-borne diseases are major issue in all of the towns surveyed, with them being especially acute in many of the towns in the Kambia District. Current initiatives, whether large or small scale, in general have failed to properly address water access issues, during the end part of the dry season in particular when people are more exposed to water contamination. A major positive is that some form of water commercialisation existed in all but three of communities, suggesting that there is certainly a ready market for purified water sales from kiosk. Most previous project initiatives to instigate fees for water have failed due to inadequate fee collection systems. This will be addressed with the current project, as the utilisation of ENFO's previously installed CCSs offer an already tested avenue for revenue collect. Likely, the biggest challenge, will likely be selling the purified water without packaging it, as the packaging provides a perception that the water inside must be clean.