HHWT – assessment of acceptance and impact

Aurelie MOY – December 2016

Inter Aide Sierra Leone

Executive summary

In 2011, Inter Aide Sierra Leone launched a pilot program of Household Water treatment as part of a WASH project in North Bombali district. Between September 2016 and February 2017, different surveys have been conducted to assess the acceptance of the program by the communities and its impact on health. Some tests and analyses have also been done to understand better the properties of free residual chlorine in water after treatment. The methodology and the results of those surveys are presented in this report.

- **Good acceptance** of the HHWT program by the communities:
    - 100% of communities that received the training by IA continue HHWT, even after years *(survey of 64 communities out of 107 in whole Bombali district)*
    - 80% of pots have treated water at all times *(survey of 340 pots in 29 communities)*
    - Among the 20% of defaulters: 58% are temporary, 42% are permanent
    - Reasons for failure:
        - Pot owner absent or unable to go to the stream (20%)
        - Was absent during IA's intervention (19%)
        - Use private hand-pump nearby (17%) (urban setting and specific context)
        - Chlorinator absent (16%)
- Introduction of HHWT has a **strong positive impact on health in the communities**:
  *Those figures come from the study of small samples and comprise many biases; they only give **global tendencies** that may also come from other factors but IA's intervention.*
    - Prevalence of diarrhoea of CU5 drops from 12% to nearly 0%
    - Mortality rate of CU5 decreases clearly (from 587‰ to 292‰)
- Proper CLTS triggering leads to a latrine coverage of about 80%
- Average water consumption in communities is between 1.5 and 1.7 L/day/person between November and January – no impact of HHWT could be proved
- 18% of chlorinated water have a 0 FRC *(47 samples with 0 FRC out of 261 DPD tests conducted)*, but 100% of it is still safe *(13 safe results out of 13 coliform tests conducted)*

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APM	Assistant Program Manager
CHW	Community Health Worker
CI+	Upper Confidence Interval
CI-	Lower Confidence Interval
CLTS	Community Led Total Sanitation
CU5	Children Under Five
DPD	Diethyl-p-Phenylene Diamine
HHWT	Household Water treatment
IA	Inter Aide
FF	Field Facilitator
FRC	Free Residual Chlorine
MoCU5	Mother of a Child Under Five
NA	No Answer
NGO	Non-Governmental Organization
PHU	Peripheral Health Unit
StdDev	Standard Deviation
U5MR	Under Five Mortality Rate
WATSAN	Water and Sanitation
WHO	World Health Organization
WP	Water Point

Introduction

The research on HHWT included different house to house surveys and some complementary lab tests following 3 main objectives:

1. Assess the **acceptance of HHWT** by the communities

- *Do people in the communities effectively treat water with chlorine? How many of them can be considered as defaulters?*
- *For which reasons do the defaulters not use chlorine?*
- *How should we adapt the HHWT strategy according to this knowledge?*

2. Assess the impact of HHWT on **health**

- *Did the introduction of bleach in the communities reduce the diarrhoea prevalence of CU5?*
- *Did it reduce the mortality of CU5?*
- *What is the impact on latrines' coverage of CLTS triggering and light sensitization on sanitation?*
- *Does the introduction of HHWT increase the average daily water consumption per capita in the communities? Do people in the communities drink enough water according to WHO's recommendations?*

3. Get a **better understanding of FRC**

- *How many pots have 0 FRC in their containers after treatment? Is chlorinated water effectively safe for drinking in the communities?*
- *Which factors influence FRC?*
- *How should we adapt the HHWT strategy according to this knowledge?*

I] Acceptance of the HHWT program by the communities

1. Methodology of the survey

1.1 Agenda

The survey has been prepared in October 2016 and conducted in November 2016.

- Before the survey:
  - Preparation of the survey form and guidelines
  - Discussion with the surveyors, the supervisor and the APM about the objectives, the questions to be asked and the methodology
- First surveys in common (01/11/2016):
  - 2 first surveys (Kamakubuna II and Kamatarawalie) conducted by Musa and Alusine one after each other (the other one witnessing) under Aurelie's supervision
  - Amendments of the survey form and guidelines according to the lessons learned (see annex 1: Guidelines on house to house surveys)
- Second survey in common (02/11/2016):
  - 1 survey (Kamakanka) conducted by Musa (Alusine witnessing) under Aurelie's supervision
  - Use of the new form and respect of the new guidelines
- Surveys of 9 communities in Gbanti Kamaranka by Musa (03/11/2016 – 22/11/2016)
- Surveys of 7 communities non informed of the visit in Sella Limba, Gbanti Kamaranka, Magbaimba Nduhahun and Senda Tendaren by Alusine and Aurelie (03/11/2016 – 11/11/2016)
- Surveys of 10 communities in Sella Limba by Alusine (03/11/2016 – 24/11/2016)

1.2 Organization of the survey

To get a picture of the global acceptance of the HHWT program by the communities, **general visits of 64 communities from all campaigns** (2011 to 2016) have been conducted. In those communities, **meeting** was organized with the water committee members and random villagers to assess their level of acceptance and understand the global functioning of HHWT in a community (see annex 2: Questionnaire for communities).

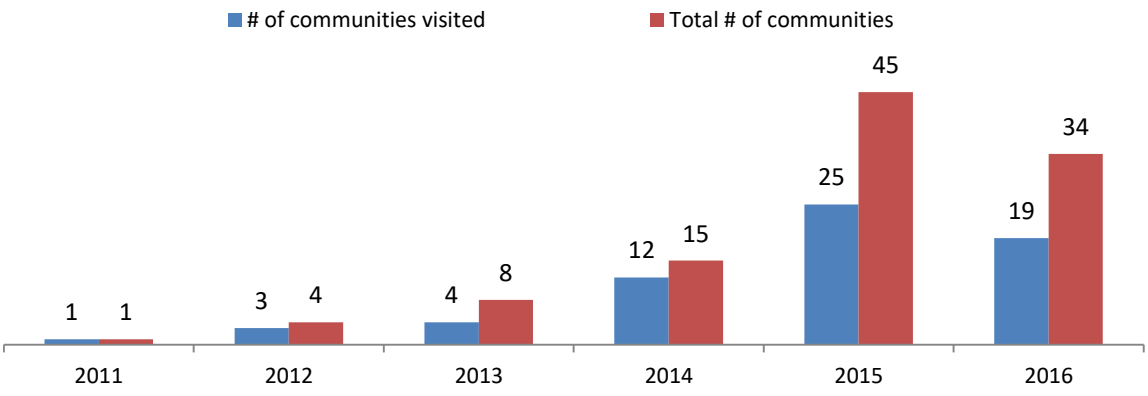


Figure 1 - Number of communities visited per date of training

To get a detailed picture of the acceptance of each pot in the communities and not only the water committee members, **house to house surveys** have been conducted in **22 communities from the 2014-2015 campaign** (see annex 3: Sample of communities). Those 22 communities were **informed of IA's visit** the day before the survey, so that as many pots as possible would be available. The survey has also been conducted **unexpectedly**

(the communities were not informed of IA's visit) in **7 random communities** from **other campaigns** (see annex 3: Sample of communities). Hence, the results come from the survey of **340 pots** in **29 communities**.

The FF went house to house to ask the pot's owners (most of the time the mothers) **if they had chlorinated water** (see annex 4: Form for survey on acceptance). The mothers' answers were considered reliable. If the mother said that water had been treated with chlorine, **indicators** were recorded (dosage used[1], chlorinator in charge of the treatment, cleanness of the container, time since treatment and source of water) and a **DPD test** was conducted to measure the Free Residual Chlorine; those results have been analysed (see part III] Properties of Free Residual Chlorine). If she did not have chlorinated water, further questions were asked to find the **reason for failure** (with different propositions of answers and a column "Other" in case of the reason was not cited).

DPD test

A DPD test is a colorimetric test consisting of adding a DPD-1 pill to the sample. The reaction creates a reddish tint that has to be compared to the different levels of the scale that indicate the free chlorine residual concentration, that is to say the amount of chlorine remaining in water after treatment.
The FRC should be between 0.2 and 2 mg/L (at least 30 minutes after treatment) in order to fight further contamination and avoid a too strong taste at the same time.

1.3 Communities sample description

Size

The size of the communities surveyed varies **from 9 to 218 people**.

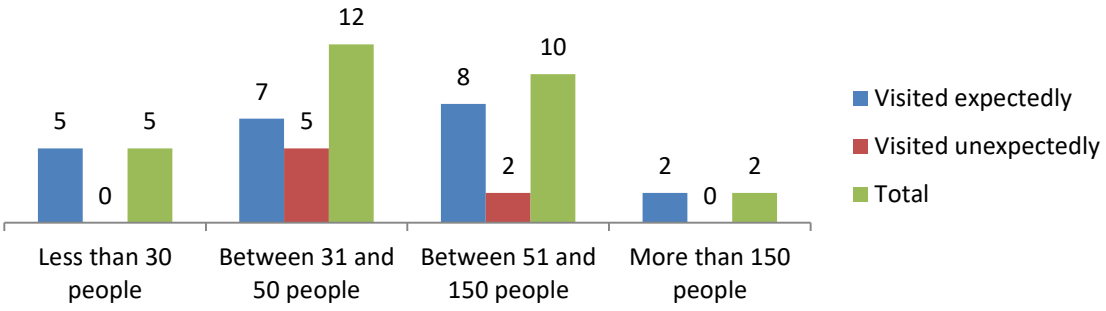
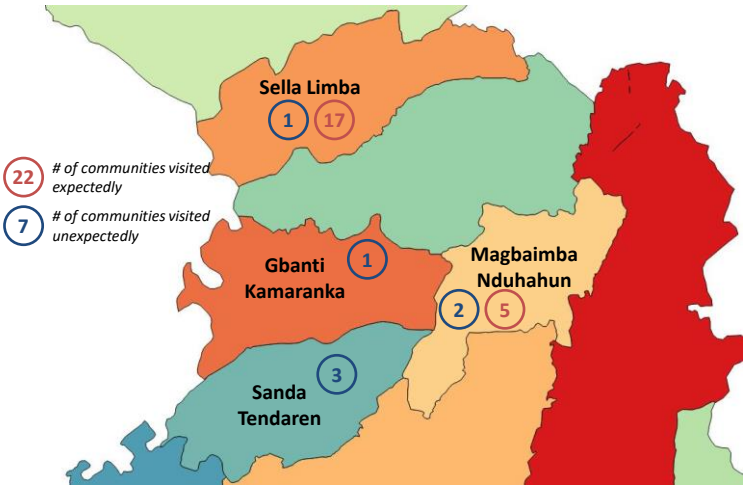


Figure 2 - Size of the communities surveyed

Location

The survey has been conducted in **4 chiefdoms**: Sella Limba, Magabaimba Nduhahun, Gbanti Kamaranka and Senda Tendaren representing **10 sections**.

[1] In case of some chlorinators use a different dosage than the one recommended (2 mL / 5 gallons)



Picture 1 - Location of the communities surveyed

Remoteness

As bleach shop are usually located in main towns, the distance of the community to the shop can be considered as an assessment of the remoteness of the community. The distance between the community and the bleach shop varies **from 900 m to 7.7 km**.

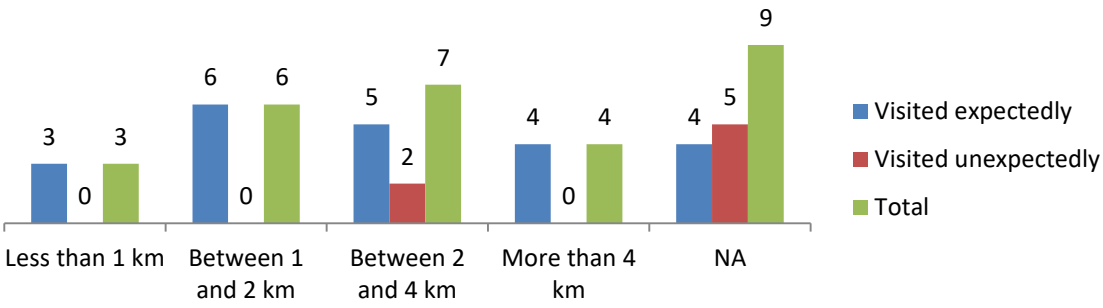


Figure 3 - Distance from the community to the bleach shop

Water point conditions

WPs are **more or less accessible** from the villages. Some WPs are very close and easily accessible (less than 2 minutes walking on a main road, ex: Madineh) while other WPs are far away and have **very bad access paths** (ex: in Kakanthy, very sloppy and slippery pathway down the hill).

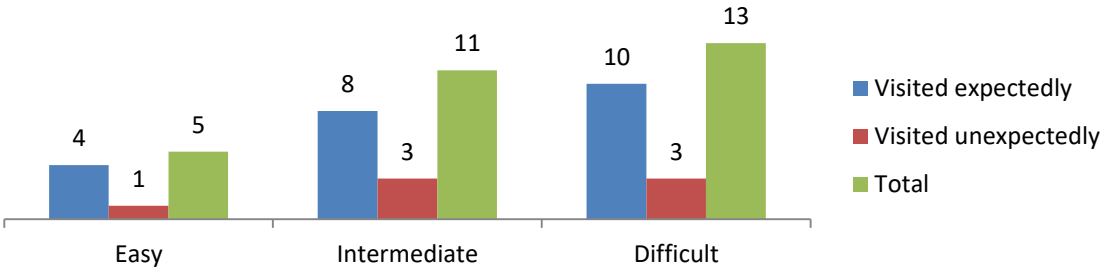


Figure 4 - Water point accessibility[2] in rainy season

[2] Water point accessibility is considered difficult if the path is sloppy, slippery, long…

The communities have different types of WP during rainy season: **streams** (about 50% in rainy season), **local wells** (about 30%) or **swamps** (about 20%). Most of the time, streams are much less turbid than local wells (local wells face the issue of re-digging that increases turbidity), and swamps are intermediate. Commonly, communities fetching water in swamps during rainy season face more constraints during dry season because swamps usually run dry earlier.

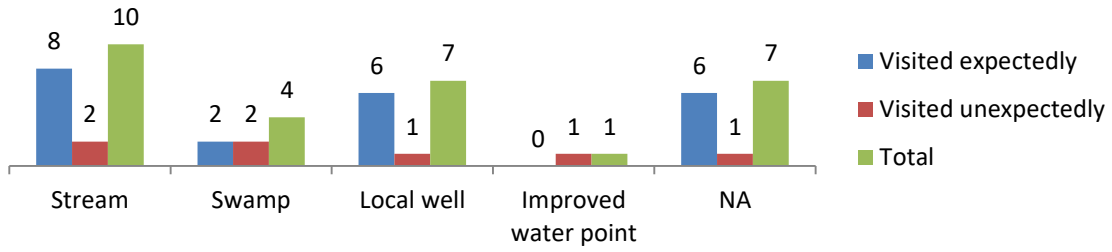


Figure 5 - Type of water point during rainy season of the communities surveyed

Stream	Swamp	Local well
		
Kayumbay	*Kakasekie*	*Kamakubuna*
		
Madineh	*Lower H' Plan*	*Kamatarawalie*

Table 1 - Picture of some traditional WPs during rainy season

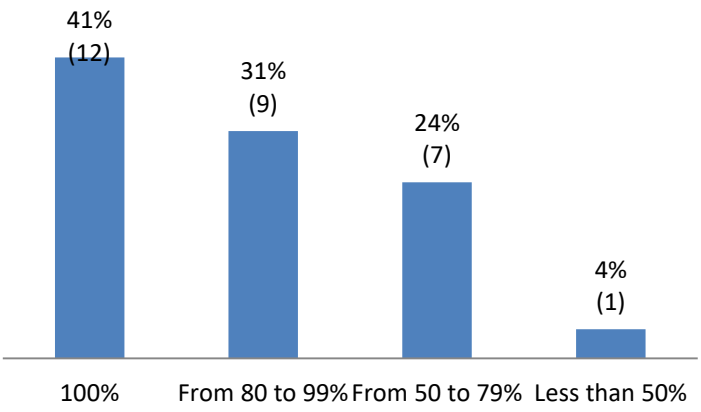
2. Presentation of results

2.1 Defaulter communities

Among the 64 bleach communities visited out of 107 in Bombali district, **no "defaulter community" has been identified**: 100% of the communities trained by IA on HHWT have the chlorination kit available and in good status, chlorine and treated water in most pots. All communities that went through the strategy (from first contact to training) continue HHWT, whether they have been trained a few months or a few years ago.

2.2 Defaulter pots within communities

Among the 340 pots surveyed, 271 had chlorinated water available for drinking, that is to say **80% of the pots**. 41% of the communities had no defaulter pot.



Note: Community with less than 50% of pots with treated water
The chlorinator was in the farm at the time of the visit: only 1 pot out of 6 had treated water, the other ones were waiting for the chlorinator to come back in the afternoon to treat water.

Figure 6 - Repartition of the communities according to the % of pots with treated water

2.3 Reasons for failure

Reasons for failure	Frequency	Type of failure	Recommendations
Pot owner absent or unable to go to the stream	20%	Temporary	*Local source improvement would facilitate water fetching and encourage people to refill more frequently*
Absent during IA's intervention (don't have the material and/or have not been sensitized)	19%	Permanent	*More emphasize during strategy explanation and follow-up visits on the community's responsibilities*
Use private hand-pump nearby	17%[3]	Permanent	
Chlorinator absent	16%	Temporary	*More emphasize during training and follow-up visits on the importance to train other people*
No time / laziness	9%	Temporary	
Wait for everybody	9%	Temporary	
Brought treated water to the farm	4%	Temporary	
Can't pay / doesn't want to pay	2%	Permanent	
Bad taste	1%	Permanent	
Other (mental issues)	1%	Permanent	

Table 2 - Frequency of each reason for failure and recommendations

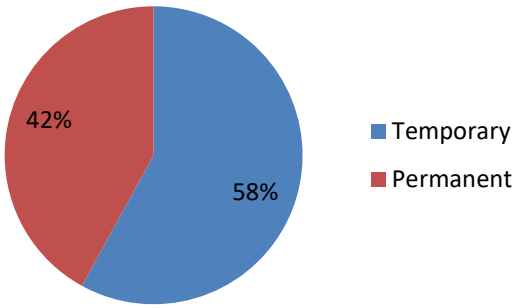


Figure 7 - Repartition of the type of defaulters

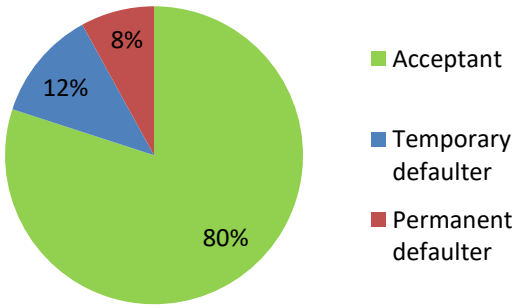


Figure 8 - Repartition of the type of pots

[3] Limited to a small number of households who can afford it but the other villagers of the communities need HHWT.

- **Pot owner absent or unable to go to the stream:**
    - Either old persons – rely on other people (less available) to fetch water for them
    - Either the pot owner responsible for water is sick or injured
      Most of those temporary defaulters drink pure water from their neighbours (except 2 of them who drink rain water because they thought it is safe and only stream water has to be treated)
        - ➔ Reason particularly frequent in communities with bad WP accessibility (Kayumbay – 6' to reach the WP; Kakanthy – 5' on a very sloppy and slippery pathway)
        - ➔ *Solution: Local source improvement to make water fetching easier and encourage people to refill more frequently*

Picture 2 - Sloppy access path to WP

- **Was absent during IA's intervention:**
    - No sensitization: have not been sensitized about the importance of safe water and don't feel the need to treat water like their neighbours. Those permanent defaulters drink directly stream and rain water.
    - And/or no material: did not receive 5 gallons container and did not buy it themselves. Those permanent defaulters drink from their neighbours (or drink rain water thinking it is safe).
        - ➔ *Solution: Insist during strategy explanation on self-sufficiency after training (community responsible for incorporating new inhabitants into the strategy)*
- **Use private hand-pump nearby:** limited to big communities with access to private hand-pump[4] (Kadonkay – 146 people; Lower H'Plan – 203 people) and to a few number of pots in those communities (2 out of 34 in Lower H'Plan, 10 out of 17 in Kadonkay) that can afford it (100 or 200 Le / container). In Lower H'Plan, the chlorinator herself (a nurse) drinks from hand-pump but treats water for others.
    - ➔ *HHWT still practised by most of the pots in those communities; not a reason to prioritize smaller communities – IA should continue to target largest communities under 150 people*
- **Chlorinator absent**
    - ➔ *Solution: Insist during training/follow-up on the importance to train other people that the chlorinators*
- **No time / laziness:** either didn't have time to fetch water or have fetched water/collected rain water but did not have time to treat it. For most of them, the treated water finished a short time ago (in the morning, in the evening the previous day…).
    - ➔ Reason particularly frequent in communities with bad WP accessibility (Kayumbay, Kakanthy)
- **Wait for everybody:** found in one community where people were waiting for everybody to come back from the farm to do the treatment
- **Brought treated water to the farm**
- **Can't pay / doesn't want to pay**: marginal (2 pots out of 69 defaulters)
- **Bad taste**: marginal (1 pot out of 69 defaulters)

[4] Communities around Kamakwie where private hand-pump well have been constructed most of the time after introduction of HHWT by leaders' families (such as politician) who finance the construction and allow other villagers to pay for the use of it.

Contrary to what could be thought, no defaulter has been identified for the following reasons:

- Used to traditional WP: All pots sensitized by IA understand the importance of safe water and accept the idea that treated water is better than water directly from the traditional water point
- No bleach in the shop / No bleach in the community: None of the communities reported a shortage issue by the bleach reseller; all of them had a bottle available (meaning that they went to refill in the shop) and open (meaning that they use it)
- Issues with water committee: Strong togetherness and election of water committee by the community itself enable to avoid such issues
- Didn't pay last contribution: It happens in many communities that a pot can't pay the contribution one time but it does never stop them to get treated water
- Wants a well: some people may only trust hand dug wells to get safe water and not consider HHWT as a serious solution – but no pot was found reluctant because wishing for a well

3. Discussions

The acceptance assessed through this survey may be **biased by the fact that the communities are informed of the visit**, which could make them change their behaviour. Knowing our arrival, people would make sure to have treated water when they usually don't. Actually, **this type of bias is marginal**: the percentage of pots with treated water in the informed communities is only slightly higher (80% vs. 76%).

	# of communities surveyed	Total # of pots	# of pots with treated water	% of pots with treated water
Expected	22	290	233	80%
Unexpected	7	50	38	76%
Grand total	**29**	**340**	**271**	**80%**

Table 3 - Comparison of the percentage of treated water in expected and unexpected visits

According to the team FF, informing the communities of IA's visit has low influence on villagers' behaviours, and **this figure of 80% of pots with treated water is strongly reliable**.

II] Impact of the HHWT on health in the communities

1. Methodology

The goal of this survey was to **assess the impact of HHWT on health in the communities.** The introduction of **HHWT** sometimes came after **latrines construction** (*"old strategy"*) or only with a light **sensitization on sanitation** but no proper latrines follow-up (*"new strategy"*).

CLTS triggering

The purpose of the CLTS triggering is to lead the community to say **"we need to use and build latrines"**. The methodology of the triggering enables the community to realize this on its own instead of suggesting directly the solution.

During the CLTS triggering, the FF conducts a transect walk in the village and force villagers to face reality of open defecation and contamination routes (open food and water, flies, rain). The villagers should come to the idea that the kaka needs to be stored somewhere other than open defecation areas. Sensitization is strengthened by the calculation of the amount of kaka produced by the village in one year and the financial cost of open defecation (transport, treatment at the hospital and lower productivity). The meeting ends with the community's realization that they need to build more covered latrines and to use them to prevent sickness.

Picture 3 - CLTS triggering

To assess the impact of **introduction of HHWT**, a sample of communities that benefitted from the **old HHWT strategy** has been chosen. Most of those communities had benefitted from the **construction of slab latrines in 2008-2009**, and were **introduced to HHWT in 2015**.

One initial house to house survey had been done in December 2014 in the 24 communities of the 2014/2015 campaign before the introduction of HHWT. The FF went house by house to ask each pot owner (most of the time the mothers) questions about **population in their pot** (total number of people, number of male, number of female, number of CU5, number of birth last year), **health** (CU5 diarrhoea today, CU5 deaths last year and reason for death) and **hygiene** (knowledge of the key messages) had been asked (see annex 5: Form for initial house to house survey). The total **number of houses** and **number of latrines in use** in the community was also recorded.

For the redo survey, 22 communities out of those 24 have been chosen to be part of the sample (one community did not go through the HHWT strategy because a local NGO promised them a well[5]): this sample is **the same as the 22 communities visited expectedly** described in part I] 1.3. The same questions about population, health and hygiene have been asked. Only **one question about health has been added (CU5 diarrhoea last week)** to have a more precise idea of diarrhoea prevalence after introduction of HHWT (because the fact that there is no diarrhoea the day of the visit can hide over events and underestimate prevalence). The redo survey has been conducted in November 2016, about two years after the initial one.

[5] Kamakankwie had started the preparation phase: IA had collected their 25% contribution for the purchase of the material, when a local NGO called CADEPS (receiving funding from UNICEF) promised them a well. IA withdrew to avoid conflict with another NGO. CADEPS stopped operations over one year and we don't know if UNICEF will fund them again. Nothing happened yet. IA still has the money of this community and waits for information from UNICEF to take a decision.

	Initial survey	Redo survey
Date	December 2014	November 2016
Status	After latrines construction, before introduction of HHWT	After introduction of HHWT
Questions asked	See annex 5	See annex 5[6]
# of communities	24	22
# of houses	186	189
# of pots	329	291
Population	1,749	1,594
CU5 population	289	238

Table 4 - Description of the surveys

According to the answers, different indicators were calculated: the **prevalence of diarrhoea by CU5** (p), the **annual mortality rate of CU5** (μ) and **the mortality rate of CU5** (U5MR).

$$p = \frac{Number\ of\ CU5\ with\ diarrhoea\ today}{Population\ of\ U5\ children}$$

$$\mu = \frac{Number\ of\ deaths\ of\ U5\ children\ during\ the\ year\ of\ calculation}{Population\ of\ U5\ children + \frac{Number\ of\ deaths\ of\ U5\ children\ during\ the\ year\ of\ calculation}{2}} \times 1000$$

$$U5MR = 1 - e^{-\mu t} \text{ with } t = 5 \text{ years}$$

Formula 1 – Calculation of the indicators

2. Presentation of results

	Initial	Redo
Number of latrines	158	150
Number of houses	186	189
Latrines coverage	85%	79%
Number of CU5	298	238
Number of CU5 with diarrhoea the day of the visit ***(according to the MoCU5)***	**34**	**1**
Prevalence of diarrhoea	**12%**	**Positive but close to 0%**
Number of CU5 with diarrhoea the week before the visit *(according to the MoCU5)*	NA	8
Number of death of CU5 within one year	56	17
Annual mortality rate μ	177‰	69‰
U5MR	**587‰**	**292‰**
Health project (reference)	293‰	165‰
Number of death due to diarrhoea *(according to the MoCU5)*	31	0
% of death due to diarrhoea *(according to the MoCU5)*	55%	0%
Other reasons for death *(according to the MoCU5)*	*"Fever/malaria"* (23%) *"Just after birth"* (11%)	*"Just after birth"* (65%) *"Fever/malaria"* (24%)

Table 5 - Results of the surveys (introduction of HHWT after latrines construction)

[6] With additional question after "U5 diarrhoea today": "U5 diarrhoea last week"

For the **decrease of latrines coverage** from 85 to 79% between December 2014 and November 2016, we can assume that:

- some communities that did not have benefited from slab latrines construction in 2008-09 constructed new latrines after CLTS triggering by IA
- some latrines collapsed and have not been rebuilt
- the number of collapsed latrines is higher than the number of newly built latrines

It is important to notice that among the latrines in use, few respect the criteria of proper sanitation: **few of them were covered** at the time of the survey (either they don't have a cover at all, either they have one but it is not on the pit). What's more, many latrines in use had **damaged fences**.

Although the information about the number of diarrhoea within one week in the redo survey can't be compared with the initial survey, the only 8 cases of diarrhoea among the 238 CU5 the week before the visit in the redo survey confirms the similar good results of the day of the visit. It allows concluding that the prevalence of diarrhoea by CU5 in communities after latrines construction and introduction of HHWT is still positive but **very close to 0%**.

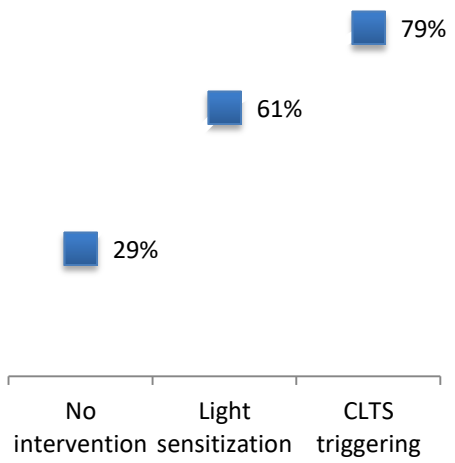
It is difficult to establish a direct link between deaths of U5 children and diarrhoea – see 3. Discussions.

Latrines' coverage

Before intervention:
Initial house to house surveys have been conducted in 20 communities before introduction of HHWT; those communities had not benefitted from slab latrines construction previously. 27 latrines have been counted for 94 houses, that is to say a latrines' coverage of **29%**.

Light hygiene and sanitation sensitization:
In the new HHWT strategy, no proper CLTS triggering is conducted but communities are lightly sensitized on hygiene and sanitation. In the redo surveys of 6 communities that benefitted from this fast strategy, 23 houses have been counted for 38 houses, that is to say a latrines' coverage of **61%**.

CLTS triggering:
As explained above, proper CLTS triggering leads to a latrines' coverage of about **80%**.



3. Discussions

3.1 Limits

The results obtained by this methodology are surprising.

The initial prevalence of diarrhoea seems to be particularly high, when it seems to be miraculously low in the redo survey. According to data collected in the PHUs, some CU5 are still admitted in the PHUs for diarrhoea even after latrines construction and/or introduction of HHWT in their community: even if close to zero, **diarrhoea prevalence by CU5 after intervention is positive**.

As well for the U5MR: for the 3 surveys, **U5MR calculated before intervention is very high** (between 442‰ and 589‰, meaning that one child over two would die before reaching 5 years). We can compare those results with **national average**: 175‰ in Sierra Leone in 2010 according to WHO (even if WHO's methodology may be challengeable as well). U5MR in Bombali district is estimated in 2010 by WHO at 112‰. We can also compare

with results **from surveys done by IA as part of a health project** in other chiefdoms of Sierra Leone with a similar methodology. The health project consisted in sensitization on hygiene and sanitation, construction of slab latrines and sometimes training of a CHW. The average calculated U5MR **293‰ before intervention and 165‰ after**.

			Initial survey						Redo survey				
Intervention	Location	Date	Total pop	CU5 pop	Nb deaths last year	µ	**U5MR**	Date	Total pop	CU5 pop	Nb deaths last year	µ	**U5MR**
Health project	Mahari	Apr-11	2,248	502	50	95‰	**378‰**	Apr-12	2,162	408	16	38‰	**175‰**
	Kortohun	Apr-11	4,757	887	91	98‰	**386‰**	Apr-12	4,933	838	64	74‰	**308‰**
	Tambiama	Nov-11	4,256	761	46	59‰	**254‰**	Nov-12	3,389	686	5	7‰	**36‰**
	Madina Loko	Nov-11	3,129	535	29	53‰	**232‰**	Nov-12	3,048	458	9	19‰	**93‰**
	Kagbaneh	Nov-12	4,430	768	35	45‰	**200‰**	Nov-13	4,404	828	24	29‰	**133‰**
	Bumbanbain	Nov-12	2,566	418	27	63‰	**269‰**	Nov-13	2,566	486	18	36‰	**166‰**
TOTAL			21,386	3,871	278	69‰	**293‰**		20,502	3,704	136	36‰	**165‰**

Table 6 - Results of surveys done as part of a health project

Some factors could explain that the **mortality is particularly high in the selected sample**:

- Those communities are all located in **rural areas**, where mortality is higher than urban areas
- Some communities are particularly **remote**, making access difficult for intervention of NGOs or government
- The communities are **very small**: the average population is 55 people (HHWT only), 72 people (HHWT after latrines)
- The communities have very **poor WASH facilities**: drink directly from traditional water point and have low latrines coverage (29% for HHWT only)
- The **level of education** is very low

Still, considering those factors, the U5MR remains surprisingly high and it is important to keep in mind all the biases that challenge the results' reliability.

First, those results can be challenged by the **small size of the sample** (between 200 and 300 CU5 in each survey), leading to **wide confidence intervals** (around +/- 100‰ for the U5MR). Then, the answers given by the MoCU5 include many uncertainties on:

- The **total number of CU5**: many MoCU5 only know approximately the age of their children
- The **number of CU5 with diarrhoea today**: the answers of MoCU5 to this question is poorly reliable unless the FF asks to see the sick child
- The **number of deaths of CU5 last year**: uncertainties about
    - The age of the child who died: was he really under five?
    - The date of the death: was it really within the 12 last months?
- The **reason for death**: the reason for death of a CU5 is seldom clearly known by the mother, and there is big chance that the previous questions asked by the FF influences the answer. When the FF asks first if one CU5 has diarrhoea today and then if a CU5 died last year and for which reason (methodology of the surveys for CLTS and HHWT), diarrhoea comes as a **reason for 58% of the deaths**, fever comes for 22%. When the questions are inverted (methodology of the health projects)**, diarrhoea comes as a reason for only 8% of the deaths**, and fever comes to 45%.

Intervention	Location	Nb deaths last year	Initial survey # death / diarrhoea	% death / diarrhoea	# death / fever	% death / fever	# other	% other
HHWT after CLTS		56	31	55%	13	23%	12	21%
Health project	Mahari	50	12	24%	23	46%	15	30%
	Kortohun	91	5	5%	42	46%	44	48%
	Tambiama	46	1	2%	26	57%	19	41%
	Madina Loko	29	4	14%	12	41%	13	45%
	Kagbaneh	35	0	0%	13	37%	22	63%
	Bumbanbain	27	1	4%	9	33%	17	63%
TOTAL		**278**	**23**	**8%**	**125**	**45%**	**130**	**47%**

Table 7 - Difference of reasons for deaths depending on the questions' order

According to this, the proportion of deaths of CU5 *"due to diarrhoea"* in the initial surveys is overestimated. In 2010, WHO estimates that **18%** of post neonatal deaths (aged between 1 and 59 months) are caused by diarrheal diseases.

Then, there may be **conscious or unconscious biases introduced by both the interviewee and the interviewer**:

- Interviewee: people who wish for assistance by an NGO may darken the situation in their village during the first contact and make it more beautiful after the program to show that they have understood the messages spread by the NGO
- Interviewer: the FF may want to increase the difference between initial and redo surveys so that his action on the field seems more efficient

Concerning the diarrhoea prevalence, another **temporal bias** has to be taken into account: the initial survey was done in December while the redo survey was done in November (when rains were still coming and people were still drinking rain water). This temporal difference, coupled with the seasonality of diarrhoea, may introduce a bias.

What's more, this strong decrease in mortality rate and prevalence of diarrhoea may come from other factors that IA's intervention, and it is **not easy to input the evolution directly to IA's intervention**:

- **CHW** may have been trained in some communities, enhancing global health
- **Ebola outbreak in 2014** may have:
  - Increased the mortality rate calculated in December 2014
  - Decreased the mortality rate calculated in November 2016 because of increased sensitization on hygiene and sanitation (esp. hand washing)

Still, those results give global tendencies that can be trust. Indeed, the differences are significant and the wide confidence intervals don't overlap. **Global trends of decrease of diarrhoea prevalence and mortality of CU5 can be trust**, but absolute rates can only be trust gingerly.

	Diarrhoea	Population	Diarrhoea prevalence			
			p	Δp	CI-	CI+
Initial	34	289	11.8%	3.7%	8.1%	15.5%
Redo	1	238	0.4%	0.8%	0%	1.2%
Δ			**-11.4%**			

Table 8 - Comparison of diarrhoea prevalence between initial and redo surveys

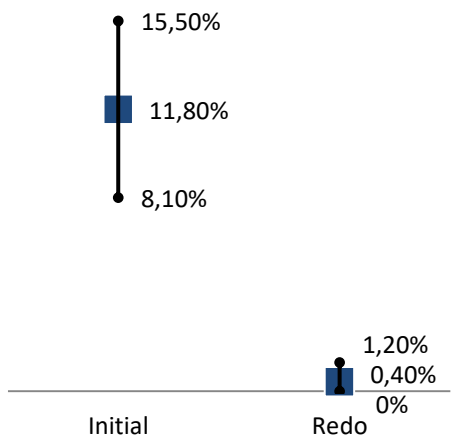


Figure 9 - Prevalence of diarrhoea by CU5 and confidence interval

	μ				U5MR			
	μ	Δμ	CI-	CI+	U5MR	CI-	CI+	ΔU5MR
Initial	177‰	40‰	136‰	217‰	587‰	494‰	662‰	84‰
Redo	69‰	31‰	38‰	100‰	292‰	172‰	394‰	111‰
Δ	**-108‰**				**-295‰**			

Table 9 - Confidence intervals of calculated μ and U5MR

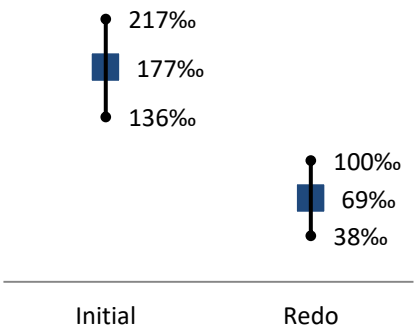


Figure 10 - Annual mortality rate μ and confidence interval

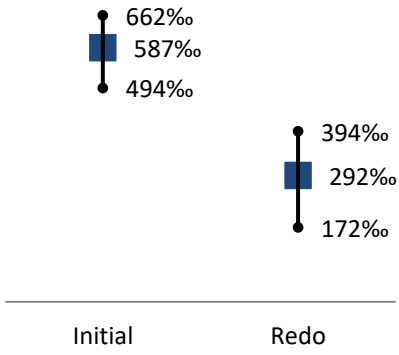


Figure 11 - U5MR and confidence interval

3.2 Conclusions

Finally, both measures of diarrhoea prevalence and mortality rate comprise **many biases and uncertainties** that reduce their reliability. The decreases in diarrhoea prevalence and mortality measured have to be considered as **upper estimations**. Still, the **tendencies are clear** and it is legitimate to trust that **intervention with HHWT or latrines have a strong positive impact on health**.

Between the two indicators, **the diarrhoea prevalence should be trust more strongly**:

- Questions about diarrhoea comprise less uncertainties: observable the day of the survey and doesn't rely on the mother's memory
- The link between HHWT and diarrhoea is more direct than the link between HHWT and mortality: many other factors influence child mortality and it is hard to pretend dividing by 2 the U5MR while acting only on diarrhea and not on malaria

3.3 Recommendations

In order to get more accurate data on the impact of the program, **conduction and analysis of initial and redo house to house surveys** have to be continued following the recommendations below:

- **Increase the awareness of the FF** towards the importance of the quality of data collection to reduce uncertainties about:
    - The **total number of CU5**: the FF should systematically ask to see the CU5, and if there is any uncertainty about the age, do the quick test (ask the child to catch his ear with his opposite hand by passing up his head: if the hand reaches the ear, the child has more than 5 years)
    - The **number of CU5 with diarrhoea today**: the FF should systematically ask to see the sick child and confirm if he seems to be sick or not
    - The **number of deaths of CU5 last year**:
        - Age of the child who died: when was he born? was he really under five?
        - Date of the death: was it really within the 12 last months? Always use temporal references (ex: Christmas, Ramadan, beginning of rainy season, last groundnuts harvest, mangos falling, etc…).
    - The **reason for death**: do not suggest any answer to the pot owner – let her give the reason by herself.

  
  Picture 4 - Child under 5

  Globally speaking, the FF should **spend more time with each pot owner** to confirm as often as possible the validity of the answers, and should fulfil the form **as objectively as possible**.
- **Enhance the form for house to house survey** (see annex 6: Enhanced form for house to house survey):
    - **Invert the questions**: ask the number of death of CU5 and the reason for death before the number of CU5 with diarrhoea
    - Keep the question about **CU5 with diarrhoea within the week** in the initial and redo surveys to allow comparison
- A **training** should be organized with all the FF to explain them the purpose of the amendment of the form, make them aware of the main traps of the survey to which they have to pay more attention and share those recommendations
- To make sure that the FF have taken into account those recommendations and increased their rigor on data collection, some **confirmations of survey** can be planned (a supervisor goes randomly in some communities surveyed by one FF, redoes the survey and checks the consistency of results).

Impact of HHWT on water consumption?

One part of the survey aimed at assessing if introduction of HHWT influences **water consumption.**

Hypotheses:

Introduction of HHWT could increase water consumption:

- Strangers know that water is pure in this village and ask for water when passing through
- Villagers know that treated water is pure: they stop drinking directly from the stream (consumption not measured) and drink only from the container

Introduction of HHWT could decrease water consumption:

- Villagers don't like the taste of chlorine / are afraid of drinking it
- Treating water is time-consuming so people have less often water available for drinking

It was planned to measure water consumption in HHWT communities and compare it with communities before introduction of HHWT. One form was created to facilitate calculation and a training was organized to explain the methodology to the FF (see annex 7: Training on water consumption calculation). The FF came the day before the measurement, asked all pot owners not to throw the balance drinking water before IA's visit and came back early in the morning the day after. According to the size of the container, the volume of balance water, the number of days of consumption and the number of people drinking in this container, the **average water consumption per day and per capita** was calculated.

To measure water consumption **after introduction of HHWT**, the same sample of 22 communities from the 2014-2015 campaign has been chosen and the measurement has been done in **151 pots** in **November**. In average, the consumption was **1.5 L/day/capita**.

The measurement of water consumption was not available in the initial survey of those 22 communities, so a sample of **13 future bleach communities** has been chosen (where the FF were doing first contact and latrines follow-up) as the **reference**.

Surveyor	Date	Community	# of pots	Pop
Chermor A. Bangura	10/01/2017	Gandebu	6	33
Joshua S. Kargbo	08/01/2017	Tombohun	9	42
Joshua S. Kargbo	09/01/2017	Romankay	6	24
Joshua S. Kargbo	06/01/2017	New site	10	45
Joshua S. Kargbo	07/01/2017	Mabombolili	9	51
Alusine Samura	06/01/2017	Macomborma	13	50
Alusine Samura	05/01/2017	Makoheh	8	32
Alusine S. Kargbo	05/01/2017	Makokoi	11	57
Alusine B. Kamara	08/01/2017	Makoli	20	105
Hassan Bangura	08/01/2017	Mangahun	19	136
Hassan Bangura	10/01/2017	Kargbo	10	49
Alusine Samura	12/01/2017	Gain	20	97
Chermor A. Bangura	13/01/2017	Makendi	23	101
TOTAL	**January 2017**	**13 communities**	**164**	**822**

Table 10 - List of the reference sample of communities

Because of some delays due to construction constraints, the measurement was done in **January** in **163 pots**. In average, the consumption was higher: **1.7 L/day/capita**.

Communities	# of pots measured	Average of water cons	StdDev of Water cons
Test (after HHWT)	151	1.5 L / day / capita	0.6
Reference (before HHWT)	163	1.7 L / day / capita	0.6
Grand Total	**314 pots**	**1.6 L / day / capita**	**0.6**
Total variance	**0.59**		

t Student calculated	**3.45**
t Student table (p=95%)	**1.98**
SIGNIFICANT DIFFERENCE	

Table 11 - Student test analysis to assess the impact of HHWT on water consumption

According to a Student test (see the formula next page), the **difference between the two samples is significant**. Unfortunately, both surveys have not been conducted at the same period of time and it is hard to conclude that the difference comes from introduction of HHWT. Temperature is higher in January (November is the end of the rainy season with still regular rains), and we can assume that **the increase comes more from the temporal bias than from the introduction of HHWT**.

Finally, this survey only gives **ideas of water consumption in Northern Sierra Leone in November and January** (between 1.5 and 1.7 L/day/capita). The result may be biased by two factors:

- Overestimated consumption: When a person wants to drink, she/he turns some water into the cup, drinks and throws the balance water remaining in the cup.
- Underestimated consumption: People using other water sources:
    - water direct from water point: limited in the HHWT communities that have been sensitized on the issue of safe water; may be more important in the reference communities, esp. for people working in the farm
    - palm wine: limited to certain (non-Muslim) communities and to certain people (mainly men)
    - packet water: consumption of packet water limited in the communities because of low purchasing power (consumption only in case of travel to bigger towns)

Globally, the second factor seems to be limited compared to the first one and those values of water consumption must be considered as a high estimations.

But the survey **doesn't give any results** regarding impact of HHWT on water consumption. To assess it properly, the same methodology should be followed but **the measurements should be done exactly at the same time in the test and reference communities**.

III] Properties of Free Residual Chlorine

Some tests conducted on the field with samples of water from the HHWT communities lead to the following hypothesis related to the properties of FRC:

1. FRC would depend on the type of water source (rain / stream)
2. FRC would decrease with the dirtiness of the container
3. FRC would decrease with time since treatment
4. FRC would decrease with time since opening of the bleach bottle
5. FRC would depend on the storage conditions of the bleach bottle and the container

The hypothesis 1, 2 and 3 were tested through a **statistical analysis** of 261 DPD tests conducted on the field, and the hypothesis 2, 4 and 5 through **tests conducted in the lab** at office level.

1. FRC statistical analysis

1.1 Methodology

In order to **assess the impact of different factors on FRC in water** (time since treatment, water source, cleanness of container), the **DPD tests** conducted in each pot with chlorinated water during the house to house surveys in bleach communities (see I] 1. Methodology of the survey) have been **recorded in a database and analysed**. The containers with a FRC above 2.0 have not been taken into account because they undeniably come from a wrong dosage not recommended by IA.

The FRC statistical analysis uses a sample of **261 DPD tests** done in **29 different communities** in **November 2016**. The water source (rain / stream / pump / well), time since treatment (1h to 72h) and cleanness of the container (yes/no) have been recorded for each sample.

Water source	# of DPD tests
Rain	42
Stream	209
Pump[7]	5
Well	5
Grand Total	**261**

Time since treatment	# of DPD tests
1h	1
2h	21
6h	3
12h	29
15h	9
24h	122
48h	75
72h	1
Grand Total	**261**

Cleanness of the container	# of DPD tests
No	46
Yes	187
NA	28
Grand Total	**261**

Table 12 - Description of the sample of DPD tests used for the statistical analysis

For each factor, **Student tests** have been conducted.

[7] 5 pots surveyed used to treat water from a hand-pump facility with chlorine.

Student tests are simple statistical tests that enable to **determine if the difference between two samples of variables is significant or not**.

For two samples of variables with n_1 and n_2 measures in each, of averages m_1 and m_2 and standard deviations σ_1 and σ_2, we calculate the **total variance** v:

$$v = \sqrt{\frac{n1 * \sigma 1^2 + n2 * \sigma 2^2}{n1 + n2 - 2}}$$

Then we calculate **t Student calculated**: $\frac{|m1 - m2|}{v * \sqrt{\frac{1}{n1} + \frac{1}{n2}}}$

And we compare this t Student calculated with **t Student given in a table**: if t Student calculated is higher than t Student table, the samples are significantly different.

Formula 2 - Student test

In addition to DPD tests, **coliform tests with a DelAgua kit** have been conducted on a sample of 13 containers of treated water in which FRC had dropped to 0 (see annex 8: Protocol of coliform tests with DelAgua kit). This test enables to spot faecal coliforms (Escherichia Coli or E. Coli) in a sample of water. These bacteria testify the faecal contamination presence.

1.2 Presentation of results

Measured FRC

The measured FRC varies **from 0 to 1.2** and reaches **0.4 in average**. **18% of the tests revealed a 0 FRC** although water had effectively been treated. A big majority of FRC are comprised between 0.1 and 0.5, and a very thin minority exceeds 1.0.

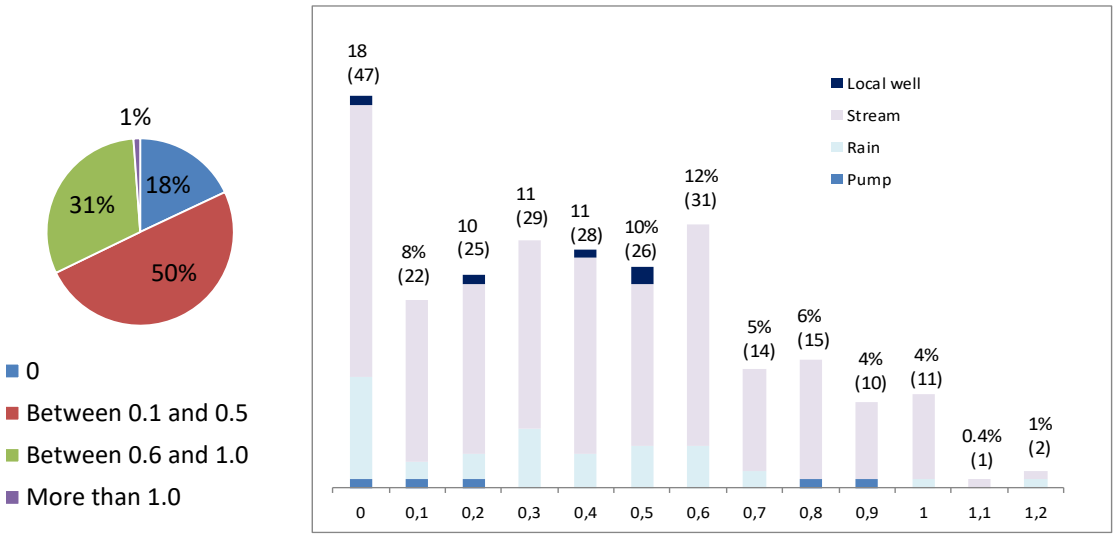


Figure 12 - Repartition of FRC measured in the communities according to type of water

Note: There is **low chance that a 0 FRC was measured because water had not been treated**. People would easily say if they have treated water or not, and the DPD test can be seen as a kind of threat that would encourage them not to lie; most of the time, they don't even pull the container out of their house when they don't have chlorinated water. According to this, we can consider that all samples had effectively been treated.

Coliform tests revealed that **water treated with chlorine in which FRC dropped to 0 is still safe**. For the 13 samples, **all coliform tests were negative** (absence of coliforms).

Influent factors

The results of this analysis of the influence of each factor reveal that:

1. Water source has **no significant impact** on FRC

Water source	# of DPD tests	Average FRC	StdDev of FRC
Rain	42	0.32	0.29
Stream	209	0.42	0.31
Grand Total	**251**	**0.40**	**0.31**

Total variance	0.30
t Student calculated	1.77
t Student table (p=95%)	1.98
NO SIGNIFICANT DIFFERENCE	

Table 13 - Student analysis to assess the impact of water source

We can notice that there are **big differences of water quality for one same type of water source**:

- Rain water can be more or less turbid and contaminated depending on the way it is collected (directly in a bucket or from a roof) and depending on the cleanness of the bucket and the roof…
- Stream water can be more or less contaminated depending on the number of communities upstream, the type of soil…

According to this, **statistically speaking we can't conclude directly that one type of water source (rain or stream) would lead to higher or lower FRC after treatment**, and the communities should continue treating indifferently rain and stream water. Actually, we know (according to tests previously conducted in December 2015) that **the turbidity of water source is one of the important factors explaining differences of FRC**, more than the type of water source.

Mission report December 2015: Tests on chlorination dosage evolution (made at office level) – 16/12/2015

Some chlorination tests were made with James, Gabriel, Kelvin, Guard & Damien… in order to verify different possibilities of evolution of chlorine level in containers according to different parameters of contamination with the water fetched from the office well.

1st round of test: chlorine level from 4 different bottles + impact of dust "recontamination".

- **We tested 4 different bottles (bought the same day in the shop, from the same lot). Dosage of 2ml/20l: the free residual chlorine (FRC) was similar for the different bottles and was giving at least 2mg/l of residual chlorine with filtered water after 30 min and after 2 hours (and a bit less than 2 mg/l –between 1.5 and 2- after 30 min for unfiltered water).**
- **For experimentation: we added one *spoon of dust*/soil in the treated unfiltered container (20 liters), after 2 hours the residual chlorine was around 1 mg/ liter.**

2nd round of test: Impact of recontamination on treated water (2 liters).

Repetitions for 2 initial levels of Free Residual Clorine.
2lines of 4 buckets filed with 2 liters of treated water.

- ***FRC =2 mg/l (above line of buckets)***
- ***FRC =0.8 mg/l (below line of buckets)***

4 type of "recontamination" of the water: ***Nothing / leaf of cashew tree/soaking kelvin' hands*/ 1spoon of dusty soil***

****Kelvin soak is right hand in above bucket and his left hand in below bucket at the same moment during 20 sec.***

Initial FRC	***Free Residual chlorine (FRC) 2 hours after "recontamination" (mg/l)***			
	Nothing(control)	leaf of cashew tree	soaking kelvin' hands	1spoon of dusty soil
2 mg/l	***2***	***0.9***	***0.05***	***0.5***
0.8 mg/l	***0.5***	***0.1***	***0***	***0***

This test shows that "recontamination" with hands result in a more important reduction of FRC than with tree leaves or dust (oxidation of chlorine on hands is rapid and there is not much organic matter in dust; while tree leafs are quite impervious).

***Water in the mouth;* A complementary test as a curiosity: Testing the water (2mg/l initial FRC) after putting it in the mouth: No more FRC! Oxidation process of the chlorine is done immediately in the mouth.**

2. Cleanness of containers has **no significant impact** on FRC. Still, results from the lab tests induce that the cleanness of the container has an impact on FRC (see III] 2. Lab tests).

Cleanness container	# of DPD tests	Average FRC	StdDev of FRC
No	46	0.34	0.33
Yes	187	0.41	0.30
Grand Total	**233**	**0.40**	**0.31**

Total variance	0.31
t Student calculated	1.46
t Student table (p=95%)	1.96
NO SIGNIFICANT DIFFERENCE	

Table 14 - Student analysis to assess the impact of cleanness of container

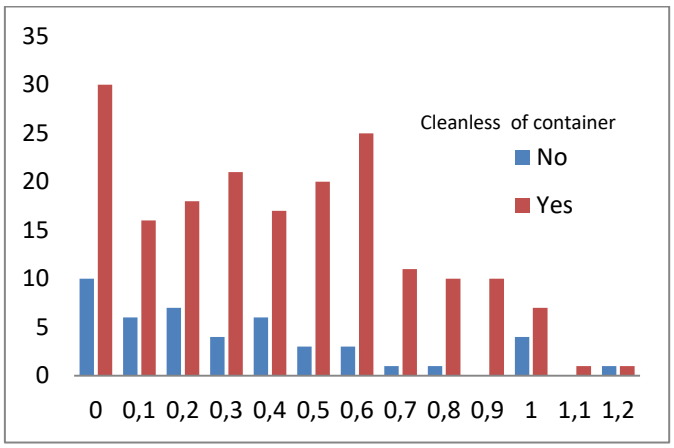


Figure 13 - Repartition of FRC measured in the communities according to cleanness of containers

Actually, the **assessment of the cleanness of containers by the FF is very subjective and poorly reliable**, which could explain why the analysis of this factor doesn't lead to significant results.

3. Time since treatment has **significant impact** on FRC – **FRC decreases with time**

Time since treatment[8]	# of DPD tests	# of 0 FRC	% of 0 FRC	Average FRC	StdDev of FRC
2h	21	0	0%	0.74	0.26
12h	29	5	17%	0.39	0.31
24h	122	16	13%	0.41	0.25
48h	75	25	33%	0.23	0.28
Grand Total	**247**	**46**	**19%**	**0.38**	**0.30**

Between 2 and 12h		Between 2 and 24h		Between 12 and 48h		Between 24 and 48h	
Total variance	0.29	Total variance	0.29	Total variance	0.29	Total variance	0.26
t calculated	4.15	t calculated	4.83	t calculated	2.54	t calculated	4.56
t table (p=99%)	2.00	t table (p=99%)	1.96	t table (p=95%)	1.98	t table (p=99%)	1.96
SIGNIFICANT DIFFERENCE		**SIGNIFICANT DIFFERENCE**		**SIGNIFICANT DIFFERENCE**		**SIGNIFICANT DIFFERENCE**	

Between 12 and 24h	
Total variance	0.26
t calculated	0.26
t table (p=95%)	1.98
NO SIGNIFICANT DIFFERENCE	

Table 15 - Student analysis to assess the impact of time since treatment

There is one inconsistency between 12 and 24h after treatment: average FRC 12h after treatment (0.39) is lower than 24h after treatment (0.41). Actually, the Student test between 12 and 24h reveals that this difference is not significant.

The **FRC decreases strongly with time** (from 0.74 in average 2 hours after treatment to 0.23 48 hours after treatment).

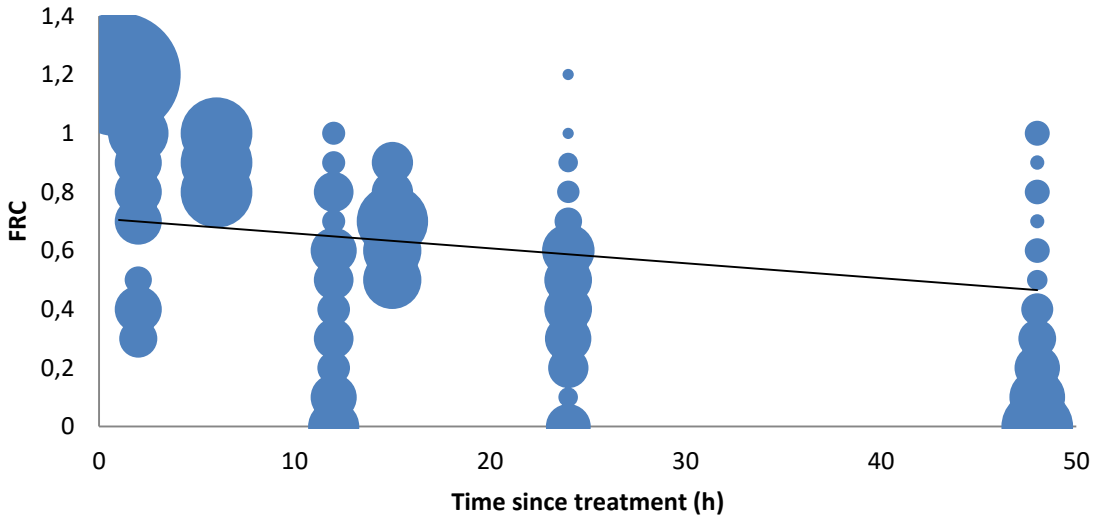


Figure 14 - Weight repartition of the measured FRC along time

[8] Measures stop at 48h after treatment (except one) because communities are recommended to redo the treatment every two days (they use balance water for another purpose and fetch new water to treat it)

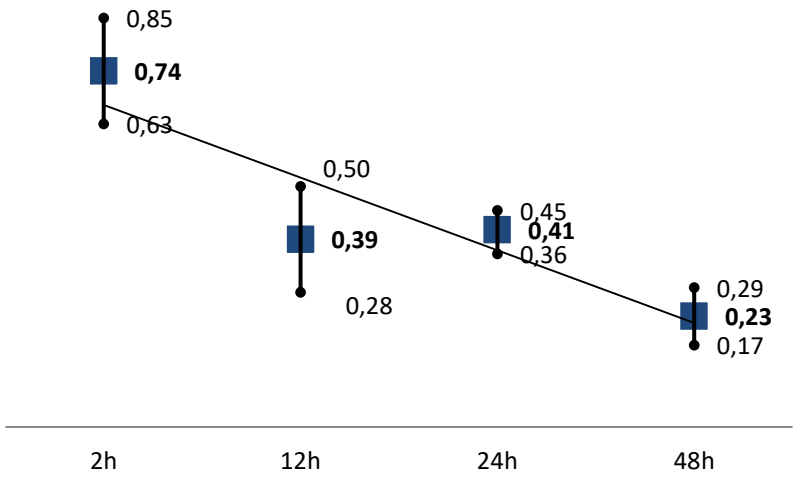


Figure 15 - Average FRC per time since treatment and confidence interval

And **the number of 0 FRC increases with time** (from 0% 2 hours after treatment to 33% 48 hours after treatment).

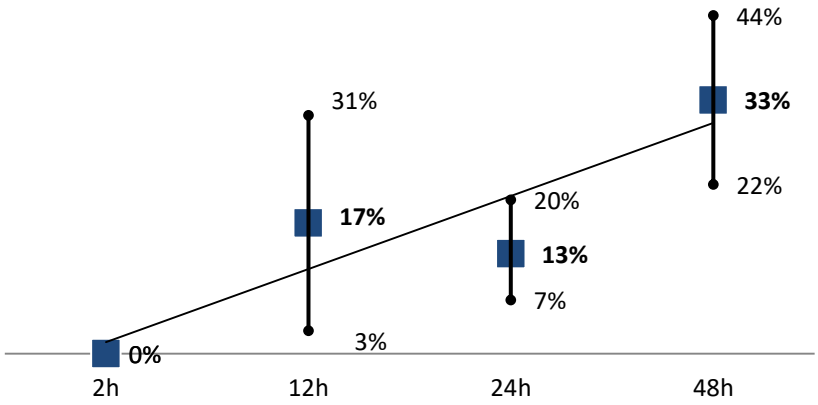


Figure 16 - Frequency of 0 FRC per time since treatment and confidence interval

Still, 77% of the samples still have positive FRC 48h after treatment and we can consider that **the recommendation to redo the treatment every 2 days is a good guarantee for safe water**.

2. Lab tests

2.1 Methodology

In parallel, some tests have been conducted in lab to confirm or deny some conclusions, and to assess some additional factors. A protocol for tests in lab has been prepared (see annex 9: Protocol for tests in lab) to assess the following factors:

1. **Bottle's time after opening and conditions of use after opening**
2. **Container's conditions of use after treatment**
3. Chlorine concentration in the bottle
4. Bottle's time after manufacturing and storage conditions before opening
5. Water pH

Only the **two first tests** could have been conducted, and the first test could only be conducted during 5 weeks. The impact of the water turbidity had already been enlightened.

2.2 Presentation of results

Bottle's time after opening and conditions of use after opening

Each week during 4 weeks, three containers full of water from the same source (hand dug well) were treated with different bottles of chlorine: one bottle ("never") was only opened for the treatment, the second one ("sometimes") was opened 30 minutes / day, the third one ("frequently") was opened 1 hour / day.

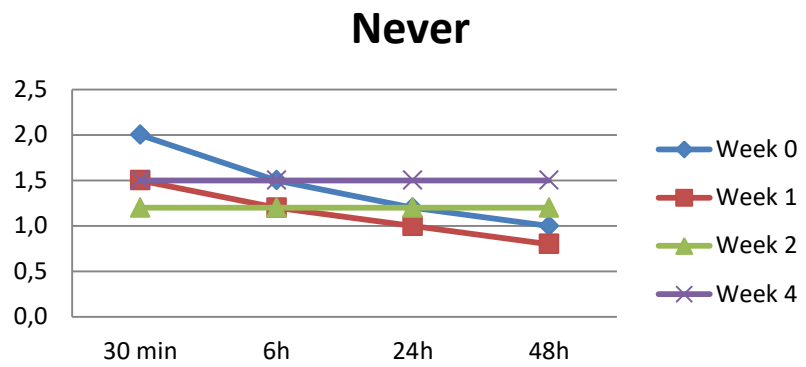
Week 0				
	30 min	6h	24h	48h
Never	2.0	1.5	1.2	1.0
Sometimes	2.0	1.5	1.5	1.2
Frequently	2.0	1.5	1.2	1.0

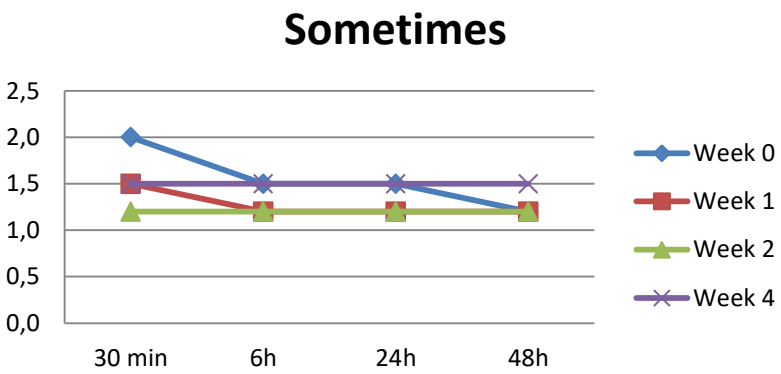
Week 1				
	30 min	6h	24h	48h
Never	1.5	1.2	1.0	0.8
Sometimes	1.5	1.2	1.2	1.2
Frequently	1.5	1.2	1.0	1.0

Week 2				
	30 min	6h	24h	48h
Never	1.2	1.2	1.2	1.2
Sometimes	1.2	1.2	1.2	1.2
Frequently	1.2	1.2	1.2	1.2

Week 3				
	30 min	6h	24h	48h
Never	1.0	1.0	1.0	1.0
Sometimes	1.5	1.2	1.2	1.2
Frequently	1.5	1.2	1.2	1.2

Week 4				
	30 min	6h	24h	48h
Never	1.5	1.5	1.5	1.5
Sometimes	1.5	1.5	1.5	1.5
Frequently	1.5	1.5	1.5	1.5





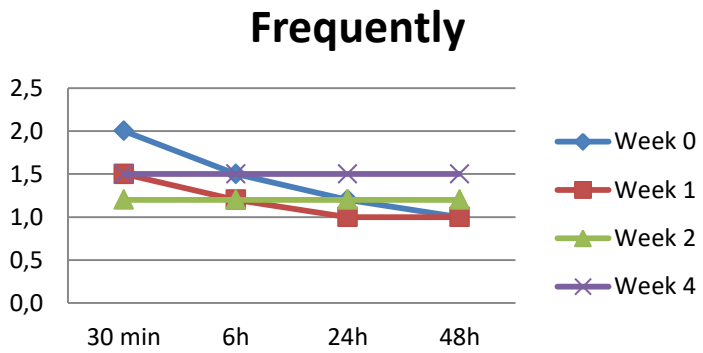


Table 16 - Results of the lab test on bottle's time after opening and conditions of use after opening

The FRC are equivalent for any conditions of use of the bottles (never: bottle opened only for treatment; sometimes: bottle opened 30 minutes / day; frequently: bottle opened 1 hour / day). The **conditions of use seem to have no or low influence on FRC**.

As well, there is a slight decrease with time after opening of the FRC 30 min after treatment, but this difference disappears from 6 hours to 48 hours after treatment: the **bottle's time after opening seems to have no or low influence on FRC**.

Another factor has been enlightened unexpectedly by these tests: weeks after weeks, the decreasing trend of FRC with time reduces: from week 2, the FRC in all containers is almost constant from 30 min to 48h after treatment. The main difference along the weeks is the cleanness of containers. In week 0, the containers had just been bought at the market and have certainly not been cleaned perfectly (some of them had a strong odour of petrol). Weeks after weeks, those containers have contained nothing else but clean water (from hand-pump) and chlorine. According to this, we can assume that **the cleanness of the container has a strong impact on FRC**.

Container's conditions of use after treatment

Experimentation 1: Three containers full of water from the same source (hand dug well) were treated with the same bottle of chlorine. The first one ("never") was opened only for the treatment, the second one ("sometimes") was opened 2 hours / day and the third one was opened 6 hours / day.

Experimentation 1				
	30 min	6h	24h	48h
Never	0.8	0.4	0	0
Sometimes	1.5	1.2	1.2	1.0
Frequently	1.5	1.3	1.3	1.2

Experimentation 2				
	30 min	6h	24h	48h
Never	1.5	1.2	1.2	1.0
Always	1.5	1.2	1.2	1.0

Table 17 - Results of the lab tests on container's conditions of use after treatment

The results from the **experimentation 1** are opposite as expected: FRC decreases faster in the container opened only for the DPD tests than in the containers opened 2h and 6h per day. Actually, the containers used for this experimentation were new, and the container "Never" had a strong taste of petrol. This difference may be due to a difference of cleanness of the containers.

Another experiment has been done **(experimentation 2)** with two clean containers, one always open, the other one never open (only for the DPD tests). As the previous experimentation, the water came from the same hand-pump and the samples have been treated the same way with the same bottle of chlorine. We can conclude from the results that **the conditions of use of the container after treatment have no or low influence on FRC**.

3. Discussions and conclusions

The results from the statistical analysis and lab tests about the impact of the cleanness of containers are opposite. We can assume that this contradiction comes from the fact that the assessment of the cleanness of the container by the FF is very **subjective** and may be a poorly reliable factor. We know that **chlorine reacts with organic matter present in water**: a dirty container has more chance to have a lower FRC, and on this point the lab tests are more reliable than the statistical analysis.

Finally, we can summarize the factors influencing or not FRC:

Influence on FRC	No or few influence on FRC
Presence of germs / organic matter in the fetched water	Date of opening of the bleach bottle
Time since treatment	Conditions of use of the bleach bottle
Turbidity of local water point	Conditions of use of the container
Cleanness of container	

Table 18 - Factors influencing FRC

Some lessons have to be learned from this study:

- Not too much attention should be paid to the **date of opening of the bleach bottle**: the FF should not convince the communities to buy a new bottle 2 months after opening of the first one
- Not too much attention should be paid to the **conditions of use of the bleach bottle and the container**
- The advice to redo the **treatment every 2 days** has to be kept because the FRC decreases strongly with time. Anyway, in most of the pots, population is big and the 5 gallons container is empty before the end of the 2 days: this advice is not a big constraint for the communities
- The FF should explain to the communities that **the more the water is turbid, the less the chlorine will be efficient**: this should not encourage them to increase the dosage in case of high turbidity, but to find water points less turbid (or fetch water in a particular area of the water point where water will be less turbid) – if the traditional water point is particularly turbid, the community should be considered as priority for local source improvement.
- The FF should explain to the communities that **the more the container is dirty, the less the chlorine will be efficient**: importance to wash regularly the container with soap
- Finally, if the FF measures a 0 FRC in a community but:
    - Water has effectively been treated (checked with the pot owner and the chlorinator): properly filtered and with the right dosage
    - Water has been treated less than 2 days ago
    - Container is clean

  It probably means that the **water fetched contained germs** with which chlorine has reacted. The FF should explain this to the pot owner, clarifying that water is still safe because it has been treated but will not be safe anymore in case of new contamination: the pot owner should pay a particular attention to the hygiene and sanitation rules (clean cup, use of latrines, hand washing).

ANNEX 1: GUIDELINES ON HOUSE TO HOUSE SURVEYS

WHY?

- **Initial survey:** understand the initial situation in the community in terms of water and sanitation
- **Redo survey:** understand the final situation in the community in terms of water and sanitation after IA's intervention to measure its impact

WHEN?

- **Initial survey:** after first contact, request letter and hygiene and sanitation sensitization
- **Redo survey:** at least 6 months after IA's intervention, in the same period (ideally, on the same month) as the initial survey to avoid seasonality biases

HOW?

- Don't ask the community members to gather all together but to stay in their house and the FF will come house by house
- Share the village into two parts: the right hand part and the left hand part. Begin with the right hand part house by house. At the end of this part, make sure there is no other house that you would not have seen. Then come back to the starting point by surveying the left hand part house by house. At the end of the left hand part, make sure you have not missed any house.
- Rapid questionnaire (not more than 45mn)
- Always write down the answers immediately after the question
- Analysis of the results is based on the quality, the reliability and the precision of the answers. The FF should:
    - take time to explain the objectives of the visit
    - take time to assess every pot
    - make people confident – ask for privacy if too many people
    - ask the good questions
    - use direct observations to confirm the answers as often as possible
    - not hesitate to ask again the same question and go deeper if it seems not well understood or if doubt on the answer
    - repeat the main answers and validate with the interviewee on the important questions

WHO? Survey done by pot with the woman of the household

BEFORE THE SURVEY

- Villagers have been informed about the survey
- All pot owners are asked NOT TO THROW THE BALANCE WATER that they use for drinking – keep it until the visit (needed for some measurement).
- **FOR THE INITIAL SURVEY ONLY:** Villagers have been informed about the fact that there is still no commitment for any IA intervention in term of water point or latrine construction
- Villagers have accepted to receive the FF in their house to answer to the questionnaire

AFTER THE SURVEY

- The results will be **summarized by the supervisor** and shared with the FF.
- As soon as possible after the survey, **feed back the results to the community**

MATERIAL NEEDED

- Sheets of the question form
- One pen
- 1 pool tester and DPD tablets

MEMO HOUSE TO HOUSE VISIT

0. Village general information

- Before the house to house visits, begin with fulfilling the upper part of the table: community, chiefdom, section, date, surveyor name
- FOR THE REDO SURVEY ONLY: Chlorinator table
  Ask the water committee the number of chlorinators, their names and if they are more than 2, the number of pot each chlorinator is responsible for

1. Population

When counting population, it is good to have the woman count on her fingers while listing names and make sure to tell her to count herself.

- **Mother name:** The interviewee is the mother or woman in charge of the children
- **Total members in the pot:** *"How many of you are feeding inside your pot?"*
  - The result must be equal to the addition of total male and total female
  - Be sure that a member of the house is not counted in two different pots
- **Total males in the pot:** *"How many of you are male from the youngest child born today to the oldest pa?"*
  - Include all males in the pot (babies, children, adult)
  - Don't include the men who are no more living in the house (in Freetown or in other village for work)
- **Total females in the pot:** *"How many of you are female from the youngest child born today to the oldest ma?"*
  - Include all females in the pot (babies, children, adult and interviewee herself)
- **U5 children:** *"Among the total, how many males and females are under 5 that cannot go yet to school or farm?"*
  - **See the child** (U5 supposed to be around)
- **Number of birth last year:** "*From this season last year to now, how many children did you give birth to, dead or alive?"*
  - **See the baby**
  - Include dead babies
  - Precise the period with help of a significant event (ex: Christmas, Ramadan, beginning of rainy season, last groundnuts harvest, mangos falling, etc…)

2. Health

- **U5 diarrhoea today:** "*Is there a case of diarrhoea TODAY for children under 5 years?"*
  - If the survey occurs in the evening, ask the DAY of the survey; if it occurs in the morning, ask the DAY BEFORE
  - Be sure that the interviewee understands the word "diarrhoea" (at least three liquid stools per day). *"Do you know what diarrhoea is? How can you see that your child is affected by this disease?"*
  - Count only the number of sick children under 5 (not above)
  - **See the sick children**
- **U5 diarrhoea last week:** "*Has there been a case of diarrhoea LAST WEEK for children under 5 years?"*
  - Count only the number of sick children under 5 (not above) during the PAST 7 DAYS
- **U5 death last year:** *"Did some under 5 years die last year?"*
  - Count only children dead under five years old (not above)
  - The number of death children includes the dead premature and still-born babies
  - Precise the period with help of significant event as explained before
- **Causes of death:** *"How did the child die or what was the problem before he died?"*
  - Only asked if the above question is positive
  - Enter in each column a figure
  - The total of causes should be equal to the number of death

3. Latrines

- **Latrines in use:** *"Does this house get latrine?"*
  - Identify each latrine of the village with one letter (A, B, C…). **Visit all of them.**
  - Write in the cell the letter of the latrine that the pot is using.
  - Write 0 if the pot doesn't use a latrine.

4. Water Consumption

Ask to see the container that they use for drink. (/!\ Not the container that has been treated).

- **Volume of the container/ bucket dedicated to drinking (in L): Assessed by the FF himself.**
  Ex: 5 gallons = 22 L ; 1 gallon = 5 L
- **Volume of water balance (in L): Assessed by the FF himself.**
  Ex; ½ of 5 gallons = 11 L ; ¼ of 5 gallons = 5 L
- **Volume of water consumed by the pot (in L): Assessed by the FF himself.**
  = Volume of the container MINUS Volume of water balance
- **Number of days of consumption:** *"When did you fetch water in this container?"*
  Deduce the number of days during which pot members have drunk water from this container (ex: 1 day, 2 days, 3 days…)
  If it makes less than 1 day, the daily consumption can't be calculated further.
- **Volume of water consumed by the pot per day (in L): Assessed by the FF himself.**
  = Volume of water consumed by the pot DIVIDED BY Number of days of consumption
- **Number of people who drank in this container:** *"How many people have drunk from this container?"*
- **Volume of water consumed per person per day (in L): Assessed by the FF himself.**
  = Volume of water consumed by the pot per day DIVIDED BY Number of members in the pot

5 – HHWT (FOR REDO SURVEY ONLY)

- **Treatment:** *"Has this water been treated with chlorine?"*
  - Yes/No question
  - If no, go directly to the question Reasons for no treatment (strikethrough the other cells)
  - If yes, strikethrough the cells Reasons for no treatment
- **Dosage:** *"Do you know how much chlorine has been put in your container?"*
  - Aims at assessing if some pots ask for a particular dosage (want more or less chlorine in their water)
  - If they answer with a certain number of syringes, ask to see the syringe to deduce the corresponding volume in mL
  - If they treat in a 5 gallons and then turn the water into a smaller container, write down the dosage for the 5 gallons
  - Strikethrough the cell or write a question mark if the pot owner doesn't know
- **Chlorinator number:** ***"****Who treated your water?"*
  - Find the corresponding number in the chlorinators table
- **Clean: Assessed by the FF himself**
  - Yes/No question
- **Time since treatment:** *"When has the water been treated?"*
  - If the water has been treated, indicate the time since treatment (ex: 2h, 24h, 48h)
- **Type/ Source of water:** *"Where did you fetch this water?"*
  - Ex: rain, stream, swamp…
  - If there are different streams, indicate stream 1, stream 2…
- **DPD test: FRC** Done by the FF himself
  - Do the DPD test and write down the result
- **Reasons for no treatment:**
  - IF THE WATER HAS NOT BEEN TREATED ONLY
  - This is the most important part of the survey: strong attention must be dedicated to this part, and many questions must be asked to understand deeply the reason
  - If no suggested answer corresponds to the situation, write in "Other"
  - Whatever the reason is, the "Explain" column must always been fulfilled with detailed explanations

ANNEX 2: QUESTIONNAIRE FOR COMMUNITIES

Interview of: the committee, the families

Introduction of the village:

- Number of families
- Number of pots
- Number of persons

Introduction of HHWT:

- When did they begin HHWT?
- How did they hear about it?
- When have they been trained – which training did they receive?
- Everybody? Head of household? Women? mostly the committee ?
- How many kits did they receive? What material
- Status of the material now (jerrycan, bucket, cover, syringe, clothe)?

Committee:

- How they have been nominated? Responsibilities?
- For how long?
- If there is a problem, someone who is moving, not performing well?
- Did some people change since the beginning? Why?

Treatment organization:

- Can you explain me how you treat water?
- Who is treating?
- Is it always the same person?
- How it is organized, when?
- How they are organized for filtration?
- Are they always using the clothe?
- Clothe – where it is stored? Cleaned?
- Which quantity of water (how many containers)?
- Frequency of treatment (every morning? how long last a jerrycan?)
- What dosage?
- House by house or do people drop their jerrycans at the chlorinators' houses?
- For which purposes is used this water?
- Where it comes from?
- Difference between dry and rainy season?
- How they are organized if the chlorinator is absent – sick, less motivated, gone?
- Every house relies on this chlorinator?
- Chlorinator paid?
- If he/she doesn't have the time, someone else? If too much jerrycans to treat, assistant?
- How do they manage when they are on the farm? Do they drink treated water?

Supply in the shop:

- Refill – organization? Per household – buy in bulk, the committee for everybody?
- Which quantity per purchase?
- Time in between purchases?

- Which shop?
- How far is the shop – accessibility?
- Always open?
- Ever shortage?

Chlorine consumption:

- How many bottles they have now?
- Who is storing it – households, committee?
- Where it is stored – conditions?
- When it has been bought last time?
- How many bottles bought since the beginning?
- Evolution?

Contribution:

- Number of contributors
- Amount of the contribution
- Frequency
- Who collects the money?
- Cost of a bottle of chlorine
- How they organize to save money for this
- Follow-up by the committee (fee collection / money / buy of chlorine)
- Cost for travelling? Who pay?
- What is happening if people don't pay?
- What is happening if you don't collect enough money?

Material:

- Clothe: If is dirty or lost, buy new one? If new: quality? Where buy? From which budget?
- Jerrycan, bucket and cover: If broken?
- Syringe: If indications have been erased? If lost?

Water point:

- Number of water point
- Status of the traditional water point – water quality turbidity, seasonal?
- Work done on water point?
- Other sources for water consumption (rain water, bottles, palm wine...)?
- Other sources treated?

Impact on health:

- Impact on health / diarrhea
- What is the effect on the water? How they perceive it? (Invisible bacteria?)
- Taste of the water – level of chlorine

Relations to IA:

- How often IA come to visit?
- Which activities? Sensitization? Monitoring (what exactly?)
- Who sensitize them except IA?

Conclusion:

- Why they adopted HHWT?
- Are there not some people who are reluctant to use chlorine?
- How they were managing before?
- Why they are chlorinating?
- How they see chlorination vs before vs pump: serious?
- How they see chlorination vs before vs pump: sustainable?

To do in the community:

- Measure FRC (Free Residual Chlorine) and turbidity if it seems high
- Check the secretary's notebook (picture)
- Take many pictures
- Go to see the water point
- Note the GPS coordinates
- Expiring date on the bleach bottle
- Bacteriological test?

	Amount of chlorine added in 5 Gallons	FRC	Water turbidity	Water pH	Water consumption	Chlorine theoretical consumption	Chlorine refill	Cost for the community
Village A								
Village B								
Village C								

ANNEX 3: SAMPLE OF COMMUNITIES

Surveyor(s)	Date	Community	Date of training	# of pots
Musa Kamara, Alusine Kamara & Aurelie Moy	02/11/2016	Kamakanka	2015	7
Musa Kamara, Alusine Kamara & Aurelie Moy	01/11/2016	Kamakubuna 11	2015	5
Musa L. Kamara	03/11/2016	Kakassekie	2015	6
Alusine B. Kamara	23/11/2016	Kamullay	2015	23
Musa L. Kamara	03/11/2016	Kamahalie	2015	8
Alusine B. Kamara	22/11/2016	Kamagboto	2015	8
Alusine B. Kamara	18/11/2016	Kamabon	2015	5
Alusine B. Kamara	17/11/2016	Katherie Yimbon	2015	30
Alusine B. Kamara	15/11/2016	Kapotor Fullah	2015	21
Musa Kamara, Alusine Kamara & Aurelie Moy	01/11/2016	Kamatarawalie	2015	3
Alusine B. Kamara	15/11/2016	Kayumbay	2015	36
Alusine B. Kamara	14/11/2016	Lower H.Plan	2015	34
Alusine B. Kamara	14/11/2016	Kasekenday	2015	9
Musa L. Kamara	04/11/2016	Kamasorie	2015	11
Musa L. Kamara	03/11/2016	Madina	2015	5
Alusine B. Kamara	04/11/2016	Kakanthi	2015	16
Alusine B. Kamara	24/11/2016	Kadonkay	2015	22
Musa L. Kamara	20/11/2016	Magrubu	2015	13
Musa L. Kamara	20/11/2016	Thogbuhun	2015	7
Musa L. Kamara	22/11/2016	Mahai	2015	9
Musa L. Kamara	22/11/2016	Small Mabiama	2015	7
Musa L. Kamara	06/11/2016	New Site (One House)	2015	5
TOTAL	**November 2016**	**22 communities**	**2015**	**290 pots**

Table 19 - List of the 22 communities visited expectedly

Surveyor(s)	Date	Community	Date of training	# of pots
Alusine Kamara & Aurelie Moy	03/11/2016	Kansuron	2012	8
Alusine Kamara & Aurelie Moy	09/11/2016	Bathmiss	2016	13
Alusine Kamara & Aurelie Moy	09/11/2016	Romula	2016	6
Alusine Kamara & Aurelie Moy	10/11/2016	Masieba	2014	5
Alusine Kamara & Aurelie Moy	10/11/2016	Masamura	2014	6
Alusine Kamara & Aurelie Moy	11/11/2016	Mantufarah	2014	6
Alusine Kamara & Aurelie Moy	11/11/2016	Worreh Line	2013	6
TOTAL	**November 2016**	**7 communities**	**2012 to 2016**	**50 pots**

Table 20 - List of the 7 communities visited unexpectedly

ANNEX 4: FORM FOR SURVEY ON ACCEPTANCE

HOUSE TO HOUSE SURVEY FOR BLEACH COMMUNITIES 2016 - 2

Section:

Number of chlorinators:

5. HHWT

Nb	Chlorinator name	# of pot/chlor.

Treatment	
Dosage	
Chlorinator number	
Clean	
Time since treatment	
Type/ source of water	
DPD test: FRC	
Bad taste	Reasons for no treatment
Doesn't know the importance	
Used to traditional water point	
Chlorinator absent	
No time/ Laziness	
No bleach in the community	
No bleach in the shop	
Issues with water committee	
Can't pay	
Doesn't want to pay	
Didn't pay last time	
Wants a well	
Other	
Explain	

ANNEX 5: FORM FOR INITIAL HOUSE TO HOUSE SURVEY

INITIAL HOUSE TO HOUSE SURVEY

Date:	Surveyor name:		
Community:	Chiefdom:	Section:	
Distance to water point:	Water point in dry season:		
Total population:	Nb houses:	Nb lat in use:	
			PAGE /

	#		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Population	House (1, 2, 3)																					
	Pot (a, b, c)																					
	Mother name																					
	Total members in the pot																					
	Total male in the pot																					
	Total female in the pot																					
	U5 children																					
	Nb of birth last year																					
2. Health	U5 diarrhea today																					
	U5 death last year																					
	death causes	diarrhea																				
		fever/malaria																				
		ARI																				
		just after birth																				
		other																				
3. Key messages	Use latrines																					
	Wash hands																					
	Safe water																					
	cited																					

ANNEX 6: ENHANCED FORM FOR HOUSE TO HOUSE SURVEY

SIMPLIFIED HOUSE TO HOUSE SURVEY FOR BLEACH COMMUNITIES

Community: Chiefdom: Section:

Date: Surveyor name: PAGE /

	#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Population	House (1, 2, 3)																				
	Pot (a, b, c)																				
	Mother name																				
	Total members in the pot																				
	Total male in the pot																				
	Total female in the pot																				
	U5 children																				
	Nb of birth last year																				
2. Health	U5 death last year																				
death causes	diarrhea																				
	fever/malaria																				
	ARI																				
	just after birth																				
	other																				
	U5 diarrhea today																				
	U5 diarrhea past week																				
3. Latrines	Latrines in use																				
4. Key messages	Use latrines																				
	Wash hands																				
	Safe water																				
	Cover food																				

ANNEX 7: TRAINING ON WATER CONSUMPTION CALCULATION

Agenda (1 hour)

1. **Purpose of the measure (5 min)**

- Assess the evolution of water consumption after HHWT introduction
- Measures currently done in 24 HHWT communities from the 2015 campaign by Musa and Alusine
- Need a reference in communities before HHWT introduction

2. **Identification of the future bleach communities followed by each FF (15 min)**

- Question to each FF: which future bleach communities are you currently following?
- Write down the communities and FF

3. **Methodology for the calculation (10 min)**

- Calculation possible in the communities where the FF stays at least 24 hours
- D0: ask all pot owners to keep the water balance in the container that they use for drinking until the following day in the morning
- D0 + 1, early in the morning: go house to house to do the measure for each pot
- Presentation and explanation of the form

4. **Practise (20 min)**

- Fulfil many containers with different levels of water to train the FF to assess the volume of water balance
- Simulation:
  - Pretend to be one pot owner with a container
  - One FF will ask the questions
  - All the FF try to do the calculation according to the answers given by the pot owner

5. **Attention ! (10 min)**

- The calculation can't be done if the pot owner fetched water less than 24 hours ago
- You can use a calculator if you have it on your phone
- A, B columns: assessed by the FF
- D, F columns: answers of the pot owner
- C, E, G columns: calculated by the FF

Water consumption calculation

Community:	Chiefdom:	Section:
Date:	Surveyor name:	

Pot			Average water consumption per day per capita						
			A	**B**	**C** = A - B	**D**	**E** = C / D	**F**	**G** = E / F
House (1, 2, 3)	Pot (a, b, c)	Mother name	Volume of the container / bucket dedicated to drinking (in L)	Volume of water balance (in L)	Volume of water consumed by the pot (in L)	Number of days of consumption	Volume of water consumed by the pot per day (in L)	Number of people who drank in this container	Volume of water consumed per person per day (in L)

ANNEX 8: PROTOCOL OF COLIFORM TESTS WITH DELAGUA KIT

0. Water sample collection

A) Preparation

Sterilize with ethanol a sufficient number of glass pots to collect water (sterilize with ethanol on a tissue, including the cover, let it dry and close the cover hermetically)

- Take a cool box with one or two cold drinking water bags inside
- Plan your trip to minimize the time spent on the field with collected samples

B) Water Sample Collection

Once you find a sample of water that you want to test (treated with chlorine but FRC dropped to 0):

- Disinfect your hands with alcohol
- Grasp the glass pot by keeping your finger away from the top and turn water from the container to the glass pot
- Close hermetically the pot.

C) Storage

- Store carefully the pot in the cool box
- Write down the number of the sample and all necessary information including the name of the community and the pot owner.

D) Back to Lab

- Either do the tests directly (see below)
- If you plan to do the tests later, keep the samples in a fridge

I. Preparation of the culture medium

0) Wash and clean your hands and the worktop of the lab. Clean the metal sample cup with alcohol and a tissue.

1) To make the culture medium for 16 petri dishes, you need 50 ml of sterilized water (ex: packet water or boiled and cooled water). Pour this 50 ml in the metal cup.

2) Weigh the amount of Lauryl Sulphate powder you need. For 50 ml of culture medium, you need 4 g (8 spoons of the plastic test tube) of Lauryl Sulphate. Pour the Lauryl Sulphate in the metal cup into the 50 ml of water. Shake it gently to dissolve the powder.

3) Pour some drops of methanol in the plastic bottle and shake it. Clean the cap with alcohol and a tissue. Let it dry.

4) Pour the culture medium solution into the plastic bottle and close the cap.

See also notes on this subject on the Pratiques website

www.interaide.org/pratiques/content/ia-sierra-leone-water-test-guidelines
www.interaide.org/pratiques/content/optimisation-dune-campagne-danalyse-retours-dexperience-en-haiti-cahos


II. Sample processing

A) Sterilizing the Filtration Apparatus

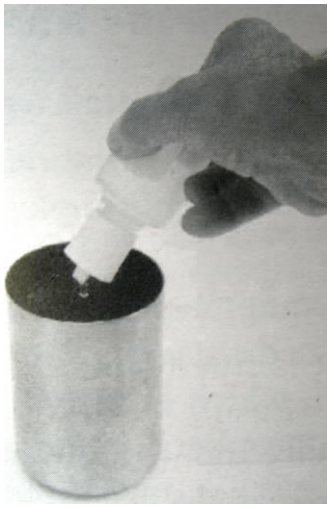
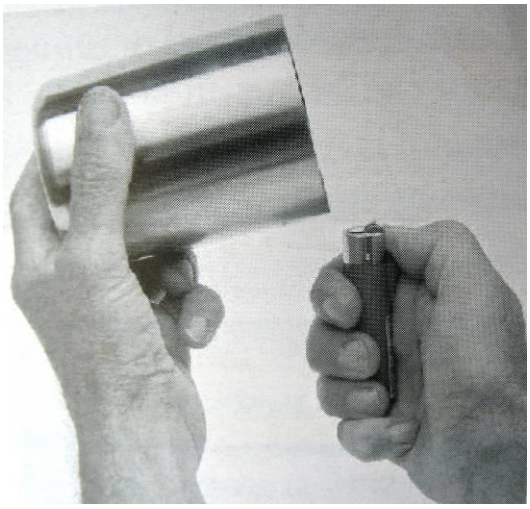
0) Wash your hands and the environment.

1) Clean with alcohol and a tissue the filtration assembly. Pour about 20 drops of methanol into the metal cup.

2) Carefully ignite the methanol in the sample cup. Allow the methanol to burn for several seconds.

3) When almost completely burned up, place the filtration head over the cup and seal it. Use the plastic collar of the filtration assembly to secure it in the loose but not free position.

Keep the filtration sealed for at least 15 minutes before use. Do it after each sample

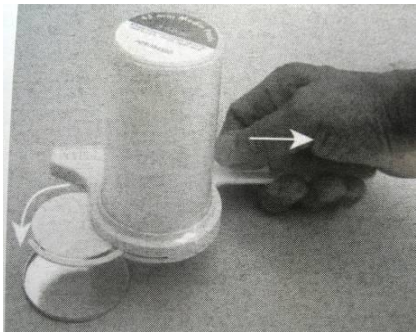
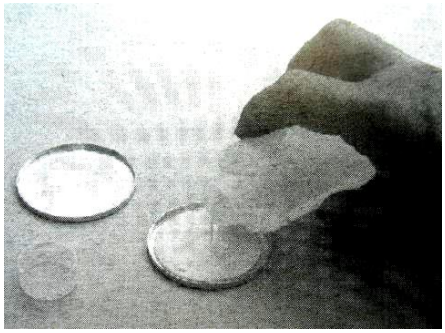
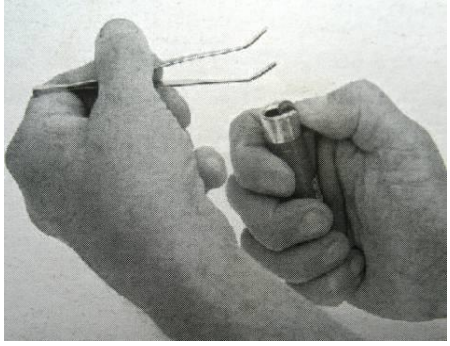




B) Petri dishes preparation

1) Lay the Petri-dishes on the work surface. Clean them with alcohol and a tissue. Dispense one pad into every first Petri dish using the dispenser. Do not touch the pad with your fingers.

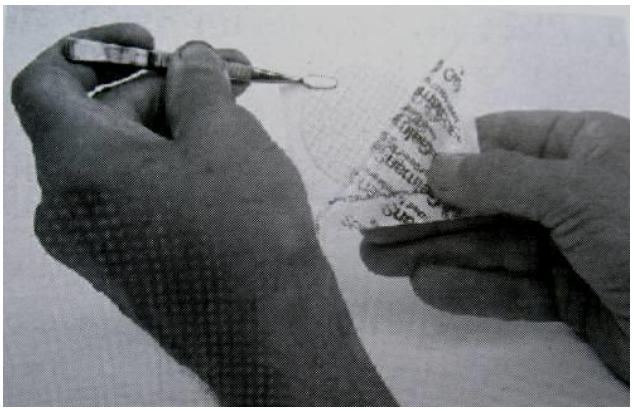
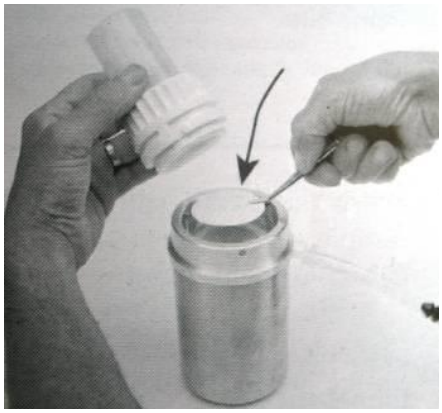
2) Pour the medium onto the absorbent pads. Leave a slight excess so that the pad will not dry during incubation. Cover them.

3) Flame the tips of the tweezers with lighter for 5 seconds and leave to cool. Keep it away from any contacts on any surface, hands or tool….

C) Filtration

1) Assemble the filtration apparatus. Unscrew the plastic collar and filtration funnel. Do not place these on any surface other than the filtration base.
2) Use the sterile tweezers to remove a sterile membrane filter from the packet. Do not touch the membrane with your fingers.
3) Place the membrane onto the filter support.

4) Screw the collar tightly.

5) Pour the sample into the filtration funnel to the mark engraved on the funnel. Take care not to allow debris to enter the funnel.

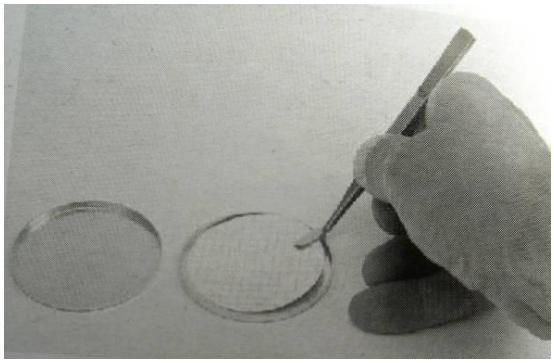
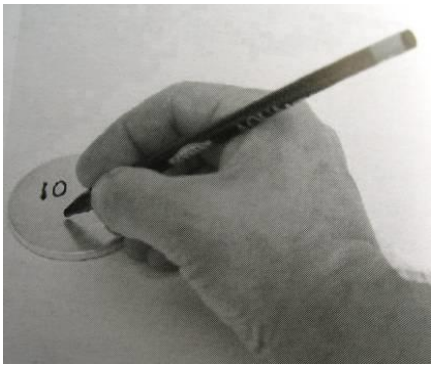
6) Connect the vacuum pump with the filtration base. Squeeze the pump to draw all the water through the filter. Stop pumping once the water has gone.



7) Unscrew the collar, remove the funnel and lift the membrane with the sterilized tweezers. Do not touch the membrane with your fingers.

8) Lower the membrane on to an adsorbent pad in a Petri dish.

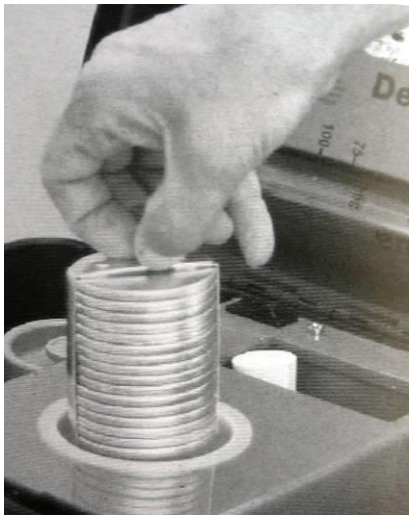
9) Replace the lid and mark it with the number of the sample.

10) Record on a sheet the number of the sample and the name of the community and pot owner.

11) Before filtering a new water sample, sterilize the filtration apparatus once again.

12) Once you have finished, stack the Petri dishes. Place them with the lid uppermost into the carrier. Return the carrier to the incubator pot. Sterilise the filtration apparatus. Wait for 60 minutes before switching on the incubator. Incubate the samples for 16 to 18 hours.

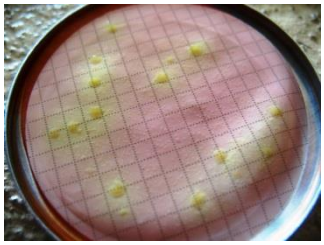


D) Cleaning

Clean and disinfect with alcohol all glasses and caps used for taking water samples. Store them upside down on a tissue. Clean and disinfect the working surface and all tools you have used. Clean your hands with soap. Clean the door handle of the lab if you went out of the room during the experiment.

III. Counting colonies

A) Observation



Do the counting as soon as possible after the Petri dishes have been removed from the incubator.

Remove the Petri dishes from the incubator, remove the lid and observe the surface. Count all yellow colonies.

Do not count colonies that are transparent, red or blue.

Fill the sheet with the colonies counting.

B) Disposal

Throw the contaminated materials (pads and filters) directly into the combustion drum outside. Do not use the common garbage bins. Sterilize every Petri dish by cleaning them entirely with a tissue and alcohol. Clean the inside of the incubator and the plastic cap. Clean and disinfect the working surface and all tools you have used. Clean your hands with alcohol. Clean the door handle of the lab if you went out of the room during the experiment.

C) Cleaning

Clean and disinfect with alcohol all glasses and caps used for taking water samples. Store them upside down on a tissue. Clean and disinfect the working surface and all tools you have used. Clean your hands with alcohol. Clean the door handle of the lab if you went out of the room during the experiment.

ANNEX 9: PROTOCOL FOR TESTS IN LAB

The following lab tests aim at completing the tests done at field level in order to assess the different factors influencing bleach power in order to get a better understanding of the FRC results. The two first hypotheses have to be checked in priority.

1. **Bottle's time after opening and conditions of use after opening**
2. **Container's conditions of use after treatment**
3. Chlorine concentration in the bottle
4. Bottle's time after manufacturing and storage conditions before opening
5. Water pH
6. Water turbidity
7. Water source
8. Other suggestions

For all these tests, water will be treated always with the same process of filtration (except for the turbidity test – exp. 6) and treatment in 1 gallon containers with a 0.5 mL dosage of chlorine.

Material required for all experiments:

- 6 x 1 gallon containers
- 1 syringe able to measure precisely 0.5 mL
- 19 bottles of chlorine from the factory:
    - 6 manufactured the same week in 6 different batches (exp. 1)
    - 10 manufactured in the same batch (exp. 2)
    - 3 manufactured in the same batch (exp. 3)
- Water from different sources:
    - Tap water (exp. 1 to 5)
    - Very turbid water (exp. 6)
    - Water from a well, water from 2 different water points and rain water collected in different ways (exp. 7)
- Soda or acidic solutions to change the pH (exp. 5)

1. **The bottle's date of opening and conditions of use after opening**

Question: Do the date of opening and the bottle's conditions of use after opening influence bleach power?

Experiment duration: 2 months

- Bottle's manipulation every day
- Treatment every week followed by 48h FRC follow-up

Material:

- 3 bottles bought in the factory manufactured the same day in the same batch
- Tap water
- 3 x 1 gallon container

Protocol

- J0: Treatment of 3 containers with the 3 bottles

- Different conditions of use:
    - Never: 1 bottle opened only for treatment
    - Sometimes: 1 bottle opened 30 minutes / day
    - Frequently: 1 bottle opened 1 hour / day
- Treatment every week after J0 during 2 months with the 3 bottles

Date	**Conditions of use**		
	Never	**Sometimes**	**Frequently**
J0	X	X	X
1 week	X	X	X
2 weeks	X	X	X
3 weeks	X	X	X
4 weeks	X	X	X
5 weeks	X	X	X
6 weeks	X	X	X
7 weeks	X	X	X
8 weeks	X	X	X

Factor: Date of opening

Never	30 min	6h	24h	48h
J0				
1 week				
2 weeks				
3 weeks				
4 weeks				
5 weeks				
6 weeks				
7 weeks				
8 weeks				

Sometimes	30 min	6h	24h	48h
J0				
1 week				
2 weeks				
3 weeks				
4 weeks				
5 weeks				
6 weeks				
7 weeks				
8 weeks				

Often	30 min	6h	24h	48h
J0				
1 week				
2 weeks				
3 weeks				
4 weeks				
5 weeks				
6 weeks				
7 weeks				

8 weeks				

Factor: Bottle's conditions of use after opening

1 week	30 min	6h	24h	48h
Never				
Sometimes				
Often				

2 weeks	30 min	6h	24h	48h
Never				
Sometimes				
Often				

3 weeks	30 min	6h	24h	48h
Never				
Sometimes				
Often				

4 weeks	30 min	6h	24h	48h
Never				
Sometimes				
Often				

5 weeks	30 min	6h	24h	48h
Never				
Sometimes				
Often				

6 weeks	30 min	6h	24h	48h
Never				
Sometimes				
Often				

7 weeks	30 min	6h	24h	48h
Never				
Sometimes				
Often				

8 weeks	30 min	6h	24h	48h
Never				
Sometimes				
Often				

2. **The container's conditions of use after treatment**

Question: Do the container's conditions of use after treatment influence bleach power?

Experiment duration: 48h FRC follow-up and containers manipulation

Material:

- 1 bottle
- Tap water
- 3 x 1 gallon containers

Protocol:

Treatment of 3 containers with the same bottle

- Treatment of 3 containers with the same bottle
- Different conditions of use of the container:
    - Never: 1 container opened only for DPD test
    - Sometimes: 1 container opened 2 hours/ day
    - Frequently: 1 container opened 6 hours/ day

Conditions of use	30 min	6h	24h	48h
Never				
Sometimes				
Often				

3. **Chlorine concentration in the bottle**

Question: Do all bottles from the factory have the same chlorine concentration?

Experiment duration: 48h FRC follow-up

Material:

- 6 bottles bought in the factory manufactured the same week but in different batches
- Tap water
- 6 x 1 gallon containers

Protocol: Treatment the same day of 6 containers with the 6 different bottles (A, B, C, D, E, F).

Bottle	**30 min**	**6h**	**24h**	**48h**
A				
B				
C				
D				
E				
F				

4. **The bottle's time after manufacturing and storage conditions before opening**

Question: Do the time after manufacturing and the bottle's storage conditions before opening influence bleach power?

Experiment duration: 12 months

- Treatment every 3 then 6 months followed by 48h FRC follow-up

Material:

- 10 bottles bought in the factory manufactured the same day in the same batch
- Tap water
- 3 x 1 gallon containers

Protocol:

- J0: Treatment of 1 container with 1 first bottle
- Different conditions of storage of the other bottles:
    - Black: 3 bottles stored in a black box
    - Indirect sunlight: 3 bottles in a room not under direct sunlight
    - Direct sunlight: 3 bottles under direct sunlight
- 2 months, 4 months and 6 months after treatment of the first bottle: treatment of 3 containers with 3 bottles stored in different conditions opened the very day of the treatment

Date	**Storage conditions**		
	Black	**Indirect sunlight**	**Direct sunlight**
J0	X		
J0 + 2 months	X	X	X
J0 + 4 months	X	X	X
J0 + 6 months	X	X	X

Factor: Time after manufacturing

Black	30 min	6h	24h	48h
J0				
J0 + 2 months				
J0 + 4 months				
J0 + 6 months				

Indirect sunlight	30 min	6h	24h	48h
J0				
J0 + 2 months				
J0 + 4 months				
J0 + 6 months				

Direct sunlight	30 min	6h	24h	48h
J0				
J0 + 2 months				
J0 + 4 months				
J0 + 6 months				

Factor: Bottle's storage conditions before opening

2 months	30 min	6h	24h	48h

Black				
Indirect sunlight				
Direct sunlight				

4 months	30 min	6h	24h	48h
Black				
Indirect sunlight				
Direct sunlight				

6 months	30 min	6h	24h	48h
Black				
Indirect sunlight				
Direct sunlight				

5. **The water pH**

Question: Does the water pH influence bleach power?

Experiment duration: 48h FRC follow-up

Material:

- 1 bottle
- Tap water
- Soda or acid to change the pH
- 5 containers

Protocol:

- Preparation of 5 solutions of water from the same stream with different pH (6, 6.5, 7, 7.5 and 8) by adding soda or acid
- Treatment of each solution in a 1 gallon container with the same bottle and 48h FRC follow-up

pH	30 min	6h	24h	48h
6				
6.5				
7				
7.5				
8				

6. **The water turbidity**

Question: Does the water turbidity influence bleach power?

Experiment duration: 48h FRC follow-up

Material:

- 1 bottle of chlorine
- Very turbid water
- 2 cloths with different quality for filtration

- 3 containers

Protocol:

- Preparation of 3 solutions of water from the same turbid water point with different turbidity
    - Container A: no filtration
    - Container B: filtration with a bad cloth
    - Container C: filtration with a god cloth
- Measure turbidity of each container
- Treatment of each solution in a 1 gallon container with the same bottle and 48h FRC follow-up

Container	**Turbidity**	30 min	6h	24h	48h
A					
B					
C					

7. Water source

Question: Does the water source influence bleach power?

Experiment duration: 48h FRC follow-up

Material:

- 1 bottle of chlorine
- Water from different sources: 1 well, 2 traditional water points, 2 rain water collected from the roof, 1 rain water collected in a bucket
- 6 containers

Protocol:

- Treatment of each water in a 1 gallon container with the same bottle and 48h FRC follow-up

Water source	30 min	6h	24h	48h
Well				
Traditional point 1				
Traditional point 2				
Rain water roof 1				
Rain water roof 2				
Rain water bucket				

8. Others?

- Coliform? After 0 result within 48 hours – depending on the first coliform tests results from the field tests
- Conductivity?
- Different bottles from the same manufacturing batch in the factory?