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Evaluation of the impact of presence / absence tests on safe water consumption

Master's Thesis

ETH Department of Civil, Environmental and Geomatic Engineering
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Abstract

Nepal's human development index ranks 145 among 188 countries. Even though 88 % of the Nepalese population had access to an improved drinking water source in 2011, a study in 2014 showed that 91 % of the households had detectable *E.coli* contamination in their stored drinking water at the household.

The aim of this study was to evaluate the impact of three different interventions on safe water consumption. The initial hypotheses were that groups with the opportunity to observe P/A water quality tests conducted during the intervention get a higher risk awareness on water quality than the group only receiving WASH information, which is expressed in more consistent water treatment and better hygiene and leads to better water quality at household level. And that if P/A tests were conducted at household level people get a higher risk awareness on water quality than the group conducting P/A tests at community level, which is also expressed in more consistent water treatment and better hygiene that leads to better water quality at household level.

During a field study, questionnaires in households and water sampling at the households and at the points of collection were conducted to evaluate 3 different WASH education campaigns. All three sites received a promotion campaign focussing on providing WASH information, in addition P/A tests were conducted at household level in one site, another included P/A tests at community level while no water quality tests were conducted in the third site.

The results showed no significant difference in risk awareness, hygiene or microbiological water quality at household level between the three interventions. The WASH intervention was very effective, since the percentage of people treating their drinking water rose from 18 % in the baseline study to 86 % after the intervention. Also other hygiene behaviours improved. Even though 77 % of all households used ceramic candle filters as household water treatment, water quality did not improve compared to the baseline study (2014). Average water quality at the point of use was worse than at the point of collection indicating a high level of recontamination during transport, treatment and storage. The recontamination in the filter can be explained due to wrong installation, handling and maintenance.

The initial set of hypotheses had to be rejected because no significant differences in WASH behaviour in the three groups could be observed neither any differences in water quality that were attributable to the intervention could be observed. The P/A tests therewith had no impact. Since the WASH information was so effective it is possible that the impact of P/A tests was relatively low and therefore not detectable any more. For further studies it is important to ensure that a careful training on the proper installation, the handling and the maintenance of the promoted household water treatment is included in the intervention.

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Table of Content

Abstract ... i

Acknowledgments ... ii

1 Introduction ... 1

2 Method ... 4

2.1 Study area ... 4

2.2 Interventions ... 4

2.2.1 WASH Information ... 4

2.2.2 Presence/absence water quality tests ... 5

2.3 Data collection ... 6

2.3.1 Survey (Behaviour study) ... 6

2.3.2 Water quality testing ... 7

2.4 Statistical analysis ... 7

2.5 Hypotheses of the study ... 8

3 Results ... 10

3.1 General results ... 10

3.2 P/A test results ... 12

3.3 Comparison of the three sites ... 13

3.4 Comparison with baseline study ... 20

4 Discussion ... 24

4.1 Impact of P/A tests on safe water consumption ... 24

4.2 Comparison with baseline study ... 27

5 Conclusion ... 28

References ... 29

Appendix ... 30

1 Introduction

Since 1990, around 2.6 billion people have gained access to improved drinking water sources but still 663 million people lack access to an improved drinking water source and 2.4 billion have no access to basic sanitation services like toilets or latrines (U.N., 2014).

According to Sobsey & Pfander (2002) around 2.2 million people, mainly children in developing countries, die of basic hygiene related diseases like diarrhea per year.

To prevent around 1.8 billion people from using a drinking water source contaminated with *E.coli*, an indicator of faecal contamination, the United Nations proposed the Sustainable Development Goals (SDGs) in 2014 (U.N., 2014). Target 6.1 of the SDGs is to achieve universal and equitable access to safe and affordable drinking water for all by 2030 (U.N., 2014). Safe drinking water defined by WHO does not hold any significant risk to health over a lifetime of consumption (WHO, 2011) and its microbial, chemical and physical characteristics meet WHO guidelines or national standards on drinking water quality.

There are many different transmission ways for faecal contamination. Even if the water at the source and at the point of collection is safe, unhygienic conditions during transport and storage can lead to recontamination (Wright, Gundry, & Conroy, 2004). The gained health benefits by improved water supply at community level may be impaired by in-house contamination. Dirty hands, containers and vessels or ladles used for water handling may contaminate water during collection, transportation and storage (Rufener, Mäusezahl, Mosler, & Weingartner, 2010). To improve water quality in the household and reduce waterborne diseases, household water treatment and safe storage have shown to be effective (Fewtrell & Colford Jr, 2004).

There are different methods to reduce diarrheal morbidity and mortality and all of them require behavioural change (Stanton, Black, Engle, & Pelto, 1992). It is important that people understand how they are affected by diseases and know the possibilities for potential pathogen contamination (Mosler, 2012). It was found that the more knowledge people have about water treatment, the more they treat their drinking water (Huber & Mosler, 2013).

Mosler developed a conceptual model called RANAS, which includes 5 factor blocks to change behaviour. The blocks of factors are risk factors, attitudinal factors, normative factors, ability factors and self-regulation factors. To define an intervention, after a baseline study, the critical behaviour factors have to be analysed to find the best intervention strategy. The intervention focuses on the factor with the biggest impact on the target behaviour (Mosler, 2012).

According to the United Nations Development Program (UNDP) the Human Development Index of Nepal is in the low human development category and ranks on place 145 among 188 countries. In 2011, 88 % of the Nepalese population was using an improved drinking water source (Asian Development Bank, 2015). Although Nepal has abundant water resources, due to population and development pressures, competing uses and sometimes also poor water resource management compromise quantity, quality and access. More than half of Nepal's water supply systems require major repairs and almost one-fifth need to be completely rehabilitated (Dixit, Gyawali, & Pandey, 2012).

In 2014 a baseline study was conducted by HELVETAS Swiss Intercooperation (HELVETAS) in Nepal and the Swiss Federal Institute of Aquatic Science and Technology (Eawag). The main objective was to assess the microbial water quality, household water management practices and opportunities for market-based interventions in five districts in Mid- and Far-Western regions of Nepal. The behaviour study showed that most people believed their water quality at the household is of good or acceptable quality. Therefore only 19 % of all interviewees treated their water at household level. But 91 % of the household had detectable *E.coli* contamination in their drinking water at household level.

The study team concluded that efforts to trigger behaviour change in the project's communities should therefore address people's perceived vulnerability of drinking untreated raw water, provide risk knowledge about the quality of the consumed water and provide information about mitigation options such as household water treatment, safe storage and adequate hygiene (Marks, Diener, Bhatta, Sihombing, & Meierhofer, 2015). Conducting water quality tests in front of the local community or in households to directly visualize water contamination is a tool that could be used to provide risk knowledge, increase the perceived vulnerability and therewith create a demand for household water treatment and safe storage. It was hypothesized that such tests have a stronger impact on safe water handling and consumption practices if they are carried out at household level with people's own water.

Due to their ease application, it was decided to use presence/absence water quality (P/A) test for WASH education interventions. The hypothesis for this thesis is that direct visualization of the drinking water quality with P/A tests triggers behaviour change and increases the perceived vulnerability.

Research questions:

- What is the effect of P/A water quality tests if the WASH education campaign includes water testing during community meetings?
- What is the effect of P/A water quality tests if the WASH education campaign includes water testing at household level with water from the household?
- What is the effect of the WASH education campaign without water quality testing?
- Is there a difference in the quality of water stored at household level between the three interventions?

The goal of this master's thesis is to evaluate if water quality tests conducted in the context of WASH education campaings can positively influence people's hygiene and water treatment behaviour and to assess the context for conducting and demonstrating such water quality tests. Further to compare different intervention approaches on safe water consumption and compare the water quality of the stored water at household level in the three sites.

The results should contribute to the understanding, which approach has the biggest effect in term of water treatment, safe storage, hygiene and microbiological water quality at household level to use the most effective approach for further studies.

2 Method

2.1 Study area

The study was conducted in the Far-Western and Mid-Western Region of Nepal in the Districts Achham and Dailekh. In Achham the research areas were Syaule, Dupke and Kotgada, in Dailekh the toles Pali, Tiyadisthan and Naula were part of the study.

The study areas were chosen since there were already existing drinking water schemes (DWS), data from the baseline study and all areas are located in a remote and hilly area.

2.2 Interventions

The recommendations made in the baseline study in 2014/2015 were implemented with different approaches in three sites. At site 1 (Achham District) the households received Water, Sanitation and Hygiene (WASH) Information and additionally got water quality tests during community meetings. At site 2 (Dailekh District, Pali) the households got WASH Information and water quality tests at household level and at site 3 (Dailekh District, Tiyadisthan and Naula) people received WASH Information but no water quality tests.

2.2.1 WASH Information

Female community health volunteers (FCHV) from all three sites were trained by HELVETAS members to provide hygiene literacy classes (HLC) and do door to door visits in every household.

The households in each site were divided into 3 to 4 groups for the HLC. Four classes within two months took place for every group. People learned about household water treatment methods and safe storage (HWTS), the importance of having and using a toilet, washing hands with soap, personal hygiene and having a clean as well as tidy kitchen.

Every household in each site was visited three times by a FCHV member. The purpose of the first door to door visit was a baseline visit to see what kind of facilities were available and in what condition they were as well as to discuss with the people about hygiene and drinking water in their household. While the second visit the FCHV reminded of the objectives of the class if the person had attended, made observations and talked about the HLC. During the third door to door visit the FCHV made observations on the WASH conditions in the household and delivered stickers if all the 5+1 Indicators were completed. The 5 indicators stand for safe water, better sanitation, personal hygiene, kitchen management and solid waste management and the +1 for the environment.

The primarily promoted water treatment method was filtration with ceramic candle filters. These ceramic candles are made of clay and the containers are produced of stainless steel. The main advantages of these filters are that they are relatively cheap, simple, easy to use and clean. They remove pathogens, turbidity and suspended solids. Locally produced products are available in Nepal. But ceramic candles have a low flow rate, are not easy to transport due to their fragility and they do not remove all the pathogens, chemical contaminations and colour. The promoted ceramic candle filters were manufactured in India and Nepal and were sold at the markets in the different areas (CAWST, 2009).

Depending on the turbidity of the raw water filters might clog and have to be cleaned regularly. To clean the candles, the surface has to be scrubbed with a soft scrubber brush or cloth to remove any accumulated dirt. Only clean water should be used for cleaning. The containers and the tap can be cleaned with soap and water.

2.2.2 Presence/absence water quality tests

Figure 1: P/A tests, left: no contamination (yellow), right: contamination (black)

The presence/absence water quality tests (P/A tests) used during the study were produced by the Environment and Public Health Organization (ENPHO) in Nepal and are easy to handle. The tested water has to be filled in the test vial and has to be incubated for 24 - 48 hours at 37°C. If the water turns black, it is contaminated, if it stays yellow, the water is clean. The test measures the presence of hydrogen sulphide (H_2S) producing bacteria (Sobsey & Pfaender, 2002). Usually the presence of these bacteria in a drinking water sample indicates the presence of faecal contamination (Manja, Maurya, & Rao, 1982).

To illustrate the potential water contamination of the water consumed by the households involved in the study, the P/A tests shown in Figure 1 were used. Water samples were taken from the drinking water storage container and filled into the vials. The incubation took place directly at household level. Household members stored them in belly belts for 24 hours. If the water was still yellow after 24 hours, the test was incubated for another 24 hours.

For the P/A test at community level at site 1, the site was divided into four groups. For each group there was a meeting, where three water samples from different points of collection (PoC) and three water samples from different households (HH) were tested by a HELVETAS Swiss Intercooperation (HELVETAS) member. The P/A vials were shown to the community and the results were discussed among the community during a meeting by FCHV supported by HELVETAS staff.

At site 2 the P/A tests took place in all households. In every HH one P/A test was conducted with their drinking water by a HELVETAS member in presence of the household members. People stored their tests in belly belts. HELVETAS staff visited the household again during the following days to discuss the results of the P/A test with the household.

At site 3 no P/A tests were conducted.

The chosen sites contained around 115 households per site and the whole community was involved in the intervention. All available households that participated in the study were involved in the evaluation. For all three interventions the whole community was involved.

Lab tests at Eawag showed that the used P/A tests work well for high contaminations (≥ 100 CFU/100 mL). For low concentration (< 10 CFU/100 mL) the tests were not reliable since some tests showed no contamination and some showed a slight change in colour (contamination). The exact detection limit could not be verified and further analysis would be required to determine this.

2.3 Data collection

To evaluate the impact of the interventions, water quality at the point of consumption in each household as well as at the point of collection was analysed. In addition to the information on water use and handling, hygiene practices and psychosocial factors were collected through qualitative interviews at household level.

Before the data collection started, local interviewers and local water samplers were trained to ensure a good quality of data. In the study areas 4 interviewers and 4 water sampler worked in pairs. While the interviewer conducted the interview, the water sampler collected the household water sample and a sample from the corresponding point of collection and processed it.

After the data collection the microbiological and household survey results were linked to assess correlations between behaviour and water quality.

2.3.1 Survey (Behaviour study)

The questionnaire was developed by Eawag for the collection of data during the baseline study and was expanded and modified to understand the people's (changed) habit and social aspects. The interviews were conducted by four Nepalese people using the software ODK on a tablet.

The questionnaire was structured in the following nine parts:

A. Household Information
B. Access to water

C. WASH knowhow, practice, attitude, self-efficacy, planning, behaviour
D. Health status and risk awareness
E. Social norms
F. Information on WASH Promotion
G. Market Information
H. Wealth index
I. Observation through the interviewer

The complete questionnaire with the possible answering choices can be found in Appendix D.

2.3.2 Water quality testing

The microbiological water quality tests were conducted using the standard membrane filtration techniques processing samples of 100 mL. The tests were conducted by two local people and two people from Swiss Federal Institute of Aquatic Science and Technology (Eawag).

In every household (HH), a water sample from the storage container was collected in the same way occupants would fill a glass of drinking water. This sample was filled into a sterile Whirl-Pak bag. A second water sample was taken of the corresponding point of collection (PoC). The samples were processed onsite. If the analysis could not take place immediately after the sampling, the samples were stored in a cooling box transported to the next HH, where they were processed.

The microbiological analysis was done according to the protocol in Appendix A. The 100 mL water sample was filtered through a membrane filter with 0.45 µm pore size. The filter was transferred to a Nissui compact dry plate (CDP) and was incubated at 35 ± 2 °C for 24 hours. After incubation the CDP was removed from the incubator and the number of colony forming units (CFU) of *E.coli* and total coliforms were counted. To minimize contamination during processing, the funnel and tweezers were sterilized before each filtration and a negative control was run every day. For the negative control, the water was disinfected using a UV light (Steripen). Every 10th sample was duplicated to ensure accuracy and estimate the precision of the results.

After the testing, all CDPs were burned to prevent garbage handlers and playing children from health risks.

Incubation took place in a field incubator developed at Eawag and was supplied with energy from solar panels. With temperature data loggers inside the incubator the variation of the temperature during the incubation time was checked.

2.4 Statistical analysis

A total of 311 households were interviewed in all three sites (Site 1: 105 households, Site 2: 101 households, Site 3: 105 households). Five households at site 1, one household at site 2 and one at site 3 were excluded from the statistical analysis because they did not meet the required conditions like participating in the interventions or only a part of it. After cleaning the data all answers in the questionnaire were number coded to run different statistical tests in IBM SPSS Statistics 23.

For the statistical analysis mean, median, standard deviation and frequencies were calculated. To examine a correlation between different variables and the *E.coli* concentration level at the household, for ordinal variables Pearson correlations (r) and the level of significance (p) were calculated. For the correlation of categorical variables with *E.coli* concentration level at the household Pearson Chi-square (χ^2) was used.

To calculate the wealth index of the households, principal component analysis was used. To form the wealth index, factors including the education level of the interviewee, type of sanitation facility in the household, durable assets like electricity, radio, solar panels, type of roof, floor and walls were included. The complete list of factors can be found in Appendix B. The computed factors were divided in quintiles to show different wealth levels (poor, second, middle, fourth, rich) (Gwatkin et al., 2000).

A hygiene index was calculated by taking the average of the hygiene conditions of the water transport and storage container, toilet and hand washing facilities. The hygiene conditions of transport and storage containers included their cleanness and information if the container was broken. For the condition of the toilet its cleanness was included and for the condition of the hand washing facility its condition, cleanness, and if soap and water were available were of importance (Appendix C).

Variables that were significantly correlated with water quality at household level in bivariate analysis were included into a model using linear regression in IBM SPSS Statistics 23.

Intervention results were also compared with data from the baseline study available from households in the intervention areas. For site 1 in the baseline there were 44 selected cases, for site 2 33 corresponding households and for site 3 only 22.

2.5 Hypotheses of the study

Due to the illustration of the water quality with P/A tests during the intervention people may be more aware of a potential contamination. This leads to the following hypothesis:

Hypothesis 1: Groups with WASH education campaigns including P/A tests get higher risk awareness on water quality than the group only receiving WASH information, which is expressed in more consistent water treatment and better hygiene, which leads to better water quality at household level than in the group only receiving WASH information.

When water is tested during community meetings (point of collection and household samples), so households not testing their own drinking water, it is assumed to have a lower impact on behaviour than household water tests in each household. Therefore the following hypothesis was set up:

Hypothesis 2: The group with P/A tests at household level get higher risk awareness on water quality than the group with P/A tests at community level. This is expressed in more consistent water treatment and better hygiene what leads to better water quality at household level than in the group with P/A tests at community level.

3 Results

3.1 General results

The three study sites are all located in a rural, hilly area. A short overview of the three sites is given in Table 1. In all sites mostly women answered the questionnaire and in average they were about 37 years old. 47 % of people completed an informal education and 90 % work in agriculture. Table 1 shows that site 3 is the wealthiest site and in site 2 more than 50 % of the people are in the poorest and second poorest categories. There is a statistically significant difference in education level ($\chi^2 = 24.3$, $p < .01$) and wealth ($\chi^2 = 26.1$, $p < .01$) between the three sites.

Table 1: Overview of general information per site and in total

	Site 1	Site 2	Site 3	Total
Age	38.1 (± 14.9)	37.5 (± 16.3)	36.5 (± 14.5)	37.4 (± 15.2)
Gender				
Female	79.0 %	92.0 %	80.8 %	83.9 %
Male	21.0 %	8.0 %	19.2 %	16.1 %
Education				
None / Do not know	14.0 %	28.0 %	11.5 %	17.8 %
Informal education	53.0 %	42.0 %	47.1 %	47.4 %
Primary	15.0 %	17.0 %	9.6 %	13.8 %
Secondary	8.0 %	10.0 %	15.4 %	11.2 %
College / higher	10.0 %	3.0 %	16.3 %	9.9 %
Wealth				
Poor	23.5 %	26.3 %	11.9 %	19.9 %
Second	14.1 %	31.3 %	15.8 %	19.9 %
Middle	18.8 %	13.8 %	26.7 %	20.3 %
Fourth	25.9 %	17.5 %	16.8 %	19.9 %
Rich	17.6 %	11.3 %	28.7 %	19.9 %
Occupation				
Agriculture	90.0 %	91.0 %	88.4 %	89.8 %
Small business	4.0 %	4.0 %	4.8 %	4.3 %
None	2.0 %	1.0 %	0.0 %	1.0 %
Other	4.0 %	4.0 %	6.8 %	4.9 %
Occupation of spouse				
Agriculture	48.0 %	32.0 %	27.9 %	35.9 %
Foreign employment	31.0 %	44.0 %	33.7 %	36.2 %
No spouse	8.0 %	10.0 %	10.6 %	9.5 %
Service	4.0 %	2.0 %	10.6 %	5.6 %
Other	9.0 %	12.0 %	17.3 %	12.9 %

Table 2 shows that 93 % of the households have a water-sealed toilet and in 91 % the toilet was clean. 31 % had no hand washing (hw) facility, whereas there were big differences between the sites.

Table 2: Hygiene indicators of transport and storage containers, toilet and hand washing facilities per site

	Site 1	Site 2	Site 3	Total
Toilet				
Kind of toilet				
No latrine	2.0 %	2.0 %	0.0 %	1.3 %
Pit latrine	0.0 %	9.0 %	3.0 %	3.9 %
Water-sealed latrine	97.0 %	86.0 %	95.0 %	92.8 %
Pour flush latrine	1.0 %	3.0 %	2.0 %	2.0 %
Cleanness of toilet	95.9 %	88.8 %	89.4 %	91.3 %
Toilet with lid	100.0 %	96.9 %	97.1 %	98.0 %
Hand washing facility				
Kind of hw facility				
No hand washing facility	10.0 %	54.0 %	29.8 %	31.3 %
A drum with a tap	83.0 %	19.0 %	12.5 %	37.8 %
Pour water from a bucket	7.0 %	27.0 %	57.7 %	30.9 %
Good condition of hw facility	90.0 %	80.4 %	67.1 %	79.9 %
Cleanness of hw facility	86.7 %	67.4 %	60.3 %	73.2 %
Soap available	74.4 %	58.7 %	64.4 %	67.5 %
Water available	84.4 %	69.6 %	64.4 %	74.2 %
Storage container				
Cleanness of container	98.0 %	97.0 %	99.0 %	98.0 %
Broken container	1.0 %	5.0 %	1.0 %	2.3 %
Container with lid	89.0 %	86.0 %	90.0 %	88.5 %
Transport container				
Cleanness of container	95.0 %	88.0 %	90.0 %	91.1 %
Broken container	1.0 %	4.0 %	1.9 %	2.3 %
Container with lid	66.0 %	56.0 %	50.0 %	57.2 %

3.2 P/A test results

The results of the P/A tests conducted at community and household level are shown in Table 3. At community level, 12 household samples and 12 point of collection samples were tested (3 household and 3 PoC samples per group). At the intervention at household level, 110 household samples were tested.

Table 3: P/A test results done during the intervention

		24 hours incubation		48 hours incubation	
		No contamination	Contamination	No contamination	Contamination
Community level	HH sample	10	2	5	7
	PoC sample	12	0	12	0
Household level	HH sample	17	93	0	110

The results in Table 3 show that after 48 hours of incubation point of collection water tested at community level showed no contamination. 7 of 12 household water sampled turned black, so they were contaminated. All household samples tested within the households (site 2) showed contamination after 48 hours.

Figure 2 shows what kind of information people remembered from the P/A tests during the interventions and the type of water treatment applied by them.

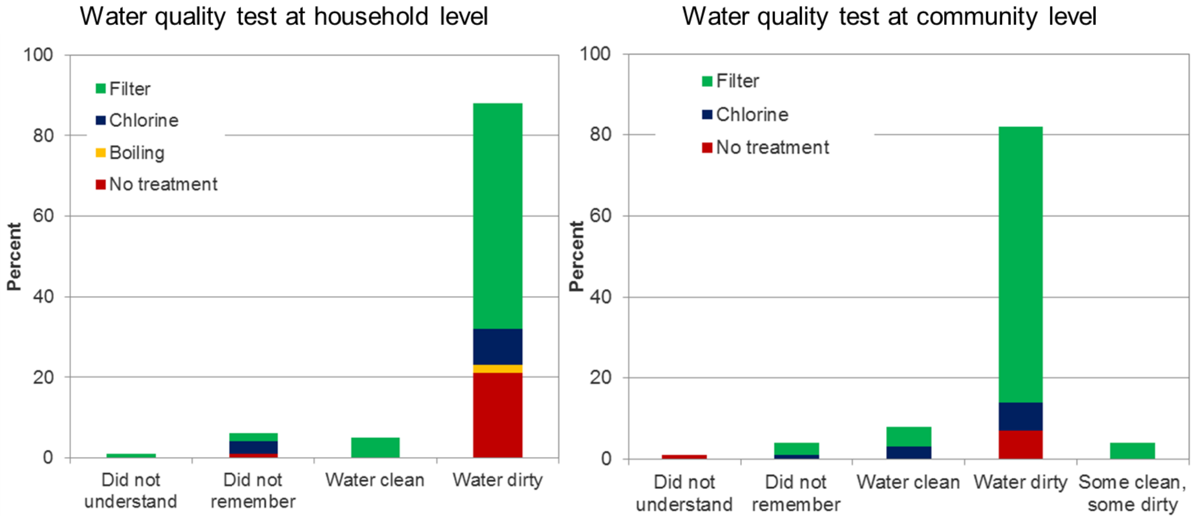

Figure 2: P/A water quality test results during the intervention at household level (left) and community level (right) and the used water treatment method.

Figure 2 (left) shows that 88 % of the interviewees answered that the P/A tests during the intervention made at household level (site 2) showed that their water was contaminated. In households, where the P/A test showed that the water was clean, people use filters. Whereas in households were the test showed that the water was dirty, 24 % of the people did not treat their water. As shown in Figure 2 (right) 82 % responded that the P/A tests at community level (site 1) showed that the water was dirty. 9 % of these households did not treat their drinking water, whereas all households that responded that the P/A tests showed that the water was clean or that some water was clean and some was dirty use a water treatment method.

3.3 Comparison of the three sites

The results of the questionnaire show that most of the people, as shown in Figure 3, collect the drinking water mainly from piped water in the village (e.g. community taps). In a few cases also piped water in the house or yard, unmanaged pipe system, open and protected sources (e.g. managed pipe system) are used. These sources are often used, if the community taps does not work or are not running regularly.

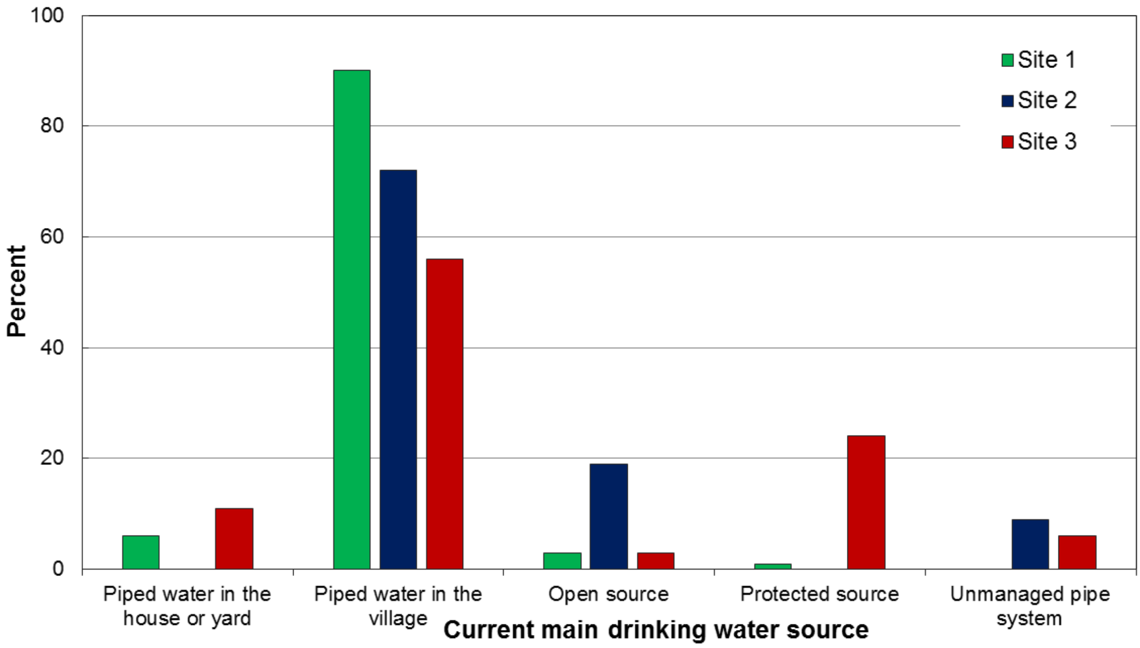

Figure 3: Distribution of primary used point of collection per site

In all three sites, most people think it is a bit (49 %) or very risky (36 %) to drink directly from the point of collection. Overall only 13 % of the respondents' percept is that the water is quite or very safe at the point of collection.

Figure 4: Used containers (left: plastic bucket, middle: gallon, right: gagri)

The used containers for collection and transportation are shown in Figure 4. While over 80 % of people at site 1 use a gagri to collect and transport their water, at sites 2 and 3 people use gagris, plastic buckets or gallons about evenly. During the observation, it could be verified, that 57 % of these containers have a lid, 91 % of the containers were clean and only 2 % broken (Table 2).

Figure 5: Example of a ceramic candle filter with stainless steel containers and a tap

Most people think the water at the point of collection is not safe to drink and 86 % treat their drinking water. After the intervention most of the people bought a water treatment product - primarily a ceramic candle filter (Figure 5). At site 2 the percentage of households who did not buy any treatment product is the highest (19 %). At site 1 and 3 the percentage of households who bought a treatment product is over 90 %. Over all three sites 77 % of all people use a filter, 8 % chlorinate (use of PIYUSH) and 6 % boil the water as shown in Figure 6.

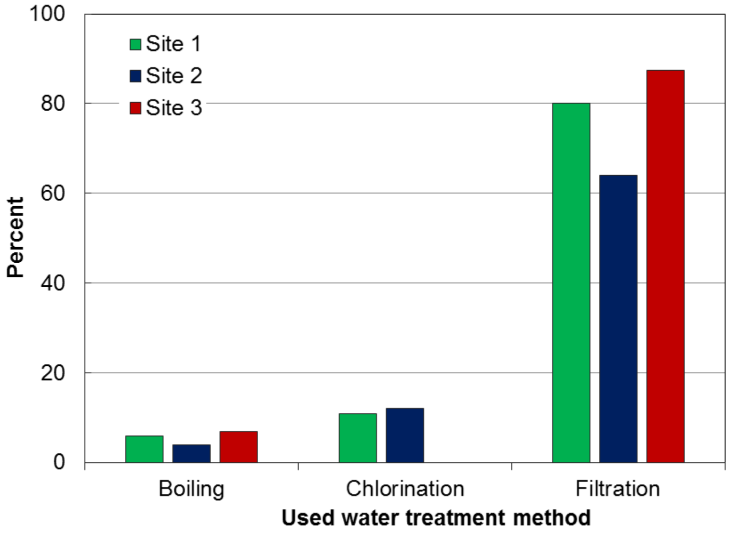

Figure 6: Used water treatment methods in each study site

The main stated reasons to treat the water were that it is important for health (71 %), unsafe water causes diarrhoea (53 %) and the (collected) water is not safe (41 %). After the treatment, people's perception of the quality of their drinking water is medium (20 %), good (52 %) or very good (22 %). The main reasons for people not treating the water are that it is too expensive (57 %) and they do not have time to do it (43 %).

People owning a filter usually use it to store drinking water directly in there. All of the 304 interviewees clean their safe storage container usually every day (69 %) or every second day (26 %). 38 % use water or water and sand to clean it, 39 % use sometimes soap or ash and 23 % us almost always soap or ash. Therefore in 98 % of the households a clean storage container could be found as shown in Table 2.

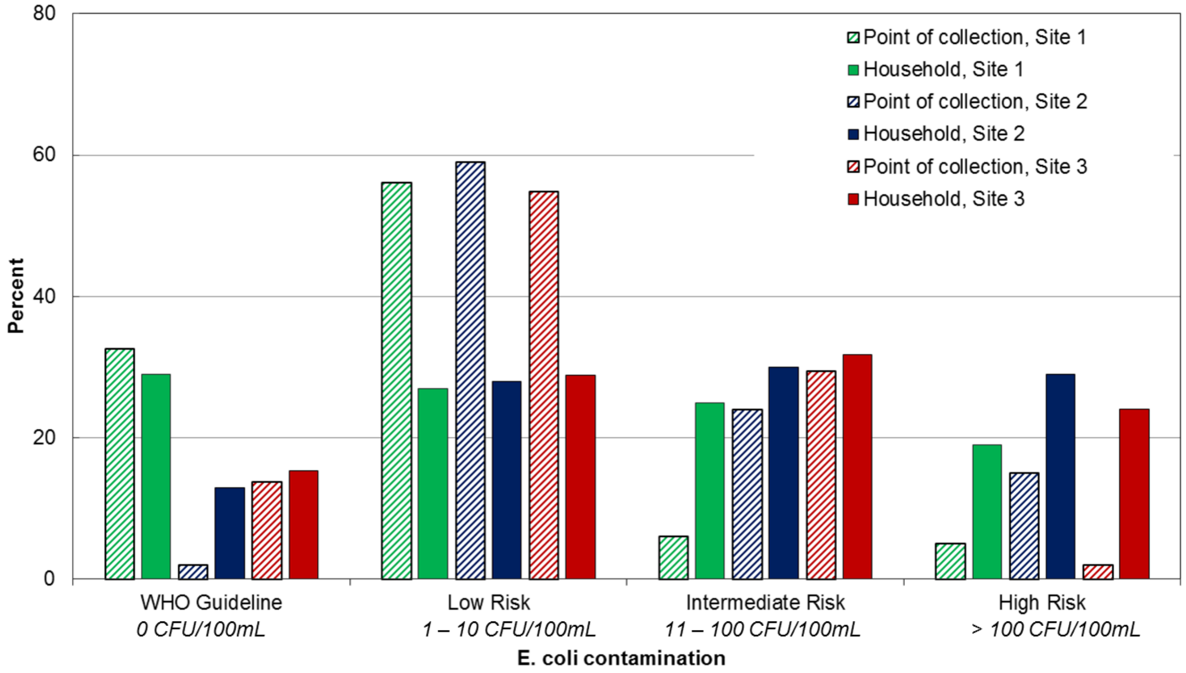

Figure 7: *E.coli* contamination at the point of collection (striped) and in the household (solid)

The microbiological quality at the point of collection and in the household is shown in Figure 7. The majority of the households (73 %) collect their drinking water at a point of collection with no detected *E.coli* or low risk level and only 7 % collect high risk water. But after the collection, transportation, treatment and storage 24 % of the households have water within the high risk level and only 47 % still have no detected *E.coli* or a low level of contamination.

Figure 7 shows that at site 1 89 % of the households collect their water at a point of collection with no or a low contamination. Site 3 has almost no points of collection with high risk contamination. Site 2 has the lowest number of households collecting their water at a point of collection with no detected *E.coli* and more households collect high contaminated drinking water. For the microbiological quality at household level, there is not a big difference between the three sites. Site 1 has a better quality at household level than the other sites, but a worse quality than at the point of collection.

The quality of the household water at site 1 is the best since there is the highest percentage of households with no detected *E.coli*. While at site 2 only 2 % of the households collect their drinking water at a safe (WHO guideline) point of collection, after the treatment 13 % have safe water.

Knowledge level on different methods for water treatment varied only little over the three intervention sites: 40 – 45 % knew chlorination, 85 – 96 % were aware of filtration and 3 – 7 % of the households said that they do not know any treatment method at all.

The water quality at household level significantly correlated with the following factors:

- Chlorination of drinking water (χ^2 = 25.7, p < .01)
- Use of a water treatment method (χ^2 = 13.8, p < .01)
- Treating water every day (χ^2 = 9.2, p < .05)
- Method of cleaning the safe storage container (χ^2 = 14.0, p < .05)
- Wealth (r = -0.17, p < .01)
- *E.coli* concentration level at point of collection (r = 0.23, p < .01)

There could not be found a statistical significant difference of the water quality level at household level between the three sites.

Based on these variables a multiple, linear regression to predict the *E.coli* concentration level at the household level was calculated. A significant regression equation was found (F(6,259) = 8.289, p < .001), with an R^2 of 0.161. The analysis shows that "Wealth" (beta = -.19, t(265) = -3.11, p < .01), "Chlorination of drinking water" (beta = -.31, t(265) = -5.03, p < .001) and *E.coli* concentration at point of collection (beta = .20, t(265) = 3.44, p < .01) did significantly predict the *E.coli* concentration level at HH level. However "Use of a water treatment method" (beta = .01, t(265) = .07, not significant), "Treating water every day" (beta = .03, t(265) = .19, not significant) and "Way of cleaning the safe storage container" (beta = -.04, t(265) = -.69, not significant) did not significantly predict *E.coli* concentration level at HH.

Figure 8 shows that in households not treating their drinking water, water quality between points of collection to household decreases. For households treating the water with chlorine an improvement in water quality can be seen. In households using a filter water quality decreases in all three sites.

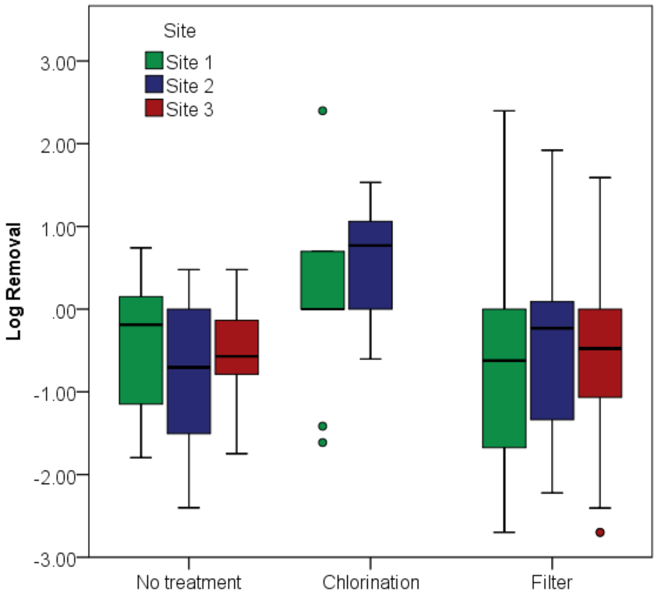

Figure 8: Log removal of *E.coli* concentration between PoC and HH for no treatment, chlorination and use of filter for each site. Negative values mean a decrease in water quality from PoC to the HH, positive values an improvement.

As shown in Figure 9 (a), 73.8 % of the households not treating their water have higher contaminated water at the household than at the point of collection, for the other households only a slight improvement occurred.

Only four households used boiling (Figure 9, b) and in only one of the households there was an improvement in water quality.

21 households used chlorination to treat their water, in 57.1 % of the cases an improvement in water quality between the point of collection and the point of use could be achieved and in 23.8 % water quality stayed the same as shown in Figure 9 (c). The conducted chlorination tests showed that 11 households (52 %) had residual chlorine in the water and 48 % of the tests were negative (no residual chlorine). 91 % of those households that tested positive for residual chlorine had an improved water quality while 60 % of those that said that they chlorinate water but tested negative for residual chlorine had and improved water quality.

Figure 9 (d) shows that filtration does not ensure a good quality of water. 65 % of households' water is higher contaminated after filtration than at the point of collection. But there are 6 % where water quality improved more than 1 log and in 3 % of households' water was the water at the point of collection highly contaminated and after the filter it meets the WHO Guideline.

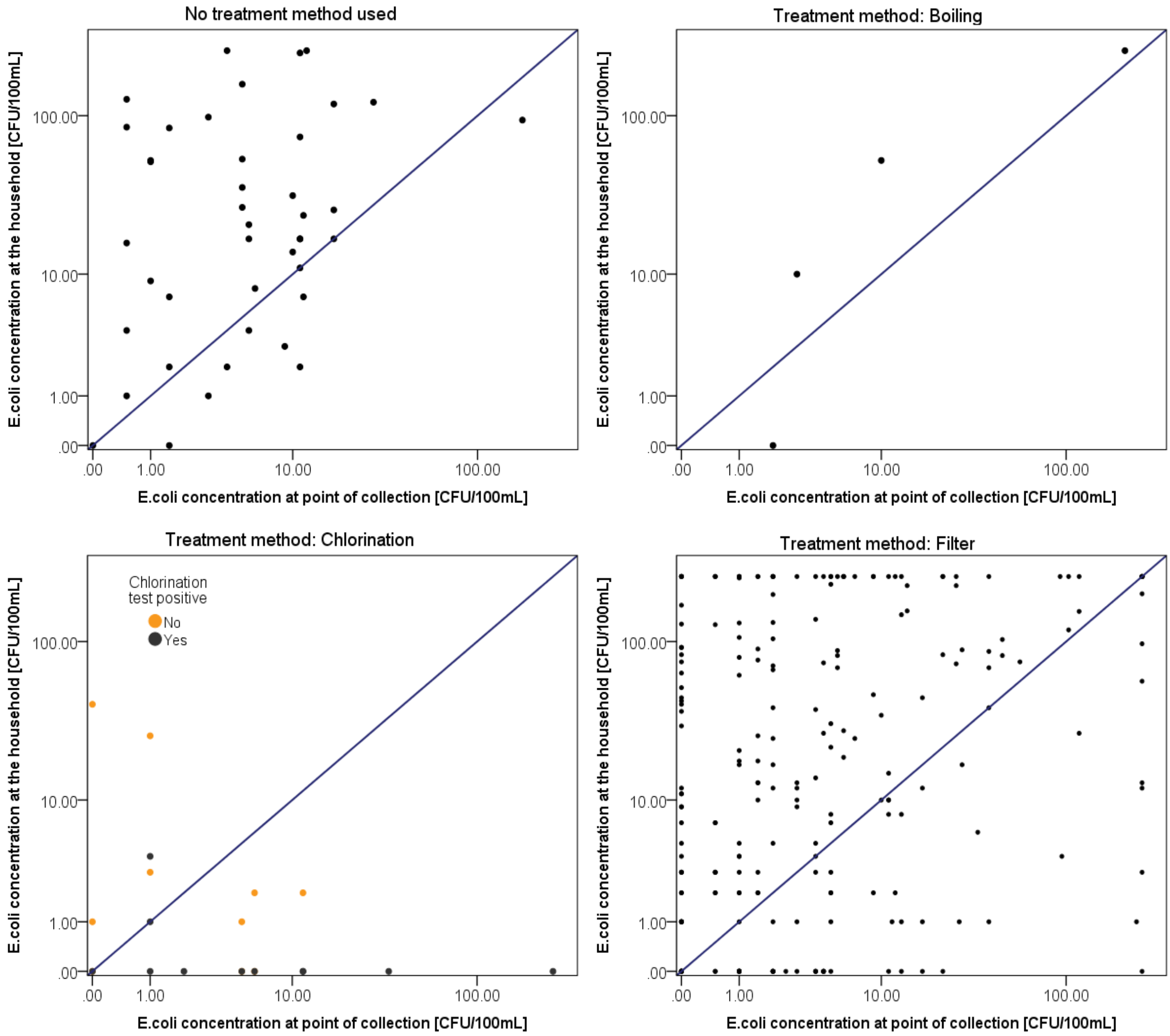

Figure 9: *E.coli* concentration at point of collection and household with (a) no treatment method used, (b) HH using boiling, (c) HH using chlorination and (d) HH use a filter for treating water.

Between chlorination to treat water and no treatment there is a significant difference in water quality level at the household ($\chi^2 = 27.2$, $p < .001$) as well as in the log removal from the point of collection to the household ($r = 0.38$, $p < .001$).

There is also a statistically significant difference in water quality level at household between households not treating their water and households using a filter ($\chi^2 = 13.6$, $p < .01$).

Table 4 shows a comparison of the log removal of *E.coli* from the point of collection to the household for the different filter brands, the minimum and maximum log removal and observed number of each filter brand.

Table 4: Comparison of the log removal of *E.coli* from the point of collection to the household for the different filter brands

Filter brand	Number of filters	Log removal Mean ± SD	Log removal Minimum	Log removal Maximum
Milton	102	-0.73 ± 1.09	-2.70	2.40
Vinayak	12	-0.52 ± 1.16	-2.10	2.37
Tulip	64	-0.45 ± 1.01	-2.40	1.92
Surya	29	-0.59 ± 0.64	-2.22	1.34
Surya Vinayak	20	-0.44 ± 1.05	-2.70	1.23
Other	8	-0.41 ± 0.96	-1.78	0.65

There could neither be found a statistical significant difference depending on the filter brand in water quality level at household nor log removal of *E.coli* from point of collection to household.

3.4 Comparison with baseline study

While during the baseline survey only 18 % of the interviewees responded to treat their water, after the interventions there were 86 % of the people (Table 5), which is statistically significant ($t = 5.41$, $p < .001$).

Table 5: Percentage of people treating water and the used transport and storage containers before and after the intervention

	Before intervention	**After intervention**
Treating drinking water	18 %	86 %
Transport containers		
Gagri	67 %	60 %
Plastic bucket	47 %	37 %
Gallon	0 %	38 %
Other	20 %	8 %
Storage containers		
Gagri	64 %	17 %
Plastic bucket	43 %	8 %
Gallon	0 %	6 %
Filter	0 %	77 %
Other	17 %	6 %

Before the intervention in the baseline study 49 % did not know any method for water treatment (Figure 10). After the intervention almost all people (96 %) could name at least one water treatment method and 82 % at least satisfactory explained one of the methods. The most known water treatment method before the intervention was boiling, afterwards it was filtration. Figure 10 also shows that the variation between the sites was larger before the intervention than afterwards.

The container used to collect and transport water from the point of collection to the household was similar before and after the interventions as shown in Table 5. After the interventions people additionally used gallons to gagris and plastic buckets. Before the intervention most of the people used the same container to collect, transport and store the drinking water, most often gagris and plastic buckets. After the intervention all households having a filter (77 %) used them to store their drinking water.

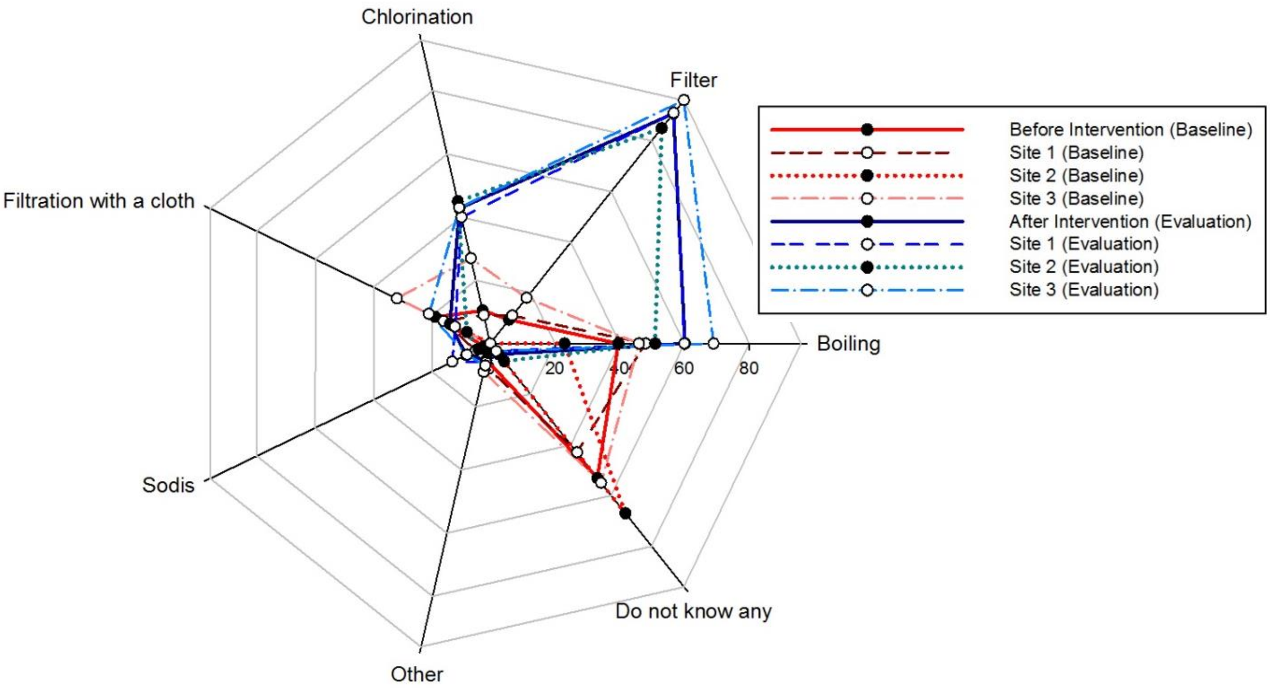

Figure 10: Known water treatment methods per study site before and after the intervention.

The condition of the containers after the interventions were better (Figure 11), while before there were 44 % of the containers clean, afterwards 91 % were clean. In the baseline study only in 14 % of the households the transport container had a lid, after the intervention 57 % had one.

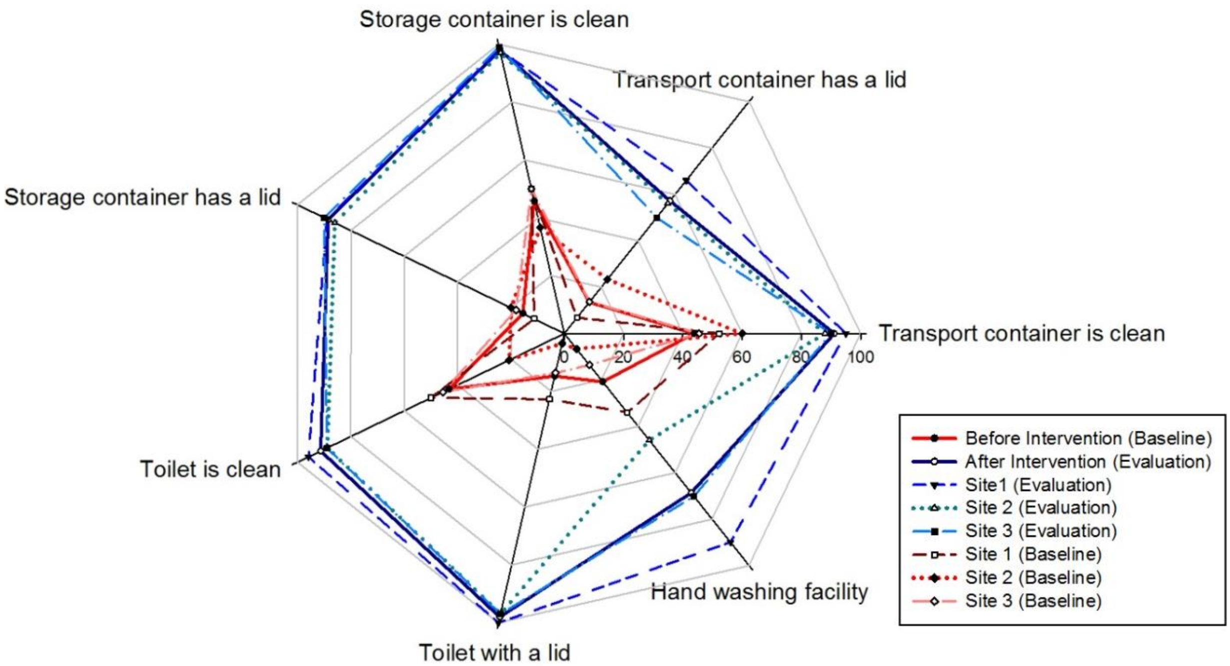

Figure 11: Hygiene indicators before intervention (red) and after intervention (blue)

While during the baseline study 46 % had a clean storage container and only 16 % of the households had a storage container with a lid, after the intervention 98 % of the containers were clean and 88 % of them had a lid. Already in the baseline study 99 % of the household had a toilet but only 40 % of the households had clean toilets, after the intervention 90 % of the households had a clean toilet and 97 % had a lid.

Figure 11 shows that after the intervention the transport and storage containers and the toilets more often had a lid and were clean than before the intervention, the change is statistically significant using t-tests ($p < .001$) in all six observations. The households having a hand washing facility increased significant ($t = 9.69$, $p < .001$) between the baseline and evaluation study.

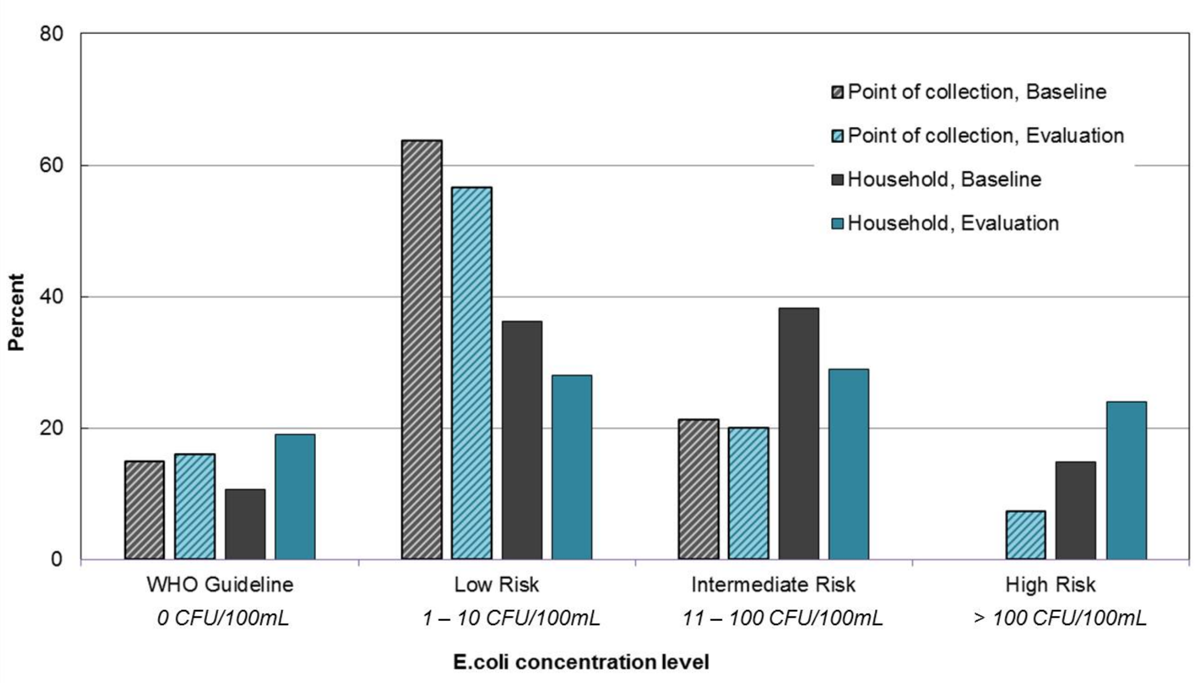

Figure 12: *E.coli* concentration level at point of collection (stripped) and household (solid) before and after the intervention (grey: before intervention, baseline, blue: after intervention, evaluation)

Figure 12 shows the *E.coli* concentration level at the point of collection and households before and after the interventions. *E.coli* concentrations of the PoC stayed in the same range, whereas HH water quality slightly changed to the extremes: less HH showed low and intermediate risk and more HH met WHO guideline or showed high risk. Using t-test there could not be found a significant difference between baseline and evaluation study on either point of collection or household water quality level.

4 Discussion

In this section the results are discussed to answer the research questions and to test the hypotheses.

4.1 Impact of P/A tests on safe water consumption

There was a big impact in all 3 intervention sites since the majority of people purchased and use a treatment product. Most households' perception on the quality of the water at their source changed. The majority thinks now that drinking water directly from the point of collection is not safe but after treatment it is medium to very safe. Unfortunately, the microbiological water quality at the point of collection and household water show the opposite trend.

There could not be found a significant correlation between household water quality level and the 3 different interventions. Hypothesis 1 saying that groups with WASH education campaigns including P/A tests get higher risk awareness on water quality than the group only receiving WASH information, which is expressed in more consistent water treatment and better hygiene, which leads to better water quality at household level than in the group only receiving WASH information has to be rejected. Further Hypothesis 2, assuming that the group with P/A tests at household level get a higher risk awareness on water quality than the group with P/A tests at community level, which is expressed in more consistent water treatment and better hygiene and leads to better water quality at household level than in the group with P/A tests at community level, has to be rejected too.

Figure 2 (left) shows that most respondents remembered that the test showed contaminated water while only 5 % said they had clean water. These people may have remembered the first result (after 24 hours), when the water was still yellow (did not show contamination). For the P/A tests at community level the test results recorded by HELVETAS and from the questionnaire did not match. Although only 7 of 24 tests showed contamination 82 % of the interviewees responded that the tests showed contaminated water.

Since in each group 3 PoC and 3 HH samples were tested and all PoC samples showed no contamination, there is a big discrepancy between the test results collected by HELVETAS and what people remembered. The reason for this can be a misunderstanding between the HELVETAS staff and the household members or people did not understand the test or the explanations. It is also possible that the intervention focused on telling the households how important it is to treat their water because otherwise it is not safe and people only remembered this and not the actual test. Another explanation could be that the test results were not explained correctly and people thought it was contaminated due to the colour change from no colour to yellow.

It strikes that all households answering their water was clean during the intervention, bought a treatment product (Figure 2, right), whereas some of the households that answered their P/A test showed contaminated water did not buy any treatment product. So it seems that the P/A test did not have an impact on the willingness to purchase a treatment product and use it.

Further it had to be taken into account that at site 3 another study took place in November and December. Due to the presence of 3 researchers in this area, people may have been made more aware of water safety and the importance of treating their drinking water so the results of site 3 could possibly be biased.

To find an explanation for the decrease in water quality between point of collection and household despite household water treatment the following hypotheses were set:

1. **Water treatment method does not work:** if the treatment system does not work, the water quality should be in the same range as if there would be no treatment system
2. **Bad quality of treatment system (differs on brand):** if there is a significant difference of water quality depending on the brand of the treatment system
3. **Wrong installation, handling and/or maintenance:** if there is a random distribution of water quality between the households

Since only four households used boiling to treat their drinking water, the hypotheses were not only tested for chlorination and use of filter as water treatment methods.

1. **Water treatment method does not work:**
    a. Chlorination: Figure 8 shows that households using chlorination have an improvement in water quality at household level compared to households without treatment. This difference was shown to be statistically significant and therefore this hypothesis for chlorination as water treatment method has to be rejected.

    b. Use of filter: In Figure 8 there cannot be seen a big difference in the median of log removal between point of collection and household water quality of households not treating and using a filter. But comparing Figure 9 (a) with Figure 9 (d) a complete different distribution is shown and there could be found a significant difference in the *E.coli* concentration between households not treating their water and treating it with a filter. For using a filter as a water treatment this hypothesis has to be rejected.

    This hypothesis has to be rejected for both used water treatment methods.

2. **Bad quality of treatment systems**
   a. Chlorination: Since all households used PIYUSH to chlorinate their water, the differences in efficiency between the households cannot be explained with different brands.
   b. Use of filter: There could not be found a significant difference in *E.coli* concentration level between the different filter brands. Table 4 and Figure 9 (d) show that with all brands it is possible to achieve a good water quality in the household, even though water at the point of collection was contaminated.

   Therefore the decrease in water quality between point of collection and household water cannot be explained by bad quality of the treatment product.

3. **Wrong installation, handling and maintenance**
   a. Chlorination: Figure 9 (c) shows that if sufficient chlorine is used, the chlorination test showed a positive result: only in 1 household water quality decreased and 82 % had no detectable *E.coli*. If the chlorination test showed a negative result, only 30 % of the households had no detectable *E.coli*.
   b. Use of filter: Since there are cases in Figure 9 (d) where the filters work completely fine and reduce a high contamination at point of collection to no detectable *E.coli* at the household, it seems that the water quality depends on the handling and installation of the filter and not on the filter itself.
      Most of the households did not have the filter for longer than some weeks. Therefore, a possible explanation can be that the filter containers or candles have not been disinfected properly before using it for the first time. It is important to completely clean the filter before installing it by washing the candle, the containers and tap with boiled water so that there is no contamination from the production and transport when using the filter. Since everybody puts his filter together by himself, it is well possible that they are not installed properly. The seals have to be in the right place and the candle has to be screw tightly enough, otherwise contaminated water from the upper container can leak through and contaminate the drinking water. During data collection many filters with loose candles were encountered. If a candle is broken (flow rate gets high) it has to be replaced.

   Hypothesis 3 is the only that was not rejected. Further studies should be conducted to gain more insight into the influence of proper installation, handling and maintenance on preventing recontamination.

4.2 Comparison with baseline study

Since there is no significant difference between the 3 interventions, the data of the evaluation was compared with the baseline study. As shown in Table 5 the intervention was very effective, since the percentage of people treating their water rose to 86 % as compared to 18 % at baseline. The WASH intervention showed the households how important it is to treat their water and also showed and explained them the feasible water treatment methods. Households after the intervention had more knowledge about these treatment methods as shown in Figure 10 than before the intervention. The percentage of people not knowing any treatment method significantly decreased among the households involved in the intervention.

All hygiene indicators (Figure 11) in all sites improved after the intervention. People now are aware that it is important to clean and close their transport and especially the storage container to reduce contamination. In addition most households had a clean toilet that was closable. People are also more aware of the importance of hand washing and have now, after the intervention more often hand washing facilities in their households.

As expected water quality at the point of collection, as shown in Figure 12, stayed in the same range before and after the interventions. Since the percentage of people treating their water increased, it was assumed that water quality at household level would increase with more people treating their drinking water at the household. But in Figure 12 only a slight shift to the extremes in water quality at household level can be seen. Despite water treatment at household level the quality of water at the point of consumption could not be improved.

The WASH intervention implemented without P/A tests had a big impact on hygiene, risk awareness and willingness to treat drinking water. It is possible that due to this impact, the relative impact of P/A tests were small, so a significant difference could not be found. Since the evaluation of the impact of the WASH intervention was done only 2-4 weeks after the conclusion of the promotion activities, it would be important to check the behaviour again after 6 months to 1 year to see the long term impact and the sustainability of the intervention on behaviour change.

5 Conclusion

The initial set of hypotheses has to be rejected because there was no significant difference between the 3 WASH interventions relating to people treating their drinking water, hygiene indicators and microbiological water quality at household level.

Since this evaluation took place only 2 to 4 weeks after the final intervention, only a short term behaviour change could be seen, so to evaluate if one intervention is more sustainable than the others, a long term behaviour change evaluation would be interesting.

Although P/A tests are known as easy to handle and illustrative, the result showed that people assumed contamination if there was a colour change, even though water changed to yellow, meaning no contamination. Therefore it is important to train staff sufficient to explain the test results properly within a community so that people remember the real results and understand the tests.

Compared to the results before the intervention, there was a significant improvement in knowledge and use of water treatment, and hygiene indicators but there was no improvement in microbiological water quality at household level.

By evaluating the effect on different water treatment products it could be seen that especially people using a filter do not have better water quality at the household. Possible causes are wrong installation, handling and maintenance of the filter. Since most people only had the filter for a few weeks, it is also possible that their handling and maintenance improves.

It would be important for further studies to include installation, handling and maintenance into the interventions when promoting treatment methods.

For future interventions it would be interesting to see, where exactly the contamination in the filter occures, therefore it would be necessary to analyse water in the household before and after filtration. If this recontamination cannot be prevented other treatment methods should be promoted.

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Appendix

Appendix A. Protocol for Compact Dry Plates onsite

1. Before filtering, the filter unit is sterilized by pouring methanol into the permeate cup (until the bottom is fully covered) and lit on fire. When most methanol is burnt and only about ¼ of the bottom of the permeate cup is covered with liquid, the raw water filtration unit is placed upside down in the permeate cup. To place it in the cup, it should be locked loose in the 2nd locking position (1-loose, 2-loose locked, 3-thightly locked) so that every part is disinfected and the raw water cup does not fall out.

2. When the upper part is placed upside down in the permeate cup, disinfection takes a minimum of 10 minutes.

3. While waiting, Label the Compact Dry plates with date, time, sample number and the source of the sample and prepare Compact Dry Plates. Remove the lid and pour about 3-6 drops (about 1 mL) of distilled water onto the dry plate. The Compact Dry Plate needs to be moist in every part. When the dry plate is not used immediately, the lid should be closed to prevent contamination.

4. To prepare the filtration unit for filtration, the upper part has to be turned upside and the plastic raw water receptacle needs to be turned until it is in loose position. The upper part has to be pushed firmly onto the permeate cup.

5. The membrane for filtration has to be placed with sterilized tweezers. To sterilize tweezers, put a drop of methanol on the tweezers and keep them in the flame of a lighter for at least 3 seconds. The sterilized membrane is placed on the membrane supporting unit with one hand using the sterilized tweezers and by lifting up the plastic raw water receptacle with the other hand. The plastic raw water receptacle is screwed tightly to position 3 (locked position) when the membrane is placed.

6. 100 mL of diluted sample is filled into the raw water receptacle up to the 100 mL marker line. The sample is filtered by using the hand pump to create a vacuum in the permeate chamber of the filtration unit.

7. To remove the filtration membrane from the filtration unit, sterilized tweezers are used. The filtration membrane is placed on the Compact Dry Plate by placing it on one edge on the dry plate and then "rolls" it down in a manner that no air pocket forms. The lid is closed firmly to prevent it from falling off and allowing recontamination.

8. Incubate the Compact Dry Plates for 24 hours at 37 °C. For incubation, Compact Dry Plates are put upside down in the incubator.

9. After 24 hours of incubation 3 different types of bacteria colonies can be visible:

- Blue colonies are *E.coli*
- Red/Pink colonies are Total coliforms
- Yellow/all other colours : Other bacteria, will not be counted

The colonies were counted in the closed Dry Plate by tapping them with a small marker pen to avoid double counting and left outs. If there were many colonies but they are countable, the plate was divided into four parts and colonies were counted only in this quarter. The number was then quadrupled to result in the number of colony forming units (CFU) per 100 mL.

Appendix B. Wealth Index: Defining factors for PCA

Factors included in Questionnaire	**Removed due to low frequencies or merging of factors**
Education level of interviewee	None 1, Informal education 2, Primary 3, Secondary 4, College and higher 5
Type of Sanitation facility used: Use the bushes, Shared water sealed toilet, households own simple pit latrine, households own water sealed toilet	Continuous variable defined: bushes 1, shared pit latrine 2, own pit latrine3, a shared water sealed toilet 4, own water sealed toilet 5
Durable assets: Electricity, Radio, TV, Solar panel, mobile phone, Bicycle, Motorbike, Car, Fridge, Watch	Binary variables
Type of fuel used: Wood, Charcoal, Kerosene, Gas, Electricity	Binary variables
Owning or renting house	Binary variable
Observation type of walls of house: Stone with mud, Stone with cement, Brick with cement, Wood planks, Corrugated iron, Cement	Continuous variable defined: Stone with mud 1, Wood planks 2, Stone with cement 3, Brick with cement 4, Corrugated iron 5, Cement 6
What type is roof: Straw, roof tiles/stone slates, CGI Sheet, RCC, Mud	Continuous variable defined: Straw 1, mud 2, roof tiles/stone slates 3, CGI Sheet 4, RCC 5
What type is floor: Earth, cement, floor tiles	Continuous variable defined: earth 1, floor tiles 2, cement 3
Nr of rooms per adult in HH	
How much land does your family have?	
For how many months do you have to buy extra food? Up to 3 months 3 to 6 months more than 6 months No own land	Continuous variable defined: No own land 1, more than 6 months 2, 3 to 6 months 3, up to 3 months 4

Appendix C. Hygiene Index

To calculate the Hygiene Index, first the condition of the transport and storage container, toilet and hand washing facility (hwf) was predicted as shown in Equation 1 - 4. For each condition a number between 0 and 1 was found. Since 1 means a good condition, if the container was broken, the answer from the questionnaire had to be changed (0=broken, 1=not broken).

$$Condition\ transport\ container = \frac{transport\ container\ clean + |transport\ container\ broken - 1|}{2} \quad (1)$$

$$Condition\ storage\ container = \frac{storage\ container\ clean + |storage\ container\ broken - 1|}{2} \quad (2)$$

$$Toilet\ condition = toilet\ clean \quad (3)$$

$$Condition\ hwf = \frac{hwf\ in\ good\ condition + soap\ is\ available + hwf\ is\ clean + water\ is\ available}{4} \quad (4)$$

After calculating separate conditions, they were averaged to get the Hygiene Index (Equation 5)

$$Hygiene\ Index = \frac{cond.transport\ container + cond.storage\ container + toilet\ condition + cond.hwf}{4} \quad (5)$$

Appendix D. Questionnaire

(●): single answer, (○): multiple answers possible

Introduction:
All the information you provide is confidential and your name will not be disclosed anywhere. The results will be treated anonymously. Participation in this study is voluntary. You don't have to take part if you don't want to. You don't have to answer any question you don't want to, and you can stop the interview at any time. If you decide not to participate there will not be any negative consequences.
Do you have any questions? Do you agree to participate in this study?
If you have any further questions you can contact Madan Bhatta from Helvetas. The phone number of the Helvetas office in Surkhet is: 083521092 / 083521093

A – Household Information

Name of person interviewed

What is the gender of the respondent?
- Male
- Female

What is the age of the respondent?

What is your mobile phone number?

How many people live in your household?

Do you live in a single household or as part of a compound?
- Single household
- Part of a compound

How many children do you have?

How many children are below the age of 5?

How many children go to school?

Are you able to read or write?
- Can neither read or write
- Can read only
- Can both read and write

What is the highest education level you have completed?
- None / Don't know
- Informal education
- Primary
- Secondary
- College and higher

What is your occupation?
- Agriculture
- Small business
- Daily labourer
- Employed
- Government service
- Other independent work
- Retired with pension
- None

What is the occupation of your spouse?
- Agriculture
- Service
- Small business
- Daily labourer
- Other independent work
- Retired with pension
- None
- Foreign employment
- No spouse

B - Access to water
Which water sources do you use to collect drinking water? ○ Piped water in the house or yard ○ Piped water in the village ○ Rainwater harvesting ○ Open source ○ Protected source ○ Unmanaged piped system ○ River, stream or canal ○ Lake ○ Bottled water ○ Do not know
What is your current main drinking water source? • Piped water in the house or yard • Piped water in the village • Rainwater harvesting • Open source • Protected source • Unmanaged piped system • River, stream or canal • Lake • Bottled water • Do not know
Which water sources do you use for cooking? ○ Piped water in the house or yard ○ Piped water in the village ○ Rainwater harvesting ○ Open source ○ Protected source ○ Unmanaged piped system ○ River, stream or canal ○ Lake ○ Bottled water ○ Do not know
Which water sources do you use for dish washing, washing body and hands? ○ Piped water in the house or yard ○ Piped water in the village ○ Rainwater harvesting ○ Open source ○ Protected source ○ Unmanaged piped system ○ River, stream or canal ○ Lake ○ Bottled water ○ Do not know
Which water sources do you use for washing clothes and cleaning the house? ○ Piped water in the house or yard ○ Piped water in the village ○ Rainwater harvesting ○ Open source ○ Protected source ○ Unmanaged piped system ○ River, stream or canal ○ Lake ○ Bottled water ○ Do not know

Now I am going to go through a list of CONCERNS that some families in this area have expressed. Suppose that the government could help your village with just ONE of these issues. Which would YOUR FAMILY choose?

- Health and healthcare services, Sanitation (toilet and drainage)
- Transportation and roads
- Security and crime
- Electricity services
- Jobs and unemployment
- Education
- Support for agriculture
- Water supply services
- Do not know / could not respond
- Other major concern

Please specify other:

C - WASH knowhow, practice, attitude, self-efficacy, planning, behaviour

How is the quality of the water you use for drinking?

- Very good
- Good
- Medium
- Bad
- Very bad

What do you think is the major cause for contamination of your drinking water source?

- Open unprotected source
- Unmanaged system/fittings chamber pipe
- Open defecation
- Settlement above source
- Deforestation
- Don’t know
- Other

Please specify other:

How safe is it to drink the water directly from the source?

- Very safe
- Quite safe
- Neither safe nor risky
- A bit risky
- Very risky

What do you think is in the water that makes it risky to drink?

- Toilet waste
- Chemicals
- Animal waste
- Germs
- Don’t know
- Other

Please specify other:

How important is it for you to treat the water?

- Very important
- Quite important
- Medium important
- Not important
- Not at all important

Which methods for water treatment do you know?

- Boiling
- Filtration with a cloth
- Flocculation and sedimentation
- Chlorination
- Sodis
- Use of filter
- Other
- Do not know any

Please specify other:

Do you use any method to treat your drinking water? • Yes • No
Which methods for water treatment do you use? ○ Boiling ○ Filtration with a cloth ○ Flocculation and sedimentation ○ Chlorination ○ Sodis ○ Use of filter ○ Other Please specify other:
Can you explain to me the procedures of the different methods (the ones the interviewee knows) for water treatment? • Good explanation of at least 4 methods • Good explanation of 3 methods • Good explanation of 2 methods • Satisfactory explanation of 1 method • Cannot explain well
Who in your family is mainly responsible for water treatment? ○ Wife ○ Husband ○ Daughter ○ Son ○ Other Please specify other:
How often do you treat your water? ○ Every day ○ Sometimes ○ Only during rainy season ○ Only for sick people ○ Only for babies and children below 5 years ○ Never ○ Do not know
Why do you not or not regularly treat your water? ○ It's not important ○ It's not necessary ○ I did not know about it ○ I did not enjoy it ○ It's not nice ○ I forget to do it ○ I do not have time to do it ○ It requires too much physical effort ○ It is too expensive ○ Others also do not treat their water ○ Other Please specify other:
Why do you regularly treat your water? ○ The water is not safe ○ Unsafe water causes diarrhea ○ It is easy to do ○ I do enjoy it ○ I like the method ○ I was told to do it ○ It is cheap ○ My neighbours, family and friends also treat their water ○ Other reason Please specify other:

How strongly do you intend to treat your water in future?
- Not at all
- A little
- Medium
- Strongly
- Very strongly

How effortful do you think it is to always treat your water?
- Not effortful at all
- A little effortful
- Medium effortful
- Very effortful
- Extremely effortful

How much time consuming do you think it is to always treat your water?
- Not time consuming at all
- A little time consuming
- Medium time consuming
- Very time consuming
- Extremely time consuming

How much do you like to always treat your water?
- I don’t like it at all
- I don’t like it
- I do not care
- I like it
- I like it very much

Imagine that you have much work to do. How confident are you that you can always treat your water?
- Not at all confident
- A little confident
- Medium confident
- Very confident
- Extremely confident

How much do you pay attention to have the products in the household you need to treat the water?
- No attention at all
- A little attention
- Medium attention
- Much attention
- Extreme attention

Within the last 24 hours:
How often did it happen that you intended to treat your water and then forgot to do so?
- Never (0 %)
- Seldom (25 %)
- Sometimes (50 %)
- Often (75 %)
- Always (100 %)

Is it a habit for you to always treat your water? (or do you have to remind yourself)
- Not at all automatically
- A little automatically
- Medium automatically
- Very automatically
- Extremely automatically

What kind of containers do you use to collect & transport water from the source?
- ○ Gagri
- ○ Plastic bucket
- ○ Gallon
- ○ Filter
- ○ Container with narrow opening and tap
- ○ Other

Please specify other:

What kind of containers do you use to store the drinking water? ○ Gagri ○ Plastic bucket ○ Gallon Filter ○ Container with narrow opening and tap ○ Other Please specify other:
Do you use the same container for water transport and water storage? • The same container is used • A different container is used
Do you clean your safe storage container? • Yes • No
How often do you clean your safe storage container? • Every day • Every second day • At least once per week • Less often than once per week
How do you clean your safe storage container? • I use water or water and sand • I use chlorine to disinfect it almost always • I use chlorine to disinfect it sometimes • I wash it almost always with soap or ash • I wash it sometimes with soap or ash
YESTERDAY, can you tell me how many times you washed your hands?
How many times did you use soap?
When do you wash your hands? ○ When they are dirty ○ After going to the toilet ○ After cleaning baby's bottom ○ Before eating ○ Before cooking ○ There are no special occasions ○ Never ○ Do not know
What is the reason/purpose of washing hands? ○ To remove dirt ○ To remove pathogens ○ To look nice and clean ○ It is important for health ○ Dirty hands cause diarrhea ○ It is easy to do ○ I like hand washing ○ I was told to do it ○ It is cheap ○ My neighbours, family and friends also wash their hands ○ Do not know
Where do members of your family usually go to the toilet? • I use the bushes • A shared simple pit latrine • A shared water-sealed toilet • Household owns simple pit latrine • Household owns water-sealed toilet

D - Health status and risk awareness
What are the causes for diarrheal diseases? o Some pathogens o Faecal pathogens o Dirty hands o Dirty food o Dirty water o Explanation does not correspond with real cause
How high do you feel is the risk that you will get diarrhea if you drink untreated water? • No risk • Little risk • Quite a risk • A significant risk • Very high risk
Imagine you have diarrhea, how severe would be the impact on your daily life? • Not severe at all • Not severe • A bit severe • Very severe • Extremely severe
Imagine your child below 5 years has diarrhea, how severe would be the impact on his life and development? • Not severe at all • Not severe • A bit severe • Very severe • Extremely severe
How many members in your family above 5 years suffered from diarrhea in the last 3 days?
How many children under 5 years in your family suffered from diarrhea in the last 3 days?
How many members in your family above 5 years suffered from respiratory illness in the last 3 days?
How many children under 5 years in your family suffered from respiratory illness in the last 3 days?
E - Social norms
How many of your neighbours treat their water? • Almost nobody (0 %) • Some of them (25 %) • Half of them (50 %) • Most of them (75 %) • Almost all of them (100 %)
How many of your neighbours wash their hands at critical times? • Almost nobody (0 %) • Some of them (25 %) • Half of them (50 %) • Most of them (75 %) • Almost all of them (100 %)
How many of your neighbours have their own toilet? • Almost nobody (0 %) • Some of them (25 %) • Half of them (50 %) • Most of them (75 %) • Almost all of them (100 %)

People who are important to you, how do they think you should always <u>treat your water before consumption</u>? • Not at all • A little • Medium • A lot • Extremely
People who are important to you, how do they think you should always <u>wash your hands with soap</u> at critical times? • Not at all • A little • Medium • A lot • Extremely
F - Information on WASH Promotion
Have you received any information on water treatment and hygiene from Helvetas in the last 2 months? • Yes • No
What did you learn during that training? ○ I learned that it is risky to drink untreated water ○ I learned about new methods for water treatment ○ I learned where I can buy products for water treatment ○ I learned that it is important to wash hands ○ I learned how to install hand washing stations ○ I learned that it is important to have and use toilets ○ Other Please specify other:
Have you observed how a water quality test was done during a community meeting? • Yes • No
What did the water quality test done at community level tell you? ○ I do not remember the test ○ I did not understand the test ○ It showed that the water is contaminated ○ It showed that the water is clean ○ Some tests showed the water was contaminated, some showed the water was clean ○ Other Please specify other:
Were you able to conduct a water quality test with your own water? • Yes • No
What did the water quality test done with your own water tell you? ○ I do not remember the test ○ I did not understand the test ○ It showed that the water is contaminated ○ It showed that the water is clean ○ Other Please specify other:
Did the information on water, hygiene and sanitation change your behaviour? • Yes • No

Which behaviour did you change after your received information on water treatment and hygiene?

- ○ I purchased a product for water treatment
- ○ I am now regularly treating water
- ○ I am now sometimes treating water
- ○ I installed a hand washing station
- ○ I do wash my hands more often
- ○ I use soap to wash my hands
- ○ I wash my hands at critical times
- ○ I regularly disinfect the water storage container with chlorine
- ○ I regularly wash the water storage container with soap
- ○ Other behaviour changes

Please specify other:

Did the water quality test at community level change your behaviour?

- Yes
- No

Which behaviour did you change after you observed the water quality test at community level?

- ○ I purchased a product for water treatment
- ○ I am now regularly treating water
- ○ I am now sometimes treating water
- ○ I installed a hand washing station
- ○ I do wash my hands more often
- ○ I use soap to wash my hands
- ○ I wash my hands at critical times
- ○ I regularly disinfect the water storage container with chlorine
- ○ I regularly wash the water storage container with soap
- ○ Other behaviour changes

Please specify other:

Did the water quality test with your own water change your behaviour?

- Yes
- No

Which behaviour did you change after you were able to conduct a water quality test with your own water?

- ○ I purchased a product for water treatment
- ○ I am now regularly treating water
- ○ I am now sometimes treating water
- ○ I installed a hand washing station
- ○ I do wash my hands more often
- ○ I use soap to wash my hands
- ○ I wash my hands at critical times
- ○ I regularly disinfect the water storage container with chlorine
- ○ I regularly wash the water storage container with soap
- ○ Other behaviour changes

Please specify other:

Have any of your family members attended the Hygiene Literacy class conducted by FCHV?

- Yes
- No

Had FCHV visited your Household?

- Yes
- No

Which method between HLC and door to door visit did you find more effective?

- HLC
- Door to door visit
- Both
- None

G - Market information

Did you buy any product for water treatment?

- None
- Chlorine, Piyush
- Filter
- Other

Please specify other:

Where **did** you purchase chlorine solution?

Where **did** you purchase a ceramic water filter?

Where **did** you purchase the other product?

Why did you not buy any chlorine for water treatment?

Why did you not buy any filter for water treatment?

H - Wealth index

For how many months do you have to buy extra food (not sufficient production from own agricultural activities)?

- Up to 3 months
- 3 to 6 months
- More than 6 months
- No own land
- Don't know / no answer

Does anyone from your household own/ have any of these items?

- Electricity in the house
- Radio
- TV
- Soar panel
- Mobile phone
- Bicycle
- Motorbike
- Car
- Fridge
- Watch
- None of this

What kind of fuel do you use mainly for cooking?

- Wood
- Charcoal
- Kerosene
- Gas
- Electricity

Are you the owner of your house?

- Own house
- Rent house

How many rooms does your house have?

What type of walls does the main house have?

- Stone with mud
- Stone with cement
- Brick with cement
- Wood planks
- Corrugated iron
- Cement

What type of roof does the main house have?

- Straw
- Roof tiles / Stone slates
- CGI Sheet
- RCC
- Made from mud

What type of floor does the main house have? • Earth • Cement • Floor tiles
How much land does your family own?
I - Observation through the interviewer (your own observation)
Can you show me the product you use for water treatment? ○ Black kettle (for boiling) ○ Chlorine bottle available ○ Water filter available ○ SODIS bottle available ○ PUR (flocculation & sedimentation) available ○ Cloth for filtration available ○ No product for water treatment present
Can you show me the containers you use for water transport? ○ Gagri ○ Plastic bucket ○ Gallon ○ Filter ○ Container with narrow opening ○ Container with narrow opening and tap ○ Other Please specify other:
Condition of water transport container In which condition is the container used for water transport?
Is the water transport container clean? • Yes • No
Does the water transport container have a lid? • Yes • No
Is the water transport container broken? • Yes • No
Can you show me the containers you use for water storage? ○ Gagri ○ Plastic bucket ○ Gallon ○ Container with narrow opening ○ Container with narrow opening and tap ○ Other ○ Same container for transport and storage Please specify other:
Condition of water storage container In which condition is the water storage container?
Is the water storage container clean? • Yes • No
Does the water storage container have a lid? • Yes • No
Is the water storage container broken? • Yes • No

What kind of toilet does the HH have on the compound? • No latrine • Pit latrine • Water-sealed latrine • Pour flush latrine
Condition of the toilet In which condition is the toilet?
Is the toilet clean? • Yes • No
Does the toilet have a lid? • Yes • No
Are these materials available? ○ Sandals / slippers ○ Drum with water ○ Brush ○ None of these
What kind of hand washing facilities does the HH have? • None • A drum with a tap • They pour out water from a bucket
Condition of hand washing facilities In which conditions are the hand washing facilities?
Is the hand washing facilities in good condition? • Yes • No
Is soap available? • Yes • No
Is the hand washing facilities clean? • Yes • No
Is water available? • Yes • No
Are the household and the cowshed together or separate? • Together • Separate