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Bringing Consumers to the Table: Perceptions and Practice of Household Water Treatment Methods in Nepal

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1. Detailed Reporting By District

Chlorination

(Dang / Kapilvastu / Parsa / Panchthar)

Boiling

(Dang / Kapilvastu / Parsa / Panchthar)

Colloidal Silver Filter

(Dang / Kapilvastu / Parsa / Panchthar)

SODIS (Solar Disinfection)

(Dang / Kapilvastu / Parsa / Panchthar)

2. *Study Tools (ENGLISH)*

3. *Study Tools (NEPALI)*

4. *Water Test Results*

The CS Filter

- *IDE Nepal*

Chlorine Quantity

- *ENPHO*

Acronyms

UNICEF	-	United Nations Children's Fund
BCHIMES	-	Between Census Household Information, Monitoring and Evaluation System
WHO	-	World Health Organization
USAID	-	United States Agency for International Development
DACAW	-	Decentralized Action for Children and Women
I/NGO	-	International/Non Government Organization
HIP	-	Hygiene Improvement Project
IDE	-	International Development Enterprise
POU	-	Point of Use
SODIS	-	Solar Disinfection
FCHV	-	Female Community Health Volunteers
ENPHO	-	Environment and Public Health Organization

Executive Summary

The objective of this Point-of-Use Product Trial was to contribute to the base of formative research available to develop the national Point-of-Use (POU) Marketing Strategy, and a hygiene improvement strategy and implementation workplan for POU treatment for four selected DACAW (Decentralized Action for Children and Women) districts in Nepal. These four districts are the focus of the USAID-funded and UNICEF-supported pilot districts, namely Panchthar, Parsa, Kapilvastu and Dang, where the hygiene activities have continued since the mid-nineties. This specific formative research component aimed to provide a hands-on consumer perspective of the general concept of water disinfection, and explore consumer perception of using four types of water disinfection methods over time, to capture perceived benefits and obstacles of use.

The trial methods included those proven efficacious in lab conditions and currently or soon-to-be-available in Nepal—boiling, SODIS (solar disinfection), colloidal silver filters and chlorination. Twenty mothers in each district were asked to try one method which was supplied to them free of cost for a period of about one month; five mothers in each district tried each method. Trained qualitative researchers visited mothers in their home approximately 3 and 30 days after the initial visit to assess immediate reactions, and then reactions and continued practice over time.

Each method was evaluated by a group of mothers with small children according to particular characteristics:

- Taste
- Smell
- Appearance
- Temperature
- Acceptability to family members
- Effort, convenience, maintenance
- Perceived effectiveness
- Perceived value

After trying one method for a minimum of one month, respondents were shown water treatment options and asked to compare “their” method with the others along the delineated characteristics outlined above. A short baseline survey, essentially an abbreviated version of the larger UNICEF baseline survey, was applied in each household at first visit to assess socio-demographic measures, current knowledge, perceptions and practice related to hygiene and sanitation.

A fifth treatment method, the Biosand filter—an intermittent slow sand filter, was considered for the product trial, but eventually was not included for both logistic

and security reasons. The size and weight of the filter made transport difficult, and suspect to mobilize throughout the districts given the precarious security situation in Nepal and the possibility of the components being mistaken for homemade bombs. As a solution, researchers re-visited households from a previous filter promotion project and talked with a small sample of current and past Biosand filter users and interviewed them about the likes and dislikes of that treatment method. As in the other study households, Biosand users were shown the other four treatment methods and asked to compare Biosand to those other methods, commenting on the various criteria such as smell, taste, efforts, and so on.

Key findings:

All mothers participating in the study were quite willing and needed little convincing to try the water treatment method assigned to them. This was particularly noteworthy because the general finding is that most households visited do not see their water as unfit for drinking. Other studies have shown that up to 56% of tube well water had fecal contamination (Arsenic Testing Study in the Terai, 2003) and the 2001 DHS survey documented hygiene and storage practices that guaranteed further contamination of water at the household level. Actual contamination at point of first contact was assessed, and many but not all water samples collected prior to method use were contaminated.

Households were overall successful in using the various techniques to treat water. On the second visit, the majority tested clean, indicating householders success at using the method. This was true for all methods but the CS filter, which actually showed a slight increase in disinfection. It is assumed but not proven that water still testing positive for coliform and e-coli after treatment was from secondary contamination, although researchers have no evidence that water was ever effectively treated.

Respondents across all districts noted the following characteristics of water that was “good and fit to drink”:

- Clear
- Free of turbidity, visible dirt and/or sand and to a lesser extent:
- Free of bugs and insects
- Absent of (objectionable) smell
- Cool water was also a highly desired attribute, though not necessarily tied to water that was “fit” to drink.

Virtually no one expressed any sense of “microbial” or bacterial contamination (not the words per se, rather the concept of matter in the water that might cause illness) when considering the need to treat water. Likewise, few attributed diseases in general or diarrhea in particular to unfit water; rather most to “stale” food. While some significant number responded that drinking clean water could help to avoid diarrhea, this was not a predominant concept for most participants.

The respondents were not able to comment and give their opinion on the attributes of drinking water easily especially concerning the water’s appearance and texture. The researchers had to probe with specific words and note respondent opinions after respondents were given descriptions such as slippery and oily texture.

After baseline measure, when researchers explained that the method left with them (and on the final visit when all methods were explained) would get rid of bacteria and invisible, disease-causing matter in the water, participants appeared to grasp this concept of “contamination,” and valued the benefit of making the water “healthier” for their family. They repeated this benefit throughout the interviews, both at second and third visits.

Demonstration prior to assigning the method was enough to learn to adequately use the assigned method, and for the most part, proper use was maintained over the one-month study period. Most respondents anticipated on first visit that they would be able to use the method easily, and this opinion persisted over the month-long trial. During the one month observation period, few adaptations or modifications of the treatment methods were seen among the respondents, despite the study methodology design, which invited problem-solving and method adjustment to increase desirability and ease of method use. This lack of barriers to use, perceived difficulties, or dislikes of methods was actually a surprising finding, as researchers had anticipated greater resistance to incorporating a routine of treating water. The few modifications made or observed are outlined in the last section of the summary.

Without considering the cost of purchase or use, the most popular method across all districts was the CS filter for its ease of use, followed by chlorinating water. The other two methods, SODIS and to a less extent boiling were satisfactory to consumers. Serious concerns arose, however, about the efficacy of the CS filter based on the level of contaminated water after treatment with the CS filter. Questions remain about the efficacy of the CS filters and it will be important to determine whether problems are with the filter systems themselves or with secondary contamination associated with improper filter maintenance.

Most common dislikes of the methods included the warm temperature rendered by boiling, SODIS, and to a much lesser degree, perceived to be from chlorination. Some respondents found the smell of chlorination to be problematic, although none discontinued use because of the smell. Interestingly, smell rather than taste of chlorination was more commonly mentioned as disagreeable. Smell was mentioned to a lesser extent with other methods.

Other barriers included the receptacle size, or rather the limited amount of water that could be disinfected at one time, and the time needed to disinfect another “batch.” This was true for all methods except for SODIS, where households were given an adequate number of bottles to treat the household’s supply of water. The portability of the SODIS bottles was a perceived benefit of this treatment method.

While participants had little previous practice storing water and particularly storing water or “letting it sit” overnight, little resistance was encountered in storing SODIS or the CS filter treated water.

All respondents said that they had shared their one-month method use experience with their neighbors and were overall quite positive about the new water treatment methods introduced to them.

Discontinuation of treatment method was almost exclusively attributable to method malfunction or running out of supply. Method malfunction was observed more in the cases of SODIS (weather conditions) and the CS filter (broken filter candle or candle nut).

While most all study participants continued their method use over the entire trial period¹, anecdotal evidence suggests that they did not exclusively consume disinfected water over the study period, rather supplemented the treated water with their ‘regular’ water. Certainly, with the exception of solar disinfected water, which is treated in its own portable container, no participants carried treated water to drink outside the home.

Researchers noted a lack of a second vessel for treating and storing water as an obstacle to easy treatment with all methods other than the CS filter. Lack of

¹ In Panchthar, researchers were unable to return to most homes within 30 days due to the security situation. As a result, chlorine users had run out of their 30-day supply and therefore technically “discontinued” use, though for no reason other than lack of supply and unavailability of product in the commercial market.

furniture or objects to lift the CS filter from the ground to access the tap was an initial obstacle that was easily resolved by householders (often with researcher assistance) by raising the filter on a platform of bricks or similar material.

Other findings include:

- Respondents perceived SODIS (solar disinfection) as a relatively easy method of water disinfection, but did not particularly “like” it as it was dependent upon sun, and couldn’t be used in all weather conditions. Many reported general lack of availability of bottles that could present a barrier to method use. The research team also reported unavailability of bottles at study locations. Even among the respondents, using bottles for drinking water was not a common practice. Many respondents using SODIS were eager to try a different water treatment method, preferably a method that could be used throughout the year and not be dependent on sunshine. No respondent expressed any reservations about drinking water that sat overnight, nor of the perceived effectiveness of “solar” disinfection even on a cloudy day.
- Respondents liked the ease and convenience of the CS filter, and their reported commitment to continue to use of the colloidal silver filter was high. The CS filter was the method most preferred among all the others across a range of attributes. It was also the least preferred with reference to the filter’s affordability. During the study period, however, participants found the filters themselves to be delicate and a number experienced problems with the candles. Households that stopped using the CS filters had all done so because their filters no longer ‘functioned.’ Problems included “shedding” clay from chips in the candles, color “bleeding” into the upper filtration bucket, leaking taps, and broken connector screw knob or candle. Field workers observed inconsistent quality and flow rate of candles. Lastly, water from three-fourths of all filters tested positive for contamination. All filters were confirmed functional before being given to respondents, so we can assume high rates were due to either “fatal” damage occurring somewhere after testing or secondary contamination due to some unidentified reason. These product issues are of concern, and must be resolved before this method can be widely promoted.
- Most mothers using chlorination well accepted the method. They reported the method to be easy to use. However, most respondents reported the smell of the disinfected water to be “not good.” Most respondents said they are willing and able to pay for the method at its market price. Across the range of water attributes, chlorination was the second most preferred treatment method after the CS filter. However

the respondents were more comfortable with the price of chlorination to that of the CS filter.

- Most respondents reported boiling to be an easy process to disinfect water. It was, however, the least preferred water treatment method. Boiled water was said to be warm and not pleasant to consume, particularly during the hot summer months. It was found to be unappealing to family members. The respondents did not comment on the reduced time required for boiling water in this “new” recommended boiling technique, which instructed that water was disinfected at the sight of the first big bubble. This is most probably attributable to the fact the householders adhered to the previous recommendation of bringing water to a hard boil for 3-10 minutes.

Among the Biosand filter current users and drop outs, the flow rate seemed to be a concern for all; and all were well aware of the filter’s benefits, but the effort and the patience needed to collect water was cited as the major reasons as to why some of them opted to discontinue use.

Chapter I: Introduction

1.1. Background

Since the mid-1970s, UNICEF has been the major partner of government sector agency to pioneer gravity water supply schemes and hand pumps in Nepal. Support to improving water supply conditions was directly aimed at improving the dismal health conditions of children, prevailing in Nepal. An estimated 17,000 children below five years of age die each year due to diarrheal diseases, due to lack of access to quality water supply and poor environmental sanitation.

Access to drinking water supplies in Nepal has significantly improved in the last decade. In 2000, the national coverage had reached 79.9% (BCHIMES, 2001). Overall trends in water accessibility are thus encouraging. However, the mid- and far western regions have comparatively lower coverage and also higher disease incidence. The workload associated with this heavy disease burden falls disproportionately upon women and the girl child, who conventionally are the primary caretakers of young children. Access to safe drinking water is a human right; it is also a prerequisite for hygiene and sanitation to safeguard health.

In addition to accessibility, the quality of water provided is becoming of more concern as accessibility improves. The most common and widespread water quality problem is fecal contamination. It is commonly accepted in the water sector that the microbiological quality rarely meets the WHO guidelines even in so-called "safe" water supplied. Microbiological contamination is one of the sources of diarrhea, typhoid, Hepatitis A and contributes to child malnutrition. Despite the low quality of drinking water in most rural households, there is very little water treatment available either at bulk supply level or within the household in rural areas.

Project overview

To contribute to the reduction of diarrheal incidences in Nepal, UNICEF in collaboration with USAID, non-government agencies and public partners (e.g. Ministry of Physical Planning and Works, Ministry of Health etc.) are drawing on the lessons learned from other countries to develop a household-based drinking water treatment promotion project,

In the Nepal Demographic Health Survey 2001, the percentage of children under five years with diarrhea in the two weeks preceding the survey was estimated at 20%. Furthermore, the two-week prevalence of childhood diarrhea is highest among infants of 6-11 months old (35%) and frequent diarrhea is considered to be a major contributor to growth faltering seen in this age group.

The project is based on the premise that treatment of drinking water through several options such as locally produced sodium hypochlorite solution, boiling, filtering, SODIS, etc. will reduce the risk of diarrheal incidences.

UNICEF intends to implement this as a pilot project in selected DACAW (Decentralized Action for Children and Women) districts, namely Panchthar, Parsa, Kapilvastu and Dang, where the activities in the field of hygiene have continued since the mid nineties. The DACAW strategy is to strengthen family and community capacity to care for and support the development of children, expand access to quality and responsive basic social services and strengthen decentralized governance in favor of children and women's development. The project will benefit from the DACAW approach which includes community involvement in design, project implementation, strengthened network, and effective collaboration with the government,

There will be two levels of activity, one at the national level through mass media, advertising and the other by way of targeted intervention in the four project districts. The public-private partnership approach will be used to improve chances of sustainability and efficiency of the project. The implementation will be through the field staff, government pg-Tiers, I/NGOs who are already familiar with similar programs in the districts, and will compliment the ongoing water supply and sanitation program activities supported by UNICEF and its partners.

The overall objective of the project will be to reduce morbidity and mortality among children under five in Nepal through a coordinated communication and social mobilization campaign promoting use of drinking water treatment options in households. The household-based treatment initiative will follow an approach with a formative research being conducted to provide information for operational design.

1.2. Objectives of the study

With technical assistance from USAID's Hygiene Improvement Project, a product trial component of four point-of-use methods was added to the broader formative research design carried out for UNICEF. The methods included in the trial include those proven effective in lab conditions and currently or soon-to-be-available in Nepal—boiling, SODIS, colloidal silver filter and chlorination.

The objective this Point-of-Use Product Trial is to contribute to the base of formative research used to develop the national Point-of-Use Marketing Strategy and a hygiene improvement strategy and workplan for POU treatment for 4 selected DACAW districts in Nepal which are the focus of the USAID-funded and UNICEF-supported pilot districts, namely Panchthar, Parsa, Kapilvastu and Dang,

where the activities in the field of hygiene have continued since the mid-nineties. This specific component of the formative research aimed to provide a hands-on consumer perspective of the general concept of water disinfection, as well as explore consumer perception of using four categories of water disinfection methods over time, in order to capture perceived benefits and obstacles of use.

Specific Objectives

The specific objectives of the product trials study is as follows:

- Document current levels of knowledge, practice and perceived risk of household water quality and water disinfection techniques
- Explore consumer acceptability of the concept of water treatment and of the particular methods. Assess consumer reaction of treated water by “critical factors”: attractiveness, acceptability, effort, perception of effectiveness and value
- Document reported willingness to pay for various options
- Document key effectiveness issues for the various methods

1.3. Focus of the study

Target Audience

- Mothers with children below 5 years of age and caretakers.

1.4. Methodology

This section outlines the study design and the target population of the baseline study, under four sub-headings –

Quantitative and qualitative methodologies were used to collect information from the respondents. A total of 80 mothers were interviewed in all four districts. All four POU treatment methods were assigned in all the four districts. A total of 20 households were selected in every district and the POU methods were equally distributed among the participants.

Because of the purposive sampling to allow for repeated access to product trial participants, the demographic profile of the sample is slightly elevated above the general study population of the baseline survey. While the sample is slightly more educated with slightly greater access, it is reasonable to say the product trials findings are relevant, and can be considered with the other formative research for intervention planning within the four districts targeted for intervention.

Locations	POU method				Total / Location
	Chlorination	Boiling	SODIS	CS Filter	
Dang	5	5	5	5	20
Kapilvastu	5	5	5	5	20
Parsa	5	5	5	5	20
Panchthar	5	5	5	5	20
Total / Method	20	20	20	20	
Total Sample					80

Three visits were made in each household to assess use and acceptability over time. During the first visit, an abbreviated baseline questionnaire containing basic demographics, key knowledge, perceived risk and practice was carried out and one POU treatment method was assigned to the mother. A second visit to the same household was carried out in a three-day interval. Experience on the method use and initial acceptability of method were noted and problems related to method use were identified and resolved together with the householder. Third visit was made after approximately thirty days of method use. Experiences on one-month method use were collected. Respondent perception of effectiveness of the method, their acceptability and continuous use, willingness to pay for treatment method were explored and noted. The one month interval allowed for opportunity to use the method for relatively extended period, experience its use and maintenance of the various methods.

A fifth method of disinfection, the Biosand filter, was considered for inclusion in the product trial, but eventually not included for both logistic and security reasons. The size and weight of the filter made transport difficult as well as suspect to mobilize throughout the districts. As a solution, researchers visited Biosand filter users and drop-outs (households that had discontinued use) and interviewed them about the same product attributes.

Each of the methods was evaluated by a group of mothers with small children according to particular characteristics:

- Taste,
- Smell,
- Appearance,
- Temperature,
- Acceptability to family members,

- Effort, convenience, maintenance,
- Perceived effectiveness and
- Perceived value.
-

i. Development of Study tools

Development of study tools, pre-test of the instruments, training of the researchers and data collection in four study districts were carried by the core team members of the study team with assistance of the HIP Deputy Director and Country Coordinator during the period of June-August, 2005.

HIP provided Solutions with draft instruments for the first, second and third visits. An abbreviated version of the quantitative instrument was developed by Solutions for application in the broader formative research activity. Comments and suggestions received from UNICEF and Solutions were incorporated by Solutions and HIP into the development of test version of the instruments. All instruments were then translated into Nepali as per discussion with the clients. The final draft of the survey instruments was pre-tested through field test in Lalitpur, Chapagaon, a non-sampled district.

The goals of the field pre-test of the questionnaires were to:

- Appraise respondents' comprehension, load and interest
- Appraise Interviewers' Task
- Appraise Questionnaire flow

Based on the pre-test results the study questionnaire and discussion guides were modified and finalized with consultation and approval of UNICEF, USAID/HIP and other concerned officials.

ii. Recruitment of Participants

For the purpose of qualitative study the participants were purposively selected to meet certain criteria which reflected the "typical, representative sample" included in the baseline survey. Since the participants were not selected from among participants of the baseline survey, an abbreviated version of the survey was applied to all study participants to provide basic demographic and KAP (knowledge, attitude and practices) data.

The researchers worked with the female community health volunteers (FCHVs) to

identify and recruit participant households. FCHVs know their communities well and therefore were able to identify households meeting the criteria. Participants chosen for the study had fulfilled a set of criteria, and represented a range of “typical” households in each district. The range would include typical water sources of the region; age and education range; All participants were women with children, since women are the primary water gatherers and water managers. Participants with "reasonable access" to researchers were selected for logistical reasons. It is likely this created some selection bias and skewed the sample slightly upward, although the abbreviated survey findings can be considered comparable to the larger sample randomly selected and representative of study areas.

1.5. Field work process

The study was carried out in three phases, home visit 1, home visit 2 and home visit 3.

Home Visit 1:

During home visit 1 the purpose of the study were explained to the women and they were asked to participate in the study. An abbreviated baseline survey was applied to gather information, respondent demographics on their current sources of water hygiene practices, awareness and practice of methods to make water fit for drinking.

One method, previously selected, was demonstrated to the women and they were asked to continue the use of that method. The focus during the demonstration was on the procedures only and NOT on the benefits and challenges of the water disinfection method.

Home Visit 2: After 3 days

The purpose of the home visit 2 was to get information on participants' reactions to use, their assessment of water by “critical factors”: The critical factors measured were—attractiveness, acceptability, effort, perception of effectiveness, value. Information was also gathered on their assessment of the water in comparison to the water they were drinking before the point-of-use device was introduced to them. The second visit also included:

- Test of water quality
- Problem-solving if needed in using the particular disinfection method

- Request for continuation

Only if they declared that they were going to STOP using their method, and if it was certain that they “meant it,” an alternative method was to be offered. Problems encountered and negotiated solutions were documented as study findings.

Home Visit 3: After 30 days

The purpose of the home visit 3 was to get participants’ reactions on the point-of-use device after an extended period of use and assessment of water by “critical factors”. The critical factors measured were again attractiveness, acceptability, effort, perception of effectiveness, value. Information was also gathered on their assessment of the water in comparison to the water they were drinking before the point-of-use device was introduced to them, perception of factors over time and of use and maintenance issues over time.

In addition to the point-of-use device that the household had been using, demonstration of all the other point-of-use devices were carried out. After the demonstration, information on their preference of methods was collected based on the comparison of methods. This last comparison of methods was not an ideal design for comparison, but given a range of technical and logistic constraints, was deemed the best possible design for a comparative assessment of the consumer acceptability factors across methods.

Chapter 2: General Characteristics of Participants

2.1 Socio-demographic characteristics

Age

The 80 respondents, who were selected across the four study districts (Kapilvastu, Dang, Parsa and Panchthar) for the point-of-use water treatment study, were in the age range of 18 – 45 years. Among them most were in the age of 21-30 years.

Table 2.1.1 Age distribution of the respondents

Age	Freq	Percent
< 20	8	10.0%
21 – 25	26	32.5%
26 – 30	27	33.8%
31 – 35	11	13.8%
36 – 40	5	6.3%
41 – 45	3	3.8%
Above 45	0	0.0%
TOTAL	80	100.0%

Education

Among the respondents 45% were illiterate. Among the literates, 23% had learnt to read and write through non-formal education programs. Other received education of different grades from formal schools (Table 2.1.1).

Table 2.1.2 Literacy status of the respondents

	Freq	Percent
Non Formal Education	10	12.5%
Class 1-4	8	10.0%
Class 5-10	12	15.0%
10 and above	14	17.5%
Illiterate	36	45.0%
Total	80	100%

2.2 Environmental conditions of the study households

Housing

Among the respondents, around 25% of them lived in houses in which the roof construction was made up of straw; nearly 24% of them had tin roofs while around 22% of them had cemented roofs. Some of the houses had roofs made of bamboo and tiles (Table 2.1.3)

Table 2.2.1 Roof Constructions

	Freq	Percent
Cement	17	21.3%
Tin	19	23.8%
Tiles	6	7.5%
Bamboo/Wood	7	6.3%
Straw	31	25.0%
Total	80	100.0%

Fuel and energy

About three fourth households in the study population used firewood as the main source of energy for household consumption. Biogas and dried cow dung were used by one fifth households as source of energy and fuel. Few families were using kerosene oil and LP gases for cooking purposes.

Table 2.2.2 Patterns of fuel and energy consumption

	Freq	Percent
Firewood	58	72.5%
Kerosene	1	1.2%
Biogas	7	8.8%
Dried cow dung	9	11.2%
LP Gas	5	6.3%
Total	80	100.0%

Livestock ownership and its management

Nearly three fourth households (59 out of 80 families) owned livestock in different scale. One third of the owners had animal shed attached to the houses; in one household it was found inside the house, which is a common practice in many communities in Nepal.

Table 2.2.3 Distance of animal shed from kitchen

	Freq	Percent
Inside house	1	1.7%

Attached to house	19	32.2%
Less than 5 meters	4	6.8%
6 - 10 meters	10	16.9%
11 - 15 meters	4	6.8%
16 - 20 meters	5	8.5%
21 - 25 meters	4	6.8%
More than 25 meters	9	15.3%
Back yard	3	5.1%
Total	59	100.0%

Human excreta disposal

Out of 80 sampled households, 29 (36.3%) households had latrine. Among those who had latrine 14% had latrines attached to the house. Other 14% households had constructed latrines in less than 5 meters distance from house. All latrines were constructed within 35 meters from the house.

Table 2.2.4 Distance of latrine from house

Distance from house	Freq	Percent
Attached to the house	4	13.8%
Within 5 meters	4	13.8%
Within 10 meters	1	3.4%
Within 15 meters	7	24.1%
Within 20 meters	4	13.8%
Within 25 meters	4	13.8%
Within 35 meters	5	17.2%
Total	29	100.0%

Other facilities in the households

Among the respondents, around 65% of them had electricity connection, around 62% of them had owned radios and 39% owned television set as means of recreation and information. As a means of transportation, more than half of the responding families owned bicycle; few families owned motorcycle for this purpose.

Table 2.2.5 Facilities available or Ownership at the household

	Freq	Percent
Electricity connection	52	65.0%
Water Tap	35	43.8%
Radio	49	61.3%
Television	31	38.8%

Telephone	2	2.5%
Bicycle	43	53.8%
Motorcycle	4	5.0%
Biogas plant	9	11.3%

Base – 80 Respondents Total

2.3 Drinking water source, storage and handling

Drinking water sources

In 22 out of 80 households (27.5%), private tube well or bore hole was the main source of drinking water. One-fifth families used common public tube well or bore water sources for drinking and other household purposes. About 14% of the responding households were using dug well as source of drinking water. Slightly more than half of these dug wells were privately owned by the families and others were common public dug wells. Some families shared the water sources with the neighbors.

Table 2.2.1 Main sources of water

	Freq	Percent
Piped water in dwelling	9	11.3%
Public tap	9	11.3%
Private tube well/bore hole	22	27.5%
Public tube well/bore hole	20	25.0%
Private dug well	6	7.5%
Public dug well	5	6.3%
Stone tap	1	1.3%
Neighbors' tube well/bore hole	3	3.8%
Other (specify)	5	6.3%
Total	80	100.0%

Availability of drinking water

Regarding the availability of drinking water from the main sources, about 18% (14 out of 80 households) reported that water was not available from their main sources throughout the year. Five households reported to have alternative sources of drinking water. They could use these alternative sources in case of shortage of water from the main source or at times when the water of the main sources is turbid during rainy season. Overwhelming majority (96.3%) of the households reported to be using the same water for cooking and drinking purpose.

Distance to the water source

These water sources were close to most of these households. Most respondents reported that it took them less than 15 minutes to bring water from their water source. About 5% respondents required over 30 minutes to fetch water.

Table 2.2.2 Distance to water source

	Freq	Percent
Water in the premises	25	31%
Less than 15 minutes	40	50%
15-30 minutes	11	14%
More than 30 minutes	4	5%
Total	80	100%

Use of containers to collect and store water

Metal buckets and large 15 liters vessels 'gagris' were commonly used in bringing water from the source. Some families also used plastic buckets, clay pots and other containers.

Table 2.2.5 Vessel used for bringing water from the source

	Freq	Percent
Small gagri – 10 litres	6	7.5%
Larger gagri – 15 litres	29	36.3%
Plastic Bucket	6	7.5%
Metal Bucket	23	28.8%
Clay pot or spherical vessel	10	12.5%
Other containers	6	7.5%
Total	80	100.0%

Regarding the practice of storing the drinking water, it was found that 10.0% stored the drinking water in a separate vessel. Ninety percent of the households used the same vessel to collect and store the water.

Table 2.2.6 Storage practice of drinking water

	Freq	Percent
Stored in the same vessel	72	90.0%
Poured into another storage vessel	8	10.0%
Total	80	100.0%

Most respondents covered their water receptacle. Eighty percent households reported that they covered the lid of the vessels in which they stored water.

Table 2.2.7 Practice of covering lid of vessel in which water is stored

	Freq	Percent
Yes	64	80.0%
No	15	18.8%
Sometimes	1	1.3%

Total	80	100.0%
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Among the households 66.2% said that the main reason for covering the water with the lid was to protect the water from dirt. About 30.8% reported the reason to be to protect the water from flies and insects. No direct relation between the quality of drinking water and diarrhea was made by the mothers. Stale and spoiled food was mostly the reported cause of diarrhea.

Table 2.2.8 Reasons for covering lid of vessel in which water is stored

	Freq	Percent
To prevent from dirt	43	66.2%
To prevent from flies/insects	20	30.8%
Other (specify)	2	3.1%
Total	65	100.0%

2.4 Water treatment: knowledge, awareness and practice

Knowledge and perception

Regarding the fitness of water for drinking, 83.8% of the respondents mentioned that water, which was “crystal clear” was fit for drinking. These respondents used Nepali term “sanglo pani” to describe clear water, which was good for drinking. About one fourth of the respondents perceived absence of smell and dirt as the good quality of drinking water.

Table 2.3.1 Perception of respondents: water fit for drinking

	Freq	Percent
Clear water / "sanglo pani"	67	83.8%
No Smell	10	12.5%
Clean	9	11.3%
No Dirt	8	10.0%
Not Turbid	7	8.8%
No Insects	6	7.5%
No Sand	6	7.5%
Tasty	5	6.3%
No Bacteria and Germs	4	5.0%
No Dust	2	2.5%
No Mud	2	2.5%
Others	6	7.5%

Base – 80 Respondents, Multiple responses accepted

More than two third of the respondents felt that the water from their main source was always fit for drinking. About one third expressed that the water they used was either usually or sometimes good for drinking. Only one respondent perceived that the water she used was never good for drinking.

Table 2.3.2 Perception of the respondents about the quality of water they use to drink

	Freq	Percent
Always good	54	67.5%
Usually good	13	16.3%
Sometimes good	12	15.0%
Never good	1	1.3%
Total	80	100.0%

Most of these respondents associated turbidity of water with contamination and 'dirtiness' and considered such water unfit for drinking. Smell in water was among the factors for some respondents as affecting the quality of drinking water. Similarly, for a large number of respondents presence of objects like sands, insects, leaves moss in water makes it unfit for drinking.

Table 2.3.3 Perception of respondents on water not fit for drinking

	Freq	Percent
Turbid	46	58%
Dirty	36	45%
Smell	15	19%
Sand	14	18%
Insects	12	15%
Dust	12	15%
Germs & Bacteria	11	14%
Mud	8	10%
Yellow	5	6%
Leaves	3	4%
Moss	1	1%
Light water	1	1%
Hot	1	1%

Base – 80 Respondents, Multiple responses accepted

Regarding the treatment of water, 81% of the respondents were found to be aware of the treatment of water. Among the participants who were aware of water treatment, majority of them mentioned boiling the water as a method of treatment. Half of them mentioned that sieving water through cloth for would clean the water. More than a quarter of the participants knew that keeping water vessels covered would make the water safe.

Table 2.3.5 Awareness of water treatment methods

	Freq	Percent
By boiling the water	38	58.5%
Sieve it through Cloth	34	52.3%
By keeping water vessels covered	18	27.7%
By filtering water with water filters	15	23.1%
Letting water settle/ Sedimentation	10	15.4%
By using some medicines (liquid)	5	7.7%
By using some medicines (tablets)	2	3.1%
Use different source for drinking water	1	1.5%
Solar Disinfection	1	1.5%
Other	11	16.9%

Practices

Those who were aware of water treatment method (65 out of 80) were further probed on their use of water disinfection methods. In spite of knowledge and

awareness about the methods of water treatment, nearly 40% of the participants had not used any method to treat drinking water in last 30 days.

Table 2.3.6 Water treatment practice in the last 30 days

	Freq	Percent
Yes	40	61.5%
No	25	38.5%

Base – 65 Respondents

Among those who were treating water, most reported that they were boiling the water for drinking purpose. One-third respondents said that they covered the water vessel to keep it clean. About 40% of the respondents reported to have sieved the water through cloth.

Table 2.3.7 Practice of water treatment – methods practiced

	Freq	Percent
By keeping water vessels covered	13	32.5%
By boiling the water	22	55.0%
By using some medicines (liquid)	2	5.0%
By filtering water with water filters	4	10.0%
Letting water settle/ Sedimentation	2	5.0%
Sieve it through Cloth	16	40.0%
Other	2	5.0%

Out of the 40 respondents who were using one or the other water treatment method (see table 2.3.6), 32 respondents reported to always use the method to treat water.

Table 2.3.8 Practice of water treatment – Frequency of treatment

	Freq	Percent
Always	32	80%
Not always	8	20%
Total	40	100%

Chapter 3: Chlorination

3.1 Experiences of using chlorination during home visit 2 and 3

During home visit one after the administration of abbreviated baseline questionnaire chlorination method was assigned to the families. The respondents were shown how to prepare chlorinated water. After trying out the method for about three days and then about thirty days, respondents were asked to share their experiences of chlorination use.

General perception about chlorination

Most respondents gave positive responses regarding chlorination of water for disinfection. The general perception was that chlorination was a good method of disinfecting water. Most women using chlorination reported it to be easy to use. They said that it would kill germs and bacteria present in the water and would also protect them against diseases. Some respondents reported that chlorination was not a good method for immediate use, as it required half an hour to disinfect the water. Few respondents expressed that this method had one good benefit: one could disinfect water once and use it for drinking throughout the day. Some respondents expressed that chlorinated water had slight smell. Few others said that the water felt a little heavy. Some respondents mentioned that after chlorination the water had become warmer and this was uncomfortable to be drunk during summers.

After trying chlorination for three days and for about thirty days the respondents expressed mixed feelings. Most respondents said that after disinfecting the water, it had become safer to drink as the bacteria and germs present in the water were killed. Some respondents said that the water contained “medicinal smell,” while others complained about “slight smell.” While some respondents felt like drinking more and more water because the chlorinated water did not quench their thirst, others felt that the water was tastier now and also safe to drink because the bacteria was killed. Some respondents added that the taste of the water had also changed because of the chlorine. Contrary to this, a few respondents mentioned that the taste of the water was same as before. One respondent reported of observing slight change in the color. Most respondents stated that they felt safe to drink chlorinated water while some informed that they did not feel safe to drink chlorinated water. One respondent in Parsa reported to have felt sick after consuming disinfected water. The respondent who reported to have felt sick after consuming the disinfected water was learnt to have used double dose of chlorine to disinfect the water. She had difficulty in estimating quantity of water the bucket contained.

All respondents disclosed that disinfecting water with chlorine was a new method that they had learnt from the researchers.

The responses provided by the respondents during visit two and visit three were not different except that during third visit the respondents and the family members said that they had gotten used to the method and were very comfortable and confident in using chlorine to disinfect the drinking water.

3.2 Consumer acceptability and continued use

CONTINUED USE

During home visit two and three it was found that all respondents reported use of chlorine to disinfect drinking water. During visit one, the respondents were shown how to use chlorine to disinfect the water. During visit two and three, it was found that the respondents were not only able to verbally describe the process of chlorinating water but also were confident in demonstrating the method use. All respondents had followed the instructions of using chlorine appropriately.

After continued use of chlorination for approximately one month, all of the respondents mentioned that they would continue using chlorine to disinfect water and that they had no problem with its use. During visit three one respondent disclosed that she had exhausted the whole bottle of chlorine as she was using it regularly. It would be good to explore further if a) she was disinfecting large quantity of water, b) if she was using the right amount to disinfect water. This respondent added that it had been only three to four days since she had run out of chlorine. Some respondents complained of the product not being available in the market. Upon request from where to get bottle of chlorination, it was informed that soon chlorine was going to be available in the market.

During home visit two in Parsa district, it was learnt that one respondent was unable to continue chlorination to disinfect water. The reason was her school-going child, who was present during the method demonstration and had heard about the benefits of disinfecting the water, without the knowledge of her mother and other family members, had taken the bottle of chlorine and poured the entire bottle into a well. This well had been abandoned for quite sometime as the water in the well looked bad. The perception of the child was that chlorine would kill the bacteria and germs present in the well and make it drinkable. This explains the incomplete knowledge the child was able to get from the conversation that had occurred during the method demonstration.

One respondent mentioned that the Red Cross had tested their water quality earlier and had confirmed that it was fit for drinking. This had created a confidence in the respondents that her water quality was good and therefore she was not willing to put in extra effort to disinfect water with chlorine, hence she had stopped using it. However, during the course of the interview, the respondent mentioned that from now on she would continue to use this method. She also said that because the water got warmer after chlorination, she wished to go to the market and buy a clay vessel in which she could save the chlorinated water. Clay pots are known to keep the water cool in the community.

2 of the respondents in Panchthar were found not to be using the method during home visit two. The reason mentioned to discontinue using chlorine was the smell in the water. It was interesting to note that one respondent reported that her child fell sick soon after consuming chlorinated water. When the benefits of the method were explained to the mother and her family members who had stopped using chlorination, they were convinced and agreed to continue to use the method. In Panchthar, the visit three was carried out with a gap of two months, between visit two and three, because of the conflict situation. It was observed that none of the families were continuing the use of chlorine as the bottle supplied to them had already finished. However, all respondents were easily able to describe and demonstrate the method use.

Most respondents reported to be willing to continue to use chlorination but none had thought on where to access the bottles. During the time of interviews such chlorine bottles were not available in the market for purchase. In response to the respondents query, the researchers informed that chlorine liquid would soon be available in the market.

Some respondents in Panchthar said that because the children did not like the smell of chlorinated water and also because one of the children fell ill after consuming the water, they would not use this method, instead they would use boiling water.

CONSUMER ACCEPTABILITY: ATTRIBUTE ACCEPTABILITY

In all four study districts, the respondents were asked for their impressions on the attributes of water in terms of its taste, smell, appearance, texture and temperature. In spite of some differences in the attributes, all of the respondents agreed that chlorination was a good, easy to use method for disinfecting water.

Taste:

Regarding the taste of chlorinated water the respondents found the taste to be good. For most respondents it was fine. Some expressed that the taste of water was better prior to the disinfection whereas others found it be better after the disinfection. In Kapilvastu, most respondents reported that because chlorinated water was good for health they would use it regardless of the taste. In Parsa, some revealed the taste to be bland while others reported to not have noticed any change in taste. Some respondents in all districts reported the chlorinated water did not taste good because of the medicine put into the water. A few families mentioned that chlorinated water did not quench thirst.

Smell:

Most respondents from the four research districts reported to have felt the presence of smell in the disinfected water. Some reported the smell to be very strong whereas some said the smell was light. Most reported the smell to be medicinal which they did not like. One respondent was exceptional. She reported to have liked the smell. Few respondents mentioned that the smell in the water was felt primarily after drinking the water not before drinking. Most respondents said that the water was better before being chlorinated. In spite of most respondents not liking the smell of chlorinated water and feeling that the water was better before being chlorinated, all respondents still felt that this water was good for drinking purposes.

Appearance:

There were mixed reactions from the respondents and their family members on the appearance and texture of chlorinated water. While some felt that the water looked turbid after disinfection others felt that it looked clear and not turbid anymore. Some mentioned the water being slippery while others felt that it was not slippery. Some reported that the water was blue in color. The color of the chlorine bottle was blue and it can be assumed that this could have influenced such comments from the respondents. Some even reported that there was no change in the water. In spite of variations in the responses most of the respondents felt that the appearance of the water now was better than before and that it was good for drinking purpose. The responses related to appearance of the disinfected water were found inconsistent among the users.

Temperature:

Most respondents mentioned that the water was warm or hot after chlorination. They said that warm water was not good for drinking. Few respondents felt that the temperature of the chlorinated water was cool. Some expressed that the chlorinated water would be good during winter season. Regardless of the variations in the responses related to the temperature of the chlorinated water all respondents reported that it was good for drinking.

Acceptability from family members:

The respondents were asked about the comments made by their family members, mainly the husband and the mother in law. In all the cases, the respondents mentioned that their family members liked the method, because it would kill germs and bacteria and protect them from diseases. There were instances, when the family members reminded the mothers to disinfect the water and encouraged them to give it to everyone in the house to drink. Some family members refused to drink the chlorinated water because they did not like the smell. In some families it was mainly the young children who did not like to drink chlorinated water. All respondents expressed that they would recommend this water purification method to others, primarily friends, neighbors and people they knew in the village.

3.3 Effort, convenience, maintenance

Justification of effort, time, convenience of the method

On the effort required to use the method, most of the respondents felt that using chlorination to disinfect water was easy to use and not at all complex. They said that they did not have to make any modification or changes in the method to make it easier for use. They also felt that they did not need to put in much effort to use this method and that the time spent in disinfecting the water was well justified. Some respondents mentioned that to use chlorination method they needed one extra vessel in the house. This seemed to be a problem for them. One respondent reported that she had to disinfect about 30 litres (two buckets) of water daily. Due to unavailability of a bigger vessel she had to disinfect water twice during the day and this was reported as problematic for the mother. She also reported the method to be time consuming, as she had to wait half an hour before drinking the water. Most respondent reported that the time given to disinfect the water was worth it. All respondents acknowledged that after chlorination the water became free from bacteria and therefore it was worth the effort.

Maintenance:

Most of the respondents mentioned that they used ashes and water for cleaning the vessels in which water was treated. Some also mentioned the use of soap, detergent and hay with water. Common practice among most respondents was found to be cleaning the container prior to filling it with water. Some only rinsed the container before filling the water. Most of the respondents reported to have cleaned their vessels everyday, whereas some reported the frequency of cleaning the container once in two days. Upon observation, the vessels looked clean from inside in most respondent's house. In some households the vessel was seen to be dirty from inside. It was a common practice among most respondents to use soap or ash with hay to clean the water container prior to filling it with water.

Perception of Effectiveness:

All respondents said that the water disinfected with chlorine was fit for drinking. They found the method to be effective and felt that it was good for drinking. Most of the respondents mentioned that they were very satisfied with chlorination because it would now kill the germs and bacteria present in the water and would thus protect their health. The respondents also mentioned that the water looked clearer now and that the taste of the water was also good. To some the smell in the chlorinated water was very bothersome, while others mentioned that the smell gradually faded away. They expressed that it was a matter of getting used to the smell. Most respondents said that because chlorination made the water fit to drink, it really did not matter if the water was warm or had some smell. All respondents reported chlorination to be an effective water disinfection method.

Sharing and referral:

On the second visit most of the respondents mentioned that they had not talked about the method to anyone in the neighborhood. However, during the third visit it was observed that the respondents had talked about using chlorination in their neighborhood and other people in the village. While sharing the method with others, the respondents talked about how this new method of using chlorine in water would make water fit for drinking thus protecting them from diseases. The respondents added that they would also tell the people that chlorinated water would help decrease diarrhea cases and other diseases. One respondent mentioned that her neighbor had requested to share the chlorine with her but she had refused to do so. All respondents mentioned that they would recommend their neighbors and people they knew in the village about using chlorine to disinfect water thus making it fit for drinking. The respondents, in general, felt that this method of disinfecting water with chlorine would be fit for everyone in their community. Most respondents said that this water would

be best for families with young children. All the respondents who were using chlorinated water for about a month mentioned that it was consumed by everyone in the family and not restricted to a special few.

3.4 Perceived Value:

The estimated price for one chlorine bottle reported by the respondents ranged from rupees 20-200. Most of the respondents estimated the price of the bottle of chlorine to be around rupees 50. Most respondents informed that they were willing to and able to pay the price if it was within the range of rupees 50. Few respondents said that they would not be able to pay for chlorine even if it was within the range of rupees 50. They expressed that it was too expensive and unaffordable. Others who estimated rupees 100 for a bottle of chlorine informed that they would not be able to afford such a price. Installment payment to purchase chlorine bottle was of interest to some respondents. Others expressed that they did not need to buy chlorine bottle in installment.

Effectiveness of Method in Household Setting:

	Visit 1	Visit 2
Contaminated	12	5
Not Contaminated	8	15
Total	20	20

Coliform count, present/absent vile was used to test the water quality during visit one and two. Most water samples collected prior to method use were contaminated. But after the method use most water samples tested clean. Few water samples tested contaminated even after the method use. Interestingly, in Panchthar prior to method use only two households water sample tested contaminated but after the method use four households water sample tested contaminated. Contaminated test results could be attributed to a) method efficacy; b) secondary contamination.

3.5 Choice of Methods:

Regarding the choice of method it is essential to note that the respondent had used chlorination for about one month and were more confident in describing and assessing the attributes of water disinfected with chlorine. The other POU methods were demonstrated during the third visit and disinfected water was given to the mother and family members, if present, to describe and assess on all the attributes. It was found that the mothers took good amount of time to express the attributes.

Across a range of attributes of water (taste, smell, and appearance/texture) along with the effort and time required to disinfect the water, the respondents who had used chlorination for the month preferred chlorination among all the other products. The CS filter was preferred over other methods with reference to taste, smell and appearance of the water, except for the price. From among the four water treatment methods boiling was declared to be most unappealing way of treating the water. Some also reported SODIS to be least preferred method.

3.6 Other Comments

Storage and treatment vessel:

It was observed that during both the home visits that all respondents used the same vessel for storing and treating the water.

Use of Bottles in the household:

The use of bottles for drinking water was not a common practice in most of the families.

Objections with drinking stale water:

All respondents reported to not have any problems in drinking water that had been sitting overnight. It was not perceived as stale or “baasi pani.” They felt that water disinfected with chlorination would never be stale and they would drink it any time because it was good for their health.

Chapter 4: Boiling

4.1 Experiences of boiling water during home visit 2 and 3

During home visit one after the administration of abbreviated baseline questionnaire, the method of boiling water was assigned to the families. Each of the families was given a kettle, which they could use to boil the water in the family. The respondents were shown how to boil water and were informed that they did not need to boil the water for long duration. Respondents were instructed that one big roll of boiling was enough to disinfect the water using boiling as a water disinfection method. In the interval of about three and thirty days home visits were made by the interviewers and respondents were asked to share their experiences of boiling water.

General perception about boiling water

The respondents mentioned that disinfecting water by boiling it and making it fit for drinking was a good system. Moreover they also felt that it would kill the germs and bacteria in the water and would thus protect their health. The women who were boiling water mentioned that it was a system easy to use and could be followed by everyone. Some also mentioned that they did not have to purchase anything extra from the market, and could utilize the things they already had in their houses. The regular cooking fuel could also be utilized to boil water.

On any difference noticed, while most of the respondents commented on how easy it was to boil water especially with the use of regular household fuel, there were some who commented on the taste of water and how it was warmer now. Some of the respondents mentioned that the taste of water was bland “khallo” while some felt that such boiled water did not quench their thirst. The study was carried out during summer and the users found the boiled to be warm to drink.

4.2 Consumer acceptability and continued use

CONTINUED USE

During visit one, the respondents were shown how to boil water as a water disinfection method. During visit two and three, it was found that the respondents were easily able to describe and demonstrate the process of boiling water. All respondents had followed the instructions of boiling water appropriately. During both the home visit two and three, it was observed that all of the respondents were boiling water as a water disinfection method.

In Parsa during visit three, it was seen that one of the respondents had stopped boiling water. The respondents mentioned that it was mainly due to the temperature that she did not feel like continuing with the method. She mentioned that drinking this water, which was warm was not at all comfortable during the summer season. When informed that they could boil the water and keep it to cool for a while before drinking, it did not increase the appeal of the method.

After continuing to boil water for approximately one month, all of the other respondents mentioned that they would continue to disinfect water by boiling it and that they had no problem with its use.

CONSUMER ATTRIBUTE ACCEPTABILITY

In all four study districts, the respondents were asked for their impressions on the attributes of water in terms of its taste, smell, appearance, texture and temperature. Only in the cases of smell and appearance of water did the respondents have conflicting opinions. In spite of some differences within those attributes all of the respondents agreed that the system of boiling water for disinfecting water was a good practice for drinking water.

Taste:

Most of the respondents mentioned that the taste of water after boiling the water was good and fine for drinking. Few mentioned that there was a slight change in the taste, and mentioned that water was now bland in taste “khallo.” Others found no change in the taste. Most of them felt that the taste of water was better while comparing it with the water they were consuming earlier; all of them felt that the water from this new system was good for drinking purpose.

Smell:

There were mixed reactions from the respondents regarding the smell of water after boiling it. While some mentioned a light smell others felt that there was no smell in the water. On comparing it with the water they were drinking earlier, they again had mixed reactions to. Some felt it was better now while other felt that it was just the same. There were some who thought it was better before. However in spite of such differences all felt that this was good for drinking purpose.

Appearance:

There was mixed reactions from the respondents and family members on the appearance of water after boiling it. While some felt that the water looked turbid after boiling, others felt that it looked clear and not turbid anymore. Other comments on the appearance of the water were that it looked yellowish /green in color, and slippery. Again in comparison, most of the respondents felt that the appearance of the water now was better than before and that it was good for drinking purpose. In spite of their varied reactions, most of them felt that the appearance of the water now was better than before and that it was good for drinking purpose.

Temperature:

Most of the respondents felt that the temperature of the water was warmer or hot as mentioned by some after boiling the water for drinking purpose. However, in spite of the temperature most of the respondents felt that the water was good for drinking.

Acceptability from family members:

The respondents were asked about the comments made by their family members, mainly the husband and the mother in law. In all the cases, the respondents mentioned that their family members liked the system of boiling water. The family members felt that this system would kill bacteria and germs present in water and would thus make water fit for drinking. The family members also mentioned that the use of this system (boiling water) would protect their children from suffering from diarrhea and stomach problems. Some respondents reported that one or two members of their families would not drink the boiled water at any case, as they preferred drinking cool water straight from the tube-well.

4.3 Effort, convenience, maintenance**Justification of effort, time, convenience of the method**

Most of the respondents felt that boiling the water for drinking purpose, was easy and not complex. However, there were a few who felt that it was hectic to light fire many times and felt that it was time consuming. In spite of the above responses, most of the respondents felt that the time given for this was well justified and that water was now free from bacteria and which was good for health. It was observed that mostly the women boiled the water while preparing the morning and evening meal and the boiled water was shared between all

members of the family during meal times. This meant that for throughout the day boiled water was not available for drinking. Saving boiled water for the whole day consumption was not reported to be convenient by most of the respondents. Other practical observation was that the common cultural practice was that the male members and elders used jugs and “*lota*” to drink water. Each of these jugs and *lota* contained about a liter or more of water. Offering about one liter or more of boiled water every time to drink was reported not to be convenient for the respondents.

Maintenance:

Most of the respondents mentioned that they used ashes and water for cleaning the utensils in which water was boiled. Some also mentioned the use of soap, detergent and hay with water. A common practice among most respondents was to clean the utensils after every use. Upon observation, the vessel looked clean from inside in most respondent's house.

Perception of effectiveness:

All the respondents said that the water disinfected by boiling was fit for drinking as it had health benefits. The respondents reported boiling to be an effective method. Most of the respondents mentioned that they were satisfied with the method because it would kill the germs and bacteria present in the water and would thus protect their health. Some of the respondents also mentioned that the taste of the water was good. In one instance, a respondent who was not satisfied with boiling felt that the taste and smell of the water was not good while consuming the water.

Sharing and referral:

On the second visit most of the respondents mentioned that they had not talked about the method to anyone in the neighborhood. However, during the third visit it was observed that the respondents had talked about boiling water in their neighborhood and other people in the village. While sharing the method with others, the respondents talked about how this method of boiling water would make water fit for drinking thus protecting them from diseases. The respondents added that they would also tell the people that boiled water would help decrease diarrhea cases and other diseases. The respondents, in general, felt that this method of disinfecting water by boiling would be fit for everyone in their community. Most respondents said that this water would be best for families with young children. All the respondents who were using boiled water for about a month mentioned that it was consumed by everyone in the family

and not restricted to a special few. It was also observed that the respondents did not comment on this new technique of boiling water to the first bubble.

4.4 Perceived Value

The estimated price in terms of cost of fuel for boiling the water required for their family reported by the respondents ranged from rupees 10-20 per day. Most respondents informed that they were willing to and able to pay the price if it was within the range of rupees 10. Some were not able to estimate the cost because they mentioned that the fire would already be burning in the kitchen for other purpose. In this scenario it was difficult for some to estimate the cost. In the same scenario some felt that there was no extra cost involved because fire was already burning.

Effectiveness of the method in the household setting:

	Visit 1	Visit 2
Contaminated	11	4
Not Contaminated	9	16
Total	20	20

A coliform count, present/absent vile was used to test the water quality during visit one and two. Most water samples collected prior to method use were contaminated. But after the method use most water samples tested clean. Few water samples tested contaminated even after the method use. In Parsa, prior to method use three household's water sample tested contaminated. Even after the method use the three household's water sample still tested contaminated. Contaminated test results could be attributed to a) method efficacy; b) secondary contamination.

4.5 Choice of Methods:

Regarding the choice of method it is essential to note that the respondent had followed the technique of boiling water for about one month and were more confident in describing and assessing the attributes of boiled water. The other POU methods were demonstrated during the third visit and disinfected water was given to the mother and family members, if present, to describe and assess on all the attributes. It was found that the mothers took good amount of time to express the attributes.

Across a range of attributes of water (taste, smell, and appearance/texture) along with the effort and time required to disinfect the water, the respondents who were boiling water, preferred the CS filter followed by chlorination among

all the other products. The CS filter was preferred over other methods with reference to taste, smell and appearance of the water, except for the price. From among the four water treatment methods boiling was declared to be most unappealing way of disinfecting the water. Some also reported SODIS to be least preferred method.

4.6 Other Comments

Storage and treatment vessel:

In all cases it was observed that the women were using the same vessel for storing and treating the water. However during visit three in some cases, it was noted that some of the households were using separate utensil to store after it had been boiled.

Use of Bottles in the household: The use of bottles to drink water was also not a common practice in all of the households.

Objections with drinking stale water: The respondents were asked to comment on the use of stale water "*baasi pani*." Some mentioned that they never drink water which has been kept overnight, while most of the respondents felt that after boiling, there would not be a problem in drinking that water even if it had been kept overnight.

Chapter 5: Colloidal Silver Filter

5.1 Experiences of using colloidal silver (CS) filter during home visit 2 and 3

After the administration of the abbreviated baseline questionnaire, the mother was given colloidal silver filter to try out its use. The researcher demonstrated how to fit the filter and ensured that the mother was able to fit the filter all by herself. Responses on the experience of filter use were collected in about three days and about a month gap.

General perception about the CS filter

Most respondents provided positive responses regarding the use of the CS filter. The general perception was that the CS filter was a good method of water purification. Most women using the CS filter reported it to be easy to use. They said that it would kill germs and bacteria present in the water and would also protect them against infections. A general feeling shared by most of the respondent who were using the CS filter during the study period mentioned that the CS filtered water looked clear. Some of the respondents reported that the temperature of water felt warm after the use of the CS filter.

5.2 Consumer acceptability and continued use

CONTINUED USE

During visit one, the respondents were shown how to use the CS filter to treat the water. During visit two and three, it was found that the respondents were confident in explaining the fitting process and use of the CS filter. Most respondents reported correctly the process of fitting and using the CS filter. Some respondents were confused about proper placement of the washers in the CS filter.

During home visit two it was found that all the respondents were using the CS filter to disinfect the water. A few respondents complained about not being able to use the CS filter because the tap of the filter was leaking. The researchers from the study team re-installed the filter altogether and made the filter ready for use.

However during visit three, it was noted that four of these households among the twenty who were using the CS filter had not been able to continue the use.

In all of the four cases, the primary reason was the nut and the pipe through which water runs out after being filtered had broken. In one household the candle itself had broken into two pieces. Due to unavailability of that filter candle in the local market, the respondent had not been able to continue using the CS filter. The respondents reported that the CS filter use required delicate handling of the product.

After continued use of the CS filter for about one month, during visit three, all of the respondents mentioned that they would continue using the CS filter. Even the respondents who were not able to use the CS filter due to the broken candle mentioned that they would continue its use if a replacement would be made available. Few respondents and their family members whose filter had manufacturing errors and the broken candle were ready to immediately pay for the filters. While most of the respondents mentioned that they had no problem with using the CS filter, a few commented on the leakage of water, mainly from the tap. Cleaning of the filter at the water source was also observed to be very unfriendly. The respondents were required to hand pump the water themselves and then clean the filter containers and candles. Most tube-wells were fixed in the middle of an elevated cemented platform. Even though the respondents used toothbrush to gently brush the filter candles, extremely careful handling of candle was required while cleaning the candles.

CONSUMER ACCEPTABILITY: ATTRIBUTE ACCEPTABILITY

In all four study districts, the respondents were asked for their impressions on the attributes of water in terms of its taste, smell, appearance, texture and temperature. In spite of some differences in the attributes, all of the respondents declared that the CS filter was a good and easy to use method for treating water.

Taste:

Regarding the taste of water treated through the CS filter most of the respondents found the taste to be good. Most respondents reported the taste of water was better after being filtered, whereas other respondents found it to be just the same. All of them reported the taste of water treated in the CS filter was better than the water they were drinking earlier.

Smell:

The respondents had mixed reactions to the smell of the water. While some felt that there was no smell in water, others mentioned a slight smell in water.

Again some could only mention a slight smell while others were specific in mentioning the smell of plastic in water. One of them felt that the water from the CS filter had a slight smell of medicine. There were also some who felt that there was a smell of mud in water. The smell of the mud could be attributed to the candle. Though there were various responses regarding the smell of filtered water, most respondents thought that smell of filtered water was better than before and it felt good while drinking. The responses related to smell of the treated water were found inconsistent among the users of the CS filters.

Appearance:

Most of the respondents and their family members mentioned that the water looked clear after the use of the CS filter. While most felt that the water treated with the CS filter was better than before, all of them voiced that it was good for drinking purpose.

Temperature:

It was a general feeling amongst most of the respondents that the temperature of the water was warmer after using the CS filter to treat it. In spite of the response from the respondents that the temperature of the water became warmer after using the CS filter all respondents reported that it was be good for drinking as it had health benefits.

Acceptability from family members:

The respondents were asked about the comments made by their family members, mainly the husband and the mother in law regarding the method. In all the cases, the respondents mentioned that their family members liked the method, because it would kill germs and bacteria and protect them from diseases. Most mothers reported that the family members reminded the mothers to refill the filter containers and encouraged them to give it to everyone in the house to drink. It was observed that the CS filter was placed in the house where everyone could see the water being filtered. This made the method appealing to them. Each member of the household reported something positive about the method.

5.3 Effort, convenience and maintenance

Justification of effort, time and convenience of the method

On the effort required to use the method, most of the respondents felt that

using the CS filter to treat water was easy to use. During demonstration, it was observed that the respondents were a little confused on how to fit the filter. But with repetition of instruction and demonstration they became confident. Some respondents mentioned that for their own convenience they filled the upper bucket with water twice daily, at night and in the morning. This would ensure that they had enough water for consumption all the time. They also felt that they did not need to put in much effort to use this method and that the time spent in disinfecting drinking water was well justified.

Some of the respondents commented on the slow flow rate and the leakage problem in the tap of the filter. One of the respondents expressed that the water was filtered in small quantities. The capacity of the CS filter container is 12 liters. One respondent felt that this amount was not enough and she had to frequently fill the container to get the required amount of filtered water for family use. The mother found this process to be a little hectic. Some respondents commented on the size of the filter. She said that it would have been better and easier if the filter were a little larger. They said that they did not have to make any modification or changes in the method to make it easier for use. However, some respondents mentioned that treating the water twice daily would ensure that there was sufficient water ready for consumption.

Most families did not have tables where the filters could be placed. Therefore, bricks were used to make an elevated even platform where the filters could be placed. Even in cases where an elevation was created using bricks, the respondents did not comment on any difficulty in accessing the tap because of the low ground.

Maintenance:

During visit one the respondents were taught how to clean the CS filters. The respondents were told to clean the bucket of the CS filter with soap and water and very gently clean the filter candle with the toothbrush provided to them along with the CS filter. The respondents were told to clean their CS filter once a week. Most of the respondents mentioned that they used the toothbrush provided with the filter to clean the candle. They reported that they usually cleaned the filter container with soap and water. During visit two all the respondents reported that the filter should be cleaned at least once a week but they had not cleaned it yet as the filter was used for only about three days. During visit three, most of the respondents reported to be cleaning the CS filter once in two weeks. Only few respondents reported to be cleaning the filter once a week. During observation, it was also noted that some candles were bleeding and a few of them had uneven surface. The amount of water being filtered from each of the filters was different. On one side of the candle it was written how

much water the candle could filter within an hour. This estimate varied in every candle. The range was from 1.4 to 4.5 liters per hour. This raises question on the manufacturing of the product.

Upon observation, most of the filter containers were clean from inside during home visit two, but during home visit three some filter containers were seen to be dirty both from outside and inside. During observation, it was also found that some of the taps was leaking. The taps were made of plastic and it demanded very careful handling. If twisted tightly they would easily break or become loose. Also the plastic rod that held the candle had also broken in one household. This could be due to poor handling of the product.

Perception of Effectiveness:

All respondents said that the water treated in the CS filter was fit for drinking. They found the method to be effective and felt that it was good for disinfecting water. Most of the respondents who used the CS filter mentioned that they were very satisfied with it because it would kill the germs and bacteria present in the water and prevent from them from illness. Most respondents also found the water to be very clear.

Another observation made regarding the CS filter was the difficulty in tightening the knobs. The field researchers also mentioned some difficulty in trying to determine and explain the optimum effort required to tighten the knob. Any extra effort would cause the filter knob to slip and create room for leakage from the top container. Although the researchers had given instructions to the respondents that the filter need not be dismantled while cleaning it, few of the respondents mentioned that they had done so while cleaning the filter once a week. These respondents had initiated on their own, to dismantle the filter while cleaning it. Such behavior could only be due to the fact that the researchers had demonstrated to the respondents how to fit together the CS filter and made sure that they knew the right procedure in fitting together the CS filter. It can only be assumed that with this knowledge of fitting the CS filter, some of the respondents had acted on their own, to dismantle the filter while cleaning. Possible leakage could have occurred while fitting the CS filter together due to the difficulty in tightening of the knobs with the optimal effort.

Among the respondents who were unable to continue the use of the CS filter due to breakage of the filter candle outlet pipe, most of them did not explain exactly how the damage had occurred. It is possible that such damage could have occurred when the respondents dismantled the filter components while cleaning it.

Sharing and referral:

On the second visit itself most of the respondents mentioned that they had talked about the CS filters with others in their neighborhood.

While sharing about the method with others, the respondents talked about how the CS filter treats the water and how it would protect them from diseases. Some also mentioned that the CS filtered water would be good for the health of the child and mother. All respondents reiterated that they would recommend the CS filter to their neighbors and people they knew in the village. Most respondents felt that the CS filter would be fit for everyone in their community. There were few respondents, who felt that it was good for families who were open to experimenting new techniques and also for those who could afford it. Regarding the use of water, the respondents mentioned that water from the CS filter was consumed by everyone in the family and not restricted to a special few. The families also reported of sharing the filtered water with children and elders in the neighborhood.

It is important to note that consumption of filtered water only throughout trial period was not confirmed.

5.4 Perceived Value:

The estimated price for the CS filter reported by the respondents ranged from rupees 100-2500. Most of the respondents estimated the price of the filter to be around rupees 350-400. Most respondents informed that they were willing to and able to pay the price if it was within the range of rupees 400-450. The prices estimated by the respondents were around 40% - 50% lower than the factory price (rupees 750) of the CS filter. Beyond this was an unaffordable price, reported many. They expressed that it was too expensive and unaffordable. The respondent, who estimated the price to be rupees 2500, declared that she would never be able to afford the CS filter at such a price. Installment payment to purchase the CS filter was of interest to most of these respondents.

Effectiveness of the method in the household setting:

	Visit 1	Visit 2
Contaminated	14	15
Not Contaminated	6	5

Total	20	20
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Coliform count, present/absent vile was used to test the water quality during visit one and two. Most water samples collected prior to method use were contaminated. In this case after the use of the CS filter, the cases of contaminated water were even greater than tested earlier.

The CS filters used in the study were tested and confirmed for use by IDE Nepal (International Development Enterprise Nepal) (report attached in annexure).The additional contamination seen in some of the cases is assumed to be because of secondary contamination.

5.5 Choice of Methods:

Regarding the choice of method it is essential to note that the respondents had used the CS filter for about one month and were more confident in describing and assessing the attributes of water treated in the CS filter. The other POU methods were demonstrated during the third visit and treated water was given to the mother and family members, if present, to describe and assess on all the attributes. It was found that the mothers took good amount of time to express the attributes.

Across a range of attributes of water (taste, smell and appearance/texture) along with the effort and time required to treat the water, the respondents using the CS filter for the month preferred the CS filter among all the other products. The CS filter was preferred over other methods with reference to taste, smell and appearance of the water. Price was not appealing to most respondents and their family members. However, among the family members whose filter had broken within one month use reported of the desire to buy and replace the broken items of filter with their own money. From among the four water treatment methods boiling was declared to be most unappealing way of disinfecting the water. Some also reported SODIS to be least preferred method.

5.6 Other Comments

Storage and treatment vessel:

It was observed that during both the home visits all respondents used the same vessel for storing and treating the water. Whenever needed the filtered water was taken straight from the filter recipient. A separate storage vessel was not used to store the filtered water.

Use of Bottles in the household:

The use of bottles for drinking water was not a common practice in most of the families. There were very few instances the respondents mentioned that they used bottles for storing drinking water. In Kapilvastu, it was interesting to see that during visit two all respondents mentioned that they did not use bottles for drinking water. But during visit three some respondents mentioned that they used bottles for drinking water. This means that this was a new practice among some of the respondents to use bottles for storing drinking water.

Objections with drinking stale water:

When the respondents were asked about any objections with drinking stale water, all of them mentioned that they could drink filtered water even if it was left overnight. On further comments on the water, while most of them said everything was fine, one of the respondents commented on the difficulty faced during opening and closing the tap. The plastic taps were found to be too tight. The fear was if one tried to move the tap with strength it would go loose. One of the respondents also commented on the size of the filter. She said the amount of water the filter could contain was not enough for their family.

Chapter 6: SODIS (Solar Disinfection)

6.1 Experiences of using SODIS during home visit two and three

During home visit one after the administration of abbreviated baseline questionnaire, SODIS method was assigned to the families. The interviewers demonstrated SODIS method to the respondents and made sure that they were able to use the method on their own. The respondents were also given instructions on proper usage and disinfection process during different weather conditions (during sunshine and cloudy weather). The respondents were asked to try out the method first for about three days and then for about thirty days. Respondents' experiences using the method were gathered by the researchers in three days and in one month interval.

General perception about SODIS

Most respondents gave positive responses regarding SODIS. The general perception was that SODIS was a good method of disinfecting water. The respondents readily accepted the method of disinfecting water using SODIS. The researchers were very careful in explaining the procedure and effectiveness of the method in making the water free from germs and bacteria. It was also observed that in most of the cases, the respondents were able to recall and express that the use of SODIS would make water free from germs and bacteria. During the demonstration of the technique it was also not very easy to find an elevated platform to put the bottles exposed to sunlight. It was often required to scout around the premises to find a location best suited for the purpose. In some instances, the bottles were in easy reach of children and were used as a fun toy.

Most women using SODIS reported it to be easy to use. They said that it would kill germs and bacteria present in the water and would also protect them against diseases. Most agreed that after disinfecting the water using SODIS the water would be fit to drink. There were some respondents who reported that water disinfected using SODIS remained warm and this was not very pleasant to drink during the summer season.

After trying SODIS for three days and for about thirty days the respondents expressed mixed feelings. Most respondents said that after disinfecting the water, it had become safer to drink as the bacteria and germs present in the water were killed. Most of these respondents commented on the temperature of water after the water was disinfected using SODIS. They felt that the taste of the water had changed. While some felt that the water was bland in taste, there

were a few who mentioned that this water did not quench their thirst. The respondents however, all agreed the process of SODIS to disinfect water would make water fit for drinking.

6.2 Consumer acceptability and continued use

CONTINUED USE

It was encouraging to note that most of the respondents were able to follow the instructions on using SODIS to disinfect water. However there were few instances where some of the respondents were consuming the water even if it had not been disinfected properly. Respondents were not exposing the bottles to sunlight for adequate duration. There was also another instance where the respondent shook the bottle only ten times before leaving it in the sunlight whereas they were asked to shake the half filled bottle twenty times. The flaws in the process were pointed out and proper directions were once again demonstrated by the researchers. During visit two and visit three, it was observed that most of these respondents were not able to use SODIS due to rainy weather conditions.

Responses for one of the households could not be collected during visit three. It was learnt from the respondent's neighbors that the respondent and her mother-in-law were not on good terms. The mother-in-law questioned the respondent as to why she was picked to try this method and did not take things positively. Moreover, the mother-in-law took away ten bottles out of the twenty bottles given to her and gifted away five bottles to her neighbor. Due to the poor relationship of the mother and daughter-in-law and the fact that the mother-in-law was making an issue of why her daughter-in-law was chosen for demonstration and use of SODIS, the researchers upon discussion with the neighbors, refrained from visiting the respondent's house during visit three.

During visit three all respondents mentioned that they would continue to use this disinfection method. Regarding the problems with the use of SODIS, even though most of the respondents were committed to its future use and mentioned they had no problems, there were some who said that this method was not good for the monsoon period. And therefore they felt that if they were to continue disinfecting water they needed a system that could be used during all seasons.

CONSUMER ACCEPTABILITY: ATTRIBUTE ACCEPTABILITY

In all the four study districts, the respondents were asked for their impressions on the attributes of water in terms of its taste, smell, appearance, texture and temperature. In spite of some differences in the attributes, all of the respondents agreed that SODIS was a good, easy to use method for disinfecting water. It was only with reference to the taste of water where some of the respondents felt that water was bland in taste after using SODIS to disinfect water. Some respondent complained of the slight smell in the water.

Taste:

Regarding the taste of SODIS water the respondents found the taste to be good. For most respondents it was fine. Some expressed that the taste of water was better prior to the disinfection whereas others found it be better after the disinfection. In Kapilvastu and Parsa, most respondents reported that the water became bland "*khallo*" after using SODIS to disinfect it. It was mainly in Panchthar where the responses from the women were completely different from one another. Some of them reported to have not felt any change in the taste whereas others said that the taste had changed. Some reported that they like the taste and others reported to have disliked the taste. In spite of some differences most respondents mentioned that the taste of SODIS was better than the water they were drinking earlier. All the respondents felt that SODIS water, in general, was good for drinking purpose.

Smell:

Most respondents from the four research districts reported to have felt the presence of smell in the disinfected water. Most of the respondents, who mentioned the presence of smell in water, described the smell as that of a plastic bottle. There were also some others who described the smell as the smell of sun.

Regardless of the smell, all respondent said that it was good for drinking. This explains that respondent understand the benefits of drinking SODIS water.

Appearance and texture:

Most respondents revealed that the water appeared clear after using SODIS. However, there were some respondents who felt that there was no change in the appearance of water before and after the use of SODIS. In Kapilvastu, there were some mixed reactions from the respondents on the appearance of water. While some perceived the water to be clear, others felt that it was turbid. In addition to the difference of perception in appearance, some also felt that

water felt slippery.

In spite of some differences in the perception regarding the appearance of water, most agreed that the appearance of water was now better than before. All respondents also claimed that this was good for drinking purpose.

Acceptability from family members:

The respondents were asked about the comments made by their family members, mainly the husband and the mother in law.

In all the cases, the respondents mentioned that their family members liked the method, because it had the ability to kill germs and bacteria and protect them from diseases. There were instances, when the family members reminded the mothers to disinfect the water and encouraged them to give it to everyone in the house to drink. Some family members, in most cases children and the elderly, refused to drink the SODIS water because they did not like the plastic smell. All respondents expressed that they would recommend this water purification method to others, primarily friends, neighbors and people they knew in the village. Most said that SODIS was a method that was dependent on the sun therefore they would prefer a method that could be used throughout the year without being dependent on the sun.

In most households the water disinfected with SODIS was well accepted by the family members. The decision-makers of the family such as husbands and mother-in-laws mentioned that disinfecting water in the sun would kill the bacteria and germs in water and would protect their family members from diseases.

6.3 Effort, convenience, maintenance

Justification of effort, time, convenience of the method

In response to any complexities involved in SODIS method, most of the respondents reported that using SODIS to disinfect water was a method easy to use and it was not at all complex. Most respondent reported that much effort was not required to disinfect water in this manner and that the time given for disinfecting water was worth it.

There were some respondents, who mentioned that disinfecting water in this manner was a bit time consuming. They mentioned that the possibility of using larger bottles would be beneficial. This remark raises a question of whether the

respondents had completely understood the use of bottle advised for SODIS. Most of the respondents filled their bottles with water straight from the tube-well and did not report any difficulty in following the SODIS process.

The respondents did not comment on other difficulties using this system.

Maintenance:

Most of the respondents mentioned that they used detergent and water for cleaning the bottles in which water was disinfected. Some also mentioned the use of soap, and ash with water. During visit three, it was observed that a few of the respondents mentioned the use of rice grains and water to clean inside of the bottles. Common practice among most respondents was found to be cleaning the bottle prior to filling it with water. Some only rinsed the bottle soon before filling the water. In some households the bottles had dirt particles inside. One of the bottles even looked green on the inside.

Perception of Effectiveness:

Most of the respondents felt that the time spent on disinfecting water through SODIS method was worth it. The respondents felt that the system of SODIS was effective and it made water fit for drinking thus protecting their health except that it had to sit in the sun for long hours. Most of the respondents mentioned that they were satisfied with this method and felt that the water tasted good and was clearer. They also reported that method would kill the germs and bacteria present in water.

However there were some who felt that they were not too satisfied with the system and could not use it on a continuous basis because they had to be dependent upon the weather condition and could not use it during the monsoons. Some of the respondents who were not too satisfied with this system commented on the water remaining warm during the summers and the smell of bottle was unpleasant while drinking water. The others who were satisfied with SODIS mentioned that the water now looked clean and clearer and most importantly was free from bacteria.

Sharing and referral:

By the time of visit two, most respondents had not talked about SODIS with anybody in their community. However after using the method for about a month, most of the respondents mentioned that they had talked about this system with their neighbors. They reported that they had shared with their

neighbors how SODIS water would help protect them against diseases. Some even commented about the disinfection process, on how the energy from heat and sunlight would kill the bacteria that may be present in water. All respondents felt that SODIS would be good for everyone in the community. All the respondents mentioned that SODIS water was consumed by everyone in their families. Its consumption was not restricted for any special occasion or person. Everyone was drinking it whenever they felt thirsty.

6.4 Perceived Value:

The estimated price for one bottle reported by the respondents ranged from rupees 3-15. Most of the respondents estimated the price of the bottle to be less than rupees 5. Most respondents informed that they were willing to and able to pay the price if it was around rupees 5. There were also a few respondents who said that more than 5 rupees cost per bottle would be unaffordable for them. The bottles given to the respondents were either mineral water bottles or Pepsi and Coke bottles. These bottles were not easily available in the community. One had to either buy mineral water or Pepsi and Coke to use the bottle for SODIS.

Effectiveness of the method in the household setting

	Visit 1	Visit 2
Contaminated	14	4
Not Contaminated	6	16
Total	20	20

Coliform count, present/absent vile was used to test the water quality during visit one and two. Most water samples collected prior to method use were contaminated. But after the method use most water samples tested clean. Few water samples tested contaminated even after the method use. Among these instances, in one case the water sample taken was straight from the SODIS bottle. This could be an indicator that the respondent had not followed the procedures properly and left the water bottle for a lesser amount of time. In another case the water sample was from a glass, which indicates possibilities of secondary contamination.

6.5 Choice of methods:

Regarding the choice of method it is essential to note that the respondent had used SODIS for about one month and were more confident in describing and assessing the attributes of SODIS water. The other POU methods were demonstrated during the third visit and disinfected water was given to the

mother and family members, if present, to describe and assess on all the attributes. It was found that the mothers took good amount of time to express the attributes.

Across a range of attributes of water (taste, smell, and appearance/texture) in addition to the effort and time required to disinfect the water, the respondents using SODIS preferred the CS filter followed by chlorination among all the other products. The CS filter was preferred over other methods with reference to taste, smell and appearance of the water, except for the price. From among the four water treatment methods boiling was declared to be most unappealing way of disinfecting the water.

6.6 Other Comments

Storage and treatment vessel:

It was observed during the study that the usual practice of the respondents was to store water in the same vessel after bringing it from their water source. After the study team introduced the method of SODIS and gave them bottles to disinfect water, the respondents mentioned during visit two and three that they were now using the bottles to store the water as well. In this manner it was observed that they were now using the bottles to store and disinfect the water.

Use of Bottles in the household:

Most of the respondents reported on the use of bottles for drinking water. It is to be noted here that these were the same bottles provided by the study team for disinfecting water using SODIS.

Objections with drinking stale water:

Most of the respondents mentioned that they had no objections on drinking the disinfected water even if it was kept overnight. Though some of the respondents mentioned that they never drank stale water, they mentioned that they would drink this since it was disinfected water and had health benefits.

Chapter 7: Biosand Users/Drop Outs

A fifth method of disinfection, the Biosand filter—an intermittent slow sand filter², was considered for inclusion in the product trial, but eventually not included for both logistic and security reasons. The size and weight of the filter made transport difficult, as well as suspect to mobilize throughout the districts. As a solution, researchers visited Biosand filter users and drop-outs (households that had discontinued use) and interviewed them about perceived benefits, challenges and the range of product attributes – appearance, taste, smell, temperature, perceived effectiveness, etc.

The Biosand was only distributed in Parsa, therefore Parsa was the only district where interviews were conducted. Three Biosand users and three drop-outs were interviewed.

PARSA

Biosand Users

Two of the respondents had started using Biosand filter within the last 4 months, while it had been 1 year for the other respondent. All of them mentioned that they had been using water from this filter daily.

Among these respondents, two of them used metal buckets for storing water while one of them used ceramic pot for storing water. It was observed that the use of bottles for drinking water purpose was not a common practice in these households.

The respondents had observed many changes in water after the use of Biosand filter. Most of them commented that there was no yellow residual effect while washing clothes and cooking food. Some also found the taste of water to be better now. Other comments made on the change in water, after the use of this filter was that water was now free from arsenic. The respondents also noticed that the oily layer in water was not there after they started using Biosand filter.

The respondents mentioned that they did not have major difficulties while using the system. However one of them mentioned that the iron nails and brick pieces usually blocked the holes made for dripping water and this was the only

² Dr. David Manz of the University of Calgary developed a household version of the intermittent slow sand filtration, called the Biosand filter.

problem while using this system.

One of the respondents found this system itself effective and didn't feel the need to improve on it. The others mentioned that the flow rate was a problem. They mentioned that the flow rate was very little and due to that, large quantities of water could not be collected at a single instance. The respondents felt that a system which could provide large quantities of water at a single instance would be more preferable.

All the respondents felt that the time given for treating water using Biosand filter was well worth it, because the water is now free from arsenic and healthier to drink. However one of them mentioned that it would have been better if they did not have to clean the Biosand filter every now and then.

On the time required prepare water for these families; the respondents mentioned that they had to wait for about 2-4 hours depending upon the family size. With reference to the time given, everyone felt that it was well worth it because water is free from arsenic and moreover it also protects their clothes and utensils.

The respondents were cleaning the system every 2 weeks however one of them was cleaning it every 2 days.

All of these users of Biosand filters were completely satisfied with the system. Most of them felt that they could now drink clean and clear water which was free from arsenic. Due to this they felt that it would help protect them against diseases. There were some who also felt that the taste of water from the Biosand filter was tastier and did not contain any smell.

Two of the respondents had not talked about this system with anybody else in the village. One of them who had mentioned about it to others in the village mainly talked about how it would protect them against diseases. The respondent also talked about the taste and smell of water which was pleasant for drinking.

The respondents mentioned that all of their family members liked the system of Biosand filter. They appreciated the taste and smell of water and noticed that the water was not oily in appearance anymore.

The respondents mentioned that they would recommend this system to others in the village and talk about how water would be free from arsenic after the use of Biosand filter. They further felt that this system was appropriate for everyone

in their village. According to the respondents there wasn't anyone for whom the system wasn't good for.

Everyone felt that the effort given in using this system was very justified. According to them the only effort needed was for cleaning the system every 15-16 days. This they felt was no comparison to the benefits they were receiving from Biosand filter.

The other methods of water treatment (CS filter, chlorination, boiling and SODIS) were demonstrated to the Biosand users and asked to compare and comment on their preference based on various attributes of water (taste, smell, appearance, effort, price etc.). Across these range of attributes, the Biosand users preferred the CS filter against other methods except in reference to price where they preferred the system of Chlorination. The respondents also felt that appearance of water was better from Biosand filter as against the other methods demonstrated.

Biosand Drop Outs

Among the drop outs, it was observed that all the respondents had not even used the Biosand filter for a year. One of them used for 4-5 months, the other used for about 7 months and the third respondent mentioned that they had used for approximately 9 months. One of the respondents mentioned that this filter did not provide them with adequate water when required and this was the main reason why they left using Biosand filter. Another respondent mentioned that they had dug another tube well with 145 ft. of depth and this was free from arsenic. They had stopped using Biosand filter after this new source of arsenic free water was created.

These respondents who had stopped using the Biosand filter however talked about the clear appearance of water as an attribute they liked in Biosand filter water. They also mentioned that the taste and smell of water was good in this water. When the respondents were asked to comment on aspect they did not like about the Biosand filter, the low flow rate was mentioned by all. The filter was not able to provide the quantity of water they required at a time. Among other aspects one of the respondents mentioned that they did not like the effort required in cleaning the system, while another mentioned that the outlet of the filter (tap) was always leaking.

All the respondents mentioned that the main reason why they stopped using Biosand filter was the lower flow rate as mentioned above. All of these respondents had not done anything to treat water further after stopping the use of Biosand filter.

The complexities involved with using the system was also related to the lower flow rate. The respondents mentioned that if any modification was to be made then it should be related to the lower flow rate. They themselves had not been able to do anything about this issue of flow rate.

The respondents felt that very little effort was required in this system. They all mentioned that the actual effort was the patience required when waiting for the water to get filtered.

It was observed that the family members had liked this system. They all had felt that this would make water free from arsenic and which was good for the health of the family members. Some of the respondents mentioned that this was an initial reaction to the filter but later on when the issue of flow rate came in, the family members also did not like it. They all looked forward to this system being modified so that they could get the required quantity of water at any time.

Only one of the respondents had mentioned about this system to others. The respondent had mentioned about how this system would make water free from arsenic. One of the other respondents mentioned that the person who introduced this system to them had talked about Biosand filter to the other households which had arsenic affected water source.

Two of the respondents mentioned that they would recommend this system to other people who are suffering from arsenic affected water source. One of the respondent mentioned that she would not recommend this system because of its poor flow rate.

All the respondents felt that this was fit for all in their community. There were some who felt that this was specifically good for others who had arsenic affected water source. One of the respondents also mentioned that this was not good for large families due to the flow rate but it would be alright for smaller families.

The other methods of water treatment (CS filter, chlorination, boiling and SODIS) were demonstrated to the Biosand users and asked to compare and comment on their preference based on various attributes of water (taste, smell, appearance, effort, price etc.). Across these range of attributes, the Biosand drop outs preferred the Biosand filter against other methods mainly in reference to taste and smell of the water. However with reference to effort required, time taken and price they preferred the system of Chlorination.

Chapter 8 – Considerations and Discussion Marketing Water Disinfection

Again, the main objective of this component of the study was to examine the overall acceptability or resistance to the concept of point-of-use water disinfection, and examine the various point-of-use products/methods across a common set of attributes. Together, these findings will contribute to the formulation of the point-of-use marketing plan.

Demonstrated high interest in disinfection techniques although low perception of risk of infected water in causing diarrhea or other illness.

Study participants were all quite willing to try the various methods of water disinfection, and expressed few challenges in using the method for a period of at least one month. Because of limitations of study methodology, householders did not have to spend their own resources on obtaining and using the disinfection methods, so “easy and willing” did not consider cost.

Quite noteworthy is the fact that while most all participants were enthusiastic to try the various disinfection methods, few perceived problems with their water quality. The problems they perceived had to do with visible turbidity in the water, and to a lesser extent sand or dirt in the water and lastly a foul smell to the water. Virtually none expressed any sense of “microbial” or bacterial contamination (not the words per se, rather the concept of matter in the water that might cause illness). Likewise, few attributed diarrheas to water; rather most to “stale” (contaminated) food. While some responded that drinking clean water could help to avoid diarrhea, this was not a predominant concept for most participants.

However, householders readily picked up the concept of microbial contamination of water when researchers explained this as a benefit of disinfection, and quickly incorporated this into the perceived benefits of water disinfection.

So while study participants were open to trying disinfection methods, few perceived much risk of disease due to water. The concept of water that is “fit to drink” had everything to do with the appearance and smell of the water, and on another dimension, the water temperature. The implication of all this for promoting point-of-use disinfection methods is that there is no “perceived risk” of the problem and therefore little motivation to expend scarce household resources on disinfection products. Any intervention to build demand will have to focus on increasing the perception of risk of badly managed and untreated water, while

highlighting “self-efficacy,” the behavioral concept that there is indeed some action that can be taken to address the perceived problem. Any demand creation must address the issue that “clear water” can still cause illness.

Conversely, no product will be acceptable if it does not address the overwhelming preference for water that is not turbid. This benefit must be highlighted to consumers, and products must assure “crystal clear” water.

Key Attributes Across All Water Disinfection Methods:

The study carefully examined consumer preference for various attributes across all methods. Critical attributes included: clear, not turbid water with little or no smell. Another attribute that was clearly important to product trial participants was the temperature of the water, and promotion must consider that boiling and SODIS actually raise the temperature of the water. Interestingly, some participants perceived that chlorination and rarer that filtering also “heated” the water. This is particularly relevant in the hot summer months, when participants mentioned a preference for cool water direct from the water source and stored as needed in a metal, clay or plastic container.

Also mentioned, though not directly as a “problem” with any particular method, was the volume of water disinfected at a time. Because water was generally stored in the collection or disinfection vessel until transferred to the drinking vessel, study participants commented on the flow rate of filters and the size of the filter storage unit and the small capacity of the boiling kettle.

Some barriers that were anticipated by researchers were not realized, most notably a prohibition on drinking water stored overnight, was not mentioned by householders as disadvantages of certain water disinfection methods, most notably SODIS and possibly the filters.

Addressing Issues of Access:

Study participants were actively asked to recount dislikes or problems they were incurred with method use, and surprisingly few problems were voiced. A few specific problems noted by researchers though not necessarily articulated by participants are noted below. Because participants had little overall resistance to the concept of disinfection (although saw little need for disinfecting water other than simple filtration), promotion of point-of-use disinfection should focus on the “supply side”:

- assuring the efficacy of all methods (particularly of the CS filter) and

- assuring easy access of product through disperse distribution systems and schemes that assure price is not an insurmountable barrier to use. This again reflects in particular to the CS filter which requires a sizable initial outlay of cash for the average rural Nepali family. None of the methods aside from boiling are currently available in rural Nepal. Planners should consider an intensive phase which focuses on preparing the supply of filters before working to generate demand or promote disinfection. In other countries, the price and distribution networks of chlorination were carefully studied to allow for purchase by poor and rural people. Finance and credit schemes have been used successfully to allow for installment payments on filters. The private sector has been engaged in other counties in assisting with rural distribution of empty bottles for solar disinfection.

The importance of an interpersonal communication component

Respondents were all able to describe to researchers the steps involved in each method, both at 3 days and 1 month. Most reported talking to family and neighbors about their method. This implies that disinfection is conceptually easy to grasp, and that respondents retained detailed explanations even over the course of the month. Participants also readily grasped the concept of disinfection from microbial contamination. Though there is no solid data to prove this, one can speculate that the intensive interpersonal component of the research helped to anchor somewhat detailed instructions in the minds of householders, and therefore any “demand creation” and promotion should include an interpersonal component.

Recommendations for disinfection of household water – ALL water in ALL households??

It became quite clear that while most all households were actively engaging in water disinfection when prompted, few disinfected water all of the time. This was related to a number of factors, including lack of an “extra” water storage container in the household to disinfect enough water for continuous use; and lack of a portable vessel to bring when outside the home. Also related was a perceived lack of time to repeatedly disinfect enough water for household use (see discussion below on receptacle size).

The authors must note that it is unclear if householders felt the need to consume disinfected water all the time, which relates to a lack of perception of bad water quality. While children and elders were named as benefiting most from “good” water, there was no evidence of differential consumption by age or gender.

One stated benefit of SODIS was that extra storage bottles were now available for household use and for carrying for work outside of the home, which underscored the current lack of availability.

This lack of an additional vessel as well as overall cost considerations create a number of critical challenges, and invite the question of **which recommendation is appropriate for water disinfection:**

- disinfect all water, requiring exponential time or product to disinfect water also used for cleaning, washing and cooking;
- disinfect water used just for drinking, or drinking and food preparation, requiring that this water is separated from other waters, when currently there is often no separate or spare container for drinking water;
- disinfect all water consumed in the home, without an articulated strategy for disinfecting water outside of the household setting.

Lastly, the addition of this product trials component, not a common formative research technique, can be considered a valuable addition to the available methods for collecting quantitative and qualitative information used for planning hygiene improvement interventions.

Annexes

Detailed Reporting by District

Chlorination

(Dang, Kapilvastu, Parsa, Panchthar)

Boiling

(Dang, Kapilvastu, Parsa, Panchthar)

Colloidal Silver Filter

(Dang, Kapilvastu, Parsa, Panchthar)

SODIS (Solar Disinfection)

(Dang, Kapilvastu, Parsa, Panchthar)

Study Tools (English and Nepali)

Steps of POU Method

Abbreviated Questionnaire

Interview Guide (Home Visit 1, 2 and 3)

Interview Guide (Biosand Users and Dropouts)

Water Test Results

The CS Filter – IDE Nepal

Chlorine Quantity - ENPHO