

# Researching Water Quality, Consumer Preferences and Treatment Behaviour

The Water Supply and Treatment and Safe Water Promotion Groups are partnering with Helvetas Swiss Intercooperation to improve drinking water quality for homes across rural Nepal. The objective is to develop and implement a water treatment strategy through systematic field-based monitoring. S. Marks<sup>1</sup>, A. Diener<sup>1</sup>, M. Bhatta<sup>2</sup>, D. Sihombing<sup>3</sup>, R. Meierhofer<sup>1</sup>

## Introduction

In rural Nepal, 88 % of households have access to an “improved” drinking water source [1]. Yet many of these water points cannot guarantee microbiologically safe drinking water. Water quality data is limited due to difficulties with systematic collection in remote communities, leaving program managers without the information needed to plan treatment strategies. A research team from Sandec’s Water Supply and Treatment and Safe Water Promotion Groups partnered with Helvetas Swiss Intercooperation in Nepal to assess household drinking water quality, behavioural factors determining water handling practices, and market conditions for treatment products using field-robust data collection techniques.

## Project background

The Helvetas Water Resource Management Project (WARM-P) aims to identify water resources and foster effective, equitable, and efficient use at the local level across five districts of Nepal (Achham, Dailekh, Kailali, Kalikot, and Jajarkot) [2]. Within the WARM-P service area there is the added goal to improve drinking water quality through a demand-led treatment and safe storage approach.

Several critical questions were identified within WARM-P: To what extent are households’ drinking water supplies contaminated with faecal bacteria? How do households collect and manage their water? Are households using any existing water treatment techniques? Which behavioural factors determine the water handling and consumption practices? Which consumer preferences and behavioural factors should be addressed to create demand for safe water? What is a promising market-oriented strategy that has potential for sustainable implementation at scale?

## Drinking water quality assessment

The objective of the water quality assessment was to quantify the concentration of faecal bacteria in households’ drinking water supplies. Water samples were collected from

166 points of collection (household or public taps, boreholes, and traditional wells) and 512 household storage containers (Photo 1). In addition, structured observations were conducted at the intakes of piped systems to assess potential contamination sources. Samples were collected in Whirlpak bags and transported within six hours to temporary laboratory stations centrally located within villages. Samples were processed to enumerate *E.coli* concentrations using membrane filtration with compact dry plates. Plates were placed in a solar-powered incubator at 35±2 °C for 24 hours before colony forming units (CFUs) were counted.

Nine out of every ten households sampled were accessing an improved source for their main drinking water supply. Most households (91 %) were using the same container for transport and storage. Nearly all storage containers (91 %) had detectable *E.coli* in excess of the WHO guideline for microbial safety of drinking water [3], with 21 % of stored water samples containing over 100 colony forming units (CFUs) per 100 mL. At the point of collection, 31 % of the samples were free of faecal contamination and about one in ten samples contained >100 CFU *E.coli*/100 mL (Figure 1).

Better water quality at the point of collection was associated with cleaner water in storage containers (Spearman’s  $\rho$  (283) = 0.25,  $p < 0.001$ ). For water systems which households identified as providing water continuously (no interruptions), water quality was significantly cleaner than for systems experiencing daily interruptions (Mann-Whitney  $U$  (196) = 3380,  $p < 0.05$ ). Intake observations revealed the close proximity of animal faeces and farming, as well as missing intake protection, as potential reasons for contaminated piped water supplies.

## Water treatment and hygiene behaviour

Structured interviews with households (n = 512) were conducted to assess behavioural and environmental factors determining water handling and consumption practices. Fifty percent of survey respondents had at least a primary school level of education. Only 4 % of households had adequate hand washing facilities and 41 % of respondents reported washing their hands two times daily or less. Most households (87 %) had a ventilated improved pit (VIP) latrine. Five percent of households and 19 % of children under age five had experienced



Photo 1: Water transport and storage containers.

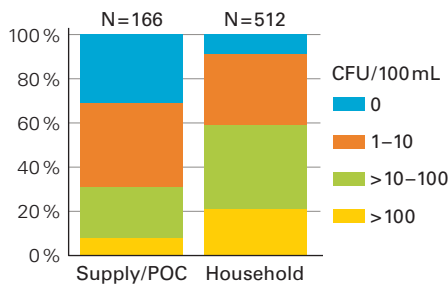


Figure 1: *E.coli* concentration levels for point of collection and household water samples.

diarrheal and acute respiratory illness, respectively, within the past three days.

Most households said that their drinking water quality was “good” (57 %) or “acceptable” (25 %) (Figure 2), and 46 % attributed no or little diarrhoea risk to drinking untreated water. Still, two-thirds of respondents stated that water treatment was “important” or “quite important” to practice. However, across the five Village Development Committees (VDCs) visited, between 53 % and 94 % of the households did not practise any form of water treatment. Knowledge of different water treatment technologies was very limited; most households (70 %) could not explain more than one treatment method.

In bivariate tests, household water treatment use was significantly and positively correlated with: having access to treatment products locally, emotional factors regarding water treatment, having sufficient knowledge of treatment methods, intention to treat, assuring the continuous practice of treatment, and believing it is important to treat water (Spearman’s  $\rho$ , all  $r > 0.3$ ,  $p < 0.001$ ). In a logistic regression model of household water treatment use ( $n = 78$ , 1 VDC only), two behavioural factors were statistically significant at the  $p < 0.05$  level: risk knowledge regarding consumption of untreated water (OR = 2.7) and availability of water treatment products in the home (OR = 3.2).

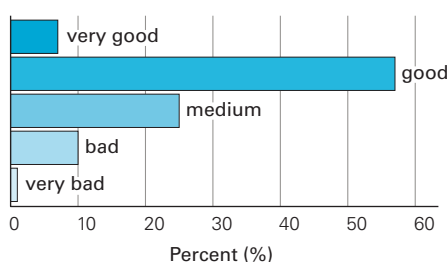


Figure 2: Households' perception of their own drinking water quality.

A reduced logistic regression model on water treatment use ( $n = 438$ , 5 VDCs) found that risk knowledge regarding the consumption of untreated water (OR = 1.3), knowledge of treatment methods (OR = 1.4), and intention to use treatment products (OR = 1.8) were each significant at the  $p < 0.05$  level.

### Market assessment

To assess underlying consumer preferences for treatment products, health risk perceptions, and local market conditions, the research team applied an explorative approach and conducted expert interviews ( $n = 122$ ) with health practitioners, merchants, households and sector institutions. Additional data sources included structured observations ( $n = 201$ ), household survey questions ( $n = 512$ ), and local and national records.

The health sector analysis revealed a preference for short-sighted coping strategies, mirrored by most households' health risk management practises. Interviews with physicians and pharmacists suggest that patients show little to no preference for preventative measures to safeguard health, including consistent water treatment. Rather, health risk management focuses on reactive measures to treat symptoms. Acute water-borne diseases are rarely laboratory tested and their treatment is dominated by antibiotics, whereas vital rehydration is often neglected and indication of a high prevalence of viruses is largely ignored.

Findings suggest that the demand for water treatment is limited by preference rather than price and availability. Water treatment products (mainly ceramic filters and chlorine) are available at urban wholesalers, but market penetration in rural areas is still low and has not kept pace with the reach of toilet infrastructure and soap. The mean stated monthly willingness to pay for water treatment is 80 NPR\*, while the revealed monthly expenses for its proxies (hand-soap and private water connection fee) suggest an ability to pay of 110 and 50 NPR, respectively. Both estimates could theoretically match the monthly cost for chlorine disinfection (~25 NPR). However, only 10 % of households state that water treatment products are a priority for household investments in the coming year ( $n = 201$ ).

### Conclusion

In the coming year, the research team will work closely with Helvetas to develop and implement a strategy for promoting safe

water consumption and hand washing behaviour. Several key findings regarding drinking water quality, behavioural factors, and market conditions emerged from the baseline study to directly inform this effort.

First, study results reveal that water quality deteriorated between the point of collection and storage, implying that re-contamination occurred during handling and transport. In addition, one in ten water samples taken at the point of collection had *E.coli* concentrations  $> 100$  CFU/100 mL, highlighting the inadequacy of current infrastructure-centred definitions for an “improved” water source. Potential explanations for contamination within piped networks include infiltration through broken joints or pipes or inadequate source protection.

Second, we found that households almost universally reported valuing water treatment, but few actually practised it. This could be explained by the fact that most households perceive their own water quality to be acceptable or good. An effective behaviour change campaign will target knowledge on personal risk and mitigation options, emotional factors, and the perception of personal vulnerability to highlight the importance of consuming safe water. An intervention should also support households to develop strategies for assuring access to safe water products, and improving access to hand washing infrastructure.

Finally, the market analysis revealed low demand for safer drinking water despite sufficient ability to pay for treatment products. Interviews with physicians revealed that many patients prefer a biannual antibiotics therapy to investing in preventative measures to safeguard health, such as household water treatment or frequent hand washing.

\* 1 NPR = 0.01 CHF or 1 Rappen

- [1] Joint Monitoring Programme (2012): Progress on Drinking Water and Sanitation. Geneva/ New York World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply and Sanitation. <<http://www.wssinfo.org/>>.
- [2] Helvetas Swiss Intercooperation (2014): Water: Our Work, 1–7.
- [3] World Health Organization (2011): Guidelines for Drinking Water Quality, Fourth Edition. Geneva.

<sup>1</sup> Eawag/Sandec, Switzerland  
<sup>2</sup> Helvetas, Nepal  
<sup>3</sup> UNESCO-IHE, The Netherlands  
 Contact: sara.marks@eawag.ch