Assessing a Drinking Water Security Strategy in Rural Western Nepal

REACH aims to improve drinking water security for households reliant on spring-fed piped supplies through multi-barrier interventions and impact assessments. Findings show the importance of chlorination methods adapted to intermittent, low-flow conditions. Carola Bänziger[1], Ariane Schertenleib[1], Bal Mukunda Kunwar[2], Rubika Shrestha[2], Madan Bhatta[2], Sara J. Marks[1]

Introduction

Faecal contamination of drinking water supplies is a leading cause of diarrhoeal diseases globally, especially among children under the age of five [1]. Although the majority of Nepal's 29 million residents have access to an improved water supply, less than a third of the population have a water source free from contamination [2]. A team from Eawag's Water Supply and Treatment group and Helvetas-Nepal's Integrated Water Resource Management Project (IWRM-P) led the REACH Project, which aimed to implement and evaluate a combination of water safety interventions tailored to spring-fed piped water systems. The goal of the project is to extend access to safe water across the IWRM-P service area. The research was jointly funded by the Swiss Agency for Development Cooperation (SDC) and REACH: Water Security for the Poor (University of Oxford and the UK Department for International Development).

Study site and methods

Karnali and Sudurpashchim Provinces consist of mountainous and hilly terrain, with low access to safe water and high rates of childhood diarrhoeal illness relative to national averages [3]. The study was conducted in the Kalikot, Jajarkot, Dailekh and Surkhet in Karnali and in Achham district in Sudurpashchim (Figure 1). Helvetas' IWRM-P serves 45'000 people; the REACH project delivered piped supply upgrades to 10'966 of these people from 2017 – 2020. Some water schemes provide continuous (24 h) service, while others provide intermittent service with variable opening times and service durations throughout the year.

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Water quality analysis in the field.

Thirty-three rural communities were selected for the study based on the existence of a functioning drinking water system and community agreement to participate. All water schemes had a similar branched design, consisting of a spring source connected to a reservoir tank by a distribution line, with water then flowing to private or public taps. Of the study communities, 21 were assigned to the treatment group and 12 to the control group. Baseline data collection included a household survey to assess water-related perceptions and practices, standard system inspections from source to tap and water sampling at collection taps and household storage containers (i.e. point of consumption) (Photo). Next, five field laboratories were installed and a combination of interventions based on the findings from the system inspections were implemented within the 21 treatment communities. The survey and water sampling were repeated at the study endline (14 months after baseline).

The water safety interventions included:

- Quarterly inspections of the piped system;
- A centralised data management system linked to local labs;
- Targeted infrastructure improvements, e.g. intake protection, roughing filters at intakes and/or reservoirs, and general repairs and maintenance in pipelines, valve chambers, etc.;
- Local watershed restoration;
- Household hygiene and filter promotion;
- Training of community water safety task forces; and
- System-level chlorination in selected schemes.

In each of the five laboratories, the research team trained local technicians in standard water testing protocols (*E. coli*, total coliform bacteria, pH, free residual chlorine and turbidity) and conducted regular quality control visits. Additionally, water quality training was offered to regional and national government actors. Lessons learned and recommendations for establishing and operating rural water quality laboratories were disseminated through local, national and international channels.

Findings

Each study community consisted of 29 to 250 households and 15 households per community were interviewed for a total of 493 surveys. Among the households interviewed, water supply (34 %) was the biggest concern mentioned at baseline, followed by transportation and roads (23 %). Most respondents used piped water connections (97 %) and had access to improved sanitation (81 %).

E. coli concentrations at the point of consumption for the treatment and control schemes were comparable at study baseline. The percentage of households meeting the WHO drinking water quality guidelines of <1 *E. coli* CFU/100mL> was about 10 % for both groups. By study endline, treatment schemes had significantly

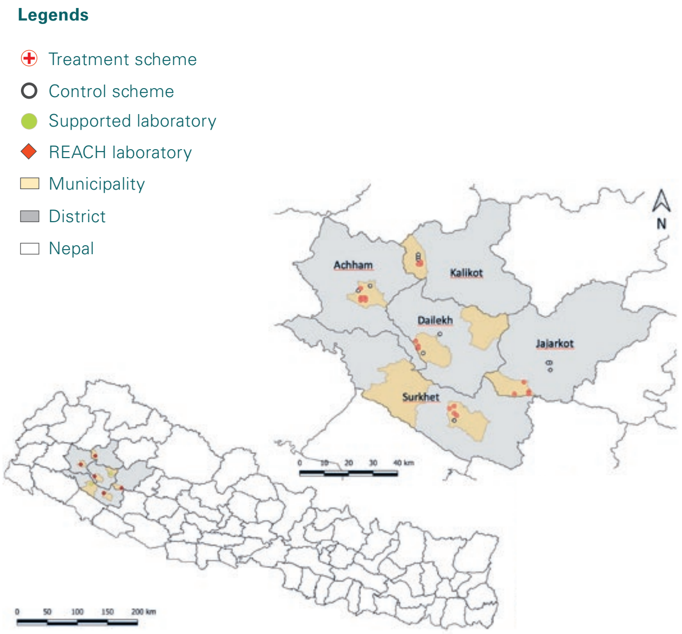

Figure 1: Map of Nepal, showing the five study districts.

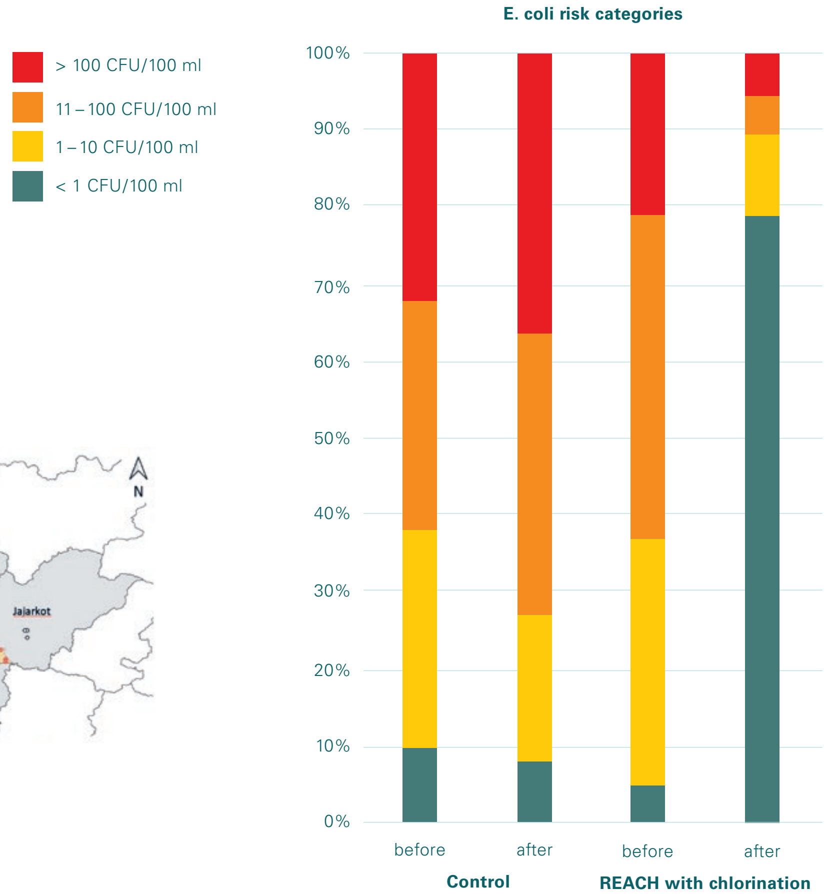

Figure 2: Microbial risk categories for stored water samples in chlorinated treatment communities and control communities.

lower levels of faecal contamination than control schemes, and the share of households with no detectable *E. coli* increased significantly to 19.8 %. The share of control scheme samples free of *E. coli* did not, however, change significantly. Treatment schemes that included chlorination delivered the highest water quality, with the share of samples with no detectable *E. coli* increasing from 5.3 % to 78.9 % (Figure 2).

In addition, the share of people in the treatment communities reporting confidence that the system would be functioning well in one year increased significantly, from 79 % to 93 % at the study endline, while no such increase was observed among the control communities. Similarly, the treatment communities showed significant gains when compared to the control communities in terms of reporting less service interruptions, user satisfaction, and service availability.

Conclusion

Chlorination was the most effective intervention for improving water quality at the point of consumption. Nevertheless, all interventions had a positive impact on system functionality, users' reported satisfaction, and their awareness of the risks posed by poor water quality. This study provides rigorous verification of the effectiveness of interventions at different hazard points for achieving improved water security in an underserved area. Evidence suggests that this water security strategy can be just as effective in improving drinking water safety in similar rural settings, and could be especially suitable for systems delivering intermittent, low-flow supplies.

Through close engagement with national and international stakeholders, the REACH project has integrated its water security approach with the current institutional knowledge in the sector. Project outputs include a video brief in Nepali and English describing REACH's risk-based strategy [4], a detailed inventory of upfront and ongoing costs and training requirements for operating rural water quality testing laboratories, and regular dissemination of the results at local and international knowledge-sharing events. •

References

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