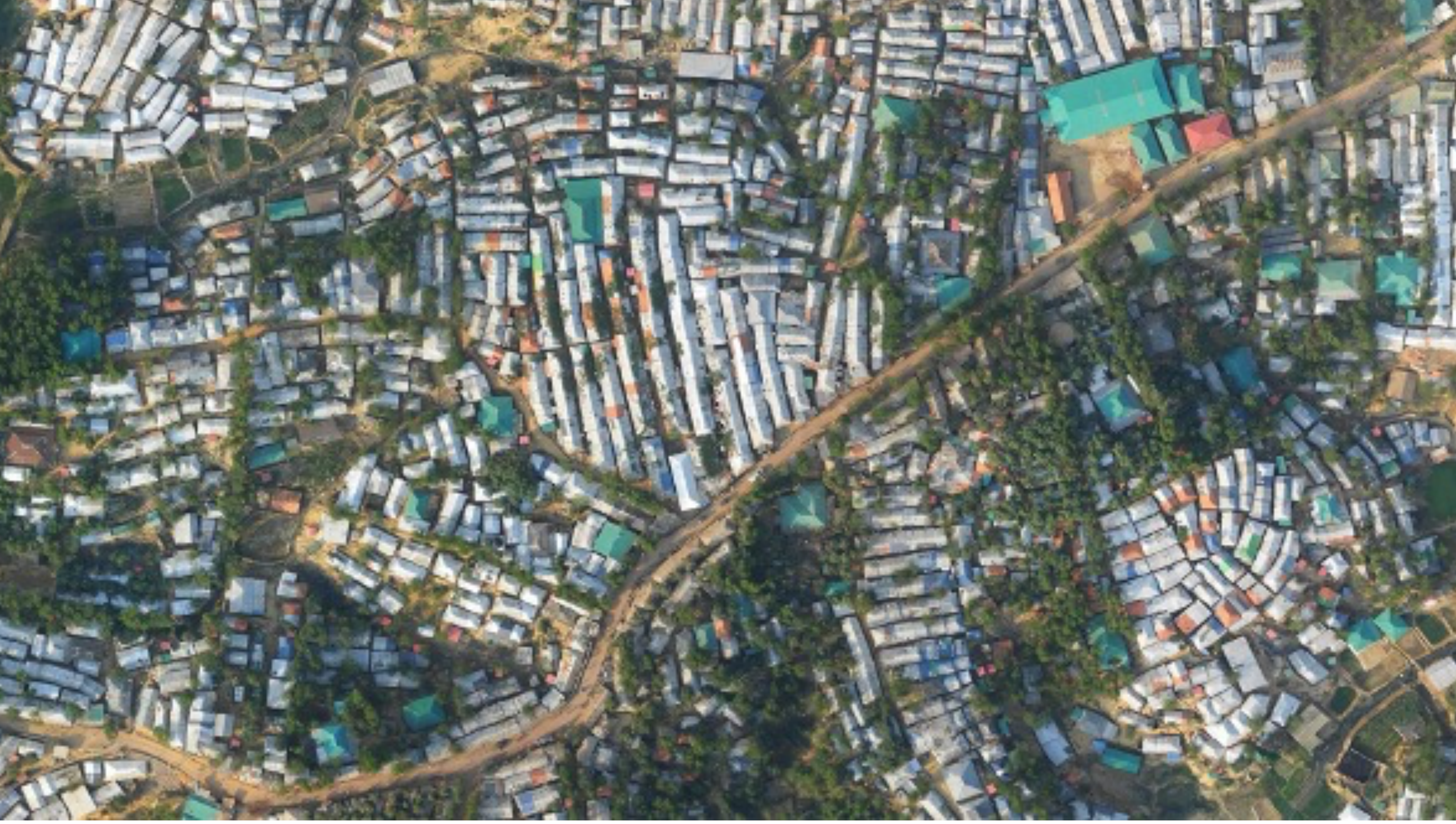

UAV Imagery: IOM

Safe Water Optimization Tool

SWOT CASE STUDY: KUTUPALONG-BALUKHALI

Using the Safe Water Optimization Tool to improve water quality at a refugee settlement in Cox's Bazaar, Bangladesh

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HIF Humanitarian innovation fund | elrha

Location:	Camp 1, Kutupalong-Balukhali Settlement, Cox's Bazaar, Bangladesh
Type of water system:	Groundwater with piped distribution to public tapstands
Data collection:	July - December 2019
Partner organisation(s):	MSF
Funding:	Achmea Foundation (2018-2019)

BACKGROUND

At the time of this evaluation, the Kutupalong-Balukhali refugee settlement in Cox's Bazar, Bangladesh, faced major public health challenges as the world's largest refugee settlement. Home to over 600,000 Rohingya refugees who had escaped violence in Myanmar, the camp struggled with overcrowding, inadequate shelter, and poor sanitation. These conditions increased the risk of waterborne diseases and malnutrition, especially among children. The 2019 monsoon season worsened the situation, causing flooding, landslides, and damaging over 6,000 shelters, displacing 20,000 people. Additionally, fire emerged as a new threat. The camp's living conditions were tough, with cramped makeshift tents on uneven terrain.

Our evaluation focused on a chlorinated water supply system in Camp 1 in the northwest sector of the settlement. The rapid influx of refugees in 2017, combined with high population densities and challenging environmental conditions, led to acute water, sanitation, and hygiene (WASH) needs. There was widespread fecal contamination of water sources, including of the deep aquifer, and of household supplies, contributing to the public health crisis. Water chlorination activities were prioritised throughout the mega-settlement to ensure drinking water safety.

SITE INFORMATION

The Camp 1 water system was built by Médecins sans Frontières (MSF) and served 83,000 people at the time of the study. This water system was composed of ten sub-networks supplied by 14 deep boreholes equipped with hybrid diesel-solar submersible pumps.

Water was abstracted from a deep aquifer and chlorinated using high-test calcium hypochlorite (HTH) via inline chlorinators. No other water treatment was done. Water was distributed via pipelines from ten elevated reservoirs to 190 tapstands around the Camp 1 area.

Other water sources in Camp 1 included shallow tubewells equipped with handpumps that were drilled during the initial phase of the emergency. These tubewells were not suitable for long-term potable supply due to chronic maintenance issues and the lack of protective chlorination.

DATA COLLECTION

We collected tapstand and household water quality data at the study site between July and December 2019.

At tapstands, we measured air temperature, along with common water quality parameters including FRC, water temperature, electrical conductivity (EC), turbidity, and pH. measured FRC and turbidity using digital chlorometers and turbidimeters. Other water quality parameters including EC, pH, and temperature were measured using a portable digital multi-meter. Equipment was calibrated every one- or two-days using manufacturer calibration standards. Data was recorded into KoboToolBox using mobile phones and uploaded for review by the supervisor each day.

Once water-users had filled their containers at the tapstand, they were approached at random by the monitoring teams and requested to participate in the study. If they consented, we accompanied the enrolled water-user back to their shelter where we marked the container of collected water.

We returned to the household several hours later to take a second timed measurement of FRC from the marked container. We also observed water handling behaviours at the tapstand and household, noting container type, whether containers were covered, and drawing method.

We alternated between collecting tapstand samples in the morning and following up at households in the afternoon (approximately 6- to 8-hours elapsed time) and collecting tapstand samples in the afternoon and following-up the next morning (approximately 16- to 18-hours elapsed time). This is a typical pattern of data collection for the SWOT that mirrors common practices of water collection and use in refugee settlements.

We also carried out a knowledge, attitudes, and practices (KAP) survey between November 21, 2019 and December 5, 2019. This survey helped us develop a wider contextual understanding of how water was used on site (collection, storage, and usage practices) and to understand attitudes toward chlorinated water and barriers to use of the chlorinated system.

SWOT RECOMMENDATION & IMPLEMENTATION RESULTS

In total, we collected 2,221 paired water quality observations; after data cleaning, 2,094 observations were sent for analysis.

Our results confirmed that significant post-distribution chlorine decay was occurring in the systems, with stored water losing approximately half of the FRC measured at the tapstand. In general, the data indicated that the majority of FRC decay occurs within the first few hours of storage and then levels off over time.

The KAP survey found moderate levels of use (69% reported chlorinated tapstands were their primary water source) and acceptance of chlorinated water (81% of those reported no complaints). For those who did not use chlorinated tapstands for drinking water, the barriers were related to access and social constraints, rather than taste and odour concerns.

Water collection and storage practices were typical, with most households collecting water in the early morning (7 to 9 AM) and again in the afternoon/early evening (3 to 7 PM).

More than 66% of respondents who reported collecting water from chlorinated tapstands reported storing water for up to 12 hours, while 32% reported storing it overnight. The typical maximum storage duration thus occurred when water was collected in the late afternoon and then stored until the next morning, an approximate 15-hour duration. This was therefore selected as the protection duration for the SWOT target.

The SWOT's modelling was used to generate a site-specific FRC target for 15 hours of household storage and use. The first three months of data collected at the site (899 paired samples) was used to generate the SWOT target (this is a much larger data volume than what is normally required to generate a SWOT target, which is 100-150 paired samples at a minimum). To achieve an average household FRC of 0.3 mg/L after 15 hours of storage, the SWOT recommended a tapstand FRC target of 0.95 mg/L. With this SWOT FRC target, the predicted household water safety (HWS) score was 91 to 99%. The SWOT FRC target was converted to a range of 0.85 to 1.05 mg/L for the water system operators to implement in the second half of the study (October to December 2019).

0.95 mg/L

SWOT tapstand FRC target

Unfortunately, the water system operators were not able to implement the SWOT FRC target fully and reliably in the water system during the pilot study. As a result, there was no significant improvement in household water safety between the first and second round of data collection. However, there were sufficient samples recorded with a tapstand FRC close to the SWOT target that we were able to estimate what the improvement would have been, were the SWOT target to be fully achieved. This analysis showed that achieving the SWOT target range of 0.85 to 1.05 mg/L across tapstands in Camp 1 would result in a HWS score of over 90%, compared to less than 50% using the existing Sphere targets.

In summary, this study shows that the SWOT could effectively model post-distribution chlorine decay using real-world water quality monitoring data, and if the SWOT target were to be fully implemented at tapstands, it would result in substantial improvements in household water safety. This was the first time that the SWOT was used in an active humanitarian response and this performance demonstrates that the SWOT effectively generated FRC targets in this context.

KEY TAKEAWAYS

The proof-of-concept evaluation of the SWOT at the Kutapalong-Balukhali Camp 1 demonstrated that the SWOT can generate site-specific and evidence-based water chlorination targets using routine water quality monitoring data from humanitarian field settings. The site-specific water chlorination target generated by the SWOT for Kutapalong-Balukhali Camp 1 was associated with improved household water safety outcomes compared to the status quo Sphere water chlorination target, however, lack of feedback mechanisms between water quality monitoring and water treatment operations meant that the FRC target recommendations were not consistently achieved.

The SWOT can therefore help water system operators in refugee/IDP settlements ensure that drinking water remains protected and safe to drink up to the point-of-consumption, something that is not reliably achieved by currently available sector guidelines, but to do this, SWOT interventions must consist of more than just modelling and also provide ongoing programmatic support in monitoring and treatment to WASH field teams.

NEXT STEPS

Shortly after the end of the pilot, MSF handed responsibility for the water systems in Camp 1 to a local NGO, BRAC. To our knowledge, the water quality monitoring plan developed by MSF was not continued after this.