

# Field Trial of an Automated Batch Chlorinator System at Two Shared Shallow Tubewells among Camps for Forcibly Displaced Myanmar Nationals (FDMN) in Cox's Bazar, Bangladesh

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## Supplementary Materials

**Table S1.** Free residual chlorine concentration level with different iron concentrations in 4 tubewells, Cox's Bazar-2017.

Sampling Dates	Tubewell ID	Concentration of iron (mg/L)	~5.25% NaOCl: Water (mL)	Concentration of chlorine used for treatment	Concentration of Free Chlorine (mg/L)
8/28/2018	17*	<0.2	1500:750		9.1
8/28/2018	17	<0.2	1500:750	3.5%	8.6
8/28/2018	17	<0.2	1500:750		9.3
8/28/2018	17	<0.2	1500:750		10.3
	Mean free chlorine concentration (SD)				9.3 (0.7)
8/29/2018	13	6.5	1500:750	3.5%	3.5
8/29/2018	13	6.5	1500:750		0.02
8/31/2018	13	6.5	1500:500	3.9%	0.4
8/31/2018	13	6.5	1500:500		0.4
	Mean free chlorine concentration (SD)				1.11 (1.6)
8/29/2018	2**	7	1000:500	3.5%	0.04
	Mean free chlorine concentration (SD)				0.04
8/31/2018	5	1.5	1500:750		4.2
8/31/2018	5	1.5	1500:750	3.5%	2.6
8/31/2018	5	1.5	1500:750		4.4
8/31/2018	5	1.5	1500:750		3.7
	Mean free chlorine concentration (SD)				3.73 (0.83)

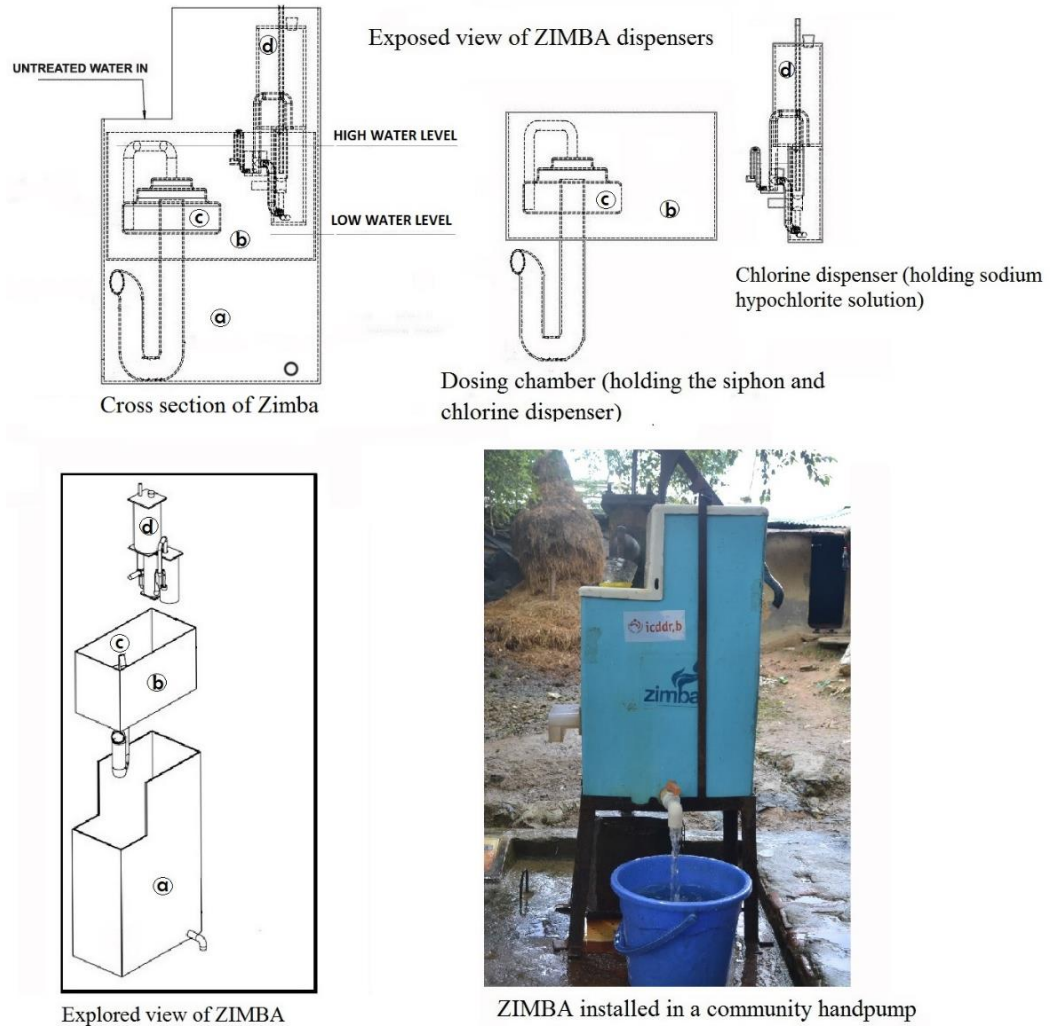
\*At the beginning of the field trial, we had installed Zimba at deep tubewell ID-17, but we received complaints from the household users that the handle had become too tight to pump water. Hence, we removed the Zimba from tubewell ID-17. \*\*Tubewell 2 had a very high (7 mg/L) concentration of iron and it was not providing sufficient residual chlorine immediately after treatment. Additionally, the color of the water became red due to a chemical reaction between iron and residual chlorine immediately after mixing resulting in the removal of the Zimba from tubewell ID-2.

**Table S2.** A comparison table among WHO recommended drinking water quality, pre-treated water quality, and post-treated (zimba) water quality.

Parameters	WHO	Pre-treated source water	Pre-treated stored water in household own vessel	Post-treated (zimba) source water	Post-treated (zimba) stored water in household own vessel	Post-treated (zimba) household stored water in project provided safe storage containers
		Mean	Mean	Mean	Mean	Mean
<sup>1</sup> Iron (mg/L)	0.3-3.0	4.0	2.2	5.8	1.9	2.8
<sup>1</sup> TDS (ppm)	<300	240.3	238.0	215.3	253.1	235.4
<sup>1</sup> Free Chlorine (mg/L)	0.2-2	NA*	0.15	2.1	0.39	1.4
<sup>1</sup> Total Chlorine (mg/L)	0.2-2	NA	0.17	2.21	0.5	1.72
<sup>2</sup> Turbidity (NTU)	≤5	2.55	2.6	2.50	1.8	2.81

NA\* = Not applicable for underground source water. <sup>1</sup>WHO (1996): Guidelines for drinking-water quality, 2nd ed. Vol. 2. Health criteria and other supporting information. World Health Organization, Geneva, 1996.

<sup>2</sup>WHO (2017): WATER QUALITY AND HEALTH - REVIEW OF TURBIDITY: Information for regulators and water suppliersWorld Health Organization, Geneva, 2017.



**Figure S1.** Zimba automated chlorine dispenser. Figure provided by inventor Suprio Das. Figure showing (a) Outer box: upper part of the outer box holds dosing chamber and lower part acts as a secondary tank which water flushes into after chlorination. (b) Dosing chamber: this chamber holds an automatic siphon and the chlorine dispenser. As untreated water from the handpump starts filling up this chamber, 3 mL of sodium hypochlorite solution is ejected from the chlorine dispenser into this water. When the water level reaches the high-water level (10 L) the automatic siphon is triggered and this 10 L of treated water is flushed into the secondary tank. (c) Siphon: Water from the dosing chamber flushes into the secondary tank through the siphon. (d) Chlorine dispenser: This consists of a chlorine reservoir and a combination of interconnected pipes and tubes. Dimensions of the Zimba are 76 cm x 45 cm x 25 cm; the outer casing, dosing chamber, and the siphon are made of fiberglass and the dispensers are made of acrylic.

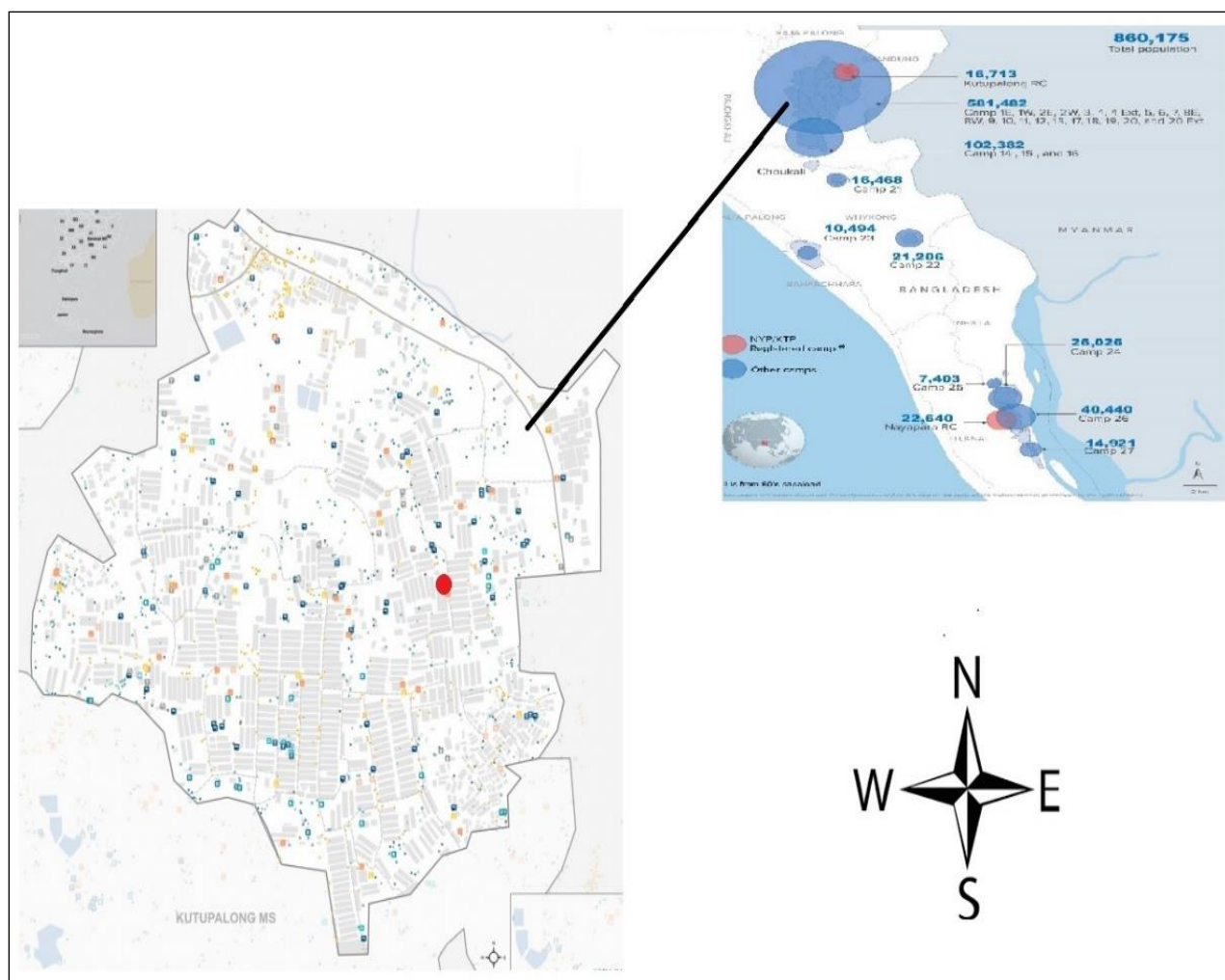


Figure S2. Study site map.

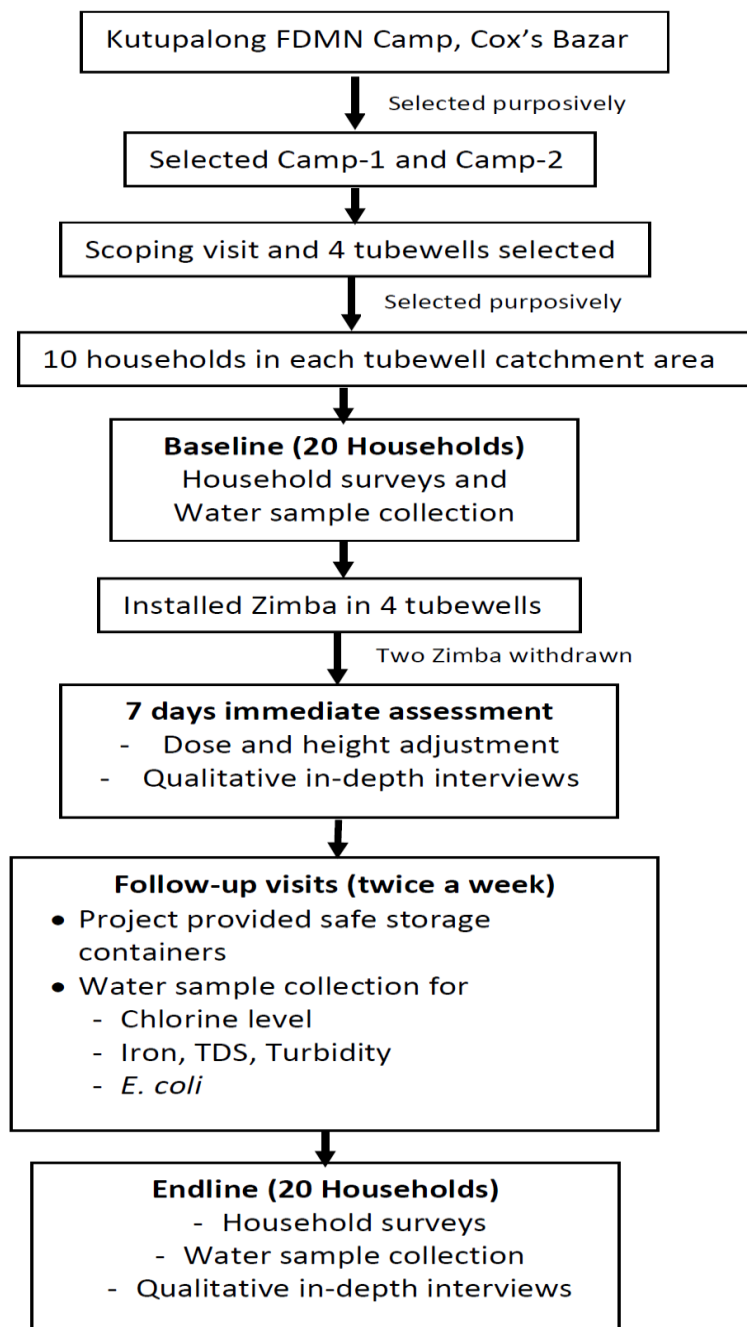


Figure S3. Study flow chart.



**Figure S3.** Raised footstep to resolve the increased height of tubewell after Zimba installation, Rohingya camp, Cox's Bazar-2017.