**Supplementary materials**

**Table S1** | WaSH education survey questions asked pre and post the education programme

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **Question** | **Response** | **Code** |
| A | Household ID |  |  |
| B | Interviewer ID |  |  |
| C | Date |  |  |
| D | Time |  |  |
| E | Village |  |  |
| F | Sub-village |  |  |
| G | GPS |  |  |
| H | Contact number |  |  |
| **Sanitation specific questions** | | | |
| 1 | Do you wash your hands after you have been to the toilet? | No | 0 |
|  |  | Yes | 1 |
| 2 | Do you wash your hands before you cook? | No | 0 |
|  |  | Yes | 1 |
| 3 | Do you use soap when you wash your hands? | No | 0 |
|  |  | Yes | 1 |
| **Water specific questions** | | | |
| 4 | What is your primary source of drinking water? | Open well | 0 |
|  |  | Tanira pump | 1 |
|  |  | MSABI pump | 2 |
|  |  | Surface water | 3 |
|  |  | Other | 4 |
| 5 | Do you think your water is safe to drink? | No | 0 |
|  |  | Yes | 1 |
| 6 | Do your treat your water prior to drinking? | No | 0 |
|  |  | Yes | 1 |
| 7 | Based on your water quality test results is your water safe to drink? | No | 0 |
|  |  | Yes | 1 |
|  |  | Sometimes (explain) | 2 |
| 8 | Will you treat your water now prior to drinking as a results of a contaminated water quality results? | No | 0 |
|  |  | Yes | 1 |
| 9 | Did the results of the water quality test change your opinion about your water? | No | 0 |
|  |  | Yes | 1 |
|  |  | Don’t know | 2 |
| 10 | Would you purchase the test in the future? | No | 0 |
|  |  | Yes | 1 |

**Table S2** | Media costs of producing one H2S test for 100 mL of water sample in Dar es Salaam, Tanzania

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Media component 1** | **Action** | **Volume (brand)** | **Cost (US$)** | **Quantity (g) per 100 mL** | **Cost per test 2 (US$)** |
| Bacteriological peptone | Energy source | 500 g (Oxoid) | $94.11 | 40 g | $0.38 |
| Di-potassium hydrogen phosphate | Ion source | 500 g (Univar) | $65.00 | 3 g | $0.02 |
| Ferric ammonium citrate | Iron source | 500 g (Univar) | $65.00 | 1.5 g | $0.01 |
| Sodium thiosulphate | Sulphate source | 500 g (Univar) | $27.60 | 2 g | $0.01 |
| Liquid detergent | Surfactant | 1 L (Jet) | $4.60 | 2 mL | <$0.01 |
| Total | – |  | $256.31 | – | $0.41 |

1 Sourced from laboratory suppliers in Dar es Salaam, Tanzania.

2 Based on 5 mL of H2S media being used for testing 100 mL of water sample.



**Figure S1** | Hydrogen sulphide (H2S) tests result colours: (A) glass bottles (100 mL) in size with first bottle indicating a negative result, then a graduation of colour change until the last bottle which is a full positive result; (B) glass bottles (5 mL) indicating results from negative (left) to positive (right).

**Table S3** | Colour changes, risk categories and recommendations for H2S tests results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Levels** | **100 mL** | **5 mL** | **Bacteria/100 mL** | **Risk category** | **Recommendation** |
| 1 | No change | No change | <20 | Low | Consider treating for extra safety |
| 2 | Black | No change | >20 to <100 | Medium | Needs to be treated before drinking |
| 3 | Black | Black | >100 | High | Must be treated before drinking |

**Table S4** | Laboratory results for the colour changes recorded in H2S tests over different inoculations of positive control bacteria (*Salmonella enterica*) and incubation times (24–96 h)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***S. enterica* density** | | | **0** | | **5** | | **10** | | **50** | | **100** | | **1,000** | |
| **Volume (mL)** | | | 100 | 5 | 100 | 5 | 100 | 5 | 100 | 5 | 100 | 5 | 100 | 5 | |
| **Test** | **Temp (°C)** | **Time (h)** |  |  |  | |
| Incubator group A | 37 | 24 | − | − | − | − | − | − | − | − | + | − | + | + | |
| 48 | − | − | +++ | ++ | +++ | ++ | +++ | ++ | +++ | ++ | +++ | ++ | |
| 72 | − | − | +++ | ++ | +++ | ++ | +++ | ++ | +++ | ++ | +++ | ++ | |
| 96 | − | − | +++ | ++ | +++ | ++ | +++ | ++ | +++ | ++ | +++ | ++ | |
| Incubator group B | 37 | 24 | − | − | − | − | − | − | − | − | + | − | + | − | |
| 48 | − | − | +++ | ++ | +++ | + | +++ | − | +++ | ++ | +++ | ++ | |
| 72 | − | − | +++ | ++ | +++ | ++ | +++ | ++ | +++ | ++ | +++ | ++ | |
| 96 | − | − | +++ | ++ | +++ | ++ | +++ | ++ | +++ | ++ | +++ | ++ | |
| Ambient group A | 22–30 | 24 | − | − | − | − | − | − | − | − | − | − | − | − | |
| 48 | − | − | + | − | + | − | + | − | ++ | − | ++ | − | |
| 72 | − | − | ++ | + | ++ | − | +++ | ++ | +++ | + | +++ | ++ | |
| 96 | − | − | +++ | ++ | +++ | + | +++ | ++ | +++ | ++ | +++ | ++ | |
| Ambient group B | 22–30 | 24 | − | − | − | − | − | − | − | − | − | − | − | − | |
| 48 | − | − | + | − | + | − | + | − | ++ | − | ++ | + | |
| 72 | − | − | ++ | + | ++ | ++ | ++ | ++ | ++ | + | ++ | ++ | |
| 96 | − | − | +++ | ++ | +++ | ++ | +++ | ++ | +++ | ++ | +++ | ++ | |

**Table S5** | Laboratory results for H2S tests and *E. coli* tests recorded against environmental water samples with an indication of risk level indicated by the H2S tests

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test** | | **Physical** | | | **H2S – 24 h** | | | | ***E. coli*** | | **H2S - 48 h** | | | | | **H2S – 72 h** | | | | | | | **RISK H2S** | | |
| **pH** | **TDS** | **Turb** | **100 mL** | | **5 mL** | | **Filter** | | **100 mL** | | **5 mL** | | | **100 mL** | | | **5 mL** | | | | **24 h** | | **48 h** |
| **Group** | **#** |  | **ppm NaCl** | **NTU** | **A** | **B** | **A** | **B** | | **Avg** | **A** | **B** | | **A** | **B** | | **A** | **B** | | **A** | **B** |  | |  | |
| Tap water | 1 | 7.8 | 212 | 0 | − | − | − | − | | 0 | − | +++ | | − | − | | + | +++ | | − | − | SAFE | | LOW | |
| 2 | 7.2 | 223 | 4 | − | − | − | − | | 3.5 | +++ | +++ | | − | − | | +++ | +++ | | − | − | SAFE | | LOW | |
| Filter pot | 3 | 8 | 199 | 0 | − | − | − | − | | 0 | − | − | | − | − | | − | − | | − | − | SAFE | | SAFE | |
| 4 | 7.5 | 222 | 0 | − | − | − | − | | 0 | − | − | | − | − | | − | − | | − | − | SAFE | | SAFE | |
| MSABI rope pumps | 5 | 7.5 | 196 | 43 | − | − | − | − | | 9 | +++ | +++ | | ++ | ++ | | +++ | +++ | | ++ | ++ | SAFE | | HIGH | |
| 6 | 7.2 | 808 | 0 | − | − | − | − | | 0 | − | − | | − | − | | − | − | | − | − | SAFE | | SAFE | |
| 7 | 7.4 | 334 | 0 | − | − | − | − | | 0 | − | − | | − | − | | − | − | | − | − | SAFE | | SAFE | |
| 8 | 7.6 | 101 | 7 | − | − | − | − | | 0 | − | − | | − | − | | − | +++ | | − | − | SAFE | | SAFE | |
| Tanira bores with pumps | 9 | 7 | 215 | 0 | − | − | − | − | | 0 | +++ | +++ | | ++ | − | | +++ | +++ | | ++ | − | SAFE | | HIGH | |
| 10 | 7.6 | 254 | 0 | − | − | − | − | | 1 | +++ | +++ | | − | − | | +++ | +++ | | − | − | SAFE | | LOW | |
| 11 | 7.5 | 123 | 0 | ++ | − | − | − | | 3.5 | +++ | +++ | | ++ | ++ | | +++ | +++ | | ++ | ++ | LOW | | HIGH | |
| 12 | 7.3 | 161 | 0 | − | − | − | − | | 2.5 | +++ | +++ | | − | ++ | | +++ | +++ | | − | ++ | SAFE | | HIGH | |
| Shallow open wells | 13 | 7.5 | 94 | 30 | +++ | +++ | ++ | ++ | | 350 | +++ | +++ | | ++ | ++ | | +++ | +++ | | ++ | ++ | HIGH | | HIGH | |
| 14 | 7.3 | 136 | 23 | +++ | +++ | ++ | ++ | | 2,850 | +++ | +++ | | ++ | ++ | | +++ | +++ | | ++ | ++ | HIGH | | HIGH | |
| 15 | 7.2 | 156 | 25 | +++ | +++ | ++ | ++ | | 500 | +++ | +++ | | ++ | ++ | | +++ | +++ | | ++ | ++ | HIGH | | HIGH | |
| 16 | 7.1 | 225 | 20 | +++ | +++ | + | + | | 100 | +++ | +++ | | ++ | ++ | | +++ | +++ | | ++ | ++ | HIGH | | HIGH | |
| Surface water | 17 | 8.1 | 26.5 | 7 | +++ | +++ | ++ | ++ | | 1,050 | +++ | +++ | | ++ | ++ | | +++ | +++ | | ++ | ++ | HIGH | | HIGH | |
| 18 | 7.9 | 25 | 7 | +++ | +++ | ++ | ++ | | 1,050 | +++ | +++ | | ++ | ++ | | +++ | +++ | | ++ | ++ | HIGH | | HIGH | |
| 19 | 7.3 | 32.8 | 22 | +++ | +++ | ++ | ++ | | 1,050 | +++ | +++ | | ++ | ++ | | +++ | +++ | | ++ | ++ | HIGH | | HIGH | |
| 20 | 7.2 | 171 | 19 | + | + | − | − | | 100 | +++ | +++ | | ++ | ++ | | +++ | +++ | | ++ | ++ | LOW | | HIGH | |

**Table S6** | H2S test results as risk categories for 47 different water sources

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Type** | **Source1** | **n** | **Risk categories** | | |
| **Low** | **Med** | **High** |
| Household | Ceramic filter pot | 2 | 2 | – | – |
| Improved | Bottled water | 9 | 9 | – | – |
|  | Public tap | 2 | 2 | – | – |
|  | Borehole (rope pump) | 9 | 9 | – | – |
|  | Borehole (hand pump) | 4 | 3 | 1 | – |
| Un-improved | Dug well (unprotected) | 15 | – | 1 | 14 |
|  | Surface water (pond) | 4 | – | 1 | 3 |
| Latrine | Anal wash bucket | 2 | – | 1 | 1 |
| Total |  | 47 | 25 (53%) | 4 (9%) | 18 (38%) |

1 Source categories based on the WHO and UNICEF JMP methodology (UNICEF *et al.* 2015).

**Table S7** | Locally produced commercial H2S test kit component costs in Tanzanian shilling (TSZ) and USD

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Details** | **Price TZS\*** | **Price US$** |
| Reagents ^ | From Table 1 | 660 | $0.30 |
| Plastic tube (20 mL) | From medical supplier | 300 | $0.14 |
| Plastic bag packaging | Purchased in supermarkets | 80 | $0.04 |
| Information booklet | Colour printed | 650 | $0.30 |
| Sticker label | Colour printed | 40 | $0.02 |
| Distribution | Transport costs# | 150 | $0.07 |
| Marketing | Fliers, posters# | 500 | $0.23 |
| Total |  | 2,380 | $1.10 |

\* Exchange rate of US$ 1:TZS 2,200.

^ The media price is for a 20 mL test including cotton absorbent pad.

# Breakdown based on bulk selling costs.

**Table S8** | Distribution and sales of the H2S test in the Kilombero Valley

|  |  |  |
| --- | --- | --- |
| **Distributor** | **Tests supplied** | **Tests sold** |
| Pharmacy | 306 | 29 |
| MSABI \* (office, exhibition, education team) | 107 | 104 |
| Other NGOs | 300 | 300 |
| Total | 713 | 433 |

\* NGO conducting the research study.

**Table S9** | WaSH education meetings breakdown of participants numbers between the two education groups

|  |  |  |
| --- | --- | --- |
| **Meetings** | **Number** | **%** |
| Held in total | 165 |  |
| With H2S test | 94 | 57 |
| Without H2S test | 71 | 43 |
| Participants total | 3,408 |  |
| Women | 1,283 | 38 |
| Men | 1,114 | 33 |
| Children | 1,597 | 17 |
| With H2S test | 1,784 | 52 |
| Returned for H2S results | 1,373 | 77 |
| Without H2S test | 1,624 | 48 |

**Table S10** | Breakdown of WaSH education meetings conducted with and without H2S tests, including water source and H2S test results

|  |  |  |
| --- | --- | --- |
|  | **Number** | **%** |
| Water sources tested |  |  |
| Dug well | 42 | 48 |
| Bore (rope pump) | 3 | 3 |
| Bore (hand pump) | 31 | 35 |
| Other | 12 | 14 |
| H2S test results \* |  |  |
| Low | 30 | 34 |
| High | 8 | 8 |
| Very high | 50 | 54 |

\* Results from 88 H2S tests are available from the 94 meetings. Six test results were not recorded by the field team.