Effectiveness of Large Scale Water and Sanitation Interventions: the One Million Initiative in Mozambique[+]

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Abstract

The *One Million Initiative* of the Government of Mozambique aims at supplying access to clean drinking water and adequate sanitation for one million people. The program has constructed hundreds of new boreholes and implemented trainings on sanitation in communities from three provinces. To evaluate the program, a panel survey design was set up with a baseline in 2008, a midterm in 2010 and an end-line in 2013. The survey covers interviews with 1600 households, focus group discussions about the community and water points in 80 clusters in 9 districts. To our knowledge this is the first rigorous evaluation of such a large scale program in the water and sanitation sector. This paper summarizes the findings of the baseline and midterm surveys in terms of health impacts, latrine ownership and the use of improved water sources. Our results indicate that the water point intervention had a sizeable impact on the use of improved water sources and on the health outcome of children under 5 but no impact for older individuals, while the sanitation component of the program had a strong impact on latrine ownership and health outcome for older individuals, and a limited impact on hand-washing with soap and the use of improved water sources when it was available in the community.

1. Introduction

In this paper we present an evaluation of a very large intervention, aimed at reaching a million people. It is not immediately evident how such programs are to be evaluated. Although there has been an enormous advance in the use of rigorous statistical methods for evaluation, including randomised control trials (RCTs), these techniques are designed for small-scale interventions such as conditional cash transfer programs. Large programs are typically not randomly assigned and often cannot even be implemented in this way. There have been several suggestions in the literature proposing evaluation methods for larger scale programs, e.g. World Bank (2006), Elbers et al., (2009), Elbers and Gunning (2011). For identification of the program impact these methods rely on differences in program

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intensity across locations or groups. The current evaluation follows this approach to evaluate the One Million Initiative, a very large water and sanitation program in Mozambique.

The earlier literature on the impact of water and sanitation interventions is summarized in Fewtrell et al. (2005) and IEG (Independent Evaluation Group, 2008). For water interventions a distinction is made between interventions aimed at the source (supplying safe drinking water, chlorination) and interventions aimed at treatment of water at the point of use (boiling, chlorination, filtration). Water treatment at the source seems to have little effect, if any. Water treatment at the point of use is more effective: in the studies reviewed by Fewtrell et al. the relative risk of diarrheal disease is 0.69 in treatment households. Regarding the supply of safe water, the earlier studies suggest that house connections are effective in improving health outcomes while standpipes and communal wells are not.

Sanitation interventions promote latrine use usually by means of construction of latrines or subsidized access to building latrines, while hygiene interventions rely on hygiene trainings to promote hygiene awareness, in particular hand-washing and latrine use. According to both the IEG and Fewtrell et al. surveys these interventions are generally effective, yielding relative risks of around 0.70 although there is some indication of publication bias. On the other hand, some of us have been involved in a number of impact studies which found that households often do not even recall the hygiene and sanitation training they have received let alone the lessons learnt. (IOB 2007, 2008, 2009).

In an older meta analysis of 144 studies by Esrey et al. (1991) the authors find a favourable impact of water and sanitation programs on a number of water-related diseases. They stress the importance of providing water close to the point of use and integrating hygiene education into water and health programs.

Jalan and Ravallion (2003) investigate the impact of access to piped water in rural India. they find a substantial effect in terms of lower prevalence of diarrhea, but there is an important interaction with income and education: in poor households the effect is very small, particularly if mothers are poorly educated. This suggests that investing in water supply is effective only when combined with sanitation and health training. The One Million Initiative is an example of such a combination.

A recent innovation is the Community Led Total Sanitation (CLTS) approach which aims at the promotion of latrine use and relies on confrontational methods to convince households of the health risks of open defecation practices. A numerous developing countries have adopted this approach in recent years,[1] however the effectiveness of this approach have not yet been rigorously assessed. An exception is Pattanayak et al. (2009), who found that shaming techniques employed in CLTS coupled with a subsidy approaches employed in the Indian Total Sanitation Campaign (TSC) resulted in an 30 percent increase in improved latrine ownership. However, Pattanayak et al. (2007) find no conclusive evidence that the program reduced diarrhea prevalence in the last two weeks of children under 5.

[1] For a complete list of countries using the CLTS approach to sanitation see http://www.communityledtotalsanitation.org/where

Furthermore, Chakma et al. (2008) evaluated the impact of the TSC campaign on the health of 1250 Open Defecation Free (ODF) villages and compared them to the health status of 1100 individuals in non ODF communities. The study undertook parasitological and microbial analysis of stool, urine, soil and water samples from participants in the ODF and non ODF communities. The study concluded that diarrhoeal morbidity and overall worm infestations decreased significantly in communities that benefited from the ODF status.

Mozambique is extreme in the extent of open defecation and the high child mortality due to diarrhea. Concerns about these outcomes have led to the so-called ‘One Million Initiative’, a program initiated by UNICEF. The program involves the creation of new, improved, communal water sources and a version of the CLTS sanitation approach aimed at eradicating open defecation. At the request of both UNICEF and the donor (the Government of the Netherlands) the impact of the program is being evaluated. As an important advocate of programs such as the One Million Initiative UNICEF in particular is very keen on having direct evidence on their effectiveness. The main instrument for the impact evaluation is a household panel survey. Two of the three rounds envisaged have now been held. This paper presents evidence on the impact of the One Million Initiative, using the first two rounds of survey data.

The literature reviewed above does not suggest that such a program will have a substantial impact on health. In terms of sanitary practices, we find that the CLTS intervention succeeded in inducing people to build and use latrines. We also find that the creation of new improved water points has induced many households to switch to the new water sources. The question is whether these intermediate outcomes also lead to improved health. We address this using a ‘black box’ regression of a health indicator proxying for diarrhoea prevalence on treatment indicators for the water and sanitation interventions. We find that the CLTS intervention does have a favourable effect on health, confirming the findings in the literature on the effectiveness of sanitation programs. Regarding safe water use, we find a significant impact of the newly created improved water sources on the health of very young children but not on older individuals. To investigate the mechanism underlying these black box results, we use IV regressions. We find that the direct effect of safe sanitary practices on health is positive and highly significant. The effect of using improved water sources is much weaker and driven by the effect of safer water on the health outcome of very young children.

The rest of this paper is organized as follows. Section 2 describes the One Million Initiative in detail. The survey and the data are discussed in section 3. The next section discusses the identification strategy. The results are presented in section 5. Finally, section 6 concludes.

2. The One Million Initiative

The One Million Initiative[2] (2006-2013) covers three provinces in Mozambique: Manica, Sofala and Tete with a total population of 4.9 million people. The program therefore targets a significant part of the population. Among the goals of the Initiative are that at least 70 percent of the population in the three provinces use safe drinking water and that at least 50 percent use improved sanitation facilities. The program tries to achieve these goals by making improved water sources available at the community level, either by rehabilitating non-functional boreholes or by creating new ones; in addition it visits communities to offer sanitation training. Both types of interventions are community specific and can therefore at the household level be considered as *intentions to treat*.

In addition to the water point and sanitation interventions, a hygiene promotion was implemented in every community visited by the local NGO responsible for implementing the education and training part of the program. The impact of the hygiene promotion cannot be evaluated using the survey as it was implemented in all communities prior to the baseline.

Ultimately, the rationale behind a water and sanitation (WASH) program is to improve the health of the population. Using safe water is expected to reduce the prevalence of diarrhea and other water-related diseases. Safe hygienic practices will enhance this effect, while unsafe practices can nullify it.

From the outset the intention was to work through existing government institutions rather than setting up a separate donor run organization to implement the initiative. However, UNICEF maintains very strict auditing controls over the program. In particular, UNICEF does not disburse unless the relevant government administrative bodies have worked out the plans for a particular component of the program in detail. UNICEF's role does not go further, in particular it does not engage in policy conditionality. This combination of relying on government implementation and strict financial procedure makes the Initiative an interesting departure from sector budget support as commonly practiced, but this is not the topic of the present paper which focuses exclusively on the Initiative's health impact and its transmission channels. Details about the placement of the interventions can be found in Appendix A.

The sanitation component of many WASH programs involves sanitation and hygiene awareness promotion by means of a Participatory Hygiene and Sanitation Transformation

[2] See http://www.unicef.org/mozambique/child_survival_3151.html, accessed March 2011.

(PHAST) program.[3] The effectiveness of PHAST is questionable: IOB(2007, 2008, 2009) describe several evaluations where households who did receive PHAST training did not even recall this fact let alone any lessons. In Mozambique the effectiveness of PHAST was also questioned by program officers of the One Million Initiative. Therefore, after initially using PHAST, the One Million Initiative has resorted to the so-called Community Approach to Total Sanitation (CATS) in order to improve safe sanitary practices of the rural population. CATS combines Community Led Total Sanitation (CLTS) trainings with a reward system for communities that become open defecation free (ODF).[4] CLTS itself is a highly confrontational method developed by Kamal Kar in Bangladesh (Kar with Chambers, 2008) and has been adapted to the Mozambique context. In essence it relies on shaming a community by letting them discover the consequences of open defecation. The shaming is expected to lead to a communal decision to eradicate the practice of open defecation. CATS involves only promotion of safe sanitation practices and does not fund e.g. construction of latrines; implementation is left to the households.

3. Survey design, data and attrition

The evaluation is based on survey data collected in two rounds, in 2008 and 2010. (A third round is envisaged for 2013.) The sample consists of 80 communities selected from 9 of the 18 districts in the three provinces covered by the Initiative. The Initiative is targeted at the poorer communities and these have been oversampled to ensure sufficient statistical power. To neutralize the effects of selective program placement we use first difference regressions for the assessment of impact or include community dummies.[5]

Assigning treatment and control communities *ex ante* was ruled out. UNICEF considered *ex ante* assignment unethical, since it would involve telling some communities that they would benefit only later from the program, if at all. However, because of oversampling of poorer communities there are sufficient numbers of treated and untreated communities to enable a statistical impact analysis.

For each of the sample communities three surveys have been carried out. First, a household sample was conducted in 80 randomly selected communities. In each community 20 households were selected by systematic sampling from a randomly chosen contiguous group of approximately 100 households (corresponding to about 500 persons).[6] To ensure that survey households are indeed living

[3] See http://www.who.int/water_sanitation_health/hygiene/envsan/phastep/en/, accessed February 2011.
[4] For details about the reward system of CATS see Godfrey (2009).
[5] Note that one would expect poorer communities to score worse on many human development outcomes. Therefore it can be argued that any unadjusted cross-sectional evidence is likely to *under*estimate impact.
[6] For details on the sampling procedure, see UNICEF / WE Consult (2009)

close to a potential new borehole, communities were first asked which location they would prefer for a new water point. In the baseline households were then sampled in the neighbourhood of that area.[7] The household survey covers general household characteristics, health, water and sanitation practices. See Appendix B for a description of the household and community characteristics. The second survey was held among local community leaders from the immediate vicinity of the sample households. A third survey was conducted of water sources used by the sample households. In addition a limited number of water samples were taken for biological analysis.

The total number of households per survey round interviewed is 1600, of which 1310 were interviewed in both the 2008 and 2010 rounds. Attrition pattern among households is discussed in Appendix B. Communities can be divided into four treatment groups: those without any intervention, those with only water interventions, those with only sanitation interventions, and those subject to both types of interventions. Since the interventions were targeted on poorer communities there are significant differences between the baseline characteristics of the four groups (see Appendix B). In addition there are small but significant differences in some characteristics not directly related to targeting: household size, age of the household members and education. Any impact of these differences should be eliminated by including household fixed effects. As expected the targeting is reflected in substantial differences between communities. Since 290 households dropped out of the survey between rounds 1 and 2 selective attrition needs to be considered. A probit analysis of attrition suggests that there are no differences between those who left and those who remained except for household size. However, the effect is small.

The main health indicator in both the 2008 and 2010 rounds of the household survey is self-reported prevalence of 'water borne diseases' with a recall period of six months. This is a MICS indicator[8] that has been used as part of monitoring for the millennium development goals throughout the world. We find this indicator problematic, since many households may not be familiar with the concept of water borne diseases. The concept was not defined in the questionnaire although enumerators were allowed to give the examples of diarrhoea, typhoid and cholera. To construct a more robust health measure we aggregated the indicator at the household level and converted it to a binary variable taking the value 1 if any household member was reported to have suffered from a water related disease in the six months period preceding the interview and zero otherwise. Our interpretation (based on comparison with other data sources such as the DHS) is that the level of these diseases is underreported but that the indicator can still be used to analyze trends and health effects. In addition, we do not use the indicator to measure levels, therefore our analysis depends on the

[7] In some locations improved water sources were created shortly before the baseline survey. This does not seem to have had an effect on the baseline survey outcomes.

[8] MICS stands for Multiple Indicator Cluster Surveys. These surveys have been developed by UNICEF to produce internationally comparable indicators on a range of indicators in the areas of education and health. Households were also asked about water borne diseases during the two weeks preceding the interview. This is the common recall period used in health studies. However, the results implied far too low prevalence to be credible and could therefore not be used for evaluating program impact.

assumption that the degree of misreporting in the four treatment groups does not change between survey rounds. A disadvantage of this procedure is that the impact of the Initiative cannot be measured in terms of prevalence as commonly defined.

4. Identification strategy

The pathways and barriers of disease transmission are summarized in Figure 1, which is adapted from Waddington and Snilstveit (2009). As the figure shows, faecal pathogens are carried into the body via fingers, flies, fields, food and unclean water. Water, hygiene and sanitation interventions reduce the risk of contracting diarrheal diseases by blocking the pathways of faecal pathogens. Sanitation interventions promoting the use of proper sanitation can provide a barrier to disease transmission from faeces to the environment (ground water, fields and flies). Hygiene interventions promoting proper hand-washing (at all critical times using soap or ash and running water) aim to block transmission from fingers to drinking water, food and body. Water interventions aim at breaking down the transmission from water to food and body either by improving water quality at the source or providing water treatment methods at the point of use. However, any water, sanitation or hygiene intervention can only minimise risk along certain pathways. Therefore, in order to break the transmission cycle completely, a combination of the interventions is necessary. The One Million Initiative aims to achieve this using a combination of water point and CLTS sanitation training interventions.

Figure 2 depicts how the interventions of the One Million Initiative affect the barriers of disease transmission. The framework outlined in the figure underlies the analysis in this paper. In the Figure the CLTS intervention is assumed to affect latrine usage (directly, and indirectly through increased latrine ownership) as well as proper hand washing practice. Water treatment at the source comes in the form of boreholes providing safe drinking water. Notably absent from Figure 1 is water treatment at the point of use which is not targeted by the One Million Initiative, therefore we cannot evaluate its impact. In addition, according to our survey results water treatment is not usual practice in Mozambique.

Econometric issues

In the statistical analysis, we use binary outcome variables (e.g. the ownership of latrines, use of improved water sources). To evaluate the impact of the water point and sanitation interventions on these binary variables, we specify the following probability model:

$$Y_{h,t} = F\,(\alpha_t + \beta_w\, W_{\ell(h)}\, d_t + \beta_s\, S_{\ell(h)}\, d_t + \gamma\, X_{h,t} + \lambda_{\ell(h)} + \eta_h + \varepsilon_{h,t},) \qquad (1)$$

where $Y_{h,t}$ is the binary outcome variable of interest for household h at time t; $W_{\ell(h)}$ and $S_{\ell(h)}$ are indicating whether there was a water point or sanitation intervention in the cluster of household h, respectively; d_t is a time indicator: it is zero in 2008 and 1 in 2010; $\boldsymbol{X_{h,t}}$ includes household (and cluster) specific control variables like household size and wealth. In the model, α_t, $\lambda_{\ell(h)}$ and η_h denote time, cluster and household specific fixed effects, respectively, while $\varepsilon_{h,t}$, is a random error component. Depending on the choice of function F and the distribution of $\varepsilon_{h,t}$ model (1) reduces to the normal, logistic or linear probability model.

We are interested in the coefficients β_w and β_s, which measure the treatment effect of the interventions.[9] To estimate these effects, we primarily rely on specifications of the linear probability model. However, logit models are estimated to verify the robustness of our results. We use both first difference and pooled estimators.

To obtain the linear probability model we use the identity function for F in equation (1). Taking first differences one obtains

$$\Delta Y_{h,t} = \alpha + \beta_w W_{\ell(h)} + \beta_s S_{\ell(h)} + \gamma \Delta X_{h,t} + \Delta\varepsilon_{h,t}, \qquad (2)$$

where d_t disappears because d_2-d_1=1, and α denotes α_2- α_1. The time-invariant household and cluster specific fixed effects drop out due to differencing. The advantage of this estimator is that it removes all household specific time-invariant unobservables ('fixed effects') that can bias the estimates of the treatment effect due to non-random placement of the interventions. However, this comes at a cost. Observed time-invariant variables can also contain information on the processes studied and this is also lost through differencing. Moreover, the standard errors become larger compared to estimation in levels.

In the logistic model it is also possible to allow for fixed effects of time invariant variables. However, the fixed effects logit model can only be estimated conditional on a change in the outcome variable.[10] For example, the probability that the outcome variable changes from 0 to 1 from $t=1$ to $t=2$ conditional on a change in the outcome variable is

$$P\left(Y_{h,1} = 0, Y_{h,2} = 1 \,\middle|\, Y_{h,1} + Y_{h,2} = 1\right) = \frac{\exp\left(\alpha + \beta_W W_{\ell(h)} + \beta_S S_{\ell(h)} + \gamma \Delta X_{h,2}\right)}{1+\exp\left(\alpha + \beta_W W_{\ell(h)} + \beta_S S_{\ell(h)} + \gamma \Delta X_{h,2}\right)} \qquad (3)$$

In order to compare the coefficient estimates of the fixed effects logit model to those of the linear probability model, we calculate the average partial effects.[11] Note that the sample size for the conditional logit regression is reduced, therefore the standard errors are higher than in the linear fixed effects model.

If the household specific effects are uncorrelated with the treatment status after controlling for the location of the household, i.e.

$$W_{\ell(h)}, S_{\ell(h)} \perp \eta_h \mid \lambda_{\ell(h)}, \qquad (4)$$

[9] Note that model (1) rules out synergy effects arising from the joint implementation of water point and sanitation interventions. We experimented with cross-terms for the interventions but found no significant effects. In the context of use of improved water sources the reader is referred to the success rate of CLTS intervention results relating to synergies.
[10] See Cameron and Trivedi (2005).
[11] The partial effect is the defined as $\partial P/\partial X$, where X denotes the list of regressors.

pooled estimators controlling for *location* fixed effects can be used to estimate the treatment effect consistently. This assumption is not unrealistic given that the interventions are at cluster level, therefore selectivity bias is likely to be dealt with using location dummies. Using pooled data, the distribution of the outcome variable can be estimated using

$$Y_{h,t} = F(\alpha_t + \beta_w W_{\ell(h)} d_t + \beta_s S_{\ell(h)} d_t + \gamma X_{h,t} + \lambda_{\ell(h)} + e_{h,t}), \qquad (5)$$

where $e_{h,t} = \eta_h + \varepsilon_{h,t}$. We estimate this model for the linear probability and logistic models to check the robustness of the earlier (differenced) estimates.

Regressions for individual outcomes

For the health outcome, it is also possible to use individual level instead of household level data. Unfortunately, the dataset does not allow for matching of the household members in the two survey rounds. Therefore, we use household and location fixed effects to deal with time-invariant unobservable factors affecting the health outcome of household members.[12] The distribution of the individual health outcome in this case can be written as

$$Y_{m,h,t} =$$

$$F(\alpha_t + \beta_w(A_{m,h,t}) W_{\ell(m,h)} d_t + \beta_s(A_{m,h,t}) S_{\ell(m,h)} d_t + \delta A_{m,h,t} + \gamma X_{m,h,t} + \lambda_{\ell(m,h)} + \eta_{m,h} + \varepsilon_{m,h,t}), \qquad (6)$$

where the binary variable $Y_{m,h,t}$ denotes the health outcome of household member m in household h at time t. We allow for age dependence ($A_{m,h,t}$) of the impact since we expect a higher disease risk for young children.

Success rate of CLTS interventions

In case of the impact on latrine ownership and the use of improved water sources, one would expect that the interventions are especially aimed at households who have not yet acquired a latrine or started using an improved water point. Therefore the question arises how successful the interventions are in convincing non-owners and non-users to change their behaviour. To formalize the impact on adoption behaviour, consider the following linear probability model for latrine ownership at round 2 of the survey:

$$p_h = p^N_{\ell(h)} + (1 - p^N_{\ell(h)}) S_{\ell(h)} \pi + z_h \gamma + \varepsilon_h, \qquad (7)$$

where p_h is the probability that household h in location $\ell(h)$ owns a latrine. We assume that there is a probability $p^N_{\ell(h)}$ that households from location $\ell(h)$ own a latrine regardless of having received CLTS training. Otherwise there is a probability π that the CLTS training would convince a household to

[12] Note that some of the households were only surveyed in one of the rounds. The household dummy of these households is identified using cross-sectional data only.

build one. Therefore, π is the success rate of the CLTS training on households who would not have owned a latrine in round 2 without the training. The binary variable $S_{\ell(h)}$ indicates if there has been a CLTS intervention in location ℓ. According to equation (7), p_h further depends on observed (z_h) and unobserved (ε_h) household characteristics, which are taken to be independent of $p^N_{\ell(h)}$. Of course, p^N_ℓ can only be estimated for locations without CLTS training, but if we assume that the intervention indicator $S_{\ell(h)}$ is independent of p^N_ℓ then the population average p^N of p^N_ℓ can be estimated from the non-CLTS locations.

Denote the average latrine ownership in location ℓ in round 1 by $q_{1\ell}$. Assuming that $q_{1\ell(h)}$ is independent of ε_h in equation (7) and that $p^N_{\ell(h)} \perp S_{\ell(h)} \mid q_{1\ell(h)}, z_h$, we can use $q_{1\ell(h)}$ as instrumental variable. The second assumption seems reasonable if z_h includes a wealth indicator since placement of the CLTS intervention has been concentrated in the poorer locations.[13] Regarding the exogeneity of $q_{1\ell(h)}$, note that it is the latrine ownership rate at baseline, very similar to $p^N_{\ell(h)}$ and therefore unlikely to contribute to round 2 latrine ownership (p_h), given the latter variable $p^N_{\ell(h)}$. Moreover $q_{1\ell(h)}$ is a location level variable. With a suitable set of controls z_h one would therefore expect it to be uncorrelated with ε_h. Taking conditional expectations in equation (7) to obtain

$$E(p_h \mid S_{\ell(h)}, q_{1\ell(h)}, z_h) \approx E(p^N_{\ell(h)} \mid q_{1\ell(h)}, \overline{z}_{\ell(h)}) + \pi S_{\ell(h)}(1 - E(p^N_{\ell(h)} \mid q_{1\ell(h)}, \overline{z}_{\ell(h)})) + z_h \gamma, \quad (8)$$

where $\overline{z}_\ell$ indicates the local average of z in location ℓ. It is convenient to linearize the conditional expectations on the right hand side:

$$p^N_{\ell(h)} = E(p^N_{\ell(h)} \mid q_{1\ell(h)}, \overline{z}_{\ell(h)}) + \omega_{\ell(h)} = \alpha + \beta q_{1\ell(h)} + \delta \overline{z}_{\ell(h)} + \omega_{\ell(h)} \quad (9)$$

and substituting this in equation (7) we ultimately arrive at the nonlinear regression equation

$$p_h = \alpha + \beta q_{1\ell(h)} + \delta \overline{z}_{\ell(h)} + (1 - \alpha - \beta q_{1\ell(h)} - \delta \overline{z}_{\ell(h)}) \pi S_{\ell(h)} + \gamma z_h + \varepsilon_h + \omega_{\ell(h)}(1 + \pi S_{\ell(h)}). \quad (10)$$

Note that the conditional independence assumption implies that $\omega_{\ell(h)} \perp S_{\ell(h)}$ and, since $S_{\ell(h)}$ is a binary variable, $\omega_{\ell(h)}(1 + \pi S_{\ell(h)}) \perp S_{\ell(h)}$. We estimate (10) using nonlinear least squares both for latrine ownership and the use of improved water sources[14] in clusters with a water point intervention to find the impact of the CLTS intervention on the adoption behaviour of non-user households.

[13] It is noticeable that the correlation between average 2008 latrine ownership and the CLTS intervention is very low (0.06) and insignificant. Latrine prevalence has therefore not guided CLTS targeting.
[14] In this case p_h is redefined as the probability of using improved water sources at round 2.

IV regression

Equation (1) is a 'black box' regression in the sense that it does not specify through which channels the interventions affect health outcome. We like to go beyond this by quantifying the impact of using latrine and improved water sources by households. **Error! Reference source not found.**1 depicts the three likely channels from the interventions to the health outcome variable: using latrines, improved sources and hand washing. To identify the impact these three separately we need at least three instrumental variables. Formally, let $H_{h,t}$ indicate health outcome and consider the following linear probability model:

$$H_{h,t} = \alpha_t + \delta_1 B_{h,t} + \delta_2 L_{h,t} + \delta_3 P_{h,t} + \gamma X_{h,t} + \lambda_{\ell(h)} + \eta_h + \varepsilon_{h,t} \quad (11)$$

where $B_{h,t}$ denotes the use of improved water source, $L_{h,t}$ stands for latrine use and $P_{h,t}$ is used for proper hand washing practices. In the estimation of (11) we instrument $B_{h,t}$, $L_{h,t}$ and $P_{h,t}$ by the two interventions and in some variants also by baseline cluster level indicators of latrine ownership and availability of improved water sources. In the basic specification we use only the water and CLTS interventions and assume $\delta_3 = 0$, so that the impact of the interventions is channelled exclusively through the use of improved water sources and latrines. Hence, using only the water point and CLTS interventions as instruments the impact of latrine and improved water use is just identified. In subsequent regressions we test the restriction that $\delta_3 = 0$ by adding other instrumental variables. We estimate (11) using the first difference model and also by pooling the data at household and individual level.

In all regression models except for the logit and instrumental variable models we report cluster robust standard errors to control for any remaining unobserved heterogeneity and serial correlation in the case of the pooled regression.

5. Results

In this section, we focus on four questions. First, whether the CLTS sanitation training has succeeded in convincing people to build and use latrines, and employ proper hand washing practices. Second, whether the water point interventions and the sanitation training have induced people to switch to improved water sources. Third, whether the One Million Initiative has led to a reduction in reported water related diseases. Finally, we investigate whether these results are compatible with the framework depicted in Figure 2.

Impact on sanitary practices: latrine ownership, latrine use and hand washing

The most important aim of the CLTS sanitation training intervention is to convince people from a community to abandon the practice of open defecation and switch to latrine use. The success of this intervention can therefore be measured directly by looking at latrine ownership.[15] The effect of the interventions on latrine ownership is investigated in Table 1: regressions (1)-(3) report the results for the differenced indicator, which measures the change in latrine ownership status. Regression (1) includes only the sanitation training and water point interventions, while (2) controls for changes in household size and wealth, which were the variables explaining attrition. The effect of the CLTS sanitation training is large and significant: households in locations that received the CLTS intervention are on average 12.1 percentage points more likely to own a latrine in 2010 due to the sanitation training. This finding is confirmed in regression (4) in the table, which pools households across the two survey rounds while controlling for household size, wealth and time and location fixed effects. The results are also robust to the functional form of the probability model: the partial effects in the conditional and pooled logit models in regression (3) and (5) are comparable those obtained using the linear probability model.

The impact of the CLTS training can be underestimated due to the presence of households who already owned a latrine prior to the sanitation intervention. To assess the effect of the CLTS intervention on the non-owners, regression (1) in Table 2 reports the nonlinear least squares estimates following the specification of equation (10). This regression uses all households from the second survey round and includes both household and location-level controls. The estimate of π is 0.221, which implies that the CLTS training succeeds in convincing around 22 percent of households to build a latrine who otherwise would not have done so.[16] The NLS results also suggest that the more asset-rich households are more prone to owning a latrine.

Regarding the use of latrines, Table 3 presents descriptive evidence that owning a latrine is almost equivalent to using one: according to the survey more than 95 percent of the adults from households with a latrine also use it, but for children the share is lower, at two thirds. This result is not surprising given that the cost of building latrines must be covered by the households themselves. On the other hand, less than 10 percent of the households not owning a latrine use one. These usage statistics do not change between in the two survey years.

Proper hand washing practice can help reduce the incidence of diarrhea. As mentioned before the CLTS intervention is mainly aimed at latrine construction and discouraging open defecation practices, however it also stresses the importance of proper hand-washing. Table 4 shows that almost all adults report washing their hands at critical times (before eating, after defecation and disposing of baby's faeces). However, hand-washing is mostly done without using soap or ash and running water, which limits its effectiveness in reducing diarrheal diseases. In the analysis, we define proper hand-washing by hand-washing with soap or ash at critical times (before eating and after defecation) by all adults in

[15] Shared use of latrines is very low in the surveyed population.

[16] This estimate compares very well to values obtained using linear regressions to estimate (10) in the absence of parameter restrictions (not reported).

the household. Table 5 reports the impact of the interventions on this indicator. The first difference regressions (1)-(3) show that the sanitation intervention increased the likelihood of adults washing their hands using soap or ash by on average 10 percentage points. However, the coefficient estimate is only marginally significant in the differenced regressions, and becomes insignificant in the pooled regressions of (4) and (5).

Impact on use of improved water sources

The water point interventions comprise the 'hardware' part of the program. Around 2000 water points will eventually be created or rehabilitated under the program, mostly in the form of boreholes. The location of the borehole is chosen considering geological conditions and the preferences of the community selected for the new water point.

To assess the success of water point interventions in inducing households to switch to using improved water sources, Table 6 presents the regression results. Both the differenced, (1)-(2), and pooled, (4)-(5), regressions indicate that around a third of the households started using improved water sources as they became available through the water point interventions.[17] In the difference regressions (1)-(2) the CLTS intervention has a positive and sizeable (14 percentage points) effect on the use of improved water sources that is marginally significant.

The regressions in Table 6 do not take into consideration that in some of the communities there existed functioning improved water sources at the time of the baseline survey partly constructed by the One Million Initiative prior to the baseline in 2008. In fact, in 20 of the 80 clusters there were functioning boreholes in the neighbourhood (as sampled by the water points survey at the baseline).[18] The average use of improved water sources at the baseline is substantially higher in these communities: in clusters with a working improved water source 47.3 percent of the households already used an improved water point, while almost no one used it in the other clusters. As a result, the impact of the water point interventions is likely to be different in communities with improved water points prior to the interventions. We have therefore repeated the regressions separately for the cluster with and without a working borehole at baseline. The impact of the water point intervention in the no-borehole clusters increases to 50.6 percentage points with an extra 10 percentage points if there was a sanitation training, as well (regression results not reported). On the other hand, if the community already had an improved water point then the impact of an additional improved water point through the One Million Initative does not induce the remaining non-users to switch to

[17] The strange estimates for the conditional logit regression (3) in Table 6 can be explained by the observation that almost no households discontinued using improved water sources in clusters with CLTS interventions, which is picked up by the unrealistic coefficient for the CLTS variable.

[18] In 10 out of these 20 clusters there was also a water point intervention by the One Million Initiative. A likely reason for a water point intervention in a community already having a functioning borehole could be that the number of households per water point was too high.

improved water sources. However, in this case the CLTS training increases the probability of using improved water sources by 33.1 percentage points (regression results not reported).

To analyze the impact of the sanitation intervention on the use of improved water sources in somewhat more detail, regression (2) in Table 2 reports the results of applying the nonlinear model of equation (10) to the use of improved water sources using households form clusters with a water point intervention. Parameter π gives the impact of CLTS training on a switch to using improved water sources by non-users in the water point intervention clusters. The estimate of the impact is 31.2 percentage points, which although insignificant is very close to the impact of CLTS in the communities with functioning boreholes mentioned above.

An important reason for households not to switch to using improved water sources could be that the newly installed improved water source is too far away. To assess the importance of distance to the water source with regard to usage, we rely on GPS location information collected during the 2010 survey round. The regression result in Table 7 verifies that distance is a highly significant determinant in the decision to use improved water sources: households living more than half a kilometre from the source are very unlikely to use it.

Impact on health

Now, we turn to the main interest of the analysis. We investigate the health impact of the One Million Initiative using the household level indicator whether any household member was affected by water-borne diseases in the last 6 months.[19] It is known that young children are the most at risk of diarrheal diseases, therefore we also redo our analysis at the household level for children under age 3 and 5 years. As a check on our findings, we also report results using individual level data assuming different impacts for the young children.

The results for all household members are reported in Table 8. The impact of the sanitation training is very consistent across the various specifications with an average of 8 percentage point reduction in the probability of any household member contracting water related diseases in the last 6 months.[20] The coefficient estimate is significant at the 5 percent level for the pooled and logit estimators, while the p-value is 0.053 for the differenced regressions. Regarding the water point interventions, access to improved water sources does not seem to improve the average health outcome of the households. Note that there was also a large decline (16.3 percentage point) in disease prevalence between the two survey rounds that cannot be explained by the program. Further, regression results in Table 8 also suggest that water-borne diseases are not significantly related to wealth status in the surveyed sample.

[19] See discussion about this indicator in section 3.

[20] A possible objection to this positive finding is that it is simply a placebo effect since the dependent variable is based on the self-reported MICS indicator. Presumably such a placebo effect would wear off so that this interpretation can be investigated once the 2013 data are available.

However, an additional household member increases the probability of at least one member being ill by 1.3-2.7 percentage points on average if above age 5 and by 4.5-5.7 percentage points if under age 5, verifying that young children are indeed more likely to suffer from diarrheal diseases.

To assess whether the interventions affect young children differently compared to older household members, Table 9 reports the results using as dependent variable the indicator whether any child under age 3 or 5 years was affected by water-borne diseases in the household. The sample size is limited to the households having such a child at the time of the survey. Results are reported for the pooled estimators only because the sample size drops substantially when conditioning on households with a young child in both survey rounds. Regressions (1) and (2) in Table 9 report results on the impact of the interventions on children under age 5: neither of the interventions seems to have a significant impact on the health outcome of children under 5.[21] Regressions (3) and (4) report the results for children under 3, which show a different pattern: the impact of the sanitation intervention vanishes completely, while the water point intervention significantly reduces the probability of a very young children being affected by diarrheal diseases by 10 percentage points on average. This finding can be related to the fact that, on the one hand, the very young children do not yet use latrines and are more forgiven for not practicing hygienic behaviour; and on the other hand, they are more vulnerable to consuming contaminated water as their immune system is less resistant.

Table 10 further investigates the heterogeneous impact of the interventions by using individual rather than household level data, which allows a disaggregation according to age groups. Pooled regression results are reported because it was not possible to match the household members in the two survey rounds. However, household fixed effects are used[22] to control for unobserved household characteristics and standard errors are clustered at the community level. The results verify the findings of Table 9 that the impact is indeed different for young children and older household members: for the youngest children no significant impact of the sanitation training can be demonstrated on the basis of the survey data.[23] On the other hand, the water intervention reduces the likelihood of disease by on average around 5 percentage points for young children. Note that the impact on individual children under age 3 and under age 5 is not significantly different in Table 10. For older household members the result is reversed: the sanitation training reduces the likelihood of disease by an average of 3.3 percentage points for the older individuals. The result on the older household members presumably drives the household aggregate results reported in Table 8.

Summarizing, the above results suggest a favourable effect of the CLTS intervention while young children benefit more from the water point interventions.

[21] Note that the sample size is reduced by half compared to Table 8.
[22] For the households not present in both rounds a cross-sectional household fixed effect is used.
[23] Note however, that the coefficient on CLTS for young children is not significantly different from that on older household members either.

Sanitation, improved water sources and health

The regression results above reported on the intention-to-treat effect of the water point and sanitation interventions of the One Million Initiative. However, we are also interested in the mechanism underlying the 'black box' results. The likely channels from the interventions to the health outcome variable are depicted on Figure 2, which suggests an instrumental variable regression of the health indicator on water source type, latrine use and hand-washing, instrumented by the interventions and possibly by baseline cluster level indicators of latrine ownership and availability of improved water sources. We first present results concentrating on the latrine use and safe water use channels, disregarding hand-washing. Then, we investigate the relevance of proper hand-washing for the health outcome. Finally, we investigate the transmission mechanism for the individual health outcomes disaggregated by age groups.

Table 11 reports the instrumental variable regression results for the impact of use o latrines and improved water sources. Regressions (1) and (3) use only the interventions as instrument for the use of latrine and safe water, while regressions (2) and (4) also include the additional instruments: share of households owning a latrine in the cluster at the baseline, and the indicator of having a functioning borehole in the community at the baseline.[24] Both the difference and the pooled regressions confirm the importance of latrine use: if the household members use a latrine, it is on average between 39 and 54 percentage points less likely that any household member has experienced an episode of water related diseases. The use of improved water sources decreases the likelihood of water related diseases by an additional 10 percentage points on average, however this effect is insignificant. Our preferred regression is (4), where the additional instruments are the strongest both in validity and relevance. Here, both improved water use and safe sanitary practices significantly decrease the likelihood of water related diseases in the households by 12 and 40 percentage points on average, respectively.

In Table 12 we investigate the importance of the hand-washing channel for the surveyed households. Regressions (1) and (2) add proper hand-washing as the third channel to the IV regression. In this case, there are three channels for the two intervention instruments, therefore these regressions can only be estimated by including the cluster level baseline indicators as instruments, as well. The results indicate that proper hand-washing does not significantly reduce disease prevalence at the surveyed households. Notice, however, that the first-stage F statistics of the hand-washing variable indicates that the instruments are only weakly related to hand-washing. Recall, that the results of Table 5 also show only a marginally significant effect of the sanitation training on hand-washing practices. Therefore, we conclude that it is not possible to properly evaluate the hand-washing channel given the data.

[24] The Sargan test of overidentifying restrictions cannot reject the hypothesis that these additional instruments are valid.

As an alternative, regressions (3) and (4) in Table 12 use a composite variable of latrine use and proper hand-washing to assess the joint importance of sanitary practices. The composite takes values between 0 and 3, adding 1 for proper hand-washing and 2 for latrine use.[25] The results for latrine use are consistent with the findings of Table 11, with an impact of latrine use on the health outcome between 29 and 39 percentage points without proper hand-washing and between 44 and 55 percentage points when practicing proper hand-washing. However, the impact on hand-washing is likely to be driven by the fixed weight between hand-washing and latrine use.

Finally, Table 13 presents the results on the individual level analysis of the latrine and safe water use channels. In this case, it is possible to separate the effect of latrine and safe water use on health outcomes by age categories. Only the interventions are used as instruments for latrine and safe water use, and they are interacted with the age categories. The results suggest that safe sanitary practices reduce the water related disease instances mainly of those household members that are in the age of possibly using latines by 20 percentage points, but not significantly that of the youngest children (although the coefficients are not significantly different). Regarding the use of improved water sources, only the children under 5 years of age significantly benefit from them in terms of their health outcome: their likelihood of suffering from water related diseases decreases by 10 percentage points as a result of using improved water sources.

Summarizing the above results, the improvement in the health indicator appears to be driven mainly by safer sanitary practices and only to a limited extent by the improved water sources except in the case of young children, where the mechanism is reversed.

Discussion

The results above show the success of the One Million Initiative in inducing households to switch to using improved water sources and latrines constructed by the households themselves. In addition, the CLTS training had a marginal effect on households using soap or ash to wash their hands. However, the results suggest that the program improved the health outcome of households almost exclusively through the promotion of latrine building and subsequent use. Below we offer some discussion of these results.

Using results from Table 8 suggest that the CLTS intervention reduced water-borne disease prevalence by 3 percentage points among the sampled households, which is around a 10 percent of the disease prevalence in the sample at the household level. The success of the CLTS approach to sanitation is remarkable for two reasons. First, a typical finding in similar evaluations studies (including earlier evaluations of WASH programs by the authors in Tanzania, Yemen, and Egypt) is

[25] The construction of the composite is rather ad-hoc, however we experimented with different weights and found comparable results.

that hygiene training has little effect, if any. The One Million Initiative is a favourable outlier in this respect. It would seem likely that the difference is due to the confrontational nature of the CLTS approach which is quite different from the traditional PHAST training program promoted by the WHO.[26] Second, Table 3 shows that owning a latrine is also almost equivalent to using one, which is not surprising given that the households have to put in the effort of constructing a latrine themselves. This suggests that the CLTS approach is right in focusing on the promotion of latrine ownership.

The health impact of latrines might be underestimated due to the fact, that the newly constructed latrines are almost exclusively traditional pit latrines and not the improved latrines promoted by WHO. However, switching from open defecation to using traditional latrines already produced a significant health impact in our sample. One might also expect spill-over effects arising from the latrine ownership and use of other households in the community, which generally leads to a more hygienic environment in the community. This impact is also included in the impact of CLTS using the 'black-box regressions' in Table 8.

Regarding safe water use, the lack of impact of the water point interventions on the health outcome could be explained by a considerable contamination of water with E-coli bacteria between the source and the point of use: water in the household is far less safe. Such a difference in water quality is a common finding in other WASH studies as well. See for instance IEG (2006). A total of 149 water samples taken from the Mozambique program area during the 2010 round of the survey show a decrease in the percentage of E-coli free samples from 37 percent to 14 percent between source and point of use, confirming the findings quoted from the literature. On the other hand, we find that the probability of a contamination-free sample at the point of use increases by 25 percentage points if the water is originally from a contamination-free source. Hence, in our case improving the supply of safe water does lead to a limited improvement of drinking water quality at the household. Unfortunately, the number of water samples is too limited to investigate whether this improvement is sufficient to explain our health results.

An alternative explanation could be that older household members become more resistant to consuming contaminated water, thereby reducing the magnitude of possible impact. This is in line with the finding that the water point interventions and the switch to using improved water sources do significantly reduce diarrheal disease prevalence for the young children, who are more vulnerable to being affected diarrheal diseases. Therefore, the use of safe water sources is expected to affect health outcomes of young children but less so of adults.

[26] See http://www.who.int/water_sanitation_health/hygiene/envsan/phastep/en/, accessed February 2011. It is important to note that we cannot use the Mozambique data to assess the effectiveness of PHAST since all sample households were exposed to that training. Strictly speaking we therefore only assess the effect of adding a CLTS training to PHAST instruction.

6. Conclusion

The One Million Initiative is an ambitious large-scale program aimed at improving the lives and the health of a million people in one of the poorest countries in the world. It uses the promotion of safe sanitation practices and installation of improved water sources as instruments to accelerate the achievement of the Millennium Development Goals with respect to the access to drinking water and adequate sanitation for rural families.

In this paper we have focused on the health impact of the One Million Initiative. Using a two-round survey we can trace some of the channels through which it operates, namely the switch to using safe water sources and a change in sanitary practices. Using an indicator of disease prevalence based on a MICS indicator for the prevalence of water related diseases, we find that between the 2008 and 2010 survey rounds the disease indicator in the sample declined from 30 percent to 14 percent. The analysis suggests that 3.1 percentage points of this 16 point decline or 19 percent can be attributed to interventions under the One Million Initiative, in particular to the sanitation intervention. To the extent that our disease indicator is an appropriate indicator, proportional to the prevalence of water related disease, this is an important and detectable effect at the level of the program population.[27]

The health impact of the sanitation intervention is mainly attributable to its success of convincing people to build latrines, but it is also detectable that the ClTS training motivated non-user households to start using improved water sources in communities where improved water points were or became available. On the individual level, our results indicate that the benefits of the sanitation intervention are mainly enjoyed by household members above the age of 5.

Regarding the water point interventions, we find that it has a limited impact on health outcomes. On the individual level, it decreases the likelihood of water related disease incidence of the youngest children but it does not have any impact on the health of the older household members. However, it does have a sizable impact on the use of improved water sources by creating access to it. Unfortunately, this does not translate into a positive impact on health. This might happen because bacterial contamination of drinking water takes place between the source and the point (and time) of use. Such contamination should undermine or severely diminish the impact of increased access to improved water sources. Therefore, it might be beneficial for the program to increase its focus on the software component of water use practices after improved water sources are available in the communities.

[27] Our sample is not representative of the population in the program area of the 'One Million Initiative' since locations receiving improved water facilities were over-represented in the sample. Reweighing the sample observations would be necessary to calculate impacts at the population level.

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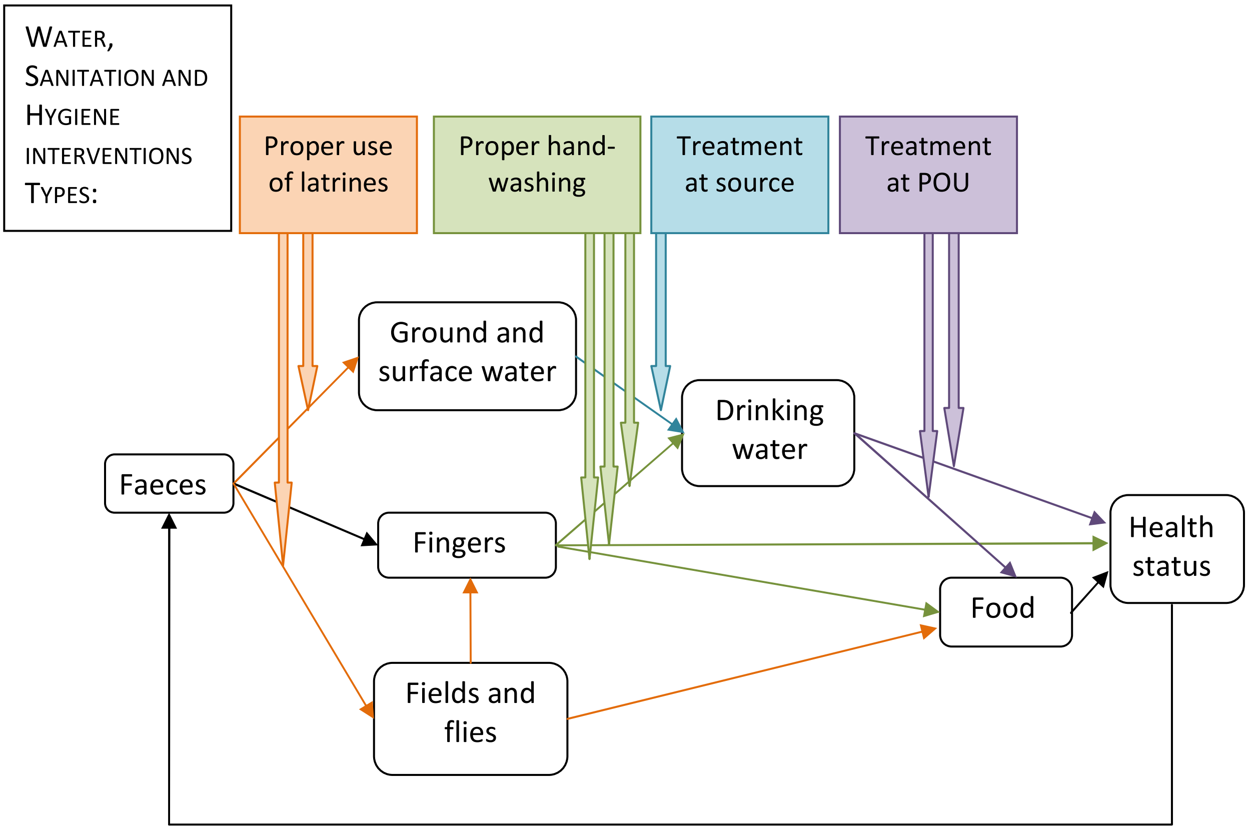
Figures and Tables

Figure 1: Transmission pathways and barriers of faecal-oral disease



Source: adapted from Waddington and Snilstveit (2009).

Figure 2: Impact of water and sanitation interventions on health

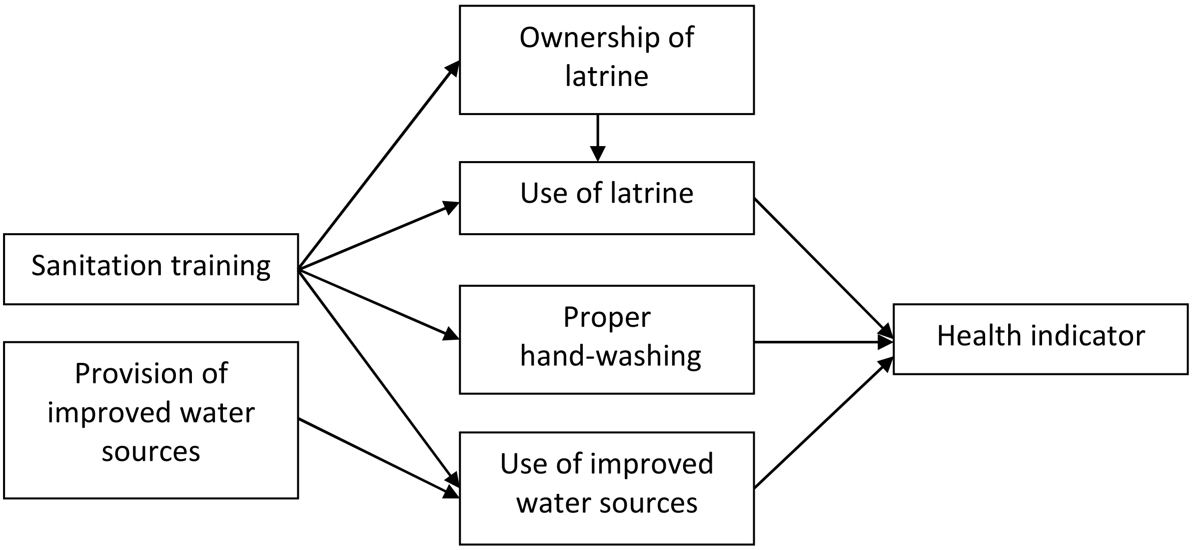


Table 1: Impact on latrine ownership

Household FD	Household FD	Household FD	Household FD logit		Household pooled	Household pooled logit	
Regression	**(1)**	**(2)**	**(3)**	mean	**(4)**	**(5)**	mean
Mean dependent var	0.105	0.105	0.730	effect	0.494	0.494	effect
Water point intervention	0.024	0.023	0.488	0.082	0.025	0.124	0.017
	(0.045)	(0.046)	(0.347)		(0.049)	(0.234)	
Sanitation training (CLTS)	0.121**	0.126**	0.639*	0.108	0.146**	0.995***	0.137
	(0.056)	(0.056)	(0.350)		(0.057)	(0.273)	
Intercept	0.050***	0.059***	0.783***	0.132	- 0.166***	- 18.92***	-2.612
	(0.026)	(0.026)	(0.197)		(0.023)	(0.584)	
Observations	1310	1310	300		3200	3200	
Adj. R-squared[2]	0.018	0.037	0.098		0.419	0.349	
First difference	yes	yes	yes		no	no	
Year, location dummies	no	no	no		yes	yes	
Household dummies	no	no	no		no	no	
Additional regressors[1]	no	yes	yes		yes	yes	
Clustered s.e.	yes	yes	no		yes	no	

Dependent variable: (4)-(5) latrine ownership (binary); (1)-(2) change in ownership; (3) obtained latrine=1, lost latrine=0 (binary)

[1] Additional regressors: household size, wealth

[2] MacFadden's adjusted R^2 for logit models

Signif. Codes: '*' 0.1, '**' 0.05, '***' 0.01

Source: Household survey and program data on interventions, 2008 and 2010.

Table 2: Impact of CLTS training on non-owners and non-users

Dependent variable	**Latrine ownership**	**Use of improved water source**
Regression	**(1)**	**(2)**
Mean dependent var	0.549	0.668
π: effect of CLTS on non-owners	0.221***	
	(0.070)	
π: effect of CLTS on non-users		0.312
		(0.289)
α: constant	0.064	0.764*
	(0.151)	(0.411)
β: share of latrines at baseline	0.915***	
	(0.050)	
β: improved wp in cluster at baseline		0.123
		(0.144)
δ_1: water intervention	0.008	
	(0.040)	
δ_2: average household size in cluster	-0.024	-0.005
	(0.030)	(0.008)
δ_3: average wealth in cluster	-0.023	0.018
	(0.110)	(0.028)
γ_2: household size	0.012**	-0.002
	(0.005)	(0.099)
γ_3: wealth	0.116***	-0.211
	(0.020)	(0.620)
Observations	1600	720

Nonlinear least squares estimator (see equation (10). Clustered standard errors between parentheses.

Regression (1) includes all households; regression (2) only households from clusters with water point intervention.

Signif. Codes: '*' 0.1, '**' 0.05, '***' 0.01

Source: Household survey and program data on interventions, 2008 and 2010.

Table 3: Latrine use by ownership

Latrine use by ownership (% of owners)	Men	Women	School children	Other children
Household owns latrine in 2008	95.6	97.2	65.8	65.5
Household owns latrine in 2010	93.6	98.1	69.2	45.0
Household does not own latrine in 2008	6.0	6.2	3.9	4.2
Household does not own latrine in 2010	9.6	10.7	6.0	4.3

Source: Household survey, 2008 and 2010

Table 4: Hand washing at critical times

Hand washing (% of respondents)	Year	Men	Women	School children	Other children
Before eating	2008	100.0	100.0	99.9	96.4
	2010	99.9	100.0	99.8	98.7
After defecation	2008	96.1	96.0	84.7	66.7
	2010	96.9	95.6	83.8	73.0
After disposing baby's faeces	2008	--	89.5	74.0	55.7
	2010	--	90.0	71.5	56.3

Source: Household survey, 2008 and 2010

Table 5: Impact on adults' hand-washing with soap or ash at crucial times

	Household FD	Household FD	Household FD logit		Household pooled	Household pooled logit	
Regression	**(1)**	**(2)**	**(3)**	mean effect	**(4)**	**(5)**	mean effect
Mean dependent var	0.209	0.209	0.780		0.146	0.146	
Water point intervention	0.000	0.000	- 0.019	-0.003	- 0.004	0.056	0.010
	(0.058)	(0.058)	(0.256)		(0.053)	(0.223)	
Sanitation training (CLTS)	0.102*	0.099*	0.474*	0.080	0.071	0.331	0.056
	(0.060)	(0.059)	(0.269)		(0.052)	(0.231)	
Intercept	0.172***	0.165***	1.050***	0.176	0.124***	- 1.926***	-0.325
	(0.036)	(0.036)	(0.152)		(0.023)	(0.497)	
Observations	1309	1309	490		3199	2890	
Adj. R-squared[2]	0.006	0.011	0.002		0.130	0.097	
First difference	yes	yes	yes		no	no	
Year, location dummies	no	no	no		yes	yes	
Household dummies	no	no	no		no	no	
Additional regressors[1]	no	yes	yes		yes	yes	
Clustered s.e.	yes	yes	no		yes	no	

Dependent variable: (4)-(5) hand-washing with soap/ash after defecation and before eating (binary); (1)-(2): change in variable, (3) 1=adopted, 0=abandoned (binary)

[1] Additional regressors: household size, wealth

[2] MacFadden's adjusted R^2 for logit models

Signif. Codes: '*' 0.1, '**' 0.05, '***' 0.01

Source: Household survey and program data on interventions, 2008 and 2010.

Table 6: Impact on use of improved water sources

	Household FD	Household FD	Household FD logit		Household pooled	Household pooled logit	
Regression	**(1)**	**(2)**	**(3)**	mean	**(4)**	**(5)**	mean
Mean dependent var	0.277	0.277	0.931	effect	0.283	0.283	effect
Water point intervention	0.318***	0.320***	0.265	0.015	0.330***	1.897***	0.299
	(0.089)	(0.088)	(0.419)		(0.087)	(0.125)	
Sanitation training (CLTS)	0.159*	0.158*	18.64	1.073	0.142	0.353***	0.056
	(0.089)	(0.092)	(1175)		(0.090)	(0.127)	
Intercept	0.071*	0.069	1.631***	0.094	- 0.029	- 1.788***	-0.281
	(0.043)	(0.043)	(0.313)		(0.028)	(0.132)	
Observations	1310	1310	421		3200	3200	
Adj. R-squared[2]	0.170	0.173	0.191		0.562	0.173	
First difference	yes	yes	yes		no	no	
Year dummy	no	no	no		yes	yes	
Location dummy	no	no	no		yes	no	
Household dummies	no	no	no		no	no	
Additional regressors[1]	no	yes	yes		yes	yes	
Clustered s.e.	yes	yes	no		yes	no	

Dependent variable: (4)-(5) use of improved water source (binary); (1)-(2) change in use; (3) 1=adopted use; 0=discontinued use

[1] Additional regressors: household size, wealth

[2] MacFadden's adjusted R^2 for logit models

Signif. Codes: '*' 0.1, '**' 0.05, '***' 0.01

Source: Household survey and program data on interventions, 2008 and 2010.

Table 7: Distance to improved water points as a determinant of their use

Dependent variable: 1 if household used improved source in 2010. 0 otherwise

Mean dependent variable: 0.42

Coefficient	Estimate	Clustered Std. error
Intercept	0.784 ***	0.045
Improved source 10-250 m further away	-0.351 ***	0.083
Improved source 250-500 m further away	-0.55 ***	0.074
Improved source 500-999 m further away	-0.727 ***	0.052
Improved source 1 – 2 km further away	-0.641 ***	0.072
Improved source 2 - 3 km further away	-0.784 ***	0.045
Improved source 3 - 4 km further away	-0.764 ***	0.047

Signif. codes: '***' 0.01, '**' 0.05 '*' 0.1

Source: Household Survey, 2010 round. Number of observations 1222. Adjusted R-squared 0.33.

Table 8: Impact on health outcome

Regression	Household FD (1)	Household FD (2)	Household FD logit (3)	mean effect	Household pooled (4)	Household pooled logit (5)	mean effect
Mean dependent var	-0.163	-0.163	0.264		0.223	0.223	
Water point intervention	- 0.010	- 0.008	- 0.229	-0.042	- 0.039	- 0.528**	-0.080
	(0.040)	(0.039)	(0.248)		(0.039)	(0.215)	
Sanitation training (CLTS)	- 0.083*	- 0.081*	- 0.522**	-0.096	- 0.080**	- 0.440**	-0.067
	(0.043)	(0.042)	(0.264)		(0.040)	(0.221)	
Household size		0.027***	0.133**	0.024	0.013***	0.080***	0.012
		(0.008)	(0.058)		(0.005)	(0.022)	
Number of children under 5		0.030	0.240*	0.044	0.032***	0.205***	0.031
		(0.020)	(0.137)		(0.010)	(0.067)	
Wealth		- 0.023	- 0.195	-0.036	- 0.008	- 0.045	-0.007
		(0.031)	(0.183)		(0.015)	(0.082)	
Intercept	- 0.127***	- 0.119***	- 0.730***	-0.134	0.454***	- 0.302	-0.046
	(0.030)	(0.030)	(0.151)		(0.030)	(0.350)	
Observations	1280	1279	440		3161	3161	
Adj. R-squared[2]	0.004	0.024	0.029		0.093	0.066	
First difference	yes	yes	yes		no	no	
Year, location dummies	no	no	no		yes	yes	
Household dummies	no	no	no		no	no	
Additional regressors[1]	no	yes	yes		yes	yes	
Clustered s.e.	yes	yes	no		yes	no	

Dependent variable: (4)-(5) reported prevalence of water related disease in household in last 6 months (binary); (1)-(2) change in disease prevalence; (3) 1=disease in 2010 and not in 2008, 0= disease in 2008 and not in 2010 (binary)

[1] Additional regressors: household size, number of children under 5. wealth

[2] MacFadden's adjusted R^2 for logit models

Signif. Codes: '*' 0.1, '**' 0.05, '***' 0.01

Source: Household survey and program data on interventions, 2008 and 2010.

Table 9: Impact on children's health outcome

Regression	Children under 5 pooled (1)	Children under 5 pooled logit (2)	mean effect	Children under 3 pooled (3)	Children under 3 pooled logit (4)	mean effect
Mean dependent var	0.254	0.254		0.146	0.146	
Water point intervention	- 0.027	- 0.405	-0.066	- 0.103**	- 1.248***	-0.136
	(0.046)	(0.299)		(0.046)	(0.407)	
Sanitation training (CLTS)	- 0.062	- 0.271	-0.044	- 0.005	0.080	0.009
	(0.046)	(0.309)		(0.050)	(0.415)	
Household size	0.020***	0.109***	0.018	0.009	0.080**	0.009
	(0.007)	(0.031)		(0.006)	(0.039)	
Number of children in category	- 0.010	0.052	-0.008	- 0.001	- 0.038	-0.004
	(0.018)	(0.099)		(0.028)	(0.219)	
Wealth	0.006	0.037	0.006	0.003	0.023	0.002
	(0.019)	(0.118)		(0.020)	(0.155)	
Intercept	0.509***	- 0.028	-0.005	0.416***	- 0.476	-0.052
	(0.055)	(0.478)		(0.048)	(0.551)	
Observations	1595	1595		1366	1366	
Adj. R-squared[2]	0.088	0.031		0.055	-0.006	
First difference	no	no		no	no	
Year, location dummies	yes	yes		yes	yes	
Household dummies	no	no		no	no	
Additional regressors[1]	yes	yes		yes	yes	
Clustered s.e.	yes	no		yes	no	

Dependent variable: (4)-(5) reported prevalence of water related disease for children in age category in the household in last 6 months (binary); (1)-(2) change in disease prevalence; (3) 1=disease in 2010 and not in 2008, 0= disease in 2008 and not in 2010 (binary)

[1] Additional regressors: household size, number of children under 5. wealth

[2] MacFadden's adjusted R^2 for logit models

Signif. Codes: '*' 0.1, '**' 0.05, '***' 0.01

Source: Household survey and program data on interventions, 2008 and 2010.

Table 10: Impact on individual health outcome

Regression	Children under 5 pooled (1)	Children under 5 pooled logit (2)	mean effect	Children under 3 pooled (3)	Children under 3 pooled logit (4)	mean effect
Mean dependent var	0.070	0.070		0.070	0.070	
Water point intervention for children in age category	-0.047**	-0.804**	-0.173	-0.053***	-0.675*	-0.146
	(0.019)	(0.335)		(0.019)	(0.395)	
Water point intervention for older individuals	0.015	-0.254	-0.055	0.011	-0.331	-0.072
	(0.018)	(0.227)		(0.011)	(0.284)	
Sanitation training (CLTS) for children in age category	-0.021	-0.276	-0.060	-0.007	-0.051	-0.011
	(0.021)	(0.339)		(0.021)	(0.400)	
Sanitation training (CLTS) for older individuals	-0.034**	-0.620***	-0.134	-0.033***	-0.652**	-0.141
	(0.020)	(0.233)		(0.012)	(0.300)	
Child in age category	0.076***	1.214***	0.262	0.087***	1.358***	0.294
	(0.008)	(0.105)		(0.007)	(0.126)	
Household size	0.005	0.067*	0.015	0.006***	0.104**	0.023
	(0.006)	(0.038)		(0.002)	(0.043)	
Number of children in age category	-0.001	-0.015	-0.003	-0.008	-0.271**	-0.059
	(0.008)	(0.097)		(0.005)	(0.116)	
Wealth	-0.011	-0.106	-0.023	-0.013	-0.423**	-0.092
	(0.015)	(0.140)		(0.008)	(0.169)	
Intercept	0.507***	-0.266	-0.057	0.513***	0.279	0.061
	(0.016)	(0.940)		(0.058)	(0.629)	
Observations	11564	11564		11548	11548	
Adj. R-squared[2]	0.193	-1.837		0.194	-2.300	
First difference	no	no		no	no	
Year, location dummies	yes	yes		yes	yes	
Household dummies	yes	yes		yes	yes	
Additional regressors[1]	yes	yes		yes	yes	
Clustered s.e.	yes	no		yes	no	

Dependent variable: (3)-(4) reported prevalence of water related disease for individuals in last 6 months (binary); (1)-(2) change in disease prevalence

[1] Additional regressors: household size, number of children under 5. wealth

[2] MacFadden's adjusted R^2 for logit models

Signif. Codes: '*' 0.1, '**' 0.05, '***' 0.01

Source: Household survey and program data on interventions, 2008 and 2010.

Table 11: Health effect of the use of improved water sources and latrines

Regression	Household FD (1)	Household FD (2)	Household pooled (3)	Household pooled (4)
Mean dependent var	-0.162	-0.162	0.224	0.224
Use of improved water source	-0.040	-0.107	-0.109	-0.127*
	(0.110)	(0.070)	(0.109)	(0.069)
Use of latrine	-0.545**	-0.394**	-0.465	-0.395**
	(0.358)	(0.193)	(0.337)	(0.180)
Household size	0.031***	0.030***	0.017***	0.016***
	(0.008)	(0.008)	(0.004)	(0.004)
Number of children under 5	0.033*	0.032*	0.026**	0.027***
	(0.020)	(0.019)	(0.011)	(0.010)
Wealth	0.016	0.002	0.050	0.040
	(0.040)	(0.030)	(0.047)	(0.027)
Intercept	-0.072*	-0.073**	0.375***	0.385***
	(0.037)	(0.030)	(0.090)	(0.076)
Observations	1276	1276	3158	3158
F-stat, first stage (water)	54.0	46.7	182.7	51.5
F-stat, first stage (latrine)	8.64	7.97	21.4	36.3
Sargan statistic, df, prob		2.45, 4, 0.65		0.07, 2, 0.97
List of additional instruments[1,2]		Water×FB, FB, SLB, CLTS×SLB		Water×FB, CLTS×SLB
First difference	yes	yes	no	no
Year, location dummies	no	no	yes	yes
Household dummies	no	no	no	no
Clustered s.e.	no	no	no	no

Dependent variable: (3)-(4) reported prevalence of water related disease in household in last 6 months (binary); (1)-(2) change in disease prevalence

[1] Instrument list always includes Water, CLTS, HH size, number of children under 5, wealth.
[2] Baseline controls: FB is functioning borehole in cluster; and SLB is the share of latrines in cluster (excluding hh)

Signif. Codes: '***' 0.01. '**' 0.05. '*' 0.1

Source: Household survey and program data on interventions, 2008 and 2010.

Table 12: Health effect of hand-washing, use of latrines and improved water sources

Regression	Household FD (1)	Household pooled (2)	Household FD (3)	Household pooled (4)
Mean dependent var	-0.163	0.239	-0.162	0.239
Use of improved water source	-0.101	-0.088	-0.091	-0.104
	(0.070)	(0.106)	(0.073)	(0.074)
Use of latrine	-0.379*	-0.393		
	(0.209)	(0.242)		
Proper hand-washing	-0.042	-0.115		
	(0.280)	(0.434)		
Safe sanitary practices[1]			-0.147*	-0.185**
			(0.079)	(0.087)
Household size	0.030***	0.024***	0.029***	0.015***
	(0.008)	(0.006)	(0.008)	(0.004)
Number of children under 5	0.031	0.021	0.030	0.029***
	(0.019)	(0.015)	(0.019)	(0.010)
Wealth	-0.000	0.041	-0.012	0.041
	(0.037)	(0.035)	(0.027)	(0.027)
Intercept	-0.069	0.348***	-0.059	0.411***
	(0.051)	(0.103)	(0.037)	(0.074)
Observations	1275	1928	1271	3151
F-stat, first stage (water)	46.0	31.6	46.4	51.4
F-stat, first stage (latrine)	7.95	24.1		
F-stat, first stage (hand-washing)	2.88	3.52		
F-stat, first stage (sanitary)			7.12	29.7
Sargan statistic, df, prob	2.51, 3, 0.47	0.728, 1, 0.39	2.55, 4, 0.64	0.03, 2, 0.97
List of additional instruments[2,3]	Water×FB, FB, SLB, CLTS×SLB	Water×FB, CLTS×SLB	Water×FB, FB, SLB, CLTS×SLB	Water×FB, CLTS×SLB
First difference	yes	no	yes	no
Year, location dummies	no	yes	no	yes
Household dummies	no	no	no	no
Clustered s.e.	no	no	no	no

Dependent variable: (2)-(4) reported prevalence of water related disease for individuals in last 6 months (binary); (1)-(3) change in disease prevalence

[1] Safe sanitary practices = 0 if no latrine use and no hand-washing with soap; 1 if hand-washing with soap but no latrine use; 2 latrine use but no hand-washing with soap; 3 if both.

[2] Instrument list always includes Water, CLTS, HH size, number of children under 5, wealth.

[3] Baseline controls: FB is functioning borehole in cluster; and SLB is the share of latrines in cluster (excluding hh)

Signif. Codes: '***' 0.01, '**' 0.05, '*' 0.1

Source: Household survey and program data on interventions, 2008 and 2010.

Table 13: Impact of use of improved water sources and latrines on individual health outcome

Regression	Children under 5 pooled (1)	Children under 3 pooled (2)
Mean dependent var	0.070	0.070
Use of improved water source for children in age category	-0.104**	-0.134***
	(0.045)	(0.044)
Use of improved water source for older individuals	0.027	0.026
	(0.036)	(0.036)
Use of latrine for children in age category	-0.082	-0.063
	(0.141)	(0.109)
Use of latrine for older individuals	-0.256**	-0.254**
	(0.107)	(0.107)
Child in age category	-0.004	0.020**
	(0.051)	(0.008)
Household size	0.007***	0.007***
	(0.002)	(0.008)
Wealth	0.003	0.004
	(0.011)	(0.011)
Intercept	0.479***	0.472***
	(0.066)	(0.065)
Observations	11564	11548
F-stat, first stage (water, child)	18.6	21.6
F-stat, first stage (water, older)	11.1	10.3
F-stat, first stage (latrine, child)	23.8	28.3
F-stat, first stage (latrine, older)	13.9	13.0
First difference	no	no
Year, location dummies	yes	yes
Household dummies	yes	yes
Clustered s.e.	no	no

Dependent variable: (2) reported prevalence of water related disease for individuals in last 6 months (binary); (1) change in disease prevalence

Signif. Codes: '*' 0.1, '**' 0.05, '***' 0.01

Source: Household survey and program data on interventions, 2008 and 2010.

Appendix A. Intervention placement

The interventions in the One Million Initiative are purposefully not randomized across communities in the program area. Emphasis is put on reaching poorer, more vulnerable communities that do not have or have only limited access to safe water sources and sanitary facilities. This appendix describes the selection process of the intervention communities in the program districts.

In general, the district government decides on the location of water point interventions (rehabilitation and construction of new sources) based on information collected by an NGO responsible for implementing the Community Participation and Education (PEC) in the district. PEC consists of three components: (1) community mobilization and hygiene training, (2) water committee training, and (3) sanitation training. The PEC NGOs have the crucial role of communicating the program to the communities, and the situation in target areas to the local authorities. Information over the needs of communities is collected by inviting communities to formally apply for a water point intervention under the first component of PEC. Local authorities analyze and prioritize the applications regularly. Priority areas are set yearly by the government. In 2008 the focus was on densely populated areas, while in 2009 it shifted to more remote areas and in 2010 schools and health centers were also targeted.

The PEC NGO is also responsible for carrying out the water, sanitation and hygiene trainings of the program. Hygiene training is done in every community the PEC NGO visits (therefore in all communities in the survey sample) with particular attention to proper hand washing practices. A water committee training is carried out at locations where there is an improved water source or after the water point intervention was implemented. The training focuses on the importance of managing the improved water source and its maintenance through a dedicated water committee.[28]

The PEC NGOs can decide on the locations for the sanitation trainings, perhaps with the assistance of the local government. The sanitation component of the One Million Initiative from mid 2008 is Community Approach to Total Sanitation (CATS). This approach combines the Community Led Total Sanitation (CLTS) trainings with a reward system for communities that become open defecation free (ODF). PEC NGOs are rewarded for the number of ODF communities in their district, therefore it is in their interest to introduce CLTS at locations where their likelihood of success is high. Based on Kar et al. (2008) the success of CLTS is related to factors including health problems, leadership, size of community and geographical factors.

[28] Setting up a water committee is also a precondition for applying for a water point intervention.

Appendix B. Balance and attrition

This appendix discusses the characteristics of households and communities in the four intervention groups of the program. In addition, the issue of households changing between the two survey rounds is addressed.

Table A1 reports outcomes for four different groups: those without interventions, those with only the water point intervention, those with only the CLTS interventions, and those with both interventions. The table shows that in the 2008 round water related diseases were significantly more common and latrine use[29] and ownership were significantly less common in the CLTS intervention group. This reflects the targeting of interventions at poorer villages. On the other hand, the water point intervention was more common in locations where households use improved water sources for drinking. This partly reflects the fact that some water point interventions had taken place just before the survey interview.[30]

Regarding other household characteristics, Table A2 shows that households were similar among the intervention groups in most dimensions at the baseline. Exceptions are lower wealth[31] and less common water treatment in the CLTS intervention group, which again reflects intervention targeting. The other exceptions are education and hygiene knowledge, which in 2008 were somewhat better for the group receiving both the CLTS and the water point intervention.

Community characteristics at baseline are summarized in Table A3 by intervention groups. It shows that intervention communities differ from no-intervention communities in many respects so that it will be necessary to take these differences into account in the analysis.[32] This issue is dealt with by controlling for cluster fixed effects in the regression analysis.

Finally, Table 4 reports on attrition between the 2008 and 2010 survey rounds. A probit analysis of attrition probabilities shows that larger and 'older' households were somewhat more likely to be interviewed twice. These differences seem relatively unimportant for the present study. We therefore conclude that the survey is suitable for the impact analysis of WASH interventions provided proper care is taken of intervention targeting, either by including community dummies or by using double difference estimation. Except for household size there is no substantial difference between the characteristics of the 1310 panel households and the other 290.

[29] Latrine use is calculated as the average use of latrines by adult household members. Children are excluded from the calculation to make the variable comparable between households with and without children.

[30] In some locations improved water sources were created shortly before the baseline survey. This does not seem to have had an effect on the baseline survey outcomes.

31 Household wealth is proxied by a linear combination of personal asset ownership indices, the weight having been determined by the principal component of 2008 asset ownership.

32 Note that the differences are not statistically significant due to the small number of locations per treatment group.

Table A1: Comparison of outcome variables

Variable	Year	Mean control group	Diff. water point[1]	Diff. CLTS training[1]	Diff. both interventions[1]	N obs
Water related disease in household	2008	0.277	- 0.001	0.170***	0.036	1588
		(0.448)	(0.031)	(0.046)	(0.028)	
	2010	0.183	- 0.092***	- 0.005	- 0.076***	1574
		(0.387)	(0.022)	(0.036)	(0.021)	
Ownership of latrine	2008	0.479	- 0.086***	0.014	- 0.093***	1600
		(0.500)	(0.034)	(0.046)	(0.030)	
	2010	0.528	- 0.071**	0.129***	0.084***	1600
		(0.500)	(0.034)	(0.044)	(0.030)	
Use of latrine	2008	0.525	- 0.108***	- 0.011	- 0.101***	1600
		(0.500)	(0.034)	(0.046)	(0.030)	
	2010	0.596	- 0.104***	0.122***	0.040	1597
		(0.491)	(0.034)	(0.042)	(0.029)	
Proper hand-washing	2008	0.183	- 0.027	- 0.026	- 0.011	1600
		(0.387)	(0.025)	(0.034)	(0.023)	
	2010	0.377	- 0.050	0.009	0.062**	1599
		(0.485)	(0.033)	(0.045)	(0.030)	
Use of improved water source	2008	0.121	0.116***	- 0.042	0.027	1600
		(0.326)	(0.027)	(0.026)	(0.021)	
	2010	0.206	0.394***	0.009	0.508***	1600
		(0.404)	(0.032)	(0.038)	(0.026)	
Share of households in both rounds		0.815	0.015	- 0.008	0.005	1600
House is abandoned (share of HHs)		0.075	0.008	0.011	0.020	1600
New household in house (share of HHs)		0.033	- 0.003	- 0.012	0.006	1600
Number of households		720	300	140	440	1600

[1] The differences shown are relative to the control group.
Signif. Codes: '*' 0.1, '**' 0.05, '***' 0.01
Source: Household survey and program data on interventions, 2008 and 2010.

Table A2: Comparison of selected household characteristics

Variable	Year	Mean control group	Diff. water point[1]	Diff. CLTS training[1]	Diff. both interventions[1]	N obs
Household size	2008	5.476	0.220	- 0.019	0.267	1600
		(2.562)	(0.187)	(0.238)	(0.161)	
	2010	5.233	0.100	- 0.262	0.078	1600
		(2.427)	(0.168)	(0.209)	(0.146)	
Number of children under 5 years	2008	0.873	0.017	- 0.102	0.063	1599
		(0.887)	(0.063)	(0.082)	(0.056)	
	2010	0.864	0.103	- 0.107	0.057	1598
		(0.940)	(0.070)	(0.080)	(0.057)	
Number of children under 3 years	2008	0.481	0.049	- 0.066	0.081**	1600
		(0.615)	(0.047)	(0.056)	(0.040)	
	2010	0.503	0.067	- 0.038	0.011	1600
		(0.648)	(0.048)	(0.056)	(0.039)	
Wealth index	2008	0.993	- 0.048	- 0.211***	0.011	1600
		(0.623)	(0.041)	(0.059)	(0.037)	
	2010	0.922	- 0.013	- 0.229***	0.034	1600
		(0.610)	(0.041)	(0.055)	(0.037)	
Mean household age	2008	23.513	- 1.216	1.494	- 1.351**	1599
		(11.920)	(0.750)	(1.208)	(0.680)	
	2010	24.520	- 0.199	2.219	- 0.171	1593
		(13.401)	(0.935)	(1.481)	(0.834)	
Female headed household	2008	0.113	- 0.007	0.042	0.000	1445
		(0.316)	(0.023)	(0.035)	(0.020)	
	2010	0.152	- 0.008	0.062	- 0.007	1467
		(0.359)	(0.025)	(0.039)	(0.023)	
Household education	2008	0.832	0.057**	- 0.044	0.051**	1586
		(0.374)	(0.023)	(0.038)	(0.021)	
	2010	0.868	- 0.018	- 0.082**	0.061**	1600
		(0.339)	(0.024)	(0.037)	(0.018)	
Water treatment	2008	0.089	0.008	- 0.075***	0.041**	1600
		(0.285)	(0.020)	(0.015)	(0.019)	
	2010	0.124	- 0.070***	0.019	0.051**	1600
		(0.329)	(0.018)	(0.032)	(0.022)	
Hygiene knowledge (maximum 5)	2008	3.396	- 0.009	- 0.139	0.225***	1600
		(1.185)	(0.077)	(0.111)	(0.068)	
	2010	3.776	0.110	- 0.119	- 0.200***	1599
		(1.030)	(0.072)	(0.098)	(0.062)	
Knowledge of practices to prevent diarrhea (max 8)	2010	3.527	- 0.127	- 0.320**	- 0.218**	1592
		(1.546)	(0.110)	(0.123)	(0.094)	
Causes of diarrhea (max 6)	2010	2.987	- 0.347***	- 0.180	- 0.426***	1592
		(1.338)	(0.099)	(0.115)	(0.079)	
Number of households		720	300	140	440	1600

[1] The differences shown are relative to the control group.
Signif. Codes: '*' 0.1, '**' 0.05, '***' 0.01
Source: Household survey and program data on interventions, 2008 and 2010.

Table A3: Comparison of community characteristics, 2008

Variable	Mean control group	Diff. water point[1]	Diff. CLTS training[1]	Diff. both intervention[1]s	N obs
PHAST sanitation training in community	0.417	- 0.017	- 0.131	- 0.144	80
	(0.500)	(0.155)	(0.202)	(0.128)	
Minutes drive from local center	72.222	2.111	7.063	- 4.949	80
	(77.270)	(16.829)	(17.380)	(24.970)	
Mobile coverage in community	0.806	- 0.234*	- 0.139	- 0.139	77
	(0.401)	(0.153)	(0.221)	(0.125)	
Weekly market in community	0.194	- 0.052	- 0.028	- 0.147**	77
	(0.401)	(0.118)	(0.180)	(0.082)	
Primary school in community	0.806	0.128	- 0.139	0.058	79
	(0.401)	(0.094)	(0.221)	(0.100)	
Health post in community	0.806	- 0.139	0.028	- 0.033	79
	(0.401)	(0.143)	(0.180)	(0.113)	
Size of community	2.250	- 0.250	0.321	0.023	80
	(1.360)	(0.383)	(0.575)	(0.411)	
Number of clusters	36	15	7	22	80

[1] The differences shown are relative to the control group.
Signif. Codes: '*' 0.1, '**' 0.05, '***' 0.01
Source: Community survey in 2008 and program data on interventions.

Table A4: Probability of households to be present in both rounds

Regression	Probit (1)	Probit (2)	LPM (3)	LPM (4)
Mean dependent var	0.819	0.817	0.819	0.817
Water point intervention	0.066	0.106	0.015	0.024
	(0.085)	(0.091)	(0.031)	(0.034)
Sanitation training (CLTS)	- 0.049	- 0.081	- 0.011	- 0.019
	(0.087)	(0.091)	(0.031)	(0.034)
Water related disease prevalence at baseline	0.023	0.088	0.007	0.022
	(0.082)	(0.088)	(0.021)	(0.021)
Use of improved water sources at baseline	- 0.063	- 0.121	- 0.017	- 0.033
	(0.105)	(0.111)	(0.032)	(0.034)
Ownership of latrine at baseline	0.152*	0.168**	0.041*	0.046*
	(0.078)	(0.082)	(0.023)	(0.025)
Proper hand washing practices at baseline	0.089	0.168	0.024	0.041
	(0.101)	(0.108)	(0.023)	(0.025)
Household size at baseline	0.086***	0.106***	0.021***	0.024***
	(0.018)	(0.022)	(0.004)	(0.005)
Number of children under 5 at baseline	- 0.039	0.034	- 0.009	0.007
	(0.048)	(0.059)	(0.012)	(0.014)
Wealth at baseline	0.086	0.109	0.023	0.028
	(0.062)	(0.069)	(0.022)	(0.023)
Female headed household at baseline		0.147		0.035
		(0.129)		(0.034)
Mean age in household at baseline		0.010**		0.002**
		(0.004)		(0.001)
Household education at baseline		0.041		0.016
		(0.115)		(0.035)
Intercept	0.317**	- 0.178	0.665***	0.547***
	(0.113)	(0.217)	(0.041)	(0.074)
Observations	1587	1424	1587	1424
Adj. R-squared[1]	0.012	-0.027	0.018	0.024
Clustered s.e.	no	no	yes	yes

Dependent variable: household is present in both rounds (binary)

[1] MacFadden's adjusted R^2 for probit models

Signif. Codes: '*' 0.1, '**' 0.05, '***' 0.01

Source: Household survey and program data on interventions, 2008 and 2010.