Determining the effectiveness and mode of operation of Community-Led total Sanitation: The DEMO-CLTS study

FINAL REPORT

Authors: Miriam Harter & Hans-Joachim Mosler

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Contents

Additional document contains:

1. Executive Summary

Globally, 2.3 billion people lack access to safe sanitation services and 892 million people practice open defecation, which poses a dramatic threat to public health. Community-Led Total Sanitation (CLTS) aims at eliminating open defecation by applying participatory activities that engage entire communities. By evoking a shift in social norms that oppose open defecation (OD), CLTS motivates communities to set a common goal to become open defecation free. CLTS has shown to be successful in eradicating open defecation, however, results remain diverse and in-depth understanding of CLTS' mechanisms is still lacking.

This study tries to close this research gap. It aims at revealing the effectiveness and mode of operation of the community-led total sanitation (CLTS) intervention to decrease the incidence of open defecation. In particular, it aimed at determining which elements of the CLTS implementation process are highly efficient in increasing latrine coverage and under which social conditions CLTS is most effective. Additionally, the mode of functioning for CLTS is investigated, and an evidence-based, behavior change approach (i.e., the Risk, Attitude, Norms, Ability, Self-Regulation [RANAS] Model) is contrasted with CLTS to disclose the most effective method of decreasing OD through behavioral change. The study consisted of two phases: in the first, two cross-sectional studies were carried out in Cambodia and Mozambique that investigated CLTS effects 6 months after implementation and the perception of CLTS participants of different intervention activities in 600 households each. In a second step, in a cluster-randomized and controlled trial in Ghana with 3216 households, CLTS was tested against CLTS combined with three RANAS-based interventions and all four intervention arms were contrasted to one control arm.

Results corroborate the effectiveness of CLTS in all three study regions in Ghana the effect was tested against a control arm. Main findings of the pre-studies in Cambodia and Mozambique were that CLTS participation not only provokes latrine construction but also rebuilding in case of former damage of latrines. An overarching theme for the success of CLTS showed to be the social conditions of communities, which provided a fruitful ground for CLTS. This study leads to the recommendation to set focus on follow-up processes, involve natural leaders, pay attention to social norms and people's confidence in their abilities to construct and maintain latrines. Help them to develop detailed action plans and strengthen commitment. Additionally, incentives showed to be a powerful tool for the success of CLTS. Finally, this study showed that in all samples owning a latrine was a reliable predictor to using latrines as well. Therefore, CLTS in fact might lead to an improvement of health conditions.

2. Author information and acknowledgements

Miriam Harter is a PhD student at Eawag, the Swiss Federal Institute of Aquatic Science and Technology, and the University of Zurich. She is working in the Environmental and Social Sciences Department at Eawag and more specifically belongs to the group Environmental and Health Psychology. Hans-Joachim Mosler is a senior researcher at Eawag and professor at the University of Zurich. He is the head of the Environmental and Health Psychology group at Eawag, where the research focus is on health behavior change and health promotions in the global south.

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3. Acronyms and abbreviations

BCT: Behaviour Change Technique

CLTS: Community-Led Total Sanitation

JMP: Joint Monitoring Program of WHO and UNICEF

MRC: Medical Research Council

NGO: Non-Governmental Organisation

OD: Open Defecation

ODF: Open Defecation Free

RANAS: Risk Attitudes Norms Abilities Self-Regulation Model of behaviour change

RCT: Randomised Controlled Trial

SDG: Sustainable Development Goal

UN: United Nations

UNICEF: United Nations International Children's Emergency Fund

WASH: Water, Sanitation, and Hygiene

WHO: World Health Organisation

4. List of figures and tables

5. Problem statement

In 2010, the United Nations included the human right to water and sanitation and 5 years later published the sustainable development goals (SDGs) that included goal #6: the provision of safe sanitation services for all global inhabitants by 2030. In the updated status report on the achievements of the SDGs, the Joint Monitoring Program of WHO and UNICEF admit that it is still a long way to go as in 2015, 2.3 billion people still lacked access to safe sanitation services and 876 million people practiced open defecation (WHO & UNICEF, 2017). The danger of open defecation lies in the transmission of fecal bacteria that lead to diarrheal diseases through the contamination of soil and water bodies (Landrigan et al., 2017; Prüss-Üstün et al., 2016; Wolf et al., 2018). The problem mainly affects the marginalized and poor in low- and middle income countries: the burden of disease is 120- to 150 times higher (Prüss-Üstün et al., 2016). Access to safe sanitation services can cut the prevalence of diarrheal risks and 5.5% of deaths of children under the age of five could be prevented in low-and middle income countries by providing safe sanitation services (Prüss-Ustün et al., 2014).

In recent years, the access to safe sanitation has increased, consequently leading to a reduction of premature deaths caused through diarrheal diseases between 2010 and 2015 by 38.3% (GBD 2015 Risk Factors Collaborators, 2016). However, one single individual can only marginally reduce his or her risk for diarrheal diseases by stopping open defecation. As long as other community members practice open defecation, everyone else remains at risk (Geruso & Spears, 2018; Jung et al., 2017a; Vyas et al., 2016). Only if a certain threshold of community latrine coverage is achieved, health protection of all community members can be assumed. Jung et al. (2017b) identified a threshold of 60% latrine coverage, whereas Wolf et al. (2018) found a 45% reduction of diarrhea when at least 75% of the community were using household latrines.

Community-Led Total Sanitation (CLTS) focuses on the elimination of open defecation in rural areas of low- and middle income countries. CLTS is a behavior change campaign that especially focuses on entire communities instead of individual households. First introduced by Kamal Kar in Bangladesh, the approach has spread all over the world and is today the widest applied sanitation campaign (USAID, 2018). Key concepts of CLTS are the involvement of whole communities to set up a common goal of achieving an open defecation free state. It does so by inviting to a “triggering event” where participatory activities implemented by local facilitators are realized and local leaders are enrolled, so-called natural leaders as role models for the community. CLTS explicitly tries to evoke strong feelings like shame and disgust to motivate people to start the process of latrine construction and originally strictly avoids the provision of

subsidies (Kar & Chambers, 2008). The CLTS components are presented in more detail in Section 6.

The effects of CLTS on motivating people to construct latrines and stop open defecation has been commonly agreed on in research and practice (for an overview of results see literature review by Venkataramanan et al. (2018)). However, the understanding of CLTS effectiveness, what are the underlying mechanisms which explain the success or for which target populations the intervention is most successful is still undiscovered. Results on CLTS mainly stem from grey literature and only few rigorous scientific research has been presented on CLTS effects and mechanisms (USAID, 2018). Moreover, results of CLTS projects rarely hit the above-mentioned protective thresholds of 60% to 75% latrine coverage. This calls for the need of a thorough analysis of CLTS and its mechanisms to provide information on possible improvements.

6. Study goals and research questions

A more effective application of CLTS requires knowledge of how the intervention works on both the individual and the community levels. On the individual level, it is necessary to understand how CLTS works on the behavioral determinants that convey behavioral change, as they are displayed in the Risk, Attitudes, Norms, Abilities, Self-regulation (RANAS) model, for example (the RANAS model is explained in more detail in Section 7).

On the community level, it is essential to know the interactions of individuals and institutions (e.g., chiefs, religious leaders, influential minorities, etc.) that cause the social dynamics involved in reaching the ODF status. Positive as well as possible negative effects of attaining the ODF status in a community should be monitored during and after a CLTS implementation (see “Dealing with different responses,” CLTS Handbook, pp. 38–39). Additionally, it is unknown whether CLTS is the best intervention through which to realize an ODF community, or whether an evidence-based approach targeting specific behavioral determinants would be more effective. In the context of these statements, the following research questions (RQ) will be answered:

RQ 1: How do CLTS participants perceive different activities of the CLTS triggering event?

RQ 2: Which factors of the CLTS implementation process are most predictive for CLTS achievements in terms of community’s latrine coverage?

RQ 3: Does CLTS successfully provoke latrine construction and stop open defecation (compared to a control group)?

RQ 4: What are the mechanisms that lead CLTS to success? In terms of psychological determinants and potential moderating factors?

RQ 5: Can CLTS be improved by combining it with evidence-based, behavioral change strategies based on the RANAS-model of behavior change?

RQ 6: Which characteristics describe a fertile ground for CLTS to be most effective in stopping open defecation?

7. Community-Led Total Sanitation (CLTS)

The Handbook on CLTS recommends structuring implementation in three phases (for a detailed description (Kar & Chambers, 2008)):

Pre-triggering: facilitators collect information about the target community. The Handbook mentions several challenges that are relevant for planning and implementing a CLTS intervention. Facilitators therefore should collect information on the community's social composition, access to water and the current sanitation situation, as examples.

Triggering event: facilitators implement a selection of different participatory activities during a community meeting with the goal of eliciting a collective need for behaviour change. Activities might include a *transect walk*, during which community members lead facilitators to the places of open defection; the drawing of an *open defecation map,* on which community members locate their houses and important land marks of their community as well as the places used for open defecation (see Figure 1). Further activities are the description and demonstration of *faecal-oral transmission routes* with the goal of the realization of community members that with open defecation "they are eating each other's faeces" (page 18); the *calculation of faeces* produced in the community per year as well as the *calculation of medical costs* related to diarrheal diseases. Facilitators might identify so-called *"natural leaders"* that emerge during the triggering event and are supposed to provide support during the construction process. Facilitation of a *community action plan* towards an ODF community and finally, facilitators can suggest the implementation of *by-laws* developed by community members themselves, such as fines for people defecating in the open.

Figure 1*: Open defecation mapping in rural Ghana during CLTS triggering event. Source: author.*

Post-triggering: in the weeks after the triggering event facilitators are supposed to visit the community 1-2 times every week shortly after the triggering and later reduce the visits to once per month until the community is open defecation free (ODF). During those visits, facilitators should provide support and remind the community of their self-set goals. Visits might further include encouragement of support of vulnerable households within the community and inclusion of children as agents of change.

The Handbook on CLTS explicitly tells readers that the activities described should rather serve as guidance and not a strict manual with the effect that CLTS implementation varies vastly across countries and cultural settings as well as between implementing NGOs (Venkataramanan et al., 2018). Some implementing NGOs omit for example the transect walk because participants use the chance to leave the event, or other facilitators report that presenting human excreta in the middle of the community is considered as a taboo (Sigler et al., 2014).

8. Understanding behavior change: The RANAS approach

The RANAS methodology, developed by the Environmental and Health Psychology (EHPsy) group at the Swiss Federal Institute of Aquatic Science and Technology (EAWAG), has proven to be a valid and reliable tool to reveal the socio-psychological functioning of behavioral change interventions. Briefly, the methodology consists of a before-after-control (BAC) design, whereby socio-psychological, environmental, and technological factors are surveyed before and after an intervention is received by an intervention group, but not by a control group. A difference-in-difference analysis compares the differential change in behaviors and in behavioral factors between the intervention group and the control group. Mediation analysis discloses which behavioral factors—and, in turn, behaviors—changed due to the intervention. Mediation analysis is important in determining how the intervention worked (or did not work) as expected.

The basic assumption of the RANAS methodology is that, to change behavior, the mindset of the target population has to be changed. This means that behavioral determinants (i.e., socio-psychological factors), such as knowledge, beliefs, feelings, etc., about the behavior have to be altered. The RANAS model comprises several socio-psychological factors, which have been shown to be determinants of water, sanitation, and hygiene (WASH) behaviors. The model describes factors classified into the following five factor blocks (see Figure 2): (1) Risk factors concern the perceived vulnerability and perceived severity of contracting a disease, as well as health knowledge about the possibility of being affected by a potential contamination. (2) Attitude factors comprise beliefs about costs and benefits of the targeted behavior, as well as

feelings (i.e., arising when thinking about or performing the behavior). (3) Norm factors include different social influences: the perception of how many other's show the behavior already, how much other's approve or disapprove of this behavior and personal importance (personal standards, or what should be done). (4) Ability factors characterize how-to-do knowledge (i.e., knowing how to perform the behavior), as well as the confidence to perform, maintain and recover a once stopped behavior (5) Self-regulation factors help in dealing with conflicting goals or distractions during behavior implementation and maintenance. Having a plan when, where and how to perform the behavior might help to fulfil as well as being able to always provide everything that is needed to perform the behavior (i.e., action control). A central concept of self-regulation is barrier planning, which concerns the development of plans to overcome anticipated impediments. Moreover, in order to consistently practice a behavior, a person has to be committed to doing so, and the behavior has to be remembered at critical moments.

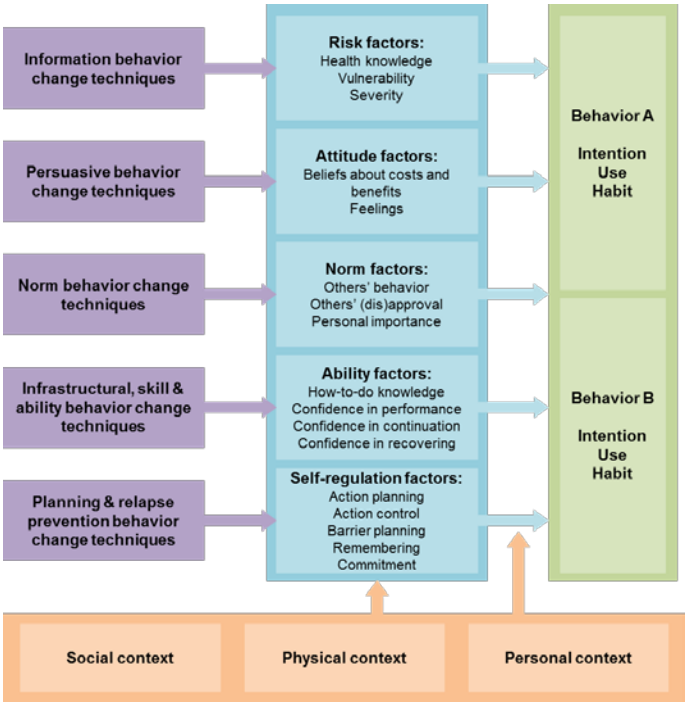


Figure 2: The RANAS model of behavior change (Mosler & Contzen, 2016)

To change behavior, a successful intervention must change some of these behavioral determinants. This project will demonstrate how different elements of CLTS work through these determinants.

9. Overview of the entire study

The DEMO-CLTS study included surveys in Cambodia, Mozambique and Ghana and was realized between November 2014 and November 2018. Figure 3 gives an overview of the timeline of the DEMO-CLTS study. Figure 4 further describes the study design used in the longitudinal study in Ghana.

Figure 3: Timeline of the DEMO-CLTS study

Figure 4 displays the timeline of the cluster randomized and controlled trial in Ghana. One qualitative and three quantitative data collections were realized and different intervention arms implemented. For the last follow-up survey, 81% of the baseline sample was again interviewed.

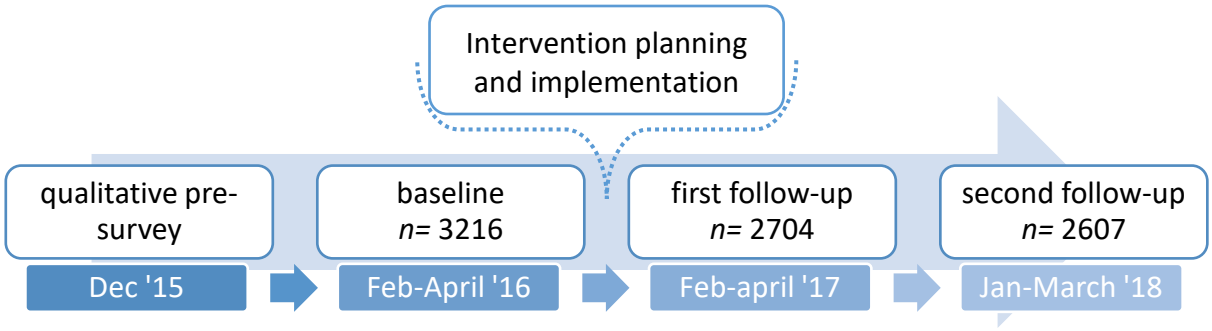


Figure 4: Study design for the cluster-randomized and controlled trial in Ghana

10. General methods

The following sections give overviews on how the different surveys were realized, which methods were used and how the sample was selected for each study area.

10.1. Qualitative research

In all three countries, a qualitative pre-study helped to inform the questionnaire construction, in terms of item selection, possible hindering reasons or feelings connected with latrine construction, open defecation, latrine use and community conditions. Several households, key informants of the implementing NGO on different organizational levels, health workers, community leaders and regional governmental representatives were interviewed. We further interviewed representatives of households that had already constructed latrines and households that had not to gain deeper insights in their (hindering) reasons for construction.

10.2. Enumerator recruitment and training

For all three countries, the recruitment of enumerators was done independently of the implementing organizations in order to avoid biases of community members recognizing NGO facilitators. The main criteria for enumerators to be selected for the surveys was language skills and previous research experience. We tried to conduct every interview in a language the respondent spoke fluently. Especially in Ghana, this proved to be difficult as seven different languages were spoken in the study area. In Mozambique, we further decided to balance the team of enumerators for gender, as our partnering NGO recommended. Female respondents were expected to feel more comfortable with female enumerators as in Mozambique; the topic of sanitation behavior is rather sensitive.

During training the questionnaire items were discussed for understanding and later translated in all local languages and the team was further regrouped into language groups to rehearse the administration of questions and for each language group to adopt uniform words and terminologies. This was followed by role-plays at both the language group and general group levels to test enumerator's interview and communication skills. The questionnaire was pretested in two days and debriefing was done after every day of pretest to share field experiences and necessary adaptations of the instruments. The questionnaire was structured around socio-demographic characteristics, open-defecation habits, latrine construction and latrine use, psycho-social determinants of open defecation, latrine construction and use of households and the physical and social context of the communities. The survey included some checked observations, which are recorded by the enumerator based on his/her own judgement and joint decisions taken during training. Every enumerator was assigned five respondents daily and after every day of data collection, the research manager crosschecked the interviews for data quality.

10.3. RANAS questionnaire

Based on previous questionnaires of the RANAS model, items were framed relating to three different target behaviors: latrine construction, latrine use and open defecation to test whether for example positive attitudes towards open defecation could hinder the uptake of latrine use. All factors of the RANAS model were investigated in Cambodia and Mozambique and later two factors were excluded because we found no explaining value in both countries. Those were action control and remembering. Table 1 presents sample items for each of the RANAS factors (Ghana) for latrine construction (short version of the entire questionnaire can be found in the annex).

Table 1: Sample items for psychosocial determinants based on the RANAS-model of behavior change

Risk factor block	
Vulnerability	Generally, how high do you think is the chance that you get diarrhoea? *1=not at all high to 5=very high*
Severity	Imagine that you have diarrhoea, how severe would be the impact on your life? *1=not at all severe to 5=very severe*
Health knowledge	Could you please tell me for each of the following aspects whether it is a cause of diarrhoea or not? – e.g., Water contaminated by bacteria. *1=Yes; 2=No; 99=I don't know*
Attitudes factor block	
Feelings	How proud are you of your own latrine? *1=not at all proud to 5=very proud*
Beliefs about costs and benefits	How expensive is it to construct your own latrine? *1=not at all expensive to 5=very expensive*
Norm factor block	
Other's behaviour	How many of your relatives within your community constructed an own latrine? *1=(almost) nobody to 5=(almost) all*
Other's approval	How much do people who are important to you (e.g. family, parents, friends) approve that you construct a latrine? *1=approve not at all to 5=approve very much*

Abilities factor block	
How-to-do-knowledge	Which of the following features are necessary for a hygienic latrine? E.g., vent pipe. *1=Yes; 2=No; 99=I don't know*
Confidence in performance	How confident are you that you can construct a latrine even if this is difficult (e.g. gathering the materials)? *1=not at all confident to 5=very confident*
Confidence in continuation	How confident are you that you can finish the construction of a latrine even if problems arise (e.g. you run out of money)? *1=not at all confident to 5=very confident*
Confidence in recovering	Imagine that the latrine got damaged. How confident are you that you will be able to repair the latrine again? *1=not at all confident to 5=very confident*
Self-Regulation factor block	
Commitment	How committed are you to constructing your own latrine? *1=not at all committed to 5=very committed*
Action Planning	Do you have a plan how you will gather the materials for the latrine construction? *1=Yes;2=No*
Barrier Planning	Do you have a plan how you can construct a latrine if you are running out of materials? *1=Yes;2=No*

10.4. Study instruments

The RANAS questions formed the core of the instrument. Further scales and items were included to inform about the community level of the intervention effects. Those were for example a scale measuring the level of social identity. Additionally, items measuring demographics were included and in Ghana for the first follow-up survey, questions about the intervention implementation and perception were added (Figure 5 shows a typical interview situation in Cambodia). A short observational spot-check of the household's hygienic situation and the latrine formed the end of the questionnaire in all three countries. For the long-term follow-up in Ghana, a picture of the household latrine was taken and the cleanliness and status of latrine construction was recorded.

Figure 5: Household interview in Cambodia

Additionally, spot checks conducted by study supervisors on the sanitation situation of the community were included for all three countries. These community spot checks included items asking for the general cleanliness of the community and the availability of latrines. In Ghana it further recorded GPS locations of the site used for the CLTS triggering event.

The intervention implementation in Ghana was further accompanied by a monitoring questionnaire that assessed in weekly interviews the changes within a random selection of intervention communities.

10.5. Community and household selection

Cambodia. The communities in Cambodia were selected by the regional offices of Plan International according to the following criteria: CLTS had been implemented and the time elapsed did not exceed 6 months. A total of 30 intervention communities were selected in the two districts of Siem Reap and Tboung Khmum with 20 households on average, resulting in a sample of 600 households.

Mozambique. Four districts, with 6.8% of the sample being located in Meconta, 29.9% in Angoche, 32.4% in Monapo, and 30.9% in Mogovolas were selected. The local partner, Pathfinder International selected the districts and communities, because CLTS had been implemented not more than 6 months ago. Additionally to 26 communities, where CLTS had been facilitated, we included 6 control communities in the sample of Mozambique. In each community we interviewed 20 households on average (total sample size: 640 households).

Ghana. In Ghana, Global Communities decided to conduct the study in two districts of the Northern Region, because no sanitation campaign had been implemented there before. The two districts were Sawla-Tuna-Kalba and Bole districts. Within those two districts, governmental representatives and the study manager according to two criteria selected 134 communities: minimum community size of 25 households (cluster size) and accessibility by car or motorbike for logistical reasons. The selection resulted in 3216 households for the baseline survey. During the first follow-up 2704 and second follow-up 2609 households were interviewed again.

Household selection. In all three countries, selection of households within the communities was done following a method for random selection by the enumerators, which is referred to as the Random Route selection (Hoffmeyer-Zlotnik, 2003). The group of enumerators was divided and each enumerator sent to a different section of the community (see Figure 6). They were instructed to select every third household on their way and ask for permission to conduct an interview. If no one was at home or the household denied participating, the enumerator tried the next following household.

Figure 6: Team in Cambodia discussing with the village leader on the community structure

The selection criteria for participants were 1) they had to be at least 18 years old and 2) have resided within the community for more than 6 months. Men and women were equally

considered for the sample in Ghana, because both might contribute to the decision of latrine construction and CLTS explicitly targets the whole community. In Cambodia and Mozambique, mainly female participants were interviewed, because they are the main caretakers of the hygienic situation of the family and latrines had already been constructed in the afterwards of CLTS implementation.

For the longitudinal survey in Ghana, measures were taken for relocation of study households for both follow-up surveys. We asked respondents to provide us with their phone numbers if existent, assessed household head's names, nick names and recorded the area of the community where the house was located. We assigned a unique number to each household and this numbers were written on the wall of each house (see Figure 7).

Figure 7: Household ID given to each respondent (Ghana)

10.6. Conducting the survey

Every participant was informed about the study content and gave his or her consent to participate. No reimbursement was given to participants in Ghana and Mozambique. In Cambodia participants received a bar of soap for participation, what is the policy of the partnering NGO Pathfinder International. The interview lasted 60 minutes on average in all three countries and for all surveys. Items that used a Likert-type answer scale with five different answer options, a visual scale was used in Ghana for all three surveys (see Annex). The enumerator read the answer options to the respondent and simultaneously pointed them out on the scale. The respondent then selected one of the answer options.

10.7. Statistical analysis

Several statistical analysis were applied to measure outcome effects of CLTS. For Cambodia and Mozambique, Chi-Square tests showed group differences in latrine ownership between control group and intervention groups. For Mozambique, regression analysis revealed psychosocial factors of the RANAS factors that explained group differences of latrine owners to non-owners and people who reconstructed a damaged latrine to those who did not.

For Ghana, the size of the study project allowed multi-level analysis to account for the nested nature of the data: households within communities. Multi-level regression analysis were used to measure intervention effects. Additionally, mediation analysis of the effects of CLTS on latrine construction revealed, which psychosocial factors of the RANAS model were changed

by the CLTS intervention, and how those changes lead to latrine construction. Further, a moderation analysis was run to test, whether CLTS would be more effective in communities with higher social identity. Regression analysis further revealed which factors describing the implementation process of CLTS explained latrine coverage on community level.

10.8. Ethical considerations

Every participant in all three countries gave his or her consent to participate in the studies. Prior to this information was provided concerning the study purpose, the freedom to stop interviews, the confidentiality and privacy of the data. For study participants in Ghana, names and phone numbers were recorded in order to relocate study households for follow-up surveys. Every household was assigned a unique number and later names deleted from the dataset. Only the study manager had access to the file containing private information. The whole study design was presented to the Ethical Board of the University of Zurich and was approved. Additionally, the Ghana Health Service approved the RCT in Ghana (GHS- ERC 05/01/2016) and the Ministério de Saúde (Comité nacional de bioéetica para a saúde) approved the study in Mozambique (IRB00002657).

11. Intervention development and implementation in Ghana

Based on the RANAS approach, psychosocial factors were identified that explained differences in households that showed high intention to construct latrines, versus households with lower intentions. The usual doer/non-doer analysis was not possible to be applied because of the low rates of doers (i.e., latrine owners, 3%).

The results of the analyses are presented in the following Table 2. Additional activities were developed based on the baseline data and added to CLTS as implemented by the partnering NGO.

Table 2: RANAS factors targeted by different RANAS-based intervention activities and CLTS

Factors that showed to be different for households with high vs. low intention to construct a latrine.	***Expected to be targeted by CLTS***	***Additional household action planning***	***Additional public commitment***
Contextual factors			
Physical context		x	
Awareness of sanctions	x		
Communication about sanitation	x		
RANAS factors			
Health knowledge	x		
Severity	x		
Beliefs about costs and benefits	x		
Feelings			x
Other's behavior			x

Other's approval		x
Personal norms		x
Confidence in recovery	x	
Action planning	x	
Commitment	x	x

11.1. CLTS implementation in Ghana

Global Communities, the partnering NGO in Ghana, implemented four intervention activities that formed part of the CLTS canon. Those were the Open defecation mapping, Selection of natural leaders, Calculation of medical costs and Community action planning. After the triggering event, facilitators came back for regular follow-up visits and natural leaders were trained together in a central training on transmission of fecal bacteria and the necessity of latrines.

11.2. Household action planning

In addition to CLTS, the facilitators worked in teams of two and visited every household in the communities allocated to this intervention arm in the week after the triggering event. During their visits, a detailed household action plan was developed with the person responsible for latrine construction in each household. The facilitator supported the household member in choosing a latrine type, estimating the time needed for each step in construction, and considering which materials would be needed and who would be responsible of each step in construction. Both facilitators and household members signed the action plan. It also served as a monitoring tool for both facilitators and household members by which the progress of latrine construction was recorded. The plan was copied for the facilitator and one plan remained with the household.

Figure 8: Household action plan to construct a latrine

11.3. Public commitment

Public commitment involved participants stepping up in front of the community after the triggering event and showing their commitment to construct latrines. The facilitators were advised to praise the first volunteers as progressive and respected. The remaining community members clapped for those who committed publicly to constructing latrines. The commitment to construct a latrine was made visible by providing stickers to those who had promised to do so (Figure 10). The sticker was to be located where it would be visible to by-passers. After the latrine was constructed, owners received a white flag from the facilitators, which was hung on the latrine (Figure 9).

Figure 9: Flag provided to households with a completed latrine.

Figure 10: Sticker provided for households publicly committing to construct a latrine.

11.4. Intervention arms in the RCT in Ghana

Table 3 shows how the above described intervention activities were combined to different intervention arms in the RCT in Ghana. Four intervention arms were compared to one control arm. Each arm contained 25 communities with 25 households on average.

Table 3: Intervention arms implemented in the RCT in Ghana

Intervention arms	CLTS	RANAS 1	RANAS 2
CLTS only	CLTS		
CLTS + RANAS 1	CLTS	Public commitment	
CLTS + RANAS 2	CLTS		Household action planning
CLTS + RANAS 1&2	CLTS	Public commitment	Household action planning
Control arm	x	x	x

12. Results for the cross-sectional study in Cambodia

Sample Size	*N*= 625
Gender	97.4% female
Age	MN= 40 years (SD= 12)
Education	MN= 2.9 years (SD= 3.2)
Marital status	80% married 11.5% widowed
Religion	99.5% Buddhists
Household size Monthly income (USD)	MN= 5 (SD= 1.8) MN= 126 (SD= 142)

The implementation agency Plan International realized CLTS activities in all target communities of the two districts selected for the study. CLTS had been implemented 6 months prior the survey. The two study areas significantly differed when comparing open defecation rates: the percentage of latrine users in Tboung Khmum (59%) was less than in Siem Reap (75%), whereas the percentage of latrine users also practicing OD (= Mixed Users) was in both provinces comparable (14% and 11%).

Table 4 showes the figures for the target bevaviours separate for the two study districts and Figure 11 for the entire sample (*n*= 625).

***Table 4**: Outcomes for the two study districts in Cambodia*

	Tboung Khmum		**Siem Reap**	
	%	***n***	**%**	***n***
OD	27.0	*80*	14.1	*42*
Mixed Use	13.9	*41*	11.1	*33*
Latrine Use	58.8	*174*	74.8	*223*
Total	100.0	*296*	100.0	*298*

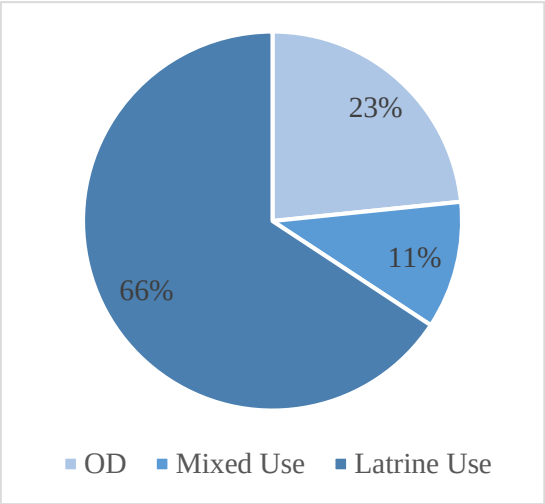


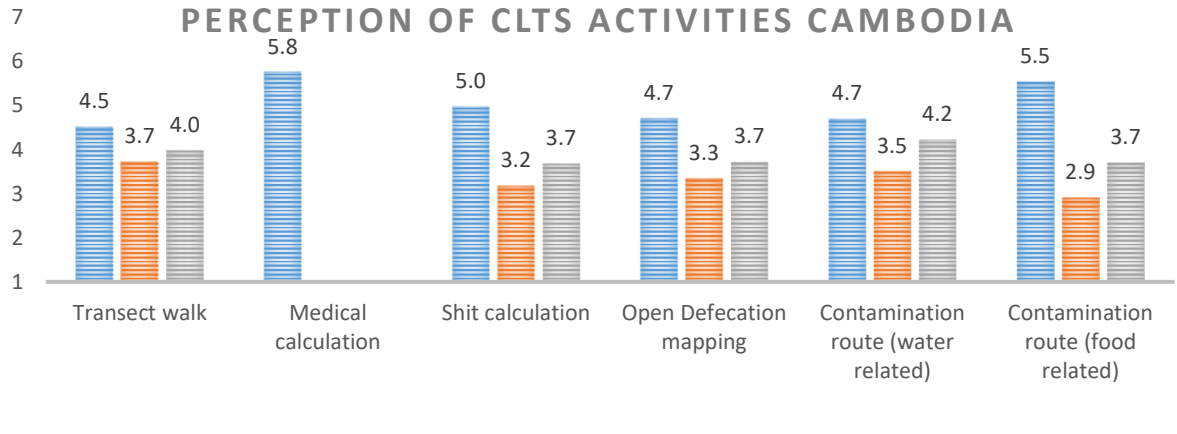
***Figure 11**: Cambodia behavioral outcome*

12.1. Participation in and perception of CLTS activities

In Cambodia, 57.3% (*n*= 358) of the study sample participated in CLTS events. Asked about what they remember from the triggering event, 56% of participants recalled the OD mapping, 12% shit calculations and 11% the glass of water activity.

***Figure 12**: Latrine pit components in Cambodia*

Concerning perception of participants of the different CLTS activities, the overall picture is positive. Activities were rated on three criteria: whether people liked the activity, whether the activity made them feel disgusted or ashamed. People liked the medical calculation most, followed by the demonstration of the food-related fecal-oral transmission route and the calculation of the amount of feces produced per community and household per year. People did not feel ashamed, but reported to having felt disgusted by the transect walk and the activity that showed the contamination of drinking water by fecal bacteria (see Figure 13). It is noteworthy, that the activity expected to not eliciting emotions, medical calculation, was liked most.



General means of the answers to the following questions:

- How much did you like or dislike this activity? (1= dislike very much – 7= like very much)
- Did it make you feel ashamed? (1= not at all to 5= very much)
- Did it make you feel disgusted? (1= not at all to 5= very much)

Figure 13: Perception of CLTS activities (liking, shame and disgust) in Cambodia

12.2. Time of CLTS implementation and effect on latrine construction

From the households owning latrines, 8.3% (n= 19) built their latrine in the last 6 months. Most of the latrine owners 71.5% (n= 309) had constructed their latrine more than 2 years ago. In the surveyed villages, CLTS was first implemented in 2011 and then implemented again in 2014. That means that the first implementation already had a great effect. The second implementation could increase the construction by 8.3%.

12.3. Perception of latrines in Cambodia

The respondents considered their latrine as quite accessible, even when it rains, or at night. The use was reported to be safe and convenient for women, old and very young members of the household (see Figure 14).

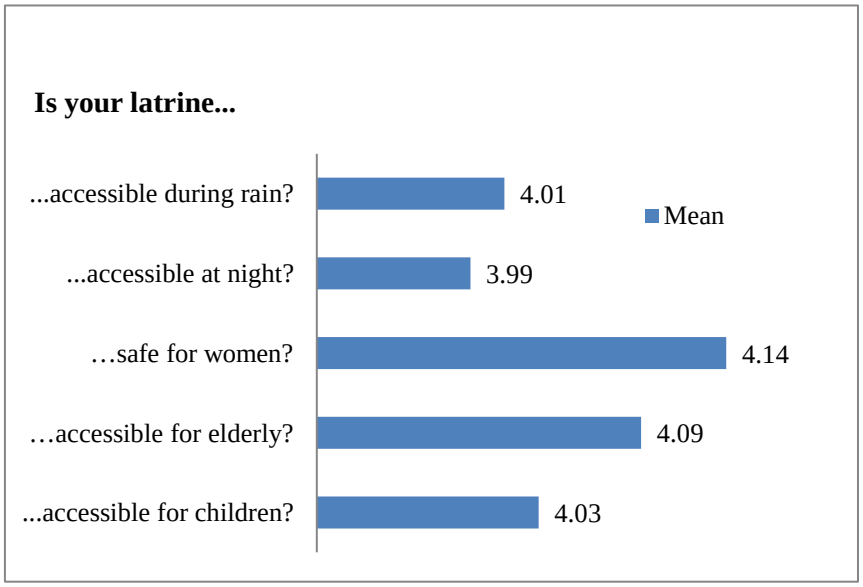


Figure 14: Latrine accessibility and perception in Cambodia

What we learnt from the CLTS-study in Cambodia: intervention communities are more likely to have higher latrine coverages. However, the implementation of CLTS in a second intervention phase is not as successful as might be expected. CLTS activities were perceived as positive, but did not strongly elicit shame and disgust (research question 1). People perceive their latrines as convenient.

13. Results from the cross-sectional study in Mozambique

Figure 15: Household latrine in Mozambique

Sample Size	*N*= 640
Gender	99.5% female
Age	MN= 34 years (SD= 13)
Education	MN= 2.3 years (SD= 2.5)
Marital status	85% cohabiting or married 4.1% widowed
Religion	43% Islam 49% Catholic
Household size	MN= 5 (SD= 1.9)
Monthly income (USD)	MN= 11.7 (SD= 19.8)

The data was collected in the northern region of Mozambique, namely in the rural communities of Nampula district. Two criteria were used for the selection of the communities: (1) only those communities where SCIP Nampula (a program implemented by Pathfinder International and partners, funded by USAID) had realized CLTS in the past 8 months were eligible and (2) communities should have comprised of more than 20 households. Of the communities meeting the two criteria, a list of 26 communities were selected randomly. In early 2015, heavy rains hit the north of Mozambique. The resultant floods destroyed 10,860 houses (Mozambique: Floods Emergency Appeal MDRMZ011 Final Report: International Federation of Red Cross and Red Crescent Societies, 2015). Before the rains, the northern district of Nampula was chosen for the survey. Several of the communities in the province to be surveyed had been declared as ODF. Two research articles were published using results from the survey in Mozambique. One analyzed the relationship between CLTS and latrine construction, the second consequently the relationship of CLTS with rebuilding of damaged latrines. The main findings are reported in the following.

13.1. Perception of CLTS activities in the sample in Mozambique

Compared to the CLTS participants in Cambodia, the perception of CLTS activities is slightly different in Mozambique (see Figure 16).

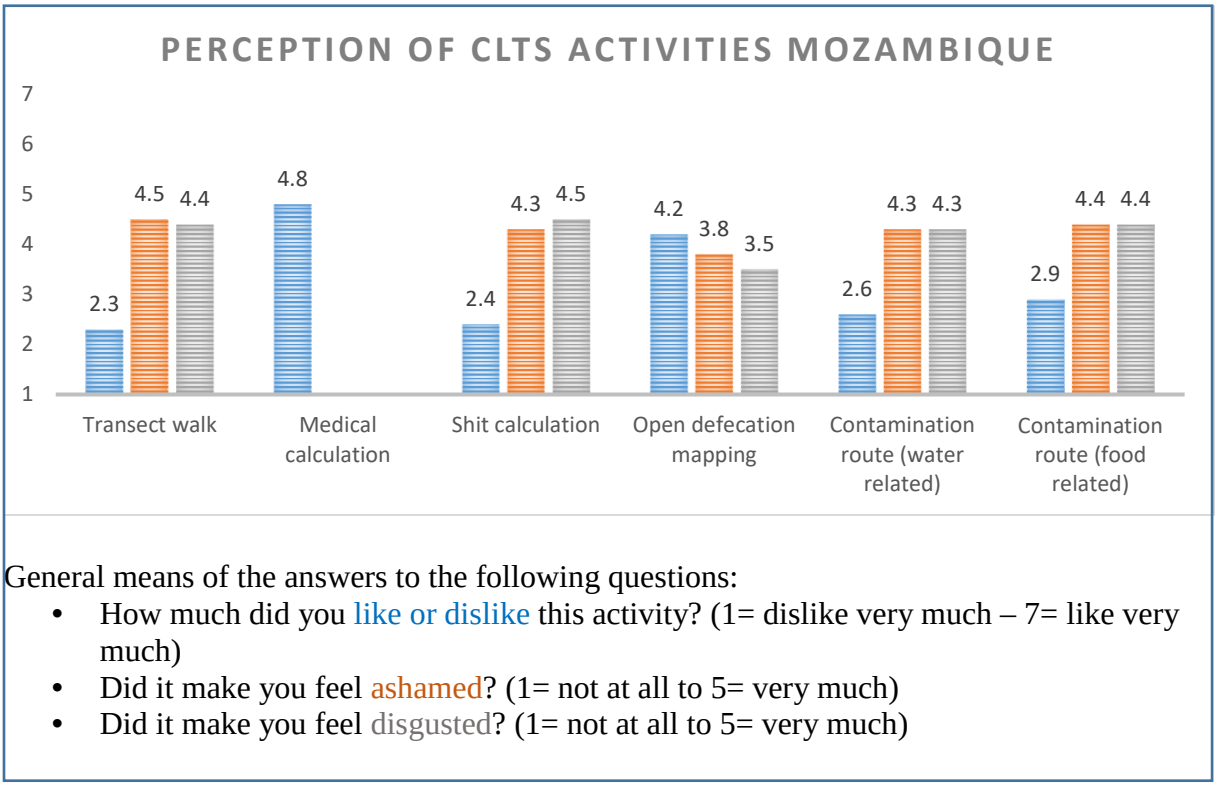


Figure 16: Perception of CLTS activities (liking, shame and disgust) in Mozambique

Compared to Cambodia, the CLTS intervention implemented in Mozambique leads to high shame and disgust and acceptance for several CLTS activities is rather low.

13.2. Latrine construction and participation in CLTS

The sample in Mozambique revealed that participation alone is not a necessary precondition for latrine construction, but receiving information about CLTS already motivates individuals to construct latrines without personally having participated in the triggering event (see Figure 17).

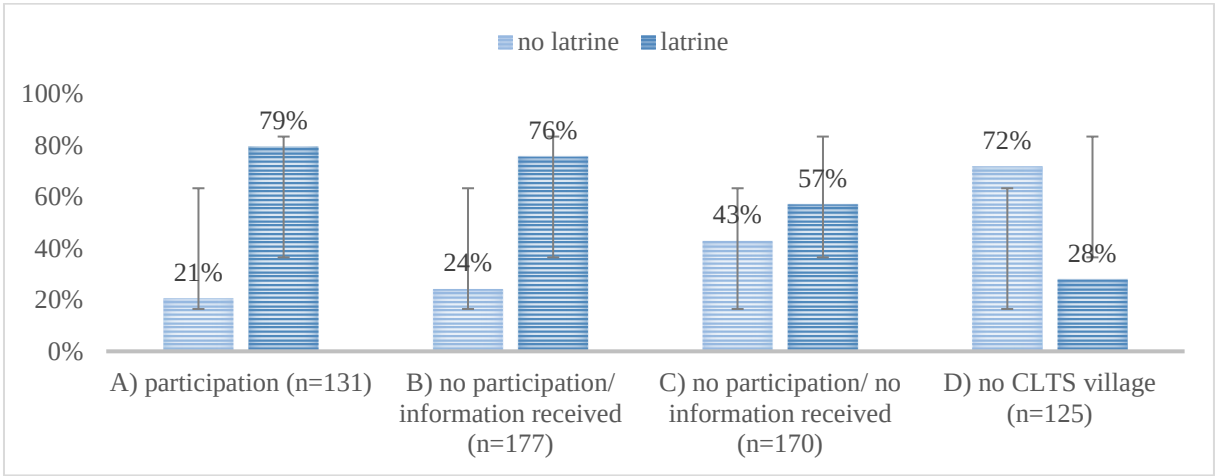


Figure 17: Mozambique: Participation in CLTS and latrine ownership

13.3. Rebuilding of latrines and participation in CLTS

Close to 50% of previous latrine owners had to face a collapse of their latrines due to the heavy floods in early 2015. Interestingly, not only does CLTS motivate people to construct latrines, but participation in CLTS also is positively related with rebuilding of once damaged latrines (Figure 19). Overall, 52% (n= 151) of damaged latrines were rebuilt and out of those who rebuilt their latrines, 64.8% had received information on CLTS. This difference showed to be statistically significant (χ^2 (1) = 17.995, p < .0005).

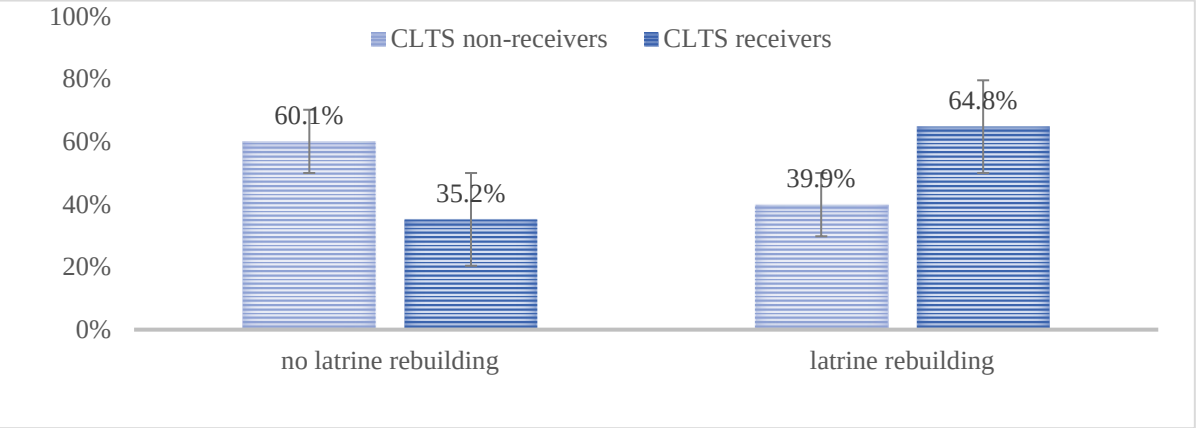


***Figure 19**: CLTS and rebuilding of damaged latrines in Mozambique*

13.4. Psychosocial factors explaining latrine ownership

Following the above-described RANAS model for behaviour change, psychosocial determinants were identified that were related to the probability of CLTS participants to construct latrines. In other words, we investigated, which psychosocial determinants mediate the intervention effect of CLTS on the probability to construct a latrine. However, the data from Mozambique only allowed to draw first correlative conclusions and no empirical evidence, because data was not assessed in a before-after control trial.

Figure 20: a collapsed latrine in Mozambique

In Mozambique the psychosocial determinants that were related with CLTS and latrine construction are displayed in Figure 21. CLTS participants showed higher values on factors describing the social context (social cohesion and inclusion), norm factors (other's behaviour and others' (dis) approval) and on ability factors (confidence in recovery) and those higher values were related to a higher probability of constructing a latrine. This means that CLTS participants felt more connected to their fellow community members, perceived more other community and family members to also own latrines and important others (e.g., community leaders) to approve of latrine construction. Participants also felt a stronger confidence in their ability to reconstruct a latrine in case of damage. On the other side, lower values compared to non-participants on vulnerability and the belief about costs and benefits were also negatively related to the probability of latrine construction. In the case of feeling vulnerable, the interpretation is more complex: participants felt less vulnerable, maybe because they also constructed latrines and now *are* indeed less vulnerable, because they use their own household latrine. Accordingly, *high* feelings of vulnerability was related to *low* probability of owning a latrine. Similarly, participants realized that the costs related to latrine construction are not as high as they might have expected, because they already had constructed latrines. Therefore, non-owners / non-participants have higher beliefs of costs of latrine construction.

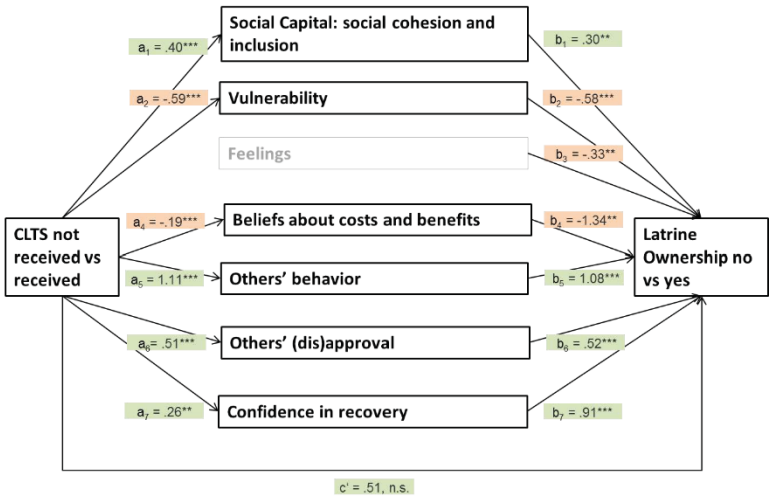


Figure 21: Mediation of intervention effects by psychosocial determinants of the RANAS model (Harter et al. 2018)

13.5. Psychosocial factors explaining latrine reconstruction

We further investigated the psychosocial determinants that are related with rebuilding of a collapsed household latrine. Again, this data is only correlative. Factors that were related to latrine *construction* (as presented above) were found to be very similar to those that were related to *rebuilding*. CLTS participants had higher values on social cohesion and inclusion, had lower perceptions of being vulnerable and perceived more other community members already owning a latrine. Higher values on social cohesion/ inclusion, lower values on vulnerability and higher values on other's behavior were positively related to the probabilty to rebuild latrines.

Figure 22: Interview situation in Mozambique

What we learned from the CLTS-study in Mozambique: CLTS is an intervention that is positively related to latrine construction and rebuilding. CLTS activities were perceived not as positive as in Cambodia and elicited rather strong negative feelings, shame and disgust (answer to research question 1). CLTS showed to not only successfully influence the decision of people who actually participate in a CLTS triggering event, but spreads it's information in intervention communities. It kicks off a process of change within target communities. Psychosocial determinants that mediated the intervention effects on latrine construction were identified. Those were social cohesion/inclusion, vulnerability, beliefs about costs and benefits, other's behaviour, other's approval, and confidence in recovery.

14. Results from the longitudinal, experimental study in Ghana

Figure 23: Household latrine in Ghana

Sample Size (baseline)	*N*= 3216
Gender	42.6% female
Age	MN= 42 years (SD= 17)
Education	MN= 2.7 years (SD= 4.5)
Marital status	54.2% married 6.7% widowed
Religion	48.8% Christianity 25% Islam 20% Traditional religions
Household size	MN= 9 (SD= 5.5)
Monthly income (USD)	MN= 42 (SD= 78)

In two districts of the Northern Region in Ghana, we implemented a cluster-randomized and controlled trial. This means that four different intervention arms were compared to a control arm and changes on the target measures were assessed before and after the intervention implementation (for the study design please consult Figure 4). Two follow-up surveys were conducted, one 4-6 months after intervention implementation and one 12-14 months after implementation. Global Communities, our partnering NGO, was responsible for the implementation of all 4 intervention arms (for intervention description please consult section 10). The trial included initially 3216 households in 134 communities. On average, each intervention arm consisted of 25 communities and 625 households distributed over the two districts. Communities were regionally clustered and clusters were randomly assigned to one of the four intervention arms. The sample flow diagram is presented in Figure 27. The trial answered empirically the above-described research questions 2 to 6. The before-after design allowed testing intervention effects, to further relate changes on psychological factors to CLTS, and accordingly relate the changes on psychological factors to CLTS outcomes. Thanks to the close collaboration with Global Communities the analysis of CLTS allowed the testing of implementation factors and their effect on latrine coverage. Finally, thanks to the size of this trial we were able to account for differences between and within communities statistically and use multi-level analysis that provide robust results. The following section first describes the study sample in more detail (13.1), before it reports on outcomes of CLTS in Ghana represented by different outcome measures. It then portrays the constructed latrines in the study area (13.2), describes CLTS implementation factors that were positively related to latrine coverage in communities (13.3), presents psychological factors that are responsible for the intervention

effect on the decision to construct latrines (13.4) and finally introduces a social contextual factor that moderated CLTS effects (13.5).

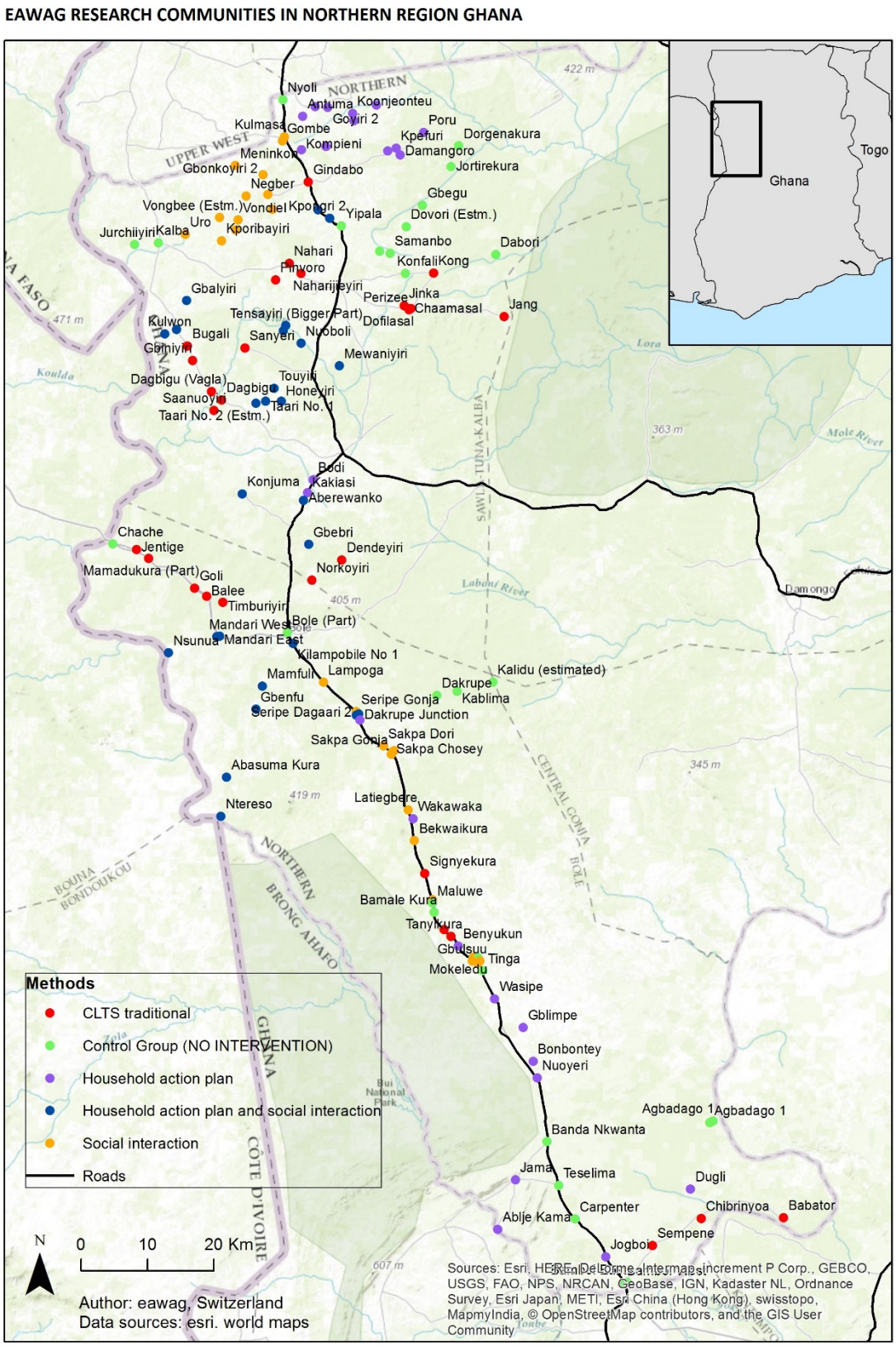


Figure 24: Study region in Ghana

14.1. Sample description

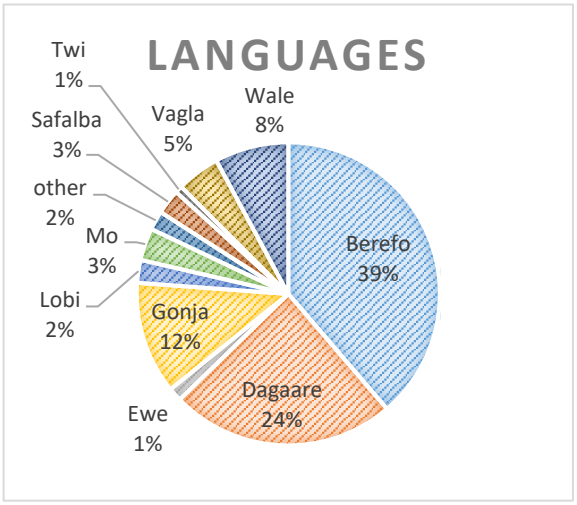


Figure 25: languages spoken in the study sample in Ghana

In 2015 for the baseline, 3126 households were interviewed, in 2016 for the first follow-up 2704 households could be interviewed a second time and in 2018 for the last follow-up 2607 households were interviewed.

The main language groups were Berefo and Dagaare, followed by Gonja (Figure 25). The majority of the sample (71%) used a borehole or tube well as their main water source (Figure 26).

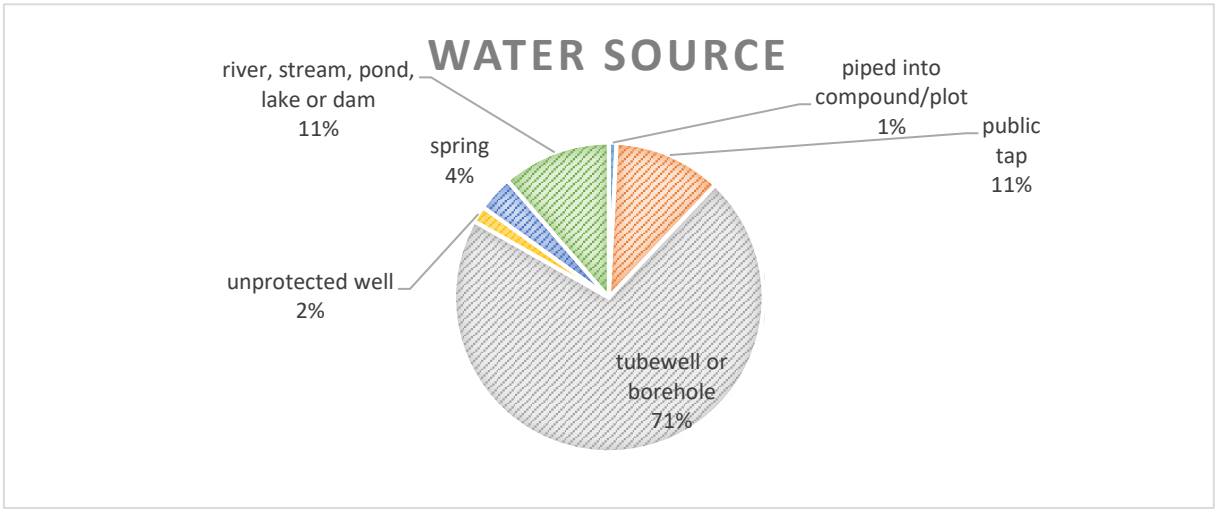


Figure 26: main water source used by the sample in Ghana

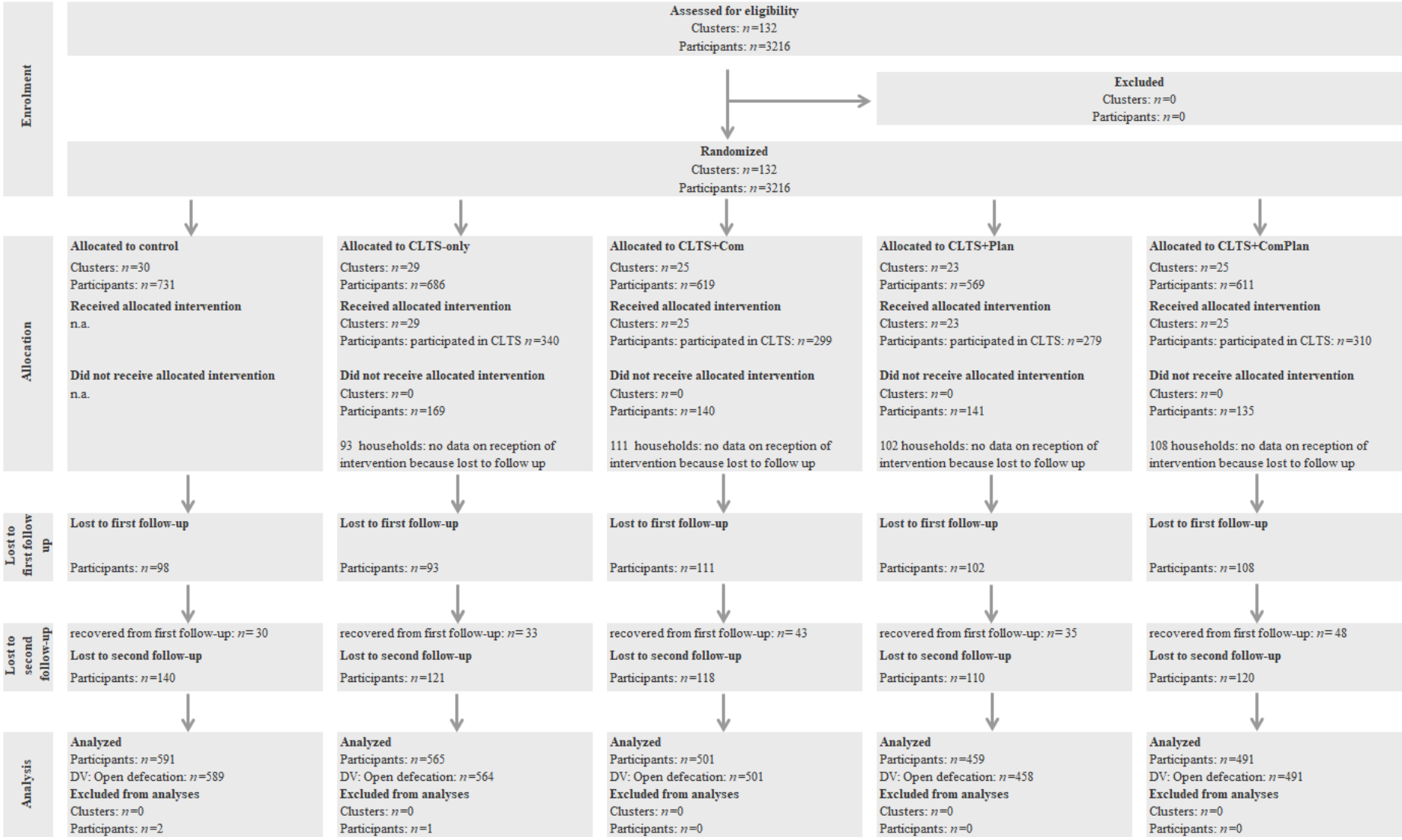


Figure 27: Sample flow diagram baseline to long-term follow-up

14.2. Effects of CLTS and CLTS + RANAS on different behavioral measures

Figure 28 gives an overview of the development in the intervention arms of different outcome measures from baseline (BL, *n*= 3216) over the first follow-up (ML, *n*= 2704) to the long-term follow-up (EL, *n*= 2609). The different intervention arms were all implemented between baseline and first follow-up survey.

The following sections answer research question 3: Does CLTS successfully provoke latrine construction and stop open defecation (compared to a control group)? and research question 5: Can CLTS be improved by combining it with evidence-based, behavioral change strategies based on the RANAS-model of behavior change?

Over all intervention arms, self-reported open defecation rates reduced from 94.4% in 2016 to 43.6% in 2018. Latrine ownership increased from 2.5% in intervention arms in 2016 to 70% in 2018. However, the outcome measure of latrine ownership is discussed in more detail in the following section.

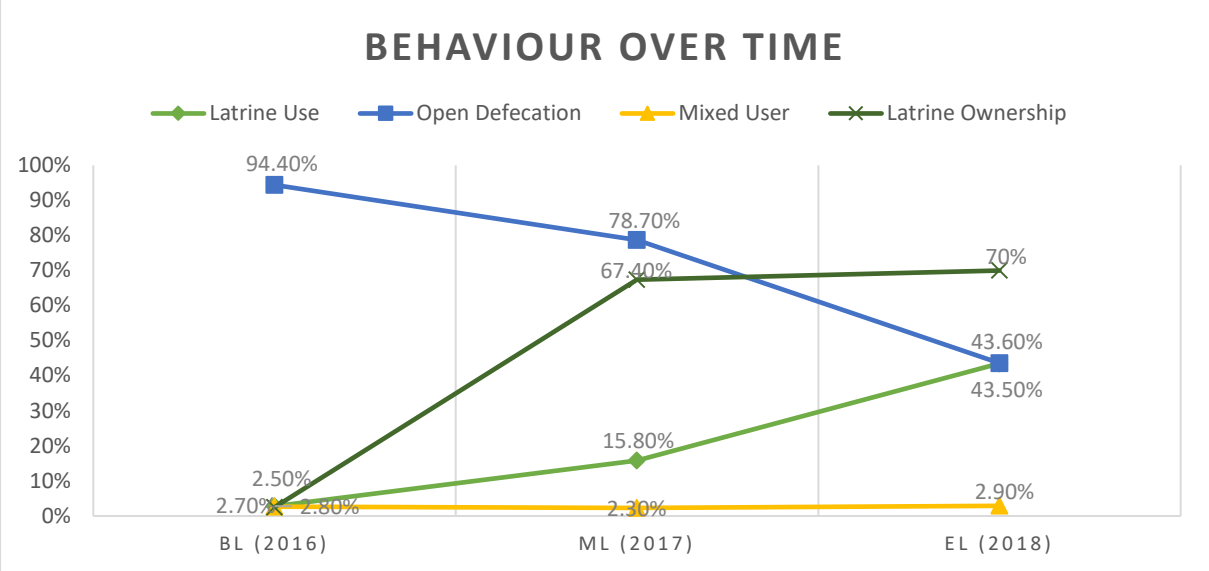


Figure 28: Development of behavior over time Ghana

Latrine construction.

In 2018, as presented above, 70% of households in the intervention arms (i.e., 1620 households) had started latrine construction. At the time of the final survey in March 2018, 42% of those latrines were still under construction. Until a latrine is finished and can be used, several steps need to be completed. Table 5 gives an overview of the number of latrines that reached the different levels of completion. It also shows that as soon as the latrine has a roof, more than 50% of the owners use it and if the latrine provides privacy (that means the user is protected

from outsider's views) 95% use the latrine. A vent pipe does not increase the use substantially, but rather is comparable to the level without vent pipe but with the protection of privacy.

Table 5: Different levels of latrine construction in the study sample of Ghana

Description of levels	Only pit	Pit + Super-structure	Pit + Super-structure + Roof	Pit + supers-tructure+ Roof+ Privacy	Pit+ Superstructure+ Roof+ Privacy+ Vent pipe
n=	*362*	*108*	*96*	*270*	*687*
Latrine use	5.2%	13.0%	53.1%	95.6%	94.3%

Figure 29 shows graphically the increase in the number of households that own and use their completed latrines from 35 cases in 2016 to 1007 cases in 2018. To finalize, the correlation of owning and using a latrine in the sample in Ghana is .97.

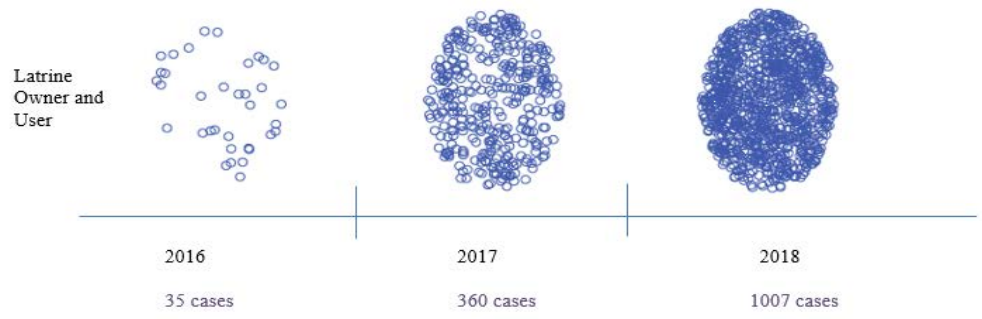


Figure 29: Increase in households that own and use a latrine over between 2016 and 2018

Comparing two districts.

Considering differences in latrine ownership, use and open defecation rates, the following picture shows that the two study districts performed differently. Open defecation rates were significantly lower in Sawla-Tuna-Kalba district and more people had started latrine construction, compared to Bole district (Figure 30).

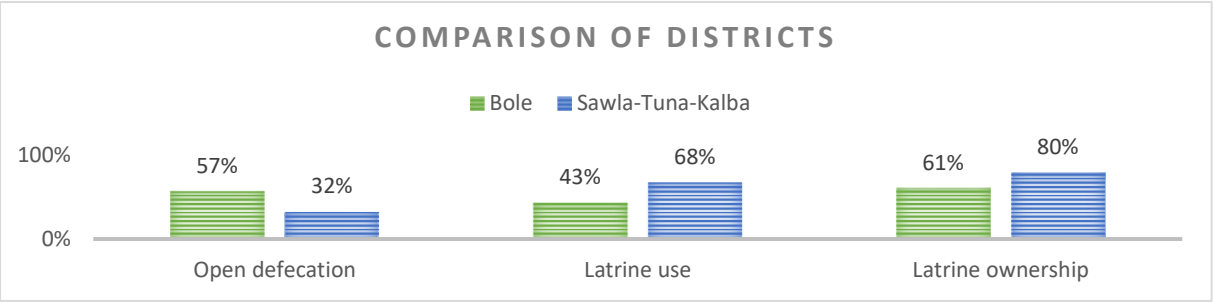


Figure 30: Behavioral outcomes in the two study districts in Ghana

Latrine coverage in communities.

The overall average of latrine coverage in intervention communities at the time of the long-term follow up is 70% that have either started latrine construction or finalized their latrine. However, as can be seen in Figure 31, latrine coverages vary strongly between intervention communities. Section 13.5 introduces one identified explanation of why communities respond so differently to CLTS interventions in the study sample in Ghana.

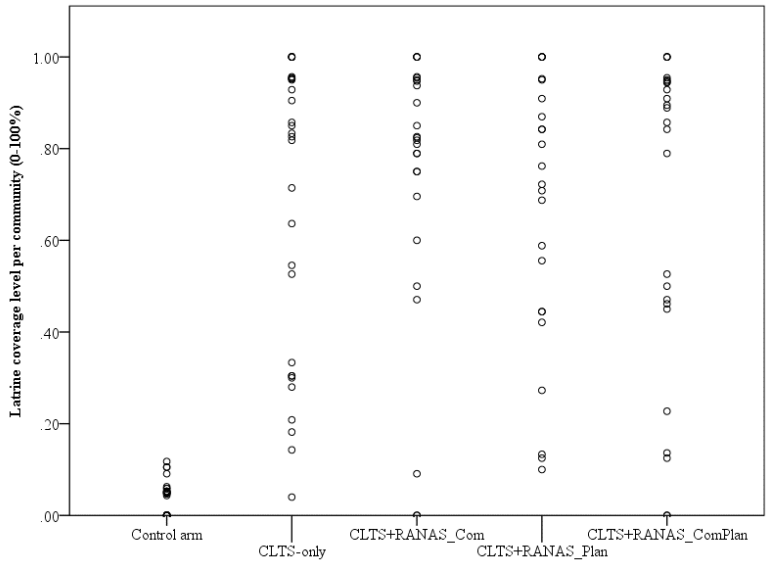


Figure 31: Variation of communities' responses to different interventions

Differences in intervention effects of CLTS compared to CLTS + RANAS interventions.

The great variance of intervention effects in the communities is the same for all four intervention arms. Moreover, the four intervention arms do not differ significantly on their effect in evoking latrine construction, as can be seen in Figure 32. The effect of CLTS and the combination of CLTS with RANAS-based interventions was tested in multilevel regression analysis and results are displayed in Table 6. It shows that CLTS and CLTS combined with any other intervention activity based on the RANAS-approach was successful in evoking latrine construction. CLTS combined with the household action plan and the public commitment

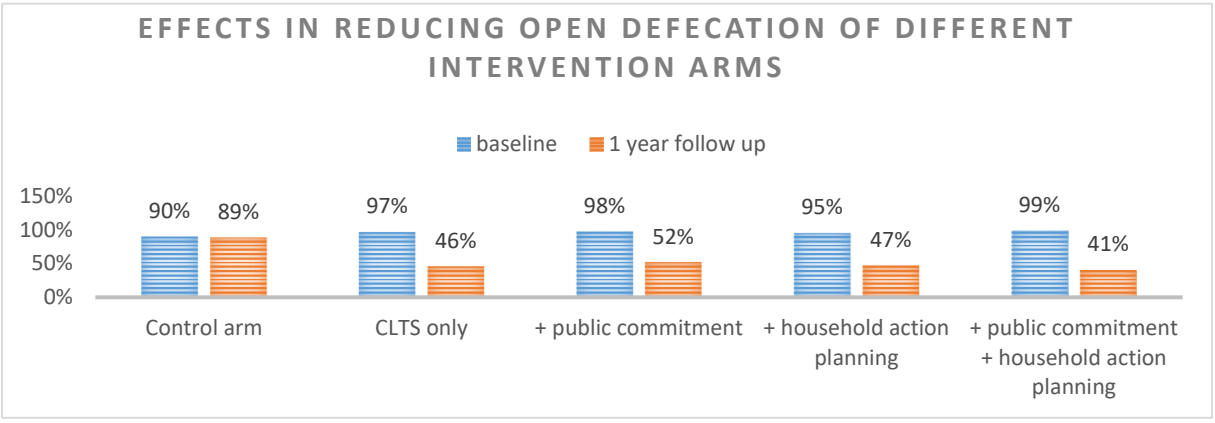


Figure 32:Intervention effects of CLTS and CLTS combined with different RANAS-based interventions in Ghana

achieved the lowest open defecation rates in target communities on average. However, this differences were statistically not significant due to the great variance between communities.

It is important to note, that in the RANAS-based interventions a considerable proportion of target households did not receive the interventions as intended: for the CLTS + public commitment intervention, 23% did not receive a sticker or a flag as planned by the intervention, 24% did not receive a household action plan and 22% did not receive sticker/flags and household action plans in the last intervention condition (see also Figure 27). This is why a more complete implementation would lead to further insights on whether the combination of CLTS with RANAS interventions that are theory-based and data-driven is more or less successful than CLTS alone.

Table 6: Parameter estimates for multilevel model of intervention effects on latrine construction

				CI_{95} for OR	
Fixed Effects (intercept, slopes)	B (SE)	p	OR	LL	UL
Intercept [a]	2.54 (1.26)	0.044	12.62	1.07	148.71
Effect of control arm compared to CLTS [b]	-3.83 *(0.42)*	<0.001	0.02	<0.01	0.05
CLTS+RANAS-Com [c]	0.27 (0.52)	0.597	1.31	0.48	3.60
CLTS+RANAS-Plan [d]	-0.02 (0.49)	0.964	0.98	0.38	2.54
CLTS+RANAS-ComPlan [e]	0.03 (0.55)	0.962	1.03	0.35	3.00
			CI_{95}		
	Estimate (SE)	p	LL	UL	
Random intercept [f]	2.76 (0.44)	0.000	2.02	3.77	
Residual variance [g]	1 (.)	.	.	.	

Note: N=2703, *B*= unstandardized regression coefficients. *CI* =Confidence interval. *OR* = Odds ratio. Probability distribution: binomial, link function: logit. All *p*-values are two-tailed. Outcome variable: Latrine construction 0=no latrine, 1=latrine (finished or under construction)

[a] Intercept: Probability for latrine construction at follow-up when CLTS was received

[b] CLTS: 0=CLTS arms, 1=control arm

[c] CLTS+RANAS-Com: 0=other arms, 1=CLTS plus RANAS-based public commitment

[d] CLTS+RANAS-Plan: 0=other arms, 1=CLTS plus RANAS-based household action planning

[e] CLTS+RANAS-ComPlan: 0=other arms, 1=CLTS plus RANAS-based public commitment + household action planning

[f] Random intercept: variation in latrine construction between communities

[g] Residual variance: variation in latrine construction between individuals per definition 1 (binomial distribution)

14.3. Factors enabling a successful CLTS implementation

Several factors that described the implementation process of CLTS in Ghana by Global Communities were compared against each other on their incremental effects on communities' latrine coverage to answer research question 2 (Which factors of the CLTS implementation process are most predictive for CLTS achievements in terms of community's latrine coverage?). For this analysis, 96 communities were considered. The factors that were entered in the analysis

were the time elapsed between the triggering event and the follow-up survey (first follow-up), the proportion of community members that participated in CLTS events, the number of selected local community leaders, whether people expected an incentive in turn of constructing latrines, how much participants felt convinced and motivated by the triggering event to construct a latrine, how much they felt ashamed and disgusted by CLTS activities, how much they liked the facilitators and the number of reported follow-up visits. Results of this comparison are presented in Table 7.

Table 7: Results of linear regression of implementation factors on community latrine coverage

	Unstandardized Coefficients		Standardized Coefficients		95% Confidence Interval for B	
Variables in the model	B	Std. Error	Beta	Sig.	Lower Bound	Upper Bound
(Constant)	-20.93	53.07		.694	-126.44	84.58
time since triggering	-1.96	1.13	-0.14	.086	-4.21	0.29
attendance at meeting	0.43	0.20	0.20	.035	0.03	0.83
number of natural leaders	2.50	0.90	0.21	.007	0.71	4.28
incentive promised	0.47	0.12	0.38	.000	0.24	0.70
convinced and motivated	5.55	10.80	0.05	.609	-15.93	27.02
ashamed and disgusted	-1.99	5.38	-0.03	.712	-12.70	8.71
liking facilitators	-4.44	8.65	-0.04	.609	-21.63	12.75
number of follow-up visits	11.74	3.27	0.37	.001	5.24	18.25

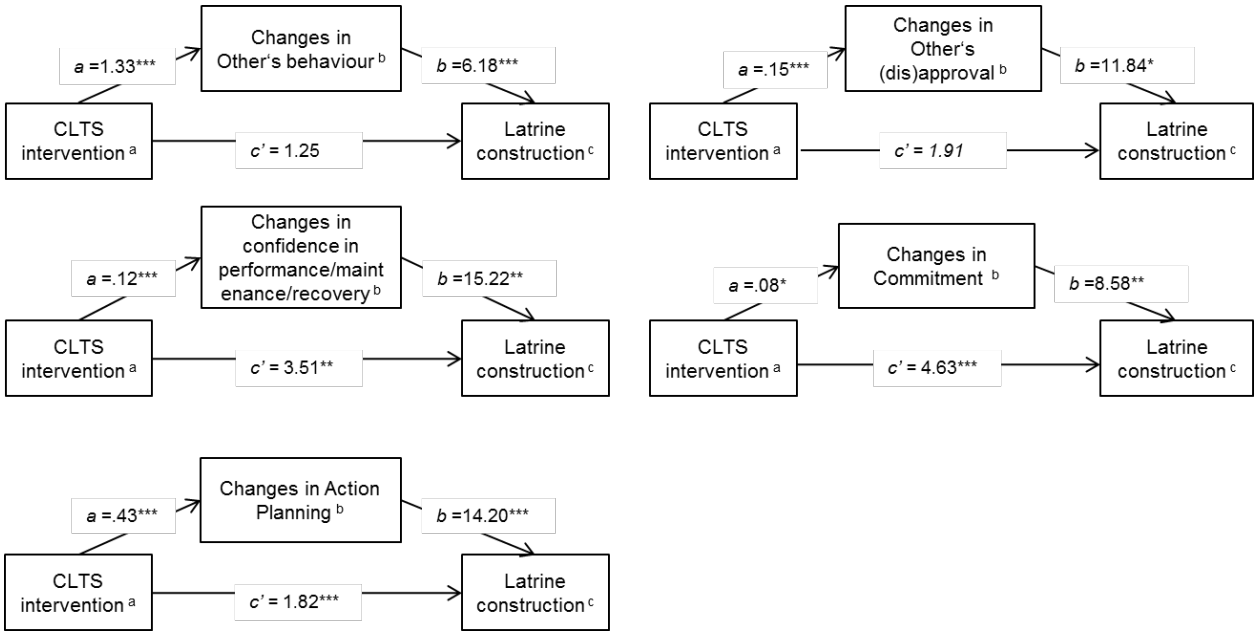
Note: R^2 = .512; (ps < .000). Confidence intervals are 95% bias corrected and accelerated. Confidence intervals and standard errors based on 1000 bootstrap samples.

The results show that the higher the proportion of community attendance at the triggering event, the more natural leaders are selected the higher are latrine coverages in intervention communities. Further, if participants expected an incentive for latrine construction, latrine coverage was higher as well as with more follow-up visits by CLTS facilitators. On the other hand, the time people had to construct latrine did not explain latrine coverage, as well as whether participants perceived the triggering event as motivating and convincing. The same accounts for the liking of facilitators. Overall, facilitators were liked very much and the triggering event was perceived very positive. Negative feelings did also not explain latrine coverage. However, Global Communities did not select CLTS activities that are supposed to elicit those strong feelings. Which is in line with the assumed cultural impropriety of many of those activities as also noted by Bateman and Engel (2018) and Engel and Susilo (2014).

14.4. Psychosocial factors explaining CLTS intervention effects

In response to research question 4 (What are the mechanisms that lead CLTS to success? In terms of psychological determinants and potential moderating factors?), mediation models tested the effects of CLTS participation on psychosocial determinants based on the RANAS

model and how those changes on psychosocial determinants related to behavior change (Mosler, 2012). The results of the multilevel mediation analyses are displayed graphically in Figure 33. It revealed that CLTS was able to increase the participants perception of social norms: they perceived more other's constructing latrines and also approving of it. Further CLTS increased people's confidence in their abilities to construct, maintain and recover latrines. People also showed higher planning abilities for latrine construction. Lastly, participants felt committed to construct latrines. Those positive changes were also significantly related to higher probabilities to construct a latrine, thus mediating the intervention effect. This analysis showed that changes on psychological determinants based on the RANAS-model were able to explain CLTS intervention effects.



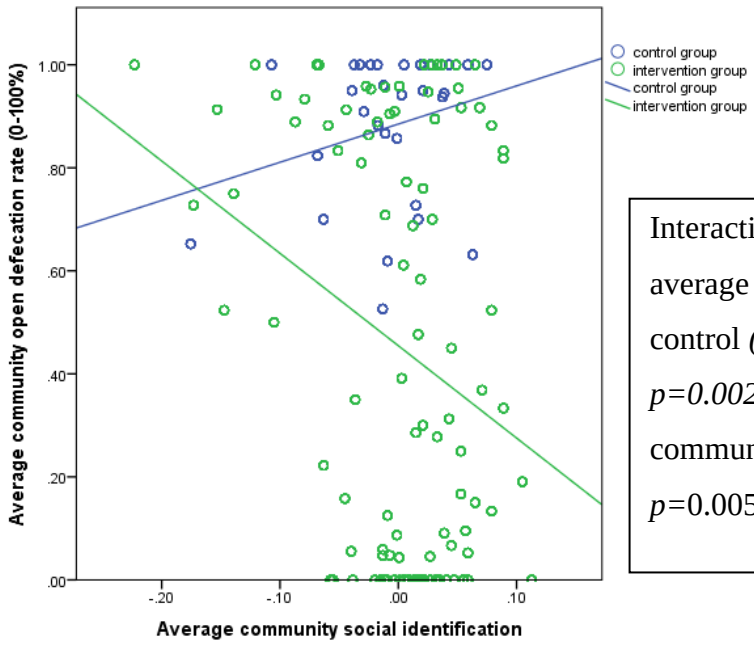
[a] CLTS intervention 0=control arm, 1=all interventions with CLTS
[b] Changes on the mediator (follow up-baseline), range -1 to 1
[c] Latrine construction was coded 0=no latrine, 1=latrine (finished or under construction)
Significance levels: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Figure 33: Single-mediation models of the intervention effect on latrine construction mediated by changes on RANAS-based psychosocial determinants

14.5. Social contextual factors explaining differences in CLTS responses

The analysis of intervention effects in research communities in Ghana showed great variances between communities' responses to CLTS. The RANAS model suggests to investigate factors that describe the context of the intervention to explain moderating effects, thus explain for which parts of the target population the intervention is most effective (research question 6: Which characteristics are a fertile ground so that CLTS most effective in stopping open defecation?). Previous research has shown that CLTS is most effective for example, if the initial

level of social capital is higher, as people are more likely to use sanctions to make non-compliers follow the collective goals (Cameron et al., 2015). A similar concept was tested here: social identity. We tested whether CLTS was more successful in communities where individuals felt stronger social identification with their community. This interaction effect was found to be significant and is graphically presented in Figure 34. This means that CLTS was more successful in stopping open defecation in communities, where people felt strongly belonging to this community and felt happy to be part of it. The assumed mechanism is that people rather follow a newly established social norm, such as to stop open defecation, if they feel more strongly associated with their community and acceptance of other community members is very important to them.



Interaction effect of community's average social identification in control *(B(SE)=0.25(0.24), p=0.002)* and CLTS intervention communities *(B(SE)*=-11.7 (4.15), *p*=0.005*)*.

Note: Reported average community open defecation rate: open defecation (coded = 1) vs. no open defecation (coded = 0) aggregated at community level.

Figure 34: Intervention effects on average community open defecation rate depending on community's average social identity

What we learnt from the longitudinal and experimental study on CLTS in Ghana is that CLTS compared to a control group is very powerful to evoke latrine construction and stop open defecation in target communities. Indeed, intervention communities are 11 times less likely to practice open defecation. The addition of RANAS-based theory-driven intervention activities did not significantly increase intervention effects. However, there remain doubts in intervention fidelity of the RANAS-based interventions and final conclusions can not be drawn about their additional effects. Multilevel analysis revealed high variances in communities' responses on CLTS interventions and this variance was explained by the social identification of communities prior to CLTS intervention. This points to the importance of the social context of the community for the success of CLTS. The investigation of the implementation process of CLTS revealed four factors especially defining the effectiveness on community latrine coverage. Those were: the attendance rate of the community at the triggering event, the number of selected natural leaders, whether participants perceived they will receive an incentive after having constructed a latrine and the number of follow-up visits provided by facilitators in the weeks after CLTS triggering. Finally, psychosocial determinants were identified that were able to explain intervention effects on latrine construction. Those were social norms, confidence in constructing and maintaining a latrine and the commitment to construct a latrine.

Figure 35: Household latrine with hand-washing station in Ghana

15. Relation of latrine coverage and open defecation rates in the three study areas

The ownership of a household latrine has been discussed as being no reliable predictor for stopping open defecation in CLTS literature (USAID, 2018). In the three samples that formed the bases of this study the correlation of owning a completed latrine and defecating in the open is strongly negative. For Ghana correlation is r^2= -0.93, for Mozambique r^2= -0.97 and for Cambodia r^2= -0.92. The relationship between latrine coverage of communities and their open defecation rate on community level is depicted in Figure 36. For Ghana, it remains apparent, that some communities have high latrine coverages, but still open defecation rates remain high. The reason why those communities do not use their completed latrines should be further investigated. It must be noted however, that all data used for this graph is self-reported. Moreover, answers could be biased through social desirability. In the case of Ghana, observational data which was used to validate latrine ownership highly correlated with self-reported latrine ownership (r^2=0.94).

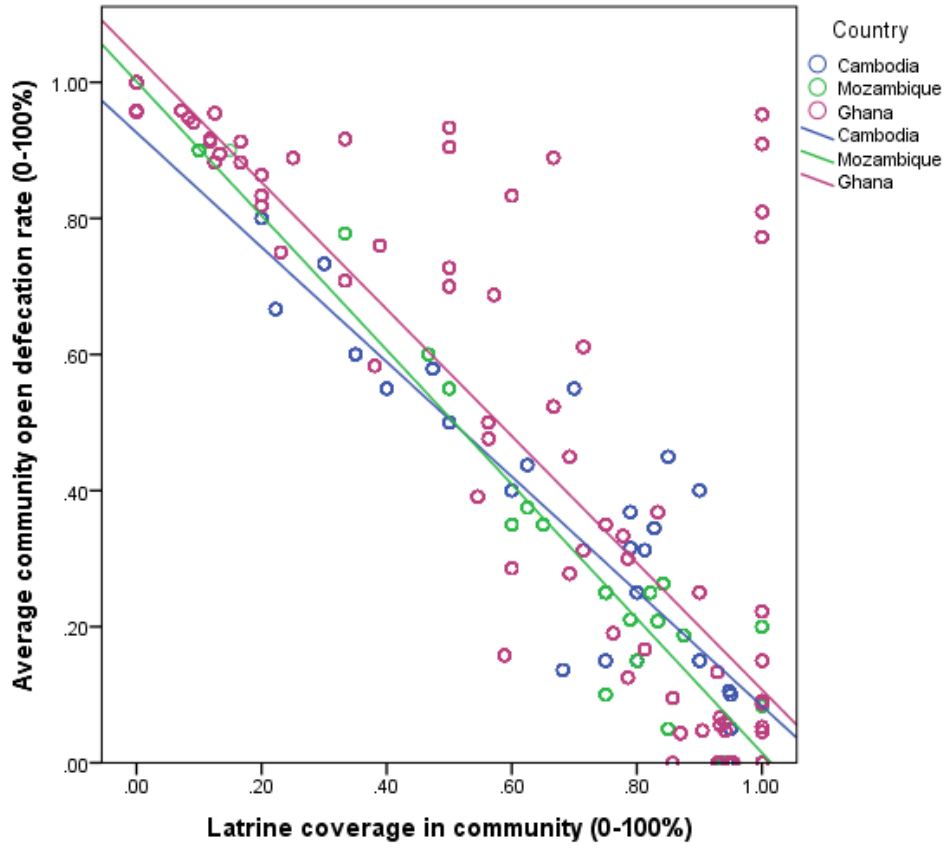


Figure 36: Relationship of latrine coverage and open defecation rate in communities of Ghana, Cambodia and Mozambique

16. Overview of study results

Figure 36 gives an overview of all study results presented in this report. Evidence from Cambodia and Mozambique is only correlative, as both studies were cross-sectional. Experimental evidence on CLTS was gained through the randomized-controlled trial in Ghana. Figure 36 still includes all study results. The figure only provides an overview, as not all components were found to be relevant in the same analysis and are not related to the same behaviors.

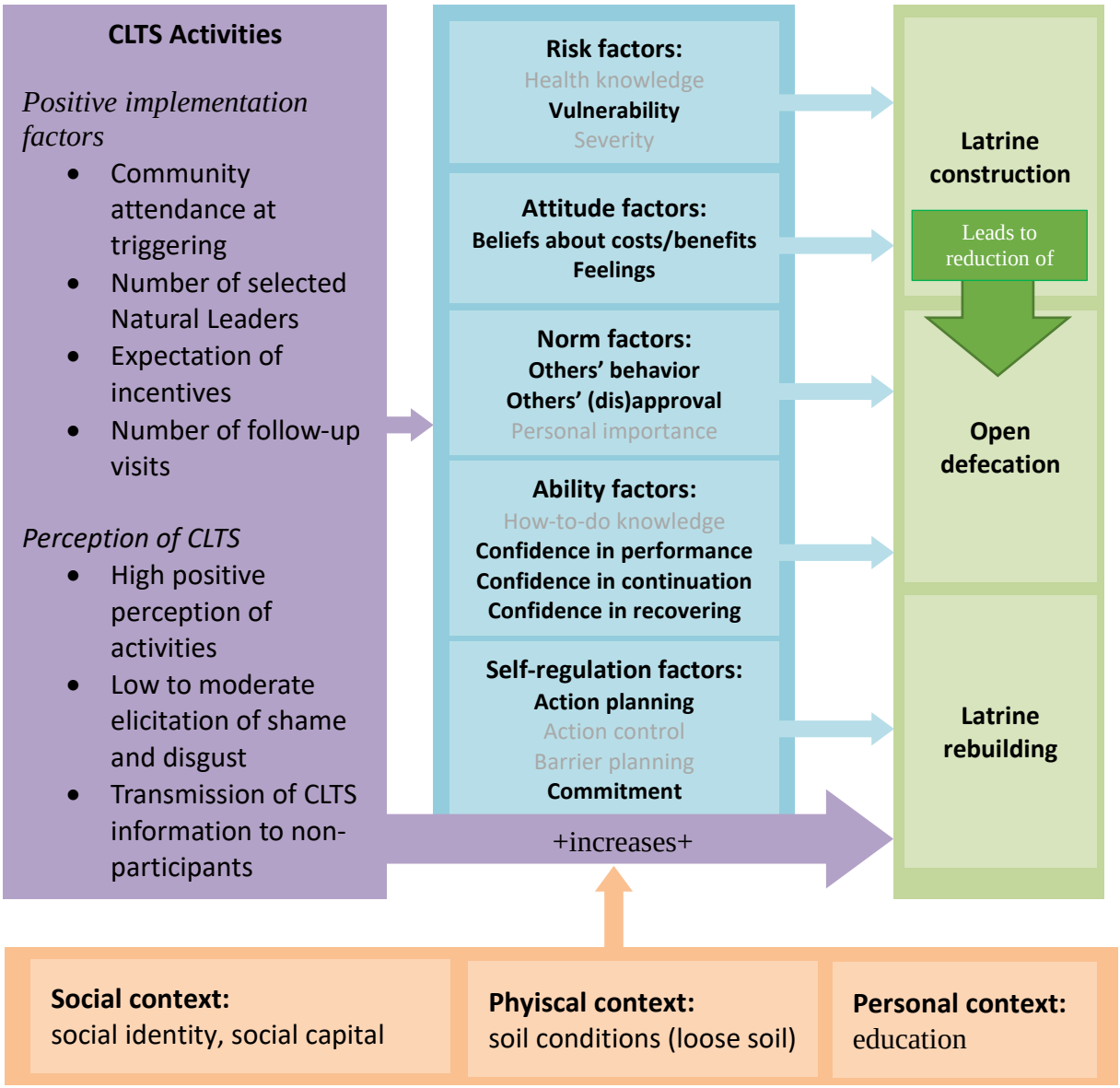


Figure 37: Overview of study results from Cambodia, Mozambique and Ghana

17. Discussion and recommendations

Overall, the results strongly corroborate the effectiveness of CLTS on evoking latrine construction and the eradication of open defecation in all three study areas in Cambodia, Mozambique and Ghana. Participants were not only more likely to construct latrines, but also rebuild them in case of damage in Mozambique. In all three samples, the relation between owning a latrine and stopping open defecation was very high. Providing evidence that CLTS is an effective measure for health improvements as reduced open defecation is expected to reduce diarrheal diseases (Prüss-Üstün et al., 2016; Wolf et al., 2018). The focus on latrine construction as the step towards achieving open defecation free communities is justified and should be implemented continuously. The remaining group of people who started latrine construction but did not finish should be considered as well as those who did not start at all. Characteristics of those should be investigated and additional support provided to foster confidence in performance, for example by planning for steps of latrine construction.

The consistent use of the constructed latrines points to the change in people's mindsets as assumed by the RANAS model. All three studies reported changes in social norms as being relevant for latrine construction. This is in line with previous discussions on the important role of evoking a shift in social norms that guides people towards stopping open defecation (Dooley et al., 2016). Moreover, changes in the confidence to construct, maintain and recover latrines was an overarching scheme that showed to explain the decision for latrine construction in all three countries. CLTS therefore is able to make people feel confident in their abilities for latrine construction.

Implications on the role of communities for CLTS and the influence of CLTS on the social structure of communities was gained through the studies presented here. First, the results showed that high attendance rates during triggering events is leading to better outcomes. This points into the direction, that CLTS leads to communication on sanitation related information as participants spread CLTS-related information. This made other non-participants also construct latrines. CLTS showed to kick off a social process and its effects showed to be positively related to social cohesion in communities in Mozambique. In Ghana, CLTS was shown to be more effective in stopping open defecation in communities where people feel highly belonging and related to their community. This leads to the recommendation to pay attention to social conditions of communities. As recommended by the CLTS Handbook, facilitators might first want to focus on those communities that are highly cohesive before triggering other communities. Additionally, they might want to first strengthen cohesion and

trust amongst community members, before implementing CLTS. For example, by enabling communication and establishing structures for social support.

Other contextual factors showed to be relevant for the success of CLTS. In Mozambique, soil conditions hindered latrine construction and the risk of flooding made people lose their commitment to reconstruct their collapsed latrines. The sample in Mozambique further showed a relation of education on the probability to own a latrine. Higher educated participants were more likely to construct latrines. This means that for CLTS to be more successful, focusing on inhabitants that are more educated might be a first step in order to start the process. Facilitators should involve such individuals and if possible enroll them as natural leaders for example. Households should be rewarded for their commitment to start latrine construction, for example by providing stickers, as was done in the RCT in Ghana. An increase in commitment was one of the driving factors of CLTS for achieving latrine construction.

In contrast to the concept of CLTS, shame and disgust do not seem to play a vital role for the success of the intervention. People like activities more if they do not elicit strong negative feelings and latrine coverage was explained by other factors than the elicitation of negative feelings. However, facilitators might also tend to avoid activities that evoke such feelings as this might be seen as culturally impropriate. Instead of focusing on activities eliciting strong negative feelings, facilitators should focus on the shift of social norms from open defecation to latrine use, use activities to strengthen communication amongst community members, enroll natural leaders and use them for social support during the follow-up process of CLTS. Additionally, frequent visits that help people strengthen their confidence in construction and maintenance as well as plan every step of latrine construction is recommended strongly by the findings of this study. Facilitators and community leaders should focus on positive feelings, such as pride and respect to make people aware of other benefits than health benefits of an open defecation free community. Finally, people were more likely to construct latrines, if they perceived to receive an incentive for it. The cautious provision of incentives and subsidies might be a powerful way of improving CLTS, but should be handled thoughtfully and not raise unrealistic expectations.

To conclude, CLTS is powerful when implemented carefully, depending on the social conditions in target communities. Focus should be set – amongst others- on social norms, follow-up visits and strengthening people's confidence in their own performance by enrolling natural leaders, who serve as multipliers of CLTS information within communities.

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