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RESEARCH ARTICLE

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Community-Led Total Sanitation implementation in Malawi: process evaluation of a sanitation and hygiene intervention

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ABSTRACT

Community-Led Total Sanitation (CLTS) seeks to eliminate open defecation by empowering households to adopt improved sanitation and hygiene behaviours. While widely integrated into national sanitation strategies of low- and middle-income countries, limited evidence exists on how implementation processes drive behaviour change. This study aimed to evaluate the implementation fidelity, reach, dose, adaptation, and mechanisms of impact of a CLTS intervention in Chiradzulu District, Malawi. We conducted a retrospective mixed methods process evaluation between January 2022 and February 2023, using 1,151 household surveys, 36 in-depth interviews, and 28 focus group discussions with community members and implementers. Outcomes assessed were latrine and handwashing facility (HWF) availability, with logistic regression used to explore associations with intervention exposure. All planned activities were delivered, but fidelity was variable ranging from low fidelity for training delivery to high fidelity for household engagement. Intervention reach was suboptimal, with limited household contact and low recall of hygiene campaigns. Combined exposure to both community and household-based activities significantly increased odds of latrine ownership (OR = 1.63, CI = 1.55–1.72) and HWF presence (OR = 1.39, CI = 1.03–1.86). CLTS programmes should strengthen intervention fidelity, integrate affordable climate resilient facilities, and strengthen household-based engagement to enhance sustainability and impact.

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Community-Led Total Sanitation (CLTS); process evaluation; water, sanitation, and hygiene (WASH); open defecation; Malawi

Introduction

Access to improved water, sanitation, and hygiene (WASH) is integral for public health (Mara et al., 2010) and a human right (WHO, 2021). Despite progress, a significant proportion of the global population does not have access to the necessary services to practice safe WASH-related behaviours (WHO & UNICEF, 2022, 2023). About 419 million practise open defecation (OD), and two billion lack access to basic hygiene services globally (WHO & UNICEF, 2023). The WHO/UNICEF Joint Monitoring Programme (JMP) estimates that in Malawi in 2024, 1.9% of the population engaged in open defecation, 22.1% had access to unimproved sanitation facilities, and 84.6% of households lacked access to basic hygiene services (WHO/UNICEF, 2024). To accelerate the progress needed to attain Sustainable Development Goal (SDG) 6 to 'ensure availability and sustainable management of water and sanitation for all' (United Nations, 2022), resources must be allocated to essential infrastructure, in combination with effective mechanisms to drive behaviour change (Andres et al., 2018; McMichael & Robinson, 2016).

One approach purported to support rapid and transformative change in rural sanitation is Community Led Total Sanitation (CLTS). CLTS has been adopted in governmental policy in many countries, including

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Table 1. Stages of Community-Led Total Sanitation (CLTS) and their intended outcomes, as applied in the WASH for everyone project, Chiradzulu District, Malawi (2022–2023).

Stage	Description	Intended outcomes
Pre-triggering	Preparatory activities: community entry, rapport building, facilitator selection, situational assessment	Build trust, ensure readiness for collective action
Triggering	Participatory exercises to highlight the health risks and social unacceptability of open defecation	Community-wide commitment to stop open defecation
Post-triggering	Follow-up visits, reinforcement, and monitoring of progress	Sustained latrine use, improved hygiene practices

Malawi (Malawi Government, 2011, 2018a). CLTS requires active community participation to eradicate OD practice and promote hygiene in rural areas (Kar & Chambers, 2008; Zuin et al., 2019) through three key stages: (1) pre-triggering, which entails preparatory tasks like community entry, rapport-building, and facilitator and community selection with the goal of fostering an atmosphere that is conducive to collective action; (2) triggering, which includes activities that make people feel ashamed and disgusted about OD practices, with the goal of getting the community to commit to change right away; and (3) post-triggering, which aims to maintain latrine construction, consistent usage, and hygiene practices through follow-up visits, monitoring, and reinforcement of behaviour change (Table 1). During this process, natural leaders, motivated and respected community members who emerge spontaneously during the triggering stage, play a vital role in sustaining momentum and mobilising others toward improved sanitation practices. The main goal of these efforts is to make the community Open Defecation Free (ODF), which means that every household has, and uses, sanitation facilities all the time and no one practices OD.

The effectiveness of the CLTS approach has generally been mixed (Zuin et al., 2019). Several CLTS studies have reported improvements in latrine coverage, sanitation use, and enteric infections following CLTS interventions (Cameron et al., 2019; Garn et al., 2017). On the contrary, other assessments and trials show no observable changes in latrine ownership or usage during CLTS implementation, and no significant child health outcomes (Cameron et al., 2019; Crocker et al., 2016; Pickering et al., 2015).

Independent assessments conducted in Asia and Africa have shown that ODF conditions can persist for multiple years after verification, though slippage, a return to open defecation, is typically noticed within two to three years (Cameron et al., 2019; Garn et al., 2017; Pickering et al., 2015; Venkataramanan et al., 2018). However, in Malawi, data on sustainability of CLTS interventions is less promising. Hinton et al., (2024) noted that in two districts designated as ODF in 2018, 17% of households returned to OD within one year, with faeces detected in approximately 10% of households. Community social capital, size, socio-economic status, capacity of natural leaders, infrequent follow-ups, and rains (Cameron et al., 2019; Harter et al., 2020; Hinton et al., 2023; Kapatuka, 2013; Kennedy & Meek, 2013; Stuart et al., 2021) have all been linked with poor sustainability of CLTS interventions.

Intervention fidelity and the implementation process have received less attention in both the short and long-term outcomes of CLTS interventions (Venkataramanan et al., 2018). Since the introduction of CLTS, most research has examined long-term outcomes without exploring the integrity of the implementation process. More evidence is needed to understand the delivery process and how these may affect CLTS.

This study describes a retrospective process evaluation of a 'WASH for Everyone' (W4E) intervention, which implemented CLTS in Chiradzulu district, Malawi. This multi-year programme targeted two administrative areas known as Traditional Authorities (TAs): TA Likoswe and TA Mpama during the first year of implementation. Our process evaluation specifically focuses on these two TAs where the W4E programme was initiated, providing an opportunity for early assessment of programme implementation. Our study addresses existing evidence gaps by determining how closely a specific CLTS programme adhered to its set protocol and exploring the implication of this on the implementation fidelity (including adherence, integrity, and quality) (Moore et al., 2015). We also explore dose, reach, acceptance, and adaptation of the CLTS programmes, as well as the possible mechanisms that may influence long-term impact of a programme (Moore et al., 2015; Peters et al., 2013).

Methods

Study setting, design and period

The WASH for Everyone (W4E) intervention was a district-wide community WASH programme implemented by two non-governmental organisations (NGOs) across all 10 TAs in Chiradzulu District from January 2022 to December 2024. Chiradzulu District, in the southern region of Malawi, has a population of approximately 360,000 (National Statistical Office, 2019). In 2017, an estimated 75% of households in this rural district lacked access to improved sanitation and 2.1% practised OD (National Statistical Office, 2019). By 2018, 53% (440 out of 831 communities) had been reported as ODF, however only 11% ($n = 49$) had been officially certified ODF by the National Task Force (Malawi Government, 2018b). In Malawi, implementing partners or district officials often 'report' communities as ODF based on what they see in the field. However, the National ODF Task Force must independently verify and approve 'certification' as ODF.

Year 1 activities were implemented in TA Likoswe (TA1) and TA Mpama (TA2) between January 2022 and February 2023 (Figure 1). The intervention primarily employed the CLTS approach (Malawi Government, 2011), consistent with the Malawi National Sanitation and Hygiene Strategy (Malawi Government, 2018a). In addition to CLTS, other intervention components included Market-based sanitation and Hygiene campaigns.

CLTS implementation in TA1

TA1 was not declared ODF prior to project implementation. Implementation activities involved pre-triggering events where the communities were sensitised to the project, triggering events to trigger OD related shame and disgust, and post-triggering which consisted of household follow-up visits to promote sanitation and hygiene (Table 1). Community Health Workers (CHWs), locally referred to as Health Surveillance Assistants (HSAs), primarily implemented CLTS in TA1. CLTS triggering activities focused on visual and participatory demonstrations of faecal-oral transmission to trigger shame and disgust. During triggering events, community members were to nominate 'natural leaders' responsible for conducting four follow-up activities with support from CHWs, a local Care Group (volunteers who usually promote maternal and child health, while mitigating malnutrition), and local leaders (chiefs) to encourage adoption of behaviours.

CLTS implementation in TA2

TA2 was officially declared ODF in 2021. Thus, pre-triggering and triggering had already been completed before the project. However, reports of slippage (defined as a decline in latrine usage or hygiene practices after ODF certification) prompted renewed household follow-up visits during the study period to monitor

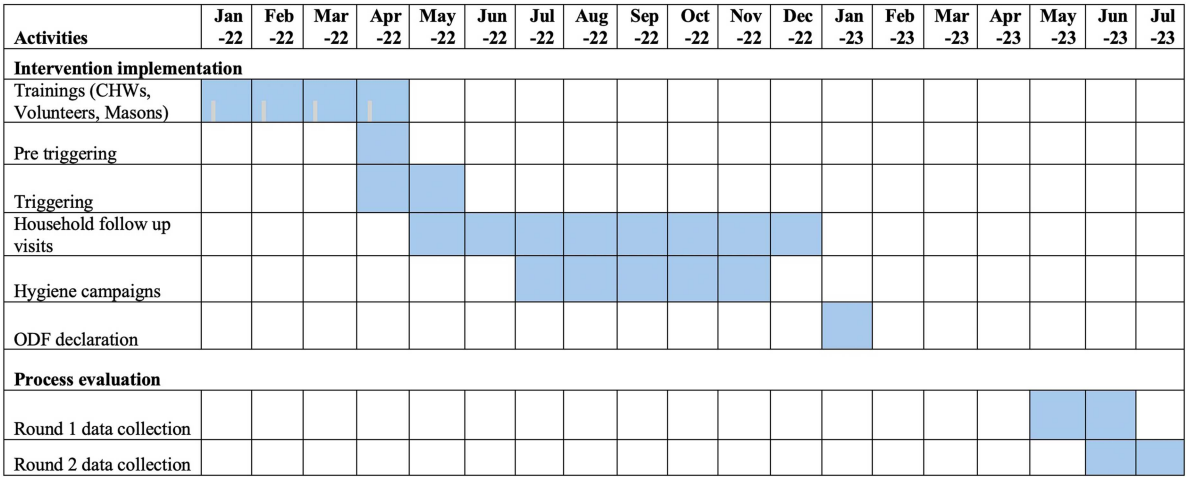

Figure 1. Gantt chart illustrating intervention implementation and process evaluation data collection rounds in TA1 and TA2, Chiradzulu District, Malawi (Jan 2022—Jul 2023).

and reinforce behaviour change. These follow-up visits were primarily conducted by CHWs with support from community task force members (a community committee that help in various community developments) and chiefs.

To ensure delivery of CLTS, the project intended to train 60 CHWs and 38 local leaders over both TAs, and 120 local Care Group members in TA.

Market-based sanitation

Implemented to support CLTS across both TAs, market-based sanitation involved promoting the construction of improved, durable, low-cost sanitation technologies, such as corbelled latrines, to community members. A corbelled latrine has a below ground, cement free brick-built dome-shaped sub-structure to mitigate the risk of collapse, and a traditional superstructure, constructed utilising locally accessible materials (Chidya et al., 2016; Holm et al., 2016). The project planned to provide practical training on corbelled latrine construction to community masons in both TAs, who would then build the latrines for a fee. The maximum cost of the substructure was the equivalent of 17 United States Dollars (USD), while the fee for erecting the superstructure varied based on the mason's assessment and pricing discretion. Local leaders recruited one community mason per sub-TA, amounting to 20 masons per TA, who were to receive construction tools upon completion of the training. Following trainings, the masons were to be introduced to the community by local leaders, local Care Group members and CHWs during triggering, community meetings, and household follow-ups to activate demand.

Hygiene campaigns

The intervention planned to engage the district hospital Health Promotion Office (HPO) to deliver the hygiene promotion campaigns in both TAs. They intended to use pre-established sanitation and hygiene messages from the Ministry of Health (MoH) through a series of four campaigns. Each campaign was to last five days and used a mobile van to disseminate hygiene messages and distribute leaflets. The campaigns specifically aimed to raise awareness on the importance of constructing latrines and practising handwashing with soap. The content of the messages remained consistent and was repeated across all four campaign rounds.

Process evaluation

Adapting UK Medical Research Council (MRC) process evaluation framework (Moore et al., 2015), we assessed context, planned implementation and the mechanism of impact of the WASH for Everyone intervention, a community-based sanitation and hygiene programme in rural Malawi (Figure 2). The framework had a predefined domain for context, and the data was used to inductively identify the specific contextual factors. The MRC framework was chosen because it has been widely used in public health research to ensure rigour and comparability across studies and offers an organised method for evaluating implementation fidelity, reach, dose, adaptation, and mechanisms of impact.

Following the completion of Year 1 implementation, two rounds of primary data collection were conducted between May and June 2023 (Figure 3). Using a mixed methods process evaluation design, this study combined quantitative and qualitative approaches including household surveys, In-depth interviews (IDIs) and Focus group discussions (FGDs).

The first round of data collection referred to as process evaluation survey, was conducted from May to June 2023, consisting of a household survey, IDIs, and FGDs (Table 2). Providing additional nuance to the process evaluation, the second round of data collection took place between June and July 2023 and consisted of the household survey implemented as part of the W4E programme annual survey (referred to as project endline survey). Additionally, at the end of intervention delivery, secondary data were collected from intervention quarterly reports and project log frames.

Study population

The evaluation included intervention implementers and community recipients. Intervention implementers consisted of project officers from the two NGOs and staff from the District Health Office (DHO), for example

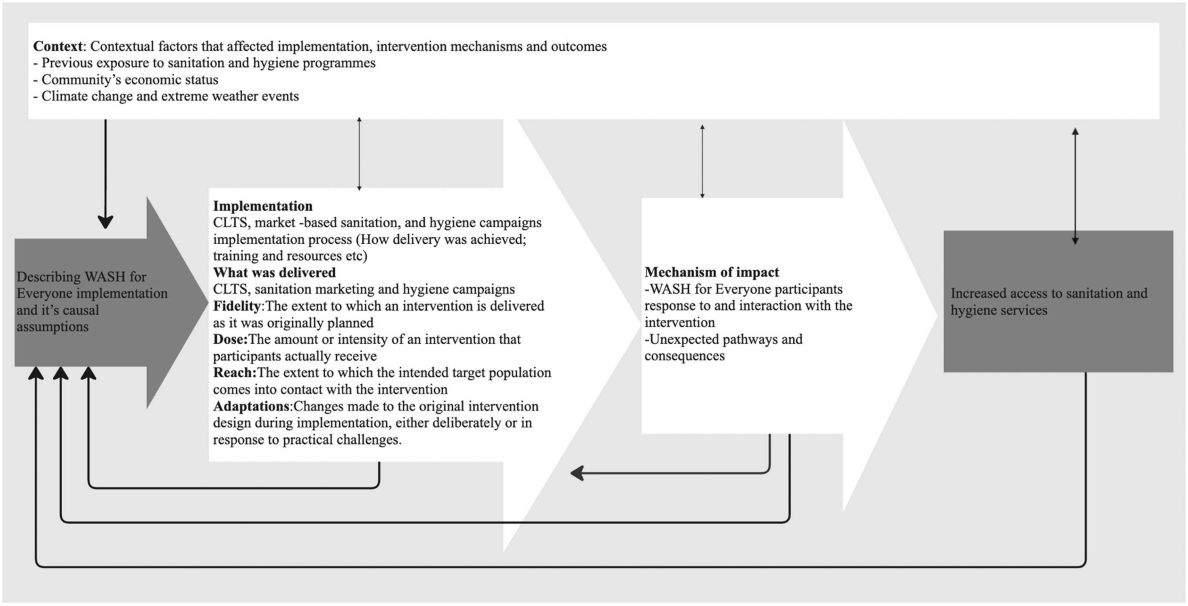

Figure 2. Process evaluation framework adapted from Medical Research Council guidance (Moore et al., 2015). Note: Context was a predefined domain within the framework, while the specific contextual factors (e.g. prior sanitation programme exposure, community economic status, and climate shocks) were inductively identified from the data during analysis.

District Health Promotion Officers and CHWs. Community stakeholders included natural leaders, community volunteers, community task force members, local leaders and trained community masons (Table 1).

Sample size

The sample size was established independently for each component of the evaluation, encompassing the household surveys and qualitative interviews.

A total of 260 households (130 per TA) were sampled for the process evaluation survey (Round 1). Simple random sampling was used to choose 13 villages for each TA, and 10 households from each village. The qualitative component applied purposive sampling to capture a range of stakeholders involved in the intervention delivery and recruitment continued until data saturation was reached. IDIs were carried out with W4E project officers, the District Health Promotion Officer, CHWs, trained masons, local leaders, and natural leaders, while FGDs were conducted with community members, community volunteers, and task force members (Table 1).

The project endline survey (Round 2), followed the same sample size calculations used for the programmatic baseline completed by implementing partners in 2022, although different households were sampled in selected villages. A total of 900 households were targeted for the survey, with 450 households sampled per TA across 15 Enumeration Areas (EAs). EAs are geographic areas canvassed by one government census representative and is composed of one or more adjacent villages.

Data collection

The research team employed seven trained enumerators, each with at least a bachelor's degree to collect round 1 data, process evaluation Survey (Figure 1). A household survey, FGDs with volunteers, task force members, and members of the community, and IDIs with project officers, the District Health Promotion Officer, CHWs, trained masons, local leaders, and natural leaders were used to gather the round 1 data. The household survey gathered information on: Demographic characteristics (e.g. age, gender, education level), sanitation facilities and hygiene practices (presence of latrine and handwashing facility), and exposure and participation to intervention activities (attendance at triggering events, household follow-ups, and hygiene

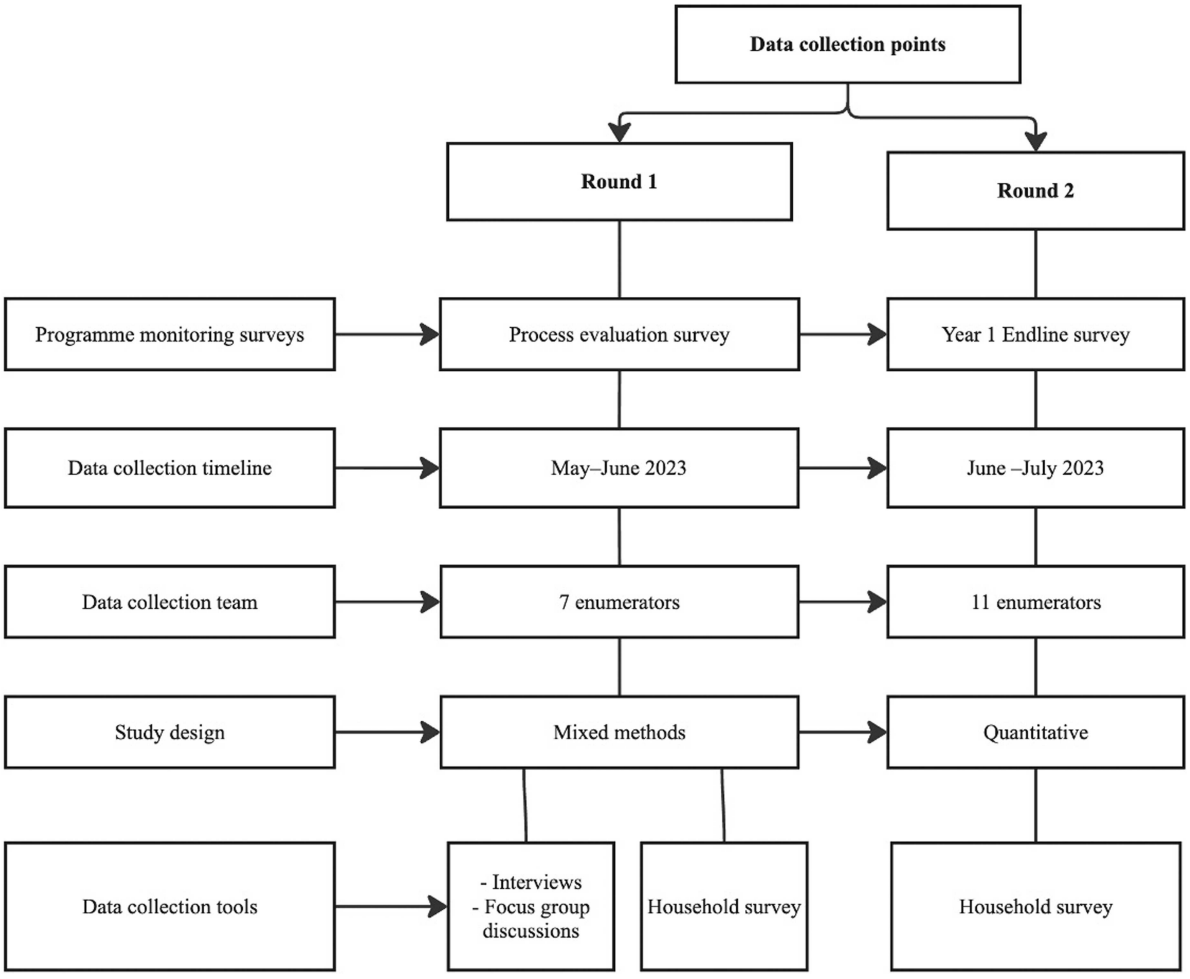

Figure 3. Overview of data collection rounds and sampling framework.

campaigns). The IDIs and FGDs investigated perceptions of intervention delivery and experiences with CLTS implementation, factors that facilitated or hindered behaviour change and stakeholder perspectives on implementation fidelity, reach, dose, adaptation, and mechanisms of impact. Guides were created in English, translated into Chichewa, pre-tested, and consistently utilised across groups. With participant consent, IDIs and FGDs were audio-recorded. Data collection tools can be accessed at https://doi.org/10.15129/b868b0b9-d056-4962-b508-96fac4742787.

Data for Round 2 (Project Endline Survey) were gathered through a household survey conducted as part of the annual monitoring for the W4E programme. It contained both pre-coded and open-ended questions about demographic characteristics (age, gender, education level), household sanitation facilities and hygiene practices, and exposure to and participation in intervention activities (triggering events, household follow-ups, and hygiene campaigns). Eleven enumerators, all of whom had at least a bachelor's degree, were employed by the implementing NGOs to gather data.

For both rounds, the enumerators were not involved in delivering the intervention. They were trained for two days on the study's goals, research ethics, and how to use the data collection tools, and then they took a pre-test for one day.

Data management and analysis

A Theory of Change (ToC) was developed by the research team, with input from the implementing partners, to inform data collection and analysis by mapping the projects intended deliverables (inputs and activities)

Table 2. Data sources used to assess implementation of the WASH for everyone project, Chiradzulu District, Malawi (2022–2023).

Data collection point	Data collection method	Data collection tool	Study participants	Sample size		Implementation aspect assessed			
				Targeted	Achieved	Fidelity	Dose	Adaptation	Reach
Round 1	Quantitative	Process evaluation household survey	Community members	260	258	√	√		√
	Qualitative	In-depth Interviews	W4E Project officers	2	2	√	√	√	√
			District Health Promotion Officer	1	1	√	√	√	√
			Community Health Workers	9	9	√	√	√	√
			W4E trained mason	8	8	√	√	√	√
			Local leaders	6	6	√	√		√
			Natural Leaders	10	10	√			√
		Focus Group Discussions	Community members	8 (80 participants)	8 (69 participants)	√	√	√	√
			Task force members	3 (30 participants)	3 (27 participants)		√		√
			Community volunteers	3 (30 Participants)	3 (30 participants)	√	√	√	√
Round 2	Quantitative	Project endline survey	Community members	900	893	√	√		√
Secondary data	Quantitative	W4E project log frame	N/A	1	1		√		√
	Qualitative	W4E quarterly reports	N/A	4	4	√	√	√	√

Note: A tick (√) indicates that the corresponding data collection tool included questions addressing that specific process evaluation aspect. Assessment criteria are drawn from the UK MRC process evaluation framework, including fidelity (delivery as intended), dose (amount delivered), reach (coverage of target population), and adaptation (modifications during implementation).

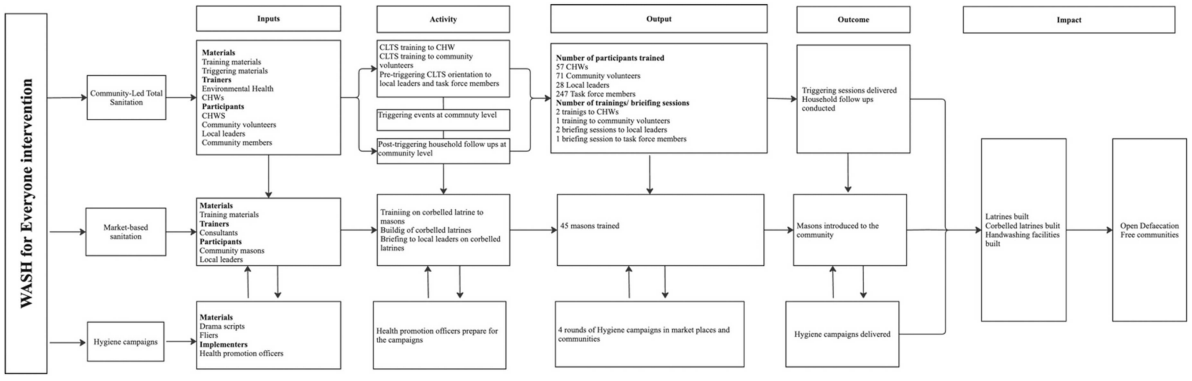

Figure 4. Theory of Change (ToC) for W4E implementation and outcome co-developed between the research and implementing teams.

with outputs and target outcomes (Figure 4). This was used to inform the assessment of the process evaluation.

For this process evaluation, we defined the original programme targets for implementation fidelity, dose, reach, and adaptation in line with CLTS guidance and W4E project plans (Figure 2). Fidelity was expected to be maintained by delivering five days of comprehensive training to all CHWs, local leaders in the targeted TAs, and Care Group volunteers in TA 1, as well as full delivery of pre-triggering, triggering, and post-triggering household follow-up visits per village. The intended dose included four post-triggering household follow-up visits per village, four rounds of hygiene promotion campaigns and the five days of training community masons, each fully equipped with construction tools. Reach targets included 100% of

households in the two TAs attending a triggering event, being visited during the four planned household follow-ups, and having exposure to at least one hygiene campaign. Adaptation was anticipated to be minimal, limited to context-appropriate tailoring of delivery, while preserving the integrity of CLTS protocols (e.g. use of participatory demonstrations, community selection of natural leaders).

The accomplishment of these implementation goals was evaluated using a variety of data sources. Qualitative reports from Focus Group Discussions (FGDs) and In-depth Interviews (IDIs), household survey responses, and reported activities in project documents were compared to determine fidelity and dose. Household survey data on attendance at triggering events, follow-up visits to households, exposure to hygiene campaigns, and interaction with trained masons were used to measure reach.

Ratings of 'low,' 'moderate,' or 'high' were assigned based on the degree of deviation from these original targets. Specifically, the ratings were applied using the following criteria:

High fidelity: Planned activities were delivered in full, with strong adherence to CLTS protocols, project plans, wide coverage, and minimal adaptation.

Moderate fidelity: Most planned activities were delivered but with partial gaps in coverage, quality, or consistency; minor adaptations were introduced that did not substantially alter programme integrity.

Low fidelity: Major components of planned activities were not delivered, coverage was limited, or adaptations significantly deviated from intended CLTS protocols.

These thresholds were adapted from established process evaluation guidance (Moore et al., 2015) and applied systematically across all intervention components.

Quantitative data

When feasible, answers to the same questions were aligned to aggregate quantitative data from the two household surveys (the project endline survey and the process evaluation survey). Since both surveys gathered similar data on demographics, sanitation and hygiene practices, and exposure to intervention activities, this strategy was chosen to maximise the sample size, increase statistical power, and enable a more thorough evaluation of results across the two survey rounds. Data were analysed using Microsoft Excel Version 16 (Microsoft Corporation, Redmond, WA, U.S.A.) and STATA 18 (StataCorp LP, College Station, TX).

Descriptive statistics (frequencies and proportions) were used to summarise demographic characteristics of respondents (age, gender, education level), household sanitation facilities (presence of latrine), hygiene practices (presence of handwashing facility with soap and water), exposure and participation in intervention activities (attendance at triggering events, household follow-ups, and hygiene campaigns), and reach of programme activities (number of people trained through CLTS, market-based sanitation, and hygiene campaigns, extracted from project log frames and reports).

Analytical procedures were linked to specific aspects of the process evaluation as follows:

Implementation fidelity: Descriptive statistics were used to summarise attendance at triggering events, household follow-ups, and hygiene campaigns.

Reach and dose: Programme monitoring data (number of people reached through CLTS trainings, triggering events, household follow up visits, market-based sanitation, and hygiene campaigns) were extracted from project log frames and reports and described using frequencies and proportions.

Mechanisms of impact: Inferential statistics were applied to examine associations. Chi-square tests were used to assess the relationship between participation in triggering events and demographic characteristics (age, gender, education). Logistic regression models were used to explore the relationship between exposure to intervention activities (triggering events, household follow-ups, hygiene campaigns) and household outcomes (presence of a latrine and/or handwashing facility). Models were adjusted for demographic characteristics (age, gender, education).

Qualitative data

IDIs and FGDs were audio-recorded, transcribed, and translated into English. Data were analysed using thematic analysis (Braun & Clarke, 2006). To guarantee consistency and dependability, the data was independently coded by two members of the research team. Following the initial coding, they discussed any differences and cross-checked each other's work until they came to an agreement. Codes were then

applied to pre-identified themes, including implementation fidelity (adherence, integrity, quality), reach, dose, adaptation, and mechanisms of impact.

A manual triangulation process was applied to integrate qualitative and quantitative findings. This involved systematically comparing themes and patterns from the qualitative data with the statistical results, to identify areas of convergence, complementarity, or divergence.

Ethical considerations

The study was approved by the Ethics Committee at the London School of Hygiene and Tropical Medicine (LSHTM Ethics Ref: 28249) and the National Commission for Science and Technology (NCST) in Malawi (P.09/22/673). Informed written consent was obtained from all study participants prior to enrolment.

Results

Description of study participants

A total of 1,151 individuals were included across both household surveys (process evaluation and project endline survey). The household survey respondents were between the ages of 18 and 84 and predominantly male (74%), 58% were married, 36% never attended school, and 62% were unemployed (Table 3). The average household size was four. Additionally, 149 community members participated in 16 FGDs.

Thirty-six intervention implementers participated in in-depth interviews, and 117 individuals participated in 12 FGDs. The study participants (9 CHWs, 30 community volunteers, 6 natural leaders, 27 community task force members, and 8 masons) were between 24 and 48 years old and had extensive work experience across various fields, with a mean of 8 years for CHWs, 10 years among the task force members, and 12 years for the masons.

Significant variations were found when participant characteristics were statistically compared across survey rounds (Table 3). Compared to Round 2, Round 1 had a higher percentage of women and proportionately more respondents from TA1 (χ^2 tests, both $p < 0.001$). The employment status varied significantly, with a greater number of participants indicating employment in Round 2 ($p = 0.013$). The education level ($p = 0.397$) and age distribution ($p = 0.928$) were similar in both rounds.

Although TA1 had a higher percentage of female respondents ($p < 0.001$), participants in TA1 and TA2 were generally similar in terms of age, education, occupation, and household size, as indicated in the Supplementary Table 1. Since most of the characteristics were similar, we combined participants from both TAs in the subsequent analyses.

Table 3. Socio-demographic characteristics of household survey respondents, TA1 and TA2, Chiradzulu District, Malawi (2023, $n = 1151$).

Variable	Total ($n = 1,151$)	Round 1 ($n = 258$)	Round 2 ($n = 893$)	χ^2 (df)	p-value
Traditional authority				90.9 (1)	<0.001
TA1	578 (50.22%)	197 (76.36%)	381 (42.67%)		
TA2	573 (49.78%)	61 (23.64%)	512 (57.33%)		
Gender				301.9 (1)	<0.001
Male	855 (74.28%)	33 (12.79%)	822 (92.05%)		
Female	296 (25.72%)	225 (87.21%)	71 (7.95%)		
Age				0.15 (2)	0.928
18–39	537 (46.66%)	122 (47.29%)	415 (46.47%)		
40–59	404 (35.10%)	91 (35.27%)	313 (35.05%)		
60+	210 (18.25%)	45 (17.44%)	165 (18.48%)		
Level of education				0.72 (1)	0.397
No formal education	416 (36.14%)	99 (38.37%)	317 (35.50%)		
Some education	735 (63.86%)	159 (61.63%)	576 (64.50%)		
Occupation					
No occupation	718 (62.38%)	178 (68.99%)	540 (60.47%)	6.19 (1)	0.013
Has occupation	433 (37.62%)	80 (31.01%)	353 (39.53%)		
Household Size				24.32 (1)	<0.001
≤3 members	575 (49.96%)	94 (36.43%)	481 (53.86%)		
≥4 members	576 (50.04%)	164 (63.57%)	412 (46.14%)		

Process evaluation findings

The results of the process evaluation are aligned with the Medical Research Council (MRC) framework (Moore et al., 2015) (Figure 1) and are reported according to implementation context, planned implementation, and the mechanism of impact.

Implementation context

Process evaluation results from all data sources found three key contextual factors affecting the intervention implementation and participant response to the intervention: i) previous exposure to sanitation and hygiene programmes; ii) the community's economic status; and iii) climate change and extreme weather events.

Previous exposure to sanitation and hygiene programmes: Multiple international NGOs have implemented sanitation and hygiene programmes in Chiradzulu in the years preceding W4E, including Development Aid from People to People (sanitation), Evidence for Action (water), and Water for People (water and hygiene).

Community economic status: 62% of community survey participants were unemployed; 23% reported small scale farming or businesses. Only 15% of respondents stated they were formally employed. Seventy-seven percent reported a monthly household income of less than $23.

Climate change and extreme weather events: Following completion of intervention implementation, the district was hit by Cyclone Freddy in March 2023, which significantly destroyed household infrastructure, including sanitation facilities (MacLeod et al., 2025).

Planned implementation

To achieve CLTS implementation, the project collaborated with CHWs, natural leaders, community volunteers, task force members, and local leaders to support household follow-ups. For effective intervention delivery, the CHWs and community stakeholders were trained on CLTS implementation and topics related to ending OD (e.g. transect walks, water with faeces demonstration, food with faeces demonstration, and shit calculations).

The market-based sanitation component included training of community masons and providing them with construction tools (measuring tape, building level, trowel, set square, and shovel) to support their work. To deliver the hygiene campaigns, the project worked with the district health promotion office by supporting the team with fuel and lunch allowances of 3.5 USD per day.

CLTS implementation

Fidelity. In total, the project trained 57 of the 60 CHWs in both TAs. All interviewed CHWs ($n = 9$) verified their participation in CLTS training. Five full days of training were planned for CHWs; however, due to CHWs being called away to a Polio Vaccine Campaign, the required five days were compressed into three half-days to maintain project timelines. Some CHWs who had previously participated in other CLTS trainings felt training was rushed.

Participants attending the triggering events reported that most triggering activities such as 'the walk of shame', community mapping, shit calculation, medical expenses, and transmission of diseases through water and food contaminated with faeces, took place. However, topics related to faecal-oral transmission were mostly explained verbally rather than using visual demonstrations, as per CLTS protocols.

> 'They did not show us how faeces reach our food, they just explained' [Female FGD participant, TA1].

Selection of natural leaders during triggering events was reported as inconsistent. According to CLTS protocol, natural leaders should be selected from individuals who actively participate in triggering sessions. However, some respondents reported that natural leaders were selected by CHWs based on previous relationships, even when these individuals did not attend triggering sessions.

> 'We did not choose natural leaders, but inspection of WASH facilities at our household was done by someone who supports the CHW during under five clinics' [Female FGD participant, TA1].

Reach. Project reports indicated that all local leaders ($n = 38$) from both TAs, 71 community volunteers (instead of 120 planned care group members) in TA1, and 247 community task force members in TA2 were reached with CLTS orientation meetings, enabling them to assist CHWs in conducting CLTS household follow-ups. All community volunteers ($n = 30$) who participated in FGDs verified their attendance and participation in a CLTS briefing. However, some members of the community taskforce team indicated that they had not attended the CLTS briefing but did conduct household follow-ups.

During pre-triggering, community members were intentionally invited to the triggering events without explicitly stating the purpose of the gathering. Depending on community preference, the invitation messages were spread by community volunteers, community criers, and CHWs. Household surveys indicated that 54% ($n = 625$) of participants received an invitation via one or more of these channels. Of these, 85% ($n = 529$) reported attending a triggering event, representing 46% of the total households surveyed. Triggering events were conducted during the week in the afternoon. Some triggering events were conducted during a market day, which resulted in a low turnout.

'I couldn't attend the meeting because it was market day, and I had to sell tomatoes' [FGD, community members].

Each of the community members who attended the triggering events stated that two to three additional individuals from their family also attended the sessions; however, most households indicated that children and the elderly members did not attend. In cases where children attended the event, most triggering events did not separate adults from children. CHWs were required to complete forms (CLTS triggering forms), detailing the number of individuals who attended, and the activities conducted during the triggering event, but these forms were not available for analysis.

Based on survey data, 46% ($n = 529$) of participants said they had taken part in triggering events. Chi-square tests were used to evaluate relationships between demographic characteristics and attendance at triggering events. Age ($p = 0.144$) and household size ($p = 0.931$) did not show any statistically significant correlations. Nevertheless, substantial correlations were identified for gender ($p = 0.003$), educational attainment ($p = 0.018$), and occupational status ($p = 0.01$) (Table 4). Compared to non-attendees, trigger event and follow-up attendees were more likely to be male, have gone to school, and report not having a job. In contrast, attendees of trigger events did not have significant differences from non-attendees in any socio-demographic characteristics, including age, sex, household size, education, or occupation. Nine percent of the survey respondents (*n* 98) stated that they were only exposed to the intervention through triggering events (trigger event only attendees).

Sixty-four percent of respondents ($n = 731$) reported exposure to household follow-up visits. Most household visits were conducted by CHWs (59%), followed by natural leaders (30%), local leaders (7%) and community volunteers (4%). FGDs with community volunteers revealed their limited capacity to carry out the household follow-ups.

Table 4. Association between socio-demographic characteristics and CLTS triggering attendance, TA1 and TA2, Chiradzulu District, Malawi (2023, $n = 1151$).

	Trigger event and follow-up attendees ($n = 529$)			Trigger event only attendees ($n = 98$)		
Variable	*n* (%)	Chi-square	*P*- Value	*n* (%)	Chi-square	*P*- Value
Age		3.87	0.144		3.59	0.166
18–39	239 (45%)			49 (50%)		
40–59	201 (38%)			28 (29%)		
60+	89 (17%)			21 (21%)		
Gender		8.83	**0.003**		3.03	0.082
Male	371 (70%)			80 (82%)		
Female	158 (30%)			18 (18%)		
Number of people per household		0.01	0.931		0.04	0.826
<=3	265 (50%)			50 (51%)		
>=4	264 (50%)			48 (49%)		
Level of education		5.58	**0.018**		0.28	0.595
Never attended education	172 (33%)			33 (34%)		
Attended education	357 (67%)			65 (66%)		
Occupation status		6.57	**0.01**		0.04	0.85
No occupation	309 (58%)			62 (63%)		
Has occupation	220 (42%)			36 (37%)		

'We were called for a meeting in March 2022 where they told us about our role in this project. However, since that meeting, we never met again' [FGD, Community Volunteer, TA1].

Dose. As part of the post-triggering phase, the project planned to conduct four rounds of household follow-up visits in each village to enhance uptake of sanitation facilities. According to project documents, only 75% of households had a latrine after the fourth round of household follow-up visits. Thus, implementation was adapted to allow up to six rounds of household follow-up visits per village.

Despite multiple household follow-up visit rounds conducted at the village level, the number of visits received varied by household. More than half (58%) of households reported receiving only one visit.

Adaptation. Despite the initial intention to involve local Care Groups in the CLTS delivery, Care Groups were not formally established in TA1. Local volunteers, referred to as community volunteers, were trained instead.

'No active care groups were found in the intervention area when we began implementation. So, we trained community volunteers instead' [KII, Project Officer].

Additionally, the number of household follow-up visits were increased from four to six because the sanitation coverage was lower than expected. To ensure that sanitation practices were more consistently adopted, this adaptation sought to give households more support and reinforcement of behaviour change messages.

Market-based sanitation implementation

Fidelity. In total, 45 masons (44 male, 1 female) from both TAs were reached with the trainings, exceeding the target of 40. It was noted that two of the nine interviewed masons resided outside the TA area. Masons were recruited by local leaders though several CHWs were critical of this approach:

'I wish we were involved in the identification of which masons to be trained. Through working with communities, I have seen bias in such initiatives because people think they may get monetary benefits if they involve a person close to them' [KII, TA2, CHW].

Upon completion of the training, the project planned to provide each mason with construction tools to support their work. However, there were insufficient materials for the masons following the training.

'We were promised that each of us will be given construction tools, but we were later told that the tools are not enough, so three of us who were from the same sub-TA level area shared the materials' [KII, TA2, Mason].

Reach. FGDs and IDIs reported limited awareness about the masons, and the type of latrine being promoted. Based on combined data from the first and second round of household surveys, 69% of households that had a latrine during the study period reported building their own, 25% used an untrained community mason, while 6% used the project's trained masons to construct traditional latrines for them. Community members who were aware of the existence of the masons perceived hiring mason as costly.

'The promoted latrines are expensive. Labour charge for construction of pit only was $17, yet I can use that to build a complete traditional latrine' [FGD, TA2, Community member].

Project documentation recorded 30 corbelled latrines built by the trained masons in both TAs by the end of Year 1 project implementation.

Hygiene campaigns implementation

Fidelity. All four rounds of hygiene campaigns were completed on schedule, meeting the intended timeline for implementation. However, while the agreed schedule was met, fidelity to key content delivery components was suboptimal. For example, only 2% of the survey participants reported receiving a leaflet during the campaign. Interviews with the Health Promotion Officer revealed that there were insufficient leaflets at the District Health Promotion Office as they were all used during COVID-19 pandemic.

'We use default sanitation and hygiene messages developed by MoH. Most of the materials were used during COVID-19, so few people received leaflets' [KII, Health Promotion officer].

Reach. Forty-seven percent of household survey participants reported hearing or attending health promotion campaigns which were conducted at marketplaces (8%), in their own village (86%), or a neighbouring village (6%).

Hygiene and sanitation messages were not the only public health messages that were delivered during the project period; 14% of the study participants who reported hearing and attending the health promotion campaigns indicated that the messages heard were about cervical cancer screening, rabies, or polio vaccination. Additionally, 15% of respondents indicated that they had trouble understanding the messages being communicated.

Dose. Forty-six percent of the participants reported being exposed to the messages once, 35% twice, and 19% more than twice.

Table 5 summarises the fidelity ratings across all intervention components, and Supplementary Table 2 provides an overview of implementation fidelity, dose, reach, and adaptation of all intervention components.

Mechanism of impact

Following intervention delivery in February 2023, TA1 was declared ODF having achieved 100% latrine and HWF coverage. Achieving this objective took more resources than anticipated, primarily extending the number of household visits required to reach 100% coverage.

Although TA2 received additional CLTS household follow-ups in response to reported post-ODF slippage, project implementers could not achieve full ODF status by the end of the study period: 92% latrine coverage and 64% coverage of HWFs.

Nine percent ($n = 98$) of household survey respondents were exposed to triggering events only, 26% ($n = 300$) exposed to household follow-up visits only, 37% ($n = 431$) exposed to both triggering and household visits, and 28% ($n = 322$) exposed to none of the CLTS components. After adjusting for confounding factors, such as demographic characteristics of the study participants, being exposed to a triggering event alone had a statistical significance on the availability of latrine, but not HWF. Exposure to household visits alone had no statistical significance on the availability of latrine, but on HWF. However, combined exposure to both a triggering event and household visit significantly increased the likelihood of both latrine and HWF availability at household level (Table 6).

Based on data from the first-round process evaluation household survey, logistic regression models found that exposure to hygiene campaigns did not have a significant effect on the presence of a latrine (OR = 0.77, $p = 0.458$) and HWF (OR = 1.19, $p = 0.518$).

To achieve intended outcomes, the project employed adaptability and flexibility during delivery. For example, no active Care Groups were found in TA1, where the project expected to employ pre-existing Care Groups in CLTS delivery. Since time and resources were insufficient to develop or remodel Care Groups, volunteers were trained to fill this job. To improve the likelihood of households adopting and consistently practicing the recommended sanitary measures, the project increased household follow-up visits from four to six.

Table 5. Fidelity ratings and implementation quality of CLTS, market-based sanitation, and hygiene campaigns, TA1 and TA2, Chiradzulu District, Malawi (2022–2023).

Component	Fidelity rating	Comment
Trainings		
CHW training	Moderate	Training was rushed due to overlap with polio campaign
Mason training	Adequate to moderate	Good training coverage but insufficient materials
Volunteer selection and training	Adequate	Care Group absence managed with adaptation
Intervention delivery		
Triggering sessions	Moderate to Low	Attendance was limited; incomplete delivery of key activities; inconsistent selection of Natural Leaders
Household follow-up visits (post triggering)	Moderate to High	More rounds conducted than planned; ensured wider reach
Masons' delivery of market-based sanitation	Low support	Limited marketing support
Volunteers' delivery of CLTS	Low support	Limited subsequent support
Hygiene campaigns	Moderate to Low	Reasonable reach but shortages of materials affected fidelity

Note: Fidelity ratings were assigned based on comparisons between planned activities and actual implementation, considering delivery quality, coverage, and adaptations. Ratings follow established criteria for process evaluation (Moore et al., 2015).

Table 6. Logistic regression of exposure to CLTS components and household-level sanitation and hygiene outcomes, TA1 and TA2, Chiradzulu District, Malawi (2023, $n = 1151$).

Respondents participated in:		Intervention reach		Observed latrine at HH			Observed HWF at HH		
Triggering	HH Follow-ups	n	%	Odds Ratio*	95% CI	*p*-value	Odds Ratio*	95% CI	*p*-value
No	No	322	28	1.00	-	-	1.00	-	-
Yes	No	98	9	1.68	(1.02 - 2.78)	0.043	1.01	(0.43 - 2.35)	0.985
No	Yes	300	26	1.09	(0.97 - 1.23)	0.142	1.15	(1.13 - 1.16)	0.000
Yes	Yes	431	37	1.63	(1.55 - 1.72)	0.000	1.39	(1.03 - 1.86)	0.029

Note: Reference category: respondents who did not participate in triggering or household follow-ups ($n = 322$).

To guarantee robust inference, models were adjusted for (respondent's age, gender, respondent's level of education, employment of the head of the family, and number of individuals per household), as well as clustering. Fully adjusted model, supplementary Table 3, can be found at https://doi.org/10.15129/b868b0b9-d056-4962-b508-96fac4742787.

After intervention delivery in both TAs and following ODF declaration in TA1, the arrival of Cyclone Freddy in March 2023 compromised the ODF status of both TAs. Project reports indicate that three months after Cyclone Freddy hit the area, 68% of latrines were damaged or lost in TA1 (MacLeod et al., 2025). Recognising this slippage, the project promoted latrine reconstruction through multiple visits across April to June 2023 (MacLeod et al., 2025).

Discussion

This study sought to perform a mixed methods process evaluation of a CLTS project in rural Malawi, analysing implementation fidelity, reach, dose, adaptation, and mechanisms of impact. The assessment found that contextual challenges such as poverty and climate shocks, limited implementation as intended and had an impact on household adoption. Reach and fidelity differed among CLTS components, and overall delivery quality was compromised by shortened CHW training, uneven triggering coverage, and uneven household follow-ups. Participation in triggering events was associated with demographic characteristics. Finally, analysis of mechanisms of impact showed that combined exposure to triggering and follow-ups substantially increased latrine and handwashing facility coverage, whereas hygiene campaigns alone had minimal influence.

Our process evaluation revealed that contextual factors, such as elevated poverty rates, and the destruction of facilities caused by Cyclone Freddy, significantly impacted the delivery and adoption of interventions. It has been demonstrated that severe weather events compromise the sustainability of sanitation infrastructure, causing latrine collapse and ODF slippage (Hinton et al., 2023; MacLeod et al., 2025). CLTS has faced criticism for the construction of poor-quality, unimproved sanitation facilities with a limited life span (Alemu et al., 2017; UNICEF, 2020; Venkataramanan et al., 2018). As such, W4E provided an option for more resilient infrastructure by delivering CLTS alongside market-based promotion of corbelled latrines to ensure the sustainability and resilience of latrines. However, like other studies (Holm et al., 2016), our study found low uptake of this type of latrine, attributed to limited marketing of the available masons and relative high costs for these latrines. Our research highlights the significance of incorporating affordability and climate resilience into CLTS programming by providing new evidence on how extreme poverty and climate shocks, like Cyclone Freddy, contribute to limiting sanitation adoption and undermining ODF sustainability in Malawi. The reported high costs for the promoted latrines in our study concurs with other studies that low socio-economic status hinders the adoption of improved sanitation (Gross & Günther, 2014; Peletz et al., 2017; Tough et al., 2023; Whaley & Webster, 2011). Promoting and implementing a cost-effective design of latrines that utilise local resources and align with consumers' financial constraints encourages adoption of improved and durable latrines (Cole, 2015). Hence the need for implementers to assess how much people are willing to pay for improved sanitation facilities before promoting a specific sanitation option in the various contexts. Customer demand is key to successful sanitation marketing (Mara & Evans, 2018).

The fidelity of CLTS implementation was compromised, as CHW training was shortened, some triggering activities omitted key participatory elements, and natural leader selection did not consistently follow protocol. Despite the structured guidance provided by Malawi's National Sanitation and Hygiene Strategy, real-world implementation revealed tensions between the need for adaptability and the maintenance of fidelity. In several instances, such as the overlap between CHW training and the polio vaccination

campaign, flexibility was exercised but may have contributed to reduced fidelity and suboptimal outcomes. This is a common scenario in Malawi given the substantial workload of CHWs who are tasked not only with environmental health services, but also with Maternal Child Health (MCH), family planning, and HIV/AIDS services (Greco et al., 2017; Kok & Muula, 2013). Allocating sufficient time for CLTS training is crucial, as inadequate training can result in unsatisfactory delivery, which in turn leads to poor receipt and understanding among recipients (Toomey et al., 2020). CLTS trainings should be allocated enough time to ensure incorporation of both educational and practical components, as this tends to be more effective in generating the desired behaviour change (Goh et al., 2017; Hatfield et al., 2020; Pang et al., 2015; Panulo et al., 2022).

Compromised fidelity went beyond just training and CHW scheduling. In our study, some natural leaders were selected without attending the triggering session, potentially lacking an understanding of CLTS principles. Their lack of knowledge on CLTS may explain our finding that only 30% of the community members reported being visited by a natural leader. Natural leaders function as change agents in their communities, serving as role models, and accelerate the uptake of latrines and HWF among community members (Harter et al., 2020; Kapatuka, 2013). Our findings offer new evidence from Malawi regarding how structural workload conflicts and inconsistent community mobilisation undermine CLTS fidelity and outreach.

Our quantitative analysis found that participation in triggering events was significantly associated with gender, education level, and occupational status. This suggests that socio-demographic factors shaped exposure to CLTS activities, with women, less educated households, and the unemployed less likely to participate. Similar inequities in CLTS participation have been reported elsewhere, where literacy, gender norms, and economic constraints limited engagement with triggering and follow-up activities (Crocker et al., 2017; Venkataramanan et al., 2018). Changing the times of meetings, the ways people get messages, and the ways households are followed up on during CLTS activities may improve inclusion of CLTS activities and programme's results.

Our study results infer that exposure to both triggering sessions and household visits is more likely to result in the presence of both latrine and HWF at a household. Like other findings, WASH programmes are more effective when individuals are engaged at both community and household levels (multi-level) (Harter, 2018; Sclar et al., 2022). Thus, it is important to ensure that community members are aware of the triggering events (Routray et al., 2017), and that these are scheduled in a way that enables maximum participation from diverse groups and increases the overall number of people who attend (Moschonas et al., 2022; Panulo et al., 2022). We note, however, the overall limited increase in HWF coverage at the household level. Studies have demonstrated that CLTS generally enhances latrine coverage, whereas the presence or behaviour associated with handwashing facilities typically exhibits minimal or inconsistent changes (Harter et al., 2020; Venkataramanan et al., 2018). The positive association between household visits and the presence of HWFs suggests that CLTS programmes should utilise household-level follow-up visits as a possible mechanism to improve hygiene-related behaviours.

Study strengths and limitations

One strength of this study is its mixed methods process evaluation design, which used household surveys, in-depth interviews, and focus group discussions. This made it possible to compare results from different data sources and points of view. The triangulation of quantitative and qualitative data, the inclusion of diverse respondent groups (community members, CHWs, volunteers, and masons), and the utilisation of a well-established evaluation framework (MRC) promote the validity and credibility of our findings.

However, some limitations should be noted. First, inconsistencies in tracking the frequency and timing of follow-up visits across household surveys limited our ability to assess dose–response relationships. Consequently, the correlation between household visits and the adoption of latrines or HWF may be underestimated; subsequent evaluations must guarantee standardised monitoring of exposure data. Second, the inability of the research team to access specific reports for certain activities, such as hygiene campaigns or CLTS triggering forms, constrained our fidelity assessment. Since triangulation with direct documentation was not feasible, we may have underestimated fidelity. Third, coverage estimates may have been inflated due to recall or social desirability bias brought about by reliance on certain single self-

reported statements (such as exposure to triggering or hygiene campaigns). By using qualitative interviews and project monitoring reports as a triangulation, we tried to lessen this, but observational or objective measures would be beneficial in future research. Notwithstanding these limitations, our conclusions are more reliable because the results are consistent across several data sources.

Conclusion

Our process evaluation of a CLTS intervention in rural Malawi demonstrates that combined exposure to community triggering and household follow-up visits, rather than hygiene campaigns alone, was the strongest predictor of latrine adoption and handwashing facility presence. However, these effects were shaped by contextual vulnerabilities, including poverty and climate shocks, which interacted with implementation challenges such as uneven fidelity and reach.

Taken together with existing CLTS literature, these findings underscore the need for programmes to move beyond triggering alone and to incorporate affordability and climate-resilient sanitation options, while strengthening sustained household-level engagement to achieve durable ODF outcomes.

For routine practice, investments are needed in flexible training models for community health workers, continuous support for community volunteers and masons, and adequately resourced hygiene promotion strategies that complement sanitation-focused activities.

Future research should prioritise standardised approaches to measuring exposure and fidelity, evaluate cost-effective climate-resilient sanitation technologies, and examine how socioeconomic vulnerability and extreme weather events influence the long-term sustainability of ODF status through longitudinal designs.

Author contributions

Conceptualisation, M.P., K.C., R.D.,T.B, and T.M.; data curation, M.P., K.C., R.D.,T.B, and T.M; formal analysis, M.P., R.D. T.B, and T.M.; funding acquisition, R.D.; methodology, M.P., K.C., C.M., R.D.,T.B, and T.M.; resources, R.D.; software, M.P; validation, M.P., K.C., C.M., T.K., R.D.,T.B, and T.M.; visualisation, M.P., K.C., C.M., R.D.,T.B and T.M.; writing—original draft, M.P., T.B, and T.M.; writing—review and editing, M.P., K.C., C.M., T.K., R.D.,T.B, and T.M. All authors have read and agreed to the published version of the manuscript.

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The authors report there are no competing interests to declare.

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Data availability statement

All data underpinning this publication are openly available from the University of Strathclyde KnowledgeBase at https://doi.org/10.15129/b868b0b9-d056-4962-b508-96fac4742787.

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