



# Antecedents and consequences of adopting CLTS among tribal communities to become open defecation free: case study on Indian Swachh Bharat Abhiyan

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## Abstract

The Swachh Bharat Mission undertaken by the Government of India (GoI) has been successful in accomplishing this objective within a short period thereby catalyzing governance following Sustainable Development Goals (SDGs). It is the responsibility of any democratic nation to ensure that its citizens have universal access to adequate and equitable sanitation. The key approach adapted to igniting a change in sanitation behavior rather than constructing toilets. An effort has been made in the study to affirm that even the marginalized sections of the society residing in tribal communities of West Bengal and Chhattisgarh have benefitted from this Government of India Mission and derived the required benefits. There is enough literature available to support the justification that civil participation holds the key for successful implementation of CLTS thereby making the communities open defecation free (ODF). It is therefore imperative to understand the behavioral transformation that takes place during the CLTS implementation. A hybrid model has been proposed in the study making use of the theory of reasoned action (TRA) and theory of planned behavior (TPB) to understand the pre-adoption and post-adoption behavior of residents. In present study, used model was empirically tested for several hypotheses. The finding reflects towards subjective norms and facilitating conditions as major determinants that ensure the continuation of intention for CLTS. They play a pivotal role in improving the health and hygiene conditions in the region and thus decrease the risk of spread of epidemic diseases.

**Keywords** CLTS · TPB · Health and hygiene · Epidemic

## Introduction

Many published documents present around 892 million people practice open defecation in rural areas, among them mostly are from South Asia and Sub Saharan Africa region. As a result, Community-Led Total Sanitation (CLTS) attract policy-makers for establishing sanitation facilities to combat such issues (UNICEF and WHO). Now days, researchers focus towards nudges theory to observe and understand the behavioral change in anticipation of the welfare of the

society such as healthcare, education, and a variety of social and economic sectors (Thaler et al. 2009; Schubert 2017; Tikotsky et al. 2020; Vallgård 2012; Weimer 2020).

In this context, CLTS depends on behavioral change and social support to end open defecation.

The acceptance of the policy as a nudge should be theoretically linked with the Technology Acceptance Model (TAM) (Davis 1989) and Theory of Planned Behavior (TPB) (Ajzen 1985). That further helps to provide the information and link to use model evaluating behavioral intention. The hypothesis has been developed based on previous literature and empirically tested to study of adoption issues of CLTS in India.

The study was conducted in two phases: in the first phase, we have studied the perception and challenges of the CLTS implementation and in the second phase, the study was conducted to evaluate the post-adoption benefits of the CLTS during the spread of COVID-19 (March to May 2020) in the Indian state of West Bengal and Chhattisgarh. The results are

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very much satisfactory, as in the post-adoption scenario, the risk of the pandemic was substantially low in the surveyed areas (Table 1).

Community-Led Total Sanitation (CLTS) is one of the major initiatives undertaken to sensitize the communities and increase their awareness regarding the maintenance of health and hygiene. The majority of recent studies conducted on CLTS have focused on the outcome of the CLTS and its impact on various performance indicators relating to health and hygiene. The top ten research papers cited during 2015–2020 have been collated, described, and presented in Table 2 (Bardosh 2015; Belizario 2015; Bulaya 2015; Crocker 2017; Garn 2017; Harter 2018; Lawrence 2016; Mara 2017; Pickering 2015; Sigler 2015). The social and behavioral impact of CLTS is another interesting area where

researchers have identified the social and behavioral issues specifically relating to CLTS (Lawrence 2016; Nutor 2020; Sari 2019). Some literature studies have beautifully explored the impact of CLTS on Environmental and Social Sustainability (Belizario 2016; Head 2019; Jena 2018; Kaminsky 2015; Kresch 2020; Soboksa 2019; Youenou 2016) thereby adding a unique dimension to the study.

To give a systematic dimension to the study and explore how proper implementation of CLTS can bring about a long-term behavioral change, the study has been divided into the following sections:

The “Introduction” section presents the introduction of the study, literature review is contained in the “Literature review” section, conceptual framework and variables have been discussed in the “Conceptual framework” section,

**Table 1** Summary details of selected articles

Reference date	2020-10-12 23:00:39 +0530
Publication years	2015–2020
Citation years	5 (2015–2020)
Papers	89
Citations	678
Citations/year	135.60 (acc1=56, acc2=40, acc5=12, acc10=6, acc20=2)
Citations/paper	7.62
Authors/paper	1.00/1.0/1 (mean/median/mode)
Age-weighted citation rate	239.98 (sqrt=15.49), 239.98/author
Hirsch h-index	13 (a=4.01, m=2.60, 464 cites=68.4% coverage)
Egghe g-index	23 (g/h=1.77, 557 cites=82.2% coverage)
PoP hI,norm	13
PoP hI,annual	2.60

**Table 2** Top ten research papers on CLTS (based on citations)

Sr.	Number of citations till 2020	Authors	Title
1	149	A.J. Pickering	Effect of a Community-Led Sanitation intervention on Child Diarrhoea and Child Growth in Rural Mali: A Cluster-Randomised Controlled Trial
2	72	J. Garn	The Impact of Sanitation Interventions on Latrine Coverage and Latrine use: A Systematic Review and Meta-analysis
3	35	V. Venkataramanan	Community-led Total Sanitation: A Mixed-methods Systematic Review of Evidence and it's Quality
4	31	J. Crocker	Sustainability of Community-Led Total Sanitation Outcomes: Evidence from Ethiopia and Ghana
5	29	R. Sigler	Analysis of Behavioral Change Techniques in Community-Led Total Sanitation Programs
6	25	J. Crocker	Impact Evaluation of Training Natural Leaders during a Community-Led Total Sanitation Intervention: A Cluster-Randomized Field Trial in Ghana
7	23	K. Bardosh	Achieving “Total Sanitation” in Rural African Geographies: Poverty, Participation and Pit Latrines in Eastern Zambia
8	21	J. Crocker	Teachers and Sanitation Promotion: An Assessment of Community-Led Total Sanitation in Ethiopia
9	18	V. Belizario	Parasitological and Nutritional Status of School-age and Preschool-age Children in Four Villages in Southern Leyte, Philippines: Lessons for Monitoring the Outcome of Community-Led Total Sanitation
10	17	C. Bulaya	Preliminary evaluation of Community-Led Total Sanitation for the Control of Taenia Solium Cysticercosis in Katete District of Zambia

while the “[Research methodology](#)” section contains the research methodology. The “[Data collection](#)” section contains data collection and analysis. The “[Theoretical contributions and implications of research](#)” section highlights the theoretical contributions and research implications, the “[Practical insights and discussion](#)” section provides practical insights, while the “[Limitations and further research](#)” section discusses the limitations of the study and provides direction for future research.

## Literature review

The literature review was carried out in two dimensions: the first dimension discussed the genesis of CLTS while the second stressed the use of resource-based view further derived as TAM and TPB towards the adoption of social change. The first dimension was studied through bibliometric analysis using keyword search, while the theories adopted have been contextually explained to accomplish the second dimension.

### Genesis of CLTS

A brief literature review on the identified keywords, including “Community-Led Total Sanitation” and “Effect of CLTS,” has been presented in this section. Importantly, the literature review renders an appropriate selection of literature and helps to analyze the identified studies scientifically (Carvalho et al. 2019). The following steps have been undertaken in this study to carry out a systematic review as per PRISMA model below (Figure 1).

- Research questions
- Q1. How are TRA and TPB integrated to study the behavioral pattern during or after the implementation of CLTS?
- Q2. How are the Constructs of TAM and TPB linked with desired behavioral change?
- Q3. How are these Constructs mapped to Health and Hygiene?

Bibliometric analysis was performed on 89 research articles. Table 1 provides the summary details of selected articles.

The findings of the majority of studies about health and hygiene indicate that there is a significant improvement of the health and hygiene conditions in the communities (Biran 2018; Deng 2020; Gebremariam 2018, 2019; Gimaiyo 2019; Hürlimann 2018; Husaini 2019; Jung 2016; Mlenga 2016; Njuguna 2016; Safari 2019; Tutuanita 2019; Yeboah-Antwi 2019). The cost and benefit analysis of CLTS implementation programs reveals that CLTS interventions can yield promising cost-effective returns, particularly if rigorous

follow-up post-triggering is implemented and uptake of improved latrines is achieved (Biran 2018; Cha 2020; Ficek 2019; Holm 2016; Kayoka 2019; Woode 2018).

The positive outcomes of CLTS implementation have paved the way for the preparation of policy guidelines by various social and government organizations for further diffusion of CLTS into communities thereby deriving greater benefits (Crocker et al. 2016; Harter et al. 2019; Hueso 2016; Zuin et al. 2019, 2020).

Some literature studies have emphasized the behavioral aspect of adopting CLTS but failed to support it with a theoretical justification (Alemu 2018; Balfour 2015; Bateman and Engel 2018; Holm 2016; Lawrence 2016; Sample 2016; Sigler 2015).

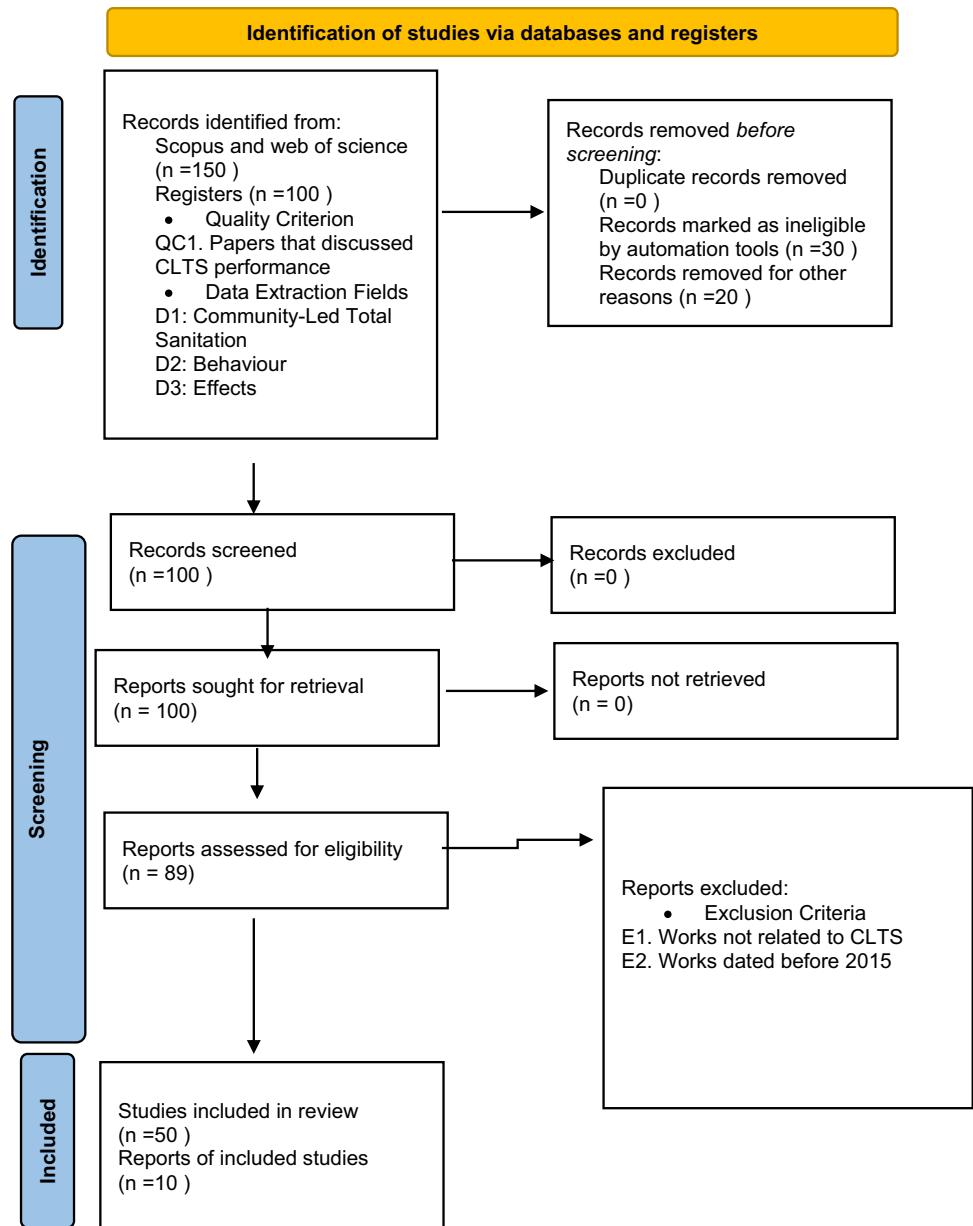
Previous studies conducted on CLTS have stressed the social and behavioral aspects; however, there still exists a literature gap as behavioral issues relating to the implementation of CLTS and continuation of its intention have still not been considerably explored. Therefore this research study has focused to underpin the factors affecting the continuation intention of CLTS with the help of pre-existing theories such as TAM and TPB in India.

### Use of TAM and TPB in the adoption of social changes

CLTS was enforced by the various agencies to derive health benefits. Technology acceptance model and theory of planned behavior models were developed using the theory of reasoned action (TRA) to study the attitude, motivation, and subjective norms within the field of health to understand health behaviors. The use of these models is however limited by their use as Ajzen acknowledged that “some behaviors are more likely to present problems of controls than others, but we can never be certain that we will be in a position to carry out our intentions. Viewed in this light it becomes clear that strictly speaking every intention is a goal whose attainment is subject to some degree of uncertainty.” The applications of technology acceptance model are widely accepted and are found in the adoption of digital services, health services, and other technological aspects of e-governance services (Alam et al. 2020; Chavoshi and Hamidi 2019; Hossain et al. 2019; Li and Shang 2020; Rubenking 2019; Tsai et al. 2019; Zhao et al. 2019), while theory of planned behavior has been instrumental in predicting the intentions to use some sociological or technological interventions (Ajzen 1985; Baker and White 2010; Fishbein and Ajzen 1975; Gagnon et al. 2012; Godin and Kok 1996; MahougbéHounsa et al. 1993; Zaremohzzabieh et al. 2019). The theory of planned behavior is used to predict the intention to use healthcare services (Godin and Kok 1996; Hu et al. 1999; Kakoko et al. 2006).

It is evident from the literature review that the use of behavioral models to study the challenges and

**Fig. 1** PRISMA model for the literature review



consequences ahead of CLTS implementation is less researched. An effort has been made in this study to address this issue. The constructs perceived usefulness of CLTS (PU), perceived ease of use (PEU) of CLTS, and facilitating conditions (FC) are derived from TAM, while attitude towards CLTS (AT), subjective norms (SN), and continuation intention (CI) are derived from TPB. The post-adoption constructs, improved health and hygiene (IHI), and decreased risk of epidemic (DRE) are developed by the authors to study the post-adoption effect of CLTS.

### Conceptual framework

#### CLTS context

It includes factors like perceived usefulness and perceived ease of use that are responsible for the successful implementation of CLTS programs and increase the scale and pace of CLTS activities. These factors play a prominent role in enhancing the sanitation coverage in the tribal areas thereby making the communities open defecation

free (ODF). They also remain instrumental in bringing about a change in behavior by sensitizing the communities and triggering emotions like disgust, shame, and respect for women, thereby creating a desire for construction and use of toilets.

### Individual context

Sustainable Development Goals have highlighted the importance of the inclusion of each individual for the successful implementation of CLTS programs to have a sustainable sanitation system. This inclusion is necessary for improving the sanitation facilities and making communities open defecation free (ODF). The attitude of individuals plays a significant role in this regard as it helps in predicting the specific behavior and bringing about sustained improvements. It not only guides the individual actions but also influences their values and beliefs thereby making the process socially more acceptable.

### District administration context

A holistic approach entailing the participation of each member of the community is required for the successful implementation of CLTS programs. The district administration plays a crucial role in accomplishing this objective. Robust plans are made and initiatives are undertaken in light of identified bottlenecks to improve the sanitation condition of the region. Government bodies, NGOs, and natural leaders act as facilitators and take the lead role by undertaking activities that bring about community cleanliness and improve the health and hygiene conditions.

Subjective norms that include acceptable behavioral standards play an important role at this stage to get sustained outcomes. An optimum and balanced combination of these factors ensures that no gap exists between the community initiatives and the desired behavioral change.

### Post adoption

The success of CLTS programs is ultimately reflected in the “post adoption” stage when individuals change their normally exhibited behavior and develop a continued intention of adopting CLTS. This not only improves the health and hygiene conditions in the region but also decreases the risk of epidemic diseases. Health experts have highlighted the crucial role that continued intention and individual behavior play in controlling the pandemic (Anderson et al. 2020).

There is sufficient grey literature on CLTS outcomes that indicates that successful implementation of the program creates a supportive and enabling environment thereby making it more sustainable. The motivated community members act as facilitators and inspire others to change their

sanitation-related behaviors. This helps in making the communities open defecation free thereby minimizing the risk of spread of epidemic diseases.

### Constructs and hypotheses development (1 para)

The proposed model has been developed based on the telemedicine model proposed by Chau and Hu. It encompasses three dimensions: CLTS context, individual context, and district administration context (Fig. 2). The model helps in analyzing whether continued intention towards CLTS can improve the health and hygiene conditions and decrease the risk of an epidemic or not.

The first dimension of the model “CLTS context” contains variables perceived usefulness of CLTS and perceived ease of use of CLTS, the second dimension of the model “individual context” contains the variable attitude towards CLTS while facilitating conditions and subjective norms constitute the third variable of the study, the “district administration context.”

#### Perceived usefulness of CLTS (PU) (1 para)

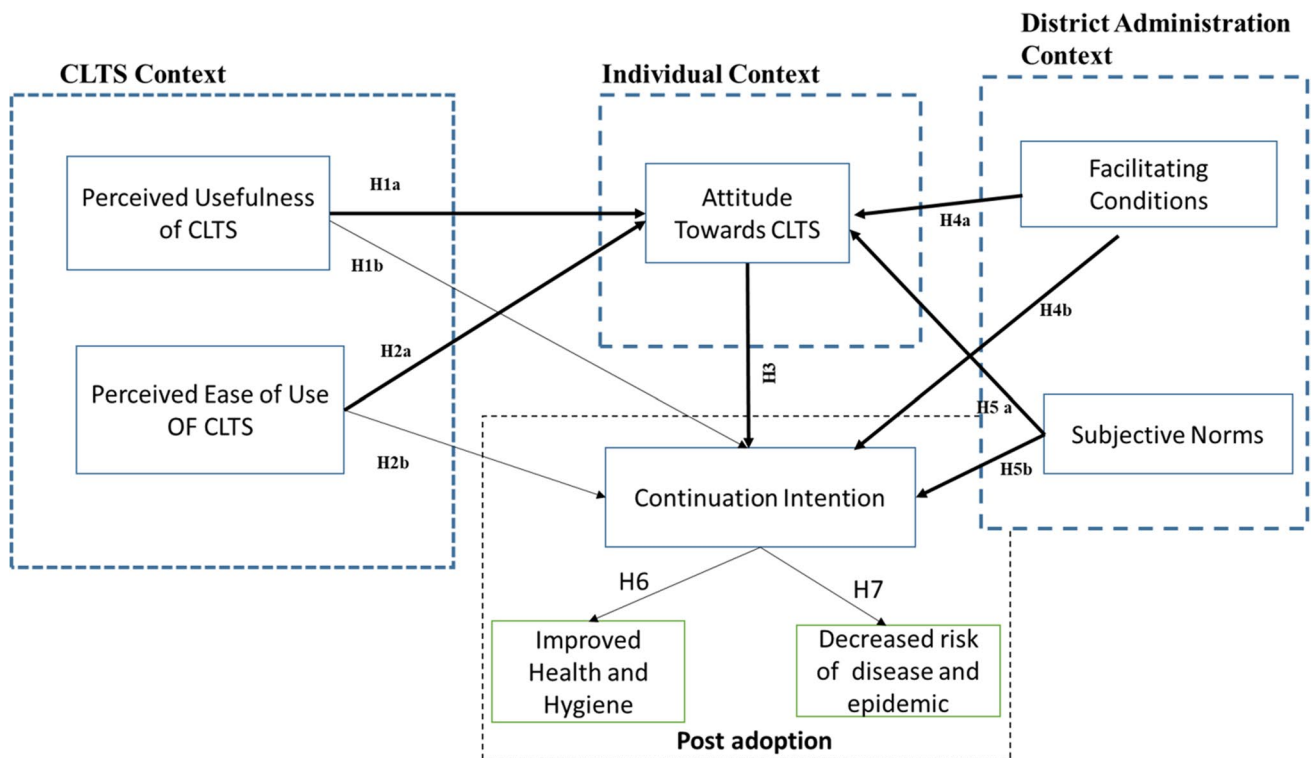
Perceived usefulness is an important variable in the CLTS context; it is the degree to which an individual perceives that exhibiting a specific behavior would enhance job performance (Davis 1989). It helps in understanding the perception of individuals towards the benefits that they would realize from the successful implementation of CLTS. Davis has proposed this variable in TAM (technology acceptance model) highlighting the important role that it plays in examining the perceived usefulness of a product or service. Therefore, focus towards CLTS to improve the sanitation services and bring about effective behavioral change. Hence, it becomes imperative to understand the impact that perceived usefulness has on the attitude of individuals towards CLTS and continuation intention. The understated hypotheses have been framed to accomplish this mission:

**H1a:** Perceived usefulness of CLTS is positively associated with attitude towards CLTS

**H1b:** Perceived usefulness of CLTS is positively associated with continuation intention of CLTS

#### Perceived ease of use of CLTS (PEU)

For any social phenomenon to be successful, it must be user-friendly (Bhattacharjee 2001). The same holds for the successful implementation of CLTS. Ease of use signifies freedom from difficulty or great effort and emphasizes on activities that individuals undertake or resources that they invest in (Adams et al. 1992; Davis 1989, Hendrickson et al. 1993). It plays a vital role as it helps in analyzing the



**Fig. 2** Conceptual framework

perception of individuals towards CLTS. It has a direct bearing on the attitude of individuals and continuation intention towards CLTS. The understated hypotheses were developed for testing this aspect.

**H2a:** Perceived ease of use of CLTS is positively associated with attitude towards CLTS

**H2b:** Perceived ease of use of CLTS is positively associated with continuation intention of CLTS

#### Attitude towards CLTS (AT)

Wan et al. (2017) and Ajzen (1991) have highlighted the importance played by attitude describing it as a multidimensional concept that helps in evaluating the negative and positive aspects concerning a certain behavior exhibited by an individual. Yang et al. (2016) observed in their study that if an individual likes a specific behavior, then the intention to exhibit it becomes even higher. It may therefore be inferred that if an individual believes that CLTS is beneficial, it will strengthen his belief towards the empowering process and bring about social awakening. This action will bring about a behavior change at the community level thereby having an impact on the continuation intention. It may therefore be hypothesized that,

**H3:** Attitude towards CLTS is positively associated with continuation intention of CLTS

#### Facilitating conditions (FC)

Robust administrative capability, strong research, and participation measures act as facilitators for the successful implementation of CLTS. Community-led, people-centered, demand-driven, and incentive-based programs play a pivotal role in successfully implementing the total sanitation programs (TSPs). Government bodies, district administration, health workers, NGOs, and community leaders act as facilitators in the process. During the implementation stage, it becomes imperative to keep the community in the primary position while institutions and infrastructure should follow. This participatory approach not just ensures equitable, transparent, and efficient deliverance but also brings about sustainability. It may therefore be inferred that facilitating conditions not only increase the effectiveness of CLTS but also have a positive impact on the attitude of individuals leading to continuation intention. The following hypotheses have therefore been tested:

**H4a:** Facilitating conditions of CLTS is positively associated with attitude towards CLTS.



**H4b:** Facilitating conditions of CLTS is positively associated with continuation intention of CLTS

### Subjective norms (SN)

Subjective norms have been defined as the social pressure that individuals experience and are the outgrowth of the theory of reasoned action (Ajzen 1991). The importance of subjective injunctive norms and subjective descriptive norms as the two components of social norms has been discussed by Fishbein and Ajzen (2011). The commonly approved or disapproved behavior is a part of the subjective injunctive norm, while the subjective descriptive norms represent the behavior shown by referral groups that are important for an individual like family members, close friends, and celebrations in the specific social context (Wang et al. 2016). Community approaches bring about a behavioral change that leads to improvement in the sanitation condition of the region and provides sustainable outcomes. Through effective utilization of approaches explained by social norms theory (SNT), the health workers, community leaders, and other implementers can address the challenges posed by the social norms thereby bringing about a change in the attitude of individuals and positively affecting the continuation intention. It may therefore be hypothesized that,

**H5a:** Subjective norms of CLTS is positively associated with attitude towards CLTS.

**H5b:** Subjective norms of CLTS is positively associated with continuation intention of CLTS.

### Continuation intention (CI)

For favorable outcomes, continuation of intention towards CLTS is required. Capacity-building measures and engagement of local leaders play an important role in accomplishing this objective. Following diffusion theory, local actors are trained, peer-communication is improved, and opinion leaders are made influencers to bring about a new behavior change (Rogers 2003). So, in context to aware about sanitation, hygienic status to improve and strengthen to exhibit the new behavior thereby improving the health and hygiene condition and decreasing the risk of diseases and epidemic. It may therefore be inferred that,

**H6:** Continuation intention of CLTS is positively associated with improved health and hygiene

**H7:** Continuation intention of CLTS is positively associated with decreased risk of diseases and epidemic

### Improved health and hygiene (IHI)

Successful implementation of CLTS promotes both hand washing and sanitation. It significantly increases the construction of toilets thereby improving the superstructure and providing privacy to the user in each household. This plays a prominent role in making the region open defecation free. Development of WASH-related facilities, presence of soap in toilets, and covering of pits drastically improves the hygiene and health conditions in the region.

### Decreased risk of diseases and epidemic (DRE)

CLTS has a marked influence on the health and life of individuals. It completely transforms the sanitation scenario and substantially improves the health condition and deteriorating quality of life of individuals, especially the poorest and the most vulnerable. This reduces the risk of the spread of an epidemic.

There is a shred of sufficient evidence to affirm that diarrhea makes children more susceptible to respiratory illness and increases the mortality rate. They also start showing other gastrointestinal illness symptoms like bloody stools. Successful implementation of CLTS reduces the prevalence of intestinal worm infections and exposure to fecal contamination due to a decrease in open defecation.

Many research studies also indicate that a contaminated environment greatly impacts environmental enteropathy. Improved sanitation plays a vital role in reducing environmental enteropathy and controlling parasite infections in young children thereby improving their growth and development.

### Research methodology

The methodology adopted here is in line with the suggestions provided by Sarstedt et al. (2016) to select an appropriate version of structural equation modeling. We have adopted common factor structural equation modeling (CBSEM) as per the context and the definitions of the construct (Figure 3).

### Case setting

The Swachh Bharat Mission of the Government of India (GOI) has successfully improved the sanitization condition in India within a short period. The key approach adopted by the government was Community-Led Total Sanitation (CLTS) also termed as Community Approaches to Total Sanitation (CATS). This research study was undertaken in the Dantewada District of Indian State Chattisgarh and

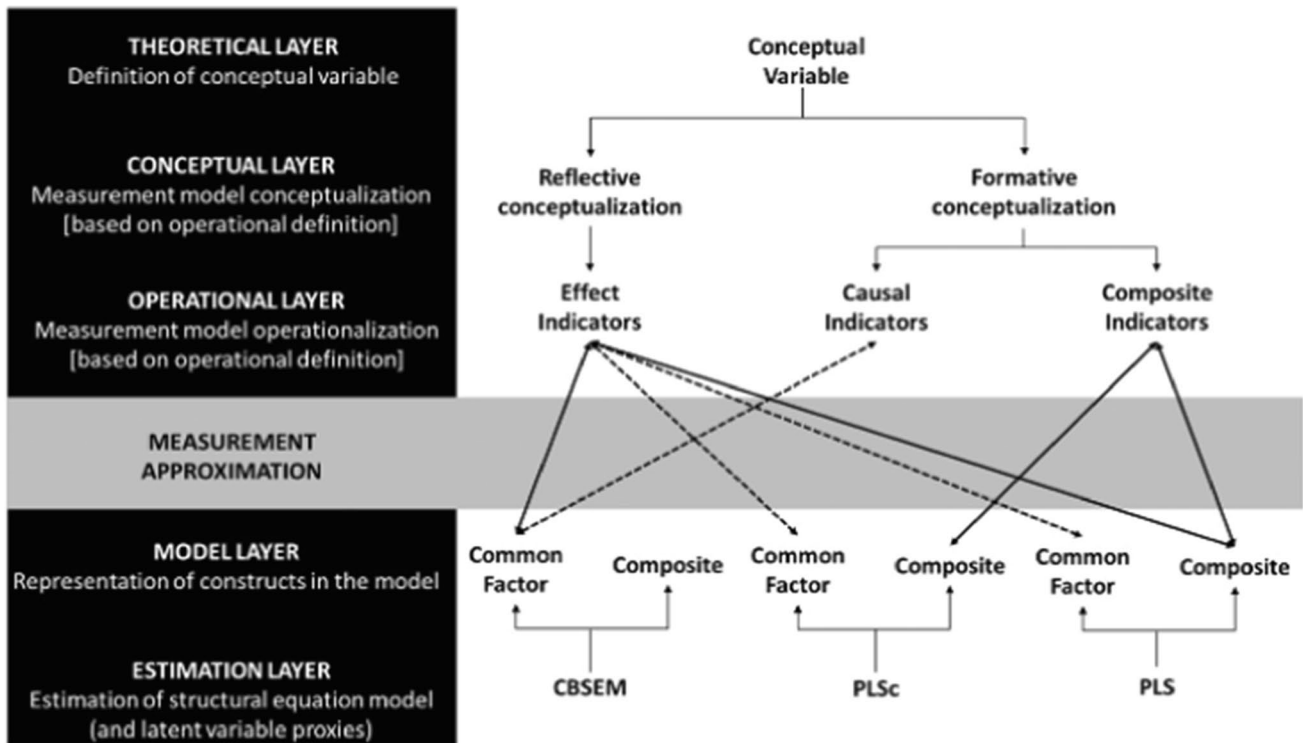


Fig. 3 Measurement and model estimation framework. 4007M. Sarstedt et al./Journal of Business Research 69 (2016) 3998–4010

Cooch Behar and Malda Districts of Indian State West Bengal.

Dantewada, also known as South Bastar District, is a small district located on the southern tip of Chhattisgarh and shares its boundaries with other Indian states, Maharashtra, Telangana, and Odisha. The district is home to nearly 0.25 million people, out of which more than 75% belong to scheduled tribes, living in and off the forests that they inhabit. Gond is the major tribe with nearly 60% population and the remaining ones include Halba, Muriya, and Maria. The district comprises 4 development blocks which cover 124 Gram Panchayats (GPs), the primary units of elected local self-government in the rural areas.

At the time of the launch of Swachh Bharat Mission-Gramin (SBM-G) in October 2014, the sanitation coverage of the district was less than 10%, with all 124 GPs remaining to be declared as ODF. To make the entire country open defecation free (ODF) within the next 5 years was not an easy task. The Community-Led Total Sanitation (CLTS) approach was the key to this success. The impact and results of CLTS had been showing across the world, and it was considered to be the best option to make this happen. The power of collective community action and the quick and effective results of CLTS had proven that things change at a rapid pace (KAR 2008). Being a participatory and empowering approach, it engages communities in a manner that stimulates self-analysis and collective local action to put an end

to open defecation (Kumar and Shukla 2011). This CLTS intervention supported by UNICEF sought to combine CLTS tools and techniques with other social mobilization methods ensuring multi-stakeholder engagement at various levels to achieve credible open defecation free (ODF) results with speed and on the scale. The key components of the strategy adopted included the following: capacity building, institutional strengthening, and ODF celebrations. A team of 30 trained CLTS facilitators was constituted to help implement SBM-G in the district. It worked well as within a year the coverage reached 40 percent and within 30 months the entire district of Dantewada was declared ODF.

Within two months Jhodiabadam, a GP with 212 households (HH) became the first GP to be declared ODF. This GP of Gidam Development Block showed extremely positive results of CLTS implementation. The effective community triggering sessions and continuous follow-ups added to this success. The key player behind this achievement was Balram Kashyap who came up as the natural leader and paved the way for this achievement. A grand event was organized by the community wherein the district officials, public representatives, and people from other GPs were invited. It became an inspirational event for other GPs to gear up and work together to obtain ODF status for their districts; Malda is located in the northern part of West Bengal and is one of the major districts of the state. It shares an international boundary with Bangladesh on the eastern part and has a



population of about 4 million which includes 53% Hindus and 46% Muslims. One percent of people belong to other religions and tribal communities. There are 9 development blocks and 146 Gram Panchayats in the district. Before the implementation of CLTS, sanitation coverage in the district was a meager 40%. To commence with, a habitation in the Manikchak block was selected as a pilot initiative, and after its success, the program was successfully scaled up in the entire district.

Bhutni Chandipur High school is a Sansad of Dakshin Chandipur GP of Manikchak development block in Malda district of West Bengal. It is an island surrounded by the river Ganges (Ganga). Commutation becomes a major challenge for the people residing in this area as they have to cross the river through boats, and the bad condition of the road adds further to misery as it becomes nearly impossible for residents to use it during the rainy season. Given the difficult topography, the place is also prone to heavy floods. The main source of income in the region is agriculture. Men usually work in major industrial cities like Kolkata, Delhi NCR, and Mumbai to earn a living leaving their family members behind to face drudgery.

Bhutni comprises six villages/pada with a population of around 3000. The total number of households in the Sansad is about 415 as described below in Table 3.

Initially, CLTS training for CFs, SHG members, ICDS workers, CSPs, and other volunteers was conducted by Knowledge Links (NGO). Thereafter, an action plan for carrying out the triggering exercise was made and implemented aggressively in the Sansad. Within 3 weeks, Bhonusarkar Tola became the first ODF village. However, the momentum slowed down a bit after this achievement. Many residents expressed their inability to construct toilets citing poverty reasons and looked forward to government support in this regard. A baseline survey was done to identify the households that required financial aid to construct toilets. It was found after the survey that 7 households required financial assistance, which was extended. The financial position of the remaining households was found to be satisfactory.

**Table 3** Details of households in village/pada

Sr.	Village/pada	No. of households
1.	Bhonusarkar Tola	54
2.	Chabimanjhi Tola	125
3.	Nabadeep Tola	34
4.	Biru Tola	52
5.	Sonatan Tola – 1	95
6.	Sonatan Tola – 2	55
	Total	415

They were repeatedly triggered and convinced to construct toilets on their own. The real challenge was to get toilets constructed in households that really could not afford it. To address this issue, all the SHG members, ICDS workers, CSPs, and teachers came forward and contributed money to get toilets constructed in these households.

All the residents enthusiastically participated in the CLTS implementation program and cooperated with the work teams. Despite commutation challenges owing to uneven roads and harsh weather conditions, they were successful in making the Sansad ODF.

Youth clubs also extended their support in an ample measure to achieve this objective. They dug pits, assembled the rings, arranged bamboos, and performed all other tasks that were required to support the cause. The exciting part was that all the political leaders and workers, irrespective of the political parties to which they belonged and political differences that they may have had, joined hands and came together for this purpose.

Nazardari teams regularly checked OD during the early morning hours and late evenings. Gandhigiri was practiced throughout to motivate and make the people understand the importance of ODF and curb it.

In Bhonusarkar Tola, residents also wanted to construct a community toilet for which each one of them contributed and collected around Rs. 22,000/- (twenty-two thousand rupees). They were unable to find space at a central location in the village where the community toilet was proposed. Bimla Mandol, a widow of around 70 years, came forward and donated a part of her residence for this purpose. She was recognized as a natural leader along with Sukhendu Mandal, Sameer Mandal, and Rakhi Deb.

The hard work and persistent efforts continued until the entire Sansad became ODF. Thereafter, a grand celebration was organized in which the District Magistrate, Administrative Officers, and Local Leaders participated and appreciated the efforts that were put-in by the residents to make the Sansad ODF. Sikha Mandol, the Pradhan of GP, congratulated the Sansad and requested other Sansads to take inspiration and become ODF. This was the first-ever ODF celebration in the state of West Bengal. The District Magistrate assured the availability of safe drinking water in the Sansad for improving the quality of life of residents and decreasing the spread of water-borne diseases.

The impact that the CFs, SHG members, ICDS workers, CSPs, etc. had on the residents was tremendous. They played a vital role in making the residents understand the importance of ODF and counseled them to stop practicing open defecation and use safe toilets. Their familiarity with local culture and language made it easier for them to communicate and associate with the people. This played a key role in the proper implementation of CLTS and helped in making the region ODF.

A longitudinal study was carried out to understand the adoption issues of CLTS and its post-adoption impact. To understand the adoption issues, the latent constructs were identified using a literature review. The TRA and TPB models were found suitable to study the adoption and post-adoption issues. Exploratory factor analysis (EFA) was carried out to find out the valid number of the latent component in the questionnaire items. Based on EFA, eight latent constructs were identified as shown in the conceptual framework. Items were assigned to these latent constructs and confirmatory factor analysis (CFA) was carried out to validate the measurement of the latent factors. The methodology used (SEM) is coherent to the steps suggested by Sarstedt et al. 2016 The steps include identifying the conceptual variable and then identifying the exact methodology (CBSEM) (Figure 3).

### Questionnaires design

Drawing upon TRA and TPB a 61 item questionnaire was designed to measure the latent constructs. EFA reveals that out of 61 items only 31 items were loaded adequately on the latent constructs (Table 4)

### Data collection

Data was collected from 585 respondents residing in various ODF villages in Dantewada district of Chattisgarh and Malda and Cooch Behar districts of West Bengal between December 2019 and April 2020. A well-designed questionnaire making use of various rating scales was prepared in local languages to accomplish this objective. It added to the convenience of respondents and helped in obtaining their unrestrained feedback. The services of a local language translator were also taken to further facilitate this process.

### Structure equation modelling

All the constructs that are measured were first-order latent constructs. The measured value against the respective items is shown in Table 3. The output of the model is shown in Figure 3. SEM was conducted using lavaan package. The output model generated is presented in Figure 4.

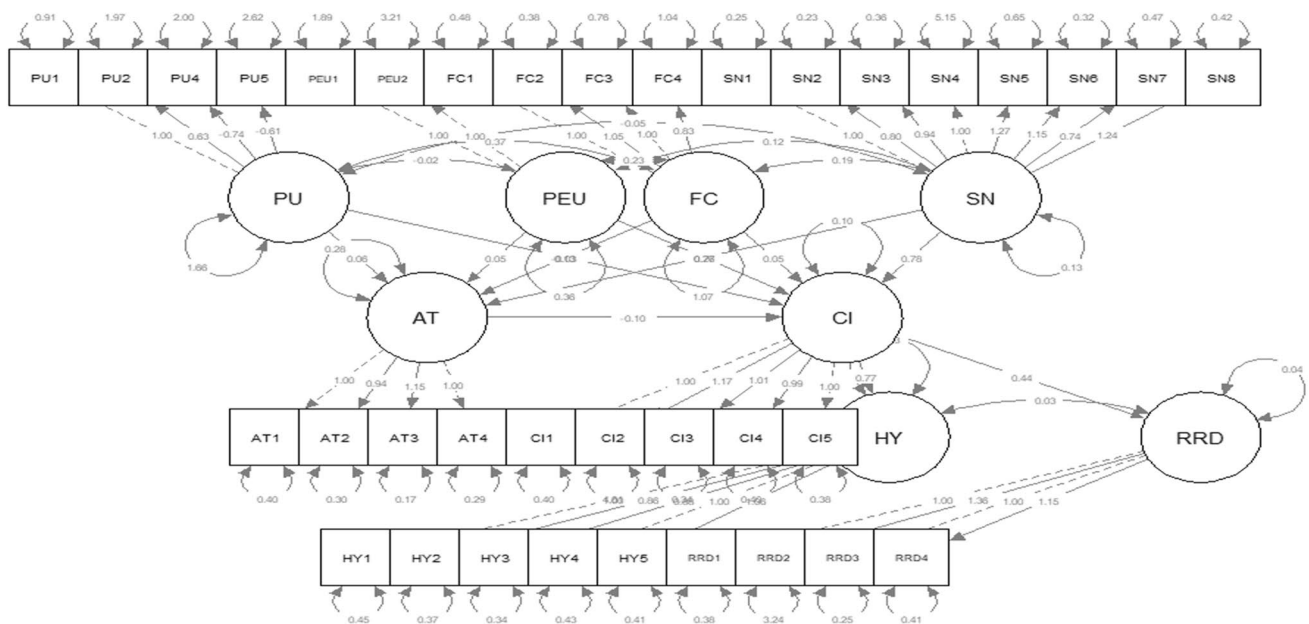
### Measurement models

The latent constructs of the model (PU, PEU, FC, AT, SN, CI, HY, and RRD) were measured using SEM using the pre-existing scale (15% of questions were changed). The scale for the measurement of RRD was developed by the authors; prior to using the scales, a pilot study was

**Table 4** Latent variable constructs

Latent variables	Estimate	Std. Err	z-value	<i>P</i> (> z )
PU =~				
PU1	1			
PU2	1.49	0.191	7.784	0
PU3	0.76	0.134	5.682	0
PEU =~				
PEU1	1			
PEU2	0.599	0.203	2.955	0.003
PEU3	2.555	0.612	4.173	0
FC =~				
FC1	1			
FC2	0.74	0.191	3.882	0
FC3	0.803	0.205	3.916	0
FC4	0.899	0.206	4.371	0
FC5	1.416	0.27	5.247	0
FC6	1.738	0.311	5.589	0
FC7	0.999	0.235	4.241	0
AT =~				
AT1	1			
AT2	1.389	0.303	4.591	0
AT3	1.627	0.345	4.718	0
AT4	2.328	0.458	5.082	0
SN =~				
SN1	1			
SN2	0.816	0.084	9.716	0
SN3	0.407	0.059	6.842	0
SN4	0.42	0.064	6.531	0
CI =~				
CI1	1			
CI2	1.784	0.367	4.862	0
CI3	0.927	0.247	3.757	0
HY =~				
HY1	1			
RRD =~				
RRD1	1			
RRD2	0.799	0.264	3.031	0.002
RRD3	1.408	0.295	4.765	0
RRD4	1.012	0.303	3.345	0.001
RRD5	1.546	0.323	4.787	0
RRD6	0.663	0.231	2.874	0.004

conducted to observe its reliability. The authors tested multiple models for a better fit. The measurement loadings of the few constructs (highlighted in yellow color) in model 1 were below or above the required cutoff and were hence deleted in model 2. It is evident that model 2 exhibits a good model fit and better reliability (Table 5). It is a good fit model for further analysis.



**Fig. 4** Structure equation modeling

### Model validity

The goodness of model 2 has rendered adequate model validity (Table 6); the authors followed the steps to check the common method bias and discriminant validity of the CBSEM as suggested by Hair et al. (2006). Harman's single factor test was run to examine the common method bias. It revealed that the maximum variance explained by the considered study variables was 29.11%. This proves that common method bias is not an issue since the retrieved variance explanation value is much less than the recommended threshold value of 50%.

Confirmatory factor analysis was carried out for examining the validity and reliability of the study constructs. To begin with, the composite reliability and Cronbach's alpha values for study measures were greater than 0.70 (Fornell and Larcker 1981).

### Path model

The path model is based on model 2 which has shown an adequate model fitness and validity. The results of the path model are shown in Figure 5. The path model shows the results of the hypotheses and their significance (Refer to Table 9 for hypothesis results). The regression results of the path model are provided in Table 8.

### Data analysis and results

Discriminant validity of the latent constructs is the extent to which a latent variable discriminates from other latent

variables. The AVE assessment is the extent of variation that a construct can explain in the observed variables to which it is theoretically related. If the AVE for each construct is greater than its shared variance with any other construct, discriminant validity is supported (refer to Table 7) (Farrell 2010) (Tables 8 and 9).

### Group analysis

The adoption of CLTS was also analyzed in groups (males and females). The results of group analysis are shown in Table 10. The results show that the subjective norms are significant in the male group, while they are not significant in the female group at 95% level of confidence; the same difference could be observed for perceived ease of use (refer to the highlighted numbers in Table 10).

### Theoretical contributions and implications of research

The study has attempted to explore the crucial role that Community-Led Total Sanitation plays in improving the health and hygiene in tribal communities and decreasing the risk of spread of epidemic diseases. The proposed hybrid model can yield outstanding results provided it is strategized and implemented with a judicious mix of responsiveness, transparency, and accountability. There is sufficient evidence in the study to affirm that CLTS as a participatory approach sensitizes the community and makes it aware of the ill effects that poor sanitation has on the health and life of people.

**Table 5** Measurement models

Latent variables	Model 1			
	Estimate	Std. Err	z-value	P (> z )
PU =~				
PU1	1			
PU2	0.688	0.072	9.505	0.000
PU3	-0.325	0.063	-5.16	0.000
PU4	-0.796	0.079	-10.038	0.000
PU5	-0.555	0.075	-7.429	0.000
PU6	-0.131	0.066	-1.986	0.047
PEU =~				
PEU1	1			
PEU2	1.146	0.29	3.958	0.000
FC =~				
FC1	1			
FC2	1.169	0.07	16.797	0.000
FC3	1.575	0.083	19.071	0.000
FC4	1.278	0.074	17.22	0.000
AT =~				
AT1	1			
AT2	1.235	0.086	14.431	0.000
AT3	1.495	0.095	15.759	0.000
AT4	1.559	0.1	15.607	0.000
SN =~				
SN1	1			
SN2	0.829	0.095	8.723	0.000
SN3	0.984	0.116	8.498	0.000
SN4	2.121	0.359	5.907	0.000
SN5	1.586	0.165	9.597	0.000
SN6	1.374	0.132	10.409	0.000
SN7	0.77	0.116	6.633	0.000
SN8	1.454	0.145	10.011	0.000
CI =~				
CI1	1			
CI2	1.989	0.393	5.059	0.000
CI3	1.788	0.202	8.845	0.000
CI4	1.867	0.211	8.857	0.000
CI5	2.474	0.264	9.358	0.000
HY =~				
HY1	1			
HY2	1.085	0.131	8.262	0.000
HY3	1.076	0.129	8.333	0.000
HY4	1.521	0.167	9.101	0.000
HY5	1.33	0.153	8.689	0.000
RRD =~				
RRD1	1			
RRD2	2.21	1.15	1.921	0.055
RRD3	5.204	1.709	3.044	0.002
RRD4	4.725	1.546	3.057	0.002
Latent variables	Model 2			
	Estimate	Std. Err	z-value	P (> z )

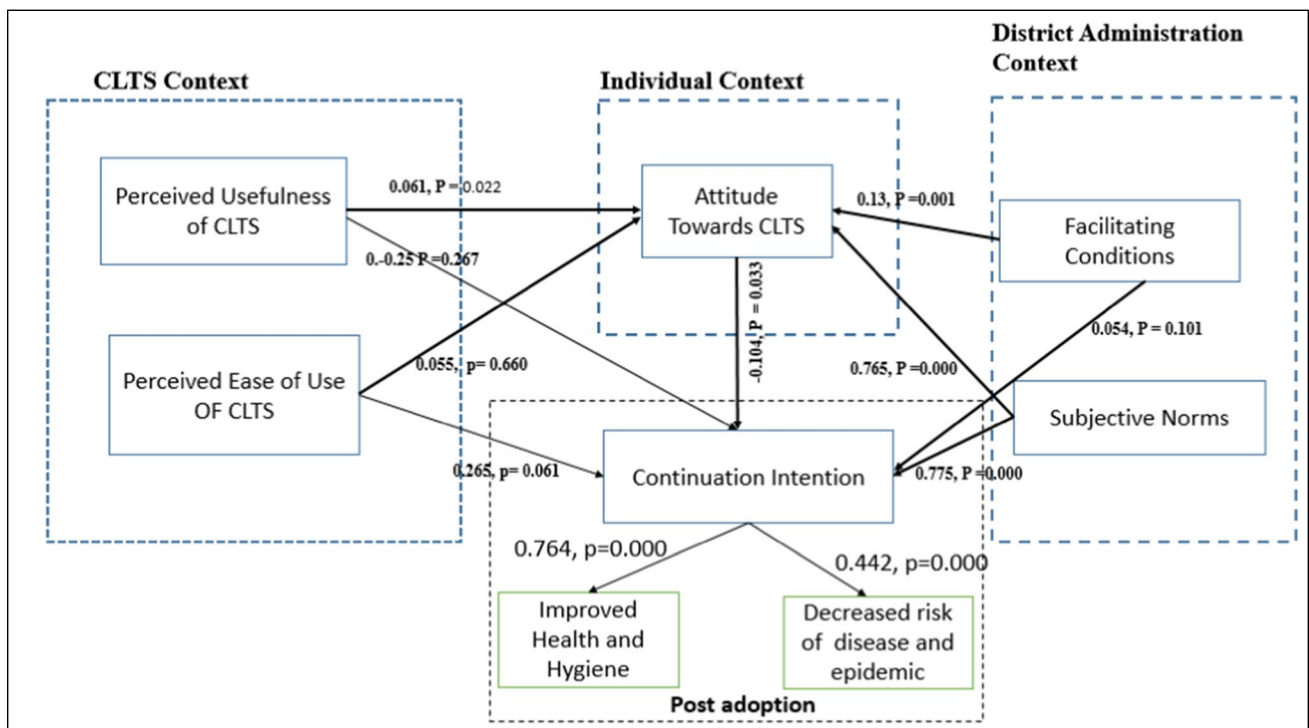
**Table 5** (continued)

PU =~				
PU1	1			
PU2	0.627	0.069	9.119	0.000
PU4	-0.738	0.076	-9.768	0.000
PU5	-0.606	0.074	-8.239	0.000
PEU =~				
PEU1	1			
PEU2	1			
FC =~				
FC1	1			
FC2	1.0	0.04	26.705	0.000
FC3	1			
FC4	0.83	0.048	17.244	0.000
AT =~				
AT1	1			
AT2	0.942	0.046	20.483	0.000
AT3	1.0	0.046	24.812	0.000
AT4	1			
SN =~				
SN1	1			
SN2	0.798	0.08	9.926	0.000
SN3	0.941	0.098	9.605	0.000
SN4	1			
SN5	1.0	0.132	9.609	0.000
SN6	1.0	0.104	11.034	0.000
SN7	0.737	0.1	7.357	0.000
SN8	1.0	0.117	10.663	0.000
CI =~				
CI1	1			
CI2	1.0	0.203	5.783	0.000
CI3	1.00	0.068	14.829	0.000
CI4	0.993	0.071	14.013	0.000
CI5	1			
HY =~				
HY1	1			
HY2	0.862	0.079	10.918	0.000
HY3	0.878	0.077	11.336	0.000
HY4	1			
HY5	1.0	0.088	12.039	0.000
RRD =~				
RRD1	1			
RRD2	1.0	0.307	4.444	0.000
RRD3	1			
RRD4	1.0	0.133	8.649	0.000

It is today that nudge is widely deployed by the policy-makers for the establishment of sanitation facilities. Behavioral operations management is an emerging area of research that makes use of human experiments especially when it is imperative to enforce nudge for the society at large (Bendoly et al. 2006). CLTS is a nudge to improve the sanitation

**Table 6** Fit indices

Fit indices' analysis of the research model	Model fit	Reference index (Upadhyay and Kumar 2020)	Source
$\chi^2/df$	2.16	<3	Barrett (2007); Falke et al. (2020); Oberski (2014); Rosseel et al. (2017)
Goodness-of-fit index (GFI)	0.8973	>0.9	Barrett (2007); Falke et al. (2020); Oberski (2014); Rosseel et al. (2017)
Adjusted goodness-of-fit index (AGFI)	0.8777	>0.9	Barrett (2007); Falke et al. (2020); Oberski (2014); Rosseel et al. (2017)
Normed fit index (NFI)	0.894	>0.9	Barrett (2007); Falke et al. (2020); Oberski (2014); Rosseel et al. (2017)
Bentler–Bonnet non-normed fit index (NNFI)	0.933	>0.9	Barrett (2007); Falke et al. (2020); Oberski (2014); Rosseel et al. (2017)
Tucker–Lewis index (TLI)	0.933	>0.9	Barrett (2007); Falke et al. (2020); Oberski (2014); Rosseel et al. (2017)
Comparative fit index (CFI)	0.94	>0.9	Barrett (2007); Falke et al. (2020); Oberski (2014); Rosseel et al. (2017)
Standardized root mean square error of approximation (SRMR)	0.049	<0.08	Barrett (2007); Falke et al. (2020); Oberski (2014); Rosseel et al. (2017)



**Fig. 5** Path model

conditions in tribal communities and decrease the risk of spread of epidemic diseases. The results of the study indicate that even if the perceived ease of use of practicing CLTS is not significantly associated with the attitude towards CLTS, the perceived usefulness of this nudge is playing a prominent role in its adoption. Facilitating conditions and subjective

norms are two important behavioral aspects that are essential to managing this nudge.

The results indicate that though facilitating conditions may not be significantly associated with the continuation intention of CLTS, they have a marked influence on the attitude towards CLTS. It is also evident that subjective norms



**Table 7** Correlation matrix (diagonal value represents AVE)

	PU	PEU	FC	AT	SN	CI	HY	RRD
PU	<b>0.46</b>							
PEU	-0.02915	0.56						
FC	0.27562	0.362513	<b>0.62</b>					
AT	0.130328	0.352131	0.466467	<b>0.77</b>				
SN	-0.1041	0.547508	0.498815	0.539544	<b>0.88</b>			
CI	-0.11906	0.613298	0.420721	0.318205	0.716614	<b>0.76</b>		
HY	-0.10863	0.559552	0.383851	0.290319	0.653814	0.912366	<b>0.97</b>	
RRD	-0.08694	0.447834	0.307213	0.232355	0.523276	0.730205	0.884681	<b>0.90</b>

The bold values signify the validity

and perceived usefulness of CLTS are playing a partial mediating role between attitude towards CLTS and the continuation intention of the CLTS.

**Table 8** Regression analysis

Regressions	Model 1			
	Estimate	Std. Err	z-value	P (> z )
AT ~				
PU	0.039	0.021	1.908	0.056
PEU	0.065	0.107	0.615	0.539
FC	0.095	0.038	2.51	0.012
SN	0.688	0.141	4.892	0.000
CI ~				
PU	-0.008	0.014	-0.604	0.546
PEU	0.157	0.093	1.689	0.091
AT	-0.075	0.039	-1.952	0.051
FC	0.036	0.026	1.41	0.159
SN	0.418	0.108	3.882	0.000
HY ~				
CI	1.03	0.146	7.074	0.000
RRD ~				
CI	0.167	0.059	2.847	0.004
Regressions:	Model 2			
	Estimate	Std. Err	z-value	P (> z )
AT ~				
PU	0.061	0.026	2.298	0.022
PEU	0.055	0.124	0.441	0.660
FC	0.13	0.038	3.455	0.001
SN	0.765	0.16	4.782	0.000
CI ~				
PU	-0.025	0.023	-1.11	0.267
PEU	0.265	0.142	1.872	0.061
AT	-0.104	0.049	-2.133	0.033
FC	0.054	0.033	1.64	0.101
SN	0.775	0.161	4.814	0.000
HY ~				
CI	0.767	0.055	13.957	0.000
RRD ~				
CI	0.442	0.043	10.214	0.000

### Practical insights and discussion

An effort has been made in this study to analyze the perception and challenges of CLTS implementation and the post-adoption benefits that can be derived through it. The major factors that affect the CLTS implementation were studied, and a hybrid model based on the technology acceptance model (TAM) and theory of planned behavior (TPB) that would help ascertain the pre-adoption and post-adoption behavior was established. The results of the study indicate that CLTS triggers the community to adopt better sanitation and hygiene practices. The community takes ownership of the entire program to improve the sanitation conditions within the region. Once the community understands the importance of better sanitation and hygiene practices, the usage of toilets is automatically ensured. Since the community leads the program and most of the people voluntarily help each other, a lot of labor cost gets saved. CLTS is scalable and an easy to replicate process; residents of neighboring communities and villages visualize and feel the changes that are offered by open defecation free environment. This automatically triggers the residents of nearby villages and habitations to collectively wish and make their habitations open defecation free.

The process brings about a change in the behavior of the community, feelings of disgust and shame trigger the individuals, and they collectively decide to end open defecation and adopt better practices thereby preventing personal, social, economic, and environmental hazards that are caused due to open defecation.

CLTS is a community-based inclusive approach through which the marginalized and other vulnerable individuals, families, and groups are brought together into the program. Since the approach focuses on totality, every person of the community is connected and involved in the social transformation towards sanitation and hygiene. The collective behavioral change, construction of good quality toilets, and their usage are the key drivers that make the CLTS approach sustainable. Once individuals change existing habits and adopt better hygienic practices, they continue throughout their life. The benefits accrued further strengthen the roots

**Table 9** Hypotheses

Hypothesis		Results
H1a	Perceived usefulness of CLTS is positively associated with attitude towards CLTS	Supported
H1b	Perceived usefulness of CLTS has positively associated with continuation intention of CLTS	Not significant
H2a	Perceived ease of use of CLTS is positively associated with attitude towards CLTS	Not significant
H2b	Perceived ease of use of CLTS has positively associated continuation intention of CLTS	Not significant
H3	Attitude towards CLTS is positively associated with continuation intention of CLTS	Supported but opposite
H4a	Facilitating conditions of CLTS is positively associated with attitude towards CLTS	Supported
H4b	Facilitating conditions of CLTS is positively associated with continuation intention of CLTS	Not significant
H5a	Subjective norms of CLTS is positively associated with attitude towards CLTS	Supported
H5b	Subjective norms of CLTS is positively associated with continuation intention of CLTS	Supported
H6	Continuation intention of CLTS is positively associated with improved health and hygiene	Supported
H7	Continuation intention of CLTS is positively associated with decreased risk of diseases and epidemic	Supported

**Table 10** Group analysis

Regressions	Group 2		Female (122)	
	Estimate	Std. Err	z-value	P (> z )
AT ~				
PU	0.023	0.096	0.242	0.809
PEU	0.042	0.282	0.147	0.883
FC	0.177	0.085	2.09	0.037
SN	0.427	0.257	1.662	0.097
CI ~				
PU	0.028	0.087	0.328	0.743
PEU	0.802	0.36	2.227	0.026
AT	-0.055	0.106	-0.522	0.602
FC	-0.034	0.088	-0.39	0.697
SN	0.062	0.288	0.216	0.829
HY ~				
CI	0.829	0.123	6.753	0.000
RRD ~				
CI	0.564	0.102	5.512	0.000
Regressions: Group 1				
	Estimate	Std. Err	z-value	P (> z )
AT ~				
PU	0.046	0.024	1.898	0.058
PEU	0.054	0.137	0.393	0.694
FC	0.097	0.043	2.235	0.025
SN	1.041	0.234	4.444	0.000
CI ~				
PU	-0.042	0.022	-1.898	0.058
PEU	0.267	0.166	1.609	0.108
AT	-0.078	0.057	-1.354	0.176
FC	0.059	0.039	1.503	0.133
SN	0.802	0.235	3.41	0.001
HY ~				
CI	0.734	0.058	12.668	0.000
RRD ~				
CI	0.373	0.044	8.48	0.000

of such collective transformation at the community level at large thereby improving the health and hygiene conditions and decreasing the risk of spread of epidemic diseases.

## Limitations and further research

The study provides sufficient evidence that sustained behavior change can bring about community transformation through the implementation of CLTS thereby enhancing the health and hygiene conditions and decreasing the risk of epidemic diseases. However, despite these advantages, certain limitations pose challenges and hamper the successful implementation of CLTS. To make the habitation open defecation free effective triggering at the community level is required. The failure to do so makes it even difficult to facilitate collective decision-making and improve the sanitation conditions.

Community facilitators also have an important role to play towards the success of this process. They should be experienced and must possess a proper understanding of the culture, practices, beliefs, values, languages, and other behavioral aspects. Inexperienced facilitators may not be able to make the required impact at the community level and desired results may not be achieved.

In addition to the above, political and social interference or resistance may prove to be a serious bottleneck during the CLTS implementation stage. Such interferences often mislead the community and slow down the ongoing momentum. The success of CLTS largely depends on how effectively the community leads the program within its habitation; any external interference may disturb the entire process.

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Paritosh Pathak: Sample collection, methodology, data curation, interpretation, writing-original draft preparation, and visualization.

Anup Kumar: Software application, analysis, visualization, and editing

Prashant Pandey: Interpretation and analysis for environmental aspects and draft preparation.

**Data availability** Not applicable.

## Declarations

**Ethics approval and consent to participate** No ethical issue.

**Consent for publication** Not applicable in this section.

**Competing interests** The authors declare no competing interests.

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