

Research Paper

Functioning of community sanitary complexes in rural India: Insights into selected states

William Joe^{a,*}, Ruby Alambusha^a, Bevin Vijayan^a, M. Sabarisakthi^a, Sandip Surwade^a, Abhishek Kumar^a, Sujoy Mojumdar^b and Koushiki Banerjee^b

^a Population Research Centre, Institute of Economic Growth, Delhi University Enclave (North Campus), Delhi 110007, India

^b UNICEF India Country Office, Lodhi Gardens, Lodhi Estate, New Delhi, Delhi 110003, India

*Corresponding author. E-mail: william@iegindia.org

ABSTRACT

An important component of the Swachh Bharat Mission is the construction of community sanitary complexes (CSCs) to address the unmet need for sanitation for households. The success, however, critically hinges on the operational management of CSCs. We examine the functioning status of CSCs in rural areas of five Indian states. Furthermore, we study the association between alternative management arrangements with the functioning and maintenance status of the CSCs. A principal component analysis-based CSC functioning index is created based on the maintenance indicators and sanitary items to identify better-performing CSCs. The mixed-effects logistic regression analysis was applied to examine the association between management arrangement for maintenance and CSC functioning index. Four in every five CSCs were directly managed by the Gram Panchayat. Over 90% of the CSCs have running water supply but electricity connection and lighting arrangement were available in 66.1 and 55.1% CSCs, respectively. The econometric analysis finds that CSCs managed by worship area groups or those managed by village CSC user-groups have better CSC maintenance status. The cleaning frequency of the CSC has a significant association with CSC functioning status. The operational management of CSCs is an area for further policy attention for sustained community sanitation efforts.

Key words: community sanitary complexes, Gram Panchayat, logistic regression, principal component analysis, Swachh Bharat Mission

HIGHLIGHTS

- Over 90% of the CSCs have running water supply.
- Electricity connection was available in 66.1% CSCs, whereas lighting arrangements were noted in 55.1% CSCs.
- CSCs managed by worship area groups or by village CSC user-groups have better maintenance status.
- Maintenance arrangement that involves user-groups (in addition to GP) have better-performing CSCs.
- Cleaning frequency is significantly associated with CSC functioning status.

INTRODUCTION

Sanitation is an essential aspect of public health and environmental sustainability. Recognizing that poor sanitation can contribute to the spread of infectious diseases, Sustainable Development Goal (SDG 6) emphasizes the importance of sustainable water management and access to sanitation for all (UN 2019). Improved hygiene practices are essential to prevent the transmission of diseases and promote public health (Leal Filho *et al.* 2018; Pal *et al.* 2018). In addition to its public health benefits, sanitation can also contribute to gender equality by addressing the disproportionate effects of inadequate sanitation on women and girls (Giné-Garriga *et al.* 2017).

Equitable access to improved sanitation facilities hitherto was a long-standing developmental concern of India (Asian Development Bank 2009). The focus on the Water, Sanitation, and Hygiene (WASH) sector, nevertheless, gathered much-needed momentum after the launch of the *Swachh Bharat* Mission (SBM or Clean India Mission) by the Honourable Prime Minister of India on October 2, 2014. The SBM is the flagship sanitation campaign of the Government of India aiming at mass-scale behaviour change, construction of household- and community-owned toilets, and strengthening solid and liquid waste management (SLWM) (Government of India 2020). Through these mechanisms, rural sanitation coverage

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increased significantly, and by 2019, Indian villages achieved the milestone open defecation-free (ODF) status thus decimating the chances of faecal oral transmissions (Behera *et al.* 2021).

To ensure sanitation for all, the SBM Phase II (2020–2025) furthers the WASH sector agenda and aims to achieve ODF Plus status by strengthening SLWM, promoting environmental hygiene, and sustaining the ODF gains to ensure that no one is left behind. The SBM has two sub-missions for rural and urban areas, namely SBM (*Grameen* or Rural) and SBM (Urban). An important component of SBM(G) is the construction of community sanitary complexes (CSCs) to address the unmet need for sanitation for households that do not have individual household latrines due to space constraints. The focus is also on the floating population and large congregations of people in areas such as markets, places of worship, seasonal fairs, or around public events such as marriage processions and public gatherings such as village council or *Gram Sabha* meetings (Government of India 2020). Further details about CSC under SBM Phase II are included in the Supplementary material.

CSCs are an indispensable element of rural infrastructure and are necessary to ensure the complete end of open defecation. It is worth noting that community facilities are less accessible for certain groups, particularly women, children, and differently-abled persons (Van Leeuwen & Torondel 2018; Abdul *et al.* 2019; Pariyar *et al.* 2022). Hence, the focus on community-planned and -managed toilets is instrumental to improve access for all (Kar & Chambers 2008). The availability of community toilets is also crucial to support the freedom and privacy of women and girls (Kar & Pasteur 2005).

The policy focus on CSC aligns with the global concern that community sanitation is critical to promote environmental sustainability (Prescott *et al.* 2021). Notwithstanding relevance, the success in community sanitation critically hinges on the operational management of CSCs that require sustainable solutions. The practice of toilet adoption comes from providing the right kinds of toilet design (Devine 2009; O'Reilly & Louis 2014). Studies have highlighted that community toilets are not always user-friendly for various reasons such as their design, maintenance, inadequate water supply, and timings (Bharat *et al.* 2020). Although community toilets can be constructed in several areas, the monitoring and management of such public goods is a difficult proposition (Cheng *et al.* 2018; Yan *et al.* 2021). Ensuring that community toilets remain clean, safe, and functional requires regular monitoring, cleaning, and repair activities (Yan *et al.* 2021). In some cases, the responsibility for managing these facilities may fall to local government authorities or community groups, who may struggle to allocate resources effectively. The maintenance and management issues are challenging, especially in rural areas where resources are limited.

Even in the Indian context, poor functioning and maintenance were key concerns that necessitated a shift toward community-managed sanitary complexes under SBM Phase II (Government of India 2020). The enthusiasm and commitment of the community, however, varies across sociocultural settings whereby community mobilization for such interventions can be an arduous task (Gupta & Pal 2008). In order to ensure the success and sustainability of community toilets, it is crucial to implement effective monitoring and management strategies. However, there is a dearth of research on the impact of different management arrangements on the functioning and maintenance status of CSCs.

Although the role of government, donor agencies, and other organizations is instrumental in sustaining the functioning, evolution of a suitable management structure is a prerequisite to anchor the initiatives. In India, village councils are adopting alternative management strategies to mitigate the operational and maintenance challenges of the CSCs (Government of India 2020). However, continuous engagement through such strategies is necessary to create awareness, modify behaviours, prevent slippage, and create ownership of resources created. While in most cases the onus is on the concerned Gram Panchayat (GP), there are instances of public–private partnership and other strategies to sustain the CSCs and achieve the long-term objectives in community sanitation (Kumar *et al.* 2011; Jonnalagadda & Tanniru 2014; Genet *et al.* 2020). Against this backdrop, this paper examines the association between alternative management arrangements and its association with the functioning and maintenance status of the CSCs in India. The evidence and insights are based on data from 354 CSCs from five Indian states, namely Andhra Pradesh, Assam, Chhattisgarh, Madhya Pradesh, and Gujarat. Before proceeding further, a brief overview of the CSCs initiative under SBM(G) Phase II is in order.

DATA AND METHODS

Sample design and implementation

The analysis is based on a CSC survey conducted across five selected states of India (Figure 1). The sampling unit of the study consists of 360 CSCs located in five selected states, namely Andhra Pradesh, Assam, Chhattisgarh, Gujarat, and Madhya

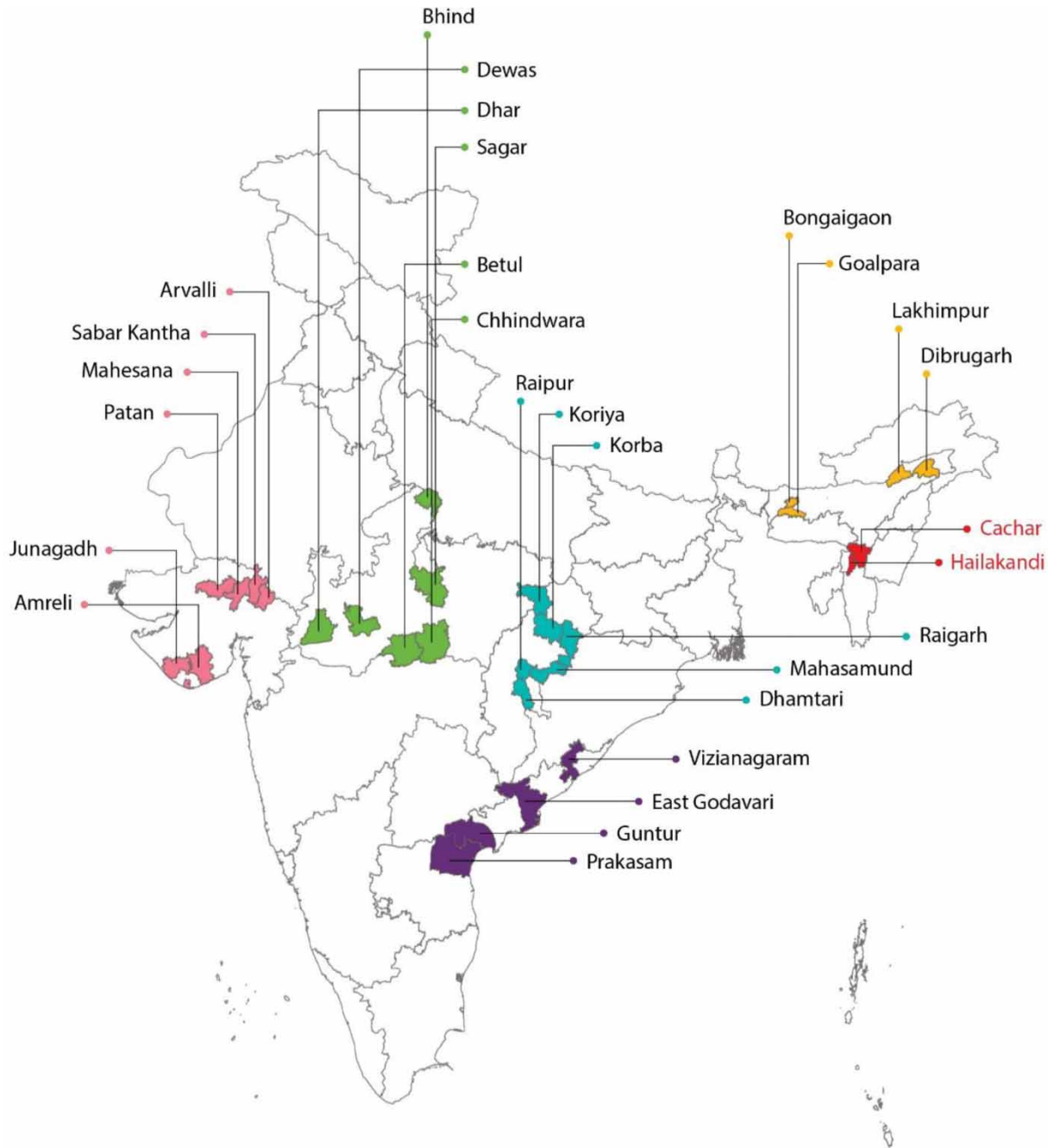


Figure 1 | States and districts selected for assessment.

Pradesh. The districts selected within the five states for the survey are as follows – Bongaigaon, Goalpara, Dibrugarh, and Lakhimpur in Assam; East Godavari, Guntur, Prakasam, and Vizianagaram in Andhra Pradesh; Raipur, Mahasamund, Dhamtari, Korba, Koriya, and Raigarh in Chhattisgarh; Amreli, Arvalli, Junagadh, Mehsana, Patan and Sabar Kantha in Gujarat; Betul, Chindwara, Bhind, Sagar, Dewas, and Dhar in Madhya Pradesh. The survey could not be conducted in Cachar and Hailakani districts in Assam due to floods.

CSCs were chosen to represent the sample population in the district. The selection of states aimed at the inclusion of dynamic geographical zones of the country and accordingly five states were selected (Andhra Pradesh, Assam, Chhattisgarh,

Gujarat, and Madhya Pradesh). The sample size was estimated using the following parameters:

$$n = \frac{Z^2 * P * (1 - P)}{d^2}$$

where n is the estimated sample size, P is the true but unknown population proportion, Z is the number of standard errors away from the mean. The quantity d is termed the precision and can be made as small as desired by simply increasing the sample size n . Here, Z is assumed to be 1.96 (covers 95% area under the normal curve or 95% confidence level) and the margin of error, d , is the relative error of 5% from the population proportion P . The above expression yields a sample size, n , of 384. However, we considered over-sampling of the CSCs across the states to allow for intra-cluster correlation. Finally, a sample of 360 CSCs for the survey was selected. However, interviews could be conducted with stakeholders at 354 CSCs. Additional details about sample size determination are included in the Supplementary material.

Outcome indicators

The functional and maintenance status of the CSCs was the main outcome variable of interest. The principal component analysis technique was applied to a set of 15 binary variables to create a CSC functioning index that describes the functional and maintenance status. This CSC functioning index is based on the following 15 indicators: electricity, running water, broomstick, brushes, buckets, mugs, soaps, washing powder or detergent, availability of cleaning staff (person), electric points for bulbs, handwashing sink, ramp for wheel-chair, railings for walking support, ventilation of all toilet units, and all toilet units in functional status. All these indicators were assigned a value of one in case that item and amenity are available at the CSC and zero otherwise.

Main explanatory variable

The type of management arrangement for the operations and maintenance of CSCs is the key explanatory variable of interest. The GPs provide minimum financial support for maintenance activities to the CSCs but the management groups are also independent to improve the functioning of the CSCs through their own resources and efforts. For analytical purposes, the following four categories were considered: (a) GP-managed CSCs, (b) CSCs managed by worship area groups, (c) CSCs managed by specific institutions and groups (schools, health centres, AWCs, SHGs, PPPs), and (d) CSCs managed by village level user-groups.

Correlates

The correlates related to the specific location of the CSC and the distance from the nearby village were considered as relevant factors in comprehending its functioning status. The latter determines the accessibility features by providing information on whether the CSC was constructed (a) within the village, (b) outside the habitation but with easy access, and (c) outside the village with access difficulties. The CSC location was categorized as follows: (a) within government buildings, (b) near schools, health centres, and AWCs, (c) public markets and bus stands, (d) near highway roads, and (e) away from public spaces. The analysis also explores the association between the frequency of cleaning of the CSC and the monthly payment for the cleaner. Finally, the information on average daily users is also used to assess its association with CSC functioning status.

Statistical analysis

Descriptive statistics on the key variables and correlates are presented. PCA is used on the 15 items (described above under the outcome variable) which form the core domain to assess the functioning status of the CSCs. PCA is a widely applied multivariate technique in which observations are described by several inter-correlated quantitative dependent (binary) variables (Filmer & Pritchett 2001). PCA extracts information from the inter-item correlations represented as new orthogonal variables called principal components. Before exploring the dynamics, the PCA-based CSC functioning index is tested for internal coherence and robustness. The Cronbach's alpha coefficient for the 15 binary coded items is computed to confirm the reliability of the items for the PCA (Cronbach 1951; Pallant 2020). The summary statistics for the 15 items used for the estimation of the first principal component are also reported. Since these variables are dichotomised (0 or 1), the weights are interpreted as marginal change (scoring factor for the item divided by its standard deviation) in the CSC maintenance index attributable to the change in the availability status of the specific CSC item (Filmer & Pritchett 2001). The

concentration index is used to describe the association of CSC item availability with the PCA-based CSC functioning index (Erreygers & Van Ourti 2011). Here, the concentration index ranges from -1 to $+1$ whereby a positive (negative) value indicates greater concentration among better (poor) functioning CSCs.

Finally, we apply multilevel logistic regression to examine the association between management alternatives and functional status of CSCs. The multilevel logistic regression uses the three-level nesting structure whereby the specific CSC, block and districts are identified for model hierarchy levels 1, 2, and 3, respectively. Three separate mixed-effects logistic models-based odds ratio and 95% confidence interval values are presented to comprehend the significance and attenuation in the association between CSC management and its functioning status. Model 1 presents the unadjusted associations, whereas Model 2 adjusts for the location of the CSC and Model 3 additional adjusts for CSC vicinity characteristics and number of users. The analysis is performed in Stata 17.0 using *xtmelogit* routine with the maximum likelihood option (Rabe-Hesketh & Skrondal 2008).

LIMITATIONS

The study has certain limitations. The evidence is based on a cross-sectional survey design and hence the associations may not necessarily imply causality. The survey was conducted across different climatic geographies which may have affected the status of the CSC during the data collection period. The survey was conducted with support from local authorities and hence the possibility of bias in CSC status cannot be ruled out as the visits were planned with prior information. The information on cleaner payment or regarding the average user of the CSCs is reported by the personnel responsible for operations and maintenance. However, no formal records were available or reviewed at the time of the visit. Furthermore, the study does not provide qualitative insights from stakeholders involved in the maintenance and management of CSCs which could have validated the better performance of certain CSC management groups as compared to other groups.

Ethical clearance

The study was reviewed and approved by the Ethics Committee of the Institute of Economic Growth, Delhi. Funding support for the study was provided by the UNICEF India country office.

RESULTS

With the exception of Assam, almost four in every five (77.1%) CSCs were directly managed by the GP (Table 1). In Assam, worship area groups (33.3%) and village CSC user-groups (30.0%) each manage one-third of the CSCs. About 5% of the CSCs were managed by specific institutions group, namely schools, health centres, or AWCs. More than two-thirds (69.5%) of the CSCs were located within the village area, 26.3% CSCs were located outside the village but with easy access, whereas 4.2% CSCs were both outside as well as distant from the village area. The CSCs were predominantly co-located with the GP building or office (41.0%). About 15% of the CSCs were co-located with specific institutions such as schools, health centres, or AWCs. Fifteen percent of the CSCs were located at market areas or bus or auto stands.

The distribution of key CSC items and features is reported in Table 2. Over 90% of the CSCs have water supply connections with ventilated toilet rooms. In 76.8% of the CSCs all toilet units are functional. Electricity connection was available in 66.1% CSCs whereas electric bulbs were noted in 55.1% CSCs. Almost three-quarters of the CSCs have mug, bucket, and hand-wash basin arrangements. Forty-one percent of the CSCs had a dedicated cleaner although the availability of key sanitary items was poor (washing powder 4.8%, soap 33.3%, brush 38.4%, and broomstick 27.4%). About one-quarter of the CSCs had ramps (26.0%) and only 13.3% had railings for providing walking support and convenience for the elderly and differently-abled persons.

State-wise variations were apparent in electricity connection whereby CSCs in Chhattisgarh (85.6%) and Madhya Pradesh (74.4%) had better provisions. The CSCs from these two states also had better availability of cleaning and sanitary materials (Table 2). The distribution of these key CSC items and features also varied by type of management arrangement for the CSCs (Figure 2). It is worth noting that village-user group-managed CSCs have a relatively low proportion of CSCs that have all toilet units functional (Supplementary material, Table S1). Also, such CSCs have fewer chances of keeping mugs and buckets. The availability of electricity connections and electric bulbs is also lower among these CSCs as well as among those managed by specific institution groups such as schools, health centres, or AWCs. About 45% of the GP-managed CSCs have a dedicated cleaner whereas this proportion is relatively low among other types of management arrangements.

Table 1 | Distribution (in %) of sample CSCs by management group and location characteristics

States	Andhra Pradesh	Assam	Chhattisgarh	Gujarat	Madhya Pradesh	All
CSC management group						
Gram Panchayats	76.9	23.3	93.3	79.6	94.4	77.1
Worship area groups	3.9	33.3	0.0	12.5	1.1	9.3
Specific groups (SHGs, Schools, AWCs etc.)	7.7	13.3	4.4	1.1	2.2	4.8
Village CSC user-groups	11.5	30.0	2.2	6.8	2.2	8.8
Ease of access to CSCs						
Within the village area	84.6	90.0	81.1	50.0	58.9	69.5
Outside village but nearby	7.7	10.0	16.7	44.3	34.4	26.3
Outside village and distant	7.7	0.0	2.2	5.7	6.7	4.2
Specific location of CSC						
Panchayat buildings	61.5	16.7	50.0	38.6	44.4	41.0
School, health centre, AWCs	15.4	28.3	8.9	8.0	21.1	15.5
Market or bus stands	0.0	11.7	16.7	11.4	23.3	15.0
Roads or highway	0.0	3.3	17.8	5.7	4.4	7.6
Other locations	23.1	40.0	6.7	36.4	6.7	20.9
<i>N</i>	26	60	90	88	90	354

Source: Authors (based on CSC survey).

Table 2 | Distribution (in %) of CSC features and items in sample CSCs

CSC Features	Andhra Pradesh	Assam	Chhattisgarh	Gujarat	Madhya Pradesh	All
All toilets functional	76.9	51.7	96.7	70.5	80.0	76.8
Broomstick	38.5	1.7	6.7	51.1	38.9	27.4
Brush	15.4	10.0	72.2	25.0	43.3	38.4
Bucket	65.4	76.7	78.9	76.1	65.6	73.5
Cleaner	23.1	15.0	70.0	19.3	56.7	41.2
Electric bulbs	38.5	46.7	70.0	38.6	66.7	55.1
Electricity	53.9	56.7	85.6	47.7	74.4	66.1
Hand-wash basin	61.5	78.3	88.9	59.1	92.2	78.5
Mug	69.2	70.0	88.9	75.0	92.2	81.6
Railing	3.9	3.3	2.2	2.3	44.4	13.3
Ramp	11.5	21.7	4.4	12.5	67.8	26.0
Soap	15.4	25.0	54.4	13.6	42.2	33.3
Ventilation	96.2	96.7	93.3	95.5	93.3	94.6
Washing powder	0.0	5.0	2.2	3.4	10.0	4.8
Water	88.5	91.7	95.6	95.5	96.7	94.6
<i>N</i>	26	60	90	88	90	354

Source: Authors (based on CSC survey).

The information on the 15 CSC items and features is used to develop the PCA-based CSC functioning index whereby CSCs in the top two quintiles are categorized as good-performing CSCs. The summary statistics of PCA analysis is presented in [Table 3](#). The PCA-based factor score has a mean of zero and a standard deviation of 1.69. The index is coherent (Cronbach's

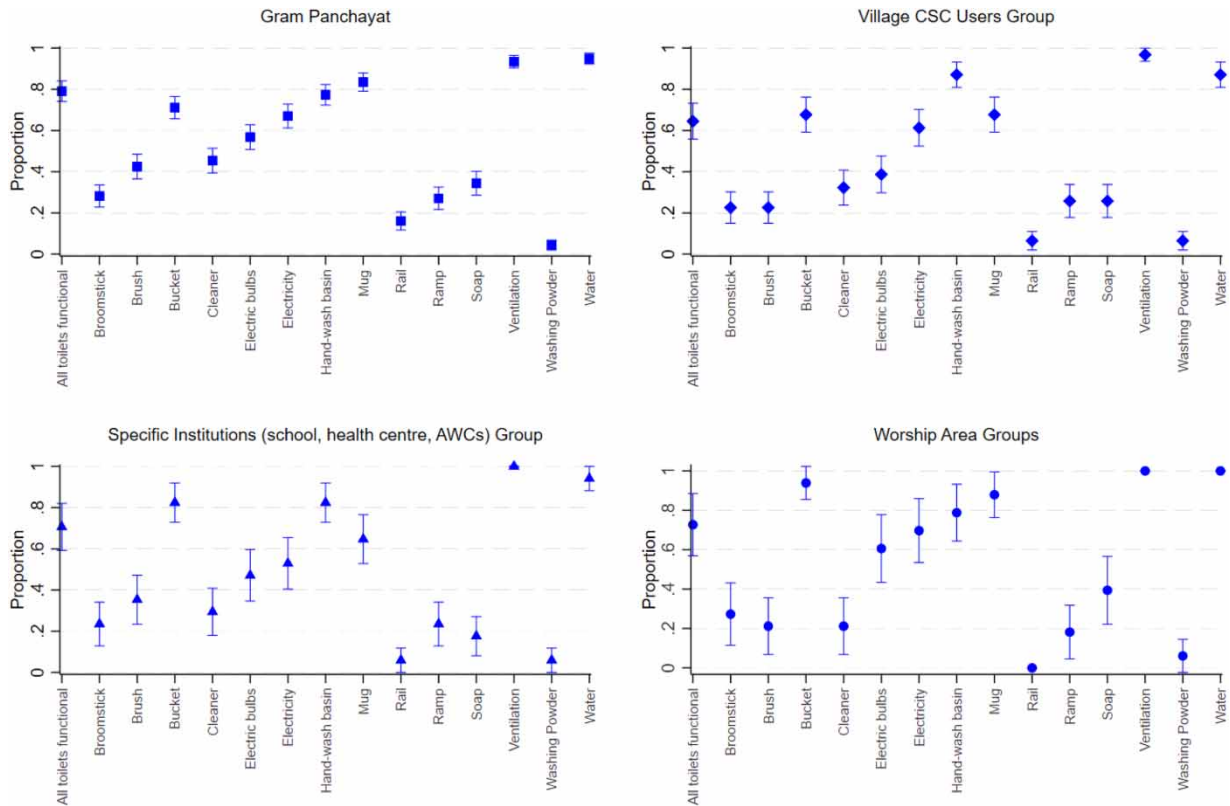


Figure 2 | Distribution (in %) of CSC features and items in sample CSCs by management arrangements.

Table 3 | Summary statistics for CSC items in the computation of first principal component

CSC Items	Scoring factor	Mean	SD	Weights	Mean (Lowest 20%)	Mean (Highest 20%)
All toilets functional	0.358	0.768	0.422	0.85	0.310	1.000
Broomstick	0.064	0.274	0.447	0.14	0.183	0.381
Brush	0.297	0.384	0.487	0.61	0.085	0.683
Bucket	0.209	0.734	0.442	0.47	0.465	0.905
Cleaner	0.386	0.412	0.493	0.78	0.028	0.968
Electric bulbs	0.371	0.551	0.498	0.74	0.070	0.984
Electricity	0.365	0.661	0.474	0.77	0.183	0.984
Hand-wash basin	0.245	0.785	0.411	0.60	0.521	0.984
Mug	0.299	0.816	0.388	0.77	0.479	1.000
Rail	0.112	0.133	0.340	0.33	0.042	0.270
Ramp	0.099	0.260	0.439	0.23	0.113	0.365
Soap	0.323	0.333	0.472	0.68	0.000	0.794
Ventilation	0.090	0.946	0.226	0.40	0.887	0.984
Washing powder	0.085	0.048	0.214	0.40	0.000	0.063
Water	0.161	0.946	0.226	0.72	0.845	1.000

Note: SD denotes standard deviation; weights or marginal effect is calculated as scoring factor/SD.
 Source: Authors (based on CSC survey).

alpha coefficient 0.65) and robust with the first principal component explaining 36.5% of the covariance. The CSC items are dichotomised (0 or 1), the weights reported in Table 3 can be interpreted as a marginal change in the CSC functioning index value attributable to a change in the status of the concerned item or feature. CSCs with all toilet units functional have highest weight (0.85) and similar higher weights are also accorded to items such as availability of cleaner (0.78), electricity (0.77), or water (0.72). Availability of broomstick has the lowest weight (0.14) in influencing the CSC functioning index score. CSCs in the lowest quintile typically have a lower presence of the selected CSC items and features (Supplementary material, Table S2). CSCs managed by specific institution groups have a relatively high share of CSCs in the bottom two quintiles of the CSC functioning index (Supplementary material, Table S3). CSCs located within the village boundary have more presence in higher quintiles. The concentration index values suggest that the availability of soap, washing powder, brushes, and electric bulbs is more concentrated among the better-functioning CSCs (Supplementary material, Table S4).

The mixed-effects logistic regression odds ratio shows that CSCs managed by worship area groups or those managed by village CSC user-groups have better CSC maintenance as per the CSC functioning index (Table 4). Model 1 shows that CSCs managed by the worship area group are 3.65 times (95% CI: 1.17–11.4) more likely to be better functioning CSC (in the top two quintiles) than those managed by GP directly. The association is consistent even in models adjusted for other CSC correlates. CSCs managed by specific institutions group (schools, health centres, AWC) do not have any advantage in CSC functioning over the GP-managed ones.

Table 4 | Mixed-effects logistic regression odds ratio for better performing CSCs by maintenance groups

Particulars	Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI
CSC management group						
Gram Panchayats	1.00	–	1.00	–	1.00	–
Worship area groups	3.65**	[1.17–11.4]	4.25**	[1.30–13.9]	3.66**	[1.05–12.7]
Specific groups (SHGs, Schools, AWCs etc.)	0.67	[0.15–2.96]	0.65	[0.14–2.98]	0.63	[0.13–3.13]
Village CSC user-groups	2.80*	[0.86–9.16]	2.87**	[0.89–9.31]	4.51**	[1.24–16.5]
Ease of access to CSCs						
Within the village area			1.00	–	1.00	–
Outside village but nearby			0.55*	[0.28–1.08]	0.65	[0.33–1.32]
Outside village and distant			0.36	[0.09–1.44]	0.56	[0.13–2.51]
Cleaner's payment						
Below Rs.3,000 per month			1.00	–	1.00	–
Rs.3,000 and above per month			1.84	[0.80–4.20]	1.30	[0.56–3.02]
CSC users (daily)						
10 users or below			1.00	–	1.00	–
11–25 users			1.08	[0.52–2.25]	0.74	[0.34–1.66]
Above 25 users			0.94	[0.43–2.02]	0.66	[0.28–1.51]
CSC cleaning frequency						
Fortnightly or monthly					1.00	–
Daily or on alternate days					10.9***	[3.76–31.5]
Weekly					6.21***	[2.12–18.2]
Random-effects parameter (variance)						
District level	0.023	[0.000–9,240.6]	0.048	[0.000–38.57]	0.102	[0.003–3.911]
Block level	0.206	[0.128–3.301]	0.160	[0.005–5.658]	0.080	[0.000–106.2]
N	354		354		354	

Note: *($p < 0.10$), **($p < 0.05$), and ***($p < 0.01$) denote significance levels. All models include an intercept term and are also adjusted for the state of CSC.

Model 2 adjusts for the location of CSC as well as correlates such as payment of the cleaner and the average daily user numbers. It is worthwhile to mention that CSCs that are located outside the village area are less likely to be in the better functioning category although the effect is not consistent across models. Model 3 further adjusts for the cleaning frequency of the CSC and finds a significant impact on CSC functioning status. When compared to CSCs that are cleaned less frequently (fortnightly or monthly or irregularly), CSCs that are cleaned daily or on alternate days are 10.9 times more likely to feature in the better-performing CSCs. Even CSCs ensuring weekly cleaning are better functioning than those which are infrequent. Table 4 also reports the variance component (random-effect parameters) and suggests that the bulk of the variation in CSC performance is attributable at the block level although Model 3 also finds substantial district-level variations.

DISCUSSION

Operational management of CSCs is of huge relevance for sustaining the sanitation agenda. Following are the five salient findings from the analysis of CSC management and functioning in the five selected states. First, most of the CSCs are managed by the GPs and are co-located within the GP building premises. Second, good-performing CSCs display greater availability of amenities (such as water and functional toilet seats) as well as cleaning and sanitary items. For instance, the availability of soap, washing powder, and brush is lower across CSCs but these products are more likely to be available in better-performing CSCs. Third, a substantial proportion of CSCs do not have electricity connections or electric points which can be a major barrier to facilitating greater use, especially by women and children. Fourth, CSCs managed by worship area groups or those managed by village CSC user-groups are relatively better functioning than those managed by GP or specific institution groups such as schools, health centres, or AWCs. Finally, the cleaning frequency of the CSCs is a key determinant of the functioning status of the CSCs.

The dominant insight of the study is twofold: (a) maintenance arrangement that involves user-groups (in addition to GP) having better-performing CSCs and (b) regular cleaning (daily or at least weekly) is a key marker of the functioning status of CSCs. It is apparent that maintenance arrangements and personnel involved in the maintenance activities are central to the sustainability of CSCs (Ssekamatte *et al.* 2019). Since CSC is a public property, users may lack the incentive and motivation to maintain it with the same care as individual latrines. Hence, the active involvement of the community in maintenance operations under SBM(G) is noteworthy (Government of India 2021). Nevertheless, most of the CSCs are directly managed by GPs across surveyed states except Assam. It is plausible that community users are not reluctant or lack the necessary impetus to lead the maintenance activities. There can be certain impediments in this regard such as insufficient mobilization in terms of financial arrangements from GPs for cleaning activities and lack of alternatives for engaging cleaning staff. While the SBM(G) guidelines provide for a sum of Rs. 300,000/- for the construction of CSC, there is no earmarking of funds for the operational expenses. While the GP has avenues to meet such expenses there has been very limited interest in exploring the user charges model for maintenance activities. This also reflects the challenges of raising resources from the community that can be associated with limited willingness to pay the users or the community for CSC maintenance (Van Minh *et al.* 2013; Mariwah *et al.* 2017). Mobilization of the village community for any intervention is a herculean task that heavily relies on the enthusiasm and support of the local leaders (Gupta & Pal 2008). Poor socioeconomic status of users and relative gaps in the fixation of such norms may also be inhibiting GPs to plan for user-charge-centric models for the maintenance of CSCs in rural areas.

McGranahan & Mitlin (2016) outline certain institutional challenges faced in community-driven initiatives to improve sanitation which include the motivation to foster collective action and the co-production challenge of working with formal service providers to dispose of sanitary waste safely. In this regard, capacity building of respective stakeholders is also identified as a key element for the management and functioning of CSCs. For this purpose, different approaches including participatory rural appraisals (PRA) by the *Gram Sabha* (village general assembly) are prescribed to motivate and strengthen community ownership of sanitation services (Kar & Pasteur 2005). However, community management also has to grapple with problems such as the indifference of the community or the GP or (village council) leaders (president or members) towards sanitation. While the GP urges for a regular grant-in-aid from the government for construction and maintenance activities, gaps in communication, coordination, and cooperation between the GP and the community are noted as deterrents in CSC management (Vijay & Ghosh 2018; Chidambaram 2020). High operation costs (including maintenance expenses) along with poor financial support (direct or indirect) are also apparent concerns in the sustainability of CSCs (Ssekamatte *et al.* 2019). The upkeep

and operations & management (O&M) of CSCs, therefore, must be based on innovative ideas (Pascoe 2015; Serlin 2017; Bharat *et al.* 2020).

Ensuring adequate procedural and financial support for maintenance expenses is essential for the sustainability of CSCs (Burra *et al.* 2003; Van Dijk *et al.* 2014). Community-managed CSCs are invigorated when their potential to avail or generate financial resources for the day-to-day management activities. Although the GPs can raise funds through alternative means to meet the cost of regular operations and maintenance of CSCs, such pragmatic provisions are yet to be fully harnessed (Government of India 2020). For instance, in Madhya Pradesh, it is noted that shops or commercial establishments selling groceries are attached to the CSC building during the construction process whereby the shopkeepers are either responsible for the CSC maintenance operations or pay a monthly rental to the GPs. However, there is also a considerable opportunity to generate income by allowing outer walls of the CSCs for advertisement or wall paintings, although it is not utilized in the surveyed states.

The location of the CSCs also has some bearing on the maintenance arrangements. Although the selection of location for CSC is a community demand-driven approach, usually co-location arrangements with government buildings are presumed as a viable alternative for routine maintenance activities. In such cases, the CSCs are mostly used by the employees and common visitors to such buildings and institutions (such as the GP office). Such provision may not necessarily bolster the objective of CSCs to reach out to the target group who are left behind in the drives for individual household latrine coverage. The location of the CSCs is also intricately linked to basic amenities such as water supply and electricity connections. Studies indicate that inadequate water supply in toilets is an important reason for underutilization of these latrines besides other reasons like unawareness of the presence of facility and sociocultural factors (Bhardwaj *et al.* 2013; Yogananth & Bhatnagar 2018; Abdul *et al.* 2019). Sufficient wall height, roofs, functional pans, doors, or other closures to ensure privacy are all noted to be important determinants of higher levels of toilet use (Barnard *et al.* 2013).

There are important policy implications of the findings. More significant efforts from the union and the state governments are desirable for creating awareness regarding the funding provisions and the motivation for enhanced funding support to the GPs for supporting sustained maintenance activities. Also, there are limited models and alternatives for CSC management. For instance, engagement with the self-help group is negligible but can be explored for CSC maintenance operations. Similarly, the GP can explore collaborating with the private sector for such initiatives. Furthermore, to ensure long-term support for CSC infrastructure, particularly water and electricity supply, all state governments should take ownership of provisioning and maintaining these basic amenities. The CSCs should be more responsive to the menstrual hygiene needs of women like – safe disposal facilities (dustbins with cover) and availability of sanitary napkin vending machines. Gender-sensitive toilet design should also be a way forward, especially in areas where it is essential to cater to the needs of all the genders like women, men, and the transgender community. Finally, monitoring of CSCs is difficult as it has to be done at each level, from the GP to the state level. Hence, technology-friendly monitoring efforts should be taken up for timely feedback and community awareness of hygiene standards.

CONCLUSION

CSCs are a necessary element of rural infrastructure to eliminate open defecation in villages. In this context, CSC construction under SBM(G) has been instrumental to address the unmet need for community sanitation. This study explored the maintenance of CSCs and highlighted the gaps and concerns related to the availability of essential cleaning items and amenities. It is apparent that community toilets are now increasingly becoming a key feature of Indian villages but monitoring and management of such public good is a difficult proposition. The location of the CSC and management arrangements for maintenance and cleaning activities are prominent concerns that also affect the accessibility of such services for certain groups, particularly women, children, people with disabilities, and those from marginalised backgrounds. Thus, to ensure holistic, safe, and sustainable sanitation in India, the focus on CSC operations and management should receive further policy attention. In the future, the research could concentrate on identifying alternative governance structures for CSCs and their corresponding financing models to enhance the functioning and maintenance of these facilities. Additionally, policymakers should establish a monitoring and evaluation framework to identify areas that need improvement and to ensure that community sanitation efforts are sustained.

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

CONFLICT OF INTEREST

The authors declare there is no conflict.

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