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Research Paper

# Service quality of household toilets in rural settlements of India: an assessment from the users' perspective

Mohammad Rashid and Debapratim Pandit

## ABSTRACT

User satisfaction with the perceived service quality of household toilets and its attributes is one of the important factors that affect users' attitudes towards toilet use. In this study, the perceived service quality of household toilets is assessed using data on users' satisfaction with individual service quality attributes and overall service quality in Gaya district of Bihar, India. The data collected from 723 households are analyzed using factor analysis and structural equation modeling (SEM). Then, an ordered logistic regression is applied to establish the relationship between the latent parameters and user satisfaction with the overall service quality of toilets. The latent factor, 'toilet structure' is found to be more important in users' assessment of the overall satisfaction followed by 'availability of water' and 'toilet maintenance'. The identified latent factors are further analyzed in terms of their variation across socioeconomic groups, which showed that households belonging to socioeconomically marginalized sections of society are dissatisfied with their toilets. The service quality of household toilets constructed using subsidies mostly by the socioeconomically marginalized households is perceived as poor. The study highlights the importance of different dimensions of household toilets which would help policy makers in designing more effective policies on rural sanitation.

**Key words** | household toilet, India, rural settlement, SEM, service quality, users' perception

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## INTRODUCTION

Discouraging the practice of open defecation and increasing the use of toilets in rural settlements are important goals for governments in developing countries, including India. Accordingly, policies are formulated towards influencing changes in attitudes and behaviors of people through increasing awareness and education and through the provision of subsidies for construction of household toilets with basic service quality (Snehalatha & Anitha 2012). Despite substantive efforts, demand for and use of toilets in India, particularly in rural areas, is not encouraging (Routray *et al.* 2015; Banerjee *et al.* 2016). While a considerable proportion of households are without toilets and defecate in the open, several existing toilet users are reverting to the practice of open defecation (Reddy *et al.* 2010). While toilet usage is directly influenced by the users' perception of the benefits and constraints of toilet use (O'Connell 2014; Hirve *et al.* 2015; Banerjee *et al.* 2016; Garn *et al.* 2017), studies have found that perceived service quality of toilets is one of the major factors influencing toilet adoption in India because it influences user beliefs about the benefits of toilet use (Jenkins *et al.* 2014; Okurut *et al.* 2015; Routray *et al.* 2015; Steinmann *et al.* 2015). Service quality represents an important concept in understanding the ways in which users appraise service provision (Morton *et al.* 2016) and

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project performance (Agarwal 2008; Tumwebaze *et al.* 2013; Jenkins *et al.* 2014). It is also important to identify the service quality attributes of household toilets that influence users' satisfaction with overall service quality based on their perspective, as users are the 'sole judges of service quality' (Berry *et al.* 1990).

User perception acts as a strong mediator and predictor of behavioral intention (Das & Pandit 2013; Morton *et al.* 2016) and could be used in developing policies that improve user satisfaction and result in improved sustainability and sustained use of delivered services (Agarwal 2008; Das & Pandit 2015; Morton *et al.* 2016), thus attracting new users and retaining the existing users of toilets. User perception also varies from person to person over space and time (Parasuraman *et al.* 1988; Bolaane & Ikgopoleng 2011; Mahmoud *et al.* 2011; Anthonj *et al.* 2016).

The present study aims to identify the relative importance of different service quality attributes of household toilets and their influence on satisfaction for overall service quality. Another objective of this paper is to understand how households' and users' attitudes towards various factors of household toilets vary with their socioeconomic background which would help decision makers to formulate appropriate policies for each target group. This study is a part of a larger study which was carried out in some selected villages of Gaya district in Bihar state, India with a sample size of 1,204. Of the total samples, 723 are used to analyze the perceived service quality of attributes of household toilets.

## RESEARCH BACKGROUND

Several rural sanitation programs have been undertaken in India starting with the Central Rural Sanitation Program (CRSP) in 1986 to Total Sanitation Campaign (TSC) in 1999 which was eventually renamed Nirmal Bharat Abhiyan (NBA) and now called Swachh Bharat Abhiyan (Clean India Mission) (MoDWS 2014). While CRSP focused on improving the sanitation services through the provision of subsidies for construction of household toilets, TSC was implemented, advocating a shift from a high to low subsidies regime and adoption of activities ensuring larger involvement of communities with a focus on bringing behavioral changes (Banerjee & Mandal 2011; MoDWS 2012). Subsidies for toilet construction are provided only to poor households mostly belonging to the category 'below the poverty line', who are allowed to select a toilet type and technology of their choice according to their financial capacity and its suitability to local geological and hydrological conditions (MoDWS 2012). The options are limited and need to adhere to a prescribed design to qualify for a subsidy (Clasen *et al.* 2012; Tremlet & Binder 2013). Despite these programs, the rate of toilet adoption and use is low in rural India (Routray *et al.* 2015; Banerjee *et al.* 2016).

The perceived social benefits of toilet use such as privacy, convenience, comfort, safety, security, and improvement in social status (Jenkins *et al.* 2014; O'Connell 2014) and the perceived social constraints of toilet adoption such as preference for open defecation, beliefs and values encouraging open defecation, and lack of education and awareness (Coffey *et al.* 2014; Hirve *et al.* 2015; Mara 2017) are the major determinants of toilet adoption in rural India. However, several studies have found that users' perception of service quality of toilets and its attributes is also an important constraint in toilet adoption and use (Clasen *et al.* 2014; Jenkins *et al.* 2014; O'Reilly & Louis 2014; Routray *et al.* 2015; Garn *et al.* 2017; O'Reilly *et al.* 2017).

Household toilets provided under sanitation programs are of basic service quality and are designed to move the poor families to the first rung of the sanitation ladder (O'Reilly *et al.* 2017) which often does not match with the household's expectations (Tremlet & Binder 2013; Coffey *et al.* 2014). The different toilet options provided under the sanitation programs are designed considering the attributes that define the technical specifications of toilet structures and ignore attributes related to the availability of water and toilet maintenance which are required for its sustained use (O'Reilly *et al.* 2017; Rashid & Pandit 2017). The service quality of household toilets delivered under the sanitation schemes is also compromised by inappropriate subsidy design in terms of both the amount of subsidy and its availability; that is, subsidies are sanctioned only for a particular type of toilet (Clasen *et al.* 2012; Tremlet & Binder 2013). Additionally, while several previous studies have examined the importance of various socioeconomic factors and service quality attributes of toilets such as toilet structure, maintenance, and water supply in influencing toilet use in India (Rashid & Pandit 2017) and other developing

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countries, to our knowledge none or very few of them have prioritized these from the users' perspective.

Researchers in the fields of transportation and hospitality, among others, have applied several approaches to measure perceived service quality and to establish the relative importance of service quality attributes (Martilla & James 1977; Parasuraman *et al.* 1988; Brady *et al.* 2002; Joewono & Kubota 2007; Eboli & Mazzulla 2009; Dell'Olio *et al.* 2010; Lai & Chen 2011; de Oña *et al.* 2013, 2015; Mahmoud & Hine 2013; Pandit & Das 2013; Xionghong *et al.* 2013; Eboli & Mazzulla 2015; Karnib 2015). These approaches can be classified as the stated importance approach and the approach of derived importance (de Oña *et al.* 2012). While stated importance is directly stated by the users, derived importance is determined by establishing a relationship between satisfaction for individual service attributes and satisfaction with overall service quality. Researchers have also argued that derived importance gives more accurate results than stated importance (de Oña & de Oña 2015). This paper applies a derived importance approach to identify the key attributes driving perceived user satisfaction with household toilets.

## METHODOLOGY

### Data collection

The service quality attributes for household toilets were adopted from Rashid & Pandit (2017) as shown in Table 1. Users' perception and their attitude towards selected service quality attributes were determined by conducting a household survey in six Gram Panchayats (administrative units comprising a few villages) of Gaya district in the state of Bihar, India using a stratified random sampling technique. The percentage of households having access to a toilet (4–66% of households) is used as criterion to stratify the Gram Panchayats of the district into six strata (Census of India 2011) to ensure inclusion of users with different levels of experience in using toilets. Then, one Gram Panchayat from each stratum is randomly selected for further study. Total sample size was determined to be 1,204 (including an additional 10% of samples with incomplete and no responses) considering the total number of rural households in the district. Next, the total number of samples have been allocated to the Gram Panchayats (first stratum) and each village (second stratum) of the Gram Panchayat in proportion to the total number of households in each stratum. Households within each village were selected randomly, and the interview was carried out with the head of the household and, in their absence, an adult member of the household present at the time of the survey. This is because the decision to construct or make an improvement in the existing toilets is primarily carried out by the household heads and adult members sometimes with or without consulting other family members due to traditional family hierarchy and values. The user perception data collected from survey respondents included (1) demographic and socioeconomic information and (2) level of satisfaction with overall perceived service quality of toilets and each service attribute as shown in Table 1. The level of satisfaction is measured on a five point Likert scale (5 = very satisfied to 1 = very dissatisfied).

### Data analysis

Users' perception of service quality is a subjective measure and depends on their perception of several unobserved and observed factors (Parasuraman *et al.* 1985). While the observed factors are the individual service quality attributes of household toilets, the unobserved dimensions/constructs are based on a group of factors representing similar or correlated attributes. Factor analysis, including both exploratory and confirmatory factor analysis (CFA), is the most suitable technique to find out the unobserved dimensions underlying the observed attributes (de Oña *et al.* 2013). While exploratory factor analysis (EFA) helps in identifying latent factor/s underlying a set of observed variables without pre-decided factor structure, CFA is used to verify the predetermined factor structure of a set of observed variables (Kim & Lee 2011; Lai & Chen 2011).

In the present study, the collected data is analyzed first using EFA with principal component analysis (PCA) and varimax rotation to identify the underlying factors under these attributes. Scale diagnostics Kaiser Meyer Olkin (KMO) test of sampling adequacy, Bartlett's test of sphericity and tests of internal consistency Cronbach's alpha ($\alpha$) and mean inter-correlation (MIC) between attributes are

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**Table 1** | Attributes and their descriptions selected for the study

| Sl no. | Attributes | Description |
|---|---|---|
| 1 | Location for toilet | Site of toilet with respect to dwelling area (attached/semi-attached/detached) |
| 2 | Adequacy of toilet | Number of toilets/household |
| 3 | Type of pan | Rural pan/Orissa pan/eco-san/western pan |
| 4 | Type of disposal system | Single pit/twin pit/septic tank/aqua privy/sewer/bore hole |
| 5 | Capacity of pit/tank | Cleaning interval of disposal pit/tank (years) |
| 6 | Type of wall | Brick/mud/wood/other |
| 7 | Type of roof | RCC/GI sheet/tiles/wood/others |
| 8 | Height of wall | Height of roof from toilet platform (feet) |
| 9 | Height of door | Height of door from platform of toilet (feet) |
| 10 | Type of door | Iron/wood/plastic/others |
| 11 | Space within toilet | Available space within toilet (square feet) |
| 12 | Ventilation | Size of ventilation (large/medium/small/no ventilation) |
| 13 | Distance to source of water | Time taken in traveling, waiting and operating the source of water used for water collection for the toilet (minutes) |
| 14 | Type of source of water for toilet use | Tap within toilet/outside toilet/community tap/hand pump/others |
| 15 | Convenience in water collection | Effort required in operating source of water, collecting and carrying water for flushing and cleansing toilet (little effort/medium effort/high effort) |
| 16 | Convenience in toilet cleaning | Time, cost and quantity of water required for cleaning of pan and area within toilet (little effort/medium effort/high effort) |
| 17 | Flushing mechanism | Ways of flushing feces after defecation (mechanical flush/pour flush/dry/no flush) |
| 18 | Maintenance convenience | Effort required for repairing/replacing the damaged parts of superstructure/substructure in terms of cost, time and labor (little effort/medium effort/high effort) |
| 19 | Convenience in emptying pit/tank | Time, cost and effort required for cleaning disposal pit/tank (little effort/medium effort/high effort) |

RCC, reinforced cement concrete; GI, galvanized iron.
*Source*: Rashid & Pandit (2017).

also performed. The MIC value of $\geq 0.2$ is considered to be good in explaining dimensionality and homogeneity of scale (Piedmont & Hyland 1993). Next, CFA with maximum likelihood specification is employed to evaluate the results of EFA further. The validity of the model is tested using Chi-square, the goodness of fit index (GFI), the aggregate goodness of fit index (AGFI), comparative fit index (CFI) and the root mean square error of approximation (RMSEA). Covariances between error terms of the attributes are analyzed to make improvements in the model fit indices. Factor analysis provides a score for each latent factor which is used to identify the user's preferences for individual aspects of the service (Morton *et al.* 2016). Factor scores for each latent factor are calculated using the regression method (Distefano *et al.* 2009) and the scores are assigned to each respondent for each construct in the manner in which they responded to the attribute that loads on each latent factor.

The factor score calculated for each latent parameter and each respondent is applied to assess the variation in the perceived quality of latent parameters across household types and socioeconomic groups (Morton *et al.* 2016). Non-parametric techniques of hypothesis testing are applied to test the variations as it is assumed that factor scores are not strictly normally distributed. The Mann-Whitney U test is employed when the comparison variable has two outcomes, and Kruskal-Wallis test is utilized when the comparison variable has more than two outcomes.

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The importance of different unobserved factors identified after factor analyses is ascertained using correlation and regression techniques. Multicollinearity between the factors is not a major issue since factors are finalized only after checking for significant cross loading of the attributes on the factors/constructs. This is further cross checked using variance inflation factor (VIF). Spearman's correlation is applied to identify the relationship between the factor scores obtained after CFA and the overall satisfaction with the quality of toilets. Finally, an ordered logistic regression is applied to determine the relative importance of the unobserved factors and their impact on overall satisfaction.

## RESULTS

### Descriptive statistics of survey respondents

The collected data were refined and cleaned in Excel and incomplete and no responses were removed from the data. After data cleaning, a total of 1,050 complete responses was obtained with 723 households reporting the availability of some form of toilet which was used to establish the relative importance of service quality attributes and user satisfaction. The data covered households and respondents belonging to different socioeconomic groups as summarized in Table 2. The majority of the households are headed by a male member who belongs to the age group of 30–49 years. Fifty-one percent of respondents have constructed their toilets with full or partial financial help from the government (Table 2).

**Table 2** | Socioeconomic information of survey respondents and households

| Socioeconomic groups | Percentage of respondents/households |
|---|---|
| Total sample size (in number) | 723 |
| Gender of respondents | |
| Male | 85 |
| Female | 15 |
| Age of respondents | |
| <30 years | 15 |
| 30–39 years | 36 |
| 40–49 years | 31 |
| ≥50 years | 18 |
| Education of respondents | |
| Illiterate | 21 |
| Up to class 5th | 17 |
| Up to class 8th | 22 |
| Up to class 10th | 16 |
| Up to class 12th | 15 |
| Graduation and above | 9 |
| Economic status of households | |
| Below poverty line (BPL) | 35 |
| Low income | 24 |
| Middle income | 23 |
| High income | 18 |
| Type of toilet of households | |
| Self-financed | 49 |
| Partially self-financed | 08 |
| Fully subsidized | 43 |

### Exploratory factor analysis

Initially, EFA using PCA was performed with all 19 attributes as shown in Table 1. Next, the attributes with a factor loading of less than 0.4 were removed from the analysis and another EFA was conducted. The results of the same are shown in Table 3 which indicates that service quality of household toilets is determined by three latent parameters. Each of these parameters is defined by attributes with a factor loading of 0.4 and more, the total variance explained (TVE) and a measure of internal consistency Cronbach's alpha ($\alpha$) and mean of inter-correlation of items (MIC). The identified parameters are distinct and different from each other as no significant cross loading of attributes appears on multiple constructs. Simultaneously, the constructs are reasonably internally consistent as the estimated alpha and MIC scores for each factor are satisfactory. The factor loadings of each attribute are highlighted in Table 3.

The results show that the first factor is explained by the technical attributes of household toilets including the attributes defining the sub- and superstructures of toilets. This factor explains 37% of the variance in the measurement scale. The second factor explains the users' attitudes towards the availability of water for toilet use. The third factor includes two attributes related to the maintenance of toilets. The Cronbach's alpha value calculated for factor three is lower than the acceptable value which is possibly due to

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**Table 3** | Principal component analyses of household toilet attributes and construct loadings

| Sl no. | Attributes | F1 | F2 | F3 |
|---|---|---|---|---|
| Toilet structure (TVE: 37.2%; $\alpha$: 0.89; MIC: 0.50) | | | | |
| 1 | Space within toilet (SPA_TO) | **0.630** | 0.094 | −0.090 |
| 2 | Height of wall (HIT_WAL) | **0.684** | 0.198 | 0.081 |
| 3 | Type of wall (TYP_WAL) | **0.756** | 0.065 | 0.036 |
| 4 | Type of door (TYP_DOO) | **0.762** | 0.241 | 0.046 |
| 5 | Type of roof (TYP_ROO) | **0.721** | 0.180 | 0.154 |
| 6 | Type of pan (TYP_PAN) | **0.720** | 0.049 | 0.124 |
| 7 | Type of disposal system (TYP_DIS_SYS) | **0.784** | 0.185 | 0.103 |
| 8 | Capacity of disposal pit/tank (CAP_DIS_PT) | **0.759** | 0.228 | 0.149 |
| Availability of water (TVE:14.9%; $\alpha$: 0.85; MIC: 0.49) | | | | |
| 9 | Distance to source of water (DIS_SO_WA) | 0.084 | **0.809** | −0.079 |
| 10 | Type of source of water (TYP_SOR_WA) | 0.179 | **0.752** | −0.165 |
| 11 | Convenience in water collection (CON_WA_COL) | 0.227 | **0.808** | −0.034 |
| 12 | Flushing mechanism (FL_MEC) | 0.155 | **0.789** | 0.161 |
| 13 | Convenience in toilet cleaning (CON_TO_CLE) | 0.198 | **0.704** | 0.159 |
| Toilet maintenance (TVE: 7.9%; $\alpha$: 0.40; MIC: 0.24) | | | | |
| 14 | Maintenance convenience (MAIN_CON) | 0.034 | 0.079 | **0.796** |
| 15 | Convenience in emptying pit/tank (CON_EM_PT) | 0.201 | −0.083 | **0.722** |

KMO: 0.885, Bartlett's test of sphericity: 3445.804; $p$-value 0.000.

the smaller number of attributes (Gliem & Gliem 2003). However, the attributes have a high factor loading which shows their association and the value of their mean inter-correlation is 0.24, which is an indicator of a good relationship.

## Confirmatory factor analysis

The results of the EFA are validated through CFA. Different models of CFA have been applied to find out the appropriate latent parameters and their underlying attributes. An initial benchmark CFA is calculated with three latent factors, namely toilet structure (toilet), availability of water (water) and toilet maintenance (maintenance), which returns an acceptable degree of model fit (chi-square: 377.24 df = 87; GFI: 0.915; AGFI: 0.882; CFI: 0.914; RMSEA: 0.079) as shown in Figure 1. The shapes, arcs, and numbers associated with each arc in Figures 1 and 2 have different meanings. The double headed arrows indicate a correlation between

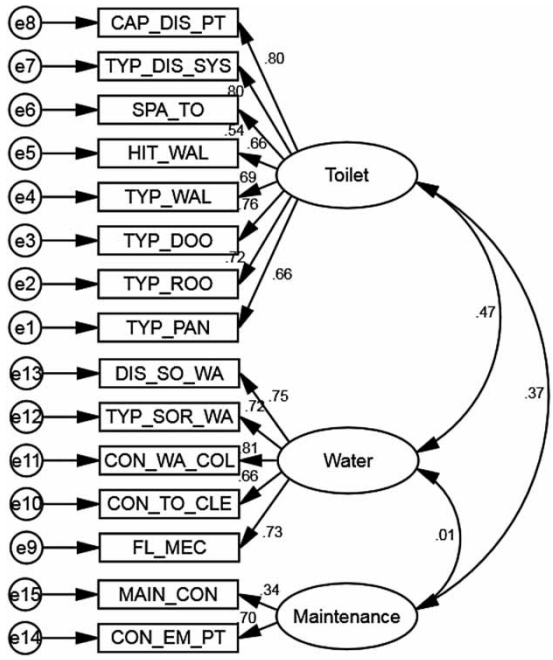


**Figure 1** | Confirmatory factor analysis (model 1).

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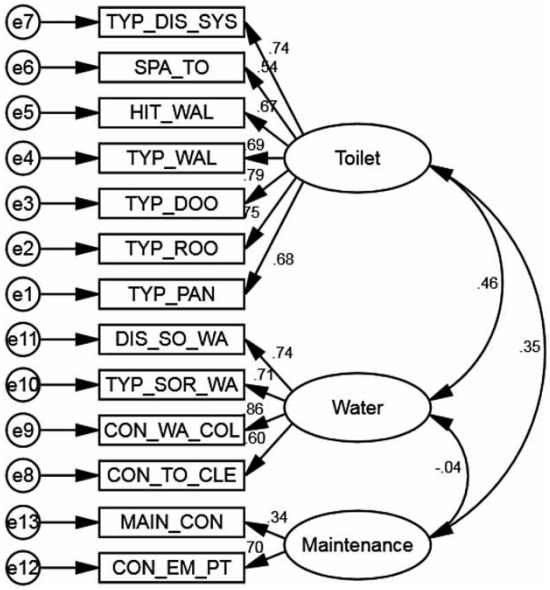


**Figure 2** | Confirmatory factor analysis (model 2).

two factors and arrows represent linear regression coefficients or factor loadings. The rectangles, ellipses, and circles represent observed variables, unobserved factors and errors, respectively (Furr 2011).

An inspection of the modification indices of the benchmark CFA shows that error terms of the attributes CAP_DIS_PT and TYP_DIS_SYS, and FL_MEC and CON_TO_CLE co-vary and removal of one of them from each set could improve the model. Subsequently, a second model of CFA is developed after removing the attribute CAP_DIS_PT and FL_MEC as shown in Figure 2 which shows enhanced model fit indices (chi-square: 179.65 df = 62; GFI: 0.952; AGFI: 0.930; CFI: 0.952; RMSEA: 0.059).

The results of model 2, displayed in Table 4, show the relationship between the observed and latent variables. While the first and second columns of the table display the variables of the model, the third to the sixth columns represent regression weight (RW), standard error (SE), probability level ($p$) and the standardized regression weights (SRW) of the model, respectively. The values obtained for each attribute included in the model are significantly different from zero. The SRWs of most of the attributes are above 0.5 except one attribute, 'maintenance convenience'. The SRW of 0.5 is considered as an arbitrary line between major and minor attributes contributing to the characteristics of an unobserved factor (de Oña *et al.* 2013).

**Table 4** | Results of confirmatory factor analysis (model 2)

| Observed variables | Latent variables | RW | SE | P | SRW |
|---|---|---|---|---|---|
| Space within toilet | Toilet structure (Toilet) | 0.946 | 0.083 | 0.000 | 0.544 |
| Height of wall | | 0.974 | 0.071 | 0.000 | 0.670 |
| Type of wall | | 1.115 | 0.078 | 0.000 | 0.693 |
| Type of door | | 1.665 | 0.104 | 0.000 | 0.794 |
| Type of roof | | 1.369 | 0.090 | 0.000 | 0.744 |
| Type of pan | | 1.000 | | | 0.674 |
| Type of disposal system | | 1.419 | 0.095 | 0.000 | 0.735 |
| Distance to source of water | Availability of water (Water) | 1.274 | 0.073 | 0.000 | 0.761 |
| Type of source of water | | 1.063 | 0.073 | 0.000 | 0.727 |
| Convenience in water collection | | 1.345 | 0.084 | 0.000 | 0.829 |
| Convenience in toilet cleaning | | 0.938 | 0.062 | 0.000 | 0.602 |
| Maintenance convenience | Toilet maintenance (Maintenance) | 0.460 | 0.146 | 0.002 | 0.354 |
| Convenience in emptying pit/tank | | 1.000 | | | 0.675 |

The relationship between latent factors and their observed attributes highlights some interesting results. The relative weights for several of the observed attributes for a particular latent parameter are similar. This similarity is because a particular latent parameter includes the attributes which have very similar satisfaction rates. The users' satisfaction for 'toilet structure' (latent parameter) is determined by 'type of door' (0.794), 'type of roof' (0.744), 'type of disposal system' (0.735) and others. The latent parameter 'availability of water' is explained using 'convenience in water collection' (0.829), 'distance to the source of water' (0.761) and others. The SRW for 'toilet maintenance' is derived more from 'convenience in emptying disposal pit/tank' (0.675) than the 'maintenance convenience' (0.354) which is defined as 'convenience in replacement and repairing of damaged parts of toilets'.

## Correlation between latent parameters and overall satisfaction

Table 5 shows the results of the Spearman's correlation analysis between the latent parameters identified in the

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**Table 5** | Spearman's correlation analysis between latent parameters and overall satisfaction

| Variable | Toilet structure | Availability of water | Toilet maintenance | Overall satisfaction | VIF |
|---|---|---|---|---|---|
| Toilet structure (A) | 1.000 | | | | 2.06 |
| Availability of water (B) | 0.524** | 1.000 | | | 1.56 |
| Toilet maintenance (C) | 0.436** | 0.017 | 1.000 | | 1.50 |
| Overall satisfaction (D) | 0.807** | 0.547** | 0.517** | 1.000 | |

**$p$-value <0.01.

factor analysis in model 2 and overall satisfaction for service quality of toilet. The results indicate that significant but low interaction exists between the variables involved in the analysis with an acceptable VIF value (≤4) (Dormann *et al.* 2013). The latent parameters identified in the factor analysis display strong and significant correlation coefficients with the overall satisfaction which indicate that the selected service quality attributes of household toilets are useful indicators of users' satisfaction.

## Overall service quality of household toilets

This section establishes the relationship between the latent variables estimated in model 2 with the overall satisfaction with service quality (dependent variable) using an ordered logistic regression model. The results of the model in Table 6 offer some degree of explanatory power compared with an intercept-only model which is indicated by the significant chi-square value. The Nagelkerke pseudo $R^2$ of the model is 0.753, suggesting that the model accounts for about 75% of the variation in perceived satisfaction levels. The results indicate that all of the latent parameters display some degree of effect on users' satisfaction with the overall service quality of household toilets. The coefficient weight of each service quality attribute represents its relative importance (priority) in determining user satisfaction. The latent parameter 'toilet structure' displays a markedly large coefficient, suggesting that user perception for various attributes of the sub- and superstructures of toilets are principal in their assessment of satisfaction. The remaining service quality factors, namely 'availability of water' and 'toilet maintenance', are also significant but display smaller coefficient weight which indicates that these are secondary issues in users' assessment of satisfaction.

**Table 6** | Ordered logistic regression with overall satisfaction as the dependent variable and latent parameters of household toilets as the independent variables

| Variable | Beta | Std Err | Wald | 95% Con. Int. |
|---|---|---|---|---|
| Toilet structure | 2.927* | 0.221 | 175.922 | 2.495–3.360 |
| Availability of water | 1.050* | 0.133 | 62.394 | 0.789–1.310 |
| Toilet maintenance | 1.064* | 0.126 | 71.228 | 0.817–1.311 |
| Model fit | | | | |
| − 2LL (intercept) | 1651.330 | | | |
| − 2LL (final) | 968.214 | | | |
| Chi-square (df = 3) | 683.116* | | | |
| Nagelkerke $R^2$ | 0.753 | | | |

*$p$-value <0.01.

## Perceived quality of latent parameters across household types and socioeconomic groups

Table 7 shows the variation in the perceived quality of latent parameters identified using the factor analysis across various household types and for survey respondents belonging to different socioeconomic groups. While the negative sign of the mean factor score indicates users' dissatisfaction, the positive sign shows users' satisfaction. The results of the hypothesis testing show some significant differences among the socioeconomic groups. In terms of the source of finance used for the construction of the household toilets, the respondents with fully subsidized toilets display a negative attitude towards all the latent parameters encompassing almost all the attributes of service quality. The variation in perceived service quality across different age groups is not significant. The perceived service quality of the latent parameters 'toilet structure' and 'availability of water' also significantly varies across caste groups, and respondents belonging to socially marginalized caste groups perceive them as poor. Similarly, the female respondents also perceive these two parameters as poor

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**Table 7** | Perceived service quality of latent parameters across household types and socioeconomic groups

| | Toilet structure | | Availability of water | | Toilet maintenance | |
|---|---|---|---|---|---|---|
| **Socioeconomic groups** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** |
| Type of toilet[a] | *P* value: 0.000 | | *P* value: 0.000 | | *P* value: 0.000 | |
| Self-financed | 0.552 | 0.311 | 0.471 | 0.653 | 0.111 | 0.822 |
| Partially financed | 0.376 | 0.329 | −0.067 | 0.792 | 0.522 | 0.803 |
| Fully subsidized | −0.806 | 0.700 | −0.597 | 0.898 | −0.265 | 0.969 |
| Age (years)[a] | *P* value: 0.310 | | *P* value: 0.788 | | *P* value: 0.403 | |
| <30 | −0.079 | 0.918 | −0.023 | 1.051 | −0.181 | 0.952 |
| 30–39 | −0.001 | 0.827 | 0.037 | 0.936 | 0.026 | 0.881 |
| 40–49 | −0.049 | 0.827 | −0.060 | 0.873 | 0.004 | 0.941 |
| >49 | 0.123 | 0.750 | 0.043 | 0.890 | 0.062 | 0.893 |
| Gender[b] | *P* value: 0.003 | | *P* value: 0.005 | | *P* value: 0.249 | |
| Male | 0.048 | 0.802 | 0.051 | 0.911 | −0.020 | 0.904 |
| Female | −0.273 | 0.903 | −0.295 | 0.929 | 0.117 | 0.953 |
| Caste[a] | *P* value: 0.000 | | *P* value: 0.000 | | *P* value: 0.584 | |
| Upper castes | 0.299 | 0.560 | 0.248 | 0.787 | 0.037 | 0.873 |
| 'Backward' castes | 0.100 | 0.785 | 0.044 | 0.883 | 0.035 | 0.888 |
| 'Extremely backward' castes | −0.150 | 0.862 | −0.243 | 1.013 | −0.038 | 0.928 |
| Scheduled castes | −0.412 | 0.949 | −0.342 | 0.941 | −0.073 | 1.000 |
| Education[a] | *P* value: 0.000 | | *P* value: 0.002 | | *P* value: 0.000 | |
| Illiterate | −0.270 | 0.851 | −0.181 | 0.758 | 0.187 | 0.955 |
| Up to class 5th | −0.389 | 0.980 | −0.237 | 0.932 | −0.102 | 1.066 |
| Up to class 8th | −0.002 | 0.806 | −0.059 | 0.933 | 0.195 | 0.874 |
| Up to class 10th | 0.085 | 0.776 | −0.044 | 0.869 | 0.116 | 0.924 |
| Up to class 12th | 0.215 | 0.683 | 0.254 | 0.998 | −0.349 | 0.736 |
| Graduation and above | 0.382 | 0.566 | 0.397 | 0.816 | −0.261 | 0.741 |
| Economic status[a] | *P* value: 0.000 | | *P* value: 0.000 | | *P* value: 0.000 | |
| Below poverty line | −0.767 | 0.749 | −0.620 | 0.924 | −0.306 | 0.967 |
| Low income groups | −0.203 | 0.780 | −0.234 | 0.829 | 0.198 | 0.939 |
| Middle income groups | 0.502 | 0.405 | 0.365 | 0.599 | 0.233 | 0.809 |
| High income groups | 0.573 | 0.293 | 0.567 | 0.734 | −0.041 | 0.816 |

[a]Kruskal–Wallis test.
[b]Mann–Whitney U test.

compared with the male respondents. Perceived service quality of toilets is also found to vary significantly with the level of education. While the respondents with the lower level of education perceive 'toilet structure' and 'availability of water' as poor, the respondents with the higher level of education perceive 'toilet maintenance' as poor. Significant variations are also observed among the households belonging to different economic backgrounds. While the poorest households, namely the 'below poverty line' group, have a negative perception for all parameters, the middle-income households have a positive perception for all parameters. On the other hand, the households belonging to the higher income group perceive 'toilet maintenance' as poor due to higher expected service quality and absence of a formal mechanism of pit or septic tank cleaning in rural areas.

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## DISCUSSION AND CONCLUSION

The primary objective of the present study is to assess users' satisfaction with the perceived service quality of household toilet in rural settlements. Factor analysis conducted on the service quality attributes shows three latent factors covering issues broadly related to toilet structure, availability of water for toilet use and toilet maintenance. The results show that the 'type of disposal system', which is an indicator of the technology used and a proxy for 'capacity of pit/tank', is a major determinant of households' perception of toilet structure which supports the findings of earlier studies (Coffey *et al.* 2014) on rural households in India. The perception of these latent factors also significantly varies across household types and socioeconomic background of survey respondents. Households are found to be dissatisfied with toilets constructed using government subsidies; this is similar to the findings of Jenkins *et al.* (2014) and Routray *et al.* (2015) who found that service quality of government constructed toilets is perceived to be poorer than the toilets constructed by the households themselves. This is also confirmed by the households belonging to the socially and economically marginalized sections of society who are the recipients of these subsidized toilets and show dissatisfaction towards all three latent service quality dimensions of household toilets. However, this variation in satisfaction among households with subsidized and non-subsidized toilets could also be a result of the difference in their perception of service quality or/and due to actual differences in the physical characteristics of toilets, which need to be investigated in future studies.

The results of the ordered logistic regression provide some useful insights. First, 'toilet structure' represents a central dimension in users' assessment of the overall satisfaction with service provision. An interpretation of this finding is that, in order to improve satisfaction, policy makers may concentrate their efforts on improving the type and capacity of the disposal system, space within toilets, height of the wall, and type of pan, wall, door, and roof. Routray *et al.* (2015) have also found that the quality of the different attributes defining toilet structure is a major determinant of toilet usage. Second, the analysis implies that the perception of 'availability of water' and 'toilet maintenance', while holding a significant impact on users' satisfaction, is subordinate to the perception of 'toilet structure'. Previous studies conducted in India and other developing countries have also reported that water supply and toilet maintenance work as facilitators of toilet construction and their usage (Hirve *et al.* 2015; O'Reilly *et al.* 2017).

The present study has few limitations which may have an influence on the overall assessment of service quality of household toilets in rural areas. The respondents of the study are mainly household heads, and perceptions of other household members may differ from household heads. Additionally, the respondents of the study are predominantly male whereas females have a different perception from males as shown in Table 7. This needs to be carefully considered in future studies. Finally, the study only considers the perception of households with toilets and the perception of households without toilets may be taken up in future as an extension of the present research. The results of the present study highlight the importance of different dimensions of service quality of household toilets and provide a framework for the assessment of overall service quality of household toilets in rural areas. This would allow policy makers to define strategies both to retain existing users and to attract new users.

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