QUISS : Quality Indicators of Shared Sanitation Facilities

in Urban Settlements in Low- And Middle-Income Countries

Final Report

eawag aquatic research

WHO Collaborating Center for Sanitation and Water in Developing Countries

Authors: Eawag-Sandec (Vasco Schelbert, Christoph Lüthi), ETH Nadel (Dario Meili, Isabel Günther)

in collaboration with NHance Development Partners Ltd. Kumasi, Ghana (Prince Antwi-Agyei, Kwaku Amaning Adjei, Bismark Dwumfour-Asare, Helen Anipa), Great Lakes University Kisumu, Kenya (Sheillah Simiyu, Ann Ouma, Loriet Marenya, Musa Obuya, Horace Omondi) and icddr,b in Dhaka, Bangladesh (Mahbub-Ul Alam, Mahbubur Rahman, Supta Sarker, Sharika Ferdous, Fazle Shahrior, Shafi Mohammed Ali Siddiqui).

Acknowledgements: Ben Tidwell (World Vision), Richard Johnston (Joint Monitoring Programme WHO), Ian Ross (London School of Hygiene and Tropical Medicine), Ashanti Bleich (Eawag-Sandec), Marius Klinger (Eawag-Sandec), Barbara Jane Ward (Eawag-Sandec), Paul Donahue (Eawag-Sandec), Arto Arman (ETH Nadel), Immanuel Stocker (ETH Nadel), Bartlomiej Kudrzycki (ETH Nadel)

Funding: The research project 'Quality Indicators of Shared Sanitation Facilities in Urban Settlements in Low- and Middle-Income Countries' (QUISS) was funded by Water & Sanitation for the Urban Poor (WSUP) and commissioned under the Urban Sanitation Research Initiative.

Finalised: March, 2020

Front Cover Photo: © Dario Meili

Abbreviations

CI	Cleanliness Index
CPR	Common Pool Resource
Eawag	Swiss Federal Institute of Aquatic Science and Technology
FGD	Focus Group Discussion
GALS	Gender Action Learning System
HH	Household
HR	Human Rights
Icddr,b	International Centre for Diarrhoeal Disease Research Bangladesh
IHF	Individual Household Facility
JMP	WHO/UNICEF Joint Monitoring Programme
MHM	Menstrual Health Management
O&M	Operation & Maintenance
QUISS	Quality Indicators of Shared Sanitation
SQI	Sanitation Quality Index
SSF	Shared Sanitation Facilities
Unicef	United Nations Children's Fund
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WSUP	Water and Sanitation for the Urban Poor

Table of Content

List of Figures

List of Tables

1 Introduction

Worldwide, 2 billion or 1 in 4 people still lack basic sanitation services, and 673 million still practise open defecation.[1] Inadequate sanitation leads to environmental pollution and has significant negative health[2] and non-health[3] consequences. In September 2015, the 17 Sustainable Development Goals (SDGs) were adopted by all member states of the United Nations. SDG6 aims at ensuring the availability and sustainable management of water and sanitation for all.

1.1 Monitoring (Shared) Sanitation Access within the SDGs

To evaluate progress towards the SDGs, the WHO/Unicef Joint Monitoring Programme (JMP) service ladder is used to benchmark and compare service levels across countries regarding access to safe sanitation. The service ladder builds on the established improved/unimproved facility type classification. Improved sanitation facilities are those designed to hygienically separate excreta from human contact.[4] The JMP service ladder divides improved sanitation facilities into three categories: limited, basic, and safely managed services. Depending on the management of excreta, individual household facilities (IHF) are categorised as either basic (improved facilities not shared with other households (HHs)) or safely managed services (improved facilities not shared with other HHs and where excreta are safely disposed of in situ or transported and treated offsite). In contrast, shared sanitation facilities (SSF) are at best classified as a limited solution – irrespective of how excreta are managed. The rationale given is that SSF are often unhygienic and do not provide adequate privacy and safety[5], particularly for women and girls[6]. Due to a lack of toilet provision within a safe environment, women, girls and children are often exposed to harassment and sexually-motivated attacks, especially at night.[7]

In low-income urban areas with poorly developed infrastructure, high population growth coupled with high poverty levels often leaves SSF as the only viable sanitation option.[8] Globally, SSF have greatly contributed to sanitation access.[9] The total number of users has increased from 335 million (= 7.5% of world population) in 2000 to 626 million (= 9.1%) by the end of 2017.[10] People using SSF in low- and middle-income countries are three times more likely to live in urban rather than in rural areas.[11]

It has been argued that under certain circumstances SSF can be considered as an adequate, hygienically safe, and socially and economically viable solution.[12] Scholars claim that categorically excluding SSF from the basic/safely managed categories would lead to a 'statistical tragedy', i.e. to a situation in which governments, international agencies and NGOs do not allocate resources to the improvement of such facilities.[13] Due to high

[1] (WHO 2019a)
[2] (Ejemot-Nwadiaro *et al.* 2015)
[3] (Hutton & Whittington 2015)
[4] Flush/pour-flush toilet, Flush to piped sewer system, Flush to septic tank, Flush to pit latrine, Pit latrine with slab, Composting toilet, Twin pit latrine with slab, Container based sanitation, and Flush/pour flush to don't know where (WHO 2018b).
[5] (Tidwell *et al.* 2018)
[6] (Isunju *et al.* 2011; Mitlin 2011; Heijnen *et al.* 2015; Sahoo *et al.* 2015; Shiras *et al.* 2018a; WHO 2019b)
[7] (Bapat & Agarwal 2003; Mitlin 2011; Kwiringira *et al.* 2014a; Cardone *et al.* 2018)
[8] (Wegelin-Schuringa & Kodo 1997; Burra *et al.* 2003; Mara & Alabaster 2008; Schouten & Mathenge 2010; Isunju *et al.* 2011; Mitlin 2011; Norman 2011; Hawkins *et al.* 2013; McGranahan 2013; Mazeau *et al.* 2014; Obeng *et al.* 2015; Cardone *et al.* 2018; Chipungu *et al.* 2018; Shiras *et al.* 2018b; Tidwell *et al.* 2019b)
[9] (Wolf *et al.* 2012)
[10] (WHO 2019a)
[11] (Isunju *et al.* 2011; Mara 2016; WHO 2019a)
[12] (Burra *et al.* 2003; Kabange & Nkansah 2015; Cardone *et al.* 2018)
[13] (Devarajan 2013; Buckley & Kallergis 2019)

poverty levels, residents in low-income urban areas are often dependent on external support for sanitation provision. Below a certain income level, most people cannot afford individual units and – anywhere below this level – increases in income do not lead to increases in demand.[14] Yet, recent estimates state that half of the potential health benefits from adequate sanitation are achieved only when roughly 75% of the community is covered.[15] Thus, some authors claim that the definition of basic/safely managed sanitation should be changed to include SSF under certain circumstances.[16] Others – for health-related reasons – exercise caution.[17] The official WHO position, in any case, is starting to shift; the new guidelines on sanitation and health state that SSF which "*safely contain excreta can be promoted […] as an incremental step when individual household facilities are not feasible.*"[18]

Monitoring and benchmarking can often create strong incentives to improve performance.[19] While many SSF are indeed of unacceptable quality, there exists, at the same time, uncertainty about the criteria that can be used to distinguish between unacceptable and acceptable quality.[20] So far, research has not determined a set of indicators that allow for monitoring and evaluating the quality of SSF. But, what does quality mean? The answer depends on who is asked. Evidently, scholars focus on different quality aspects than users. While scholars claim to take an impartial, theoretically-grounded perspective, individuals are often concerned with their immediate personal reality. The inclusion of users and their perspectives is fundamental in terms of trying to meet their needs with public investments, and in terms of ensuring user acceptance and, thus, supporting intervention success.[21] Thus, users and their perspectives on sanitation priorities are fundamental considerations.[22]

1.2 QUISS: Quality Indicators of Shared Sanitation Facilities

Disparities and discrepancies in the analysis of SSF within the JMP global sanitation framework is a critical issue and is intensely debated. It is now widely acknowledged that SSF are often the only viable sanitation solution for the urban poor, but at the same time that a lack of quality prevents a lot of SSF from providing adequate and sustainable sanitation to its users. There exists, however, no consensus as to which factors are essential to establish and sustain adequate SSF quality. As a result, there is no way to simply add SSF to the JMP indicators. A consistent set of quality indicators is paramount to set development targets enabling efficient resource allocation for progress, including monitoring outputs and assessing outcomes and impacts.

This Final Report presents findings from the research project investigating 'Quality Indicators of Shared Sanitation Facilities in Low-income Urban Settlements (QUISS).[23] The QUISS project is commissioned under Water & Sanitation for the Urban Poor's (WSUP) *Urban Sanitation Research Initiative*. Based on an extensive quantitative survey of SSF and their users across cities in Bangladesh, Ghana and Kenya, as well as qualitative studies, this research aims to identify key criteria of what constitutes acceptable SSF quality in urban low-income contexts.

[14] (Buckley & Kallergis 2019)
[15] (Prüss-Ustün *et al.* 2019)
[16] (Hawkins *et al.* 2013; Rheinländer *et al.* 2015a; Mara 2016; Evans *et al.* 2017; Massa *et al.* 2017)
[17] (Fuller *et al.* 2014; Brown *et al.* 2015; Heijnen *et al.* 2015; Baker *et al.* 2016)
[18] (WHO 2018c)
[19] (Konradsen *et al.* 2010; Evans *et al.* 2017)
[20] (Evans *et al.* 2017)
[21] (Cairncross & Mundial 1992; Lüthi *et al.* 2010; Mazeau & Reed 2010; Scott *et al.* 2017).
[22] (Mazeau & Reed 2010)
[23] www.sandec.ch/quiss

2 Research Design

2.1 Research Strategy

A research endeavour that seeks to identify indicator criteria for shared sanitation must tackle the three following questions:

1. "What is shared"?, to better define the object for which the term is to be used;
2. "What does high-quality mean"?, to grasp the characteristics of this term;
3. "Which indicators are related with high-quality shared sanitation?"

While the motivation for this endeavour is profoundly normative, the approach must aim for objective validity. Because SDG6 seeks to realise the human right (HR) of access to water, sanitation and hygiene for all, and because we ultimately seek to contribute to the development of quality indicators of SSF to monitor progress within SDG6, we depart from a rights-based approach in conceptualising quality determinants of SSF.[24]

In the absence of a comprehensive and consistent categorisation of different types of SSF, any endeavour to produce quality indicators of SSF must first aim at a (i) clarification of different categories of SSF, i.e. define its unit of analysis and (ii) define adequacy criteria for indicators in order for them to deliver reliable information. Because user priorities, behaviours and decisions are recognised to be fundamental to sustain quality[25], there is a need to (iii) depart from a user-centred approach. While technical components are inextricably linked to quality of SSF, we start categorising quality determinants by reviewing (iv) minimal technical requirements.[26] Inspired by the HR framework, we categorise quality determinants into (v) availability & accessibility, (vi) safety/security & privacy, and (vii) operation and maintenance (O&M) and cleanliness of SSF, which are all needed for establishing and sustaining adequate quality. Only then a (viii) possible list of SSF quality indicators can be compiled, which offers the basis for eventual discussions and evaluations with respect to and against the background of defined criteria.

Overall, the QUISS project consisted of a four-step mixed-methods research approach organised into a qualitative and a quantitative phase. Each step builds upon the prior one. Generally, the qualitative phase served to establish a theoretical framework and to collect user quality priorities. The findings from the qualitative phase then served as a basis for the design of a user survey and a spotcheck observation protocol for the quantitative phase.

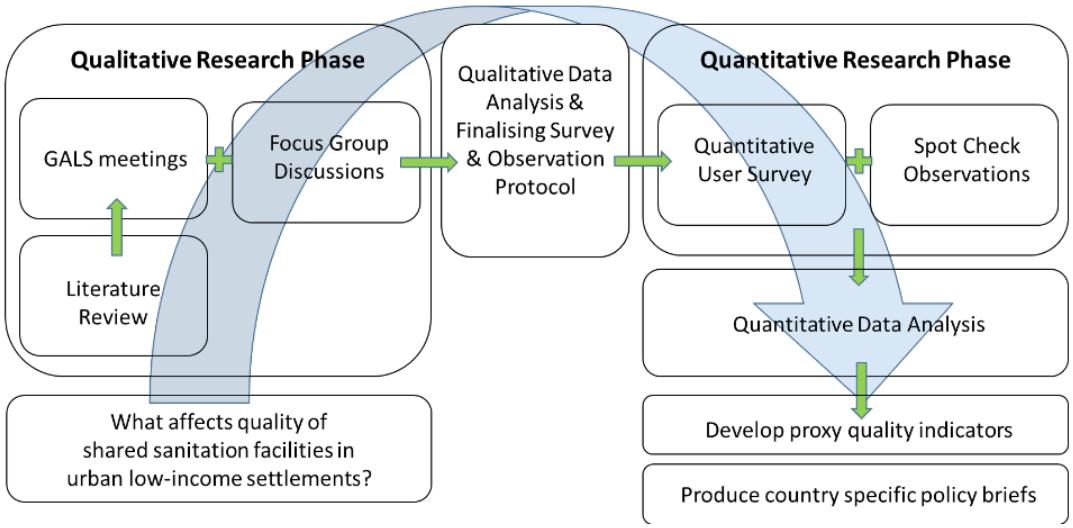
[24] (Héller 2015; Giné-Garriga *et al.* 2017)
[25] (Burra *et al.* 2003; Satterthwaite *et al.* 2005; McFarlane 2008; McGranahan 2013, 2015; McGranahan & Mitlin 2016)
[26] To define minimal technical requirements, we took official JMP and WHO/Unicef WASH monitoring documents and guidelines as a starting point (WHO 2016, 2018c, a, b, 2019b, a).

1. Scoping
    a. Draft Research Design
    b. Preliminary considerations linked to SSF quality determinants
    c. Define units of analysis and adequacy criteria for indicators
    d. Compile a list of user quality concerns
    e. Define Research Design

2. Qualitative Phase
    a. Qualitative Data Collection
        i. Desk-based Work I: Literature Review – Compile a list of user quality concerns
        ii. Field Work I: GALS Meetings – Expand list of user quality concerns
        iii. Field Work II: Focus Group Discussions – Deepen understanding of user quality concerns
    b. Qualitative Data Analysis
        i. Review results from literature review and GALS meetings to design evidence-based Focus Group Discussion guideline
        ii. Conduct qualitative content analysis for Focus Group Discussions – Separate general user quality concerns from user quality priorities
        iii. Use qualitative results to design evidence-based quantitative user survey & spotcheck observation protocols

3. Quantitative Phase
        i. Quantitative Data Collection:
            1. Field Work III: Large-scale quantitative user survey
            2. Field Work IV: SSF spotcheck evaluation
            3. Desk-based Work II: Remote spotcheck evaluation based on SSF photos
        ii. Quantitative Data Analysis
            1. Explorative data analysis and Sanitation Quality Index construction
            2. Regression analysis
            3. Comparison of indicators with regards to toilet quality measures

4. Synthesis: Evaluation Phase
    a. Evaluate which general user quality concerns and which user quality priorities are significant
    b. Evaluate quality indicators on proxy feasibilities (with indicator adequacy criteria)
    c. Define proxies for SSF quality determinants



2.2 Objectives and Research Questions

Objective

Identifying relevant aspects and criteria for quality standards of shared sanitation facilities in urban low-income settlements.

Overall Research Questions

The outlined objective can be regarded as a product or a synthesis. The synthesis itself is composed of answers to different sub-questions. These sub-questions must:

- Define the object on which the term is to be used ("what is shared"?)
- Try to grasp the characteristics of this term ("what does high-quality mean"?)
- Try to grasp the characteristics of the term quality regarding its addressees ("what does high-quality mean to whom"?)

Only then does a basis for conducting a synthesis that addresses the overall objective exist. The overarching research question, therefore, reads as follows:

Q: *What are key aspects and characteristics of high-quality shared sanitation facilities in urban low-income settlements in low- and middle-income countries*?

Since 'SSF' serves as an umbrella term that does not entail criteria that enable a distinctive categorisation, we must aim for a consistent categorisation of these facilities ("what is shared?"). The following question refers to this:

> Q1: *What key aspects inform a distinctive categorisation of different types of shared sanitation facilities?*

Similarly, if not narrowed down, 'quality' remains an imprecise term ("what does high-quality mean?"). At the beginning, we defined four quality *dimensions* to which SSF quality determinants must refer. These include an individual, structural-institutional, technical and temporal dimension. Each dimension will be approached with an overall question and a set of sub-questions. Together, they allow us to answer the overall question of each dimension. The answers of the four dimensions together – the synthesis – must then answer the overall research question. The second sub-question reads as follows:

> Q2: *What are essential (a) individual, (b) structural-institutional, (c) technical and (d) temporal characteristics that relate to quality-issues of shared sanitation facilities?*

By analysing Q1b, we ask how these findings relate to SDG6 and how our analysis on SSF quality determinants can inform the WHO/Unicef JMP framework:

> Q3: *What conclusions can be drawn with regard to how those indicators can be adequately and consistently measured within the JMP framework?*

Research Sub-Questions

The answers to Q1 and Q3 are dependent on findings from Q2, which forms the centrepiece of this research.

The literature emphasises that improving/maintaining quality of (shared) sanitation facilities depends largely on sustainable O&M. This touches on the individual, structural-institutional, and temporal dimensions, with strong links to the technical dimension.

Quality of (shared) sanitation facilities is partly dependent on individual user behaviour. This is addressed with the following question:

> Q2a: *What characteristics of shared sanitation facilities related to quality do individual users deem to be fundamental?*

To collect information, we target these characteristics with the following sub-questions:

> Q2a1. *How satisfied are users of shared sanitation facilities and what are the barriers to the sustained use of these facilities?*
>
> Q2a2. *What are the individual behaviours and habits of shared sanitation users?*
>
> Q2a3. *What are the needs, desires and demands of shared sanitation users?*
>
> Q2a4. *What are the individual incentives, motivations and capacities for improving/maintaining the quality of shared sanitation facilities?*

Quality standards are partly dependent on functional and sustainable management schemes and institutional arrangements. We therefore ask:

> Q2b: *What are the structural-institutional characteristics that enable quality of shared sanitation facilities?*

In a first step, different international experiences shall be compared, as referred to in the following sub-question:

> Q2b1: *What are different management schemes for shared sanitation based on experiences from QUISS target countries*?
>
> Q2b2: *What are highlighted strengths and weaknesses observed in those management schemes, especially when considering quality issues*?

O&M arrangements of shared sanitation facilities often lack formalisation of management schemes and a lack of legal regulation. If at all present, these often depend on cooperation among the users. Genuine cooperation thrives on incentives that are non-material in nature. These non-material motivations include reputation, trust and reciprocity. It is crucially important to pay attention to the levels and nature of trust, reciprocity and reputation around a given public good or service if we are to understand whether the various actors concerned will co-operate, and how responsibilities and accountabilities are construed. Since O&M of shared sanitation relates to a community of participants, we must unpack the structural factors relating to core actor relationships in service provision and therefore to ask:

Q2b3: *What are the characteristics of the predominating core collective relationships (levels of trust, reciprocity,…)?*

Q2b4: *What underlying motivations exist in these relationships?*

Q2b5: *What are the (formal and informal) rules in use that structure or attempt to constrain the behaviour of actors in a particular context?*

Technical aspects refer to quantifiable data, often also referred to as "hardware" data. It is a general assumption that these are genuinely informative indicators for quality issues, which is referred to with the following sub-question:

Q2c: *What are quantifiable technical components that are fundamental for the quality of shared sanitation facilities?*

This concerns essential WASH components such as water source and sanitation facility (both according to the improved/unimproved categorisation). It also entails hygiene issues, i.e. handwashing stations, anal cleansing materials and reported/observed cleanliness. An important sub-question therefore is:

Q2c1: *What are essential quantifiable WASH hardware components that are fundamental for the quality of shared sanitation facilities?*

The facility design affects issues such as accessibility, availability, affordability, functionality, safety and privacy. Current literature genuinely links these issues to quality of (shared) sanitation facilities. This is addressed with the following sub-questions:

Q2c2: *What are essential facility design features that are fundamental to the quality of shared sanitation facilities?*

Q2c3: *How do essential facility design features correlate with the quality of shared sanitation facilities?*

The aim is to also grasp the characteristics of the user(s) (number, age, gender, ability, ethnicity, relationship to other users) and compare these to other factors affecting quality of shared sanitation facilities. This is addressed with the following sub-question:

Q2c4: *How do essential user features correlate with the quality of shared sanitation facilities?*

Lastly, quality must be sustained in order to be qualified as such, which again refers to O&M. The overall goal of this research project is to find applicable indicators that inform us about the critical aspects of the *sustainability of quality*. This dimension is already addressed in Q3 (because being able to pursue quality over time is then in itself referring to the temporal dimension).

Yet, within O&M – and particularly with regard to the "high quality" of on-site sanitation – the sanitation service delivery chain deserves special attention. Aside from human dignity issues, the fundamental idea behind adequate sanitation is the prevention of health hazards as a result of environmental pollution. The JMP framework

conclusively calculates different sanitation service levels. These are ranging from "open defecation", to "unimproved"", to "limited", "basic", and finally "safely managed". To deliver a rationale to include shared sanitation options in the SDG/JMP framework, it is then only reasonable that "quality" is aligned to the JMP service levels and terminology. Only a consistent terminology and characterisation enables the setting of development targets, allows the monitoring and, ultimately, assessment of impacts.

This means that the term 'high-quality' must be consistent with 'safely managed' (= 'where excreta are safely disposed of in situ or transported and treated offsite'). Only when the whole service chain - from containment, to emptying and transportation, and finally to treatment and final disposal - is covered, health hazards can be adequately addressed.

> Q2d: *What are adequate and measurable indicators that provide information on the sustainability of O&M under special consideration of the sanitation service delivery chain?*

Collecting information on the service delivery chain by snapshot indicators represents a challenge. We therefore attempt to produce findings that provide inputs to such indicators with the following sub-questions:

> Q2d1: *What are possible bottlenecks and key aspects of a functional service delivery chain and what conclusions can be drawn regarding drivers and barriers of O&M schemes of shared sanitation facilities?*
>
> Q2d2: *What are potential adequate indicators of the sustainability of the sanitation service delivery chain?*

The findings from Q2 will provide insights to answer Q1 and help to further inform a categorisation of shared sanitation facilities. This, the precedent definitional clarification on the term "quality", and the insights from Q2 will serve as a basis for answering Q3. In synthesising the results of these sub-questions, we attempt to give a conclusive answer on the overall research question, i.e. on the key aspects of high-quality shared sanitation facilities in urban low-income settlements in low- and middle-income countries.

2.3 Methodology

This research consists of a four-step mixed-methods approach organised into a qualitative and a quantitative phase. Each step builds on the prior one. Generally, the qualitative phase serves to establish a theoretical framework and to inductively collect topic-related issues, which then serves as a basis for designing an evidence-based user survey and spotcheck observation protocol for the quantitative phase.

Step I: Qualitative Research

Literature review

- Data Collection & Analysis Method: Explorative Literature Review

Community Meetings

- Data Collection Method: Gender Active Learning System (GALS)
- Analysis Method: Directed Qualitative Content Analysis

The findings from the literature review informed the design of the community meetings (two in each target country). These meetings were conducted with the GALS method, a participative action learning methodology (Mayoux 2012). Using GALS, issue-related problems were participatively exposed and related challenges uncovered, leading to possible solutions and ways how to implement them. We sorted the identified challenges using categories derived from the literature review. The GALS meetings served three purposes: First, by consulting the very people affected, we were able to further explore the issue and to eventually complement missed but relevant quality categories. Second, these insights refined the thematic scope of the content to be discussed in the focus group discussions (FGDs). Also, they provided additional data for the preparation of contextualised policy briefs in the final stage. Lastly, the GALS meetings with about 30 to 50 participants allowed us to contact opinion leaders or other people interested in or concerned with the matter and gauge their willingness to participate in the upcoming FGDs.

Focus Group Discussions

- Data Collection Method: Focus Group Discussion
- Analysis Method: Directed and Inductive Content Analysis

We used the FGD method according to (Morgan & Krueger 1998). The FGD was performed with six to twelve participants. In total, we planned to do 18 FGDs: three women-only, two mixed and one men-only per country. In the end, five FGDs were conducted in Ghana and six FGDs in Kenya and Bangladesh. In Ghana, one women-only FGD had to be cancelled on short notice because most participants did not show up. The composition was as follows:

- Ghana: 2 women-only, 2 mixed, 1 men-only
- Kenya: 3 women-only, 1 mixed, 2 men-only
- Bangladesh: 3 women-only, 2 mixed, 1 men-only

The FGD analysis method was as follows: Audio recordings of the FGDs were translated to English and transcribed. Data was analysed, applying directed and inductive content analysis according to (Mayring 2015) using Atlas.ti 8 software (Friese 2019). Directed content analysis requires a predefined set of categories for coding, i.e. labelling statements capturing a certain theme with a descriptive code. This allows for validation and comparison with previous topic-related research findings. In inductive content analysis, narrow codes representing the statement's content are first assigned and then, through refinement, themes are inductively captured and subsumed under existing or emerging categories. This extracts information directly from the data.

Step II: Qualitative Analysis and Survey Production

The preliminary findings from the literature review, the insights from the GALS meetings, and the qualitative content analysis results from the FGDs were used to produce an evidence-based user survey and a spot-check observation protocol. For relevant (sub-)categories, triangulated questions were formulated.

We also attempted to unpack structural factors relating to core actor relationships in service provision according to (Tembo 2015). Qualitative findings did not produce adequate data for such an analysis. Thus, due to methodological reasons as well as time and budget constraints, the qualitative findings for structural factors were not further integrated into the quantitative survey. However, the contextualised Institutional Environment Reports for SSF, prepared by the respective research leaders, provided essential insights into structural factors. These insights were valuable for drafting the final policy briefs with respect to contextual particularities.

Step III: Quantitative Research

- Data Collection Method: Mobile Data Collection
- Analysis Method: Exploratory Data Analysis and Regression Analysis

The qualitatively deduced categories, indicators and drivers of high-quality shared sanitation were tested in large-scale surveys in the three study countries.

Sampling and data

For the data collection we sampled the data using a four-step sampling procedure:

1. Purposive sampling of low- and lower middle-income areas within the cities
2. Random sampling of geo points
3. Systematic sampling of plots/compounds using a skipping pattern starting from geo points
4. Random sampling of HHs on each plot/compound

The sampling procedure yielded a total sample size of 3601 survey responses: 3341 SSF users and 261 IHF users. Furthermore, 2030 spot-checks of SSF and IHF were conducted across all three countries. On each plot/compound, two HHs using the same cubicle were interviewed. Enumerators used a survey questionnaire to collect data on toilet properties, cleaning responsibilities and arrangements, MHM arrangements and privacy, user satisfaction and preferences, and demographic and HH information. Wherever possible, the same information was elicited both in the spot-check observation and the questionnaire. Further, enumerators took photos of the facilities that were remotely rated on cleanliness by research assistants as an additional data source.

From the qualitative part of the study, three quality categories were derived that were important to users: *cleanliness*, *safety/security, and privacy*. Based on these categories, and comprising of outcome variables that correspond to these categories, a sanitation quality index (SQI) and a cleanliness index (CI) were developed. For the SQI, we aggregated the outcome variables using Multiple Correspondence Analysis to calculate the weight of each variable in the index. For the CI, we compared different sources of perceived cleanliness measures: reported by the respondents, observed by enumerators, and remotely coded by the research assistants. Additionally, we developed a cleanliness index where the presence of either solid waste, insects, or visible faeces in a given cubicle indicates that it is "not clean".

Step IV: Quantitative Analysis & Synthesis

In order to identify key indicators for the quality of SSF, in a first step, we related potential indicators to the outcome indices – SQI and cleanliness - using regression analysis. We evaluated what indicators correlate with quality of sanitation facilities based on the pooled and country-wise samples. For this purpose, we ran regressions analyses, using the SQI and cleanliness as outcome variables. We included current (decisive) JMP covariates, i.e. toilet technology and the number of sharing HHs, as well as other qualitatively deducted indicators, as explanatory variables

Third, we singled out the relevant indicators and contrasted these with the current JMP framework. We evaluate whether some aspects of the framework could be reconsidered to meet the need to measure the quality of SSF. To this end, we assessed indicators' performance in separating high-quality and clean toilets from low-quality and dirty toilets.

The product of the final phase is a synthesis of the qualitative and quantitative findings (final report). It highlights key aspects of (high-)quality SSF in urban low-income settlements in low- and middle-income countries. This final report provides insights on context-specific challenges within selected cities in each target country. Moreover, it presents evidence to inform the required lack of conceptual, i.e. content-related understanding

of what the term quality entails and what its practical implications are. These insights and this evidence inform contextualised (national) policy briefs for decision makers for each target country. These products shall provide minimum quality standards for SSF, which are a basis for high-level progress monitoring, for funding decisions, and for programme design/implementation.

Adaptations and Limitations

Whereas the data collection was performed as planned, two adjustments with respect to the outlined methodological framework in the Inception Report were made. Concerning the individual sphere, even though the RANAS approach[27] would have been conducive to the evaluation of user behaviour and perception, we identified two major drawbacks in the RANAS framework for our project. On the one hand, we realised that the questions used to elicit beliefs and social norms are highly susceptible to social desirability and therefore are likely to produce biased responses. This could potentially compromise the internal validity of the approach. On the other hand, the study neither aimed to conduct a behaviour change intervention, nor was tied to a behaviour per se. Therefore, we would not have been able to run regressions of an exhibited behaviour as dependent variable on behavioural factors as independent variables.

Secondly, we intended to link individuals and structures by adopting a structural approach from sociology and to gain insights on collective action and cooperation among users. However, after starting analysing qualitative data we realised the provided insights on collective action and cooperation among users to be very limited. In addition, methodological concerns emerged within our research group with respect to measuring social capital, 'trust' and 'reciprocity'.[28] To fill this gap, the research leaders from each target country compiled a contextualised Institutional Environment Report, which informs on structural-institutional issues relevant for SSF. As far as possible, these should give consideration to political processes (politics), institutional structures (polity) and policy content (policy). In this sense, conclusions with respect to the 'structural-institutional' dimension are limited to the informational content of the respective reports.

Regarding internal validity of the quantitative results, there is a caveat about the variable selection for the SQI and the cleanliness index. There are other outcome variables that could conceivably have been included in the indices. For instance, whether the door has a lockable door could have been used as an outcome variable but was employed as an indicator instead. A lockable door from the outside might serve as an indicator for cleanliness, because by locking the toilet outsiders can be kept out. At the same time, a lockable door from the inside could have served as an outcome variable for privacy and safety/security. In future research, the sensitivity of the SQI and the robustness of the results could be analysed if additional variables are included in the index.

This quantitative study compares the sanitation outcomes in three distinct cities, located in three countries. The heterogeneity of the results reflects highly contextual differences. Many of the indicators affect quality in one context only. This has implications for the external validity of these results. One has to be cautious not to extrapolate our findings to any other context. Nevertheless, due to the large environmental and social differences between the countries, we can say with some confidence that the indicators we find to be important in

[27] (Contzen & Mosler 2015)
[28] "However, there are various unresolved issues. First, empirical work has been plagued by problems that emerge when one attempts to measure social capital. Associational measures of social capital introduce the risk of confusing shared norms and trust with enhanced flows of information. Basing social capital measures on surveys instead (i.e. asking respondents whether they feel that other people can be trusted or not) introduces the well-known divergence between stated versus actual preferences and beliefs, and appears to measure trustworthiness rather than trust". In: Bouma J., Bulte, E., van Soest D. (2008): Trust and cooperation: Social capital and community resource management. Journal of Environmental Economics and Management, Volume 56, Issue 2, September 2008, 155-166. Journal of Environmental Economics and Management

all three contexts are likely to be relevant in other contexts as well. However, more research should be conducted to strengthen such claims.

Finally, the quantitative analysis does not consider the temporal dimension of sanitation quality. For instance, some variables might be subject to seasonal variation; it is possible that certain factors only come into play in times of extreme precipitation or aridity. To test the reliability of the data in terms of seasonal variation, multiple rounds of data collection are necessary, which is beyond the scope of this study. However, data collection took place around rainy season in all three cities[29], ensuring at least a degree of comparability across the study sites.

In our view, these adjustments have not affected the quality of the data collected, their analysis, or the conclusions regarding the main research question and core goal and of the QUISS project.

29 See https://en.climate-data.org/, accessed 02.03.2020.

3 Research Activities

3.1 Phase I: Qualitative Research

The qualitative research phase of the QUISS project was designed to deliver insights into individual user perceptions, issues and priorities with respect to high-quality shared sanitation facilities (SSF) and to produce more insights on aspects of the O&M challenge essential to sustaining quality and cleanliness. First, an initial literature review[30] and derived 'quality concerns (or categories) built the starting point for conceptualising the GALS meetings[31]. Together, they formed the basis for the design of the FGD guideline[32]. Simultaneously, research leaders in each target country compiled Institutional Environment Reports to collect relevant institutional background information.[33]

The literature review is an organised collection of various (quality) aspects of available - mostly scientific - literature that has been published on SSF. It contains no discussion, judgment or conclusions regarding the collected materials. The literature review was compiled by Vasco Schelbert between October 2018 and January 2020. A draft version was reviewed by three urban water and sanitation experts[34]. Qualitative field data was collected in Ghana, Kenya and Bangladesh between January and March 2019. Qualitative fieldwork in Kumasi, Ghana was carried out from January 11th to 25th; in Kisumu, Kenya from January 28th to February 8th; and in Dhaka, Bangladesh from February 24th to March 13th. The 1st progress report summarised the preliminary qualitative findings (submitted April 2019). The QUISS research team met in Kumasi, Ghana in April 2019 to prepare for the quantitative research phase and finalise the user survey based on preliminary qualitative findings. Research leaders from each country compiled country specific GALS Meeting Reports until July 2019, while FGD transcripts were coded from July to August 2019 and analysed from September to December 2019. The 2nd progress report summarised detailed qualitative findings and outlined preliminary quantitative results (submitted September 2019).

This final report outlines detailed and summarised qualitative findings on specific user quality concerns for SSF. The collection of user quality priorities can be found in the Key Findings Summary (p. 21). This is followed by additional findings from qualitative data (see Additional Findings, p. 129). All qualitative materials can be found in the respective Appendices.

3.2 Phase II: Quantitative Research

The 1st progress report summarised the programme and activities from the QUISS team workshop in Kumasi, Ghana in April 2019. All team members finalised the quantitative user survey, the spot-check evaluation protocol, and the sampling strategy.

[30] See QUISS Final Report Qualitative Appendices, Appendix I: Literature Review
[31] See QUISS Final Report Qualitative Appendices, Appendix III: GALS Meetings
[32] See QUISS Final Report Qualitative Appendices, Appendix IV: Focus Group Discussions
[33] See QUISS Final Report Qualitative Appendices, Appendix V: Institutional Environment Reports
[34] Dr Rick Johnston, Technical Officer, Joint Monitoring Programme (JMP) at World Health Organization.
Dr Ben Tidwell, Senior Technical Advisor - WASH Behaviour Change Research at World Vision.
Ian Ross, PhD researcher, London School of Tropical Hygiene and Medicine, University of London.

Data collection took place over approximately three months, starting from the end of April 2019. To guarantee consistent, reliable, and comparable data, one week of enumerator training was carried out in each country. Quantitative data collection was finalised by July 2019. The agenda was as follows:

Enumerator Training		**Data Collection**	
Kenya:	April 29th – May 3rd, 2019	Kenya:	May 2019
Ghana:	May 27th – 31st, 2019	Ghana:	June 2019
Bangladesh:	June 23rd – June 27th, 2019	Bangladesh:	July 2019

Over this period, a total of *n=3601* interviews and *m=2027* spot-checks were conducted, exceeding the original target sample size of 3600 respondents and 1800 spot-checks. In some cases, there was no second HH available or willing to participate for a given toilet cubicle, resulting in a respondent-toilet-ratio that is slightly lower than 2:1. Section 4 (see Table 1, p. 49) gives a more detailed account of the data that was collected and provides some preliminary descriptive statistics.

The collected quantitative data was used to determine quality indicators for SSF. In the first step, the data was cleaned and analysed systematically using exploratory data analysis. In the second step, worked towards constructing quality indices. In a third step, we regressed the quality indices on potential indicators and drivers of quality.

4 Consolidated Findings

4.1 Key Findings Summary

Q: *What are key aspects and characteristics of high-quality shared sanitation facilities in urban low-income settlements in low- and middle-income countries*?

Based on the GALS meetings, general toilet availability, even if shared, and easy access (*distance*, *location*) are key quality aspects across all three countries. The participants prefer shared sanitation in close proximity to where they live, especially with respect to *usage at night*. An insufficient *toilet-user-ratio* leading to *crowding/queuing* at peak times acts as a barrier to general toilet availability. *Lack of cleanliness* including bad *smell/odour* as well as *presence of insects* are closely related issues and major factors that users relate to poor quality of SSF. Poor *individual behaviour* and on-the-spot *water availability* undermine SSF *cleanliness*. Insufficient or *no toilet cleaning after use*, poor urination practices and *disposal of solid waste in pits* as well as non- or insufficient participation in toilet *cleaning arrangements* result from poor *individual behaviour* and lead to a *lack of cleanliness*. Linked to this, distant or expensive access to water acts as a barrier to *cleanliness* because it impedes easy *toilet cleaning after use* and *toilet cleaning* in general. In all contexts, the participants complained that the *lack of cleanliness* was a source of *quarrels/disputes*, but reported that sharing can have positive aspects as well. All contexts revealed inadequate or inexistent *solid waste management*, which covers *MHM material disposal into pits*, tanks or nearby drains and can result in quickly filling and *clogging containment* and *drainage* systems as well as dysfunctional and clogged *user interfaces*.

Based on the FGD findings, the user quality priorities for SSF are (in decreasing priority): *Water availability in close proximity; cleanliness; gender-separated toilet; sanitation technology (user interface > Flush WC); additional technical components (lighting, lockable/functional door, tiling, handwashing station); privacy; (safety/security)*. Overall, *water availability* in close proximity and *cleanliness* were the most emphasised user quality priorities. Across all countries and genders, a close water source was found essential to clean SSF. *Social organisation* among users is of central importance for quality SSF. *Cleaning arrangements* as well as *financial arrangements* are the two key aspects to be socially organised among users. *Cleanliness* is mostly dependent on *individual behaviour*: Either poor user behaviour causes a lack of cleanliness or toilets are clean due to adequate cleaning behaviour, respectively. *Cleanliness* as well as *water availability* are the underlying reasons why *flush WCs* are the preferred user interface: The participants report a *flush WC* to increase convenience, as water is immediately available, therefore increasing *cleanliness* with linked beneficial effects such as decreasing *odour/smell* and *presence of insects*. With respect to user priorities, four *additional technical components* were availability of (electrical) *lighting*, *lockable/functional door*, *tiling* and *handwashing stations*. The underlying reasons for all three are again *cleanliness*, *privacy* and/or *safety/security*. Users prioritise *handwashing stations* for personal hygiene motives to prevent *health hazards*. Because it reduces *health hazards*, *handwashing station* could be subsumed under either *cleanliness* or *safety/security*. Women prioritised *lighting* and *lockable/functional door* for *privacy* and *safety/security* reasons. Men prioritised *lighting* and *tiling* for *cleanliness* reasons. Lastly, women prefer *gender-separated* for *privacy*, whereas men for *cleanliness* reasons because they complained about visible bloodstains on toilet floors and surroundings. Both motives indicate inadequate menstrual health management (*MHM)* provisions. This includes a lack of or inadequate personal hygiene facilities (*bath/shower*) for women leading to humiliating and unhygienic conditions.

In line with previous SSF research on CPR management, we evaluated *boundary conditions* with the presence of a *lockable/functional door*. A *lockable/functional door* enhances *safety/security* and *privacy* but also enables controlled access to the SSF. The assumption is that by locking out outsiders – who will not care for the sustainability of the resource of another group – the SSF will be cleaner and more sustainable. Our quantitative results support this assumption: Cleanliness is significantly higher for toilets that are lockable from the outside. This result is mainly driven by the Kenyan sub-sample.

Regarding the *presence (or absence) of management rules/structures*, qualitative FGD findings show that users deem *social organisation* to be of central importance for quality SSF. In particular, this concerns *cleaning arrangements* as well as *financial arrangements* around *O&M*. Quantitative data reveals that 43 % of the interviewed HHs report having some sort of *cleaning arrangement* (such as cleaning duty rotas) in place. The share varies considerably (see Table 2, p. 58) . On the one hand, we do not find that *cleaning arrangements* are correlated with the *number of HHs* using a cubicle. A toilet being used by a higher number of HH thus does not make it more or less likely to have a *cleaning arrangement* in place. On the other hand, we do not find that *cleaning arrangement*s significantly predict toilet cleanliness when controlling for other factors. This means that, holding all other observed variables constant, toilets are not more likely to be clean when there is a *cleaning arrangement* in place. There is, however, some evidence of an interaction between the *number of HHs* and *cleaning arrangement*s. This means that a toilet that is used by many HHs is more likely to be clean when there is a *cleaning arrangement* in place.

Previous research found that a defined user group and the *presence of management rules/structures* do not guarantee that facilities will be in proper hygienic condition.[35] After some time, management systems such as cleaning rosters can break down, indicating that there is more to quality of shared sanitation than defined boundaries and defined management structures.

Using the SQI[36] - a composite quality index - as an outcome variable, and pooling data from all three countries, results from regression analyses suggest that the most influential indicator of quality is *technology*. In particular, flush/pour-flush toilets exhibit higher index scores. SQI scores are generally lower for SSF compared to IHF. However, scores do not decrease as the *number of HHs* using the same cubicle increases. Further, results show that toilet *location*, a *lockable door*, and *tiling* are all important predictors of SQI scores. Toilets that are located outside of the compound or not immediately on the plot tend to have lower SQI scores than toilets that are inside the dwelling or inside the compound or plot. Toilets with a *lockable door* from the outside *or* the inside tend to have higher SQI scores than toilets that are not lockable at all. Toilets that are lockable from the outside *and* the inside tend to have even higher SQI scores. Toilets with *tiling* also have higher SQI scores than toilets with more rudimentary or natural floor materials. The availability of *lighting*, and the presence of a *cleaning arrangement*, is only weakly correlated with SQI scores.

Using the CI as quality outcomes (i.e.the presence of solid waste, insects, and visible faeces), yields similar results as using the SQI. *Technology* is the most influential indicator. The *number of HHs* using the same cubicle is not consistently correlated with *cleanliness*. Further, the *location*, a *lockable door* (from outside), and *tiling* are all significantly correlated with SQI scores. A *lockable door* (from outside), *tiling*, and whether the *landlord* lives on the same plot as the respondent, are all positively correlated with *cleanliness*.

Separate regressions by country yield ambiguous results. In Kenya, results suggest that the *technology* variable is an important predictor of both SQI scores and cleanliness measured by the CI. *Improved pit latrines (with*

[35] (Garn *et al.* 2017; Simiyu *et al.* 2017).
[36] The sanitatation quality index (SQI) covers outcome variables representing availability/accessibility, cleanliness, privacy, safety/security: Presence of solid waste, insects, and visible faeces; solid door and wall; solid roof and floor; reported use of the toilet at night.

slab) have significantly lower SQI scores and are less likely to be clean than *flush/pour-flush toilets* (irrespective of the outflow/containment system). *Unimproved pit latrnes (without slab*) are just as likely to be clean as *improved pit latrines* but exhibit much lower SQI scores. Furthermore, SQI scores decrease with an increasing *number of HHs*, but there is no correlation between the *number of HHs* and *cleanliness*. *Technology* and the *number of HHs* are the only significant indicators for SQI scores. However, we find a significant relationship between the CI and the toilet's *location*, the availability of a *lockable door* (from the outside), and *lighting*.

For Ghana, we do find a robust relationship between both outcomes – SQI scores and cleanliness – and *technology*. Particularly *improved pit latrines* exhibit lower SQI and cleanliness than *flush/pour-flush toilets*. The *number of HHs* are neither consistently correlated with the SQI nor the CI. Further, we find a positive correlation between SQI and the toilet's *location*, *lighting*, *tiling* and the presence of a *cleaning arrangement*. For cleanliness, we also find a positive corrrelation with *tiling*, and, surprisingly, a negative correlation when there is a *bin inside the cubicle*.

In Bangladesh, analysing the relationship between the quality outcomes and *technology* is complicated by the distribution of *technology* types. Our sample almost exclusively consists of *pour-flush to open drain/elsewhere* technologies, making a comparison with other *technology* types impossible. Also, for the *number of HHs*, we find no relationship with either the SQI or the CI. However, *water on the premises*, *lighting*, a *lockable door* (from the outside and the inside), a *cleaning arrangement*, and a close user *relationship are* all positively related to SQI scores.

Combining the results from the pooled and country-wise regressions, we find that the indicators showing the most robust relationship with the SQI and the CI are *technology* (especially *flush/pour-flush* vs. *pit latrine)*, *location*, *lockable door*, *tiling*, and, to a lesser extent, the *number of HHs* per cubicle. Contrary to what qualitative results suggest, a *water source on premises*, *handwashing stations*, *gender-separated cubicles*, and *lighting* do not show the expected positive and consistent relationship for either the SQI or the CI. Additional indicators that were expected to significantly predict SQI scores and cleanliness, but did not, are *the relationship* of the toilet users, the *age of toilet*, the presence of a *landlord on plot*, and *bin inside cubicle*.

These results are checked against the current JMP framework to test whether its sanitation service levels (*basic*, *limited*, *unimproved*) could serve as quality indicators. We compare different definitions of the sanitation service levels, where we manipulate the decisive criteria that classify an IHF or SSF as *basic*, *limited*, *or unimproved*. Redefining what is considered *basic* or *limited* as opposed to *unimproved* based on *technology* strongly improves predictive performance of the sanitation service level as quality indicator. In other words, classifying *flush/pour-flush*[37] toilets as *basic* or *limited* and *pit latrines (with/without slab)* as *unimproved* better separates clean and "high-quality" toilets from dirty and "low-quality" toilets compared to the conventional JMP definition.

Changing the threshold of HHs that classify sanitation service levels of a facility as *limited* rather than *basic* strongly increases the number of toilets classified as *basic*, while having little impact on the sanitation service level's performance as quality indicator. This means that compared to using a threshold of two HHs, substantially more toilets qualify as *basic* with a threshold of four or six HH. Also, there is less of a difference between toilets classified as *limited* and *basic* in SQI scores and the share of clean toilets. Including the *location* as a decisive factor for whether a toilet is considered *basic* or *limited* does not improve prediction performance, because the *location* strongly correlates with the *number of HHs*. All IHF in our sample are either located inside the dwelling or on the compound/plot.

[37] Inluding all outflows/containment systems of flush/pour-flush toilets: to piped sewer system, septic tank, don't know where, elsewhere or open drain.

Substituting the *number of HHs* as a decisive factor by *location, lockable door, and tiling* improves predictive performance relative to the conventional JMP definition. The improvement in the performance of the indicator is largest when pit latrines are classified as unimproved at the same time.

4.2 Q1: Categorising Shared Sanitation Facilities

Q1: *What key aspects inform a distinctive categorisation of different types of shared sanitation facilities?*

We follow Evans et al. (2017), who focus on users when distinguishing between (a) shared HH toilets[38], (b) compound toilets[39], (c) community toilets[40] and (d) public toilets[41]. While the suggested typology offers a convenient basis, we emphasised the need to evaluate the adequacy of the suggested 'typology' and suggested a more refined characterisation of these facilities if appropriate.

The quantitative study focused on shared HH toilets and compound toilets. We distinguished the two types based on their location (*inside the dwelling* vs. *on/next to the plot/compound* or *elsewhere*). We find that only 2.2% of shared toilets are located *inside the dwelling*. Only these would qualify as shared HH toilets. One the one hand, 1% of toilets located *inside the dwelling* are shared with relatives (from another household), 63% are shared with close neighbors, and 36% are shared with less-known neighbors and others. On the other hand, 2.5% of toilets located outside but *on the plot/compound* are shared with relatives, 89% are shared with close neighbors, and 8.5% are shared with less-known neighbors and others. At the same time, SSFs located *inside the dwelling* are used by a lower *number of HHs:* 64% of toilets located inside the dwelling are use by four HH or less, while just 32% of toilets located on the compound/plot are used by four HH or less. These findings suggest that the proposed categorisation is informative for the number of users but not for the relationship of those users. At the same time, its practical use for the quantitative part of the study is limited because only a small share of toilets qualify as shared HH toilets.

4.3 Q2: Individual, Structural-institutional, Technical and Temporal Characteristics

Q2: *What are essential (a) individual, (b) structural-institutional, (c) technical and (d) temporal characteristics that relate to quality-issues of shared sanitation facilities?*

Individual Characteristics

Q2a: *What characteristics of shared sanitation facilities related to quality do individual users deem to be fundamental?*

We found nine user quality priorities consistently prioritised across three different low-income urban contexts. In order of decreasing priority, users value: *immediate water access*, *cleanliness*, *gender-separated toilets*, *flush toilets*, *lighting for use at night*, *lockable/functional doors*, *tiling*, *handwashing stations* and *privacy*. Counterintuitively, *toilet-user ratio*, *waiting time*, *odour/smell* and *presence of insects* do not figure within our evaluated user quality priorities.

[38] Toilet in one HH also used by other HHs.
[39] Toilets used only by the people living in a particular compound.
[40] Non-HH toilets used by a restricted group of HHs.
[41] Toilets open to anybody.

From the evaluated user quality priorities, *cleanliness* and *privacy* can be considered as dependent or outcome variables. This means, their 'provision' is dependent on a variety of interdependent factors. These are so-called independent variables. *Immediate water access*, *gender-separated toilets*, *flush toilets*, *lighting for use at night*, *lockable/functional doors*, *tiling* and *handwashing stations* are such independent variables. This means that some of them affect *cleanliness*, some affect *privacy* and some, additionally, affect *safety/security*, which is an outcome variable as well. Taking into account the three outcome variables, the remaining seven user quality priorities can be subordinated as dependent variables as follows:

- Cleanliness
  - Water availability in close proximity
  - Flush toilet
  - Lighting
  - Tiling
  - Handwashing stations
- Privacy
  - Gender-separated toilet
  - Lockable/functional door
- Safety/security
  - Lighting
  - Lockable/functional door
  - Handwashing stations

From a practical point of view and in keeping with the final goal of QUISS, all of these are generally applicable as proxy indicators, i.e. they match the SMART adequacy criteria. The quantitative analysis reveals that out of these user quality priorities, *flush toilets*, *tiling*, and *a lockable/functional door (from in- and/or outside*) are significantly correlated with our measures of sanitation quality. Above all, *flush toilet* is the most predictive indicator of sanitation quality. Further, the *facility's location* plays an important role for sanitation quality, a factor that did not stand out in the qualitative phase. Conversely, we did not find any evidence that *water availability*, *lighting* and *handwashing stations* correlated with the quality measures.

Q2a1. *How satisfied are users of shared sanitation facilities, and what are the barriers for sustained use of these facilities?*

The quantitative survey elicited user satisfaction with the cleanliness, and the security and privacy provisions of the SSF. Regarding cleanliness, we find that most users are satisfied with the cleanliness of their SSF. In Kenya the share of respondents that are satisfied is lowest with 66%, followed by Bangladesh with 75%, and Ghana with 92%. Similarly, the share of users reporting that the feel mostly safe using the SSF at night ranges from 63% in Kenya, over 93% in Bangladesh, to 94% in Ghana. The share of users satisified with the privacy provisions of their SSF is 82% in Kenya and Bangladesh, and 95% in Ghana.

Strikingly, users are least satisfied with their SSF in Kenya and most in Ghana. This is reflected in the outcome variables used for the quantitative analysis. Contrasting the satisfaction variables with the outcome variables (CI for satisfaction cleanliness, use at night for security, and whether there is a solid wall and lockable/functional door), shows that the satisfaction variables are highly correlated with the outcome variables (see Appendix Quantitative Results, p.86) Thus, users with (observed) clean toilets are more likely to be satisfied with the cleanliness, users that report feeling secure are more likely to use the toilet at night, and users that have toilets with solid doors and walls are more likely to be satsisfied with the privacy provisions of their toilets.

The survey also elicited the most common problems with SSF as perceived by the user. In all three countries a large share reports no problem at all (see Users' perceived problems with SSF, p. 86). Overall, bad *odour/smell*, dirtiness, the number of people using the toilet (*toilet-user-ratio*) and *queuing/waiting time* were identified as the most common problems by the respondents.

Regarding country specific results, in Ghana, quantitative data shows that bad *odour/smell* is the most reported user concern, though only by 10% of the survey participants. Further, 8% report having to wait to use the toilet. Qualitative findings for Ghana support these results. On one hand, bad *odour/smell* figures as key challenges in both GALS meetings (see Ghana, p. 116) and all types of Ghanaian FGDs present absence of *odour/smell* as user quality priority (see

Quality Aspects User View	Ghana			Kenya			Bangladesh		
	Women-only	Mixed	Men-only	Women-only	Mixed	Men-only	Women-only	Mixed	Men-only
Water Availability	✓	✓	✗	✓	✓	✓	✓	✓	✓
Cleanliness	✓	✓	✓	✓	✗	✓	✓	✓	✓
Gender Separated Toilets	✓	✓	✓	✓	✗	✓	✓	✓	✓
Sanitation Technology (Flush WC)	✓	✓	✓	✓	✓	✓	✓	✓	✗
Lighting	✓	✓	✗	✓	✓	✓	✓	✓	✗
Lockable door	✓	✓	✗	✓	✓	✓	✓	✓	✓
Tiling	✓	✓	✓	✗	✓	✓	✓	✓	✗
Handwashing	✓	✓	✗	✗	✓	✓	✓	✓	✓
Privacy	✓	✓	✗	✓	✓	✓	✓	✓	✗
Odour / Smell	✓	✓	✓	✓	✓	✗	✗	✓	✗
Cleaning Arrangement	✓	✓	✓	✓	✗	✗	✓	✓	✓
Space Availability (inside)	✗	✗	✓	✓	✓	✗	✓	✓	✓
Safety / Security	✓	✓	✗	✓	✗	✓	✓	✗	✗
Toilet-User-Ratio	✓	✗	✗	✓	✓	✓	✓	✗	✓
Detergent	✓	✓	✗	✗	✗	✗	✓	✓	✓
Insects	✓	✗	✗	✓	✗	✓	✓	✗	✗
Queuing / Waiting Time	✓	✗	✗	✓	✗	✓	✓	✓	✓
Tissue / Toilet Paper	✓	✗	✗	✓	✗	✓	✓	✓	✓

Table 16, p. 124). On the other hand, while *queuing/waiting time* was mentioned in one of two GALS meetings as a key challenge, it was mentioned exclusively in women-only FGDs in Ghana. This is consistent with the Ghanaian FGD results for *toilet-user-ratio*, which was mentioned as a user priority in women-only FGDs exclusively as well. In addition, concerning dirtiness, in both Ghanaian GALS meetings *wet floor/urine on floor* figures within the five key challenges.

In Kenya, quantitative results show that most people report bad *smell/odour* (28%), the *pit being full or filling up quickly* (28%) and a *dirty toilet* (20%) to be the major user concern. Comparing the quantitative with qualitative findings produces ambivalent results for Kenya. While *dirty toilets* figured within the five key challenges in both Kenyan GALS meetings, neither of those identified bad *smell/odour* as a key challenge (see Kenya, p. 117). Interestingly, the mixed FGD in Kenya was the only FGD (from all 17) where *cleanliness* was not mentioned as a user quality priority (see

Quality Aspects User View	Ghana			Kenya			Bangladesh		
	Women-only	Mixed	Men-only	Women-only	Mixed	Men-only	Women-only	Mixed	Men-only
Water Availability	✓	✓	✗	✓	✓	✓	✓	✓	✓
Cleanliness	✓	✓	✓	✓	✗	✓	✓	✓	✓
Gender Separated Toilets	✓	✓	✓	✓	✗	✓	✓	✓	✓
Sanitation Technology (Flush WC)	✓	✓	✓	✓	✓	✓	✓	✓	✗
Lighting	✓	✓	✗	✓	✓	✓	✓	✓	✗
Lockable door	✓	✓	✗	✓	✓	✓	✓	✓	✓
Tiling	✓	✓	✓	✗	✓	✓	✓	✓	✗
Handwashing	✓	✓	✗	✗	✓	✓	✓	✓	✓
Privacy	✓	✓	✗	✓	✓	✓	✓	✓	✗
Odour / Smell	✓	✓	✓	✓	✓	✗	✗	✓	✗
Cleaning Arrangement	✓	✓	✓	✓	✗	✗	✓	✓	✓
Space Availability (inside)	✗	✗	✓	✓	✓	✗	✓	✓	✓
Safety / Security	✓	✓	✗	✓	✗	✓	✓	✗	✗
Toilet-User-Ratio	✓	✗	✗	✓	✓	✓	✓	✗	✓
Detergent	✓	✓	✗	✗	✗	✗	✓	✓	✓
Insects	✓	✗	✗	✓	✗	✓	✓	✗	✗
Queuing / Waiting Time	✓	✗	✗	✓	✗	✓	✓	✓	✓
Tissue / Toilet Paper	✓	✗	✗	✓	✗	✓	✓	✓	✓

Table 16, p. 124). *Odour/smell* was mentioned in the women-only and mixed, but not in the two men-only FGDs performed. The *pit being full or filling up quickly* is represented among the five GALS key challenges as well. While explicitly stated in the Nyalenda GALS meeting, in the Manyatta meeting the participants identified the *high groundwater table* as a key challenge. A *high groundwater table* evidently contributes to the *pit being full or filling up quickly*. None such results were found for the FGD data in Kenya.

In Bangladesh, quantitative results indicate *queuing/waiting time* (31%), bad *odour/smell* (27%), too many people using it (*toilet-user-ratio*) (22%) and *dirty toilets* (21%) to be the major user concerns. Comparing the quantitative with qualitative findings produces ambivalent results for Bangladesh. While in the Bhasantek GALS meeting bad *odour/smell* and *queuing/waiting time* figured within the five key challenges, these were absent from the Adamtek GALS key challenges (see Bangladesh, p. 118). Regarding FGD data, *queuing/waiting time* was mentioned as a user priority in all FGD types in Bangladesh, which supports the quantitative results (see

Quality Aspects User View	Ghana			Kenya			Bangladesh		
	Women-only	Mixed	Men-only	Women-only	Mixed	Men-only	Women-only	Mixed	Men-only
Water Availability	✓	✓	✗	✓	✓	✓	✓	✓	✓
Cleanliness	✓	✓	✓	✓	✗	✓	✓	✓	✓
Gender Separated Toilets	✓	✓	✓	✓	✗	✓	✓	✓	✓
Sanitation Technology (Flush WC)	✓	✓	✓	✓	✓	✓	✓	✓	✗
Lighting	✓	✓	✗	✓	✓	✓	✓	✓	✗
Lockable door	✓	✓	✗	✓	✓	✓	✓	✓	✓
Tiling	✓	✓	✓	✗	✓	✓	✓	✓	✗

Handwashing	✓	✓	x	x	✓	✓	✓	✓	✓
Privacy	✓	✓	x	✓	✓	✓	✓	✓	x
Odour / Smell	✓	✓	✓	✓	✓	x	x	✓	x
Cleaning Arrangement	✓	✓	✓	✓	x	x	✓	✓	✓
Space Availability (inside)	x	x	✓	✓	✓	x	✓	✓	✓
Safety / Security	✓	✓	x	✓	x	✓	✓	x	x
Toilet-User-Ratio	✓	x	x	✓	✓	✓	✓	x	✓
Detergent	✓	✓	x	x	x	x	✓	✓	✓
Insects	✓	x	x	✓	x	✓	✓	x	x
Queuing / Waiting Time	✓	x	x	✓	x	✓	✓	✓	✓
Tissue / Toilet Paper	✓	x	x	✓	x	✓	✓	✓	✓

Table 16, p. 124). Interestingly, bad *odour/smell* was exclusively mentioned in mixed FGDs as a user quality priority in Bangladesh. This was the reason why ultimately *odour/smell* did not figure among the overall user quality priorities. Concerning *dirty toilets*, we identified *stool remains stuck* (Adamtek) and *drainage problems* (Bhasantek) as key GALS challenges. Thus, whereas participants referred to *cleanliness* in the GALS meetings indirectly, *cleanliness* was mentioned as a user priority in all Bangladesh FGDs.

Q2a2. *What are the individual behaviours and habits of shared sanitation users?*

Concerning causes for (un)clean facilities from a user perspective, cleanliness is mostly dependent on users' *individual behaviour*, followed by availability/lack of *cleaning equipment*. Either poor *individual behaviour* causes a *lack of cleanliness*, with *children* and insufficient *toilet-user-ratio* as main reasons, or toilets are clean due to adequate cleaning behaviour. In Bangladesh, users report that the toilets are too small and inconvenient, often relating to difficulties with *MHM*, e.g. changing pads and/or body hygiene. In Ghana and Kenya, this issue was less prominent and, with a few exceptions, the *toilet size* was reported adequate. Because of the bad *odour/smell* and due to annoying and dangerous *presence of insects*, a few participants reported using the toilets only in emergencies. Overall, *location*, not *distance*, is a barrier to *physical accessibility*, especially regarding *safety/security* when *using at night*. This is also the underlying reason in normative statements regarding why a toilet in close proximity is preferred. Possible social restrictions in using a toilet refer to *social inaccessibility*. We found no qualitative evidence that e.g. *religion* or *limited mobility* affect accessibility, whereas gender does. According to qualitative data, *gender-separated toilets* are a user quality priority for SSF. Data indicates this to be a higher concern with increasing population *density* and insufficient *toilet-user-ratio*. Descriptive statements suggest that currently no separation of toilets exist. Across all three contexts, female users struggle with the same issues, particularly a lack of *solid waste disposal options* for *MHM* waste. Discussions on *reusable MHM materials* are deliberated in Bangladesh only. This suggests that in Ghana and Kenya *reusable MHM materials* are not used. Overall, adequate *MHM arrangements* and *waste bins* for *MHM materials* in the toilets are often lacking. Those that do have a *waste bin inside the toilet* report it to be embarrassing when *MHM waste* can be seen if the bin has no lid. Others report developing odours, resulting in a preference for not having a *waste bin inside the toilet*. *Used pads/clothes* often end up in the pits due to a lack of adequate disposal options and *solid waste management*. This leads to *quickly filled tanks*, *clogged pipes* and pits requiring more frequent and manual *emptying*. *Quickly filled tanks* that require frequent *emptying* increase the financial pressure on users. *Clogged pipes* lead to disfunctional toilets, and ultimately to the unavailability of the SSF.

Coping mechanisms refer to behaviour adaptation users must adopt to cope with insufficient/inadequate toilet conditions. The most prevalent *coping mechanism* is users *accompanying* each other because they are scared. Users are mostly scared when *using at night*, because of insufficient *lighting* and sometimes because the toilet is too far away (*distance*). *Missing door/locks* impeding *privacy* as well as *safety/security* was the second most often mentioned issue, though only in Bangladesh. In Bangladesh, users reported hanging up a cloth or, where solid doors without locks were present, closing doors with a rope from the inside when in use. Where no locking mechanism is available, people audibly cough from the inside to signal the toilet is occupied or are forced to manually hold the door closed. The third *coping mechanism* was to avoid using the toilet at all and to find another solution. As a *coping mechanism*, the use of *public toilets* was most prevalent in Ghana. In Ghana, the reasons that force users to use *public toilets* are *full pits/tanks* of SSF, which are locked for about three months for decomposition. In Kenya, the *location* or *distance* to the toilet forces the users to keep some sort of container at home, especially when *using at night* or during the *rainy season*. The container is used at home (e.g. in the bedroom) when needed and emptied in the morning. *Presence of insects* was mentioned as a reason to avoid using the SSF in Bangladesh. *Presence of insects* leads to inconvenience with users ultimately avoiding using the SSF. However, it remains unclear where users in Bangladesh relieve themselves instead. Further, a general *MHM*-related *coping mechanism* is that women are forced to clean *used cloths/rags* at night because adequate cleaning and *disposal options for MHM materials* are missing. MHM and related *coping mechanism*-discussions took mainly place in Bangladesh. The informative value from the FGD data for Ghana and Kenya regarding *MHM* related *coping mechanisms* remains limited. We assume that the people are (culturally) more open to talk about MHM issues in Bangladesh, which is why the data on *MHM* is richer for Bangladesh.

Q2a3. *What are the needs, desires and demands of shared sanitation users?*

Based on the GALS meetings, general toilet availability, even if shared, and easy access (*distance*, *location*) are key quality aspects across all three countries. The participants prefer shared sanitation in close proximity to where they live, especially with respect to *use at night*. Insufficient *toilet-user-ratio* leads to *crowding/queuing* at peak times, which acts as a barrier to general toilet availability. *Lack of cleanliness* including bad *smell/odour* as well as *presence of insects* are closely related issues and major factors that users relate to poor quality of SSF. Poor user behaviour and on-the-spot *water availability* are barriers to SSF *cleanliness*. Insufficient or *no toilet cleaning after use*, poor urination practices and *disposal of solid waste in pits*, as well as non- or insufficient participation in toilet *cleaning arrangements*, result from poor *individual behaviour* and lead to a *lack of cleanliness*. Linked to this, distant or expensive access to water acts as a barrier to *cleanliness* because it impedes easy *toilet cleaning after use* and *toilet cleaning* in general. In all contexts, the participants complained that the *lack of cleanliness* was a source of *quarrels/disputes*, but reported that sharing can have positive aspects as well. All contexts revealed inadequate or inexistent *solid waste management*, which covers *MHM material disposal into pits*, tanks or nearby drains and can result in quickly filling and *clogging containment* and *drainage* systems as well as dysfunctional and clogged *user interfaces*.

Based on the FGD findings, as outlined under Q2a, the user quality priorities for SSF are (in order of decreasing priority): *Water availability in close proximity; cleanliness; gender-separated toilet; sanitation technology (user interface > Flush WC); additional technical components (lighting, lockable/functional door, tiling, handwashing station); privacy; (safety/security)*.[42] Overall, '*water availability*' in close proximity and '*cleanliness*' were the most emphasised user quality priorities. Across all countries and genders, a close water source is essential to clean

[42] See Results: User's Quality Priorities: Summary, p. 64.

sanitation facilities. *Social organisation* among users is of central importance for quality SSF. *Cleaning arrangements* as well as *financial arrangements* are the two key aspects of social organisation among users. Apart from that, *cleanliness* is mostly dependent on *individual behaviour*: Either poor user behaviour causes a lack of cleanliness, or toilets are clean due to adequate cleaning behaviour, respectively. *Cleanliness* as well as *water availability* are the underlying reasons why *flush WCs* are the preferred user interface: The participants report a *flush WC* to increase convenience, as water is immediately available, therefore increasing *cleanliness* with linked beneficial effects such as decreasing *odour/smell* and *presence of insects*. In addition, the U-shaped water seal can help curbing inadequate disposal of *solid waste*, which is a main driver for *quickly filled pits* and *clogging* of pipes. With respect to technology, four *additional technical components* were availability of (electrical) *lighting, lockable/functional door*, *tiling* and *handwashing stations*. When looked at in detail, the underlying reasons for all three are again *cleanliness*, *privacy* and/or *safety/security*. Users prioritise *handwashing stations* for personal hygiene reasons to prevent *health hazards*. In this sense, because they reduce *health hazards*, *handwashing stations* could be subsumed not just under *cleanliness*, but *safety/security* as well. Women prioritised *lighting* and *lockable/functional door* for *privacy* and *safety/security* reasons. Men prioritised *lighting* and *tiling* for *cleanliness* reasons. Lastly, *gender-separated toilets* are a user priority. Women prefer *gender-separated* for *privacy*, whereas men do so for *cleanliness* reasons, complaining about visible bloodstains on toilet floors and surroundings. Both motives indicate inadequate *MHM* provisions. This includes a lack of or inadequate personal hygiene facilities (*bath/shower*) for women, leading to humiliating and unhygienic conditions. In this sense, *gender-separated toilets* are linked via *MHM* to *privacy* and *cleanliness*.

Q2a4. *What are individual incentives, motivations and capacities to improve/maintain the quality of shared sanitation facilities?*

Across all three contexts, inadequate *individual behaviour* is a main reason for unhygienic conditions. Users are not equally participating in *cleaning arrangements*, or they do not adhere to existing (in)formal *rules*. Often, participants refer to a *lack of feeling of individual responsibility* (of others) even with clearly defined user groups, which is a common reason for *quarrels/disputes*. Our data does not reveal how individual responsibility could increase. Other research[43] found that respondents are more likely to frequently clean shared toilets if cleaning is part of their daily routine activities, because it is easier to remember when to clean, and there is a cleaning commitment.

Qualitative data reveals that in Ghana and Kenya, the participants found a lack of cooperation among users together with a lack of cooperation between the users and *public authorities/proprietors/service providers* to challenge acceptable SSF quality. In Ghana and Kenya, some users suggested improving co-production through routine monitoring and supervision by local or city authorities to ensure sanitary hygienic conditions. In addition, users expect *public authorities* to regulate standards for construction quality of SSF superstructures to enhance user safety. Moreover, users expect improved planning (e.g. high groundwater table) so as to provide better *conveyance* and *disposal* solutions for faecal as well as for *solid waste*. Conversely, in Bangladesh, the participants expressed a higher feeling of *negligence* by *public authorities*. In Bangladesh, the FGD participants perceive the lack of support from *proprietors* and a lack of service provision from p*ublic authorities* as the reasons for insufficient *O&M* of toilets and *drainage* canals. The same applies to insufficient and expensive water provision, creating *affordability* issues. In this sense, compared to Ghana and Kenya, in Bangladesh the participants identified a lack of institutional support. In all three contexts users report *affordability* of *emptying* services to be an issue. Yet, although a recurrent financial burden, qualitative data suggests that it is the lack of foresight and planning for these payments that puts considerable pressure on tenant's budgets rather

[43] (Tumwebaze & Mosler 2014).

than the payments themselves. To mitigate fluctuations, including *O&M* costs in e.g. the monthly rent most likely could produce relief. Compared to *cleaning arrangements*, *financial arrangements* around procurement of *cleaning equipment* among the tenants (and *proprietor*) are rare and usually rest with the individual HHs.

Structural-institutional Characteristics

> Q2b: *What are the structural-institutional characteristics that enable quality of shared sanitation facilities?* [44]

Structural conditions frame social coordination processes and in general consist of social-institutional (financial, human and institutional capital) and physical-environmental (natural capital) conditions. With respect to social-institutional characteristics, former research[45] outlines four institutional challenges that act as barriers to quality SSF. These are a collective action challenge, a coproduction challenge, an affordability challenge, and a housing tenure challenge. In general, these four challenges refer to coordination challenges among users and governance issues. Because evaluating affordability issues would require a specific, separate methodological approach, under Q2b, we elaborate on the collective action, coproduction and housing tenure challenges. These are desk-based results from the literature review.

Collective Action

Collective action refers to the link between individuals and the community (e.g. SSF users). The collective action challenge refers to social dilemmas between the users of SSF. If users act collectively, rather than pursuing individual self-interest independently, everyone benefits. Thus, meeting individual needs and preferences is heavily dependent on the behaviours of others. This factor is essential for general access to as well as the sustainable O&M of SSF. There is evidence that the presence and quality of 'social capital' are essential when aiming for sustainability.[46] Even though a consensus is lacking on what the concept refers to[47], social capital can be described as a *network of relationships* held together by *trust*, *reciprocity*, *collective action* and *networking*.[48] Communities with higher levels of trust and a greater number of pre-existing community interaction are likely to be better prepared to cooperate and care about social norms, thus making social sanctions more effective.[49] With respect to the lack of a universally accepted definition and respective indicators, measuring social capital is a complicated and controversial task.[50] Given the importance of social capital for a successful sanitation service chain and daily O&M practices, measuring social capital might be a promising supporting proxy indicator providing information if O&M is probable. However, while several scholars developed a range

[44] We outlined in the 2nd Progress Report that the qualitative data does not provide adequate information to draw robust conclusions with respect to structural-institutional characteristics that enable SSF quality (see Adaptations and Limitations, p. 16). Thus, this section lists desk-based results from previous topic-related research (literature review) and is enriched with general qualitative and quantitative insights from our data. Contextual findings can be found in the QUISS Final Report Qualitative Appendices, Appendix V: Institutional Environment Reports. The Institutional Environment Report were compiled by the respective research leaders from each target country.
[45] (McGranahan & Mitlin 2016).
[46] (McGranahan 2013; Cameron *et al.* 2015; Cardone *et al.* 2018).
[47] (Adrianzén 2014) refers to Putnam, R. et al. (1993). Making Democracy Work: Civic Traditions in Modern Italy. Princeton University Press.Woolcock, M. (1998). Social capital and economic development: Toward a theoretical synthesis and policy framework. Theory and Society, 27(2), 151–208.
Glaser, E. et al. (2000). Measuring trust. The Quarterly Journal of Economics, 115, 811–846. Karlan, D. (2005). Using experimental economics to measure socialcapital and predict financial decisions. American Economic Review, 95(5), 1688–1699. Dasgupta, P. (2005). The economics of social capital. Economic Record, 81(1), 2–21.
[48] (Johnson 2016).
[49] (Wegelin-Schuringa & Kodo 1997; Shakya *et al.* 2014; Cameron *et al.* 2015; Cardone *et al.* 2018).
[50] (Adrianzén 2014).

of indicators[51], methodological concerns[52] emerged within our research group. Ultimately, we decided against including social capital in this study.

The level of social connectedness evinces close links to the size of a group. SSF appear to work better with a small number of families (strong social bonds) who either own the facility or clearly understand their responsibility to maintain its cleanliness over time.[53] Studies have shown that the degree of cooperation decreases with an increase in the size of the groups[54], and find that collective decision-making is more effective in compounds with fewer HHs or in those with a leader present.[55]

Quantitative data generated mixed results regarding group size and cooperation. The *number of HHs* using the same cubicle is not correlated with the presence of a *cleaning arrangement*. Also, it not more likely that there is a *cleaning arrangement* in place when a *landlord* is present on the plot. 44% of toilets with a *landlord* living on the plot have a *cleaning arrangement*, compared to 48% when the *landlord* does not live on the plot. Still, toilets are more likely to be clean when there is a *landlord* living on the plot. 46% of toilets with a *landlord* present are clean, compared to 31% if the *landlord* is not present. However, regression analyses reveal that this difference is not robust when other explanatory variables are taken into account.

In addition, former research[56] aligns successful SSF management strategies to Elinor Ostrom's common pool resource (CPR) management principles[57]. If present, the CPR principles foster work towards the successful management and therefore sustainability of SSF. These CPR principles are *boundary conditions*, *presence of management rules/structures*, i.e. *defined roles and responsibilities*, *collective decision-making* and *problem-solving mechanisms*, *monitoring* and *(graduated) sanctions*. These process-oriented indicators[58] rely on a successful interplay. The rationale is that participative decision-making processes and the inclusion of *problem-solving mechanisms* establish user ownership, thus increasing individual accountability and ultimately leading to sustainable O&M. *Problem-solving mechanisms* are *rules*, *sanctions* or *enforcement mechanisms*, the definition of *boundary conditions*, the assignment of *roles and responsibilities* to, for example, O&M, and measures that enable the *monitoring of activities*. Given the outlined adequacy criteria and the aim for cost-effective proxy indicators, evaluating the presence (and ideally the strength or effectiveness) of all CPR principles is beyond the scope of this study. Evaluating process-indicators is resource intensive, which is why these do not match the adequacy criteria. Thus, the CPR candidates that are said to be key to successful O&M of SSF and could work as proxies are *boundary conditions* and *presence of management rules/structures*. *Boundary conditions* refer to constraints that allow defining clear group boundaries and can be demarcated in various ways[59]. The *presence of management rules/structures* applies to the newly introduced 'environmental cleaning'

[51] (McGranahan 2013) (based on (Bowles & Gintis 2002). (Bisung *et al.* 2014) (based on Krishna, A., Shrader, E., 2000. Cross-cultural Measures of Social Capital: a Tool and Results from India and Panama (Social Capital Initiative Working Paper No. 21). The World Bank, Washington, D.C. Krishna, A., Uphoff, N., 2002. Mapping and measuring social capital through assessment of collective action to conserve and develop watersheds in Rajasthan, India. In: Grootaert, C., Bastelaer, T. (Eds.), The Role of Social Capital in Development: an Empirical Assessment. Cambridge University Press, New York, pp. 85-124. De Silva, M.J., Harpham, T., Tuan, T., Bartolini, R., Penny, M.E., Huttly, S.R., 2006. Psychometric and cognitive validation of a social capital measurement tool in Peru and Vietnam. Soc. Sci. Med. 62 (4), 941e953). (Adrianzén 2014) based on: Knack, S., & Keefer, P. (1997). Does social capital have an economic payoff? A cross country investigation. Quarterly Journal of Economics, 112(4), 1251–1288. Guiso, L. et al. (2004). The role of social capital in financial development.American Economic Review, 94(3), 526–556. Wang, S. (2009). Social capital and Rotating Labor Associations: An instrumental variable approach. Working paper, Department of Economics, The University of British Columbia). (Cameron *et al.* 2015).

[52] "[...], [T]here are various unresolved issues. First, empirical work has been plagued by problems that emerge when one attempts to measure social capital. Associational measures of social capital introduce the risk of confusing shared norms and trust with enhanced flows of information. Basing social capital measures on surveys instead (i.e. asking respondents whether they feel that other people can be trusted or not) introduces the well-known divergence between stated versus actual preferences and beliefs, and appears to measure trustworthiness rather than trust". In: (Bouma *et al.* 2008)

[53] (Günther *et al.* 2012; Tumwebaze *et al.* 2013; Kwiringira *et al.* 2014a; Simiyu *et al.* 2017; Cardone *et al.* 2018)

[54] (Tumwebaze & Mosler 2014; Tumwebaze *et al.* 2014; Shiras *et al.* 2018b).

[55] (Simiyu *et al.* 2017; Shiras *et al.* 2018b).

[56] (Cameron *et al.* 2015; Garn *et al.* 2017; Simiyu *et al.* 2017; Chipungu *et al.* 2018; Shiras *et al.* 2018b).

[57] (Ostrom 2002).

[58] For information on the different types of indicators, see QUISS Final Report Qualitative Appendices, Appendix I; Literature Review, chapter 2.2 Units of Measurement: How to Measure high-quality?.

[59] For example: Toilets situated within fenced and/or gated compounds and they are locked with padlocks. In compounds where toilets are locked, each HH has a copy of the keys or one key is shared by at least two HHs. In other cases, keys can be situated at strategic positions (e.g. on a wall) where they are accessible to HHs within the compound.

indicator for HCF by JMP.[60] There are are similarities between the indicators for evaluating the *presence (or absence) of management rules/structures* in the JMP[61] as well as in previous research on SSF quality.[62]

In line with previous SSF research on CPR management, we evaluated *boundary conditions* with the presence of a *lockable/functional door*. A *lockable/functional door* enhances *safety/security* and *privacy* but also controls access to the SSF. The assumption is that by locking out outsiders – who will not care for the sustainability of another group's resources – the SSF will be cleaner and more sustainable. Our quantitative results support this assumption: Cleanliness is significantly higher for toilets that are lockable from the outside. This result is mainly driven by the Kenyan sub-sample.

Regarding the *presence (or absence) of management rules/structures*, qualitative FGD findings show that users deem *social organisation* to be of central importance for quality SSF. In particular, this concerns *cleaning arrangements* as well as with *financial arrangements around O&M* (see Q2b1, Q2b2, and Q2b5). Quantitative data reveals that 43 % of the interviewed HHs report having a *cleaning arrangement* such as cleaning duty rotas in place. The share varies considerably across countries (see Descriptive statistics, p. 57). We do not find that the presence of *cleaning arrangements* is positively correlated with toilet cleanliness when we account for other explanatory variables using multiple regression analysis.

Previous research found that a defined user group and the *presence of management rules/structures* do not guarantee that facilities will be in proper hygienic condition.[63] After some time, management systems such as cleaning rosters can break down, indicating that there is more to the quality of shared sanitation than defined boundaries and defined management structures.

Coproduction

Overall, from a user perspective, local collective action is a precondition for coproduction. From a governance perspective, successful coproduction depends on an enabling environment, i.e. adequate social-institutional arrangements. Coproduction refers to the collaboration between the users and service providers and/or public agencies. This kind of collaboration is especially relevant for low-cost on-site sanitation in low-income settlements because it is essential for a functional sanitation service chain.

On one hand, a recent World Bank publication suggests that the degree of user involvement could be a telling indicator for coproduction in terms of whether users' needs are met.[64] However, the document leaves the tricky question regarding what those 'telling indicators' could look like unaddressed. On the other hand, since successful coproduction depends on an enabling environment, i.e. adequate social-institutional arrangements, this suggests that evaluating the enabling environment itself, i.e. its composing factors, could be a telling indicator for existing coproduction. Inclusive and participative sanitation approaches[65] that target collective action and coproduction perceive the enabling environment[66] as consisting of the following factors: *Government support, a complementing legal and regulatory framework, institutional arrangements, financial arrange-*

[60] (WHO 2018a).
[61] Protocols for cleaning should include (a) step-by-step techniques for specific tasks, such as cleaning a floor, cleaning a sink, cleaning a spillage of blood or body fluids (b) a cleaning roster or schedule specifying the frequency at which cleaning tasks should be performed.
[62] Defined cleaning structures were commonly in the form of a duty rota, and each HH had a specific day(s) when they cleaned toilets. It was not a written rota per se, but rather HHs followed an order (e.g. arrangement of houses within the compound) that ensured that all users participated in cleaning the toilet.(Simiyu *et al.* 2017; Chipungu *et al.* 2018)
[63] (Garn *et al.* 2017; Simiyu *et al.* 2017).
[64] (Cardone *et al.* 2018).
[65] (CLTS, cf.(Kar & Chambers 2008); CLUES, cf.(Lüthi *et al.* 2011); San21, cf.(Parkinson & Lüthi 2014).
[66] (Lüthi *et al.* 2011).

ments, *sociocultural arrangements*, and *skills and capacities*. Evidently, evaluating these factors requires a qualitative in-depth analysis[67], and these factors do not match the adequacy criteria as a result. Because coproduction refers to the collaboration between the users and service providers (and/or public agencies), and because coproduction is claimed to be essential to a functional sanitation service chain[68], one could argue that the existence of a functional sanitation service chain indicates coproduction. A thorough review or even examination of the entire sanitation chain is beyond the scope of this study. Having in mind the facility as unit of analysis[69], the WASHCost[70] approach outlines that while for an 'improved service'[71] the whole chain needs to be covered, a 'basic service' should at least serve the containment and emptying/collection links. In other words, if e.g. reliable formal pit emptying exists, this indicates (the presence of) coproduction. Past research[72] has used pit-emptying activities as an indicator for the '*nested activities*' CPR principle, which is a synonym for coproduction.[73] Therefore, in order to assess existence of coproduction mechanisms, the (reliability) of emptying services could be indicative. In addition, *water availability* as well as *solid waste management* services could be additional *nested activities*. Both are relevant to sustainability of SSF. *Water availability* is a user quality priority. The effects on SSF functionaliy due to inadequate or lacking *solid waste management* have been outlined above. *Solid waste management* as well as *water availability* are usually provided by public authorities.

Regarding emptying, the quantitative results are not particularly revealing. Emptying applies only to parts of the Kenya sample and to fractions of the Ghana sample. One third of toilets do not have a pit/septic tank (mostly in Bangladesh). Another third was never emptied (Ghana and Kenya). This means that for a large share of the sample, there is no data available on emptying arrangments.

The emptying responsibilities are strongly country dependent. In Kenya 80% of HHs that have pit or septic tanks that was emptied at least once report that the *landlord* is responsible for paying for the emptying, while in Ghana 87% report that all sharing HHs contribute to emptying costs. This suggests that coproduction related to emptying is mostly limited to Ghana.

From qualitative data we found that users report that lack of water coupled with a lack of *affordability* act as barriers to clean toilets, as they impede easy cleaning after use, and toilet cleaning in general. Quantitative data suggest that a water source in close proximity is not a good indicator for cleanliness. However, 75% of respondents report that the price of water is not a problem for the household. Similarly, 74% of respondents report that cleaning is affordable for them.

We identified a lack of *solid waste management* for used *MHM materials*, which leads to quickly filled pits. Thus, the availability of a *bin with lid inside the cubicle* and availability of formalised and regular *solid waste management* could be applied as an additional indicator for coproduction and sustainability of SSF. Surprisingly, we find that cubicles with a bin inside the cubicle are not more likely to be clean. In Ghana, where 97% of toilets with bins inside the cubicle are located, we even find a weak negative correlation with toilet cleanliness.

[67] See QUISS Final Report Qualitative Appendices, Appendix V, Institutional Environment Reports
[68] By definition, a functional, i.e. effective ('separate human waste from human contact') sanitation system is successfully operated and maintained along the entire service delivery chain.
[69] Cf.(Potter *et al.* 2011).
[70] (Potter *et al.* 2011)WASHCost defined four sanitation service parameters to assess three service levels.
Sanitation Service Parameters: Accessibility (number of toilets per HH, distance of toilets from HHs); Use (use by all members of the HH); Reliability (HH maintenance, O&M support service available); Environmental protection (toilets constructed at least 15m from water sources, safe re-use, safe disposal).
Sanitation Service Levels: Improved = Regular or routine O&M (incl. pit emptying), requiring minimal user effort | Basic = unreliable O&M (incl. pit emptying) requiring high user effort | Limited/No Service = No O&M (pit emptying) taking place and presence of extremely dirty toilets ((Potter *et al.* 2011)1, Fig. 13, p. 21).
[71] This corresponds to what (WHO 2018b)denominates as "safely managed".
[72] (Chipungu *et al.* 2018)
[73] "Nested activities" are derived from (Ostrom 2002)"nested enterprises" because sanitation is deemed a CPR that is part of a larger system. "Nested activities" refer to the above-mentioned collaboration between the users and service providers and/or public agencies and therefore to the "coproduction challenge".

House Tenure Challenge

The above-mentioned challenges generally apply to all low-income settings. The house tenure challenge applies to tenants and is particularly relevant for informal settlements, but applies to low-income settlements as well. Residents of informal and tenants of low-income settlements must reckon with the constant uncertainty of relocation, which undermines efforts to improve sanitation. Tenants have little reason to invest in sanitation facilities, and sanitation can easily become a matter of dispute.[74] Our quantitative data implies that there is a positive correlation between the duration time a HH resides on a plot/compound and the SQI and CI. This means that the longer a HH lives on a plot/compound, the more likely the toilet is to be clean. However, when controlled for tenancy status, the relationship between the duration of residency and the SQI and the CI ceases to be statistically significant. Instead, regression results suggest that the formality of the contract seems to be decisive. On average, tenants without written tenancy agreements tend to have toilets of lower quality (in terms of SQI scores) and are less likely to be clean (measured by the CI) compared to house owners. Formal tenants tend to have toilets with higher SQI scores and are more likely to be clean than house owners.

Q2b1: *What are different management schemes for shared sanitation based on experiences from QUISS target countries*?

Under management schemes we differentiate between cleaning activities, maintenance arrangements and financial arrangements.

Cleaning Arrangements

In general, users themselves are responsible for cleaning and, further, predominantly the women clean. In most cases there exists some sort of *cleaning agreement*. Across all three contexts, once-a-week cleaning activities are prevalent. *Frequency* varies between cleaning after use, cleaning daily, every second day, twice a week or weekly. Where adequate *cleaning equipment*, or at least the *brush/broom*, is available, users usually have bought them together, while *cleaning agents* are provided by each HH. For cleanling, mostly *soap* is used, but conditions can differ within each context. In Bangladesh, tenants have a tendency to expect *cleaning equipment* to be provided – either by the *proprietors* or an *NGO*. In Ghana and Kenya, it is the users who provide the *cleaning equipment*. While not questioned in Ghana, most participants in Kenya do not question this either, while others demand that these amenities to be provided by the *proprietors*. Overall, it seems that in Kenya the 'organisation level' among users is highest comparing the three contexts, with quite some users reporting that they hold a (monthly) meeting on such issues.

Maintenance Arrangements

In our case, *maintenance arrangements* refer to repair work and explicitly exclude cleaning and pit emptying. With respect to general *maintenance arrangements*, different patterns are prevalent, with both the *proprietor* and the users being responsible for organising or carrying out repair work in general. A few reported that an *NGO* deals with these issues (in Bangladesh), whereas others indicated that nobody cares, leaving the SSF dysfunctional or in an inadequate state. Overall, qualitative data indicates that in Bangladesh, the distribution of these responsibilities between *proprietors* and users are rather balanced, whereas in Ghana these lie with

[74] (Wegelin-Schuringa & Kodo 1997; Isunju *et al.* 2011)

the users and in Kenya more with the *proprietors*. These results are consistent with the distribution of pit *emptying* costs.

Financial Arrangements

Regarding *financial arrangements* for *O&M* cost distribution between *proprietors* and users, no clear pattern is visible. This depends on the kind of repair work in question, whether the *proprietor* or the users have a *feeling of responsibility*, and on the social relationship between them. Overall, data suggests that users have to pay for maintenance work. In a few cases, the *proprietors* charge a deposit or an additional amount with each rent to save for such investments, whereas some tenants organise and pay in the first place and claim to deduct their payment from the rent in hindsight. Such *financial arrangements* were more frequently reported in Ghana than in Kenya, and are absent from the Bangladesh data. Where in place, in Ghana and Kenya, the participants seem to be fine with this 'arrangement', and organisation of respective services seems to work well. For pit *emptying*, no formal prearrangement for collecting money exists. Generally, the users have to bear the costs and the money is collected among them when needed. *Affordability* of *emptying* services is an issue.

> Q2b2: *What are highlighted strengths and weaknesses observed in those management schemes, especially when considering quality issues*?

Concerning strengths, users emphasise that fostering exchange among users, creating *rules* and distributing responsibilities and making them visible via a timetable should enhance individual *compliance*. This is consistent with other research on management of CPRs. However, other reports show ambivalent results in terms of (sustained) success of such arrangements. Scholars put emphasis on the process of implementing such arrangements, which is collective decision-making among users. 'Success stories' from QUISS Kenya data suggest that it was the *proprietors* who installed and monitored the *duty roster*, rather than this being organised by the users themselves. Thus, rather than being related to the process, success may be related to the fact that the *proprietor* lived on the same compound/plot in these cases. Therefore, 'physical' and visible *duty rosters* might not be sufficient, unless complementing *monitoring* and *enforcement mechanisms* are implemented as well.

Regarding weaknesses, normative statements from both parties about how *O&M* and related *financial arrangements* should and could be organised show that the know-how is actually there, but fails to be translated into practice. Generally, both proprietors and users exhibit a lack of a *feeling of responsibility*. Instead, they expect that *cleaning arrangements* and *cleaning equipment*, *maintenance arrangements*, *financial arrangements* and *emptying* arrangements are to be organised (and paid) by the other party. Identified barriers are a lack of social identity, social cohesion, community interaction, empathy and a sense of shared responsibility. In all three contexts, participants that had a good relationship with their co-users expressed that *cleaning arrangements* and *cleaning equipment*, *maintenance arrangements*, *financial arrangements* and *emptying* arrangements (collecting contributions for emptying services) is not a problem. To address and overcome local collective action problems, *monitoring* has been repeatedly cited as a possible candidate.[75] *Monitoring* is believed to have positive impacts on individual *compliance*. Due to the incapacity and inability to enforce *compliance*, *non-compliance* of individuals is likely to result in indifference towards the SSF. Qualitative results suggest that *cleanliness* improves if the *proprietor* is living on the same plot/compound. We assume that he/she is most likely responsible for setting the *rules* and, because of enhanced ownership and proximity, is

[75] (Wegelin-Schuringa & Kodo 1997; McGranahan 2013)

more motivated and can more easily monitor user's behaviour and enforce *sanctions*. Where this is not the case, because there are no *sanctions* and/or *enforcing mechanisms*, it is often up to certain individuals to keep the SSF in an adequate state. Overall, while *boundary* conditions are in place, *formalised management rules/structures* are absent, including *clearly defined roles and responsibilities*. The same is true for collective decision-making and *problem-solving mechanisms*. This undermines *monitoring* and *enforcement mechanisms* for (graduated) *sanctions*. Although a recurrent financial burden, data suggests that it is the lack of foresight and planning for these payments that puts considerable pressure on tenant's budgets, rather than the payments themselves. To mitigate fluctuations, including O&M costs in, for example, monthly rent could most likely produce relief. Compared to cleaning activities, financial arrangements around procurement of cleaning equipment among the tenants (and proprietor) are rare and usually rest with the individual HHs.

Q2b3: *What are the characteristics of the predominating core collective relationships (levels of trust, reciprocity,…)?* [76]

Q2b4: *What underlying motivations exist in these relationships?*

Where a good social relationship and cohesion among users exist (= 'enabling environment'), *compliance* with *duty rotas* and inclusion of recurrent O&M costs into the monthly rent are expected to be more likely to be translated into practice. A closer look at the *O&M* data reveals that, overall, *proprietors* as well as users expect *O&M* to be organised (and costs paid) by the other party. Where such expectations exist, they explain the existence of informal *rules* and ineffective *enforcement mechanisms*, as well as a *lack of cleanliness* leading to dysfunctional toilets and *full pits*. A basic lack of foresight and responsibility prevent the scheduled inclusion of sanitation related recurring costs into e.g. the monthly rent. While for Bangladesh the *social organisation* level was found to be low, in Kenya and Ghana these have been found to be higher. Two reports from Ghana ('institutionalised periodical meeting') and one from Kenya ('padlock meeting') with good social relationships, organisation of *O&M* in place, and positive reports from participants in the SSF at least support this assumption.

Q2b5: *What are the (formal and informal) rules in place that structure or attempt to constrain the behaviour of actors in a particular context?*

Prevalent *rules* are mostly informal and complementary (formalised) *sanctions* and *enforcement mechanisms* are lacking. Usually, the existing rule combines permission to use the toilet with participation in cleaning activities. In Ghana and Kenya the rules are set by the *proprietors*, while in Bangladesh these are either set by the users or nonexistent. In Bangladesh, *absence of rules* is highest compared to the Ghana and Kenya. In Kenya, the chances that *proprietors* set the rules is twice as high as for users, while in Ghana there are no reports of users setting the rules at all. In Kenya, *eviction* is the most common applied *sanction*, while in Ghana it is the prohibition of *toilet use* (forced use of *public toilet*) and in some cases *eviction*. In Bangladesh, *sanctions* are almost inexistent. Due to incapacity and inability to enforce *compliance*, *non-compliance* of individuals is likely to result in indifference towards the SSF. Admonitory words from co-users remain ineffective unless the social relationship is good. Even though largely absent, effective *enforcement mechanisms* are more likely in Ghana and Kenya than in Bangladesh. This might be because *proprietors* usually do not dwell on the same plot/compound in Bangladesh. Qualitative data suggests that only when the *proprietors* live on-site or close-by, and

[76] As outlined under Q2b, while several scholars developed a range of indicators (76 see Footnote #51, p. 29.), methodological concerns (see Footnote #52, p. 29.) emerged within our research group, we rejected an evaluation of the core collective relationships (Q2b3) as well as underlying motivations (Q2b4). Thus, this section only briefly summarises general insights from the QUISS data.

have a regular exchange with the tenants, does the presence of *enforcement mechanisms* seem to be at least more likely. In other words, the more the *proprietors* are setting the *rules*, the more likely there are to be corresponding *monitoring*, *sanctions* and *enforcement mechanisms*. However, this may be correlated but not causal, as the cause might be proximity of the *proprietor* to the SSF: if the *proprietor* is living on the same plot/compound, he/she is most likely responsible for setting the *rules* and, because of enhanced ownership and proximity, is more motivated and can more easily monitor users' behaviour and enforce *sanctions*. In all three contexts, participants that had a good relationship with their co-users expressed no problems regarding *cleaning arrangements* and *cleaning equipment*, *maintenance arrangements*, *financial arrangements* and *emptying* arrangements. Qualitative results suggest a correlation between good social relationships among users and the possibility of users setting the *rules*.

Overall, *quarrels/disputes* among SSF users most often occur around *cleanliness* issues, especially related to *financial arrangements* and *cleaning arrangements*, *non-compliance* of individual users, and insufficient *toilet-user-ratio*. Results suggest that the less formalised *rules* are in place, the more disputes happen. Still, a formalisation of *rules* and *enforcement mechanisms* for financial contributions and participation in *cleaning arrangements* is missing. Institutionalised *problem-solving mechanisms* are an exception. The likeliness and efficiency of such mechanisms depend on the social relationship and cohesion among users, which in turn is dependent on time spent living together, and number of tenants living on a plot.

Technical Characteristics

> Q2c: *What are quantifiable technical components that are fundamental for the quality of shared sanitation facilities?*

In the subsequent section, we provide a combined response to the below outlined subquestions.[77]

> Q2c1: *What are essential quantifiable WASH hardware components that are fundamental for quality of shared sanitation facilities?*
>
> Q2c2: *What are essential facility design features that are fundamental for the quality of shared sanitation facilities?*
>
> Q2c3: *How do essential facility design features correlate with the quality of shared sanitation facilities?*
>
> Q2c4: *How do essential user features correlate with the quality of shared sanitation facilities?*

As delineated in the literature review[78], we depart from a HR-based approach in conceptualising quality determinants of SSF. In this respect, we take the HR framework outlined in the report of the Special Rapporteur on the human right (HR) to safe drinking water and sanitation as a starting point (Héller 2015). It describes the relevant HR standards and principles that serve to assess different levels and types of WASH services. Departing from the same normative foundation, we define three constituents to which SSF quality must refer to. These

[77] To test which features are essential for sanitation quality, we used regressions of sanitation quality measures determined by toilet cleanliness and the hardware components on design features and other toilet characteristics. Therefore, the two questions can be answered jointly, because we determine what features are fundamental by analysing correlations with sanitation quality.
[78] See QUISS Final Report Qualitative Appendices, Appendix I, Literature Review, chapter 3 Quality Determinants.

three constituents are (1) availability & accessibility, (2) safety/security & privacy as well as (3) O&M & cleanliness of SSF.

Departing from this SSF quality framework, we compiled the Sanitation Quality Index (SQI). The SQI includes relevant findings from existing scientific literature as well as qualitative findings from QUISS.

Under Q2a, we outlined nine user quality priorities. From these evaluated user quality priorities, *cleanliness* and *privacy* can be considered dependent, or outcome, variables. This means that their 'provision' is dependent on different and interdependent factors, so-called independent variables. With 'quantifiable technical components' we refer to components, whiche are independent variables. 'Quantifiable technical components' refers to 'countable' hardware components.[79] Hardware components are – for example – required for *cleanliness* and *privacy*: Qualitative data revealed that users prioritise a *lockable/functional door* (= quantifiable hardware component) for *privacy* and *safety/security* reasons (= outcome). From the nine user quality priorities evaluated, seven hardware components are quantifiable. These are: *Immediate water access*, *gender-separated toilets*, *flush toilets*, *lighting for use at night*, *lockable/functional doors*, *tiling* and *handwashing stations*.

In other words, 'quantifiable hardware components' refer to SSF hardware that contributes to the achievement of these 'quality constituents'.[80] The following hardware components were included in the assessment of the toilets' quality:

- Floor with no cracks/holes
- Solid door with no holes
- Solid wall with no holes
- Solid roof with no holes

These variables were chosen because previous research, official JMP documents for institutional WASH, and qualitative QUISS results suggest their inclusion. These variables also match the defined adequacy criteria.[81] These variables can easily and objectively be identified as part of the spot-check observation. While a solid roof and floor fall under the category of safety and cleanliness, a solid door and wall represent privacy and security.

In the quantitative analysis we find that the toilet technology, and particularly the interface, are fundamental indicators for toilet quality. Whereas flush/pour-flush toilets are strongly correlated with sanitation quality, pit latrines (with and without slab) exhibit a strong negative correlation with toilet quality, which is in line with the findings from the FGDs. There is also quantitative evidence that tiling and a lockable door are correlated with sanitation quality. We only find a weak relationship between lighting and quality outcomes. There is a significant positive relationship for Kenya, driven by a correlation with cleanliness, and a positive relationship for Bangladesh, driven by a correlation with privacy and safety/security. Contrary to the qualitative study, we do not find that water availability, handwashing stations and gender separated toilets are correlated with our definitions of sanitation quality.

[79] See QUISS Final Report Qualitative Appendices, Appendix I: Literature Review. In chapter: Units of Measurement: How to Measure high-quality?
[80] See Possible SSF quality indicators, p. 48.
[81] See Adequacy criteria for indicators, p. 43.

Temporal Characteristics

Q2d: *What are adequate and measurable indicators that provide information on the sustainability of O&M under special consideration of the sanitation service delivery chain?*

Q2d1: *What are possible bottlenecks and key aspects of a functional service delivery chain, and what conclusions can be drawn regarding drivers and barriers of O&M schemes of shared sanitation facilities?*

Qualitative data reveals that in all three contexts a lack of (formalised) *solid waste management* threatens safe faecal waste separation/storage at the source. *Solid waste* – especially used *MHM materials* – is the predominant reason for quickly filled pits/tanks and *clogging* of pipes. In effect, this leads to the unavailability of the SSF to users. Aside from *solid waste*, *full pits/tanks* are caused by inflowing rain/cleaning water. The former reiterates the lack of *solid waste management* and adequate disposal options, the latter adds the lack of *drainage* canals for rainwater. Clogged pipes and solid waste in pits/tanks require manual emptying because emptying with exhausters becomes difficult. This increases the likelihood of unsafe faecal waste disposal. Insufficient *social organisation* among users poses further challenges to adequate *emptying*. In other words, distribution of roles and responsibilities between users and *proprietors* remains unclear, especially regarding *financial arrangements*. This leads to *quarrels/disputes*. Qualitative data further reveals that in some cases a lack of (affordable) *emptying* services leads to pit emptying via drainage systems, often during the *rainy seasons*. This predominantly happens in Bangladesh and Kenya. In Ghana, 'emptying' by applying chemical substances seems popular.

In Bangladesh and Kenya, users expect sewers to solve the *clogging* and *overflow* problem. Descriptive statements on *containment* and *conveyance* indicate that in Bangladesh most SSF are connected to some sort of (unsafe) *conveyance* system, while in Ghana and Kenya pits and septic tank technologies are prevalent. Quantitative data support these findings: In Bangladesh 93% of toilets drain to an *open drain* or *elsewhere*. In Kenya, 90% of toilets have single pits, while in Ghana 53% are connected to septic tanks, and 40% are pit latrines. Normative statements indicate that participants expect covered *sewer connection* to reduce *clogging*, bad *odour/smell*, and *health hazards*. For Ghana, this is only indirectly evident, as a (cistern) flush toilet was often said to represent a high-quality toilet.

Q2d2: *What are potential adequate indicators informing on the sustainability of the sanitation service delivery chain?*

As outlined under Q2b, sustainability of SSF is dependent on collective action and a sustainable (functional) sanitation service chain on coproduction. We argued that a thorough assessment of all chain links is beyond the scope of effective low-cost indicators and, having in mind the facility as unit of analysis, that a 'basic service' should at least evaluate the *containment* and *emptying/collection* links.

Thus, for collective action, which was derived from the CPR principles, we suggested *boundary conditions* and *presence of management rules/structures*. In line with previous SSF research on CPR management, we evaluated *boundary conditions* with the presence of a *lockable/functional door*. We evaluated the presence of *management rules/structures* via *cleaning arrangements* (e.g. *duty rota*), which is consistent with JMP indicators for institutional WASH. With respect to the entire sanitation service chain, we argued that if reliable formal pit emptying exists, this indicates (at least the presence of) coproduction.

Given the importance of coproduction, the significance users assign to *water availability* in close proximity for *cleanliness*, as well as the outlined challenges resulting from inadequate/inexistent *solid waste management* options, we further argued that '*water availability* in close proximity' (e.g. <30m) as well 'availability of formalised and regular *solid waste management* service' could be applied as an additional indicator for coproduction. This, however, would require a separate evaluation on these indicator's validity and reliability.

4.4 Q3: Conclusions on the JMP Framework

> Q3: *What conclusions can be drawn with regard to how those indicators can be adequately and consistently measured within the JMP framework?*

We compared different alternative sanitation service level specifications, where we manipulated the decisive criteria that classify an IHF or SSF as *basic, limited, or unimproved*. To this end, we used the current JMP sanitation service level definitions as a benchmark to evaluate if our alternative specifications are able to separate "high-quality" from "low-quality" toilets.

We found that using a *refined user interface technology criterion* to distinguish between *basic* and *limited* sanitation service levels strongly improves predictive performance regarding SSF quality and cleanliness. In other words, classifying *flush/pour-flush*[82] toilets as *basic* or *limited* and categorising *pit latrines (with/without slab)* as *unimproved* better separates clean and "high-quality" toilets from dirty and "low-quality" toilets compared to the conventional JMP definition. As a result, this would effect that many IHF and SFF would be considered providing *unimproved* sanitation services, which are currently classified as *basic* or *limited* within the JMP framework.

Because shared/not shared – regardless of the numbers of users – is currently the only criterion to distinguish between *basic* and *limited* sanitation service levels, we contrasted the current JMP distinction with a manipulated sanitation service level calculation and included refined thresholds for considering a toilet *limited*. In our manipulated calculations, only four or six or more HHs sharing a sanitation facility are categorised as *limited* sanitation service level, depending on the specification. However, these manipulations diminished predictive performance. This means that, compared to using a threshold of two HH, there is less of a difference between toilets classified as *limited* and *basic* in SQI scores and the share of clean toilets. As a consequence, the share of toilets classified as *limited* under the JMP framework increases substantially. This trade-off between predictive precision and upgrading some SSF to the *basic* sanitation service level, could be warrantable: The loss in predictive precision is small compared to the gain in toilets classified as *basic*.

Including the *location* as a decisive factor for whether a toilet is considered *basic* or *limited* does not improve prediction performance, because the *location* strongly correlates with the *number of HHs*. All IHF in our sample are either located inside the dwelling or on the compound/plot.

Substituting the number of HH as a decisive criterion by *location, lockable door, and tiling* improves predictive performance relative to the conventional JMP definition. The improvement in the performance of the indicator is largest when pit latrines are classified as unimproved at the same time.

[82] Inluding all outflows/containment systems of flush/pour-flush toilets: to piped sewer system, septic tank, don't know where, elsewhere or open drain.

QUISS
quality indicators of shared sanitation

ETH zürich
NADEL
Center for Development and Cooperation

eawag
aquatic research

Sandec
Sanitation, Water and
Solid Waste for Development

Appendices

5 Appendix I: Quantitative Findings

5.1 Quantitative Report Summary

This quantitative analysis serves to complement and validate the results from the qualitative part of the study. To this end, an extensive household (HH) survey was conducted in Kisumu (Kenya), Kumasi (Ghana), and Dhaka (Bangladesh) between May and July 2019. We conducted over 3600 interviews with HHs and more than 2000 spot-checks of SSF and IHF. HHs and toilet facilities were sampled using a combination of systematic and purposive sampling. We collected data on toilet properties, cleaning habits and arrangements, menstrual health management (MHM) arrangements and privacy, user satisfaction and preferences, and demographic and HH information. Whenever possible, the questions from the spot-check observation and the questionnaire were identical in order to allow comparison. In addition, for triangulation purposes, enumerators took photos of the facilities. Based on these photos, the facilities were rated on cleanliness by external research assistants.

The quantitative analysis departs from the theoretical framework derived from previous research and our qualitative findings. The overall goal is to identify a set of key indicators that allow for the assessment and monitoring of SSF quality. We proceeded in four steps:

First, we developed the SQI based on qualitative evidence. The qualitative study revealed that the emerging user quality aspect can be divided into four broader categories: cleanliness, safety/security, privacy, accessibility/availability. For each of the categories, we defined representative outcome variables that were aggregated into a single outcome variable, the SQI.[83]

Second, we developed a cleanliness index (CI). The measurement of cleanliness is subjected to methodological challenges. After comparing the reliability of cleanliness measures from the three data sources (questionnaire, spot-check, and picture coding data), we decided to base the cleanliness index on observable characteristics (the presence of solid waste, insects, and visible faeces).

The SQI and the cleanliness index serve as quality measures and outcome variables in the subsequent analysis.

Third, we evaluated what indicators correlate with quality of sanitation facilities. For this purpose, we ran regression analyses, using the SQI and cleanliness as outcome variables. We included explanatory variables that are decisive within the current JMP framework, i.e. toilet technology and the number of sharing HHs, as well as other qualitatively deducted variables.[84]

Fourth, we singled out the relevant indicators and contrasted these with the current JMP framework in order to evaluate whether some aspects of the framework could be reconsidered. To this end, we assessed the indicators' performance in separating high-quality and clean toilets from low-quality and dirty toilets.

The regression analyses show that the toilet technology and the number of HHs per cubicle are both predictive indicators for the SQI and the CI . Flush/pour-flush toilets, regardless of the type of outflow (i.e. whether the

[83] Cleanliness: solid waste, insects, visible faeces; safety/security (and availability/accessibility): use at night, solid floor, solid roof; privacy: solid door, solid wall.
[84] Toilet technology, number of HHs per cubicle, water on the plot/compound, handwashing station (with soap), location of the toilet facility, lighting, lockable door, tiling, gender separated cubicles, cleaning arrangement, proximity of user relationship, age of the toilet, landlord on the plot, bin inside the cubicle.

toilet drains into a sewer, septic tank or pit, or into the open/elsewhere), show consistently higher SQI scores and are more likely to be clean. Conversely, pit latrines (with and without cement slab) consistently have lower SQI scores and are less likely to be clean than flush/pour-flush toilets.

We do not find a consistent relationship between the number of HHs and either the SQI or the CI. Especially for Ghana and Bangladesh, the correlation between the SQI and the CI is not significant when we take other explanatory variables into account. In Kenya, the relationship between the number of HHs and the SQI is more robust, but not for the CI.

The additional explanatory variables in the regressions reveal that, above all, the location of the toilet, a lockable door, and tiling significantly correlates with toilet quality.

These findings inform the current JMP framework on how to assess SSF quality. Using the terminology of the sanitation service levels, we test their use as quality indictors. We redefine what is considered *basic*, *limited*, and *unimproved*, and contrast the different specifications with regard to SQI and CI.

Classifying *flush/pour-flush*[85] toilets as *basic* or *limited* and *pit latrines (with/without slab)* as *unimproved* better separates clean and high-quality toilets from dirty and low-quality toilets compared to the conventional JMP definition.

Setting the threshold for when a toilet is considered *limited* from two or more HHs to four/six or more HHs is slightly less expedient in separating high quality from low quality toilets. Meanwhile, the altered thresholds move a large share of toilets previously classified as *limited* to the *basic* level, without greatly diluting the quality standards of the *basic level.*

Substituting the number of HH as a decisive factor by *location, lockable door, and tiling* improves predictive performance relative to the conventional JMP definition. This means that the higher the level on the sanitation ladder, the higher the average quality measured by the SQI and CI.

In the next section, we present the sampling procedure, and in section 5.3 the survey instrument and the data collection strategy. Section 5.4 entails a discussion of the conceptual framework. We discuss what affects toilet quality and present the JMP framework as a benchmark of our analysia. Section 5.5 discusses how we construct the outcome variables to measure toilet quality, and what indicators potentially predict these outcomes. In section 5.6, we present the quantitative results. First, we show descriptive statistics for demographic variables, outcomes and other characteristics on the HH level and toilet facilities. Next, we present the regression results of toilet cleanliness and quality. Last, we discuss alternative indicators for sanitation quality. We discuss caveats and limitations of the study in section5.7, followed by concluding remarks in section 5.8.

[85] Including all outflows/containment systems of flush/pour-flush toilets: to piped sewer system, septic tank, don't know where, elsewhere or open drain.

5.2 Sampling

The sampling strategy for the quantitative data collection consisted of three steps.

1. First, the country partners determined study areas based on income and the supposed availability of SSF. Only low- and middle-income areas were considered, as well as geographical factors aiming at an even distribution over the city's area.
2. In a second step, random geo-points were sampled using the QGIS software package. The geo-points served as starting positions for the HH sampling, with four enumerators each.
3. In the third step, we applied a skipping pattern. The enumerators would start with the closest compound/plot, subsequently skipping two compounds, while entering the third.[86]

Whenever possible, the enumerators spread out in four different directions from the starting point. In case there were less than four possible paths, the enumerators would walk in the same direction and split at the next opportunity (e.g., the next junction). Whenever an enumerator entered a compound/plot, each HH was assigned a number. Interviewed HHs were then randomly chosen by throwing a "digital dice" on a mobile phone application. The second HH was identified by repeating the same procedure except that the respondent had to be using the same toilet cubicle. Any respondent had to meet the following criteria:

- At least 18 years of age
- A resident of the compound/plot (dwells on the premises for at least three months)
- Regularly uses a shared/private/public toilet facility within walking distance
- Consent to participate

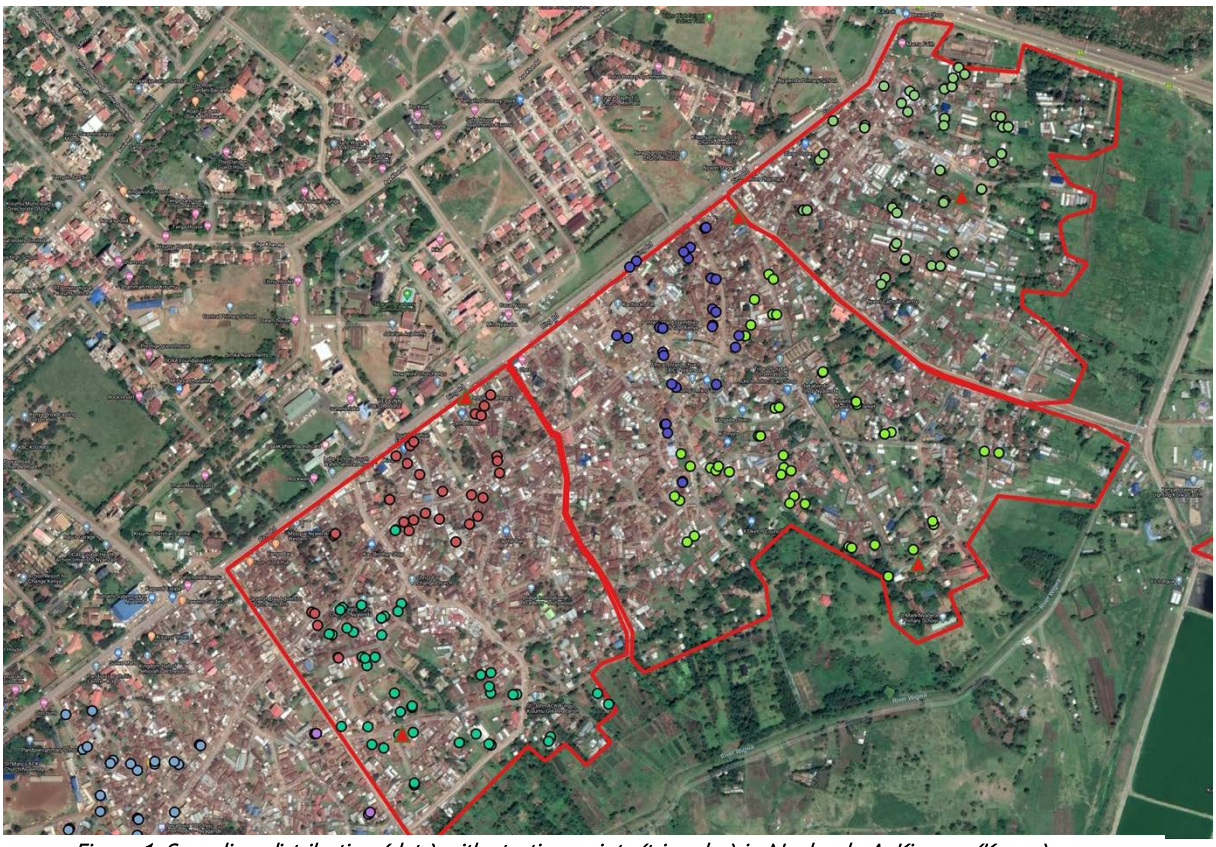


Figure 1: Sampling distribution (dots) with starting points (triangles) in Nyalenda A, Kisumu (Kenya)

[86] In our context we defined plots as formal or informal, spatially coherent property owned by the same landlord that is inhabited by two HHs or more. Compounds refer to enclosed housing units inhabited by two or more HHs with possibly different owners.

Respondents not meeting all criteria were skipped, with the enumerator moving to the next available HH on the compound. To enhance the quality and reliability of data collected, the enumerators tried to interview the HH head (= the most knowledgeable person). If she/he was not available, the next knowledgeable person was interviewed, and so on. Further, if, e.g., the first respondent was a male, the enumerators aimed for a female respondent in the second interview (with "knowledgeable" being the overriding criterion) and vice-versa.

In principle, we did not discriminate between users of shared, public, and private toilet users.[87] If a HH used a private, a community, or a public toilet, the respondent would still be interviewed and a spot-check of the private facilities would still be conducted. Even though this study focuses on shared HH and compound toilets, public and particularly private toilets were still of interest for comparative purposes. In the case of public facilities, we identified the closest facility used by the respondent and did a spot-check for these as well. We set the upper bound on the proportion of private and public toilets to never exceed 20% within a given area, leaving a minimum of 60% HH and compound SSF of the total sample.

The sampling procedure yielded a sample size of 3724 HHs. Overall, 2030 first HHs and 1694 second HHs were interviewed, meaning that in 336 cases, there was either no second HH available or unwilling to participate. For analytical purposes, we tried to include users of private, community, and public toilets. However, particularly in Kenya and Bangladesh, we did not get sufficient numbers, and had to resort to purposive sampling. In this case, the enumerators actively looked for the respective types of users, at times with the help of community health volunteers.

	All	Kenya	Ghana	Bangladesh
Total sample size	3724	1249	1196	1288
Private	261	73	108	80
Shared	3363	1164	991	1208
Public	100	3	97	0
First respondents (= spot-checks)	2030	662	645	693
Second respondents	1694	548	551	595
Spot check not completed	23	8	12	3
Total sample size [a]	**3601**	**1229**	**1087**	**1285**

[a] excluding public toilet users and incomplete observations with incomplete spot checks

In Ghana, the skipping pattern was abandoned after a few days because the spatial density of compounds with SSF was lower than expected. However, the randomly determined starting points were still maintained, except that each compound was inspected instead of every third. In the end, we collected 3363 responses from shared toilet users, 261 from respondents who owned a private toilet, and 100 from respondents using a public toilet. Additionally, we conducted spot-checks of 15 public toilet facilities in Ghana, where 97 of the 100 respondents using public toilets were residing. In the subsequent analysis, public toilet users and the corresponding spot checks were excluded, because it is not the main focus of this study. In the end this results in a total sample size of 3601 responses and 2030 spot-check observations.

Table 1 reports the general descriptive statistics related to the socio-economic status and living conditions of respondents, pooled (All) and separately for each country.

Noteworthy differences in the country samples exist in the gender of the HH head, which is mostly male Kenya and Bangladesh, while almost equally distributed in Ghana. Ghana also stood out in terms of house ownership, formal tenancy, and HH size. Further, the educational level of the interviewed HH head is clearly lower in Bangladesh, while the mean monthly income was higher compared to the other two countries. Bangladesh also had the highest share of an improved water source on premises.

[87] We follow Evans *et al.* (2017) who distinguish between (a) shared HH toilets (Toilet in one HH also used by other HHs); (b) compound toilets (Toilets used only by the people living in a particular compound); (c) community toilets (Non-HH toilets used by a restricted group of HHs) and (d) public toilets (anybody).

Variable	All	Kenya	Ghana	Bangladesh
N	3601	1229	1087	1285
First respondent	2027 (56%)	690 (56%)	644 (59%)	693 (54%)
Second respondent	1574 (44%)	539 (44%)	443 (41%)	592 (46%)
Gender of respondent				
Female	2833 (79%)	981 (80%)	837 (77%)	1015 (79%)
Male	767 (21%)	248 (20%)	250 (23%)	269 (21%)
Gender of HH head				
Female	1060 (29%)	332 (27%)	569 (52%)	159 (12%)
Male	2541 (71%)	897 (73%)	518 (48%)	1126 (88%)
Education level of HH head				
None	678 (19%)	19 (2%)	193 (18%)	466 (36%)
Primary or less	1004 (27%)	385 (31%)	224 (21%)	395 (31%)
At least secondary	1467 (41%)	592 (48%)	499 (46%)	374 (29%)
Beyond secondary	386 (10%)	188 (15%)	159 (15%)	39 (3%)
Don't know	68 (2%)	45 (4%)	12 (1%)	11 (<1%)
Income (monthly, in US$, PPP)	371 (321)	211 (195)	281 (346)	544 (289)
HH size	4.46 (2.39)	4.2 (1.9)	5.2 (3.3)	4.1 (1.6)
Rooms per HH member	0.47 (0.431)	0.55 (0.41)	0.52 (0.59)	0.34 (0.17)
Electricity	3490 (97%)	1138 (93%)	1073 (98%)	1279 (>99%)
Water source				
Unimproved	21 (<1%)	5 (<1%)	11 (1%)	5 (<1%)
Improved not on premises	1128 (31%)	769 (63%)	314 (29%)	45 (4%)
Improved on premises	2452 (68%)	455 (37%)	762 (70%)	1235 (96%)
Tenancy				
Owner	926 (25%)	212 (17%)	535 (49%)	179 (14%)
Free rent	132 (4%)	27 (2%)	86 (8%)	19 (1%)
Tenant (formal)	454 (12%)	50 (4%)	395 (36%)	9 (<1%)
Tenant (informal)	2089 (58%)	949 (76%)	71 (7%)	1079 (84%)
HHs on plot				
1	92 (3%)	32 (3%)	56 (5%)	4 (<1%)
2	199 (6%)	49 (4%)	61 (5%)	89 (7%)
3-5	953 (26%)	264 (21%)	264 (24%)	425 (33%)
6-10	1500 (42%)	523 (43%)	454 (42%)	523 (41%)
11-20	720 (20%)	311 (25%)	231 (21%)	178 (14%)
20+	137 (4%)	42 (3%)	18 (2%)	66 (5%)
Wall material (dwelling)				
Natural	76 (2%)	71 (6%)	0 (0%)	5 (<1%)
Rudimentary	638 (18%)	226 (18%)	7 (<1%)	405 (32%)
Finished	2887 (80%)	932 (76%)	1080 (>99%)	875 (68%)
Floor material (dwelling)				
Natural	151 (4%)	108 (9%)	21 (2%)	22 (2%)
Rudimentary	25 (<1%)	3 (<1%)	3 (<1%)	19 (1%)
Finished	3425 (95%)	1118 (91%)	1063 (98%)	1244 (97%)
Roof material (dwelling)				
Natural	14 (<1%)	7 (<1%)	3 (<1%)	4 (<1%)
Rudimentary	3158 (<88%)	1208 (98%)	959 (88%)	991 (77%)
Finished	428 (12%)	13 (1%)	125 (12%)	290 (23%)

Note. Percentages (for categorical data) or standard deviations in parentheses.

Table 1: Descriptive statistics of HH and plot-level characteristics

5.3 Data collection

Data collection took place between April and July 2019, starting with Kenya in April, followed by Ghana in May, and Bangladesh in June and July. It consisted of quantitative survey data using mobile devices and Qualtrics software[88]. The quantitative survey contained two sections: a user survey organized into nine sections and a spot-check evaluation protocol, including facility photos for remote picture coding. The spotcheck evaluation protocol and the full survey can be found in the appendix (see QUISS Final Report Appendix VI: Spotcheck & Survey).

Quantitative User Survey

The quantitative user survey was arranged around nine sections. These are:

- General Information
- HH Information
- Housing Situation
- Toilet Properties
- Toilet Sharing Arrangements
- MHM & Privacy Arrangements
- Toilet Cleaning Arrangements
- Emptying Arrangements
- User Satisfaction and Preferences

Spot-check Evaluation Protocol

The spot-check evaluation protocol contained questions that allow an assessment of the toilet facility in use. It was performed by the enumerator subsequent to the user survey. Areas that were evaluated are:

- The toilet technology, i.e. the interface of the toilet and the wastewater containment system in use,
- The number of cubicles,
- the location/distance of the toilet facility,
- its functionality,
- availability of water for flushing and handwashing facilities,
- its privacy arrangements, i.e. a functional door and walls without holes,
- its safety arrangements, i.e. functional lighting, a roof, and a floor without cracks.
- A bin inside/outside the cubicle,
- the visible cleanliness,
- other cleanliness factors (presence of insects, solid waste, and visible faeces inside the cubicle)
- the site and materials used for construction (superstructure (roof, walls, door)),

For triangulation purposes, a remote visual quality inspection was added by including pictures of the respective SSF evaluated by research assistants at Eawag and Nadel-ETH.

[88] https://www.qualtrics.com/

5.4 Conceptual framework

The JMP framework

To evaluate progress within the SDGs, the WHO/UNICEF Joint Monitoring Programme (JMP) service ladder (see Figure 2) is used to benchmark and compare service levels across countries regarding access to safe sanitation (WHO 2018b).[89] The service ladder builds on the established improved/unimproved facility type classification.[90] Improved sanitation facilities are those designed to hygienically separate excreta from human contact.[91] The JMP service ladder divides improved sanitation facilities into three categories: limited, basic, and safely managed services. Depending on how excreta are managed, individual HH facilities (IHF) are categorised as either basic (use of improved facilities that are not shared with other HHs) or safely managed services (use of improved facilities that are not shared with other HHs and where excreta are safely disposed of in situ or transported and treated offsite). *Unimproved* refers to the use of *unimproved technologies*, irrelevant if IHF or SSF. *Open defecation* equals *no service*.

SAFELY MANAGED
Use of improved facilities that are not shared with other HHs and where excreta are safely disposed of in situ or transported and treated offsite

BASIC
Use of improved facilities that are not shared with other HHs

LIMITED
Use of improved facilities shared between two or more HHs

UNIMPROVED
Use of pit latrines without a slab or platform, hanging latrines or bucket latrines

OPEN DEFECATION
Disposal of human faeces in fields, forests, bushes, open bodies of water, beaches or other open spaces, or with solid waste

Figure 2: The JMP sanitation ladder (Source: washdata.org)

The exclusion of SSF as a basic (and consequently safely managed) service level is generally justified for three basic reasons. Firstly, on grounds of human rights (HR) issues – concerns about accessibility to and safety of SSF at all times by HH members, especially women and girls (Isunju *et al.* 2011; Heijnen *et al.* 2015; Hutton & Whittington 2015; Sahoo *et al.* 2015; Shiras *et al.* 2018a; WHO 2019b). Secondly, due to adverse health impacts from inadequate SSF (Allen *et al.* 2008; Fuller *et al.* 2014; Brown *et al.* 2015; Heijnen *et al.* 2015). Thirdly, due to problems with O&M, particularly a lack of hygiene and cleanliness (Günther *et al.* 2012; Tumwebaze *et al.* 2013; Kwiringira *et al.* 2014a; Mara 2016; Simiyu *et al.* 2017; Cardone *et al.* 2018).

The service ladder distinguishes between facilities that drain to *don't know where* and facilities that drain to *elsewhere*. The former is considered an improved sanitation facility. It indicates that the HH does not know whether it flushes to a sewer, septic tank or pit latrine. The latter suggests that excreta openly drains into the

[89] SDG 6.2. states "*by 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations*" (https://www.sdg6monitoring.org/indicators/target-6-2/)
[90] Improved: Flush/pour-flush toilet, Flush to piped sewer system/septic tank/pit latrine, (Twin) Pit latrine with slab, Composting toilet, Container based sanitation (collected & treated), Flush/pour flush to don't know where
Unimproved: Flush/pour flush to open drain, Pit latrine without slab/open pit, Bucket, Hanging toilet/latrine, No facility/bush/field (WHO 2018b).
[91] Flush/pour-flush toilet, Flush to piped sewer system, Flush to septic tank, Flush to pit latrine, Pit latrine with slab, Composting toilet, Twin pit latrine with slab, Container based sanitation, Flush/pour flush to don't know where (WHO 2018b).

surroundings or open water bodies. It does not hygienically separate excreta from human contact and is therefore considered unimproved. In this study, we equivalently categorised *elsewhere* and *don't know where* and considered it unimproved. Over the course of data collection it became evident that it was either entirely apparent to where a toilet flushed, or not at all. If it was not determinable, the enumerators assumed that it flushed to "elsewhere". Alternatively, we conceptualised the sanitation ladder as a matrix with two facets: technology (improved, unimproved, no facility), and sharing (private/shared).

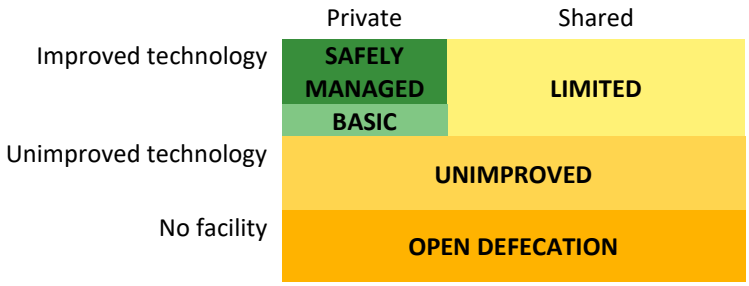


Figure 3: Technology and Sharing in the JMP Sanitation Ladder

Basic as well as *limited* refer to the use of *improved technologies*. The difference is that facilities categorised as *limited* are shared between two or more HHs. However, SSF cover a broad spectrum of different types of sharing. According to the typology by Evans *et al.* (2017) includes:

- shared HH toilets (toilet in one HH also used by other HHs);
- compound toilets (toilets used only by the people living in a particular compound);
- community toilets (non-HH toilets used by a restricted group of HHs);
- and public toilets (open to anybody).

Therefore, we derive two indicators from the JMP framework that are of interest for sanitation quality: *sanitation technology* (improved vs. unimproved) and *sharing* (private vs. shared). The question is whether these indicators are suited to predict sanitation quality or whether other or additional indicators are needed.

5.5 Outcome variables

Because Sustainable Development Goal #6 (SDG6) seeks to realise the human right (HR) to water, sanitation and hygiene for all, and because we ultimately seek to contribute to the development of quality indicators of SSF to monitor progress within SDG6, the qualitative study (see Literature Review Summary: Conceptualising SSF Quality Determinants, p. 107) departs from a rights based approach in conceptualising quality determinants of SSF (Héller 2015).[92]

The qualitative study identified user's quality determinants and subsumed them into four broader quality facets: *cleanliness*, *safety/security*, *privacy*, *and accessibility/availability*. For the quantitative study, we assign outcome variables to each quality facet. The outcome variables were selected based on their immediate representativeness for the quality facets. For practical purposes, *accessibility/availability* was omitted and incorporated into the other three categories (cleanliness, safety/security, and privacy), as it overlaps with all three. A toilet might not be accessible because it is extremely dirty; a toilet that does not have a solid floor could be

[92] The report of the Special Rapporteur on the HR to safe drinking water and sanitation provides a useful conceptual HR framework(Héller 2015).. Overall, it defines five normative dimensions. These are availability, accessibility, quality and safety, affordability, and acceptability.

unsafe to the point of being inaccessible. Similarly, if a toilet is dangerous to use at night, it might discourage users from using it, also making it inaccessible. A toilet that does not provide privacy might be inaccessible when other people are likely to be around.

The result is the following three quality facets with the associated outcome variables.

- Cleanliness:
  - Perceived cleanliness measures refer to the subjective assessment of a toilet's general state of cleanliness by an individual and includes:
    - *Reported cleanliness* (respondent)
    - *Observed cleanliness (enumerator)*
    - *Coded cleanliness (remote picture coding)*
  - Intermediate cleanliness measures: refer to observable variables as cleanliness outcomes:[93]
    - presence of *solid waste*,
    - *insects* inside the cubicle,
    - *visible faeces* inside and around the pan or the manhole.[94]
- Safety/Security:
  - *Solid roof (without holes):* The roof protects the user from external (environmental) factors such as rain. The roof is linked to personal safety.
  - *Solid floor (without cracks/holes):* The floor separates the user from excreta and is therefore a gatekeeper for pathogens through both direct contact and indirect contact, e.g. insects. A solid floor also prevents users, particularly children, from falling into the pit, should there be one. The floor is linked with personal safety.
  - *Use at night:* Whether a respondent also uses the toilet facility at night serves as an outcome for personal security and is strongly linked with general accessibility. A toilet may be avoided at night for different reasons, such as not having access to the key, inconvenience due to the distance of the toilet, or fear for personal security.[95]
- Privacy:
  - *Functional door:* We presuppose that for a toilet facility to provide a minimum of privacy, it must have a solid door without holes that would allow a person to peek through.
  - *Solid wall:* The wall must also be made out of solid material and have no holes that would allow a person to peek through

In the following, the emphasis is primarily on cleanliness. This is because it is *ex ante* questionable whether subjective (i.e. reported by respondents) outcome measures serve as valid outcome variables. We show this for cleanliness as an example, though the other outcomes might suffer from the same fallacy.

Cleanliness as outcome variable

Of the various quality outcomes presented above, we identify toilet cleanliness as one of the two principal outcome variables for the analysis (see, e.g. (Sonego & Mosler 2014; Tumwebaze 2014; Alam *et al.* 2017). There are various reasons to include cleanliness as an outcome variable to assess toilet quality. On one hand, there is a large body of research that identifies toilet cleanliness as a main driver the of adverse health effects from inadequate sanitation (Fuller *et al.* 2014; Brown *et al.* 2015; Heijnen *et al.* 2015; Baker *et al.* 2016). On the other hand, we can easily distinguish (and compare) objective and more subjective measures of toilet cleanliness.

[93] A fourth observable factor, spilled urine, was excluded because it proved impractical to distinguish spilled urine from water on sight.
[94] An intact roof and floor are also connected to cleanliness. In the case of the roof, rain can severely affect toilet cleanliness if not properly built with the right materials. The floor is connected to cleanliness because, depending on the material of the floor, it might be easier/harder to wet-clean the cubicle.
[95] . Out of the approximately 5.5 % that report not using the toilet at night, 57 % report not using the toilet at night out of fear for their personal security.

Determining toilet cleanliness includes a number of practical challenges. First, if cleanliness were to be used directly as a quality indicator, it would likely be in the form of a survey question, due to the limited resources for conducting spot-checks in large-scale HH surveys. However, self-reported data presents a high risk of social desirability bias, which affects the validity of the data (Nederhof 1985; Bertrand & Mullainathan 2001). This means that participants might report a toilet to be cleaner than it actually is because they feel ashamed or fear repercussions from the landlord. Other factors threatening reliability are variations throughout the day (Sonego & Mosler 2014) and seasonal variations due to changing climatic conditions and socio-economic activities (Kwiringira *et al.* 2016).

For these reasons, to measure toilet cleanliness we decided to compare four different data sources:

1. Reported cleanliness: Based on answers from respondents about the general cleanliness of the toilet (measured on a five-point Likert-scale from very dirty – very clean).
2. Observed cleanliness: Measured by the enumerators' subjective perception of the general cleanliness inside the toilet cubicle (measured on a five-point Likert-scale from very dirty – very clean).
3. Coded cleanliness: Two teams of independent research assistants that otherwise were not involved in this study did a rating of the toilet according to fixed criteria (Appendix). They used photos taken by the enumerators in the field as a part of the spot-check (measured on a five-point Likert-scale from very dirty – very clean).
4. Composite cleanliness index (CI): A binary cleanliness indicator (0=not clean; 1=clean) consisting of the three indicators based on spot-check observations by the enumerators,
    a. Solid waste inside the cubicle
    b. Visible faeces in or around the manhole/pan
    c. Insects inside the cubicle

    If at least one of a./b./c. is present, the cubicle is recorded as "not clean ".

For picture coding, two teams from Nadel and Eawag rated all pictures, resulting in two ratings per picture. Each team consisted of two research assistants. As visible from Figure 4: Cleanliness ratings by coding teams, the interrater-reliability was rather low (comparing the column *Eawag* and *Nadel*). This means that the ratings varied considerably between the two teams. Whereas Nadel classified more toilets as "very clean" (44%), *Eawag* classified more toilets as "very dirty" (18%). Conversely, there are only minor differences in the share of "dirty", "neither clean nor dirty", and "clean" toilets. Explanatory factors for diverging evaluations are poor lighting in toilets and tablets used for data collection not being equipped with high-quality cameras.

To aggregate the ratings from the two teams, we use two different aggregation methods. For the *generous* method, the higher score between the two ratings from *Eawag* and *Nadel* is decisive. For example, if *Eawag* classified a toilet as "clean" while *Nadel* classified the same toilet as "Neither clean nor dirty", the *generous* method records the toilet as "clean". Contrarily, for the *conservative* method, the lower score is decisive.

As expected, *reported cleanliness* is usually higher than the other cleanliness assessments. More than 50% of the respondents state that their toilet is "clean". This reiterates how unreliable reported (and subjective) quality indicators can be, since the two observed sources (observed and coded) seem be more consistent with each other than with reported cleanliness.

The high variation in the different cleanliness measures shows that issues around subjectivity of cleanliness remain, even when predetermining objective criteria tied to each cleanliness level (see QUISS Final Report Appendix VI: Spotcheck & Survey).

For the cleanliness outcome variable used in the subsequent analysis, we decided on using the composite cleanliness index (CI) based on spot-check observations for comparability and objectivity reasons. Several

studies used latrine cleanliness as an outcome measure for toilet hygiene. Some found high reliability between the cleanliness assessment of enumerators (Caruso *et al.* 2014; Alam *et al.* 2017)[96]. Another study reports low reliability between self-reported cleanliness and that observed by enumerators (Günther *et al.* 2012), whereas others did not check for reliability (Tumwebaze & Mosler 2015; Simiyu *et al.* 2017). These previous studies, paired with our own results regarding the reliability of reported cleanliness measures, lead us to choose the composite cleanliness index as our outcome variable. Thus, we established cleanliness by noting the presence of *solid waste, insects, and visible faeces* to increase the validity and reliability of the outcome measure compared to Likert-scale cleanliness outcomes, as reported in Figure 4: Cleanliness ratings by coding teams If either *visible faeces*, *solid waste* or *insects* was present, the toilet cubicle was categorised as *not clean*. Conversely, a toilet was considered *clean* if all three variables were absent. Smell/bad odour is often cited as a proxy for cleanliness (Rheinländer *et al.* 2013). Smell also emerged as an important determinant of perceived user quality (see GALS Meetings Summary: Overall Results, p. 114). Because of concerns about the measurability and the subjective nature of smell, the variable was not included in the quantitative analysis.

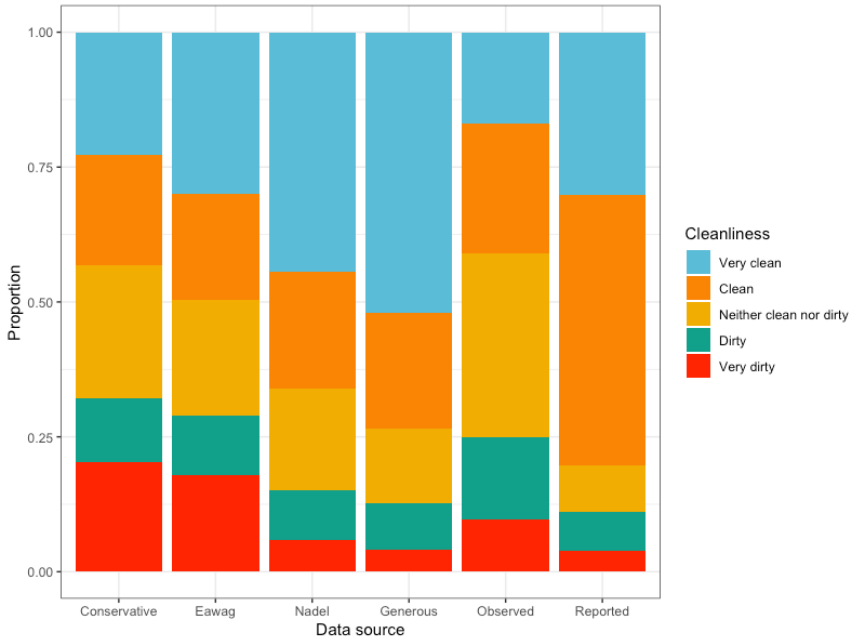


Figure 4: Cleanliness ratings by coding teams

Sanitation quality as outcome variable

As outlined at the beginning of section 52, cleanliness, while vital, is only one of a range of factors affecting quality. In order to address these factors, we developed the SQI consisting of a set of quality outcome variables. In line with the HR framework, additionally to from cleanliness, the SQI includes outcome variables on safety/security and privacy. By aggregating all outcomes into one single measure for toilet quality, dimensionality is reduced. This simplifies the analysis to one single outcome variable (where we would otherwise have to repeat the analysis for every single outcome variable separately). We conduct a multiple correspondence

[96] In this context the term reliability is used as how consistently two observations of the same object (i.e. a toilet cubicle) come to the same conclusion measuring the outcome (i.e. toilet cleanliness).

analysis (MCA) to obtain the weights for a quality index. Similar to Principal Component Analysis (PCA), MCA is a tool for exploratory data analysis and allows analysing patterns of relationships of categorical dependent variables (Abdi & Valentin 2007).[97] In principle, MCA is a generalisation of PCA applicable to categorical data. We follow (Ezzrar & Verme 2012) in employing MCA as a method for the construction of multi-dimensional indices. The weights for the components of the index are derived from the factor scores, which are a result of the MCA. MCA identifies the same number of principal components as there are variables. Every principal component is represented by a combination of all variables, which enter the principal component in the magnitude of their factor loading. The weights used for the SQI are derived from the factor loadings of the first principal component, which necessarily captures the largest share of variation in the data. We aggregate the outcome variables to a single quality score for each observation, which serves as a dependent variable in the regression models in section 5.6.

To construct the quality index, we chose all outcome variables described above for the MCA:

1. Cleanliness indicators (solid waste, insects, visible faeces) (Cleanliness)
2. Use at night (accessible 24/7) (Safety/Security)
3. Floor with no cracks/holes (Safety/Security)
4. Solid roof with no holes (Safety/Security)
5. Solid door with no holes (Privacy)
6. Solid wall with no holes (Privacy)

The SQI was defined as follows: Let $k = (1, 2, \dots, K)$ be the number of variables, $j = (1, 2, \dots, J_k)$ the number of categories in variable k, and I the dummy of each category. The weight determined with MCA is denoted by W and $i = (1,2, \dots, N)$, the number of HHs. Then the unnormalised SQI score is defined by

$$uSQI_i = \frac{1}{K} \sum_{k=1}^{K} \sum_{j_k=1}^{J_k} W_{j_k}^{k} I_{ij_k}^{k}$$

Normalisation then yields the normalised SQI score,

$$SQI_i = \frac{uSQI_i - uSQI_{min}}{uSQI_{max} - uSQI_{min}} * 100$$

Therefore, the SQI can take exhibit values between 0 and 100, with an index of 100 indicating a toilet that meets all quality requirements as defined by the index variables.

[97] PCA is a tool for dimensionality reduction that is used extensively to aggregate wealth and socio-economic variables from questionnaire data to form wealth and Socio-Economics-Status indices (Filmer & Pritchett 2001; McKenzie 2005; Vyas & Kumaranayake 2006).

5.6 Results

The following section presents the quantitative results. The section is organised as follows: First, we report descriptive statistics of the data collection. Second, we take a closer look at the results taking toilet cleanliness as the first dependent variable of interest. Third, we repeat the analysis using the SQI as the outcome variable and test whether the results obtained for cleanliness are robust to a broader definition of quality. Lastly, based on our findings, we discuss the implications for the current JMP approach.

Descriptive statistics

Variable	All	Kenya	Ghana	Bangladesh
Improved toilet *	2322 (64%)	1164 (95%)	1076 (99%)	82 (6%)
Technology *				
- Flush/pour-flush to sewer/septic tank/pit	822 (21%)	158 (13%)	594 (55%)	70 (5%)
- Flush/pour-flush to elsewhere	1231 (34%)	32 (3%)	0 (0%)	1199 (93%)
- Improved pit latrine	1477 (41%)	1005 (82%)	460 (42%)	12 (<1%)
- Unimproved pit latrine	44 (1%)	33 (3%)	11 (1%)	0 (0%)
- Other	27 (1%)	1 (<1%)	22 (2%)	4 (<1%)
Sharing [a]				
- Private	260 (7%)	73 (6%)	107 (10%)	80 (6%)
- Shared	3341 (93%)	1156 (94%)	980 (90%)	1205 (94%)
HHs per cubicle	6.13 (3.31)	6.57 (3.40)	5.49 (3.19)	6.24 (3.25)
- 1	260 (7%)	73 (6%)	107 (10%)	80 (6%)
- 2	336 (9%)	98 (8%)	123 (11%)	115 (9%)
- 3	386 (11%)	129 (11%)	122 (11%)	135 (11%)
- 4	382 (11%)	125 (10%)	128 (12%)	129 (10%)
- 5	359 (10%)	102 (8%)	125 (12%)	132 (10%)
- 6	316 (9%)	98 (8%)	111 (10%)	107 (8%)
- 7	269 (7%)	94 (8%)	74 (7%)	101 (8%)
- 8	252 (7%)	80 (7%)	66 (6%)	106 (8%)
- 9	192 (5%)	60 (5%)	37 (3%)	95 (7%)
- 10	208 (6%)	81 (7%)	61 (6%)	66 (5%)
- >10	640 (18%)	289 (24%)	132 (12%)	219 (17%)
Sanitation service level				
- Unimproved	1279 (35%)	65 (5%)	11 (1%)	1203 (93%)
- Limited	2144 (60%)	1094 (89%)	969 (89%)	81 (6%)
- Basic or more	179 (5%)	70 (6%)	107 (10%)	1 (<1%)
Improved water on premises	2452 (68%)	445 (37%)	762 (70%)	1235 (96%)

Handwashing facility with soap *	413 (11%)	23 (2%)	105 (10%)	285 (22%)
Location of toilet facility *				
- Inside dwelling	216 (6%)	46 (4%)	98 (9%)	72 (6%)
- On or next to plot/compound	3301 (92%)	1145 (93%)	975 (90%)	1181 (92%)
- Elsewhere	84 (2%)	38 (3%)	14 (1%)	32 (2%)
Lighting (functional) *	1106 (30%)	32 (3%)	447 (41%)	627 (49%)
Lock				
- Outside lock	2714 (75%)	915 (74%)	928 (85%)	871 (68%)
- Inside lock	2893 (80%)	780 (63%)	883 (81%)	1230 (96%)
Construction *				
- Tiling	724 (20%)	75 (6%)	593 (55%)	57 (4%)
- Solid door	3441 (96%)	1198 (97%)	1070 (98%)	1173 (91%)
- Solid walls	3439 (96%)	1186 (97%)	1003 (92%)	1250 (97%)
- Solid roof	3405 (95%)	1093 (89%)	1079 (99%)	1233 (96%)
Gender separated cubicle	106 (3%)	5 (<1%)	57 (5%)	44 (3%)
Cleaning arrangement	1542 (43%)	169 (14%)	486 (45%)	887 (69%)
Relationship with other users				
- Only relatives	340 (9%)	93 (8%)	163 (15%)	84 (7%)
- Only close neighbours and relatives	2961 (82%)	1077 (88%)	718 (66%)	1166 (91%)
- Other	300 (8%)	59 (5%)	206 (19%)	35 (3%)
Age of toilet facility				
- <1 year	434 (12%)	195 (16%)	54 (5%)	185 (14%)
- 1-3 years	955 (27%)	459 (37%)	193 (18%)	303 (24%)
- 4-6 years	597 (17%)	253 (21%)	126 (12%)	218 (17%)
- 7-9 years	238 (7%)	63 (5%)	77 (7%)	98 (8%)
- >10 years/don't know	1377 (38%)	259 (21%)	637 (59%)	381 (37%)
Landlord/caretaker on plot	1874 (52%)	456 (37%)	956 (88%)	462 (36%)
Bin inside cubicle *	658 (18%)	1 (<1%)	637 (59%)	20 (2%)

Note. Percentages (for categorical data) or standard deviations in parentheses.

* Observed characteristics by the enumerators.

[a] Share of private toilets is purposive and those not represent distribution of toilet sharing in the study areas.

Table 2: Descriptive statistics of toilet facility characteristics

Toilet technology and numbers of users

Table 2 shows the toilet characteristics based on reported data and spot-check observations (emphasized by an asterisk). The first row reports the frequency of improved toilets following the JMP definition (WHO 2018b). The following rows separate the toilet technology into five categories: *flush/pour-flush to sewer/septic tank/pit*, *flush/pour-flush to elsewhere*, *improved pit latrine*, *unimproved pit latrine*. In certain countries we only had very few observations in some categories. E.g., in Bangladesh, there were few flush toilets that drained into a piped sewer or into a septic tank or pit. Thus, to produce informative results, the *flush* and *pour-flush toilet* were merged into two categories: *flush/pour-flush to piped sewer system/septic tank/pit* and *flush/pour-flush to elsewhere*. The latter includes *flush/pour-flush to don't know where* as well as *flush/pour-flush to open drain*.

Results indicate toilet characteristics to be remarkably heterogeneous across the three study sites. In Bangladesh, 93% of all toilets drained *elsewhere*, of which 21% drained into the open, while for most the outflow was not determinable (72%). This is reflected in the share of toilets with improved toilet technology and the sanitation service level, which – following the JMP definition – results in approximately 6% toilets with improved toilet technology.[98]

The table reports the frequency of private and shared toilets for each country under *sharing*. Public toilet users, who were almost exclusively surveyed in Ghana, are excluded from the sample. However, the share of private toilet users is not representative for the study areas because they were surveyed using purposive sampling. *HHs per cubicle* denotes the number of HHs that use the same cubicle according to the respondent. We find that Kenyan toilets, on average, have the highest number of HHs per cubicle, followed by Ghana, then by Bangladesh. This remains the case even when we exclude private toilets that were not part of the random sampling.

Sanitation service level reports the classification in "basic", "limited", and "unimproved" sanitation. While in Kenya and Ghana the share of "basic" sanitation mostly corresponds to the share of private toilet users, in Bangladesh almost all private toilets fall under "unimproved" due to their flushing to "elsewhere".

Water source and handwashing

Improved water on premises is a binary variable indicating the availability of an improved water source within the compound/plot or inside the dwelling.[99] Overall, more than 99% of the sample reported access to an improved water source; as a result, the variability mainly comes from the location of the source (on the premises or not). Kenya has the lowest share of water on the premises (37%), followed by Ghana (70%), and finally Bangladesh (96%).

Handwashing facilities with soap are absent in 11% of the toilet facilities. The share is lowest in Kenya (2%), followed by Ghana (10%), and Bangladesh (22%).

Location, construction materials, and other features

The toilets' *location* is heterogenous across country sub-samples. Most toilets were located outside of the dwelling, but on the plot, within the compound or directly attached to it. Only a few were found elsewhere

[98] JMP (2018) classify toilets with improved technology that drain to "don't know where" as "basic" or "limited" sanitation and toilets with improved technology that drain to "elsewhere" as "unimproved" (see section 1.4). We assume that toilets that drain to "elsewhere" involve some kind of unsafe conveyance system.

[99] "Improved drinking water sources are those which by nature of their design and construction have the potential to do deliver safe water. Improved sources include: piped water, boreholes, tubewells, protected dug wells, protected springs, rainwater and packaged or delivered water." (JMP, 2018)

within 30 meters or more than 30 meters from the dwelling. For this reason, toilets located "elsewhere >30m" and "elsewhere <30m" were combined into one single category.

Only a few toilet cubicles have *lighting* in Kenya (3%), and are more likely to have lighting in Ghana (41%) and Bangladesh (49%).

Most cubicles are *lockable* either from the inside or the outside; 67% are both. In Kenya and Ghana there are more toilets that exhibit an *outside lock* (Kenya 74%; Ghana 85%) than an *inside lock* (Kenya 63%; Ghana 81%), whereas in Bangladesh almost all toilets have an inside lock (96%) and less that have an inside lock (68%).

Construction materials are similarly distributed across countries and mostly of high quality. Exceptions are that in Kenya 11% do not dispose of a solid roof, in Ghana 8% do not have solid walls, and in Bangladesh 9% do not have a solid door. In terms of *tiling*, Ghana stands out with 55% compared to 6% in Kenya and 4% in Bangladesh.

Almost only in Ghana were *bins* for the solid waste found *inside the cubicle* (59%).[100] In Kenya and Bangladesh, the share is below 1% and 2%, respectively.

Social indicator variables

Compared to the other two countries, few respondents in Kenya reported having a *cleaning arrangement* in place (Kenya 14%; Ghana 45%; Bangladesh 69%). The share of *gender-separated toilets* was below 5% throughout.

The variable *relationship with other users* describes the social proximity between the respondent's HH and the other users. The majority of toilets is used by relatives and close neighbours only, with the exception of Ghana, where 19% report that the toilet is also shared among individuals who are not next-door neighbours and people from outside the compound/plot.

In Ghana there is also an exceptionally high share of *landlords* or caretakers that live on the same compound/plot (88% in Ghana compared to 37% in Kenya and 36% Ghana).

Age of toilet

In Ghana the toilets were older, on average, than in the other two countries. 59% reported that the toilet was build 10 or more years ago. In case the respondent did not know, the time the respondent lived on the plot was applied as a lower bound. The reported figures might therefore slightly underestimate the actual age of the toilets.

Overall, the most evident finding from the descriptive statistics is that, according to the reported variables, the Kenyan sub-sample shows lower standards than the other two countries. This will have implications for the regression analyses, because it implies that we are likely to have systematic differences between the countries that might be correlated with the outcome variables. Not accounting for these country-fixed-effects would mean that differences in quality are wrongly attributed to certain predictor variables where they should be attributed to unexplained differences in overall quality level between countries.

[100] Bins outside the cubicle were omitted due to a low share in all three countries.

Toilet cleanliness

Table 3 lists all cleanliness variables and their absolute and relative frequencies by country. Irrespective of the measurement method (*reported*, *observed*, *coded*, *CI*), cleanliness scores are lowest for Kenyan toilet facilities, whereas the results indicate that Ghanaian toilets are the cleanest. This implies that one concern regarding reliability- in this case, that cleanliness could be rated differently by the enumerators in the three countries due to differing standards - can be rejected. If this were the case, we would not observe a consistent pattern across measurement methods. Additionally, the different constituents of the cleanliness composite measure are listed in the first two rows of Table 3. Table 3 reveals that Kenyan toilets have a higher *presence of insects*, *solid waste*, and *visible faeces*, while Ghana consistently scores the lowest in all three of these categories.

Variable	Value	All		Kenya		Ghana		Bangladesh	
		frq	prop	frq	prop	frq	prop	frq	prop
Cleanliness index (CI)	Clean	858	0.42	162	0.23	401	0.62	295	0.43
Insects	Yes	839	0.41	477	0.69	127	0.20	235	0.34
Solid waste	Yes	633	0.31	282	0.41	136	0.21	215	0.31
Visible faeces	Yes	428	0.21	242	0.35	48	0.07	138	0.20
Cleanliness (coded)	Very clean	420	0.21	55	0.08	244	0.38	121	0.17
	Clean	379	0.19	92	0.13	142	0.22	145	0.21
	Neither clean nor dirty	457	0.23	144	0.21	130	0.20	183	0.26
	Dirty	217	0.11	119	0.17	40	0.06	58	0.08
	Very dirty	370	0.18	252	0.37	39	0.06	79	0.11
	NA	184	0.09	28	0.04	49	0.08	107	0.15
Cleanliness (observed)	Very clean	341	0.17	47	0.07	275	0.43	19	0.03
	Clean	489	0.24	170	0.25	187	0.29	132	0.19
	Neither clean nor dirty	693	0.34	131	0.19	134	0.21	428	0.62
	Dirty	307	0.15	183	0.27	34	0.05	90	0.13
	Very dirty	197	0.10	159	0.23	14	0.02	24	0.03
Cleanliness (reported)	Very clean	686	0.34	129	0.19	449	0.70	108	0.16
	Clean	995	0.49	359	0.52	163	0.25	473	0.68
	Neither clean nor dirty	165	0.08	91	0.13	27	0.04	47	0.07
	Dirty	119	0.06	68	0.10	4	0.01	47	0.07
	Very dirty	62	0.03	43	0.06	1	0.00	18	0.03

Table 3: Distribution of toilet cleanliness by different measurement methods

Table 4 shows the proportion of toilets that are *clean*, have the *presence of insects*, *solid waste*, and so forth by sanitation service level. Let us assume that JMP sanitation service levels could be applied as toilet cleanliness predictors, then the share of clean toilets should increase with a higher sanitation service level. In other words, *basic* sanitation would have a higher proportion of clean toilets than *limited* and *unimproved* sanitation. Pooling all countries together we see that this holds for all four cleanliness measures. Conversely, the differentiation between unimproved (but potentially shared or private) and limited (improved technology but shared) is not a cleanliness predictor. An increase in the observed cleanliness variable for clean toilets is only observable from *unimproved* to *limited*. In consequence, the JMP sanitation service level is only partially informative as an indicator of toilet cleanliness.

Complexity increases when comparing country-specific data. In the Kenyan sample, there are consistently higher proportions of clean toilets in the *basic* than in the *limited* and *unimproved* service levels. However,

counterintuitively, toilets categorised under the *unimproved* service level are cleaner than those classified as *limited*. The conclusion for the Kenyan sample is similar to the pooled sample: the current sanitation service levels are unsuited to predict cleanliness differences.

In the Ghana sample, we only encountered 11 unimproved toilets, which limits analysis options. Even though we do observe increases in the proportion of clean toilets when comparing IHF (basic) to SSF (limited), the differences are not sizeable.

In the Bangladesh sample we identified a major flaw in the current JMP categorization. Since *flush/pour-flush to elsewhere* only qualify as *unimproved* toilets, all private toilets in the Bangladesh sample fall under that category.

This limits our analysis options because it only lets us compare *unimproved* to *limited* toilets, possibly hiding important variation between IHF and SSF, which predominantly classify as *unimproved* in the Bangladesh case.

As a result, the difference between *unimproved* and *limited* service levels is not informative in terms of toilet cleanliness across different measures.

Variable	Level	All	Kenya	Ghana	Bangladesh	Bangladesh (interface)
Clean (coded) [a]	Unimproved	0.44	0.24	~~1.00~~	0.45	~~0.00~~
	Limited	0.40	0.19	0.64	0.50	0.41
	Basic	0.62	0.52	0.68	~~1.00~~	0.78
Clean (observed) [a]	Unimproved	0.23	0.42	~~0.73~~	0.22	~~0.00~~
	Limited	0.46	0.26	0.70	0.30	0.24
	Basic	0.76	0.70	0.80	~~1.00~~	0.07
Clean (reported) [a]	Unimproved	0.82	0.68	~~0.91~~	0.83	~~0.00~~
	Limited	0.77	0.64	0.93	0.72	0.82
	Basic	0.98	0.97	0.99	~~1.00~~	0.97
Clean (composite)	Unimproved	0.43	0.26	~~0.82~~	0.43	~~0.50~~
	Limited	0.37	0.19	0.59	0.33	0.42
	Basic	0.69	0.57	0.77	~~1.00~~	0.46
Insects	Unimproved	0.35	0.65	~~0.18~~	0.33	~~0.50~~
	Limited	0.49	0.74	0.22	0.42	0.33
	Basic	0.20	0.37	0.08	~~0.00~~	0.38
Solid waste	Unimproved	0.31	0.35	~~0.18~~	0.31	~~0.50~~
	Limited	0.34	0.44	0.22	0.44	0.32
	Basic	0.17	0.20	0.16	~~0.00~~	0.23
Visible faeces	Unimproved	0.21	0.38	~~0.18~~	0.20	~~0.50~~
	Limited	0.24	0.38	0.08	0.30	0.22
	Basic	0.07	0.09	0.06	~~0.00~~	0.00

Note. *If n<50 for a specific cell, the value is crossed out and should not be used for analysis.*
[a] *{Very clean, clean} = "Clean", {Neither clean nor dirty, dirty, very dirty} = "Not clean".*

Table 4: Proportion of clean toilets by sanitation service level and country.

Sanitation quality (SQI)

To assess overall sanitation quality, we develop the SQI, as described in section 5.5 (Outcome variables, p. 52).

Table 5 presents the summary statistics for the SQI and included variables. The last column reports the results of the MCA in the form of factor loadings, which corresponds to the weights that are given to each variable. The loadings are subsequently used as weights on the variables to compute SQI scores. A negative sign on the factor loading will negatively impact the index score, while a positive sign will have a positive impact. All factors have the expected sign; that is, all factors that we deem to negatively impact sanitation quality actually end up having a negative sign as a result of the MCA.

Variable	Response	All (frequency)	All (%)	Kenya	Ghana	Bangladesh	Factor loadings
Cleanliness: Insects	No	2068	57.4%	28.8%	79.2%	66.4%	1.00
	Yes	1533	42.6%	71.2%	20.8%	33.6%	-1.36
Cleanliness: Solid waste	No	2443	67.8%	57.5%	78.6%	68.6%	0.81
	Yes	1158	32.2%	42.5%	21.4%	31.4%	-1.71
Cleanliness: Visible faeces	No	2793	77.6%	63.4%	91.8%	79.1%	0.66
	Yes	808	22.4%	36.6%	8.2%	20.9%	-2.27
Holes/cracks in the floor	No	3309	91.9%	85.4%	97.3%	93.5%	0.33
	Yes	292	8.1%	14.6%	2.7%	6.5%	-3.75
Solid door (without holes)	Solid	3308	91.9%	95.4%	97.4%	83.7%	0.10
	Not solid	293	8.1%	4.6%	2.6%	16.3%	-1.10
Solid roof (without holes)	Not solid	768	21.3%	35.7%	9.7%	17.4%	-2.19
	Solid	2833	78.7%	64.3%	90.3%	82.6%	0.59
Solid wall (without holes)	Not solid	562	15.6%	19.4%	11.8%	15.3%	-2.14
	Solid	3039	84.4%	80.6%	88.2%	84.7%	0.40
Toilet use at night	No	190	5.3%	12.8%	2.0%	0.9%	-2.17
	Yes	3411	94.7%	87.2%	98.0%	99.1%	0.12

Table 5: Summary statistics of sanitation quality components and factor loadings from MCA

Figure 5 shows the distribution of the SQI scores for each study site. All observations are binned according to their SQI score in bins of equal width. We find that overall, most of the observations end up having a score between 40 and 100, which indicates a skewed distribution of SQI scores. In Kenya, there is a higher concentration of low-quality toilets than in the other two countries. On the one hand, this result is driven by the fact that the cleanliness variables are also included in the SQI. Since in Kenya toilets are less likely to be clean compared to the other two countries, this result is also reflected in the SQI scores. On the other hand, it could indicate that there is a high correlation between toilet cleanliness and the other variables included in the index. This means that if a toilet is likely to be clean, it is also more likely to provide high safety, security, and privacy.

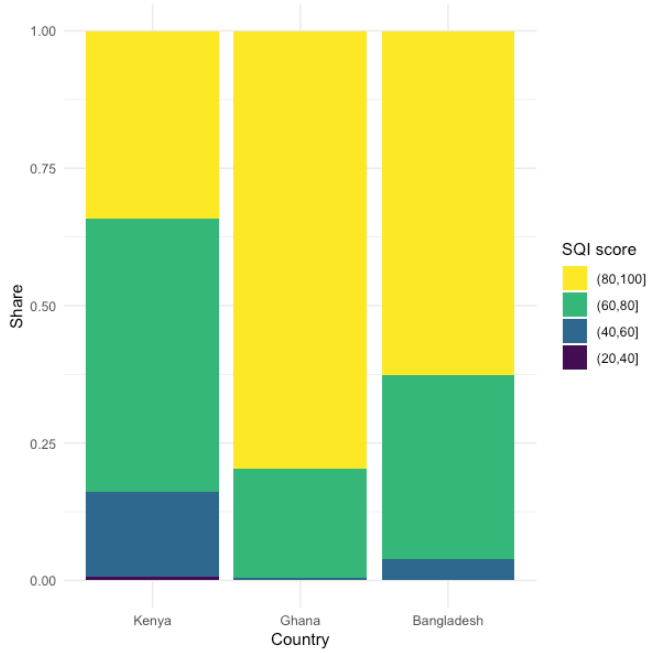


Figure 5: Distribution of toilet quality scores by country using the quality index.

Regression results

To test whether technology, the number of HHs, and potential alternative indicators are good predictors of toilet cleanliness and overall sanitation quality (measured by CI and SQI), we compare different models of logistic and linear regressions of the CI and SQI on different covariates. We first present the results of the regressions using CI as the outcome variable, as the CI is the less complex outcome variable and thus yields more intuitive results.

In all subsequent regression tables, we report robust standard errors clustered on the compound level because of the sampling design. While some of the variables are HH-level data from the questionnaire, other variables are plot/compound-level data, in particular those based on the spot-check observation. By using clustered standard errors, we acknowledge the fact that the residuals may be correlated for respondents dwelling on the same compound.

Pooled regressions with CI as outcome variable

Table 14 reports the results of the regressions using CI as outcome including country fixed effects. In column 1, the covariates reflect the current JMP classification. At first glance, the presence of improved toilet technology does not correlate with cleanliness. However, compared to IHF, there is a statistically significant negative correlation between SSF and CI.

To better understand how the two predictors (*improved toilet* and *shared toilet*) are associated with toilet cleanliness, columns 2 and 3 separately report regressions for technology and sharing. In column 2, the *improved toilet* variable was decomposed into five categories, with the reference category *flush/pour-flush to piped sewer/septic tank/pit* and *improved pit latrine*. *Improved pit latrine* was derived from the *improved toilet* variable. Compared to *flush/pour-flush to piped sewer/septic tank/pit*, all other toilet technologies seem to be less clean. The negative relationship is stronger for *improved* and *unimproved pit latrines* than for *flush/pour-flush toilets that drain to elsewhere*. In other words, flush/pour-flush toilets that drain to a piped sewer, a septic tank, or a pit are generally cleaner than flush/pour-flush toilets that drain elsewhere, and cleaner than pit latrines.

In column 3, each number of HHs that use a cubicle is represented by a separate dummy variable. This allows assessing the cleanliness of a cubicle used by a certain number of HHs relative to IHF. The coefficient for cubicles that are used by two HHs is negative but small in magnitude. This implies that a cubicle used by two HHs is slightly less likely to be clean than a cubicle only used by one HH.

Further observations for number of HH (see below: since the dummy variable)

Column 4 combines the two variables – toilet technology and the number of HHs - in one regression. Interestingly, the variable coefficients for the number of HHs decrease in magnitude, and the difference between one and two HHs becomes insignificant. Thus, if we control for toilet technology, we no longer detect a statistical difference in cleanliness between toilets used by one HH and toilets used by two HHs.

Since marginal effects are difficult to interpret in logistic regressions, Figure 6 depicts the average marginal effects (AME) for the technology variables and number of HHs. The AMEs allow us to interpret the marginal effect of a variable as a change in probability of a toilet being clean. In other words, the AME for two HHs can

be interpreted as the difference in probability of the toilet being clean compared to one HH. Consequently, the probability of having a clean toilet is 6 percentage points lower for cubicles shared by two HHs than cubicles used by one HH only. This difference is not statistically significant, as indicated by the 95%-confidence intervals included in the figure. The figure also shows that for up to ten HHs per cubicle, the marginal effects more than double, to 13% percentage points below private toilets, though the decrease in the probability of observing a clean toilet is not significantly different from a fewer number of HHs. Thus, we cannot conclude that cleanliness decreases proportionally to the number of HHs using the SSF. Only for ten HHs or more do we see a drastic decrease in the marginal effects, to 20 percentage points lower than for one HH. The presence of a coordination problem could be an explanation for this observation. In other words, the ability of HHs to organise cleaning duties becomes more difficult once the number of sharing HHs exceeds ten. Interestingly, there is a spike at six HHs, which we are unable to explain at this point. We also observe this spike in the data disaggregated by country. This at least partially rejects concerns regarding the possibility of a reporting bias (see below). Also, as Table 2 shows, we do not observe any anomalies in the distribution of HHs per toilet cubicle.

The AMEs for toilet technology are unmistakably stronger than for the number of HHs. While there is no statistical difference in CI between *flush/pour-flush toilets to piped sewer/septic tank/pit* (the reference category) and *flush/pour-flush toilets to elsewhere, improved pit latrines* are on average 36 percentage points less likely to be clean than *flush/pour-flush toilets to piped sewer/septic tank/pit.*

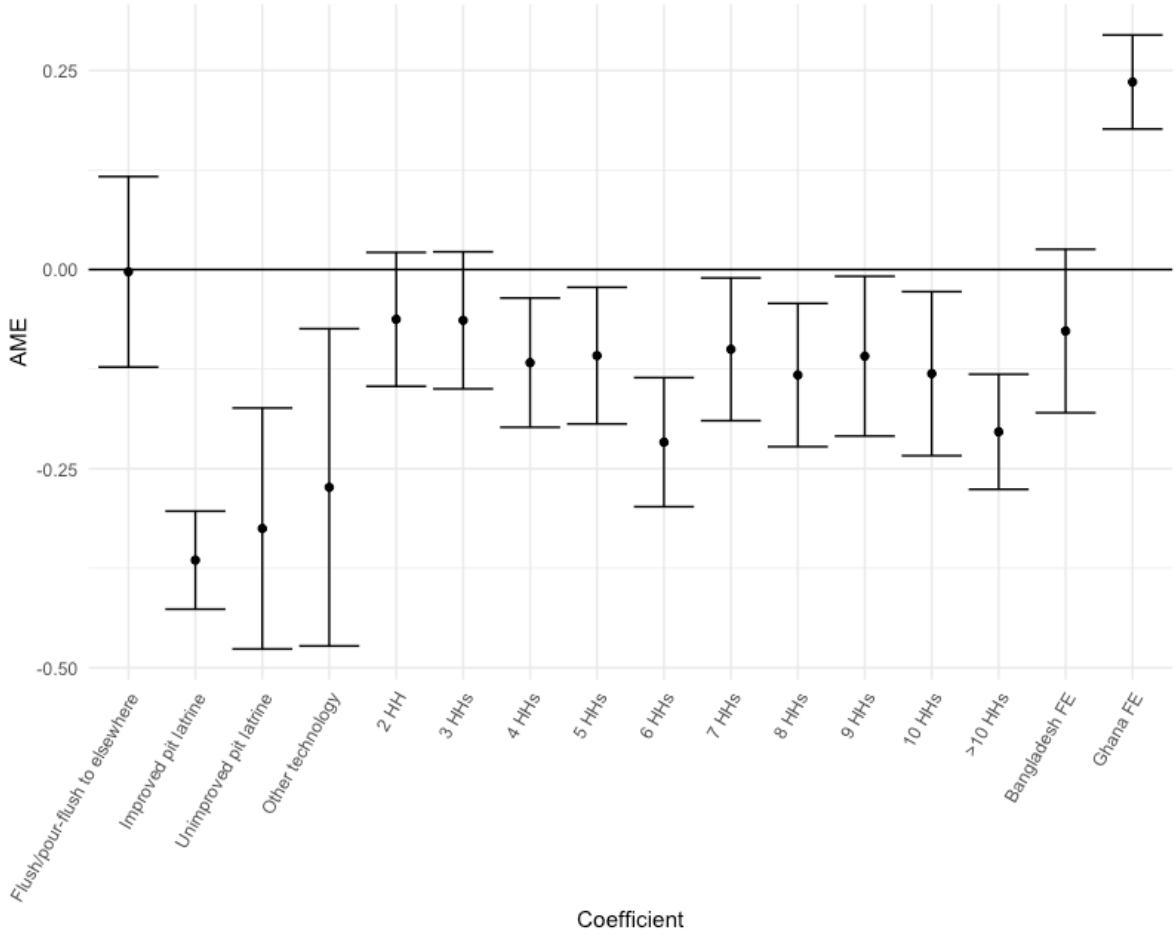


Figure 6: Average marginal effects (AME) of technology and the number of HHs per cubicle on the probability of observing a clean toilet

Adding more predictors in column 5 further reduces the predictive power of the number of HHs on cleanliness. Strikingly, all but two coefficients (for six HHs and more than ten HHs) become insignificant. This suggests that some of the variation previously captured by the number of HHs is now explained by other covariates, individually or in combination. In other words, if we control for additional covariates, the number of HHs cease to be a meaningful predictor for toilet cleanliness. The additional covariates also carry some interesting information. First, having an (improved) water source on the premises does not correlate with toilet cleanliness, all other things being equal. Second, compared to toilets that are found inside the respondents' dwelling, toilets that are outside, e.g., in close proximity on the plot/compound, are less clean. This effect is even higher for toilets that are not in immediate proximity (gathered in the category "elsewhere"). Third, and counterintuitively, neither *toilet age* nor the *user's relationship* (relatives or close neighbours vs. less well-known people) correlates with toilet cleanliness. Fourth, in line with the qualitative findings, whether the floor has *tiling* or not is positively associated with toilet cleanliness.

Further, whether there is *lighting*, whether the toilet is *lockable from the outside (*to exclude outsiders), whether the *landlord/a caretaker lives on the same plot or in the same compound*, and whether there is a *cleaning arrangemen*t all correlate weakly with toilet cleanliness.

Pooled logistic regression of toilet cleanliness with country FE

	Dependent variable:				
	Cleanliness index				
	(1)	(2)	(3)	(4)	(5)
Improved toilet	-0.38 (0.24)				
Shared toilet	-0.90*** (0.16)				
Technology					
(ref: Flush/pour-flush to piped sewer/septic tank/pit)					
Flush/pour-flush to elsewhere		-0.01 (0.28)		-0.01 (0.28)	-0.06 (0.29)
Improved pit latrine		-1.90*** (0.15)		-1.85*** (0.15)	-1.70*** (0.16)
Unimproved pit latrine		-1.63*** (0.45)		-1.60*** (0.45)	-1.42*** (0.45)
Other		-1.03* (0.55)		-1.30** (0.55)	-0.87 (0.58)
Number of HHs					
(ref: 1 HH)					
2 HHs			-0.55*** (0.21)	-0.31 (0.21)	-0.30 (0.43)
3 HHs			-0.58*** (0.21)	-0.31 (0.21)	-0.24 (0.43)
4 HHs			-0.76*** (0.21)	-0.58*** (0.21)	-0.52 (0.44)
5 HHs			-0.77*** (0.21)	-0.53** (0.22)	-0.47 (0.43)
6 HHs			-1.31*** (0.22)	-1.11*** (0.22)	-1.05** (0.45)

7 HHs			-0.80*** (0.23)	-0.49** (0.23)	-0.39 (0.45)
8 HHs			-0.93*** (0.23)	-0.66*** (0.23)	-0.58 (0.45)
9 HHs			-0.81*** (0.26)	-0.54** (0.25)	-0.49 (0.46)
10 HHs			-1.01*** (0.25)	-0.65** (0.26)	-0.60 (0.47)
>10 HHs			-1.33*** (0.19)	-1.03*** (0.19)	-0.94** (0.43)
Improved water on plot					-0.05 (0.14)
Handwashing with soap					-0.12 (0.17)
Location					
(ref: Inside dwelling)					
Inside compound/on plot					-0.47** (0.23)
Elsewhere					-1.42** (0.56)
Lighting					0.17 (0.13)
Outside lock					0.34*** (0.12)
Tiling					0.62*** (0.17)
Gender separated					0.41 (0.31)
Cleaning arrangement					0.19 (0.12)
User relationship					
(ref: Others)					
Only relatives					0.001 (0.42)
Close neighbours					0.27 (0.23)
Age of toilet					
(ref: <1y)					
1-3y					-0.001 (0.15)
4-6y					-0.02 (0.17)
7-9y					0.16 (0.22)
>10y/Don't know					-0.07 (0.16)
Landlord on plot					0.21* (0.12)
Bin inside cubicle					-0.39** (0.20)
Ghana	1.76*** (0.13)	1.20*** (0.14)	1.71*** (0.13)	1.19*** (0.15)	0.99*** (0.21)
Bangladesh	0.69*** (0.25)	-0.45 (0.28)	1.00*** (0.12)	-0.41 (0.29)	-0.35 (0.32)
Constant	-0.13 (0.28)	0.17 (0.15)	-0.46*** (0.17)	0.74*** (0.18)	0.40 (0.52)
Observations	3,601	3,601	3,601	3,601	3,601
Log Likelihood	-2,216.02	-2,071.06	-2,190.11	-2,036.94	-1,992.13

Akaike Inf. Crit.	4,442.04	4,156.12	4,406.22	4,107.87	4,052.26

Note: $^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$

Robust standard errors are clustered on the compound/plot level

Table 6: Pooled logistic regression of toilet cleanliness with country fixed effects

Additionally, we control for unobserved differences between the countries using fixed effects. In qualitative terms, including country fixed-effects does not substantially change the results compared to a regression model without fixed-effects (see Table 14 in the appendix). In other words, the sign of the coefficients and the standard errors are similar for the regression reported in Table 14 and Table 6 (in the appendix). Further, comparing the country coefficients (the last two coefficients in Table 6), and holding other things equal, Ghana consistently has cleaner toilets than Kenya (the reference category), while in Bangladesh it seems to depend on the model specification (i.e., which covariates are included in the regression model). In column 5, where all possible covariates are included, we see that Bangladesh has a country fixed-effects coefficient of -0.35; it is not statistically significant, however. This implies that the covariates included in the regression model suffice to explain the difference in cleanliness levels between Kenya and Bangladesh. Further, the country fixed-effects coefficient for Ghana remains positive and significant, meaning that we are not able to entirely explain why Ghana has cleaner toilets than Kenya and Bangladesh using just the covariates included in column 5.

Splitting the sample into separate regressions for each country allows us to detect whether there are some predictors that are only relevant in a particular country, as well as checking whether the results from the previous regressions are robust across all three study sites. Table 7 reports the logistic regression results by country, using the same model specifications as before. The first three columns again only consider the two dummy variables *improved toilet* and *shared toilet*.

The results are not consistent across countries. In Kenya, sharing the toilet with at least one other HH is more strongly associated with toilet cleanliness than in the other countries. At the same time, whether the toilet is improved or not has a greater influence on cleanliness in Ghana, though only 11 facilities observed in the country qualified as unimproved. No conclusions can be drawn with respect to Bangladesh, as neither of the two variables show a statistically significant correlation with toilet cleanliness.

To gain more insight, we decompose the improved toilet and sharing variables into additional categories. Some of the coefficients were left out of the model because there are no observations in some categories for certain countries (e.g., we did not encounter any unimproved pit latrines in Bangladesh). Columns 4-6 show that there is some heterogeneity across countries regarding technology and the number of HHs. Both are associated with dirtier toilets. Overall, our data does not support a cut-off figure between one and two HHs sharing a facility, at least regarding toilet cleanliness. Further, *pit latrines* are considerably less likely to be clean than *flush/pour-flush toilets*.

Columns 7-9 report regressions when all potential indicators are included. Overall, there is no variable exhibiting a consistent and significant relation with toilet cleanliness across all three countries. Again, the coefficients for the number of HHs per cubicle become insignificant when we control for other covariates. Regarding cleanliness, the *toilet's location* seems to be particularly important in Kenya and Ghana, while *tiling* only seems to be significant in Ghana and Bangladesh. Further, for Kenyan toilets, the presence of functional *lighting* and an *outside lock* are strongly associated with cleanliness.

There are a number of variables for which we cannot detect a correlation with the CI, counter to our expectations. Having an improved *water source on the premises* is not correlated with cleanliness in any country. The coefficients *handwashing facility with soap* are weakly significant for Ghana and Bangladesh, but have opposite signs. This means that there is a positive correlation of the presence of handwashing facilities with soap in Ghana, but a negative correlation in Bangladesh. In Ghana, if there is a handwashing facility with soap, the toilet is also more likely to be clean than if there is no handwashing facility or one without soap. Surprisingly, in Bangladesh, if there is a handwashing facility with soap, the toilet is less likely to be clean.

Logistic regression of toilet cleanliness by country

	Cleanliness index								
	Kenya	Ghana	Bangladesh	Kenya	Ghana	Bangladesh	Kenya	Ghana	Bangladesh
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Improved toilet technology	-0.34 (0.40)	-1.14*** (0.19)	-0.37 (0.37)						
Shared toilet	-1.83*** (0.26)	-0.83 (1.07)	-0.14 (0.48)						
Technology									
(ref: Flush/pour-flush to piped sewer / septic tank / pit)									
Flush/pour-flush to elsewhere				-0.61 (0.41)		0.10 (0.26)	-0.57 (0.44)		0.22 (0.27)
Improved pit latrine				-2.37*** (0.20)	-1.59*** (0.14)	-15.02 (411.93)	-1.97*** (0.23)	-1.42*** (0.15)	-14.53 (391.86)
Unimproved pit latrine				-3.14*** (0.76)	0.31 (0.80)		-1.99** (0.79)	0.15 (0.82)	
Other				-13.53 (535.41)	-1.44*** (0.46)	0.14 (1.05)	-16.53 (2,399.54)	-1.02** (0.49)	0.62 (1.08)
Number of HHs									
(ref: 1 HH)									
2 HHs				-0.70* (0.38)	-0.35 (0.32)	0.11 (0.29)	0.003 (0.47)	-0.12 (0.36)	-0.17 (0.48)
3 HHs				-0.57 (0.36)	-0.89*** (0.32)	0.41 (0.28)	0.12 (0.45)	-0.42 (0.36)	0.10 (0.46)
4 HHs				-0.75** (0.36)	-0.86*** (0.32)	-0.18 (0.29)	-0.07 (0.45)	-0.39 (0.36)	-0.44 (0.47)
5 HHs				-0.75** (0.38)	-0.89*** (0.32)	0.06 (0.29)	-0.07 (0.47)	-0.44 (0.36)	-0.25 (0.47)
6 HHs				-1.70*** (0.43)	-1.16*** (0.32)	-0.62** (0.31)	-0.88* (0.52)	-0.79** (0.37)	-0.92* (0.50)

7 HHs			-1.26*** (0.42)	-0.83** (0.35)	0.29 (0.30)	-0.52 (0.50)	-0.23 (0.40)	0.03 (0.48)
8 HHs			-1.70*** (0.50)	-0.39 (0.38)	-0.19 (0.30)	-0.88 (0.57)	0.11 (0.42)	-0.43 (0.49)
9 HHs			-0.79* (0.43)	-0.79* (0.44)	-0.08 (0.31)	0.09 (0.52)	-0.48 (0.46)	-0.38 (0.49)
10 HHs			-0.93** (0.42)	-0.50 (0.37)	-0.47 (0.34)	-0.01 (0.51)	-0.19 (0.41)	-0.78 (0.51)
>10 HHs			-1.61*** (0.34)	-0.90*** (0.31)	-0.61** (0.27)	-0.72* (0.43)	-0.49 (0.36)	-0.84* (0.46)
Improved water on plot						-0.17 (0.18)	-0.003 (0.16)	-0.05 (0.34)
Handwashing with soap						14.88 (447.78)	0.62** (0.31)	-0.34** (0.16)
Location								
(ref: Inside dwelling)								
Inside compound/on plot						-1.14** (0.49)	-0.63* (0.35)	0.41 (0.45)
Elsewhere						-2.52*** (0.89)	-1.56* (0.87)	-0.48 (0.69)
Lighting						1.69** (0.72)	0.35** (0.16)	0.02 (0.13)
Outside lock						1.13*** (0.26)	-0.26 (0.21)	0.31** (0.13)
Tiling						0.43 (0.35)	0.49*** (0.15)	0.74** (0.30)
Gender separated						1.28 (1.01)	0.73** (0.32)	0.001 (0.33)
Cleaning arrangement						0.33 (0.22)	0.12 (0.16)	0.05 (0.14)
Relationship: relatives/close neighbours						0.13 (0.39)	0.29 (0.21)	0.45 (0.39)
Age of toilet								
(ref: <1y)								
Age toilet 1-3y						-0.19 (0.25)	0.59* (0.35)	-0.03 (0.20)
Age toilet 4-6y						-0.13 (0.28)	0.56 (0.37)	0.004 (0.21)
Age toilet 7-9y						-0.31 (0.46)	0.82** (0.41)	0.06 (0.26)
Age toilet >10y/Don't know						0.11 (0.28)	0.48 (0.32)	-0.24 (0.18)
Landlord on plot						0.06 (0.18)	0.26 (0.21)	0.31** (0.13)
Bin inside cubicle						-2.26 (2,440.97)	-0.41*** (0.15)	0.42 (0.48)
Constant	0.68 (0.45)	2.33*** (0.27)	-0.15 (0.90)	1.57*** (0.30)	1.93*** (0.26)	-0.25 (0.34)	0.56 (0.75)	1.01* (0.58)	-1.10* (0.66)

Observations	1,229	1,087	1,285	1,229	1,087	1,285	1,229	1,087	1,285
Log Likelihood	-608.51	-719.52	-874.97	-513.73	-639.92	-851.31	-482.50	-610.53	-835.98
Akaike Inf. Crit.	1,223.02	1,445.04	1,755.94	1,057.47	1,307.83	1,730.63	1,027.01	1,281.06	1,731.96

Note: $^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$

Table 7: Logistic regression of toilet cleanliness by country

Pooled regressions with SQI as outcome variable

We use the SQI as the dependent variable in OLS regressions with covariates that could serve as potential proxy indicators for sanitation quality. Repeating the same procedure as performed previously with the CI, we first report the results for the pooled sample, followed by regression results on the country sub-samples. Again, country fixed-effects are included. This accounts for constant differences in SQI scores across countries not explained by the included variables. Further, we use robust standard errors clustered at the plot/compound level to correct for the face that there are two observations per compound in most cases.

Table 8 reports the regression results for the pooled sample. In the first column, the explanatory variables are *improved toilet technology* and *sharing*, the two indicators currently relevant to the sanitation service level assessments. Both coefficients are negative, with *improved toilet technology* being weakly significant. Improved toilets are, on average, 2.66 points below unimproved toilets on the SQI. Counterintuitively, these results suggest that having an improved toilet negatively affects toilet quality according to the SQI. It is highly likely that this result is mainly driven by the Bangladesh data, with toilets being mostly classified as unimproved.

Column 3 reports the *technology* and *number of HHs* as separate categorical variables. While *flush/pour-flush to elsewhere* have a higher quality score on average, *improved* and *unimproved pit latrines* perform substantially worse than *flush/pour-flush to piped sewer/septic tank/pit*. Moreover, the number of HHs seems to be negatively associated with toilet quality. However, the quality does not strictly decrease with an increasing number of HHs using the same cubicle. This means that all the coefficients for more than one HH are negative and significant, but they do not get decrease as the number of HHs increases. In fact, none of the HH coefficients are significantly different from each other, except *>10 HHs*. In particular, no pattern in the coefficients on the number of HHs is visible between two and nine HHs. For more than ten HHs, the decrease in quality is comparable to the difference between *flush/pour-flush to piped sewer/septic tank/pit* and *improved pit latrines*.

In column 4, all covariates are included. The results show a decrease in the size of coefficients of toilet *technology*, while the size of coefficients for the number of HHs increases. Furthermore, *location* affects SQI scores. Toilets *located elsewhere* than (immediately) on the plot/compound are, on average, 4.66 points lower than toilets inside someone's dwelling, all other things being equal. A *lockable door* positively affects quality. As expected, having both the possibility to lock the door from the inside as well as from the outside is better than just having one option. Other features that show a moderate positive correlation with toilet quality are *lighting*, *floor tiling*, and *cleaning arrangements*.

Comparing column 3 to columns 1 and 2 shows an increase in the adjusted R-squared by 8 percentage points. This implies that looking at the specific type of toilet technology (instead of categorising technology along the improved/unimproved definitions) and the exact number of HHs (instead simply distinguishing shared/private) increases the share of total variation that is explained with the applied regression model. Moving from column

4 to column 3 adds another 7 percentage points to the R-squared statistic. Therefore, including the additional covariates in column 4 almost doubles variation the OLS regression is able to explain.

OLS regression of sanitation quality index on quality indicators

	Dependent variable:			
	Quality Index			
	(1)	(2)	(3)	(4)
Improved toilet	-2.66* (1.62)	-2.82* (1.61)		
Shared toilet	-4.35*** (0.54)			
Technology				
(ref: Flush/pour-flush to piped sewer / septic tank / pit)				
Flush/pour-flush to elsewhere			5.81*** (1.30)	4.74*** (1.17)
Improved pit latrine			-6.00*** (0.52)	-4.53*** (0.54)
Unimproved pit latrine			-14.83*** (3.19)	-10.41*** (3.00)
Other			-11.36*** (2.12)	-8.59*** (2.19)
Number of HHs				
(ref: 1 HH)				
2 HHs			-2.23*** (0.82)	-4.12*** (1.42)
3 HHs			-1.63** (0.73)	-3.61** (1.41)
4 HHs			-3.19*** (0.75)	-5.26*** (1.45)
5 HHs			-2.98*** (0.75)	-5.08*** (1.42)
6 HHs			-3.33*** (0.74)	-5.19*** (1.45)
7 HHs			-2.46*** (0.84)	-4.28*** (1.46)
8 HHs			-3.29*** (0.92)	-5.12*** (1.51)
9 HHs			-3.16*** (1.12)	-5.05*** (1.58)
10 HHs			-4.10*** (1.07)	-5.79*** (1.63)
>10 HHs			-5.63*** (0.68)	-6.87*** (1.42)
Improved water on plot				0.96* (0.53)
Handwashing with soap				-0.88 (0.56)
Toilet location				
(ref: Inside dwelling)				
Inside compound/on plot				-0.38 (0.75)

Elsewhere				-4.66*** (1.73)
Lighting				1.64*** (0.44)
Lockable door				
(ref: Door not lockable)				
Only outside				3.96*** (1.01)
Only inside				4.53*** (0.96)
Outside and inside				7.61*** (0.77)
Tiling				2.13*** (0.50)
Gender separated				1.46 (0.89)
Cleaning arrangement				1.77*** (0.47)
User relationship				
(ref: Others)				
Only relatives				-1.58 (1.34)
Close neighbours				0.25 (0.80)
Age of toilet				
(ref: <1y)				
Age toilet 1-3y				-0.40 (0.57)
Age toilet 4-6y				0.07 (0.64)
Age toilet 7-9y				-0.63 (0.79)
Age toilet >10y/Don't know				-0.72 (0.57)
Landlord on plot				-0.51 (0.46)
Bin inside cubicle				-0.59 (0.55)
Ghana	11.07*** (0.54)	11.03*** (0.53)	8.43*** (0.56)	6.28*** (0.75)
Bangladesh	4.76*** (1.63)	4.60*** (1.62)	-3.56*** (1.34)	-4.48*** (1.27)
Constant	79.56*** (1.69)	77.65*** (1.68)	81.44*** (0.64)	76.64*** (1.80)
Observations	3,601	3,601	3,601	3,601
R^2	0.19	0.19	0.27	0.35
Adjusted R^2	0.19	0.19	0.27	0.34
Residual Std. Error	9.76 (df = 3596)	9.75 (df = 3596)	9.28 (df = 3584)	8.78 (df = 3565)
F Statistic	210.15*** (df = 4; 3596)	212.14*** (df = 4; 3596)	82.76*** (df = 16; 3584)	54.81*** (df = 35; 3565)

Note: *p<0.1, **p<0.05, ***p<0.01

Robust standard errors are clustered on the compound/plot level

Table 8: Results of pooled OLS regression of sanitation quality index.

Regressions by country with SQI as outcome variable

This section examines country-wise regressions using the SQI as the outcome variable, as presented in Table 9. Columns 1-3 report the results using current JMP indicators as quality predictors. Neither in Kenya nor in Ghana did improved toilet technology predict significantly higher SQI scores than unimproved technology. In Bangladesh, improved toilet technology scored significantly lower on the SQI than unimproved technology. However, at least for Bangladesh, this result is driven by classification difficulties that were mentioned earlier (see Table 4). The negative coefficient for toilet sharing is particularly evident for the Kenyan sample. On average, SSF score 11 points below IHF on the SQI in Kenya. At the same time, SSF score only 2 points below IHF on the SQI in Ghana. There is no detectable statistical difference in SQI scores between private and shared toilets in Bangladesh.

The country-specific results for effects of technology and number of HHs on quality are displayed in columns 4-6 of Table 9. In Kenya, *improved/unimproved pit latrines* perform worse than *flush/pour-flush* options., regardless of where they flush to. In Ghana, because no observations are available, the coefficient for *flush/pour-flush to elsewhere* is missing. Similar to Kenya but less pronounced, *improved pit latrines* in Ghana have a lower SQI score than *flush/pour-flush toilets*. In Bangladesh, *improved pit latrines* have a much lower SQI score than *flush/pour-flush toilets* on average. However, there are only 12 observations that were categorised as *improved pit latrines*, thus limiting the validity of this result. Regarding the number of sharing HHs in Kenya, there is a sharp jump between three and four HHs. Generally, the quality decreases with the number of users. In Ghana, the difference between private and shared toilets is much less pronounced, with even a slump at eight HHs. There, the difference between private IHF and toilets shared between 8 HHs becomes insignificant. Interestingly, the number of HHs does not provide any conclusions on toilet quality in Bangladesh: the coefficient only becomes (barely) significant at the 10 % level for more than ten HHs.

By comparing them to columns 4-6, we see in columns 7-9 that technology is less predictive for quality when all other covariates are added. At the same time, the number of HHs is more predictive than in columns 4-6. In Kenya, technology and the number of HHs less predictive for quality than in Ghana. For Bangladesh, the coefficients for technology and the number of HHs were originally inflated because there is partial collinearity between the number of HHs and the relationship among users (all toilets that are shared only with relatives are private toilets, except one). Table 16 in the appendix shows the original regression table. Combining the categories "only relatives" and "only relatives and close neighbours" in the *relationship* variable from the remove the collinearity problem in Table 11. The results for Bangladesh show that the number of HHs is significant only for 4 HH and 10 HH or more.

There is no variable that consistently predicts toilet quality in all three countries except toilet technology (*flush/pour-flush (to piped sewer / septic tank / pit & elsewhere) vs. pit latrines (unimproved & improved)*). However, *lighting*, a *lockable door*, and a *cleaning arrangement* are all positively associated with toilet quality in at least two of the three countries.

We do not find a consistent relationship between SQI scores and *improved water on the premises*, *handwashing with soap*, and *gender separated* cubicles, which are all indicators that emerged as essential quality features from the qualitative study.

OLS regression of sanitation quality index

	Dependent variable:								
	Quality Index								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Kenya	Ghana	Bangladesh	Kenya	Ghana	Bangladesh	Kenya	Ghana	Bangladesh
Improved toilet	1.29 (1.52)	0.43 (1.97)	-6.51*** (1.09)						
Shared toilet	-11.08*** (1.44)	-2.21*** (0.66)	-0.66 (1.10)						
Technology									
(ref: Flush/pour-flush to piped sewer / septic tank / pit									
Flush/pour-flush to elsewhere				3.24 (2.16)		3.60*** (1.14)	2.86 (2.05)		3.14*** (1.10)
Improved pit latrine				-8.74*** (0.99)	-3.91*** (0.38)	-19.10*** (2.90)	-6.46*** (1.05)	-3.15*** (0.41)	-11.54*** (2.87)
Unimproved pit latrine				-20.53*** (2.17)	-2.75 (1.86)		-13.29*** (2.15)	-2.77 (1.83)	
Other				-1.92 (11.08)	-9.10*** (1.35)	-21.90*** (4.77)	-2.43 (10.44)	-7.43*** (1.34)	-13.61*** (4.61)
Number of HHs									
(ref: 1 HH)									
2 HHs				-2.76 (1.75)	-1.55* (0.81)	-2.02 (1.35)	-3.42* (1.88)	-1.66* (0.86)	-3.24 (2.00)
3 HHs				-3.51** (1.66)	-2.65*** (0.81)	1.46 (1.30)	-4.13** (1.82)	-1.99** (0.89)	-1.69 (1.93)
4 HHs				-6.20*** (1.66)	-1.84** (0.81)	-1.65 (1.31)	-6.70*** (1.82)	-1.11 (0.88)	-4.44** (1.95)
5 HHs				-6.08*** (1.74)	-2.24*** (0.81)	-0.004 (1.31)	-6.83*** (1.87)	-1.86** (0.90)	-2.31 (1.97)
6 HHs				-6.77*** (1.76)	-2.89*** (0.83)	-0.10 (1.36)	-6.59*** (1.91)	-2.32** (0.90)	-2.43 (2.04)
7 HHs				-5.57*** (1.78)	-3.14*** (0.93)	1.08 (1.38)	-5.25*** (1.91)	-1.92* (0.99)	-2.17 (2.02)
8 HHs				-9.52*** (1.85)	-0.81 (0.96)	0.78 (1.37)	-8.58*** (1.98)	-0.30 (1.04)	-1.80 (2.03)
9 HHs				-7.48*** (1.96)	-2.53** (1.17)	0.24 (1.40)	-6.60*** (2.07)	-2.31* (1.20)	-2.70 (2.04)

10 HHs	-8.41*** (1.83)	-2.18** (0.99)	-1.37 (1.53)	-7.59*** (1.97)	-1.78* (1.05)	-4.35** (2.12)
>10 HHs	-10.25*** (1.50)	-3.10*** (0.80)	-2.36* (1.21)	-8.96*** (1.69)	-2.56*** (0.90)	-4.26** (1.91)
Improved water on plot				0.82 (0.65)	0.19 (0.42)	2.65** (1.34)
Handwashing with soap				-0.78 (2.87)	0.45 (0.67)	-1.02 (0.66)
Toilet location						
(ref: Inside dwelling)						
Inside compound/on plot				-0.06 (1.93)	-1.79** (0.75)	2.91 (1.87)
Elsewhere				-4.26* (2.57)	-2.19 (1.81)	-2.46 (2.54)
Lighting				1.74 (2.24)	1.08*** (0.41)	2.78*** (0.53)
Lockable door						
(ref: not lockable)						
Only outside				4.98*** (1.01)	-1.46* (0.84)	4.01 (3.78)
Only inside				6.34*** (1.56)	-1.01 (0.99)	6.23*** (1.38)
Outside and inside				9.38*** (0.80)	0.12 (0.64)	9.44*** (1.34)
Tiling				2.35 (1.53)	2.07*** (0.39)	0.70 (1.25)
Gender separated				3.83 (4.69)	1.70** (0.82)	0.70 (1.36)
Cleaning arrangement				1.27 (0.90)	1.12*** (0.42)	1.70*** (0.60)
Relationship: relatives/close neighbors				-0.08 (1.49)	-1.16** (0.53)	6.05*** (1.65)
Age toilet 1-3y				0.63 (0.90)	0.89 (0.92)	-1.51* (0.82)
Age toilet 4-6y				0.53 (1.01)	1.36 (0.97)	-0.65 (0.87)
Age toilet 7-9y				-2.40 (1.52)	2.24** (1.07)	-0.49 (1.09)
Age toilet >10y/Don't know				-1.11 (1.02)	1.14 (0.86)	-1.30* (0.76)
Landlord on plot				-0.72 (0.65)	0.58 (0.56)	-0.07 (0.55)

Bin inside cubicle							-0.38 (10.63)	-0.31 (0.38)	1.15 (1.99)
Constant	82.14*** (2.02)	85.64*** (2.06)	81.10*** (1.07)	87.20*** (1.38)	88.03*** (0.61)	77.47*** (1.53)	78.17*** (2.90)	86.08*** (1.49)	59.56*** (2.90)
Observations	1,229	1,087	1,285	1,229	1,087	1,285	1,229	1,087	1,285
R^2	0.05	0.01	0.03	0.19	0.14	0.10	0.30	0.21	0.22
Adjusted R^2	0.05	0.01	0.03	0.18	0.13	0.09	0.28	0.18	0.20
Residual Std. Error	11.91 (df = 1226)	6.48 (df = 1084)	9.53 (df = 1282)	11.03 (df = 1214)	6.09 (df = 1073)	9.22 (df = 1271)	10.34 (df = 1196)	5.89 (df = 1055)	8.62 (df = 1253)
F Statistic	30.12*** (df = 2; 1226)	5.66*** (df = 2; 1084)	18.29*** (df = 2; 1282)	20.56*** (df = 14; 1214)	13.02*** (df = 13; 1073)	10.51*** (df = 13; 1271)	16.03*** (df = 32; 1196)	8.82*** (df = 31; 1055)	11.51*** (df = 31; 1253)

Note: *p<0.1, **p<0.05, ***p<0.01

Robust standard errors are clustered on the compound/plot level

Table 9: Country-wise OLS regressions of sanitation quality index on technology, number of HHs, and other covariates.

Quality indicators within the JMP Framework

So far, the results suggest that

1. Toilet technology is a highly informative indicator for sanitation quality measured by the CI and SQI.
2. The number of HHs sharing a cubicle ceases to be a good indicator for toilet cleanliness and toilet quality if we control for other potential indicators.
3. The toilet location, a lockable toilet (from the outside), and floor tiling all seem to be associated with toilet cleanliness and overall toilet quality.

From these observations, we suggest options for enhancing the current JMP framework. This would generate a more detailed and improved sanitation ladder, and in doing so increase the sanitation ladder's informative and explanatory power in terms of SSF quality. Specifically, we propose to systematically expand the definition of the sanitation service levels (*Basic*, *Limited*, *Unimproved*). Subsequently, we explore the effect of the redefined sanitation service levels on the outcome classification. In other words, we analyse which alternative specification of the sanitation service level performs best in separating clean/high-quality toilets from dirty/low-quality toilets.

Table 10 presents the specifications of alternative sanitation service levels. Taking the current JMP framework (1) as a starting point, we vary the specification of the levels along two dimensions. First, we vary when a toilet is considered basic and when it is considered limited To this end, for a sanitation service level to be classified as "limited service", we manipulate thresholds: We alter the threshold from 2 HHs or ore to 4 HHs or more and 6 HHs in the specifications in rows (2) and (3). The threshold alterations are based on the observations in Table 6 and Table 7. The number of HHs only remains a robust indicator of toilet cleanliness for a higher number of user HHs. The exact number of user HHs varied with different model specifications. This is why we consider two different thresholds, one for 4 HHs and one for 6 HHs. Second, we apply the standard JMP definition in specification (4) but add an additional restriction. For a *basic service level*, the toilet facility must be located on the plot/compound or inside the respondent's dwelling. If this is not the case, the toilet is classified as limited, even though it might only be used by one HH. This is based on the observation that the *location* of the toilet is consistently associated with the CI and the SQI (in all regressions and across all three countries). Lastly, in specification (5), we completely omit the number of HHs as a criterion and use the *location*, the *presence of an outside/inside lock*, and *floor tiling* as alternative indicators. This is in line with the observation that the number of HHs is not significantly correlated with toilet quality and cleanliness if we control for these other factors.

So far, the changes in the sanitation service level specifications only affected whether a toilet is considered basic or limited. Now, we also manipulate the criteria for whether a toilet falls under the improved categories (basic and limited) or unimproved. According to the current specification, *flush/pour-flush to piped sewer systems*, *septic tanks or pits*, and *pit latrines* with slabs are considered improved sanitation. *Flush/pour-flush toilets that drain to the open or to elsewhere* and *pit latrines without slabs* are considered *unimproved* sanitation (WHO 2018b). As already mentioned before, the outflow was not determinable in 70% of the cases in Bangladesh. The inclusion of the outflow tremendously limited the predictive power of toilet technology as a quality indicator. As outlined in Table 4, only considering the user sanitation interface without the outflow considerably improves the predictive power of the sanitation service level as a quality indicator for SSF. So far, all results imply that *pit latrines* (irrespective of improved or unimproved) are considerably less likely to be clean and that they have a lower SQI score than *flush/pour-flush toilets*. Thus, apart from only evaluating the toilet technology based on the user interface, we modify the improved/unimproved facility type classification. To this end, we categorise any *flush/pour-flush option* as *improved* sanitation, while we categorise all *pit latrines*

(with/without slab) as *unimproved*. This is for illustrative purposes only. We do not recommend categorising all types of *pit latrines* as unimproved sanitation. Applying this categorisation to the JMP sanitation service levels and all four alternative specifications result in the "Version 2" specification. "Version 1" redefines what is considered *limited* rather than *basic*. "Version 2" redefines what is considered *unimproved* as opposed to improved technology (including *basic* and *limited*).

Specification	*Level*	*Version 1*	*Version 2*
(1) Current JMP definition	Basic	- Improved - 1 HH	- Flush/pour-flush - 1 HH
	Limited	- Improved - 2 HH or more	- Flush/pour-flush - 2 HH or more
	Unimproved	- Unimproved	- Pit latrine/other
(2) Sharing: threshold 4 HH	Basic	- Improved - less than 4 HH	- Flush/pour-flush - less than 4 HH
	Limited	- Improved - 4 HH or more	- Flush/pour-flush - 4 HH or more
	Unimproved	- Unimproved	- Pit latrine/other
(3) Sharing: threshold 6 HH	Basic	- Improved - Less than 6 HH	- Flush/pour-flush - Less than 6 HH
	Limited	- Improved - 6 HH or more	- Improved - 6 HH or more
	Unimproved	- Unimproved	- Pit latrine/other
(4) JMP + Location	Basic	- Improved - 1 HH - Inside dwelling/on plot/compound	- Flush/pour-flush - 1 HH - Inside dwelling/on plot/compound
	Limited	- Improved - 2 HH or more *OR* - Not on plot/compound	- Flush/pour-flush - 2 HH or more *OR* - Not on plot/compound
	Unimproved	- Unimproved	- Pit latrine/other
(5) Tech + location + lock +tiling	Basic	- Improved - Inside dwelling/on plot/compound - Outside lock and/or inside lock - Floor tiling	- Flush/pour-flush - Inside dwelling/on plot/compound - Outside lock and/or inside lock - Floor tiling
	Limited	- Improved - Not on plot/compound *OR* - No lock *OR* - No floor tiling	- Flush/pour-flush - Not on plot/compound *OR* - No lock *OR* - No floor tiling
	Unimproved	- Unimproved	- Pit latrine/other

Table 10: Specifications of alternative sanitation service levels

In Table 11 and Table 12, we take these alternative sanitation service level specifications and report the share of toilets that qualify as clean according to the CI, and the average SQI score, respectively. The aim is to determine which specification performs best in predicting sanitation quality, as measured by the CI and SQI.

We compare the share of clean toilets across sanitation service levels applying the different specifications. Ideally, an informative indicator for sanitation quality produces increasing shares of clean toilets, while increasing SQI scores are associated with higher sanitation service levels. In other words, the *basic* category should exhibit the highest share of clean toilets, followed by *limited* and *unimproved*. Analogously, *basic* should exhibit higher average SQI scores than *limited*, and *limited* should have higher scores than *unimproved*.

A previous finding (Table 4) already indicated that the sanitation service level and the distinction between improved and unimproved technology do not predict toilet cleanliness with satisfactory precision. Table 12 shows that this is also the case for the SQI. In Kenya, SQI differences between unimproved and limited sanitation facilities are minimal. In Bangladesh, *unimproved* perform even better than *limited*. Introducing new thresholds for the number of HHs that can share a toilet for it to be considered *basic* or *limited* does not produce the desired effect of increasing prediction precision. This becomes apparent when we compare the results from specifications (2) and (3) with the standard specification (1). The share of clean toilets and the mean SQI score converge slightly for basic and limited sanitation. This is the opposite of our target. Raising the threshold to four or six HHs has an detrimental effect. It leads to including more toilets in the basic category, that are on average, less likely to be clean than the toilets that were previously in that category already. This drives down the *basic* share of clean toilets.

However, changing the threshold from 2 to 4 or 6 HH also has a second effect: it classifies more toilets as *basic* that were previously classified as *limited*, as can be observed in Table 13. For example, in Kenya, raising the threshold from 2 to 4 HHs increases the share of basic toilets by 17 percentage points to 23%. In Ghana and Bangladesh, the increases are by 22 and 2 percentage points, respectively.[101] Therefore, raising the HH threshold has the potential to move many SSF to the *basic* level at without sacrificing a lot of predictive precision. This means that raising the threshold to 4 HHs increases the number of toilets classified as *basic*, while still mostly preserving the property that the indicator separates high-quality from low-quality toilets.

Further, adding the toilet's *location* to the current specification in (4) has no impact. All toilets that are located *elsewhere* (as opposed to immediately on the plot/compound or inside the dwelling) are improved and shared anyway, and thus already classified as *limited*. In specification (5), the number of HHs is omitted. Instead, we take into account the other indicators that turned out to show a strong correlation with the CI and the SQI in the regression analyses. These are *technology*, *location*, a *lockable door* (from the outside and/or the inside) and *tiling*. The results for this specification are mixed. For Kenya, results improve for both share of clean toilets and SQI scores. For Ghana, there is a slight decrease in the gap between *basic* and limited *toilets*. For Bangladesh, the insufficient number of *basic* toilets impedes the drawing of reliable conclusions.

Next, an alternative specification of the technology indicator (improved vs. unimproved technology) is added. Originally, distinguishing improved and unimproved toilet technology is based on a pit latrine having a cement slab or not. The alternative specification makes the distinction based on the toilet being a flush/pour-flush toilet or a pit latrine (irrespective of the cement slab). The results for this specification are presented in each country's second column, labelled "Kenya 2", "Ghana 2", and "Bangladesh 2", respectively. The results indicate that the sanitation service levels more strongly separate clean and high-quality from dirty and low-quality toilets. This is apparent from comparing the figures for *unimproved* to *limited* and *basic*. The only caveat is that in Bangladesh, toilets in the basic category are less likely to be clean compared to Ghana and Kenya (46% in Bangladesh vs. 97% in Kenya and 91% in Ghana). This reflects the finding from the country-wise regressions (Table 7 and Table 9).

Whether a toilet is private or shared is least predictive for toilet cleanliness and quality in Bangladesh. Changing the specifications as we did for "Version 1" yields a similar pattern as before. A higher threshold for sharing

[101] In Bangladesh, the effect of raising the HH threshold is limited because most toilets already qualify as unimproved.

HHs reduces the share of clean toilets in the basic level. In addition, a 4 HH-threshold decreases the average SQI. A higher threshold of 6 HHs decreases the average SQI score even more. Again, the Bangladesh sample is an exception. In Bangladesh, the altered thresholds actually lead to an increase in the share of clean toilets for *basic* relative to *limited*. Similar to "Version 1", adding the *location* to the current JMP definition (with a different technology definition) does not affect the results. If we omit the number of HHs completely and focus on technology, the location, the door lock, and floor tiling in specification (5), the performance of the indicator is relatively good in Kenya and Ghana, and even better in Bangladesh, both for cleanliness and for quality. However, it is still worse than when we simply change the technology definition (1).

In conclusion, altering the number of HHs as decisive criterion for *basic* or *limited* service levels does not have a large effect on the performance of the indicators. At the same time, it highly increases the share of toilets classified as *basic*. Adding *location* to the current specification is not informative – at least in our sample – because it coincides with the difference between private and shared toilets. Most toilets that are located within the dwelling are also private. Further, a specification ignoring the number of HHs and instead focusing on different indicators - namely *technology*, *location*, a *lockable door*, and *floor tiling* - performs better at separating high-quality from low-quality toilets than the current sanitation service levels in Kenya and Bangladesh, and slightly worse in Ghana. According to our results, the greatest potential for improvement of the indicators' performance lies in only considering the interface. Not considering the outflow of the toilet in combination with downgrading pit latrines to unimproved sanitation (irrespective of with/without slab) show the most potential in terms of predicting cleanliness and SQI.

Specification	Level	Kenya 1	Kenya 2	Ghana 1	Ghana 2	Bangladesh 1	Bangladesh 2
(1) Current JMP definition	Basic	0.57	0.97	0.77	0.91	~~1.00~~	0.46
	Limited	0.19	0.54	0.59	0.75	0.33	0.43
	Unimproved	0.26	0.14	~~0.82~~	0.42	0.43	~~0.12~~
(2) Sharing: threshold 4 HH	Basic	0.33	0.75	0.68	0.82	~~0.62~~	0.51
	Limited	0.17	0.56	0.57	0.74	0.25	0.40
	Unimproved	0.26	0.14	~~0.82~~	0.42	0.43	~~0.12~~
(3) Sharing: threshold 6 HH	Basic	0.30	0.70	0.64	0.79	0.48	0.48
	Limited	0.14	0.54	0.56	0.74	0.25	0.38
	Unimproved	0.26	0.14	~~0.82~~	0.42	0.43	~~0.12~~
(4) JMP + Location	Basic	0.57	0.97	0.77	0.91	~~1.00~~	0.46
	Limited	0.19	0.54	0.59	0.75	0.33	0.43
	Unimproved	0.26	0.14	~~0.82~~	0.42	0.43	~~0.12~~
(5) Tech + location + lock +tiling	Basic	0.71	0.79	0.69	0.80	~~1.00~~	0.63
	Limited	0.18	0.57	0.53	0.72	0.31	0.42
	Unimproved	0.26	0.14	~~0.82~~	0.42	0.43	~~0.12~~

Table 11: Proportion of clean toilets (composite measure) according to current and alternative sanitation specifications

Specification	Level	Kenya 1	Kenya 2	Ghana 1	Ghana 2	Bangladesh 1	Bangladesh 2
(1) Current JMP definition	Basic	83.12	87.72	86.07	88.44	~~82.74~~	81.02
	Limited	72.38	80.84	83.86	85.72	73.83	80.31
	Unimproved	71.58	71.24	~~83.43~~	81.73	80.49	~~57.37~~
(2) Sharing: threshold 4 HH	Basic	77.96	84.92	84.72	86.75	~~78.58~~	80.62
	Limited	71.40	80.79	83.78	85.63	72.35	80.26
	Unimproved	71.58	71.24	~~83.43~~	81.73	80.49	~~57.37~~
(3) Sharing: threshold 6 HH	Basic	76.13	83.94	84.61	86.56	73.28	80.47
	Limited	70.65	80.17	83.42	85.19	74.35	80.25
	Unimproved	71.58	71.24	~~83.43~~	81.73	80.49	57.37
(4) JMP + Location	Basic	83.12	87.72	86.07	88.44	~~82.74~~	81.02
	Limited	72.38	80.84	83.86	85.72	73.83	80.31
	Unimproved	71.58	71.24	~~83.43~~	81.73	80.49	~~57.37~~
(5) Tech + location + lock +tiling	Basic	84.26	85.15	85.61	86.72	~~81.16~~	82.94
	Limited	72.39	81.10	82.65	84.98	73.57	80.23
	Unimproved	71.58	71.24	~~83.43~~	81.73	80.49	~~57.37~~

Table 12: Mean sanitation quality (SQI) according to current and alternative sanitation service level specifications

Specification	Level	Kenya 1	Kenya 2	Ghana 1	Ghana 2	Bangladesh 1	Bangladesh 2
(1) Current JMP definition	Basic	0.06	0.03	0.10	0.06	0.00	0.06
	Limited	0.89	0.12	0.89	0.48	0.06	0.93
	Unimproved	0.05	0.85	0.01	0.45	0.94	0.01
(2) Sharing: threshold 4 HH	Basic	0.23	0.06	0.32	0.19	0.02	0.26
	Limited	0.71	0.10	0.67	0.35	0.05	0.73
	Unimproved	0.05	0.85	0.01	0.45	0.94	0.01
(3) Sharing: threshold 6 HH	Basic	0.41	0.09	0.55	0.33	0.02	0.46
	Limited	0.54	0.07	0.44	0.21	0.04	0.53
	Unimproved	0.05	0.85	0.01	0.45	0.94	0.01
(4) JMP + Location	Basic	0.06	0.03	0.10	0.06	0.00	0.06
	Limited	0.89	0.12	0.89	0.48	0.06	0.93
	Unimproved	0.05	0.85	0.01	0.45	0.94	0.01
(5) Tech + location + lock +tiling	Basic	0.05	0.05	0.48	0.33	0.00	0.04
	Limited	0.90	0.11	0.51	0.22	0.06	0.94
	Unimproved	0.05	0.85	0.01	0.45	0.94	0.01

Table 13: Distribution of toilet facilities according to current and alternative sanitation service level specifications

5.7 Limitations

In this section, we critically discuss the findings of the quantitative part, provide some additional interpretation for the results, and explore some of the implications and limitations that we encounter.

Outcome variables

First, we decide to limit ourselves to two outcome variables: the SQI score and a binary cleanliness index. We find that reporting on cleanliness is heavily dependent on the subject. Cleanliness results vary depending on whether they are reported by respondents, observed on the spot by enumerators, or encoded remotely by research assistants. The discrepancies in observed, reported, and picture-coded cleanliness leads us to only focus on observable variables for the cleanliness index. In doing so, we lose some of the variation that is present in the five-point Likert scale cleanliness measures, since the resulting index is binary in cleanliness ("clean" and "not clean"). While the validity increases when the measure being based on observable criteria, there is no statement on its reliability. In other words, it is not clear how much the one-time observation represents the usual cleanliness. Since we do not have reason to believe that the sampling procedure yields a biased cleanliness measure, the observed cleanliness should, *on average*, represent the basic conditions.

As with the CI, the variables included in the SQI are not exhaustive with respect to cleanliness, safety/security, privacy, and accessibility/availability. But, except *use at night*, all variables that are used for the SQI are observable. Another caveat concerns the weights of the index, which are obtained with the help of the MCA to calculate the SQI scores. As is common with MCA, only the factor loadings of the first component are used as weights, which only represents the variation in one dimension. The more of the data's variation is captured by the first component of the MCA, the higher the index' explanatory power for the whole data. In our case, the first component captures 26.5% of explained variation, while the second component only captures 14% (see Figure 11: Screeplot explained variances of the MCA). It is unclear whether 26.5% of explained variation is sufficient. Though categorical data, which is used throughout this study, exhibits lower variation by construction than would be the case for continuous data.

Overall, more research is needed to determine which variables should be included in the SQI and how sensitive it is to these changes. The robustness of the SQI with respect to different weighting methods also needs to be tested.

Covariates

One finding of this study is that the toilet type in use is heavily country-dependent. This complicates the interpretation of pooled regressions. The toilet type in use could be confounded by unobserved differences across countries. For this reason, we include country fixed effects in Table 6 and Table 8. Still, part of the problem of country-dependent data remains, as some toilet types are completely absent in some country sub-samples. This includes *flush/pour-flush to elsewhere* in Ghana and *unimproved pit latrines* in Bangladesh. This leads to imperfect (multi-)collinearity, which means that the effect of one variable is not (fully) separable from the effect of another variable. Similar to the problem of collinearity between country and toilet type, there are other variables for which this problem arises. This includes the number of HHs, the relationship of users, and the location of the toilet. There is little one can do to tackle this problem except to recode the variables into groups that are broader, mitigating the problem of collinearity while forfeiting more detailed information.

The concentration of certain toilet types in some of the countries implies that the problems associated with a certain toilet type do only occur within this context. For example, emptying costs, the financial responsibility for emptying costs, or full pits may play an important role in Kenya, which has almost exclusively pit latrines. Conversely, in Bangladesh, flush/pour-flush toilets that do not drain into a pit or septic tank are more prevalent. Therefore, there is still great potential to explore the country-specific idiosyncrasies with the data at hand.

Contrary to qualitative results, some variables did not show a significant relationship with cleanliness or the SQI. Surprisingly, immediate *water access on premises* does not affect cleanliness and is only related to quality in Bangladesh. Interestingly, it is also in Bangladesh that we observe by far the lowest number of compounds without immediate *water access on the premises*. Meanwhile, whether the toilet has functioning lighting is only correlated with CI and SQI in Kenya. Similar to the results for toilet location, this could be related to the fact that in Kenya, many of the toilets are detached from other structures, possibly increasing the need for security-enhancing measures like lighting. Gender-separated toilets are only significantly related to the outcomes in Ghana, where merely 5.2% of the toilets in the sample are gender-separated. In Kenya, there are only five respondents that reported using a gender-separated cubicle, while in Bangladesh, 3.4% reported doing so. While this may come as a surprise, one has to remember that the privacy component in the SQI is not based on perceived privacy but rather privacy-ensuring toilet design. Even though an analysis of perceived privacy and safety would be interesting, we refrained from exploring this aspect due to concerns related to reporting bias.

Alternative sanitation service levels

As one of the main results of the quantitative part, we compare the sanitation service level from the current JMP framework to alternative indicators that are based on the results from the regression analyses. Just as we did with the regressions, we analyse the alternative specifications of sanitation service levels in the light of toilet cleanliness and quality (as measured by CI and SQI). We find that some of the alternative sanitation service levels perform better in predicting cleanliness and quality than those used for assessing current JMP sanitation service levels. This does not invalidate the current JMP sanitation service levels. Nevertheless, if we define quality based on multiple dimensions, the conventional sanitation service level's explanatory power remains limited with respect to quality (and cleanliness). At the same time, applying an alternative specification of improved toilet technology (see Table 10) may mask important information for other areas of interest. More accurately, only considering the interface irrespective of the outflow is justified in the context of a quality

indicator for urban sanitation, which does not mean that outflow is an obsolete indicator. Similarly, categorizing pit latrines on a lower sanitation service level than flush/pour-flush toilets does not apply to any context. In a context where pit latrines are most prevalent, a toilet having a slab could be a decisive quality feature compared to pit latrines without slabs. But with the sample at hand, pit latrines (with /without slab)perform significantly worse than flush/pour-flush toilets in the SQI as well as in CI. This is particularly true for the Kenyan sub-sample, where a large proportion of the toilets were pit latrines. While this does not rule out that certain types of pit latrines that would perform equally well as flush/pour-flush toilets, there were simply not enough examples that would allow for this question to be examined rigorously in our sample.

Further Limitations

First, one could argue that our results are threatened by omitted variable bias because, for instance, important determinants like socio-economic status or the respondents' income were not included in the analysis. It is important to note that this quantitative analysis does not aim at establishing a causal relationship between the covariates and the outcome variables. Rather, it intends to identify indicators that best predict the outcome variables. Still, a possible concern remains that we could omit potential indicators that would perform better than the ones we included in the analysis. We can never entirely rule out this possibility. However, by applying a mixed methodology with a qualitative part to inform the survey design, we address this issue to the maximum extent possible and try our best to take the user perspective into consideration. In doing so, we minimize the risk of omitting factors that are of importance to the user but unknown to the researchers.

This study compares the sanitation outcomes in three distinct cities, located in three countries. The heterogeneity of the results reflects highly contextual differences. Many of the indicators affect quality in one context only. This has implications for the external validity of these results. One has to be cautious not to extrapolate our findings indiscriminately to other contexts. Nevertheless, due to the large environmental and social differences between the countries, we can say with some confidence that the indicators we find to be important in all three contexts are likely relevant in other contexts as well. However, more research should be conducted to further validate the findings.

Another limitation of this study is representativeness. Even though random sampling within a given settlement is achieved through systematic sampling, the selection of the settlements was purposive. We deliberately focused on settlements where the chance of encountering SSFs was higher, in accordance with expert knowledge from our local partners. We tried to ensure a certain degree of geographic dispersion across cities, but middle- and high-income areas were excluded from the selection. Therefore, the distribution of sanitation outcomes does not represent the overall situation in that city but only that of specific low-income settlements. As a consequence, characteristics that are presumably associated with higher income areas are underrepresented. Moreover, middle- and high-income areas tend to have higher shares of IHF, and thus, the IHF we encounter in low-income areas might not necessarily have the same characteristics as those encountered in middle- and low-income areas.

Last, this analysis does not consider the temporal dimension of sanitation quality, as, for instance, some variables might be subject to seasonal variation. It is possible that certain factors only come into play in times of extreme precipitation or aridity. To test the reliability of the data in terms of seasonal variation, multiple rounds of data collection are necessary, which is beyond the scope of this study. We counter this potential criticism

by noting that in all three cities data collection took place around rainy season[102], ensuring at least a degree of comparability across the study sites.

5.8 Conclusion

Our findings suggest that the sanitation service levels, as defined by JMP, could be informative indicators for sanitation quality if adjusted. Based on our results, an indicator based on the user interface is informative of sanitation quality. Overall, given our two outcome indices (SQI and CI), the sanitation service level as a classification based exclusively on two indicators, *toilet technology* and (number of) *HHs sharing a facility*, is not an informative sanitation quality indicator compared to other alternative indicators. Particularly, an alternative specification of the sanitation service level that focuses on the interface instead of the combination of interface and outflow, and puts *pit latrines* a level below *flush/pour-flush toilets*, performs better than the conventional specification by JMP. Changing the threshold of HHs that classify a facility as "limited rather than *basic* strongly increases the number of toilets classified as *basic*, while having little impact on the sanitation service level's performance as quality indicator. However, the analysis also suggests that the number of HHs can be replaced by other indicators, for instance by a combination of the facility's *location*, the presence of a *lockable door*, and *tiling*.

This study exposed various knowledge gaps requiring future research. For one, the SQI needs to be improved by testing the inclusion of more observable outcomes that can be attributed to the different quality facets. Also, exploring the causal determinants of toilet quality could be of interest. For instance, it remains unclear what mechanisms are at play when we observe different levels of cleanliness. Why do some HHs *causally* have cleaner toilets than others? Additionally, more research can be conducted at the country level. In Kenya, for instance, the high share of pit latrines could be exploited to identify the circumstances under which pit latrines are of adequate quality. One could also think about cross-validating the findings of this study by collecting comparable data in different cities.

[102] https://en.climate-data.org/

5.9 Appendix Quantitative Results

Users' perceived problems with SSF

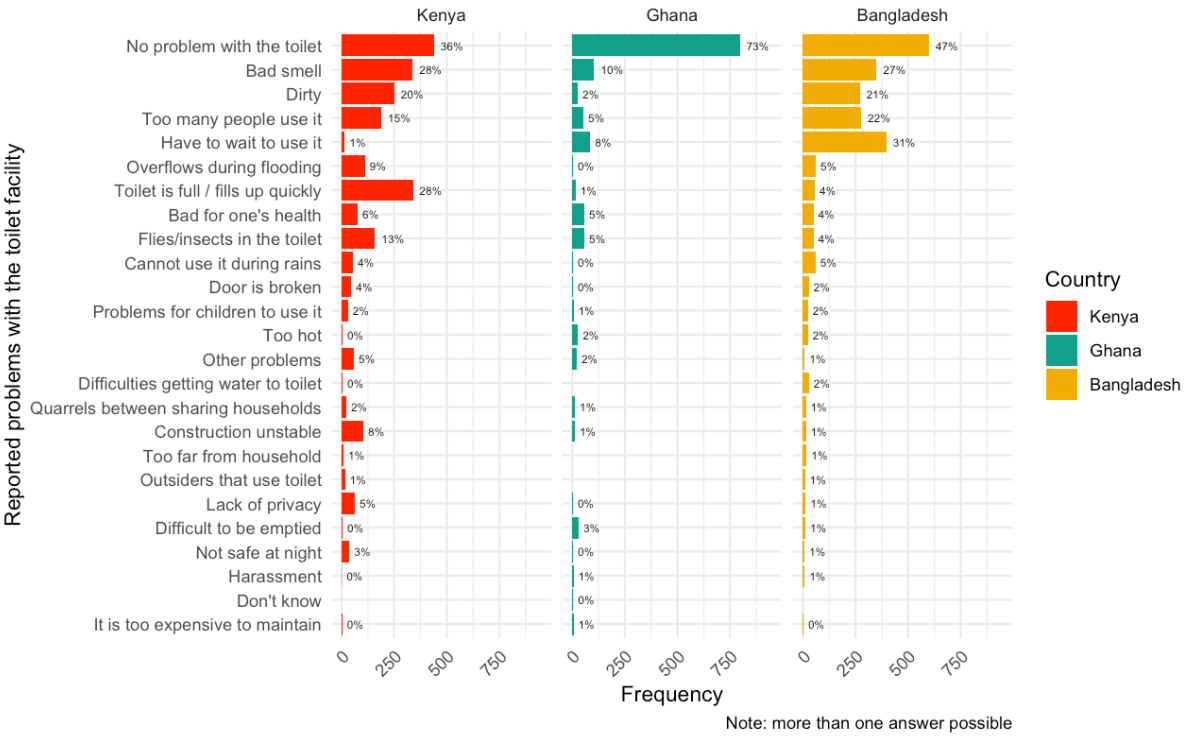


Figure 7: Reported problems by toilet users

Figure 7: Reported problems by toilet users shows the most mentioned problems with toilet in general. The respondents were asked about common problems with their SSF. Because the respondents could mention more than one problem, the sum of percentages per country can surpass 100%. The percentages represent the share of respondents that mentioned a problem. For example, 36% of the respondents in Kenya report having no problem with the toilet.

In all three countries a sizeable share report having no problems at all. The share of respondents reporting having no problem is less than half in Kenya compared to Ghana, while Bangladesh is between the two. Overall, bad smell, dirtiness, the number of people using the toilet and the long waiting time were identified as the most common problems by the respondents.

Kenya

In Kenya, most people report the smell (28%), the pit being full or filling up quickly (28%) and the toilet being dirty (20%) as the major problems. Relating these findings to the qualitative findings for Kenya yields ambivalent results. While dirty toilets figured within the five key challenges in both GALS meetings, bad smell/odour

did not. Interestingly, the mixed FGD in Kenya was the only FGD across all where *cleanliness* was not mentioned as a user quality priority. Conversely, *odour/smell* was mentioned in the women-only and mixed, but not in the two men-only FGDs performed. The pit being full or filling up quickly is represented among the five key challenges as well. While explicitly stated in the Nyalenda GALS meeting, in the Manyatta meeting participant identified *high groundwater table* as a key challenge. A *high groundwater table* evidently contributes to quickly filled pits. None such results were found for the FGD data in Kenya.

Quality Aspects User View	Ghana			Kenya			Bangladesh		
	Women-only	Mixed	Men-only	Women-only	Mixed	Men-only	Women-only	Mixed	Men-only
Water Availability	4	7	0	4	1	2	23	10	3
Cleanliness	7	2	5	6	0	2	2	2	2
Gender Separated Toilets	2	1	2	4	0	2	7	6	3
Sanitation Technology (Flush WC)	3	8	5	5	1	2	1	1	0
Lighting	2	1	0	1	2	1	13	2	0
Lockable door	4	1	0	2	1	2	4	4	0
Tiling	4	2	0	1	2	2	3	2	2
Handwashing	1	8	2	0	3	1	1	1	0
Privacy	1	2	0	0	1	2	1	1	2
Odour / Smell	3	4	2	3	2	0	0	1	0
Cleaning Arrangement	2	3	1	1	0	0	3	3	2
Space Availability (inside)	0	0	2	1	2	0	4	3	2
Safety / Security	1	4	0	3	0	1	4	0	0
Toilet-User-Ratio	2	0	0	1	1	2	6	0	1
Detergent	2	1	0	0	0	0	4	4	2
Insects	6	0	0	1	0	1	3	0	0
Queuing / Waiting Time	3	0	0	1	0	2	3	1	1
Tissue / Toilet Paper	1	0	0	1	0	1	1	4	1

Table 14 : FGD results on user quality priorities (above) and quality concerns (below) per country and FGD type

Ghana

In Ghana, also bad smell is the most reported problem, though only by 10%. Further, 8% report having to wait to use the toilet. Qualitative findings for Ghana support these results: bad smell figures as key challenges in both GALS meetings and all types of Ghanaian FGDs present absence of *odour/smell* as user quality priority (see Table 15). In one of two GALS meetings *crowding/queuing* was mentioned as a key challenge, whereas *queuing/waiting* time was only mentioned in women-only FGDs, but neither in mixed nor men-only FGDs. FGD data shows consistency since *toilet-user-ratio* was mentioned as user priority in women-only FGDs exclusively as well. Conversely, both Ghanaian GALS meetings indicate a *wet floor/urine on floor* to figure within the five key challenges.

Bangladesh

In Bangladesh having to wait to use it (31%), bad smell (27%), too many people using it (22%) and the toilet being dirty (21%) are the major problems. Qualitative findings for Bangladesh show ambivalent results. While in the Bhasantek GALS meeting both *bad smell* and *crowding/queuing* figured within the five key challenges, both these were absent from the Adamtek GALS key challenges. Regarding FGD data, *queuing/waiting time* was mentioned as a user priority in all FGD types in Bangladesh, which supports the quantitative results. Regarding bad *odour/smell* within the FGDs in Bangladesh, interestingly, this was only mentioned in mixed FGDs as a user quality priority. This was the reason why ultimately *odour/smell* did not meet the evaluation criteria regarding the overall user quality priorities. Concerning dirty toilets, these were indirectly mentioned in both

GALS meetings with *stool remains stuck* (Adamtek) and *drainage problems* (Bhasantek). Conversely, *cleanliness* was mentioned in all FGD types as user quality priority.

Discussion

Quantitative data indicates dirty toilets as major user concerns in Kenya and Bangladesh, but not in Ghana. Within FGD data, *cleanliness* was the most prioritised quality aspect among users. FGD data implied that users related *cleanliness* to *water availability*. Users perceive *water availability* (in close proximity) as essential to keeping the facility clean and prioritise *cleanliness* for comfort reasons. FGD data is consistent with past research, which found that across all countries and genders, users perceive a close water source as essential for cleaning (Tumwebaze and Mosler 2014; Kwiringira et al. 2014b). Compared to previous research findings, *cleanliness* being rated the highest priority within the FGDs is consistent with the results from (Schouten and Mathenge 2010). With water being immediately available for *flush WCs*, participants expect *cleanliness* to increase with concomitant beneficial effects, such as decreasing *odour/smell* and *presence of insects* (Rheinländer et al. 2013).

Within quantitative data, bad *odour/smell* as a user quality concern received high shares in all three countries. This is consistent with previous research (Rheinländer et al. 2013; Isunju et al. 2011; Thys et al. 2015; Tidwell et al. 2018). Conversely and surprisingly, *odour/smell* (as well as *presence of insects*) did not meet the FGD evaluation criteria. According to the FGD data, *odour/smell* seems to be more an issue in Ghana compared to Bangladesh. Because it was mentioned only in mixed FGDs in Bangladesh it did not meet the evaluation criteria regarding the overall user quality priorities. User relate *odour/smell* to *presence of insects*, as qualitative data suggests. *Presence of insects* did not meet the FGD evaluation criteria because it was mentioned exclusively in women-only FGDs in Ghana and Bangladesh. The FGD results for *odour/smell* are somewhat consistent with the findings on *presence of insects*. For both quality aspects, within FGD data the highest concern was found in Ghana and the lowest in Bangladesh. Among other contributing aspects, participants found dirty toilets and *odour/smell* to be reasons for *presence of insects*. In research, *odour/smell* and *presence of insects* are two proxies often used to assess cleanliness (Giné-Garriga et al. 2018; Giné-Garriga et al. 2017; Organization 2016).

Within the quantitative data analysis *queuing/waiting time* was evaluated as user concerns in Bangladesh and Ghana. Conversely, *toilet-user ratio* and *queuing/waiting time* did not meet the FGD evaluation criteria for user quality priorities. Insufficient *toilet-user ratio*, leading to *queuing/waiting time*, impedes toilet availability and has adverse effects on *privacy* and *safety/security*, as well as on *cleanliness*. Recent SSF research on cleanliness found that in urban low-income settlements, a SSF shared by not more than four HHs can be considered as 'acceptable' (Kwiringira et al. 2014a; Günther et al. 2012). Low *toilet-user ratios* can lead to long *queuing/waiting times*, which in some instances can account for a significant reduction in benefit (Buckley and Kallergis 2019; Napitupulu and Hutton 2008; Hutton and Whittington 2015). For FGD data, *toilet-user ratio* and *queuing/waiting time* did not meet the selection criteria because in Ghana this was mentioned exclusively in women-only FGDs. In Kenya, FGD data suggests that *queuing/waiting time* often occurs ('only') at peak times, i.e. mornings and evenings. Within the FGD data, the highest occurrence of *toilet-user ratios* and *queuing/waiting times* was

found in Bangladesh. This is not surprising, as Dhaka is known as the third most densely populated city world-wide.[103] The insufficient *toilet-user ratio* seems to be the main reason for *queuing/waiting time*. However, FGD data also indicates that *queuing/waiting time* is reinforced by toilets serving as a *shower/bathing* area as well, and for females to manage *MHM*.

User satisfaction with SSF

The quantitative survey elicited user satisfaction with the cleanliness, and the security and privacy provisions of the SSF. For each dimension, cleanliness, security, and privacy, the respondents rated their satisfaction level using a five-point Likert-scale ranging from "very dissatisfied" to "very satisfied". The following analysis contrasts these satisfaction measures with outcome variables corresponding to each dimension, respectively. The outcome variables are: the share of clean toilets using the CI for cleanliness; *use at night* (i.e. whether the respondent uses the toilet at night) for security; a privacy indicator (whether there is a solid/functional door, and a solid wall without holes) for privacy.

Figure 8, Figure 9, and Figure 10 report the frequency of the responses regarding users' satisfaction with cleanliness, security, and privacy. For each satisfaction level, the percentages of the corresponding outcome variables are reported.

Regarding cleanliness, we find that most users are at least "satisfied" with the cleanliness of their SSF. According to Figure 8, in Kenya the share of respondents that are satisfied is lowest with 66%, followed by Bangladesh with 75%, and Ghana with 92%. The percentages report the share of clean toilets according to the CI (using solid waste, insects, and visible faeces as proxies for cleanliness). For example, in the case of Kenya, of all responses where users were "very satisfied" with toilet cleanliness, 52% of toilets were also found to be clean by the enumerators' assessment of the three cleanliness criteria solid waste, insects, and visible faeces. Figure 8 shows that satisfaction with cleanliness is correlated with the CI in all three countries. The higher the satisfaction with the toilet's cleanliness, the more likely the toilet is to be clean according to the CI. If satisfaction would not be corelated with cleanliness, the share of clean toilets would be constant for all satisfaction levels.

[103] Migiro, Geoffrey . "The World's Most Densely Populated Cities." WorldAtlas, Nov. 15, 2018. URL: www.worldatlas.com/articles/the-world-s-most-densely-populated-cities.html. Accessed, 13.03.2020.

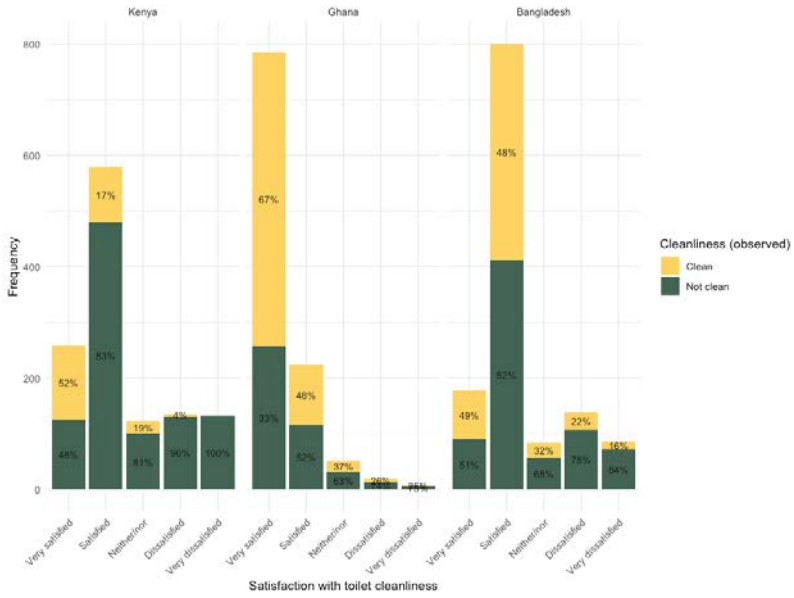


Figure 8: Share of clean toilets by user satisfaction level with cleanliness

Similarly, Figure 9 reports the perceived security of users to use the toilet at night. The share of users reporting that they feel mostly safe using the SSF at night ranges from 63% in Kenya, over 93% in Bangladesh, to 94% in Ghana. Generally, only a small share of users report not using the toilet at night (5%). As a consequence, the share of users that do not use the toilet at night is also low for all perceived security levels (columns). Still, the percentages of respondent that do not use the toilet at night decreases on average with lower perceived security. This suggests a correlation between perceived security and actual use at night. This result is particularly apparent in Kenya, where 63% of users that do never feel secure enough to use the toilet at night also report that they do not use it.

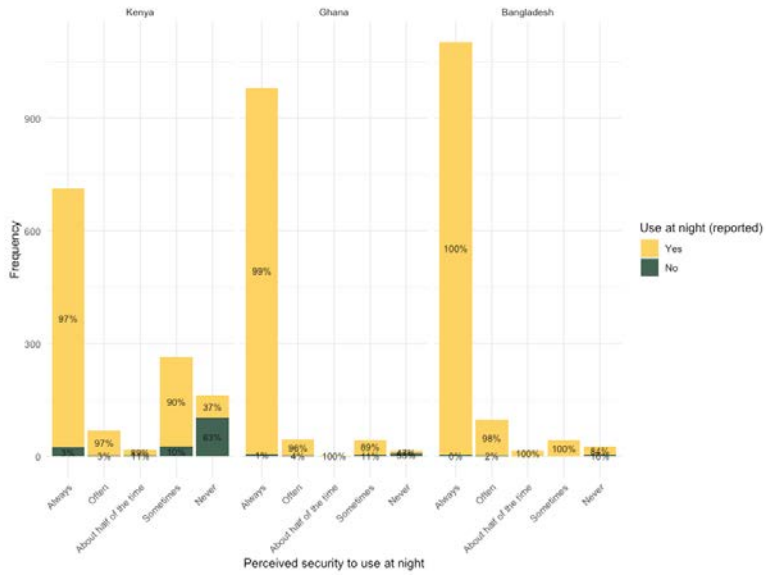


Figure 9: Share of reported use of toilet at night by perceived safety level

Figure 10 shows the distribution of satisfaction with the privacy provisions of the SSF by country. The share of users that is at least "satisified" with the privacy provisions of their SSF is 82% in Kenya and Bangladesh, and 95% in Ghana. The percentages denote to share of toilets within a given satisfaction level, that does not provide privacy. As within the SQI, privacy is measured by the presence of a solid and functional door, and a solid wall, both without holes. If one of these features is not present, the toilet provides "no privacy". As previously with cleanliness and security, the satisfaction levels are correlated with the actual outcome, in this case, privacy. This means that the higher the users' satisfaction level, the likelier it is to also observe adequate privacy provisions.

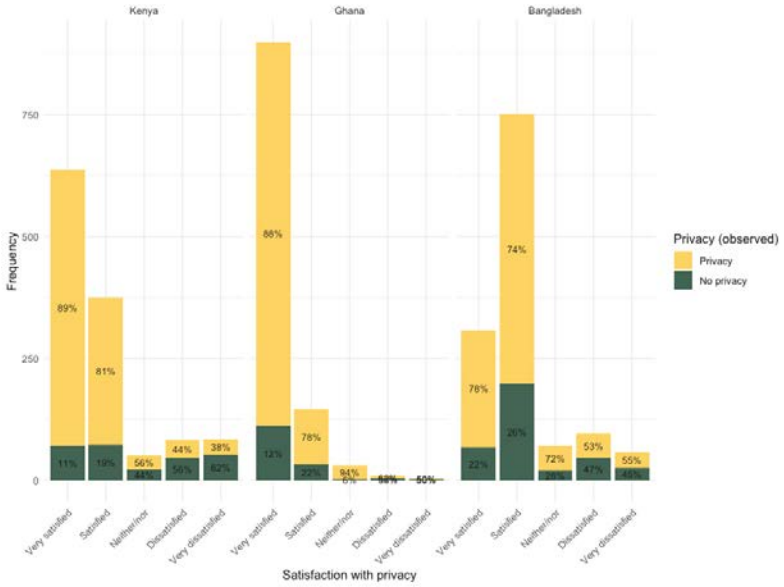


Figure 10: Observed privacy provisions (door and walls solid/no holes) by user satisfaction with privacy

Strikingly, users are least satisfied with their SSF in Kenya and most in Ghana. This is reflected in the outcome variables used for the quantitative analysis, where we also observe Kenyan SSF scoring the lowest with regard to the SQI and the CI.

House tenure

Table 15: Regressions of CI and SQI on time of residency and tenure formality

	Dependent variable:					
	clean_comp			quality_index		
	logistic			OLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Residency (years)	0.03***		-0.01	0.14***		-0.05
	(0.01)		(0.01)	(0.04)		(0.06)
Tenant (formal)		0.37***	0.35**		2.79***	2.56***
Reference = Owner		(0.13)	(0.14)		(0.57)	(0.66)
Tenant (informal)		-0.56***	-0.59***		-3.00***	-3.31***

		(0.09)	(0.11)		(0.50)	(0.67)
Free rent		0.46**	0.45**		1.67*	1.62*
		(0.21)	(0.21)		(0.94)	(0.94)
Constant	-0.55***	-0.12	-0.07	78.03***	80.17***	80.68***
	(0.07)	(0.08)	(0.13)	(0.36)	(0.42)	(0.77)
Observations	3,601	3,601	3,601	3,601	3,601	3,601
R^2				0.003	0.04	0.04
Adjusted R^2				0.003	0.04	0.04
Log Likelihood	-2,427.02	-2,375.29	-2,375.16			
Akaike Inf. Crit.	4,858.04	4,758.58	4,760.32			
Residual Std. Error				10.82 (df = 3599)	10.63 (df = 3597)	10.63 (df = 3596)
F Statistic				12.31*** (df = 1; 3599)	48.19*** (df = 3; 3597)	36.40*** (df = 4; 3596)

Note: *p<0.1, **p<0.05, ***p<0.01

Supplementary regression tables

Pooled logistic regression of toilet cleanliness

	Dependent variable:				
	Cleanliness index				
	(1)	(2)	(3)	(4)	(5)
Improved toilet	-0.13 (0.10)				
Shared toilet	-0.95*** (0.14)				
Technology					
(ref: Flush/pour-flush to piped sewer/septic tank/pit)					
Flush/pour-flush to elsewhere		-1.21*** (0.13)		-1.17*** (0.14)	-0.65*** (0.17)
Improved pit latrine		-2.21*** (0.14)		-2.15*** (0.14)	-1.70*** (0.16)
Unimproved pit latrine		-2.03*** (0.49)		-1.98*** (0.50)	-1.34*** (0.45)
Other		-0.86* (0.49)		-1.12** (0.47)	-0.55 (0.52)
Number of HHs					
(ref: 1 HH)					
2 HHs			-0.53*** (0.19)	-0.31 (0.20)	-0.19 (0.43)
3 HHs			-0.63*** (0.19)	-0.36* (0.21)	-0.14 (0.43)

4 HHs			-0.77*** (0.19)	-0.56*** (0.20)	-0.36 (0.44)
5 HHs			-0.74*** (0.19)	-0.51** (0.21)	-0.33 (0.43)
6 HHs			-1.25*** (0.21)	-1.05*** (0.21)	-0.86* (0.44)
7 HHs			-0.88*** (0.21)	-0.53** (0.22)	-0.23 (0.45)
8 HHs			-0.98*** (0.22)	-0.69*** (0.23)	-0.43 (0.44)
9 HHs			-0.91*** (0.24)	-0.61** (0.25)	-0.37 (0.46)
10 HHs			-1.08*** (0.23)	-0.67** (0.27)	-0.43 (0.47)
>10 HHs			-1.49*** (0.18)	-1.14*** (0.19)	-0.79* (0.43)
Improved water on plot					-0.04 (0.13)
Handwashing with soap					-0.19 (0.17)
Toilet location					
(ref: Inside dwelling)					
Inside compound/on plot					-0.54** (0.23)
Elsewhere					-1.69*** (0.56)
Lighting					0.22* (0.13)
Outside lock					0.38*** (0.12)
Tiling					0.87*** (0.16)
Gender separated					0.52 (0.32)
Cleaning arrangement					0.27** (0.12)
User relationship					
(ref: Others)					
Only relatives					-0.06 (0.41)
Close neighbours					0.09 (0.22)
Age of toilet					
(ref: <1y)					
1-3y					0.01 (0.15)
4-6y					-0.02 (0.17)
7-9y					0.21 (0.22)
>10y/Don't know					0.05 (0.16)
Landlord on plot					0.34*** (0.11)
Bin inside cubicle					0.10 (0.16)
Constant	0.59*** (0.15)	0.93*** (0.11)	0.51*** (0.13)	1.52*** (0.15)	0.53 (0.51)
Observations	3,601	3,601	3,601	3,601	3,601

Log Likelihood	-2,407.15	-2,150.26	-2,368.82	-2,111.46	-2,015.88
Akaike Inf. Crit.	4,820.29	4,310.51	4,759.63	4,252.92	4,095.75

Note: $^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$

Robust standard errors are clustered on the compound/plot level

Table 16: Pooled logistic regressions of toilet cleanliness without country fixed-effects

Logistic regression of toilet cleanliness by country

	Cleanliness index								
	Kenya	Ghana	Bangladesh	Kenya	Ghana	Bangladesh	Kenya	Ghana	Bangladesh
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Improved toilet	-0.34 (0.40)	-1.14*** (0.19)	-0.37 (0.38)						
Shared toilet	-1.83*** (0.26)	-0.83 (1.07)	-0.14 (0.48)						
Technology									
(ref: Flush/pour-flush to piped sewer / septic tank / pit)									
Flush/pour-flush to elsewhere				-0.61 (0.41)	-	0.10 (0.26)	-0.57 (0.44)	-	0.23 (0.27)
Improved pit latrine				-2.37*** (0.20)	-1.59*** (0.14)	-15.02 (411.93)	-1.96*** (0.23)	-1.42*** (0.15)	-14.53 (391.79)
Unimproved pit latrine				-3.14*** (0.76)	0.31 (0.80)	-	-1.96** (0.79)	0.16 (0.82)	-
Other				-13.53 (535.41)	-1.44*** (0.46)	0.14 (1.05)	-16.56 (2,399.54)	-1.03** (0.50)	0.61 (1.08)
Number of HHs									
(ref: 1 HH)									
2 HHs				-0.70* (0.38)	-0.35 (0.32)	0.11 (0.29)	-0.53 (0.89)	-0.10 (0.46)	-15.59 (717.49)
3 HHs				-0.57 (0.36)	-0.89*** (0.32)	0.41 (0.28)	-0.41 (0.88)	-0.40 (0.45)	-15.27 (717.49)
4 HHs				-0.75** (0.36)	-0.86*** (0.32)	-0.18 (0.29)	-0.61 (0.89)	-0.37 (0.45)	-15.87 (717.49)
5 HHs				-0.75** (0.38)	-0.89*** (0.32)	0.06 (0.29)	-0.59 (0.87)	-0.42 (0.45)	-15.67 (717.49)
6 HHs				-1.70*** (0.43)	-1.16*** (0.32)	-0.62** (0.31)	-1.42 (0.93)	-0.77* (0.46)	-16.34 (717.49)

7 HHs	-1.26*** (0.42)	-0.83** (0.35)	0.29 (0.30)	-1.06 (0.92)	-0.21 (0.48)	-15.39 (717.49)
8 HHs	-1.70*** (0.50)	-0.39 (0.38)	-0.19 (0.30)	-1.41 (0.95)	0.13 (0.50)	-15.85 (717.49)
9 HHs	-0.79* (0.43)	-0.79* (0.44)	-0.08 (0.31)	-0.45 (0.93)	-0.46 (0.53)	-15.80 (717.49)
10 HHs	-0.93** (0.42)	-0.50 (0.37)	-0.47 (0.34)	-0.54 (0.91)	-0.18 (0.48)	-16.21 (717.49)
>10 HHs	-1.61*** (0.34)	-0.90*** (0.31)	-0.61** (0.27)	-1.27 (0.88)	-0.47 (0.45)	-16.26 (717.49)
Improved water on plot				-0.16 (0.18)	-0.003 (0.16)	-0.04 (0.34)
Handwashing with soap				14.87 (447.68)	0.62** (0.31)	-0.33** (0.16)
Toilet location						
(ref: Inside dwelling)						
Inside compound/on plot				-1.15** (0.49)	-0.63* (0.35)	0.42 (0.45)
Elsewhere				-2.53*** (0.89)	-1.55* (0.87)	-0.48 (0.69)
Lighting				1.67** (0.72)	0.36** (0.16)	0.03 (0.13)
Outside lock				1.12*** (0.26)	-0.26 (0.21)	0.29** (0.13)
Tiling				0.45 (0.36)	0.49*** (0.15)	0.73** (0.30)
Gender separated				1.27 (1.01)	0.73** (0.32)	0.002 (0.33)
Cleaning arrangement				0.33 (0.22)	0.12 (0.17)	0.04 (0.14)
User relationship						
(ref: Others)						
Only relatives				-0.41 (0.86)	0.31 (0.35)	-14.96 (717.49)
Close neighbours				0.15 (0.39)	0.29 (0.21)	0.47 (0.39)
Age of toilet						

(ref: < 1y)									
1-3y							-0.19 (0.25)	0.59* (0.35)	-0.03 (0.20)
4-6y							-0.13 (0.28)	0.56 (0.37)	0.01 (0.21)
7-9y							-0.29 (0.46)	0.82** (0.41)	0.05 (0.26)
>10y/Don't know							0.14 (0.28)	0.48 (0.33)	-0.23 (0.18)
Landlord on plot							0.08 (0.18)	0.26 (0.21)	0.33** (0.13)
Bin inside cubicle							-2.28 (2,440.95)	-0.41*** (0.15)	0.41 (0.48)
Constant	0.68 (0.45)	2.33*** (0.27)	-0.15 (0.95)	1.57*** (0.30)	1.93*** (0.26)	-0.25 (0.34)	1.08 (1.06)	1.00 (0.63)	14.27 (717.49)
Observations	1,229	1,087	1,285	1,229	1,087	1,285	1,229	1,087	1,285
Log Likelihood	-608.51	-719.52	-874.97	-513.73	-639.92	-851.31	-482.22	-610.53	-833.51
Akaike Inf. Crit.	1,223.02	1,445.04	1,755.94	1,057.47	1,307.83	1,730.63	1,028.44	1,283.05	1,729.02

Note: *p<0.1, **p<0.05, ***p<0.01

Robust standard errors are clustered on the compound/plot level

Table 18: OLS regression of SQI on potential indicators: Multicollinearity problem

OLS regression of sanitation quality index

	Dependent variable:					
	Quality Index					
	(1)	(2)	(3)	(4)	(5)	(6)
	Kenya	Ghana	Bangladesh	Kenya	Ghana	Bangladesh
Technology						
(ref: Flush/pour-flush to piped sewer / septic tank / pit)						
Flush/pour-flush to elsewhere	3.24 (2.16)		3.60*** (1.14)	2.92 (2.04)		3.17*** (1.10)
Improved pit latrine	-8.74*** (0.99)	-3.91*** (0.38)	-19.10*** (2.90)	-6.38*** (1.05)	-3.14*** (0.41)	-11.54*** (2.87)
Unimproved pit latrine	-20.53*** (2.17)	-2.75 (1.86)		-13.04*** (2.16)	-2.80 (1.83)	
Other	-1.92 (11.08)	-9.10*** (1.35)	-21.90*** (4.77)	-2.61 (10.43)	-7.31*** (1.36)	-13.63*** (4.61)
Number of HHs						
(ref: 1 HH)						
2 HHs	-2.76 (1.75)	-1.55* (0.81)	-2.02 (1.35)	-7.71*** (2.95)	-2.06* (1.14)	-10.43** (4.80)
3 HHs	-3.51** (1.66)	-2.65*** (0.81)	1.46 (1.30)	-8.36*** (2.89)	-2.38** (1.14)	-8.73* (4.69)
4 HHs	-6.20*** (1.66)	-1.84** (0.81)	-1.65 (1.31)	-11.08*** (2.95)	-1.50 (1.14)	-11.65** (4.79)
5 HHs	-6.08*** (1.74)	-2.24*** (0.81)	-0.004 (1.31)	-10.99*** (2.89)	-2.23** (1.14)	-9.52** (4.80)
6 HHs	-6.77*** (1.76)	-2.89*** (0.83)	-0.10 (1.36)	-10.99*** (3.01)	-2.72** (1.17)	-9.61** (4.82)
7 HHs	-5.57*** (1.78)	-3.14*** (0.93)	1.08 (1.38)	-9.69*** (3.03)	-2.30* (1.22)	-9.36* (4.81)
8 HHs	-9.52*** (1.85)	-0.81 (0.96)	0.78 (1.37)	-12.91*** (3.03)	-0.69 (1.27)	-9.00* (4.82)
9 HHs	-7.48*** (1.96)	-2.53** (1.17)	0.24 (1.40)	-11.02*** (3.13)	-2.68* (1.38)	-9.89** (4.82)
10 HHs	-8.41*** (1.83)	-2.18** (0.99)	-1.37 (1.53)	-11.93*** (3.03)	-2.13* (1.24)	-11.55** (4.86)
>10 HHs	-10.25*** (1.50)	-3.10*** (0.80)	-2.36* (1.21)	-13.37*** (2.88)	-2.95** (1.14)	-11.43** (4.75)
Improved water on plot				0.84 (0.65)	0.19 (0.42)	2.68** (1.34)
Handwashing with soap				-0.86 (2.87)	0.47 (0.67)	-0.99 (0.66)
Toilet location						
(ref: Inside dwelling)						
Inside compound/on plot				-0.20 (1.93)	-1.78** (0.75)	2.97 (1.86)

Elsewhere				-4.48* (2.57)	-2.22 (1.81)	-2.44 (2.54)
Lighting				1.64 (2.24)	1.07*** (0.41)	2.79*** (0.53)
Lockable door						
(ref: Door not lockable)						
Only outside				4.91*** (1.01)	-1.48* (0.84)	4.01 (3.78)
Only inside				6.41*** (1.56)	-1.01 (0.99)	6.29*** (1.38)
Outside and inside				9.31*** (0.80)	0.12 (0.64)	9.42*** (1.34)
Tiling				2.50 (1.53)	2.07*** (0.39)	0.68 (1.25)
Gender separated				3.65 (4.69)	1.70** (0.82)	0.70 (1.36)
Cleaning arrangement				1.25 (0.90)	1.07** (0.43)	1.67*** (0.60)
User relationship						
(ref: Others)						
Only relatives				-4.39 (2.73)	-1.57* (0.92)	-1.09 (4.64)
Close neighbors				0.17 (1.49)	-1.10** (0.54)	6.14*** (1.65)
Age of toilet						
(ref: <1y)						
Age toilet 1-3y				0.65 (0.90)	0.92 (0.92)	-1.52* (0.82)
Age toilet 4-6y				0.53 (1.01)	1.40 (0.98)	-0.61 (0.87)
Age toilet 7-9y				-2.24 (1.52)	2.28** (1.08)	-0.51 (1.09)
Age toilet >10y/Don't know				-0.96 (1.03)	1.17 (0.87)	-1.26* (0.76)
Landlord on plot				-0.51 (0.66)	0.60 (0.56)	-0.01 (0.55)
Bin inside cubicle				-0.51 (10.62)	-0.32 (0.38)	1.11 (1.99)
Constant	87.20*** (1.38)	88.03*** (0.61)	77.47*** (1.53)	82.34*** (3.65)	86.42*** (1.62)	66.52*** (5.13)
Observations	1,229	1,087	1,285	1,229	1,087	1,285
R^2	0.19	0.14	0.10	0.30	0.21	0.22
Adjusted R^2	0.18	0.13	0.09	0.28	0.18	0.20

Residual Std. Error	11.03 (df = 1214)	6.09 (df = 1073)	9.22 (df = 1271)	10.33 (df = 1195)	5.89 (df = 1054)	8.61 (df = 1252)
F Statistic	20.56*** (df = 14; 1214)	13.02*** (df = 13; 1073)	10.51*** (df = 13; 1271)	15.69*** (df = 33; 1195)	8.55*** (df = 32; 1054)	11.25*** (df = 32; 1252)

Note: *p<0.1, **p<0.05, ***p<0.01

Robust standard errors are clustered on the compound/plot level

Supplementary Screeplot of MCA

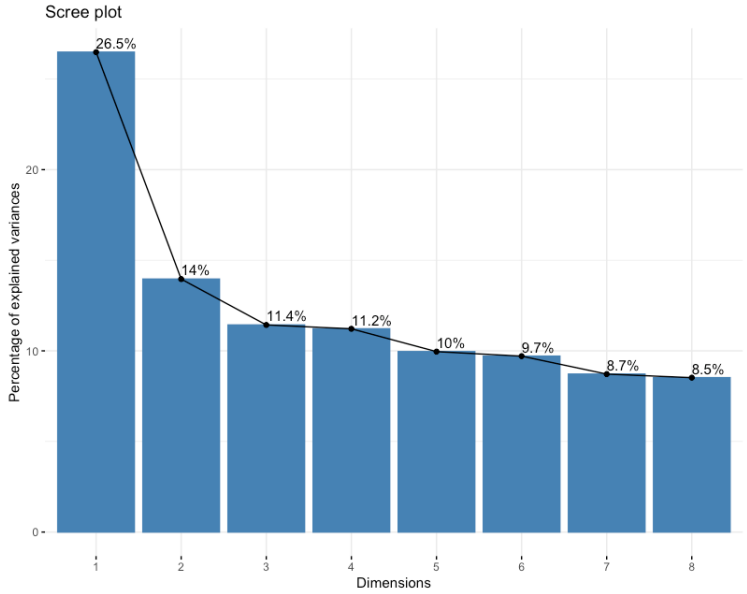


Figure 11: Screeplot explained variances of the MCA

6 Appendix II: Qualitative Findings

The literature review and the GALS meetings served to inductively collect SSF quality determinants. This enabled to set the scene and prepare the FGDs, which allowed separating general user quality concerns from user quality priorities. This section contains the findings from the qualitative phase. The first sub-chapter outlines consolidated findings. Respective data collection and analysis methods as well as detailed findings for the GALS meetings and the FGDs can be found in sub-chapter two and three and in the respective appendices.

6.1 Summary

Based on the GALS meetings, general toilet availability, even if shared, and easy access (*distance*, *location*) are key quality aspects across all three countries. The participants prefer shared sanitation in close proximity to where they live, especially with respect to *usage at night*. An insufficient *toilet-user-ratio* leading to *crowding/queuing* at peak times acts as a barrier to general toilet availability. *Lack of cleanliness* including bad *smell/odour* as well as *presence of insects* are closely related issues and major factors that users relate to poor quality of SSF. Poor *individual behaviour* and on-the-spot *water availability* undermine SSF *cleanliness*. Insufficient or *no toilet cleaning after use*, poor urination practices and *disposal of solid waste in pits* as well as non- or insufficient participation in toilet *cleaning arrangements* result from poor *individual behaviour* and lead to a *lack of cleanliness*. Linked to this, distant or expensive access to water acts as a barrier to *cleanliness* because it impedes easy *toilet cleaning after use* and *toilet cleaning* in general. In all contexts, the participants complained that the *lack of cleanliness* was a source of *quarrels/disputes*, but reported that sharing can have positive aspects as well. All contexts revealed inadequate or inexistent *solid waste managemen*t, which covers *MHM material disposal into pits*, tanks or nearby drains and can result in quickly filling and *clogging containment* and *drainage* systems as well as dysfunctional and clogged *user interfaces*. Solid waste in pits makes users spend more on pit emptying, as pits have to be emptied more frequently. This acts as a driver for manual emptying because the exhausters' hose clogs, which in turn increases the likeliness of (open) waste disposal in close proximity to the users.

While the initial qualitative results from the GALS meetings results contain collected user quality concerns, the FGD analysis strategically focussed on separating general user quality concerns from user quality priorities. According to designated evaluation criteria (see Evaluation, p. 123) and based on their score, we determined nine user quality priorities across three different low-income urban contexts. In descending order, the user priorities are: *immediate water access*, *cleanliness*, *gender-separated toilets*, *flush toilets*, *lighting for use at night*, *lockable/functional doors*, *tiling*, *handwashing stations* and *privacy*.

Overall, *water availability* in close proximity and *cleanliness* were the most emphasised user quality priorities. Across all countries and genders, a close water source was found essential to clean SSF. *Social organisation* among users is of central importance for quality SSF. *Cleaning arrangements* as well as *financial arrangements* are the two key aspects to be socially organised among users. *Cleanliness* is mostly dependent on *individual behaviour*: Either poor user behaviour causes a lack of cleanliness or toilets are clean due to adequate cleaning behaviour, respectively. *Cleanliness* as well as *water availability* are the underlying reasons why *flush WCs* are the preferred user interface: The participants report a *flush WC* to increase convenience, as water is immediately available, therefore increasing *cleanliness* with linked beneficial effects such as decreasing *odour/smell* and *presence of insects*. With respect to user priorities, four *additional technical components* were availability

of (electrical) *lighting*, *lockable/functional door*, *tiling* and *handwashing stations*. The underlying reasons for all three are again *cleanliness*, *privacy* and/or *safety/security*. Users prioritise *handwashing stations* for personal hygiene motives to prevent *health hazards*. Because it reduces *health hazards*, *handwashing station* could be subsumed under either *cleanliness* or *safety/security*. Women prioritised *lighting* and *lockable/functional door* for *privacy* and *safety/security* reasons. Men prioritised *lighting* and *tiling* for *cleanliness* reasons. Lastly, women prefer *gender-separated* for *privacy*, whereas men for *cleanliness* reasons because they complained about visible bloodstains on toilet floors and surroundings. Both motives indicate inadequate menstrual health management (*MHM)* provisions. This includes a lack of or inadequate personal hygiene facilities (*bath/shower*) for women leading to humiliating and unhygienic conditions.

Counterintuitively, *toilet-user ratio*, *waiting time*, *odour/smell* and *presence of insects* do not figure within our evaluated user quality priorities. From the evaluated user quality priorities, *cleanliness* and *privacy* can be considered as dependent or outcome variables. This means, their 'provision' is dependent on different and interdependent factors, i.e. independent variables. *Immediate water access*, *gender-separated toilets*, *flush toilets*, *lighting for use at night*, *lockable/functional doors*, *tiling* and *handwashing stations* are such independent variables. This means, some of them affect *cleanliness*, some affect *privacy* and some, additionally, affect *safety/security*, which is an outcome variable as well. Taking into account the three outcome variables, the remaining seven user quality priorities can be subordinated as dependent variables as follows:

Cleanliness	Water availability in close proximity Flush WC Lighting Tiling Handwashing stations
Privacy	Gender-separated toilet Lockable/functional door
Safety/security	Lighting Lockable/functional door Handwashing stations

From a practical point of view and having in mind the final goal of QUISS, all of them are generally applicable as proxy indicators, i.e. they match the SMART adequacy criteria. The question, if they really are and can be used as a surrogate still needs to be analysed. Including these findings into quantitative data analysis will reveal if they can work as proxy indicators or not.

6.2 Literature Review Summary

This section briefly outlines relevant aspects from the literature review, which informed the overall study design in general and the qualitative study design in particular. The complete literature review can be found in the respective Annex.

Introduction

Preliminary Considerations

We define SSF quality to be dependent on four dimensions to which indicator criteria must refer to. These dimensions shall serve as starting point for this research:

1. Conceptualising quality must be related to user needs and priorities and improving as well as sustaining standards is dependent on user behaviour and must include, therefore, *an individual dimension*.
2. Sustainable O&M is dependent on resources, management schemes and institutional arrangements. Consequently, indicator criteria for quality of SSF *must refer to a structural dimension*. Particularly regarding SSF O&M depends on a community of participants (Sparkman 2012). Therefore, attentions must be directed at *social organisation among users*, i.e. structures and practices in place that ensure cooperation among users for their common pool resource (Ostrom 2008; Tembo 2015; McGranahan & Mitlin 2016; Simiyu *et al.* 2017).
3. Contrary to (Rheinländer *et al.* 2015b), we adopt the position that focus should be on improving hygienic standards *and* toilet designs. Thus, quality evinces an inextricable link to *a technical dimension*.
4. Since we claim that sustaining adequate conditions are closely linked to O&M of facilities, it follows that the term quality is fundamentally including *a temporal dimension*.

We believe, that a research endeavour targeting indicator criteria for quality of SSF must refer to *all* the mentioned dimensions or the venture will inevitably be flawed.

How to measure high-quality?

The first question to be addressed is on what the indicators will have to produce insights. These can be insights on impacts (health-related impacts, e.g. decrease in diarrhoea and related social and economic impacts), outcomes (improved access to sanitation services), outputs (provision of infrastructure and technology), processes (e.g. how toilets are constructed and if and how the process is equitable and inclusive) and/or performance indicators. Data collection always faces the trade-off between (desired) exhaustive data and (limited) resources. When direct measurement is not feasible, 'proxy' indicators may be used. For example, the presence of a latrine (an output indicator) is often taken as a proxy for its use (an outcome indicator). Likewise, the current JMP (proxy) indicator evaluates sanitation service levels based on the technology in use, how ecreta are managed and if toilets are shared.[104] On the one hand, it is now widely acknowledged that a typology based on

[104] Open defecation (unimproved sanitation (which does not separate excreta from human contact), limited sanitation (which does separate excreta from human contact, but is shared by more than one household), basic sanitation (separates excreta from human contact and used by only one household), and safely managed sanitation, which additionally treats or manages human excreta).

technology and construction is of little use when trying to assess coverage, use and sustainability of facilities (Potter *et al.* 2011; Sparkman 2012; Jenkins *et al.* 2014; Mazeau *et al.* 2014; Andersson *et al.* 2016). The JMP approach is being questioned by many authors (Satterthwaite *et al.* 2005; McGranahan 2007; Konradsen *et al.* 2010; Mazeau *et al.* 2013; Buckley & Kallergis 2019). On the other hand, while collecting information on long-term impacts of sanitation interventions (e.g. health, well-being or quality of life impacts) is desirable, it requires a lot of resources.

A related second question is how universally applicable these indicators can be, i.e. whether the type of indicators for global monitoring differs from the type useful to decide if a toilet in a given location can be considered adequate. McGranahan (2013) emphasises that "*[v]ariations in technologies, physical contexts and hygiene practices are such that locally relevant indicators are not necessarily internationally comparable and those that are internationally comparable are not the most locally relevant* ((McGranahan 2013), p. 6). In line with this, Konradsen *et al.* (2010) call for locally-agreed definitions of 'improved' 'adequate' 'basic' sanitation to avoid debates. Low-income settlements in urban areas are completely different from rural contexts. Pit latrines with slabs are likely to pose a serious health hazard in dense urban areas while they can be considered a safe sanitation solution in a scattered village (McGranahan 2013). In such a setting, so-called 'spill-over effects' (Buckley & Kallergis 2019) do not just put those without adequate facilities at risk, but also those who have adequate sanitation facilities. Such an approach would implicate that either the sheer attempt to develop an indicator set would have to be nipped in the bud or an attempt would have to be made to define scenarios detached from facilities or users to which a particular indicator set could be applied.

These two questions necessitate the definition of so-called adequacy criteria for indicators to be applicable and deliver reliable and useful data.

In general, we are targeting the provision of indicators that are applicable and comparable worldwide in large-scale surveys for JMP monitoring purposes informing SDG 6. Thus, non-context specific proxy indicators are the only feasible option. Moreover, to increase the likeliness of their uptake, it is advisable to envisage a categorisation and terminology that is consistent with and accepted by the WHO/Unicef JMP. However, this shall not limit our focus at the scoping stage of our research endeavour.

Adequacy criteria for indicators

An adequacy criterion defines an indicator property. This is a 'necessary' property, which any selected indicator must exhibit. Where an indicator exhibits all the necessary properties defined, the indicator is 'sufficient', i.e. it delivers reliable and useful data. Together, indicators must exhibit five necessary properties to become sufficient. These properties are "Specific, Measureable, Achievable, Relevant and Time bound", in short SMART (cf.Mazeau *et al.* (2014). Significant SSF quality determinants from our qualitative and quantitative analysis must match these adequacy criteria.

Units of Analysis

A research endeavour that wants to identify indicator criteria for SSF must, in a first step, define the object on which the term is to be used ("what is shared"?), and, secondly, try to grasp the characteristics of this term ("what does high-quality mean"?). Only then, the question of which indicators are related with high-quality shared sanitation can be addressed and approached from a solid basis.

Defining the object: What is shared?

Unit of analysis: Users or facilities?

When making assessments, what are used parameters and indicators targeting? Is it the community, the user, the facility, a service provider, the service delivery chain and/or the environment? Finding clear cut-off definitions for differen types of SSF is a challenge, as shared toilets work across a range of physical structures and management models. A shared HH model can be found in community toilet blocks; community toilet models can be found in public places; and public toilet models can be blended with community toilet blocks (Cardone *et al.* 2018). A simple and generalising typology is overlooking that in practice shared toilets vary along multiple dimensions including user group size, user group restrictions, distance from dwelling, ownership, payment model (if any), and operation and maintenance arrangements (Mazeau *et al.* 2013; Mazeau *et al.* 2014). Still, defining the unit of analysis remains a necessity for the definition and application of indicators.

Users: Individuals, HHs, Family-Plots, Compounds, Communities

While the technology in use for SSF is often similar to IHF in low-income settlements, the evident main difference concerns the number of its users and corresponding diffusion of responsibility. This obviously affects coordination such as O&M and payment schemes. But, it also complicates comparability of collected data (cf. (Buckley & Kallergis 2019)). The concept of a HH as well as the number of its members is fluid. A single 'family' can live in several separate buildings, or an extended group of (distant) relatives in a single house ((Mazeau *et al.* 2014). Some tenants (and proprietors) form an extended HH-like community, so called 'compounds'. Yet, compounds remain a vague category, as a compound with six HHs may comprise twelve up to 35 users. Some sanitation solutions are organised on a community level with communal facilities (sometimes called community-based sanitation facilities or communal toilet blocks) and unlike public facilities, are located, owned, managed and used within and by residents of the community A. Mazeau et al., 2013; Simiyu, Swilling, Cairncross, et al., 2017).

Shared sanitation facilities: Distinguishing levels of sharing

Several authors have tried to capture the different characteristics of various (shared) sanitation facilities. Adapted from Norman (2011), Mazeau *et al.* (2014) and Obeng *et al.* (2015) exemplify different strategies based on categories of ownership, operation, management and payment patterns. The bottom line is that compared to IHF, SSF concerns usually a community of participants. Evidence suggests that as the number of users of a toilet increases, the structural quality may increase(Jenkins *et al.* 2014), but cleanliness decreases (Günther *et al.* 2012; Heijnen *et al.* 2014a; Exley *et al.* 2015).

In this sense, depending on categorisation strategies, some SSF can therefore likely rather resemble IHF than SSF if for example categorised based on numbers of users. Depending on the cultural and spatial context, HHs of SSF users can be spatially scattered or organised in e.g. compounds. Consequently, the number of users per SSF can vary considerably. We follow Evans *et al.* (2017) who present a merged approach[105] and focus on

[105] Adapted from Norman (2011) and Mazeau *et al.* (2013), Mazeau *et al.* (2014) distinguish between (a) HH toilets[105], (b) (landlord or neighbour) shared toilet[105], (c) community toilets[105] and (a) public toilets[105]. While somewhat similar, compared to Mazeau *et al.* (2014)) Obeng *et al.* (2015) focuses on ownership and further distinguish 'shared toilets' between (b1) co-tenant shared and (b2) neighbourhood-shared ownership.

users when distinguishing between (a) shared HH toilets[106], (b) compound toilets[107], (c) community toilets[108] and (d) public toilets[109]. Even though the suggested typology offers a convenient basis, there is a need to evaluate the adequacy of the suggested "typology" and suggest a more refined characterisation of these facilities where appropriate.

What does high-quality mean?

Previous studies that were concerned with SSF quality and sustainability determinants usually focused on drivers that foster and barriers that prevent or hamper e.g. cleanliness and sustained functionality. As above, the question is what is determined as the object and what the subject. This is, the question to ask is not only to ask "what does high-quality mean?", but also "what does high-quality mean to whom?" (= the prerogative of interpretation). To answer this, one must first define the subject that asks this question and to which object this question refers to. With this in mind, it becomes evident that this question is profoundly normatively.

Defining the subject: What does high-quality mean to whom?

Scholars widely agree that putting individuals at the centre is essential when assessing sanitation impacts (Mazeau & Reed 2010; Mitlin 2011; Mazeau *et al.* 2014; Scott *et al.* 2017). It is interesting and instructive to look at what researchers are focusing on because it allows critically interpreting results and suggested solutions, which often reproduce applied perspectives. Depending on the researcher's background, their scientific focus and approach, causes and solutions are usually found in the respective domain: Political ecology and geography representatives find political and spatial issues with effects on economic opportunities, psychology focuses on individual behaviours ultimately addressing behaviour change, social sciences focus on institutional and political challenges, engineers on infrastructure, economists on financial resources and education and so on. While e.g. the quality of the excreta containment is in the limelight of environmental engineers and public health officials, users may have different priorities such as access, cleanliness or convenience (Jenkins & Sugden 2006; Mazeau & Reed 2010; McGranahan 2013).

It becomes evident that scholars focus on somewhat different aspects than a typical user would. This does not mean that one of these perspectives is truer or more meaningful. Individual perspectives are often limited to their personal reality, while scholars can be able to take on a more uninvolved perspective. Apart from academics, it is thus essential to include user priorities to get a proper picture of what adequate sanitation is about, as these are at the crossroad of the different dimensions of sustainability (Mazeau & Reed 2010).

Based on this, our research design starts with a user-centred approach, i.e. collect user priorities via a literature review as well as qualitative field data collection, which will be used to design an evidence-based quantitative survey.

[106] Toilet in one HH also used by other HHs.
[107] Toilets used only by the people living in a particular compound.
[108] Non-HH toilets used by a restricted group of HHs.
[109] Toilets open to anybody.

Quality Determinants

Because SDG6 seeks to realise the human rights (HR) to water, sanitation and hygiene of all, and because we ultimately seek to contribute to the development of quality indicators of SSF to monitor progress within SDG6, we depart from a rights-based approach in conceptualising quality determinants of SSF. In this respect, the report of the Special Rapporteur on the HR to safe drinking water and sanitation provides a HR framework (Héller 2015). It describes the relevant HR standards and principles that serve to assess different levels and types of WASH services. Overall, it defines five normative dimensions. These are *availability*, *accessibility*, *quality and safety*, *affordability*, and *acceptability*. Our approach departs from the same normative foundation. However, while we see the reason for their use within the HR framework, we deem the dimensions *quality* and *acceptability* to be unsuitable to describe SSF quality features just because we attempt to distinguish features determining 'acceptable quality'. Thus, we separated the HR dimensions into three determinants, namely *availability & accessibility*, *safety/security & privacy* as well as *O&M & cleanliness*. Within the literature review, each determinant is elaborated on in a separate sub-chapter. Each sub-chapter refers to relevant study findings and possible indicator options. Whenever appropriate, acceptability factors and references to affordability were covered within these three sub-chapters. Regarding *quality and safety*, the HR framework refers to facilities that are 'hygienically safe to use'. This is strongly dependent on adequate (minimal) technical requirements (e.g. improved toilet technology, handwashing facilities) as well as cleanliness. While the latter is already covered in a separate category, minimal technical requirements are covered subsequently to this introduction.

Conceptualising SSF Quality Determinants

At the very beginning, we defined four quality *dimensions* to which SSF quality determinant must refer to (see Preliminary Considerations, p. 103). These are:

(a) Individual dimension
(b) Structural dimension
(c) Technical dimension
(d) Temporal dimension

In addition, based on a literature review we collected user priorities and minimal technical requirements, and, inspired by the HR framework, defined three determinants that are essential to SSF quality. These are:

(1) Availability & accessibility,
(2) Safety/security & privacy and
(3) O&M and cleanliness.

Our understanding is this: Quality categories can be understood as conditions a SSF must exhibit in order for users to perceive them as being of good/bad quality. The dimensions, in turn, are prerequisites for these categories. For example, users expect SSF to be clean. Maintaining clean conditions over time is dependent on adequate individual behaviour as well as social organisation among users (e.g. cleaning rota), and require technical components such as cleaning equipment. Cleanliness is then what we identified as a user quality concern and used as quality category. Individual behaviour, social organisation and technical components is needed to maintain good quality over time. Thus, individual behaviour, social organisation, technical components and temporal continuance is what we used as dimensions. Each quality category is dependent on at least one dimension but most require their successful interplay.

On one hand, we departed from a HR based approach (Héller 2015; Giné-Garriga *et al.* 2017). As a starting point to conceptualise and categorise SSF quality determinants, we took official JMP and WHO/UNICEF WASH monitoring documents and guidelines (WHO 2016, 2018c, a, b, 2019b, a) as a basis. JMP currently categorises sanitation quality using a ladder with five levels[110] and has developed separate indicators for HH and institutional settings with recently updated indicators to monitor WASH in HCF (WHO 2016, 2018a). This is instructive because SSF exhibit private as well as institutional characteristics: While only a defined user group uses them, their O&M relies on social organisation among users, which relationships are different compared to individual HHs. On the other hand, we identified four scientific papers from SSF research on quality determinants that provide useful inputs to those existing official documents (Mazeau *et al.* 2013; Simiyu *et al.* 2017; Chipungu *et al.* 2018; Tidwell *et al.* 2018). While structured differently, the quality factors from (Mazeau *et al.* 2013) are almost identical with the ones from (WHO 2018c) outlined above ((Mazeau *et al.* 2013) subsumes 'Quality' under 'Acceptability' [111]. Organised along four components, (Tidwell *et al.* 2018) developed the Peri-Urban Healthy Toilet Index' (PUHTI) for SSF, which is a framework to assess toilet quality based on four components, which are 'Hygienic', 'Desirable', 'Accessible' and 'Sustainable'.[112] (Tidwell *et al.* 2018) refer to the temporal dimension with their sustainability component inter alia on O&M and cleanliness (cleaning system in place). This is consistent with the JMP indicator on environmental cleaning in HCF and refers to social organisation among users. This in turn refers to CPR principles (Ostrom 1990, 1996, 2002, 2008; Ostrom & Ahn 2009; Wilson *et al.* 2013), which (Simiyu *et al.* 2017) as well as (Chipungu *et al.* 2018) focus on. They retrieve eight ((Simiyu *et al.* 2017) only seven) indicators from the CPR principles to evaluate SSF O&M by a community of participants. In doing so, they offer a more detailed evaluation framework to assess social organisation of SSF, which is essential to sustainability. Lastly, because in the context of SSF safety/security and privacy deserve special consideration particularly regarding gender and age-related issues, (Hueso *et al.* 2018) is consulted to complement these.

[110] Open defecation (unimproved sanitation (which doesn't separate excreta from human contact), limited sanitation (which does separate excreta from human contact, but is shared by more than one household), basic sanitation (separates excreta from human contact and used by only one household), and safely managed sanitation, which additionally treats or manages human excreta).
[111] Availability (Number of users per toilet seat; Nature of toilet providers); Accessibility (Physical accessibility; Social Accessibility); Affordability (Forms of payment; Price for toilet use); Acceptability (Cleanliness; Other determinants (safety, privacy, etc.).
[112] Hygienic (Concrete or other acceptable slab; Tile floor; No cracks in slab where water can leak; Handwashing place present; Soap present for handwashing; Rota functions well; Cleaning products used); Desirable (Door present and lockable from inside; No holes in walls; Odour-reduction technology present; No holes in roof); Accessible (Door present and lockable from outside; Can open door/access toilet; No one excluded by disability on plot); Sustainable (Accessible to mechanized emptying; Pit lined; Bin for solid waste).

Possible SSF quality indicators

Category	Item	Determinant	Indicator	Description	Reference
Availability & Accessibility	Water	Type	Improved/un-improved	Improved: Piped into dwelling/compound/yard/plot/neighbour, public tap/standpipe, bore-hole/tubewell, protected well/spring, rainwater collected (safely stored), tanker-truck, cart with small tank/drum, water kiosk, bottled/sachet water Unimproved: Unprotected well/spring, surface water (WHO 2018b).	(WHO 2018b)
		Distance	Distance	On premises, <500m, >500m	(WHO 2018a)
		Availability	Availability	Yes/no	(WHO 2018a)
	Sanita-tion	Type	Improved/un-improved	Improved: Flush/pour-flush toilet, Flush to piped sewer system/septic tank/pit latrine,(Twin) Pit latrine with slab, Composting toilet, Container based sanitation (collected & treated), Flush/pour flush to don't know where Unimproved: Flush/pour flush to open drain, Pit latrine without slab/open pit, Bucket, Hanging toilet/latrine, No facility/bush/field (WHO 2018b).	(WHO 2018b)
		Availability	Unlocked/key available	Doors are unlocked or with a key available at all times (24/7)	(WHO 2018a)
			Toilet-user Ratio	<5 families or 30 persons, whichever is fewer, and if the users know each other (WHO 2013) 1:20 persons (Association 2018) (Emergency settings) <1:5 HHs (Günther *et al.* 2012; Kwiringira *et al.* 2014a) Max. 3 HHs and 20 people per seat (WSUP 2018)	(Günther *et al.* 2012; UNICEF 2013; WHO 2013; Kwiringira *et al.* 2014a) (WSUP 2018)
			Waiting time	<5 minutes (Hutton & Whittington 2015)	(Hutton & Whittington 2015)
			Limited Mo-bility	Accessible without stairs or steps, have handrails for support attached either to the floor or sidewalls, a door which is at least 80 cm wide, and the door handle and seat within reach of people using wheelchairs or crutches/sticks (WHO 2018a) (In the absence of relevant national or local standards) Anyone living on plot unable to access toilet due to disability (Tidwell *et al.* 2018)	(Tidwell *et al.* 2018; WHO 2018a)
			Functional	To be functional, the hole or pit is not blocked (WHO 2018a) Toilet not full (Tidwell *et al.* 2018)	(Tidwell *et al.* 2018; WHO 2018a)

				Water is available for flush/pour flush toilets (WHO 2018a)	
				No cracks or leaks in the toilet structure (WHO 2018a)	
		Accessibility	Distance	'On premises' (WHO 2018a) <20m (WSUP 2018) <30m (Norman 2011) <50m (Association 2018) <75m* (Hueso *et al.* 2018)[113]	(Norman 2011; Association 2018; Hueso *et al.* 2018; WHO 2018a; WSUP 2018)
Safety, Security & Privacy	Safety	Handwashing	Availability	Yes/no	(Giné-Garriga *et al.* 2017; Association 2018; Hueso *et al.* 2018; Tidwell *et al.* 2018; WHO 2018a, c)
			Functional	Soap yes/no Water yes/no	
			Distance	<5m	(WHO 2018a)
		Structure / Boundary conditions	Solid roof	The toilet superstructure needs to prevent the intrusion of rainwater, stormwater runoff, animals and insects.	(WHO 2018c)
			Solid sub-structure	Concrete blocks used (Tidwell *et al.* 2018) Lined pit (Giné-Garriga *et al.* 2017)	(Giné-Garriga *et al.* 2017; Tidwell *et al.* 2018)
			Solid door	(Tidwell *et al.* 2018)	(Tidwell *et al.* 2018)
	Security		Inside lock	To be considered ~~private~~ *[secure]*, the toilet stall has doors that can be locked from the inside ~~and there are no large gaps or holes in the structure~~ (WHO 2018a).	(Simiyu *et al.* 2017; Chipungu *et al.* 2018; Tidwell *et al.* 2018; WHO 2018a)
			Outside lock	Outside lock to exclude outsiders	(Simiyu *et al.* 2017; Chipungu *et al.* 2018; Tidwell *et al.* 2018)
		Use at night	Inside Lighting	Internal lighting is bright enough to illuminate entrances, exits, wash areas, cubicles and publicly accessible areas	(Hueso *et al.* 2018)
			Outside Lighting	Entrances, exits, walkways, paths and open areas used to access the toilet are well lit with natural light or bright enough lighting	

[113] * Distance depends on the type of SSF, local standards, needs and available resources and may range from 75m or 1.5 minutes' walking distance (South Africa) over to 200–350m (India). For public toilets, distances may increase up to 1 km (India) (Hueso *et al.* 2018).

	Privacy	Structure / Boundary conditions	Solid wall	There are no large gaps or holes in the structure (WHO 2018a) ~~have closable doors that lock from the inside, and~~ No holes, cracks, windows or low walls that would permit others to see in (WHO 2016)	(WHO 2016; Tidwell *et al.* 2018; WHO 2018a)
		Gender-separated toilets	Availability	~~Toilets can be in a room with multiple stalls or in a private room with a single toilet.~~ Toilets in rooms with multiple stalls should all be dedicated for use by either women or men. ~~A gender-neutral room with a single toilet is also considered as sex-separated, as it allows women and men to use toilets separately~~ (WHO 2018a).	(Hueso *et al.* 2018; WHO 2018a)
			Ratio	1:25 (girls), 1:50 (boys), 1 urinal for 25 boys (UNICEF 2013) (If no country specific pupil-toilet ratio available) 1:50 (South Africa); 1:25 (women), 1:35 (men) (India) (Hueso *et al.* 2018)	(UNICEF 2013; Hueso *et al.* 2018)
		MHM	Hygiene: Water and soap available in a private space for washing.	Water and soap available in a private space for washing (WHO 2018a) Water access (either through a tap or bucket storage) inside the cubicle, both for increased privacy for managing menstruation and for those experiencing incontinence or other illnesses such as diarrhoea or sickness. (Hueso *et al.* 2018) Access to water and soap for washing, ideally within the toilet stall or a dedicated stall, but at least inside the toilet block. Necessary for washing menstrual materials or the body. (Hueso *et al.* 2018)	(Giné-Garriga *et al.* 2017; Hueso *et al.* 2018; WHO 2018a)
			Waste: Bin with lid inside toilet	Bin with a lid on it for disposal of used menstrual hygiene products (WHO 2018a) Safe and culturally appropriate disposal options for menstrual materials inside the cubicle (for privacy) if possible, otherwise inside the female toilet block. Washable bins with a lid for temporary storage of used sanitary materials are a good option. (Hueso *et al.* 2018)	(Hueso *et al.* 2018; WHO 2018a)
O&M and cleanliness	Cleanliness	Visible cleanliness	Faecal matter/body substances/blood	Presence of faecal matter, blood or body substances that could pose a human health risk	(WHO 2016; Giné-Garriga *et al.* 2017; Tidwell *et al.* 2018)
			Flies/insects	Presence of flies, mosquitoes on the floor, walls, seat (or pan) or around the structure	
			Trash/dirt	Presence of trash or dirt on the floor, walls, seat (or pan) or around the structure	
			Smell/odour	Presence/absence of (strong) smell	

	Clean-ing	Cleaning system in place (Congruence: Pres-ence (or absence) of management rules/ structures)	Duty Rota	A cleaning roster or schedule specifying the frequency… (WHO 2018a)	(Simiyu *et al.* 2017; Chipungu *et al.* 2018; Tidwell *et al.* 2018; WHO 2018a, c)
			Responsibili-ties	…at which cleaning tasks should be performed (WHO 2018a)	
	Social Organi-sation	O&M (Collective-Choice Arrangements)	Monitoring of SSF		(Simiyu *et al.* 2017; Chipungu *et al.* 2018; Hueso *et al.* 2018)
			Conflict and its resolution		(Simiyu *et al.* 2017; Chipungu *et al.* 2018)
			Graduated Sanctions		(Simiyu *et al.* 2017; Chipungu *et al.* 2018)
			Collective de-cision-mak-ing.	Meetings held in compound, and all members required to attend	(Simiyu *et al.* 2017; Chipungu *et al.* 2018)
	Empty-ing	Emptying Service availability (Nested Enterprises)	Reliability	Reliable, Unreliable, No Service	(Potter *et al.* 2011; Chipungu *et al.* 2018)
?	?	Affordability		Affordable do not prevent anyone from using the toilets. Fees are fair for women and girls, if use of men's urinals is free, women's fees for urination should be waived too. Maintenance arrangements and costs are factored into the long-term planning of the costs of any new or existing toilet facility (i.e lifecycle costs). (Hueso *et al.* 2018) Sanitation service is affordable, without limiting the capacity to acquire other basic goods and services guaranteed by other human rights. (Giné-Garriga *et al.* 2017)	(Giné-Garriga *et al.* 2017; Hueso *et al.* 2018)

6.3 GALS Meeting Summary

This section contains the findings of the GALS meetings conducted in all target countries. The QUISS study was carried out in low-income settlements of Kumasi (Ghana), Kisumu (Kenya) and Dhaka (Bangladesh).

More detailed information on sampling and the respective specific areas/neighbourhoods where each GALS meeting was conducted can be found in the separate country reports.[114]

Data Collection

Method

The "Gender Action Learning System" (GALS) is a FGD method, a technique from the participatory rural appraisal repertoire, originally used for gender justice in relation to livelihood improvement (Mayoux 2012). It bases upon gender separated FGDs, complemented by writing or drawing, and gender mixed presentations and plenary discussions. Two core elements from GALS are applied: The "Gender diamond" and the "Tree of diamond dreams".

Sampling

Sample criteria

The following criteria guided the selection of eligible participants:

- Users of shared sanitation facilities dwelling in a compound/plot/homestead, sharing this facility with other people from the same compound/plot/homestead
- GALS participants must not be from the same compound/plot/homestead
- Individuals who were willing to participate in the meeting
- (approximate) 50-50 distribution of male and female individuals

Sample size

The aim was to have one GALS meeting in two settlements of the respective city with each meeting having 30-50 participants.

[114] See QUISS Final Report Qualitative Appendices, Appendix III: GALS Meetings.

Data Analysis

On the one hand, data analysis was based on the two outputs, i.e. the gender diamond and the tree of diamond dreams. On the other hand, the discussions taking place in session one and two as well as the plenary sessions were audio recorded. The country respective research teams compiled GALS meetings reports that can be found in the Annex.[115] They were generally organised as follows:

1. Comparison of issues between men & women in Community #1: Similarities and Differences
2. Comparison of issues between men & women in Community #2: Similarities and Differences
3. Comparison of issues between men & women between communities #1 and #2
   a. Similarities and Differences between males and females
   b. Similarities and Differences between communities #1 and #2
4. Conclusion

Results

This section contains a global summary of the findings from the six GALS meetings in three contexts. In the following, country specific sections discuss key priority issues, identified causes and suggested solutions and closes with a conclusion.

Overall Results

On a global level, general toilet availability, even if shared, and easy access (distance, location) have proven to be key quality aspects across all three countries. The participants preferred a shared sanitation that is in close proximity to where they live, especially with respect to the use at night. Even though not consistently, insufficient *toilet-user-ratio* leading to crowding/queuing at peak times was repeatedly mentioned and act as a barrier to general toilet availability. Dirty toilets including bad smell/odour as well as presence of insects are closely related issues and were major factors that users related to poor quality of SSF. At an abstract level, poor user behaviour and on-the-spot availability of water are challenging the quality of SSF. Insufficient or no cleaning after use, poor urination practices and disposal of solid waste in pits as well as non- or insufficient participation in toilet cleaning activities are results from poor user behaviour and lead to dirty toilets. Linked to this, distant or expensive access to water was often mentioned to act as a barrier to clean toilets, as it impedes easy cleaning after use and toilet cleaning in general. In all contexts, the participants disliked that the lack of cleanliness of shared facilities is a source of quarrels and disputes among the users but reported sharing to have positive aspects as well. All settings revealed inadequate or inexistent solid waste management, which in the sanitation context was related inter alia to MHM materials being disposed into pits, tanks or nearby drains resulting in quickly filled containment systems and clogged drains as well as dysfunctional and clogged user interfaces and drains. This has important consequences as it leads to additional challenges to the users. Solid waste in pits makes users spend more on pit emptying, as pits have to be emptied more often. This acts as a driver for manual emptying because the exhausters' hose clogs, which in turn increases the likeliness of (open) waste disposal in close proximity to the users.

[115] See QUISS Final Report Qualitative Appendices, Appendix III: GALS Meetings.

In Ghana and Kenya, the participants found a lack of cooperation among users (= collective action) together with a lack of cooperation between the users and public authorities/proprietors/service providers (= co-production) to be responsible for existing challenges and issues. Compared to this, in Bangladesh, the participants expressed a feeling of negligence and expected a higher level of support and service provision from proprietors and public authorities as well as indicated affordability issues as main causes.

Table 1 contains a summary of the five priority issues from a user perspective in the respective target countries and areas. The numbers in parenthesis indicate the total votes per issue.

	Ghana		Kenya		Bangladesh	
	#1 Fante New Town	#2 Moshie Zongo	#3 Manyatta	#4 Nyalenda	#5 Bhasanthek	#6 Adamtek
#1	Broken down flush handle and/or no water for flushing (39)	Presence of insects (17)	Risk of getting diseases	Spread of diseases (33)	Drainage problems (29)	Sewerage line (23)
#2	Smell /bad odour (17)	Smell/bad odour (17)	Dirty toilets	Disposal of everything	Presence of insects/ worms (20)	Stool remains stuck (30)
#3	Dirty toilets (13)	Wet floor/urine (15)	High water table	Dirty	Queuing/waiting times (14)	Unclean (28)
#4	Urine on the toilet floor and/or wet floor (11)	Crowding/queueing (7)	Misuse of toilets	Always in use/ queuing	Odour/Smell(15)	Water/water tap not available (13)
#5	Blood stains (8)	Used Menstrual Health Management pads (7)	Open disposal of faecal waste	Gets filled up quickly	Problems during menstruation (12)	No/ broken doors (15)

Table 19 : Summary of five priority issues from a user perspective in the respective target countries and area

Country specific results

Ghana

In Ghana, over 80 male and female community residents who use SSF participated in the two GALS meetings. In both communities, discussions revealed water availability and easy toilet accessibility to be key quality factors. Other priority issues included bad odour/smell, wet floors, urine on the floor and poor MHM depicted by bloodstains and exposed used MHM materials, indicating a lack of cleanliness and solid waste management options. Both communities report a lack of adequate MHM facilities coupled with inadequate user behaviour. In Fante New Town, bloodstains on the floor (lack of adequate body washing options) were reported, whilst in Moshie Zongo it was the disposal of used pads into the pits. It is assumed that some of the differences between the remaining priority issues are due to different predominant user interfaces that are in use. Fante New Town has mostly WC or water-based systems, while dry systems are dominant in Moshie Zongo. With respect to this, challenges with flushing and unavailability of water were reported in Fante New Town, whereas in Moshie Zongo presence of insects.

With respect to problem identification of current challenges: In both communities the identified causes for wet floor and urine were poor user behaviour, especially poorly directing urine into the pit/toilet bowl when urinating. For smell/bad odour infrequent cleaning was identified to be the main cause, indicating either a lack of social organisation or – if existent but not followed – individual compliance with existing rules. Additional reasons were again related to the technology in use as the users in Moshie Zongo relate bad smell/odour to disposal of wastewater, solid waste as well as other foreign materials into the pit, leading to quickly filled pits. Further, they found dysfunctional pits (cracks) and vent pipes as contributing factors to smell/bad odour. For Fante New town, the associated causes included toilet paper being left in the disposal basket overnight, uncovered toilet paper baskets, as well as irregular or improper toilet cleaning.

With respect to suggested solutions of problems identified: User education on how to urinate properly was a common solution in both communities. Because in Moshie Zongo the people are washers, separate disposal of anal cleansing water was suggested. In Fante New Town on the other hand regular monitoring and inspection from local government authorities to improve cleanliness was suggested. For bad odour/smell the suggested solutions in both communities were frequent cleaning and cleaning after use, therefore referring to improving individual behaviour and social organisation among users. For MHM, both communities suggested user education and proper disposal options (bins).

Conclusion: Overall, many challenges faced are based on poor user behaviour, practices and attitudes towards toilet use and a lack of O&M such as basic routine cleaning practices and a lack of maintenance culture, partly expected to be caused by a lack of water. Thus, the suggested solutions encompass improving user behaviour, attitude and practices, i.e. offering user education on general hygiene practices including MHM. Further, O&M related improvements such as basic but effective toilet cleaning practices and ensuring that repairs and maintenance are undertaken as required, which includes assigning roles and responsibilities. To this end, participants believed strongly that the solutions only work if all users showed commitment and ardent effort to work through together, therefore indicating improving collective action among users. In addition, improving co-production such as involving local or city authorities by ensuring sanitary hygienic conditions through routine monitoring and supervision. Lastly, differences and similarities on the findings from the two communities suggest that toilet technology type plays a key role and should therefore be considered when identifying indicators for assessing quality of shared sanitation.

Kenya

In Kenya, a total of 66 males and females participated in both meetings. Toilet availability is generally acknowledged to prevent open defecation, but reported to be insufficient due to several reasons. Clean toilets in a plot, even if shared, are expected to lead to cleaner environments and were mentioned to be a source of attraction for tenants. Both communities rated health hazards emanating from poor sanitation facilities as the most pressing issue, which is only indirectly a quality feature as it is rather a cumulative effect of existing poor conditions. Unsurprisingly, other priority issues listed were contributing causes such as dirty toilets and quickly filled pits due to disposal of solid waste ("disposal of everything") and poor planning ("quickly filled pits/site selection"; "high water table"), indicating a lack of cleanliness and (solid) waste management options. Further, insufficient number of available toilets and a lack of water availability were reported as contributors. Other quality factors mentioned included absence of bad odour/smell, absence of insects/flies and lack of privacy, as dysfunctional superstructures such as leaking roofs, walls with holes and broken door locks have been reported to impede privacy.

With respect to problem identification of current challenges: Identified impeding factors to toilet availability are numbers of available facilities, poor user behaviour ("misuse") and a lack of social organisation leading to dysfunctional and/or dirty toilets. While social organisation among users is seen as partly emanating from a lack of collective action among users, it is also perceived as a lack of support from proprietors and public authorities. Quickly filled pits were partly related to environmental-physical conditions ("high groundwater") and to a lack of adequate services on a social organisation level leading to open disposal of faecal waste and disposal of solid waste into pits, altogether generating public health hazards. Because MHM materials are often dropped into pits as discussions revealed, this again refers to a lack of disposal options for used MHM materials.

With respect to suggested solutions of problems identified: To reduce health hazards and increase cleanliness, improving cleaning cooperation, practices and equipment as well as user education and provision of handwashing facilities were suggested in both communities. The discussions also revealed that community members need to be sensitised about the importance of proper disposal of solid waste. Further, environmental-physical factors that demand good planning shift the responsibility to proprietors and/or public authorities. The participants in Manyatta were concerned about the high water table that contributed to the fast fill up of pit latrines, whereas in Nyalenda, participants proposed identifying proper locations to construct pit latrines. This solution also speaks to the same concern of a high water table. Overall, both communities showed preference for a sewer system, an indication of what they would consider as a better form of sanitation.

Conclusion: Health hazards from poor conditions ranked highest in both communities. This shows firstly that the current sanitary conditions must be poor and the suggested solutions show secondly that the people are aware of the negative effects for personal health as well as of certain measures can produce relief. Overall, the conclusion is almost identical to the one for Ghana. Many challenges faced are based on poor user behaviour as well as a lack of regular and regulated O&M, partly due to a lack of social organisation and availability of water. Thus, the participants suggested solutions that encompass improvements on the individual level such as improving user behaviour, attitude and practices and on a social organisation level, i.e. O&M related improvements relying on collective action, as the participants mentioned the importance and benefits of cooperation among users. The participants acknowledged that clean toilets are a user responsibility, i.e. they have to organise themselves. On the other hand, they expect support from proprietors and public authorities. Proprietors are expected to provide more toilets constructed with quality material. Additionally, people are experiencing negligence from public authorities and expect them to provide support for example via monitoring cleanliness and improve planning ("high water table") to provide better conveyance and disposal solutions for

faecal waste as well as for solid waste. In this sense, similar to Ghana, the meetings in Kenya reveal that participants see the need to improve collective action but expect some sort of co-production to take place as well.

Bangladesh

In Bangladesh, a total of 95 male and female participants attended the GALS meetings. Both communities positively attributed shared toilets to lower costs and cleaning duties for HHs. General toilet availability was reported to be of major importance but insufficient. Again, water availability was a major issue as well and linked to affordability. The meetings revealed that at the top of listed challenges were drainage problems. Based on discussions with public health experts from icddr,b and environmental engineers from ITN-BUET and field observations, in the low-income settlements of Dhaka, if the outlet of e.g. a septic tank is connected to some sort of conveyance system, it is usually an open drain or – in some cases – a covered drain/pipe/canal, which usually leads into an open water body. This claim is supported by a recent SFD report from 2016.[116] In many cases, the drainage canal is dysfunctional (clogging) due to solids (sand, soil) and solid waste, therefore frequently overflowing especially during rainy seasons. Other key priority issues are referring to cleanliness issues with several underlying causes ("unclean"; "stool remains stuck"; presence of insects/worms"; "bad odour/smell"). Additionally, privacy was another key priority, although in different contexts ("problems during menstruation"; "no/broken doors").

With respect to problem identification of current challenges: Insufficient toilet availability was on the one hand attributed to insufficient toilet-user-ratio and affordability issues, on the other hand to dysfunctional toilets and missing maintenance altogether leading to queuing especially at peak times. Insufficient water availability is partly based on accessibility but on affordability issues as well. It acts as driver for dirty toilets, as people do not carry enough water to flush ("stool remains stuck"), which increases bad/smell odour. Inadequate and broken technical components ("drainage problems"; "sewerage line"), i.e. thin/broken pipes as well as accumulating solid wastes were reported as the main causes for drainage systems to clog, which in turn is based on a lack of maintenance by public authorities. This leads to a number of consequential challenges that link to cleanliness issues. Because there is no way out for the faeces, stool remains stuck creating inconvenient odours that attracts insects and worms and creates health hazards. Unclean sanitation facilities were seen as reason for children to fall sick and created a feeling of repulsion to use the toilets, which was reinforced by too many users and queuing. While dysfunctional conveyance options were partly assigned to missing cleaning by public authorities, they were as well assigned to poor user behaviour. Especially the disposal of sanitary pads into pits was mentioned as contributing reason to clogged and quickly filled pits. This shows close links to privacy. On the one hand, the men acknowledged that missing disposal options for used MHM materials produce uncomfortable and embarrassing situations for women. Additionally, privacy is linked to MHM challenges coupled with numbers of available toilets, as the women reported to feel uneasy as toilets are not gender separated especially during menstruation when men are queuing outside. On the other hand, privacy was related to broken doors as these impair user privacy, whereas missing maintenance/repair work and a lack of financial means found to be the reasons. However, according to the participants, repair work is the obligation of proprietors rather than tenants.

With respect to suggested solutions of problems identified: Apart from simply constructing more toilets, whereas the participants were aware of the space constraints, improved maintenance/repair of toilets could increase toilet availability as well, whereas tenants feel this to be the responsibility of the proprietors. To tackle

[116] Furlong, C. (2016). SFD Report - Dhaka, Bangladesh - SFD Promotion Initiative. Water, Engineering and Development Centre (WEDC). URL: https://www.susana.org/_resources/documents/default/3-2609-7-1470298292.pdf

the problem of water availability, the users suggested water provision for consistent water supply inside the latrines, but simultaneously mentioned that their monthly water bill already is too high. Like for toilet availability and maintenance/repair work, water provision was seen to be the responsibility of the proprietors or public authorities. To tackle drainage/sewer problems, the participants of both communities perceived this as a failure of public authorities and expressed a feeling of negligence. Regular cleaning of drainage canals, construction of thicker connection pipes and establishing a direct connection to the main (drainage) lines were suggested solutions. Concerning maintenance/repair works, the tenants suggested that public authorities fix laws or policies that standardise construction of houses and which could help them to advocate their concerns.

Conclusion: With respect to current challenges, drainage problems ranked highest in both communities. Whereas failures from public authorities were indicated as main reasons and a feeling of negligence expressed, poor user behaviour was acknowledged to contribute as well. In this sense, dysfunctionality of conveyance systems and clogging was seen as having institutional (missing actions from public authorities), physical-environmental (sand/soil) and individual (solid waste disposal) reasons. Water availability coupled with affordability was reported to act as a barrier to clean toilets, as it impedes easy cleaning after use and toilet cleaning in general. Affordability issues in general were more prominent compared to Ghana and Kenya. Inadequate cleanliness of facilities was partly assigned to inadequate individual cleaning behaviour after use but to missing resources (water, money) and equipment (soap, water vessels) for cleaning and self-cleaning as well. Unclean sanitation facilities were seen as reason for children to fall sick and created a feeling of repulsion to use the toilets, which was reinforced by too many users and queuing. Overall, the matter of insufficient regular and regulated O&M of toilets and drainage canals, a lack of adequate construction materials as well insufficient and expensive water provision were less attributed to a lack of social organisation among users but rather to a lack of support or service provision from proprietors and public authorities. In this sense, compared to Ghana and Kenya, the participants suggested less collective action measures but expect more co-production to happen, therefore identifying a lack of institutional support.

6.4 Focus Group Discussion Summary

This section contains an outline of the methodology and preliminary findings of the FGDs conducted in all target countries. The specific areas/neighbourhoods where each FGD meeting was conducted can be found in the separate country reports in the Annex.

Data Collection

Method

Data was collected using FGD according to Morgan and Krueger (1998). The FGD guideline was compiled based on draft findings from an extensive literature review and complemented with the findings from the preceding GALS meeting in each country respectively. Because the GALS meetings and the FGDs were staggered by countries, for comparison purposes, only minor things were added and nothing removed from the generic guideline. The generic FGD guideline can be found in the Annex.[117] Based on Morgan and Krueger (1998), the FGD guideline started with a general introduction, followed by a transition (likes & dislikes of current sanitation facility) and consisted of three key topics, namely "User Priorities", "Organisation of O&M" and "Menstrual Health Management", and closed with ending and final questions.

Sampling

We defined three sample criteria for FGD participants:

- Users living in low-income urban settlements
- Users of SSF in compounds
- Participants must be from different compounds

We conducted five FGDs in Ghana and six FGDs in Kenya and Bangladesh each. Overall, 17 FGDs were conducted, of which eight were women-only, five were mixed and four were men-only. The composition was as follows:

- Ghana: 2 women-only, 2 mixed, 1 men-only
- Kenya: 3 women-only, 1 mixed, 2 men-only
- Bangladesh: 3 women-only, 2 mixed, 1 men-only

Data analysis

Audio recordings of the FGDs were translated to English and transcribed. Data was analysed, applying directed and inductive content analysis according to (Mayring 2015) using Atlas.ti 8 software (Friese 2019). Directed content analysis requires a predefined set of categories for coding, i.e. labelling statements capturing a certain

[117] See QUISS Final Report Qualitative Appendices, Appendix IV: Focus Group Discussions.

theme with a descriptive code. This allows for validation and comparison with previous topic-related research findings. In inductive content analysis, first, narrow codes representing the statement's content are assigned and through refinement, themes are inductively captured and subsumed under existing or newly emerging categories. This allows for the gaining of direct information from the data.

Based on a literature review[118], for the directed content analysis, we collated a list of existing user quality concerns, which we used as categories[119]. Aside from these quality categories, we defined four dimensions. These dimensions are:

- Individual behaviour
- Social organisation
- Technical components
- Temporal continuance

To illustrate their relationship: quality categories can be understood as conditions a SSF must exhibit in order for users to perceive them as being of good/bad quality. The dimensions, in turn, are prerequisites for these categories. For example, users expect SSF to be clean. Maintaining clean conditions over time is dependent on adequate individual behaviour, as well as social organisation among users (e.g. cleaning rota), and require technical components, such as cleaning equipment. Cleanliness was identified as a user quality concern and used as a quality category. Individual behaviour, social organisation and technical components are needed to maintain good quality over time. Thus, individual behaviour, social organisation, technical components and temporal continuance are what we used as dimensions. Each quality category is dependent on at least one dimension, but most require more than one dimension.

These categories and dimensions provided the basis for coding the FGD transcripts. While the four dimensions were fixed, the number of categories inductively increased throughout the coding exercise. The categories and dimensions were only used as codes if users referred to them.

Coding

In the first round, we used the outlined categories or dimensions (= directed approach) or, if not applicable or exhaustive, complemented their use with an inductively emerging code. In the second round, all transcripts were checked, emerging codes refined, merged or deleted. Throughout the third and fourth rounds of coding, codes and sub-codes were subsumed into code groups. The fifth round served for completion with finalising of the code groups. When not applicable, code groups or codes remained as they emerged. After the five rounds, 199 codes were defined. Subsequently, the coding strategy is outlined in more detail, assigned codes are highlighted in italics.

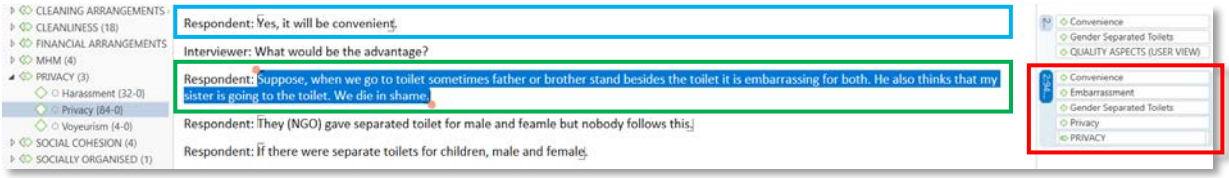
Dimensions as well as categories can be understood as consisting of different bricks, i.e. sub-dimensions, sub-categories or – to use the language of qualitative content analysis – of code-groups, codes and sub-codes. Statements can be labelled with one or more codes. Labelling statements with codes that thematically capture

[118] (Jenkins 2004; Jenkins & Curtis 2005; Satterthwaite *et al.* 2005; Jenkins & Scott 2007; Konradsen *et al.* 2010; Lüthi *et al.* 2010; Schouten & Mathenge 2010; Biran *et al.* 2011; Günther *et al.* 2011; Isunju *et al.* 2011; Günther *et al.* 2012; Giné-Garriga & Pérez Foguet 2013; Mazeau *et al.* 2013; Rheinländer *et al.* 2013; Tsinda *et al.* 2013; Kwiringira *et al.* 2014a, b; Mazeau *et al.* 2014; Nelson *et al.* 2014; Nilsson & Olsson 2014; Okurut & Charles 2014; Garriga *et al.* 2015; Kabange & Nkansah 2015; Rheinländer *et al.* 2015a; Satterthwaite *et al.* 2015; Thys *et al.* 2015; Mara 2016; Evans *et al.* 2017; Garn *et al.* 2017; Sinha *et al.* 2017; Surya *et al.* 2017; Tidwell *et al.* 2019b).

[119] For example, this included categories, such as cleanliness, functionality, availability, privacy, safety, size, odour-free, physical access, distance/location, lockable/functional door, key available 24/7, use at night, andaffordability.

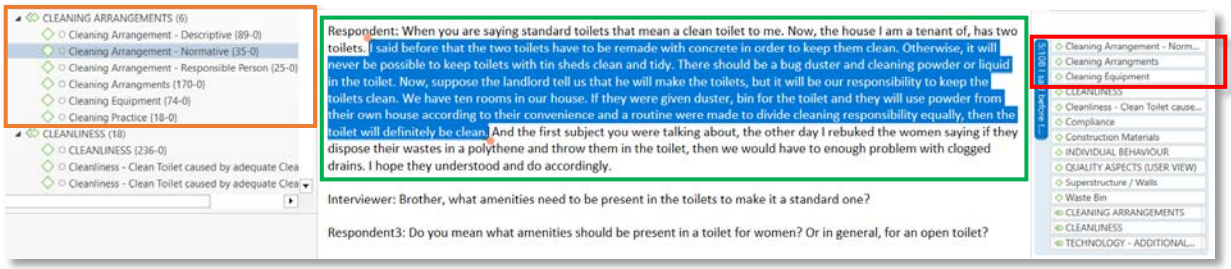
their contents or message allows sorting and structuring in logical way a large number of various statements into meaningful, instructive and comparable data clusters. The applied technique is outlined below.

In a first round, meaningful or informative statements were coded with existing codes, i.e. labelled with one of the above outlined categories or dimensions. For example, as indicated in the image below, the green box marks the statement, whereas the red box indicates the different codes that were assigned to the statement. In this case, the statement exhibits features of positive attributions to gender-separated toilets, i.e. they are perceived as convenient. This does not emerge directly from the text passage, but since it continues or elab-



orates on a statement made earlier (blue box), this must be read in context and coded respectively. Therefore, even though not directly present, the codes *gender-separated toilets* and *convenience*" were assigned to this statement (red box). Additionally, it specifies for what reasons a *gender-separated toilet* is perceived as convenient. In this case, the woman feels embarrassed/ashamed, as the current conditions do not provide enough privacy in her opinion. Therefore, the code "Privacy" was assigned to this statement as well as *embarrassment* (red box), which represents a new, i.e. an emerging sub-code to *privacy*. In this way, throughout the first round, a considerable amount of new codes and sub-codes emerged. For example, there were statements referring to *privacy*, but some of them were referring more specifically to *embarrassment*, others to *voyeurism*, while others again more generally to *harassment*. This does not mean, for example, that *voyeurism* is not a form of *harassment*, but it describes a qualitative difference, i.e. not every statement about *harassment* includes *voyeurism*. In this sense, *voyeurism* is a sub-code of *harassment*, which in turn is a sub-category of *privacy*.

In a second round, all transcripts were checked again, codes refined, merged or deleted. For example, the code *cleaning arrangement* – a sub-code of *social organisation* – has been assigned in the first round to statements referring to organisation of *cleaning arrangements*. In the second round, these were further refined into statements that were *descriptive*, i.e. how current arrangements *are*, and statements that were *normative*, i.e. describing how cleaning arrangements *should ideally be* organised. Therefore, the statement below (green box) exhibits, apart from many other themes, ideas about how *cleaning arrangements* – as well as necessary equipment – *should ideally be* organised. This is why the statement was inter alia coded with *cleaning arrangements* and *cleaning equipment* as well as the sub-code *cleaning arrangement – normative* (red box).



Throughout the second round of coding, codes and sub-codes were subsumed into code groups. In this example, the codes are part of the code group *cleaning arrangements* (see orange box), which in total consists of six codes (see number in parenthesis). As outlined above, *cleaning arrangements* in turn is a sub-code of "Socially Organisation". Certain codes were assigned to more than only one code group. For example, the code *used pads* is part of the code group *MHM*, but of the group *solid waste management* as well.

In a third and fourth round, we repeated the procedure of refining, merging or deleting codes. The fifth round served for completion with finalising code groups as much as possible according to the initially defined categories and dimensions. Where not applicable, code groups or codes remained as they emerged.

Evaluation

When participants explicitly expressed quality concerns, the statements were labelled with the code *Quality Aspects User View*. For example, if a user expressed that "soap for washing hands" is a necessity, the statement was coded with both the code *handwashing station*, as well as *Quality Aspects User View*. When a statement is labelled with two (or more) codes, we refer to this as code overlap. Comparing the code overlaps of *Quality Aspects User View* with all other 198 codes possibly assigned to a particular statement allowed for evaluating which aspects users most commonly related to SSF quality. In a first evaluation step, we evaluated overall user priorities. Overall user priorities are those that are consistently mentioned across genders and context. We defined the evaluation criteria as:

1. Overlap of a particular code (e.g. *handwashing station*) with *Quality Aspects User View*;
2. Mentioned in every country;
3. Mentioned in at least two different FGD types per country.

In the second evaluation step, we assessed gender differences regarding the previously identified quality priorities. To this end, we compared normalised code distributions by FGD type. For example, assuming the code *handwashing station* overlapped 29 times with *Quality Aspects User View* across the 17 FGDs and assuming that men and women equally prioritise a handwashing station. If so, the code *handwashing station* should have a normalised distribution of 33% : 33% : 33% between women-only : men-only : mixed FGDs. Comparing code distributions among FGD types allowed for evaluating if one gender is more strongly in support of a particular identified priority.

The different user quality priorities meeting the evaluation criteria are summarised in the following and discussed in more detail further below. The applied codes are highlighted in *italics*. Finally, the chapter closes with a conclusion. Subsequently, we outline Additional Findings (see p. 129 et seqq.).

Results

The following section presents the selection criteria for essential user quality aspects) and is followed by additional qualitative content analysis findings from all FGDs across the three countries (Additional Findings, p. 129 et seqq.).

In the first evaluation step, based on our evaluation criteria we identified nine user quality priorities (Table 1). None of these priorities was consistently mentioned in every FGD. However, reliable and direct water availability, as well as clean toilets, reached the highest score. The code *water availability* overlapped 54 times with *Quality Aspects User View* in 15 out of 17 FGDs. *Cleanliness* overlapped 28 times with *Quality Aspects User View* in 13 FGDs. The user quality priority *cleanliness* was associated with two underlying dimensions, which are *social organisation* and *individual behaviour*. Users highlighted *social organisation* as paramount to achieve quality SSF of which *cleaning arrangements*, as well as *financial arrangements*, are the two key aspects to be

organised. Apart from that, *cleanliness* is mostly dependent on user's *individual behaviour*: Either, poor *individual behaviour* causes a *lack of cleanliness* or toilets are clean due to adequate individual cleaning behaviour, respectively. Additionally, *gender-separated toilet* overlapped 27 times with *Quality Aspects User View* in twelve FGDs. Furthermore, adequate *sanitation technology* overlapped 28 times with *Quality Aspects User View* in eleven FGDs. Particularly, in Ghana and Kenya, this concerned *flush WCs* as the preferred option. Moreover, four different *additional technical components* met the evaluation criteria. They are *lighting*, *lockable/functional door*, *tiling* and a *handwashing station*. *Lighting* overlapped 22 times with *Quality Aspects User View* in nine FGDs. *Lockable/functional door* overlapped 18 times with *Quality Aspects User View* in twelve FGDs. *Tiling* overlapped 17 times with *Quality Aspects User View* in 10 FGDs. Users reported that this increases *cleanliness* due to easily cleanable surfaces. Availability of a *handwashing station* overlapped 10 times with *Quality Aspects User View* in eight FGDs. Lastly, *privacy* met the evaluation criteria. *Privacy* overlapped 18 times with *Quality Aspects User View* in eight FGDs. Participants largely linked this to the availability of *gender-separated toilets* and menstrual health management (*MHM*) provisions, as well as to the presence of a *functional/lockable/functional door*.

In summary, according to the designated evaluation criteria and based on their score, quality priorities from a user perspective for SSF are (in descending priority):

1. Water availability in close proximity
2. Cleanliness
3. A gender-separated toilet
4. Flush WC
5. Lighting
6. A lockable/functional door
7. Tiling
8. A handwashing station
9. Privacy

Quality Aspects User View	Ghana			Kenya			Bangladesh		
	Women-only	Mixed	Men-only	Women-only	Mixed	Men-only	Women-only	Mixed	Men-only
Water Availability	✓	✓	✗	✓	✓	✓	✓	✓	✓
Cleanliness	✓	✓	✓	✓	✗	✓	✓	✓	✓
Gender Separated Toilets	✓	✓	✓	✓	✗	✓	✓	✓	✓
Sanitation Technology (Flush WC)	✓	✓	✓	✓	✓	✓	✓	✓	✗
Lighting	✓	✓	✗	✓	✓	✓	✓	✓	✗
Lockable door	✓	✓	✗	✓	✓	✓	✓	✓	✓
Tiling	✓	✓	✓	✗	✓	✓	✓	✓	✗
Handwashing	✓	✓	✗	✗	✓	✓	✓	✓	✓
Privacy	✓	✓	✗	✓	✓	✓	✓	✓	✗
Odour / Smell	✓	✓	✓	✓	✓	✗	✗	✓	✗
Cleaning Arrangement	✓	✓	✓	✓	✗	✗	✓	✓	✓
Space Availability (inside)	✗	✗	✓	✓	✓	✗	✓	✓	✓
Safety / Security	✓	✓	✗	✓	✗	✓	✓	✗	✗
Toilet-User-Ratio	✓	✗	✗	✓	✓	✓	✓	✗	✓
Detergent	✓	✓	✗	✗	✗	✗	✓	✓	✓
Insects	✓	✗	✗	✓	✗	✓	✓	✗	✗
Queuing / Waiting Time	✓	✗	✗	✓	✗	✓	✓	✓	✓
Tissue / Toilet Paper	✓	✗	✗	✓	✗	✓	✓	✓	✓

Table 20: Quality aspects from a user perspective (distribution binarised, selection)

In the second evaluation step, as indicated in Figure 1, the 'gender lens' analysis shows that overall user-quality aspects statements are with 36% : 31% : 33% approximately evenly distributed. This means, all FGD types have evenly contributed. Differences exist concerning the particular quality priorities. Women expressed a higher concern for almost all quality priorities. Only two quality priorities were rated as more important by men than by women. These are *sanitation technology* (Flush WC) and *tiling*. For the *flush WC*, the distribution is with 28% : 34% : 38% rather balanced, but was rated as more important by men. For *Tiling* the distribution is with 6% : 36% : 57% imbalanced. *Tiling* was rated by far as more important by men than women, but was highest in mixed FGDs. Conversely, concerning *water availability*, the distribution is 40% : 13% : 47%. Similarly, regarding *cleanliness*, the distribution is 40% : 25% : 35%. That the share for *water availability* and *cleanliness is lowest for* men-statements and highest women's statements suggests that women suffer more from unhygienic conditions and have a higher concern for immediate water availability. It is very likely that this is due to increased body hygiene requirements for women (Mahon & Fernandes 2010; Pokharel 2018), as well as that women are often responsible for cleaning activities (Kwiringira *et al.* 2014b). The distribution for *handwashing stations* (46% : 31% : 23%) supports the claim that women have a higher concern for hygiene. The comparison further suggests that *privacy*, *safety/security*, *lighting* and *lockable/functional door* are closely related and more important to women compared to men. The same is true for *gender-separated toilets*. Overall, the distribution for *privacy* statements were 37% : 16% : 47%, indicating that this is a gendered issue, but does not rely on a 'safe space' to be discussed. *Additional technical components*, such as *lighting* (46% : 15% : 39%), *lockable/functional door* (31% : 21% : 48%) and *gender-separated toilets* (36% : 25% : 39%) were all rated as more important by women compared to men. Code overlaps between *lockable/functional door* and *privacy* and *lockable/functional door* and *safety/security* shows that it is slightly more important for *privacy* (21 overlaps) compared to *safety/security* reasons (15 overlaps).

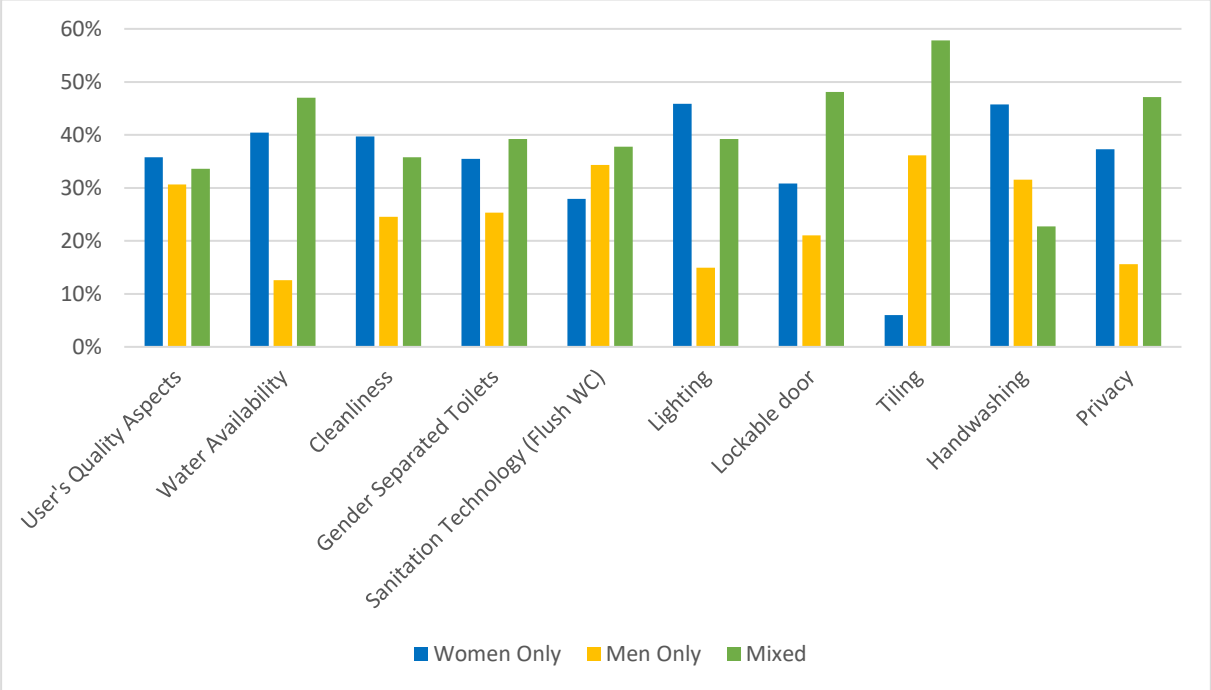


Figure 12: User Quality Priorities by gender (distribution normalised)

Discussion

In general, the study confirms previous findings on important user perceptions of aspects determining acceptable sanitation, but provides more detailed information on user priorities. Overall, *water availability* and *cleanliness* were the most prioritised quality aspects. These two are closely related: Users perceive *water availability* (in close proximity) as essential to keeping the facility clean and prioritise *cleanliness* for comfort reasons. *Water availability* as a user priority confirms previous study results (Schouten & Mathenge 2010; Sinha *et al.* 2017). Past research shows that across all countries and genders, users perceive a close water source as essential for cleaning (Kwiringira *et al.* 2014b; Tumwebaze & Mosler 2014). Compared to previous research findings, *cleanliness* being rated the highest priority is consistent with the results from (Schouten & Mathenge 2010). With water being immediately available for *flush WCs*, participants expect *cleanliness* to increase with concomitant beneficial effects, such as decreasing *odour/smell* and *presence of insects* (Rheinländer *et al.* 2013).

Surprisingly, *odour/smell* and *presence of insects* did not meet the evaluation criteria. Other research reports these to be major user quality concerns (Isunju *et al.* 2011; Rheinländer *et al.* 2013; Thys *et al.* 2015; Tidwell *et al.* 2018). *Odour/smell* seems to be more an issue in Ghana compared to Bangladesh, and did not meet the evaluation criteria because it was mentioned only in mixed FGDs in Bangladesh. *Presence of insects* did not meet the evaluation criteria because it was mentioned only in women-only FGDs in Ghana and Bangladesh. The results for *odour/smell* are somewhat consistent with the findings on *presence of insects*. For both quality aspects, the highest concern was found in Ghana and the lowest in Bangladesh. Among other contributing aspects, participants found dirty toilets and *odour/smell* to be reasons for *presence of insects*. In research, *odour/smell* and *presence of insects* are two proxies often used to assess cleanliness (WHO 2016; Giné-Garriga *et al.* 2017; Giné-Garriga *et al.* 2018). It is likely that due to the high concern for general *cleanliness*, users indirectly included a reference to *odour/smell* and *presence of insects* when referring to *cleanliness*.

Our data confirms past research that found *handwashing stations* to be SSF user priorities (Tidwell *et al.* 2019a). Our FGD data points to a current lack of functional *handwashing stations*. This is consistent with previous SSF research, which found that only 3% of SSF to be equipped with a functional *handwashing station* (Tidwell *et al.* 2019a). Users prioritise *handwashing stations* for personal hygiene motives to prevent the spread of diseases. Washing hands with soap can reduce the risk of diarrhoeal diseases by about one-third (Ejemot-Nwadiaro *et al.* 2008; Ejemot-Nwadiaro *et al.* 2015).

Users prioritise *lighting*, *lockable/functional door* and *tiling* for *cleanliness*, *privacy* and/or *safety/security* reasons. This is consistent with previous findings and recommendations (Thys *et al.* 2015; Cardone *et al.* 2018; Hueso *et al.* 2018). Women prioritised *lighting* and *lockable/functional door* for *privacy* and *safety/security* reasons. This is also consistent with previous research (Corburn & Hildebrand 2015; Hulland *et al.* 2015; Sinha *et al.* 2017). *Lockable/functional door* is a proxy often used to assess the privacy of SSF (Garn *et al.* 2017; Tidwell *et al.* 2018; WHO 2018a). Men prioritised *lighting* and *tiling* for *cleanliness* reasons. Easily cleanable surfaces are expected to decrease the effort needed for cleaning and, thus, to increase likeliness of SSF users to clean (Tumwebaze 2014; Tumwebaze *et al.* 2014). However, except for (Tidwell *et al.* 2019a) specific references to particular easily cleanable materials, such as tiled floors, are absent from scientific literature. We were, therefore, surprised to find *tiling* among the emerging user priorities. Conversely to (Tidwell *et al.* 2019a), we found a higher support from men for tiled floors.

We also expected users to express the presence of *lockable/functional doors* to positively influence *cleanliness* as they prevent, e.g. outsiders, from entering (Tumwebaze *et al.* 2014; Simiyu *et al.* 2017; Chipungu *et al.* 2018;

Shiras *et al.* 2018b; Tidwell *et al.* 2019a). However, very few statements support this assumption. Generally, the data suggests that the use of the SSF by outsiders is not a very common issue. Even though not preferred, in Bangladesh outsiders are sometimes allowed, while in Kenya outsiders are unwelcome and in Ghana this discussion was not present. Data suggests that most doors are only lockable from the inside. but stay open when not in use. This is consistent with past research (Tidwell *et al.* 2018). Except in the Bangladesh context, solid *lockable/functional doors* are present in most cases.

Interestingly, *safety/security* did not meet the evaluation criteria. We assume that participants only indirectly expressed their need for *safety/security*. As a user quality priority, *safety/security*, did not meet the evaluation criteria because it was only mentioned in women-only FGDs in Bangladesh. Like *cleanliness* and *privacy*, *safety/security* is a dependent variable, as its 'provision' is dependent on different and interdependent factors. A reason for fewer references might be that *safety/security* reveals strong links to *privacy*, for example, via a *lockable/functional door (WHO 2018a)*. It is possible that participants indirectly refer to *safety/security* when mentioning *privacy*.

Regarding *gender-separated toilets*, women prefer these for *privacy*, whereas men preferred them for *cleanliness* reasons because they complained about visible bloodstains. Both motives indicate inadequate *MHM* provisions. This includes a lack of or inadequate personal hygiene facilities for women, leading to humiliating and unhygienic conditions. In this sense, *gender-separated toilets* are linked via *MHM* to *privacy* and *cleanliness*. The importance of sanitation services responding to women's (enhanced) needs is well established (Garg *et al.* 2001; Mahon & Fernandes 2010; Schouten & Mathenge 2010; Biran *et al.* 2011; Isunju *et al.* 2011; Mitlin 2011; Norman 2011; Mukherjee *et al.* 2012; Heijnen *et al.* 2014b; Kwiringira *et al.* 2014b; Nelson *et al.* 2014; Rheinländer *et al.* 2015a; Simiyu 2015; Hueso *et al.* 2018; Pokharel 2018). Interestingly, all of the men-only FGDs explicitly mentioned and supported *gender-separated toilets*.

Surprisingly, *toilet-user ratio* and *queuing/waiting time* did not meet the evaluation criteria. Insufficient *toilet-user ratio*, leading to *queuing/waiting time*, impedes toilet availability and has adverse effects on *privacy* and *safety/security*, as well as on *cleanliness*. Recent SSF research on cleanliness found that in urban low-income settlements, a SSF shared by not more than four HHs can be considered as 'acceptable' (Günther *et al.* 2012; Kwiringira *et al.* 2014a). Low *toilet-user ratios* can lead to long *queuing/waiting times*, which in some instances can account for a significant reduction in benefit (Napitupulu & Hutton 2008; Hutton & Whittington 2015; Buckley & Kallergis 2019). *Toilet-user ratio* and *queuing/waiting time* did not meet the evaluation criteria because in Ghana this was mentioned only in women-only FGDs. In Kenya, queuing often occurs ('only') at peak times, i.e. mornings and evenings. The highest occurrence of *toilet-user ratios* and *queuing/waiting times* was found in Bangladesh. This is not surprising, as Dhaka is known as the third most densely populated city worldwide.[120] The insufficient *toilet-user ratio* seems to be the main reason for *queuing/waiting time*. However, *queuing/waiting time* is reinforced by toilets serving as a *shower/bathing* area as well, and for females to manage *MHM*. In this respect, *gender-separated toilets* and – where possible – designated *shower/bathing* areas could not only enhance user privacy, but might also produce relief on toilet availability at peak times.

If user's quality concerns are not met, they are often forced to develop *coping mechanisms*. Women are forced earlier and more often to make use of *coping mechanisms* compared to men (Kwiringira *et al.* 2014b; Simiyu 2015; Sinha *et al.* 2017; Surya *et al.* 2017). In our case, the most prevalent *coping mechanism* is *accompanying* each other because the toilet is too far away (*distance/location*) and/or when *using at night*. This links to presence of *lighting*, which is especially relevant to women when using SSF at night (Hueso *et al.* 2018), and the qualitative data reflects this. A *coping mechanism* for the lack of *lockable/functional doors* is to hang up a

[120] Migiro, Geoffrey . "The World's Most Densely Populated Cities." WorldAtlas, Nov. 15, 2018. URL: www.worldatlas.com/articles/the-world-s-most-densely-populated-cities.html. Accessed, 13.03.2020.

cloth or, where solid doors without locks are present, to lock these with an inside-rope. Where no locking mechanism is available, people audibly cough from the inside to signal the toilet is occupied or are forced to manually hold the door closed. The third *coping mechanism* reported is using a public toilet instead.

Conclusion

Our results confirm previous findings on important user quality concerns determining acceptable sanitation but provide more detailed information on user priorities. We found nine user quality priorities consistently prioritised across three different low-income urban contexts. In descending priority, user value: *immediate water access*, *cleanliness*, *gender-separated toilets*, *flush toilets*, *lighting for use at night*, *lockable/functional doors*, *tiling*, *handwashing stations* and *privacy*. Counterintuitively, *toilet-user ratio*, *waiting time*, *odour/smell* and *presence of insects* do not figure within our evaluated user quality priorities. From the evaluated user quality priorities, *cleanliness* and *privacy* can be considered as dependent or outcome variables. This means, their 'provision' is dependent on different and interdependent factors, i.e. independent variables. *Immediate water access*, *gender-separated toilets*, *flush toilets*, *lighting for use at night*, *lockable/functional doors*, *tiling* and *handwashing stations* are such independent variables. This means, some of them affect *cleanliness*, some affect *privacy* and some, additionally, affect *safety/security*, which is an outcome variable as well. Taking into account the three outcome variables, the remaining seven user quality priorities can be subordinated as dependent variables as follows:

Cleanliness	Water availability in close proximity Flush WC Lighting Tiling Handwashing stations
Privacy	Gender-separated toilet Lockable/functional door
Safety/security	Lighting Lockable/functional door Handwashing stations

Additional Findings

This chapter contains additional findings from qualitative data. It is organised along the outlined dimensions and categories to produce further insights on the research questions. The complete results can be found in the Appendix (see QUISS Final Report Appendix IV: Focus Group Discussions). The first sub-chapter deals with issues around social organisation and is sub-divided into issues around O&M and social relationships. Because thematically most suited but still decoupled from O&M, solid waste management is attached to the O&M sub-chapter. This is followed by a more user-centred section, which includes *individual behaviour* and *coping mechanisms*. Because essential *technical components* have already been part of the section above they are not treated in a separate chapter but referred to when applicable. Subsequently, user *acceptability*-related issues (apart from *cleanliness*, *privacy* and *safety/security*, which have been treated above as well) such as *comfort* and *health hazards* are outlined. This is followed by *Accessibility* factors, i.e. *physical* and *social accessibility* of SSF and *availability* factors including rules for *toilet-use*, *boundary conditions*, *functionality* as well as *toilet-user-ratio* and *queuing/waiting time* issues. For the sake of completion, the last sub-chapters briefly deals with *actors* and *tenant status*.

Overall, for Bangladesh 1013, for Kenya 517 and for Ghana 343 codes are counted. In other words, Bangladesh exhibits around three times as many codes as Ghana, and two times as many compared to Kenya. Clearly, the Bangladesh FGDs were richest in informative usable data. This has no influence on the results for quality priorities based on the evaluation criteria. Conversely, the additional results are interpreted based on the context. The code distribution for the additional findings is not normalised. On the one hand and to make an example, based on these numbers and to indicate an issue is about equally important, a normal code distribution between Bangladesh : Kenya : Ghana for a particular code should be 3 : 2 : 1 (or 50% : 33% : 17%). In other words, a 33% : 33% : 33% code distribution should indicate that in Ghana this particular issue must be weighted differently and respects a higher consideration. We are assuming these differences in code occurrences to be due to skill differences of FGD facilitators as well as more participative and communicative participants, resulting in longer FGDs and therefore more content, i.e. codes. To take into account these differences, this subchapter highlights code distribution for superordinate codes and compares different results for each country when instructive.

Social Organisation – Operation & Maintenance (Summary)

Concerning causes for (un)clean facilities, participants report that cleanliness is mostly dependent on individual user behaviour, followed by availability/lack of cleaning equipment. Either, a lack of cleanliness is caused by poor user behaviour or toilets are clean due to adequate cleaning behaviour. A lack of cleanliness is believed to be mainly caused by children and insufficient *toilet-user-ratio*. Regarding cleaning arrangements, in most cases there exists some sort of informal agreement on cleaning duties. Concerning frequency, once-a-week cleaning activities seem to be prevalent, whereas frequency varies within and across all three contexts. Participants emphasise that fostering exchange among users, creating rules and distribute responsibilities and making them visible via a timetable could enhance individual compliance. Yet, feedback from participants where these partly have institutionalised is ambivalent regarding their (sustained) success. While conditions are different within each context, *cleaning equipment* shows that in most cases *soap* is used for cleaning. Yet, especially in Bangladesh the equipment can vary significantly. Generally, where adequate cleaning equipment is available to all, users usually have bought them together or at least the brush/broom, while cleaning agents have to be provided separately. Overall, it seems that in Kenya the 'organisation level' among users is highest comparing the three contexts with several users reporting that they hold a (monthly) meeting on such issues.

Regarding a *financial arrangement* on O&M cost distribution between proprietors and users, no clear pattern is visible. This depends on the kind of repair works at issue, if the proprietor or the users feel responsible and on the social relationship between them. Overall, data suggests that users generally have to pay for maintenance work. For pit emptying, no formal prearrangement for collecting money exists. Generally, the users have to bear the costs and the money is collected among users when needed. *Affordability* of emptying services is an issue. Yet, although a recurrent financial burden, data suggests that it is the lack of foresight and planning for these payments that puts considerable pressure on tenant's budgets rather than the payments themselves. To mitigate fluctuations, including O&M costs in e.g. the monthly rent most likely could produce relief. Compared to *cleaning activities*, *financial arrangements* around procurement of *cleaning equipment* among the tenants (and proprietor) are rare and usually rest with the individual HHs.

With respect to general *maintenance arrangements*, the pattern is ambivalent as the proprietor as well as the users are responsible for organising or carrying out repair works with contextual variations. In Bangladesh the distribution of these responsibilities is rather balanced, whereas in Ghana these are with the users and in Kenya more with the proprietors. These results are consistent with the distribution of the charges for pit emptying as indicated above.

Generally, a closer look to the O&M data reveals that proprietors as well as users exhibit a lack of a feeling of individual responsibility. They rather expect that cleaning, maintenance and emptying arrangements are to be organised (and paid) by the other party. A basic lack of foresight and responsibility prevent the scheduled inclusion of sanitation related recurring costs into e.g. the monthly rent. Normative statements from both parties about how O&M and related financial arrangements should and could be organised show that the how-to-do knowledge is actually there but fails to be translated into practice. A good social relationship and cohesion among users (can) result in compliance with duty rotas and inclusion of recurrent O&M costs into the monthly rent. It is expected that where such an 'enabling environment' is present, these measures are more likely to be translated into practice.

Comparing overall country respective code distribution for *cleaning arrangements* (n=171; 53% : 29% : 18%) with *financial arrangements* (n=192; 40% : 30% : 30%) suggests that while some sort of (informal) *cleaning arrangement* is equally prevalent, Kenya and Ghana exhibit a higher organisation level, because these more often include an (informal) *financial arrangement* as well.

Social Organisation – Social Relationships (Summary)

Overall, comparing occurrence of *rules* (n=122) and *sanctions* (n=29) shows that occurrence of rules is four times higher than complementing sanctions, i.e. enforcement mechanisms. This imbalance suggests that the *rules* are mostly informal. Usually, the rule is a combination of permission to use the toilet linked to the participation in cleaning activities. In Ghana and Kenya the rules are set by the *proprietors*, while in Bangladesh these are either set by the users or inexistent. In Bangladesh occurrence of *absence of rules* is highest. In Kenya, the chances that *proprietors* set the rules are twice as high as for users, while in Ghana there are no reports of users setting the *rules* at all. In Kenya, eviction is the most common applied *sanction*, while in Ghana it is prohibition of toilet use (forced use of public toilet) and in some cases eviction. In Bangladesh, *sanctions* are almost inexistent. Due to incapacity and inability to enforce compliance, *non-compliance of individuals* is likely to result in indifference towards the SSF. Admonitory words from co-users remain ineffective unless the social relationship is good. Even though largely absent, effective *enforcement mechanisms* are more likely in Ghana and Kenya compared to Bangladesh. This might be because in Bangladesh *proprietors* are usually not dwelling in the same plot/compound because data suggests that only when the *proprietors* are living on-site or close-by and have a regular exchange with the *tenants*, enforcement seems to be at least more likely.

In other words, the more the *proprietors* are setting the *rules*, the more likely there are corresponding *monitoring*, *sanctions* and *enforcement mechanisms*. Yet, this might be correlated but not causal, as the cause might be proximity of the *proprietor* to the SSF: If the *proprietor* is living on the same plot/compound, he/she is most likely responsible for setting the *rules* and, because of enhanced ownership and proximity, is more motivated and can more easily monitor user's behaviour and enforce *sanctions*.

In all three contexts, participants that had a good relationship with their co-users expressed that *cleaning arrangements*, *financial arrangements* for maintenance and collecting contributions for emptying services is not a problem. Most positive references were found for Kenya, which is to some extent consistent with other findings. Compared to Ghana, where only the *proprietors* have been found to set the *rules*, in Kenya, even though the chances that *proprietors* set the *rules* are twice as high as for users, the possibility of users organising themselves is at least present. Conversely, in Bangladesh, *absence of rules* and occurrence of *quarrels* are most frequent. This means, in Kenya, there might is a correlation between good social relationship among users and the possibility of users setting the *rules*.

Overall, *quarrels/disputes* among SSF users most often occur around *cleanliness* issues, especially related *financial* and *cleaning arrangements*, *non-compliance* of individual users and insufficient *toilet-user-ratio*. *Quarrels* are mostly reported in the Bangladesh sample, followed by Kenya and Ghana. This suggests that the less formalised *rules* are in place, the more *disputes* happen, because Bangladesh is leading regarding the *absence of rules* and *sanctions* and Ghana leading regarding *enforcement mechanisms*. Still, a formalisation of *rules* and *enforcement mechanisms* for *financial arrangments* (contributions) and participation in *cleaning arrangements* is missing.

Institutionalised *problem-solving mechanisms* are rather the exception. Likeliness and efficiency of such mechanism depend on the social relationship and cohesion among users, which in turn is dependent on time spent living together, occurrence of transient and number of tenants living on a plot. Comparing countries, in Ghana and Kenya, where user cannot solve a problem among themselves but the problem is still being solved, usually the *proprietor* (or an *agent*) steps in. Such statements were not found for Bangladesh.

Qualitative data suggests that where a good social relationship and cohesion among users exist (= 'enabling environment'), compliance with *duty rotas* and inclusion of recurrent O&M costs into the monthly rent are expected to be more likely translated into practice. A closer look to the O&M data had revealed that overall, *proprietors* as well as users expect O&M to be organised (and costs paid) by the other party. Where such expectations exist, these are explanatory reasons for the existence of informal *rules* and ineffective *enforcement mechanisms* as well as inadequate hygienic conditions leading to dysfunctional toilets and full pits. A basic lack of foresight and responsibility prevent the scheduled inclusion of sanitation related recurring costs into e.g. the monthly rent. While for Bangladesh the social organisation level was found to be low, in Kenya and Ghana these have found to be relatively higher. Two reports from Ghana ('institutionalised periodical meeting') and one from Kenya ('padlock meeting') with social relationship among users reported to be good, organisation of O&M to be in place and corresponding reports the SSF to be in a good condition at least support this assumption.

Individual Behaviour

This section shortly elaborates on *Individual behaviour* and *coping mechanisms*. Like *social organisation*, *individual behaviour* is one of the dimensions introduced above (see Data analysis, p. 120). Even though treated as a separate code, most of the findings and their implications from *individual behaviour* are treated in the

social organisation sections on operation and maintenance (see FGD Appendix Cleanliness: Causes and Effects; Financial Arrangement - Maintenance) and on Rules / Sanctions (see FGD Appendix, Rules). Thus, the section on *individual behaviour* is deliberately kept brief. *Coping mechanisms* elaborates on adapted behaviour patterns when users cope with insufficient prevalent toilet conditions and is thematically related to inacceptable, unavailable and/or inaccessible SSF.

As already indicated, inadequate *individual behaviour* is reported to be a main reason for unhygienic conditions.[121] Either users they are not cleaning after using, they are not equally participating in *cleaning activities*, or they do not adhere to existing (in)formal *rules*.[122] Often, participants refer to a *feeling of individual responsibility*, usually a lack thereof, which is a common reason for *quarrels/disputes*. Because there are no *sanctions* and/or *enforcing mechanisms*, it is often up to certain individuals to keep the SSF in an adequate state. In some cases, participants report intentional *misus*". This might be male users urinating at the toilet walls, users stealing common utensils such as provided *waste bins* for personal use, or *children* who leave a mess with parents not caring.

Coping mechanism was assigned to statements where users reported to be forced to behave differently in order to cope with insufficient prevalent toilet conditions. Code distribution is 58% : 33: 9%. Indicating that users in Bangladesh need to adapt more often, particularly compared to Ghana. The most prevalent *coping mechanism* is that users have to accompany each other because they are scared. Either because the toilet is too far away and/or when using at night. Overall, *accompanying* seems to be more an issue in Bangladesh and Kenya compared to Ghana. Field visits suggest that in Ghana the toilets are in close proximity to the compounds, which often are enclosed. *Missing door/lock* impeding *privacy* as well as *safety/security* was the second most often mentioned *coping mechanism*, however, only in Bangladesh. Users reported to hang up a cloth or – where solid doors are present but without locks – they are closed with a rope from the inside when in use. In cases were no solid and lockable door is present, people audibly cough from the inside (and outside) to signal the toilet is occupied. In other cases, they are forced to manually hold the door from the inside. In Ghana and Kenya, these issues were not found. The third *coping mechanism* was to avoid to use the toilet at all and use e.g. a *public toilet*. While the use of *public toilets* was mentioned in all three contexts, it was most prevalent in Kenya, but the reasons therefore different. In Bangladesh, it is the *presence of insects*, in Ghana *full toilets*, which are locked for about three months for decomposition, which forces the users to use *public toilets*. In Kenya, the condition or the *location/distance* to the toilet e.g. at night or during rainy seasons were mentioned as reasons. User keep some sort of container at home, which they use when needed and empty in the morning. Further, in Bangladesh *MHM* related *coping mechanisms* were mentioned such as cleaning used MHM materials (cloths/rags) at night because adequate, i.e. private disposal as well as (rag/cloth) cleaning options are missing. It is apparent that *MHM* and related *coping mechanisms* discussions mainly took place in Bangladesh. The informative value for Ghana and Kenya remains limited. It is possible that the data is biased. One explanation that this issue was mostly discussed in Bangladesh might be that the people are (culturally) more open to talk about *MHM* issues and/or partly due to the highly skilled (public health) data collectors from icddr,b that are experienced talking to people about these highly sensitive issues.

[121] "Participants report that cleanliness is mostly dependent on individual user behaviour. Either, a lack of cleanliness is caused by poor user behaviour ("negatives" = 32 times mentioned) or toilets are clean due to adequate cleaning behaviour ("positives" = 27) respectively." See QUISS Final Report Qualitative Appendices, Appendix IV: Focus Group Discussions. In chapter: Cleanliness: Causes and Effects.
[122] "Considering "Non-compliance" shows that this refers to individuals not complying with existing rules. These findings are consistent across all three contexts with no relevant variation." See QUISS Final Report Qualitative Appendices, Appendix IV: Focus Group Discussions. In chapter: Rules.

Acceptability

Acceptability subsumes *cleanliness*, *privacy*, *safety/security*, *comfort*, and *health hazards*. While the former three have already been treated above, subsequently additional findings for the latter two are quickly outlined.

Acceptability (Summary)

Regarding *space availability* inside the toilet cubicle, in Bangladesh users generally report the toilets to be too small and inconvenient, often relating to difficulties with *MHM*, e.g. changing pads and/or body hygiene. In Ghana and Kenya, this issue was less prominent and, with a few exceptions, participants reported the toilets to be of adequate size. The remaining factors subsumed under acceptability can be grouped around *health hazards* resulting from dirty toilets and are consistent across all three contexts. Participants relate *presence of insects* to *odour/smell* and both to *health hazards*. Some participants reported to use the toilets only in emergencies because of the bad *odour/smell* and people avoid going to the toilets due to annoying and sometimes dangerous insects.

Accessibility

Accessibility is referring to physical and social accessibility and is differentiated from availability (see Availability, p. 134).

Accessibility (Summary)

Overall, *location* not *distance* is challenging *physical accessibility*. This is especially true regarding *safety/security* when using at night. This is also the reason why normative statements indicate a toilet in close proximity is preferred.

Social inaccessibility can be interpreted as eventual social restrictions in using a toilet. Neither *religion* nor *limited mobility* are relevant issues, whereas gender is. *Gender-separated toilets* are a user quality priority. With one exception, this issue was discussed with large support for the idea of *gender-separated toilets* in all FGDs. Both genders prefer separated toilets due to links to *MHM* challenges: women for *privacy* reasons, whereas men for *cleanliness* reasons. Code distribution for *gender-separated toilets* was 67% : 20% : 13 %, indicating that this might be a slightly higher concern in Bangladesh. This is plausible considering population *density* and might partly be because user numbers per toilet are higher, which is confirmed by *space/density*, which is linked to unavailability of space to build more or *gender-separated toilets*. Descriptive statements indicate that currently no separation of toilets exist.

Regarding *MHM*, overall code distribution was 63% : 21% : 15%, with qualitative data indicating that that user equally struggle, but with a higher pressure in Bangladesh, which is again consistent given population *density*. Across all three contexts, female users seem to struggle with the same issues. Used pads and cloths often end up in the pits due to a lack of adequate disposal options and *solid waste management*. This leads to quickly *filled tanks*, *clogged pipes* and pits that need to be emptied more often and usually manually. Quickly *filled tanks* increase the financial pressure on the users and *clogged pipes* lead to *dysfunctional toilets*, ultimately to unavailability. With one exception, *reusable MHM materials* were mentioned in Bangladesh only, which suggests that in Ghana and Kenya this is not being practised. *Waste bins* in the toilets are often lacking. Some of which that do have a *waste bin* in the toilets report it to be embarrassing when *MHM* waste can be seen as the bin has no lid, whereas some report it to become smelly resulting in the preference to not having a waste bin inside the toilet. Overall, *MHM arrangements* are often lacking.

Availability

While *accessibility* was conceptualised around physical and social accessibility, *availability* is distinguished in the sense that a SSF might be physically as well as socially accessible, but could still be unavailable to its users. For example, because there exist certain rules that define who is allowed to use the toilet (*toilet use* (n=41)). Further, *boundary conditions* (n=131), i.e. in- and exclusion mechanisms to distinguish between members and non-members of the SSF, e.g. *lockable doors* which are needed to provide *security* and *privacy* to the users during use, but to which e.g. a key needs to be available for its users at any time to guarantee availability. Alternatively, *functionality* (n=49) because a dysfunctional SSF is unusable and therefore unavailable. For example, external environmental conditions (e.g. rainy season) might temporarily limit the availability because *pits/tanks overflow*. Moreover, *queuing/waiting time* (n=44) and linked to this *toilet-user ratio* (n=78), because if users have to queue and wait due to insufficient number of toilets, the toilet is unavailable for basic physical needs satisfaction. In other words, for a toilet to be available to its users they must be able to use it (e.g. permission by proprietor) when needed (e.g. key available, adequate toilet-user ratio, no *queuing/waiting time*) and it must be functional (*superstructures/walls*, *not clogged*, *pit not full*, no *overflow*). This chapter is organised along these three key factors.

Availability (Summary)

Overall, qualitative data revealed that the users are sharing the assumption of *boundary conditions*. The connection between *lockable doors*, enhanced *safety/security* and *privacy* as well as *cleanliness* can be found in several statements. Even though doors seem to be present in most cases, especially in the Bangladesh context data revealed that facilities exhibit a lack of lockable and/or solid doors. As *coping mechanisms* people audibly cough from the inside (and outside) to signal the toilet is occupied or manually hold the door from the inside. This was absent from Ghana and Kenya FGDs. Generally, the data suggests that the use of the SSF by *outsiders* is not a very common issue. Even though not preferred, in Bangladesh sometimes allowed, in Kenya *outsiders* are unwelcome and in Ghana this discussion was not present.

Data further suggests that *solid waste* – especially used *MHM materials* – is mostly the reason for *clogging*. *Full tanks* are caused by *solid waste* and inflowing rain/cleaning water. The former reiterates the lack of *solid waste management* and adequate disposal options, the latter additionally a lack of *drainage* canals for rainwater. After all, comparing code occurrences between *clogging*, *full tanks*, *overflow*, *emptying* and *conveyance - sewer/drainage* reflects the situation on the ground: In Bangladesh most SSF are connected to some sort of (unsafe) conveyance system, while in Ghana and Kenya pits and septic tank technologies are prevalent. 77% of all codes referring to sewer/drainage stem from the Bangladesh FGDs, but only account for 22% regarding *emptying*. Conversely, *full tanks* code distribution is highest for Kenya (27% : 55% : 18%) and corresponds to the ratios found for *clogging* (50% : 42% : 8%) and *emptying* (22% : 40% : 40%.). Ghana has a high code occurrence of *emptying* (which is particular to pits/tanks), whereas the issues of *solid waste* disposal in pits is absent. This in turn is consistent considering the missing codes for *overflow* and the low code occurrence of *clogging* for Ghana. *Clogging* and *overflow* in turn are particular to Bangladesh and Ghana, showing consistent data: It indicates inadequate *solid waste* disposal to be *clogging* pits/tanks in Kenya and outflow valves in Bangladesh and especially during rainy season to result in *overflow*. *Clogged pipes* and *solid waste* in pits/tanks require manual *emptying* as *emptying* with exhausters becomes difficult. In Ghana, apparently '*emptying*' by applying *chemical substances* seems popular. In Bangladesh and Kenya, users expect from *sewer connections* to solve the *clogging* and *overflow* problem. Normative statements indicate that participants expect covered *sewer connections* to reduce *clogging*, bad *odour/smell* and *health hazards*. For Ghana, this is only indirectly evident as a (cistern) *flush toilet* was often said to represent a high-quality toilet.

Regarding *emptying* challenges, by far most statements relate to *social organisation*, i.e. distribution of responsibilities between users and *proprietors*, especially to *financial arrangements*. While *drainage* systems should clearly not be used, this obviously happens to empty pits, often during the rainy seasons, which predominantly seems to take place in Bangladesh and Kenya.

In all FGDs the issue of the insufficient *toilet-user-ratio* and *queuing/waiting* time is present with highest occurrence in Bangladesh for both issues, whereas in Kenya queuing often occurs ('only') at peak times, i.e. mornings and evenings. This is not surprising as Dhaka is known as the third most densely populated city worldwide and is consistent with *physical accessibility – space/density*. A closer look to the *queuing/waiting time*-data suggests that even though the insufficient *toilet-user-ratio* seems to be the main reason, it is reinforced by toilets serving as *shower/bathing* area as well, and for females to manage *MHM*. In this respect, *gender-separated toilets* and – where possible – designated *showers/bathing* area could not only enhance user *privacy*, but might help to produce relief on toilet availability at peak times as well.

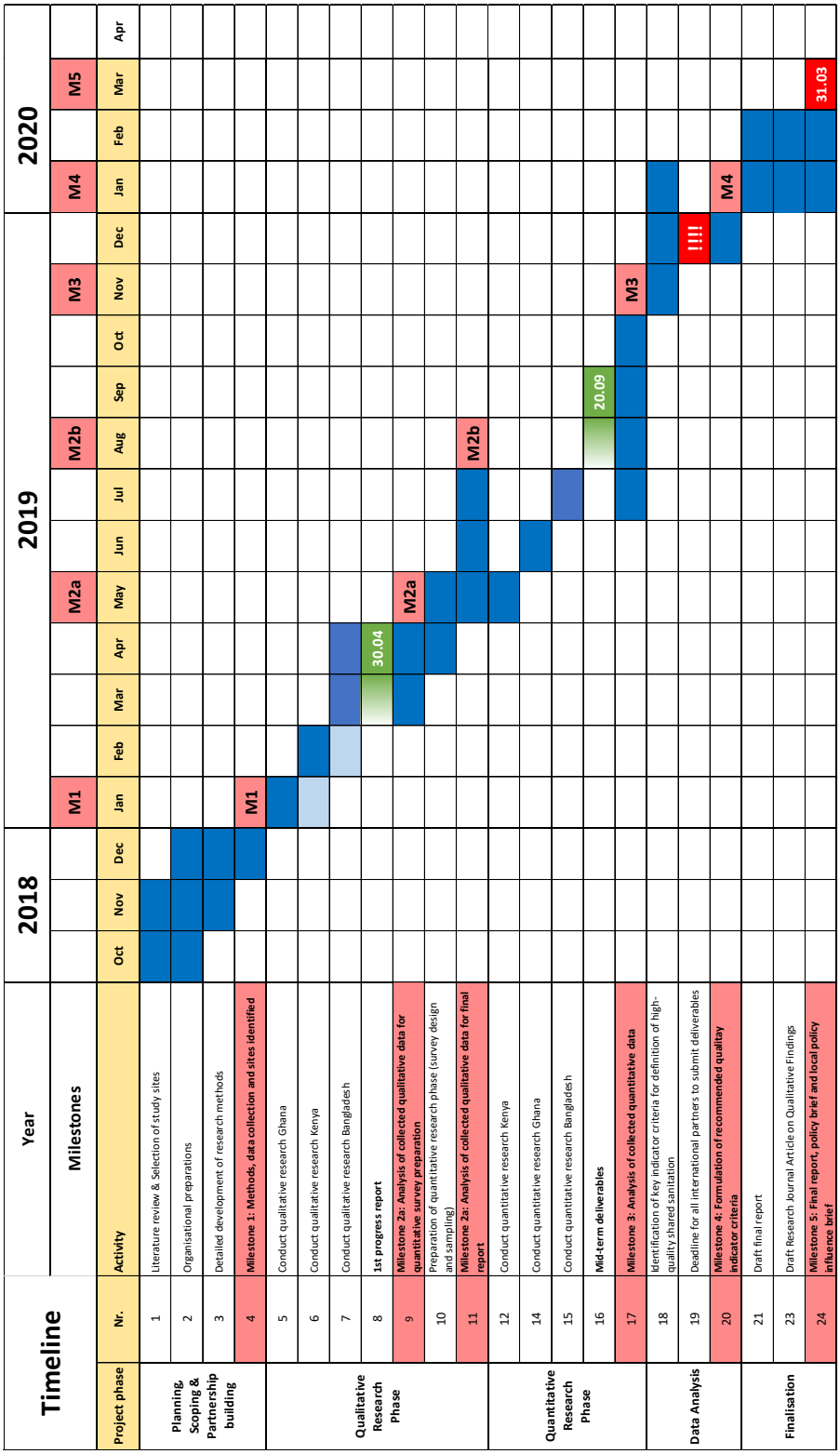
Other Aspects

For the sake of completeness, this section briefly summaries two actor related codes (*actors*, *tenant status*) applied.

While references to proprietors and children are more or less evenly distributed across all three contexts, only in Bangladesh users referred to *NGOs*. *Public authorities* were mentioned in all three contexts, but mostly in Ghana. Generally, users referred to *proprietors* when discussing *social organisation* issues such as *maintenance arrangements* and *emptying* including *financial arrangements* as well as when referring to *rules* and *sanctions*. *Children* were largely mentioned when discussing *individual behaviour* and *cleanliness*. While all FGDs in Kenya reveal statements of experienced *negligence* from *proprietors*, in Bangladesh half and in Ghana only one out of five FGDs. Compared to the other sub-codes subsumed under *tenant status*, this is the only one that emerges in all three contexts. Data suggests that while users from all contexts experience *negligence*, this is strongest in Kenya and Bangladesh and tenants from the latter context often live in uncertain circumstances, whereas in Ghana neither seems to be a pressing issue.

7 Appendix III: Administrative Appendix

7.1 Project Timeline



7.2 Country Specific Study Information

Ghana

Lead investigator:	Prince Antwi-Agyei, PhD, NHance Consultants	
Study Timeline:	Qualitative Phase:	January 2019
	Quantitative Phase:	June 2019
Study location:	City:	Kumasi
Qualitative Study Locations:	Accra Town, El Shadai, Oforikrom, Ahwiamu	
Quantitative Survey Locations:	Anwiam, Nkotwima, Breman, Ayigya, Anyaano, Bohyen, Accra Town, Manhyia	

Kenya

Lead investigator:	Sheillah Simiyu, PhD, Great Lakes University of Kisumu, Kenya	
Study Timeline:	Qualitative Phase:	January 2019 – February 2019
	Quantitative Phase:	May 2019
Study locations:	City:	Kisumu
Qualitative Study Locations:	Nyalenda A, Nyalenda B, Manyatta A, Manyatta B	
Quantitative Survey Locations:	Nyalenda A, Nyalenda B, Manyatta A, Manyatta B	

Bangladesh

Lead investigator:	Dr. Md. Mahbubur Rahman, icddr,b	
Study Timeline:	Qualitative Phase:	February 2019 – March 2019
	Quantitative Phase:	July 2019
Study locations	City:	Dhaka
Qualitative Study Locations:	Duari Para, Kamalapur, Kamrangirchar, Maniknagar, Satala, Agargaon	
Quantitative Survey Locations:	Adabor, Bhasantek, Vhatara, Hazaribag, Jatrabari, Kamrangirchar, Khilgaon, Korail, Mirpur, Mugdhapara	

7.3 Research Permits

Eawag

Eawag
Überlandstrasse 133
Postfach 611
8600 Dübendorf
Schweiz
Telefon +41 (0)58 765 55 11
Telefax +41 (0) 58 765 50 28
www.eawag.ch

eawag aquatic research

Ethical Review Application for Minimal Risk Projects Involving Human Subjects

This form is for use as described in Policy Directive 16-09. Eawag researchers who are planning to engage in minimal risk projects involving human subjects are ***strongly encouraged*** to complete relevant training through workshops or e-learning modules (e.g., the Training and Resources in Research Ethics Evaluation program, http://elearning.trree.org/, or the U.S. NIH Protecting Human Research Participants program, https://phrp.nihtraining.com).

This form is intended for use ***only*** for projects that pose ***minimal risk*** to the human subjects involved in the project and/or to Eawag as an institution.[1] Projects are considered to pose minimal risks if the "NO" box is checked for ALL of the following questions:

		YES	NO
1.	Does the project extend beyond observation of participants conducting normal activities in daily life or sport (e.g., playing games, using apps, performing exercises to test strength, flexibility and/or speed)?		X
2.	Does the project involve children or any other participants for whom a third party (e.g., a parent or guardian) would need to grant permission for participation?		X
3.	Does the project involve any participants who are likely to be coerced or otherwise unduly influenced into participation (e.g., prisoners)?		X
4.	Does the project involve the collection of any data and/or opinions that are NOT anonymized?		X
5.	Would the intended use of the anonymized data and/or opinions to be collected in the project allow the identification of individual participants?		X
6.	Does the project involve collection of sensitive personal data and/or information (e.g., regarding health, sexual orientation, ethnicity, or political/religious conviction) that must be protected?		X
7.	Does the project involve collection of sensitive personal data and/or information (e.g., child or domestic abuse, sexual functioning) that is likely to cause emotional stress or discomfort?		X
8.	Does the project involve any conflicts of interest?		X
9.	Does the project pose any obvious reputational and/or legal risks?		X
10.	Does the project involve the use of any sensitive or restricted technology?		X
11.	Do *both* the Director and Deputy Director of Eawag have a conflict of interest (e.g., direct engagement) with the project?		X

IF **ANY** BOXES ARE CHECKED "YES", DO **NOT** COMPLETE THIS FORM.

Date of application	October 24th 2018
Name of applicant (PI)	Christoph Lüthi / Vasco Schelbert
Name and date of completion of Human Subject Research Training program completed (if applicable)[2]	
Name of supervisor (if needed)[3]	Christoph Lüthi
Department(s) of applicant and supervisor	Eawag-Sandec, Christoph Lüthi
Project title	QUISS : Quality Indicators of Shared Sanitation

[1] This form is NOT intended to replace any *external* review of ethics *required* by an external agency (e.g., funding agency, international governmental agency, journal, etc.). This form may be replaced by an ethical review application approved by a Swiss project partner organization (e.g., ETH Zurich, EPFL, a Swiss Cantonal University or University of Applied Sciences).
[2] Completing such a course is *highly* recommended.
[3] Not need if the applicant is eligible to submit proposals from Eawag (e.g., tenured or tenure-track researcher)

Eawag PSP Number	5221.01506
Source (or anticipated source) of funding	Water & Sanitation for the Urban Poor (WSUP)
Project period (or anticipated project period)	October 1st 2018 – March 31st 2020
Brief project description (highlighting potential ethical issues if any)	Our research is mainly marked by cross-country surveys to examine under what circumstances a shared sanitation facility in dense urban low-income settlements can be considered of high-quality and to identify key criteria of what constitutes "high quality" shared toilets in urban contexts. Deliverables expected from the research are a detailed empirical assessment of the drivers and determinants of user experience of shared toilets and identification of the criteria of the minimum standards for "high-quality" shared sanitation. At first visit we will (1) conduct two "community meetings" using a gender-sensitive method (GALS meeting) with 30-50 participants each that serve to evaluate the main issues people experience with shared sanitation; (2) conduct four to six Focus Group Discussions (FGDs) with six to ten participants each, which serve to deepen the understanding of the issues, problems, challenges and solutions people using shared sanitation facilities face. At the second visit we will (3) perform a structure quantitative survey using mobile data collection devices with a minimum of 1000 participants, inter alia collecting information on socio-demographic characteristics, occupational history, health status/well-being. This is complemented by (4) a structured inspection of 200 toilets, which focuses on the infrastructure and technology in use, observable hygienic condition of the facility as well as the availability of water and a handwashing station. Ethical principles are addressed by using rigorous research techniques applied for visual research according to (Wiles, Prosser et al. 2008). The GALS workshops, FGDs and quantitative survey are conducted on a voluntary basis, the participants will have to sign a consent form, which includes an agreement on confidentiality and anonymization of all data collected and subsequent use for analytical purposes of all data collected. Before signing the agreement, the research endeavour is explained to potential participants and for what precisely their consent is being sought to do. The result of the study will be returned to the participants through written and verbal communication. The general results will be returned to the communities in the region and other key stakeholders (e.g. local health authorities) in restitution workshop, scientific articles and presentation in national and international congresses. We feel that the above described protocol is straightforward and the involved techniques and methodologies pose minimal risks from an ethical point of view.

The applicant hereby certifies that the project "**QUISS: Quality Indicators of Shared Sanitation**" meets the criteria stated above for minimal risk

Christoph Lüthi		30.10.2018
Applicant Name	Signature	Date

The supervisor (if needed) and Department Head hereby confirm that this project meets the criteria stated above for minimal risk

Supervisor Name	Signature	Date

Christoph Lüthi		30.10.2018
Department Head Name	Signature	Date

If (***and only if***) the applicant or supervisor is a Department Head, then the signature of the Directorate member who is the Coach[4] for that Department is also needed to confirm that this project meets the criteria stated above for minimal risk

Chris Zurbrügg		30.10.2018
Name of Directorate Member	Signature	Date

Approved for the Eawag Directorate by:

Janet Hering or Rik Eggen	Signature	Date

[4] If the Coach of the Department has a conflict of interest, then another member of the Directorate can sign for the Coach.

Ghana

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
HEAD OFFICE

P. O. BOX M. 32
ACCRA
GHANA
WEST - AFRICA

TEL: 233-30-2777651-4 (4 Lines)
FAX: 233-30-2777655
E-MAIL: headoffice@csir.org.gh
WEBSITE: www.csir.org.gh

Our Ref: CSIR/IRB/AL/VOL1

Date: 10TH JANUARY, 2019

ETHICAL CLEARANCE

RPN 013/CSIR-IRB/2018

The Council for Scientific and Industrial Research (CSIR) Institutional Review Board (IRB) has reviewed and approved your protocol.

TITLE OF PROTOCOL	:	**QUISS: QUALITY INDICATORS OF SHARED SANITATION**
PRINCIPAL INVESTIGATOR	:	**LUTHI CHRISTOPHER**
CO- INVESTIGATORS	:	***DR. PRINCE ANTWI-AGYEI***
SPONSOR	:	***WATER AND SANITATION FOR THE URBAN POOR (WSUP) CONTACT PERSON: GUY NORMAN***

Please note that a final review report must be submitted to the Board at the completion of the study. Your research records may be audited at any time during or after the implementation.

Any modification of this research project must be submitted to the IRB for review and approval prior to implementation.

Please report all serious adverse events related to this study to CSIR-IRB within seven days verbally and fourteen days in writing.

This certificate is valid till **19TH DECEMBER, 2019**.

Mr. Okyere Boateng
(CSIR-IRB, Chairman)

Cc: Prof. Victor K. Agyeman
(Director General, CSIR)

Kenya

THIS IS TO CERTIFY THAT:
MISS. SHEILLAH NAMACHANJA SIMIYU
of GREAT LAKES UNIVERSITY OF KISUMU, 30257-100 Nairobi,has been permitted to conduct research in *Kisumu County*

on the topic: *QUALITY INDICATORS OF SHARED SANITATION*

for the period ending:
12th March,2020

Permit No : NACOSTI/P/19/5546/28617
Date Of Issue : 12th March,2019
Fee Recieved :Ksh 5000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

Telegrams: "MEDICAL", Kisumu
Telephone: 057-2020801/2020803/2020321
Fax: 057-2024337
E-mail: ercjootrh@gmail.com
When replying please quote

JARAMOGI OGINGA ODINGA TEACHING & REFERRAL HOSPITAL
P.O. BOX 849
KISUMU

Ref: ERC/IB/VOL.I/568

Date 18th February, 2019

Sheila N. Simiyu

Dear Sheila,

RE: REQUEST FOR ETHICAL APPROVAL TO UNDERTAKE A STUDY ENTITILED: 'QUISS" – QUALITY INDICATORS OF SHARED SANITATION

The JOOTRH ERC reviewed your protocol and found it ethically satisfactory. You are therefore permitted to commence your study immediately. Note that this approval is granted for a period of one year (w.e.f. 18th February, 2019 to 18th February, 2020). If it is necessary to proceed with this research beyond approved period, you will be required to apply for further extension to the committee.

Also note that you will be required to notify the committee of any protocol amendment(s), serious or unexpected outcomes related to the conduct of the study or termination for any reason.

In case the study site is JOOTRH, kindly report to the Chief Executive Officer before commencement of data collection.

Finally, note that you will also be required to share the findings of the study in both hard and soft copies upon completion.

The JOOTRH – IERC takes this opportunity to thank you for choosing the Institution and wishes you the best in your future endeavours.

Yours sincerely,

WILBRODA N. MAKUNDA
SECRETARY- IERC
JOOTRH - KISUMU

INSTITUTIONAL ETHICS & REVIEW COMMITTEE
18 FEB 2019
JOOTRH

Bangladesh

File

icddr,b

Memorandum

02 January 2019

To: Mr Mahbub-Ul Alam
Principal Investigator of research protocol # PR-18086
Infectious Diseases Division (IDD)

From: Shafiqul A Sarker, MD, PhD SA Sarker
Chairperson
Research Review Committee (RRC)

Sub: Approval of research protocol # PR-18086

Thank you for your memo dated 23 December 2018 attaching the modified version of your research protocol # PR-18086, titled "Identification of indicator criteria for quality shared toilet in urban Dhaka, Bangladesh" addressing the issues raised by the Committee in its meeting held on 08 November 2018 to the satisfaction of the Committee. Accordingly, the Committee approved the research protocol to proceed subject to the approval of the Ethical Review Committee (ERC).

1. The research protocol is approved for 12-month period from the date of approval of the protocol by the Ethical Review Committee. Approval for further continuation of the research work, if needed, shall be obtained before expiration of the initial approval.

2. You should notify the IRB Secretariat of the start date of the protocol for updating in the integrated navision system. The protocol start date will not be updated in the navision system until receiving information from you. Therefore you will not be able to operate budget code and continue spending funds under the research protocol.

3. The RRC approval shall automatically be revoked after one year if the protocol is not started. After one year, you shall have to seek approval for revalidation of the protocol by the RRC & ERC before starting the protocol.

4. This approval is only valid whilst you hold a position at icddr,b; and in the event of your departure from the Centre, a new Principal Investigator will be designated for the research protocol.

5. You should notify the RRC and the ERC immediately of any serious or unexpected adverse effects on participants or unforeseen events that might affect continued acceptability of the protocol.

6. Any changes to the research protocol require the submission (in prescribed form) and approval of an amendment/addendum. Substantial variations may require a new protocol.

Postal address
icddr,b
GPO Box 128
Dhaka 1000
Bangladesh

Delivery & visitors
icddr,b
Mohakhali
Dhaka 1212
Bangladesh

T (88 02) 9827001-10
F (88 02) 9827075, 9827077
E info@icddrb.org
www.icddrb.org

7. Continued approval of this protocol is dependent on your periodically updating the Centre's database for the protocol to show the progress; and a final report/completion report should be submitted at the conclusion of the protocol.

8. You shall submit a report for time extension of the protocol (in prescribed form) if you are unable to complete the protocol activities within the time mentioned in the protocol.

9. You are responsible for systematic storage and retention of the original data pertaining to the research protocol; and the ownership of data after certain period shall be determined as per Centre's rules and regulations.

10. The RRC should be notified if the protocol is discontinued before the expected date of completion.

I wish you all the success in conducting the research protocol.

Thank you.

Cc: Senior Director, IDD
Senior Manager, Budget & Planning, Finance

icddr,b

Memorandum

19 February 2019

To: Mr Mahbub Ul Alam
Principal Investigator of research protocol # PR-18086
Infectious Diseases Division (IDD)

From: Professor Saria Tasnim
Chairperson
Ethical Review Committee (ERC)

Sub: Approval of research protocol # PR-18086

Approval Date: 19 February 2019
Expiration Date: 18 February 2020
Review Type: Full Committee Review
Risk Level: No more than minimal
Project type: New Project

Thank you for your memos dated 07 February and 14 February, 2019 attaching the modified version of your research protocol # PR-18086 entitled "Identification of indicator criteria for quality shared toilet in urban Dhaka, Bangladesh" addressing the issues raised by the committee in its Janaury 2019 ERC meeting held on 31 January 2019 at the Research Administration Meeting Room, 3rd floor of the icddr,b Main Building, to the satisfaction of the Committee. I am pleased to inform you that your protocol is **approved**. You will be required to observe the following terms and conditions in implementing the research protocol:

1. The research protocol is approved for 12-month period from the date of approval of the protocol by the Ethical Review Committee. The Federal regulations require review of an approved study not less than once per 12-month period. To comply with federal regulations, a continuing review application must be submitted to the IRB Secretariat for this study to continue beyond 18 February 2020.

   All necessary materials for continuing review must be reviewed with sufficient time for review and issuing continued approval before the expiration date. Failure to initiate a continuing review application in a timely fashion may result in discontinuation of study activities until approval can be renewed. Performing study activities, including data analysis, beyond the expiration date results in noncompliance of federal regulations.

2. The ERC approval shall automatically be revoked after one year if the protocol is not started. After one year, you shall have to seek approval for revalidation of the protocol by the ERC before starting.

3. You should notify the IRB Secretariat of the start date of the protocol for updating in the integrated Navision system. The protocol start date will not be updated in the Navision system until receiving information from you.

Postal address
icddr,b
GPO Box 128
Dhaka 1000
Bangladesh

Delivery & visitors
icddr,b
Mohakhali
Dhaka 1212
Bangladesh

T (88 02) 9827001-10
F (88 02) 9827075, 9827077
E info@icddrb.org
www.icddrb.org

Therefore you will not be able to operate budget code and continue spending funds under the research protocol.

4. As Principal Investigator, the ultimate responsibility for scientific and ethical conduct including the protection of the rights and welfare of study participants vest upon you. You shall also be responsible for ensuring competence, integrity and ethical conduct of other investigators and staff directly involved in this research protocol.

5. You shall conduct the study in accordance with the ERC-approved protocol and shall fully comply with any subsequent determinations by the ERC.

6. You shall obtain prior approval from the Research Review Committee and the ERC for any modification in the approved research protocol and/or approved consent form(s), except in case of emergency to safeguard/ eliminate apparent immediate hazards to study participants. Such changes must immediately be reported to the ERC Chairman.

7. You shall recruit/enrol participants for this study strictly adhering to the criteria mentioned in the research protocol.

8. You shall obtain legally effective informed consent (i.e. consent should be free from coercion or undue influence) from the selected study participants or their legally responsible representative, as approved in the protocol, using the approved consent form prior to their enrolment in this study. Before obtaining consent, all prospective study participants must be adequately informed about the purpose(s) of the study, its methods and procedures, and also what would be done if they agree and also if they do not agree to participate in the study.

9. They must be informed that their participation in the study is voluntary and that they can withdraw their participation any time without any prejudice. Signed consent forms should be preserved for a period of at least five years following official termination of the study.

10. You shall promptly report the occurrence of any Serious Adverse Event or unanticipated problems of potential risk to study participants or others to the ERC in writing within 24 hours of such occurrences.

11. Any significant new findings, developing during the course of this study that might affect the risks and benefits and thus influence either participation in the study or continuation of participation should be reported in writing to the participants and the ERC.

12. You shall report progress of research to the ERC for continuing review of the implementation of the research protocol as stipulated in the ERC Guidelines. Relevant excerpt of ERC Guidelines and '*Annual/Completion* Report for Research Protocol involving Human Subjects' are attached for your information and guidance.

13. Data and/or samples should be collected and interviews should be conducted, as specified in the ERC-approved protocol, and confidentiality must be maintained. Data/samples must be protected by reasonable security, safeguarding against risks such as their loss or unauthorized access, destructions, used by others, and modification or disclosure of data.

a

Data/samples should not be disclosed, made available to or use for purposes other than those specified in the protocol, and shall be preserved for a period, as specified under Centre's policies/practices.

14. You shall promptly and fully comply with the decision of the ERC to suspend or withdraw its approval for the research protocol.

15. The ERC should be immediately notified if the protocol is discontinued before the expected date of completion.

Approved documents:

a. Protocol version no 1.02, dated 23 December 2018
b. English and Bangla consent form for FGD with Male/Female; version no 1.02, dated 23 December 2018
c. English and Bangla consent form household sruvey; version no 1.02, dated 23 December 2018
d. English and Bangla assent form for FGD with adolescent girls; version no 1.02, dated 23 December 2018

The IRB of icddr,b shall take into account the regulations of the Bangladesh Medical Research Council (BMRC), WHO, international guidelines for biomedical research as laid down by the Council of International Organization of Medical Sciences (CIOMS), the Declaration of Helsinki in relation to biomedical research involving human participants, ICH Guidelines on Good Clinical Practice (GCP), National Institutes of Health (NIH), National Institute of Allergy and Infectious Diseases (NIAID), and Division of Microbiology and Infectious Diseases (DMID). If there is any new declaration involving human participants, contents of such declaration should be appropriately adhered to and the applicable laws and policies of the local government.

I wish you success in running the above-mentioned study.

Cc: Senior Director, IDD
Senior Manager, Budget & Planning, Finance

8 References

1.

Abdi, H. & Valentin, D. (2007). The STATIS method. *Encyclopedia of measurement and statistics*, 955-962.

2.

Adrianzén, M.A. (2014). Social capital and improved stoves usage decisions in the northern Peruvian Andes. *World Development*, 54, 1-17.

3.

Alam, M.U., Winch, P.J., Saxton, R.E., Nizame, F.A., Yeasmin, F., Norman, G. *et al.* (2017). Behaviour change intervention to improve shared toilet maintenance and cleanliness in urban slums of Dhaka: a cluster-randomised controlled trial. *Tropical Medicine & International Health*, 22, 1000-1011.

4.

Allen, A., Hofmann, P. & Griffiths, H. (2008). Moving down the ladder: Governance and sanitation that works for the urban poor. In: *IRC Symposium on Urban Sanitation*.

5.

Andersson, K., Dickin, S. & Rosemarin, A. (2016). Towards "sustainable" sanitation: challenges and opportunities in urban areas. *Sustainability*, 8, 1289.

6.

Association, S. (2018). *Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response*. PRACTICAL ACTION.

7.

Baker, K.K., O'Reilly, C.E., Levine, M.M., Kotloff, K.L., Nataro, J.P., Ayers, T.L. *et al.* (2016). Sanitation and hygiene-specific risk factors for moderate-to-severe diarrhea in young children in the global enteric multicenter study, 2007–2011: case-control study. *PLoS medicine*, 13, e1002010.

8.

Bapat, M. & Agarwal, I. (2003). Our needs, our priorities; women and men from the slums in Mumbai and Pune talk about their needs for water and sanitation. *Environment and Urbanization*, 15, 71-86.

9.

Bertrand, M. & Mullainathan, S. (2001). Do People Mean What They Say? Implications for Subjective Survey Data. *American Economic Review*.

10.

Biran, A., Jenkins, M., Dabrase, P. & Bhagwat, I. (2011). Patterns and determinants of communal latrine usage in urban poverty pockets in Bhopal, India. *Tropical medicine & international health*, 16, 854-862.

11.

Bisung, E., Elliott, S.J., Schuster-Wallace, C.J., Karanja, D.M. & Bernard, A. (2014). Social capital, collective action and access to water in rural Kenya. *Social science & medicine*, 119, 147-154.

12.

Bouma, J., Bulte, E. & van Soest, D. (2008). Trust and cooperation: Social capital and community resource management. *Journal of environmental economics and management*, 56, 155-166.
13.

Bowles, S. & Gintis, H. (2002). Social capital and community governance. *The economic journal*, 112, F419-F436.
14.

Brown, J., Cumming, O., Bartram, J., Cairncross, S., Ensink, J., Holcomb, D. *et al.* (2015). A controlled, before-and-after trial of an urban sanitation intervention to reduce enteric infections in children: research protocol for the Maputo Sanitation (MapSan) study, Mozambique. *BMJ open*, 5, e008215.
15.

Buckley, R.M. & Kallergis, A. (2019). The Sustainable Development Goal for Urban Sanitation: Africa's Statistical Tragedy Continues? *Journal of Urban Health*, 96, 123-130.
16.

Burra, S., Patel, S. & Kerr, T. (2003). Community-designed, built and managed toilet blocks in Indian cities. *Environment and Urbanization*, 15, 11-32.
17.

Cairncross, S. & Mundial, B. (1992). Sanitation and water supply: practical lessons from the decade.
18.

Cameron, L.A., Olivia, S. & Shah, M. (2015). Initial conditions matter: social capital and participatory development. *Available at SSRN 2704614*.
19.

Cardone, R., Schrecongost, A. & Gilsdorf, R. (2018). Shared and Public Toilets: Championing Delivery Models That Work. World Bank.
20.

Caruso, B.A., Freeman, M.C., Garn, J.V., Dreibelbis, R., Saboori, S., Muga, R. *et al.* (2014). Assessing the impact of a school-based latrine cleaning and handwashing program on pupil absence in Nyanza Province, Kenya: a cluster-randomized trial. *Tropical Medicine & International Health*, 19, 1185-1197.
21.

Chipungu, J., Tidwell, J.B., Chilengi, R., Curtis, V. & Aunger, R. (2018). The social dynamics around shared sanitation in an informal settlement of Lusaka, Zambia. *Journal of Water, Sanitation and Hygiene for Development*, 9, 102-110.
22.

Contzen, N. & Mosler, H.-J. (2015). The RANAS approach to systematic behavior change. *Methodological Fact Sheet*, 1-6.
23.

Corburn, J. & Hildebrand, C. (2015). Slum sanitation and the social determinants of women's health in Nairobi, Kenya. *Journal of environmental and public health*, 2015.
24.

Devarajan, S. (2013). Africa's statistical tragedy. *Review of Income and Wealth*, 59, S9-S15.
25.

Ejemot-Nwadiaro, R.I., Ehiri, J.E., Arikpo, D., Meremikwu, M.M. & Critchley, J.A. (2015). Hand washing promotion for preventing diarrhoea. *Cochrane Database of Systematic Reviews*.

26.

Ejemot-Nwadiaro, R.I., Ehiri, J.E., Meremikwu, M.M. & Critchley, J.A. (2008). Hand washing for preventing diarrhoea. *Cochrane database of systematic reviews*.

27.

Evans, B., Hueso, A., Johnston, R., Norman, G., Pérez, E., Slaymaker, T. *et al.* (2017). Limited services? The role of shared sanitation in the 2030 Agenda for Sustainable Development. *Journal of Water, Sanitation and Hygiene for Development*, 7, 349-351.

28.

Exley, J.L., Liseka, B., Cumming, O. & Ensink, J.H.J. (2015). The sanitation ladder, what constitutes an improved form of sanitation? *Environmental science & technology*, 49, 1086-1094.

29.

Ezzrar, A. & Verme, P. (2012). A multiple correspondence analysis approach to the measurement of multidimensional poverty in Morocco, 2001-2007. pp. 1-42.

30.

Filmer, D. & Pritchett, L. (2001). Estimating Wealth Effects Without Expenditure Data--Or Tears: An Application to Educational Enrollments in States of India. *Demography*, 38, 115-132.

31.

Friese, S. (2019). *Qualitative data analysis with ATLAS. ti*. SAGE Publications Limited.

32.

Fuller, J.A., Clasen, T., Heijnen, M. & Eisenberg, J.N. (2014). Shared sanitation and the prevalence of diarrhea in young children: evidence from 51 countries, 2001–2011. *The American journal of tropical medicine and hygiene*, 91, 173-180.

33.

Garg, S., Sharma, N. & Sahay, R. (2001). Socio-cultural aspects of menstruation in an urban slum in Delhi, India. *Reproductive health matters*, 9, 16-25.

34.

Garn, J.V., Sclar, G.D., Freeman, M.C., Penakalapati, G., Alexander, K.T., Brooks, P. *et al.* (2017). The impact of sanitation interventions on latrine coverage and latrine use: A systematic review and meta-analysis. *International journal of hygiene and environmental health*, 220, 329-340.

35.

Garriga, R.G., de Palencia, A.J.F. & Foguet, A.P. (2015). Improved monitoring framework for local planning in the water, sanitation and hygiene sector: From data to decision-making. *Science of the total environment*, 526, 204-214.

36.

Giné-Garriga, R., Flores-Baquero, Ó., de Palencia, A.J.-F. & Pérez-Foguet, A. (2017). Monitoring sanitation and hygiene in the 2030 Agenda for Sustainable Development: A review through the lens of human rights. *Science of the Total Environment*, 580, 1108-1119.

37.

Giné-Garriga, R. & Pérez Foguet, A. (2013). Water, sanitation, hygiene and rural poverty: issues of sector monitoring and the role of aggregated indicators. *Water policy*, 15, 1018-1045.

38.

Giné-Garriga, R., Requejo, D., Molina, J.L. & Pérez-Foguet, A. (2018). A novel planning approach for the water, sanitation and hygiene (WaSH) sector: The use of object-oriented bayesian networks. *Environmental modelling & software*, 103, 1-15.

39.

Günther, I., Horst, A., Lüthi, C., Mosler, H.-J., Niwagaba, C. & Tumwebaze, I.K. (2011). Where do Kampala's poor "go"?-Urban sanitation conditions in Kampala's low-income areas.

40.

Günther, I., Niwagaba, C., Lüthi, C., Horst, A., Mosler, H.-J. & Tumwebaze, I.K. (2012). When is shared sanitation improved sanitation. *The correlation between number of users and toilet hygiene*.

41.

Hawkins, P., Blackett, I. & Heymans, C. (2013). Targeting the urban poor and improving services in small towns. Poor-inclusive urban sanitation: an overview. *World Bank Water and Sanitation Programme. Available at www. wsp. org/sites/wsp. org/files/publications/WSP-Poor-Inclusive-Urban-Sanitation-Overview. pdf*.

42.

Heijnen, M., Cumming, O., Peletz, R., Chan, G.K.-S., Brown, J., Baker, K. *et al.* (2014a). Shared sanitation versus individual household latrines: a systematic review of health outcomes. *PloS one*, 9.

43.

Heijnen, M., Rosa, G., Fuller, J., Eisenberg, J.N. & Clasen, T. (2014b). The geographic and demographic scope of shared sanitation: an analysis of national survey data from low-and middle-income countries. *Tropical medicine & international health*, 19, 1334-1345.

44.

Heijnen, M., Routray, P., Torondel, B. & Clasen, T. (2015). Shared sanitation versus individual household latrines in urban slums: a cross-sectional study in Orissa, India. *The American journal of tropical medicine and hygiene*, 93, 263-268.

45.

Héller, L. (2015). Report of the Special Rapporteur on the human right to safe drinking water and sanitation.

46.

Hueso, A., Malhotra, M., Shipra, P. & Nath, P. (2018). Female-friendly public and community toilets: A guide for planners and decision makers. UNICEF, WSUP, WaterAid New York, NY; London, UK, p. 56.

47.

Hulland, K.R., Chase, R.P., Caruso, B.A., Swain, R., Biswal, B., Sahoo, K.C. *et al.* (2015). Sanitation, stress, and life stage: a systematic data collection study among women in Odisha, India. *PloS one*, 10.

48.

Hutton, G. & Whittington, D. (2015). *Benefits and costs of the water sanitation and hygiene targets for the post-2015 development agenda*. Copenhagen Consensus Center.

49.

Isunju, J., Schwartz, K., Schouten, M., Johnson, W. & Van Dijk, M. (2011). Socio-economic aspects of improved sanitation in slums: a review. *Public health*, 125, 368-376.

50.

Jenkins, M.W. (2004). Who Buys Latrines, Where and Why?

51.

Jenkins, M.W. & Curtis, V. (2005). Achieving the 'good life': Why some people want latrines in rural Benin. *Social science & medicine*, 61, 2446-2459.

52.

Jenkins, M.W., Freeman, M.C. & Routray, P. (2014). Measuring the safety of excreta disposal behavior in India with the new safe san index: reliability, validity and utility. *International journal of environmental research and public health*, 11, 8319-8346.

53.

Jenkins, M.W. & Scott, B. (2007). Behavioral indicators of household decision-making and demand for sanitation and potential gains from social marketing in Ghana. *Social science & medicine*, 64, 2427-2442.

54.

Jenkins, M.W. & Sugden, S. (2006). Rethinking Sanitation–Lessons and Innovation for Sustainability and Success in the New Millennium UNDP HDR2006–Sanitation Thematic Paper.

55.

Johnson, L. (2016). What is social capital? In: *Social Capital and Community Well-Being* (ed. Greenberg, AGTPG, Thomas P.; Bloom, Martin). Springer International Publishing , Switzerland, pp. pp. 53–66.

56.

Kabange, R.S. & Nkansah, A. (2015). Shared sanitation facilities: A reality or mirage? *American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)*, 14, 172-177.

57.

Kar, K. & Chambers, R. (2008). Handbook on community-led total sanitation.

58.

Konradsen, F., van der Hoek, W. & Evans, B. (2010). Building political commitment for sanitation in a fragmented institutional landscape. In: *Reaching the Mdg Target for Sanitation in Africa*. Ministry of Foreign Affairs of Denmark, pp. 19-22.

59.

Kwiringira, J., Atekyereza, P., Niwagaba, C. & Günther, I. (2014a). Descending the sanitation ladder in urban Uganda: evidence from Kampala Slums. *BMC public health*, 14, 624.

60.

Kwiringira, J., Atekyereza, P., Niwagaba, C. & Günther, I. (2014b). Gender variations in access, choice to use and cleaning of shared latrines; experiences from Kampala Slums, Uganda. *BMC public health*, 14, 1180.

61.

Kwiringira, J., Atekyereza, P., Niwagaba, C., Kabumbuli, R., Rwabukwali, C., Kulabako, R. *et al.* (2016). Seasonal variations and shared latrine cleaning practices in the slums of Kampala city, Uganda. *BMC public health*, 16, 361.

62.

Lüthi, C., McConville, J. & Kvarnström, E. (2010). Community-based approaches for addressing the urban sanitation challenges. *International Journal of Urban Sustainable Development*, 1, 49-63.

63.

Lüthi, C., Morel, A., Tilley, E. & Ulrich, L. (2011). Community-led urban environmental sanitation planning (CLUES). *Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf, Switzerland*.

64.

Mahon, T. & Fernandes, M. (2010). Menstrual hygiene in South Asia: a neglected issue for WASH (water, sanitation and hygiene) programmes. *Gender & Development*, 18, 99-113.
65.

Mara, D. (2016). Shared sanitation: to include or to exclude? *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 110, 265-267.
66.

Mara, D. & Alabaster, G. (2008). A new paradigm for low-cost urban water supplies and sanitation in developing countries. *Water Policy*, 10, 119-129.
67.

Massa, K., Kilamile, F., Safari, E., Seleman, A., Mwakitalima, A., Balengayabo, J.G. *et al.* (2017). Contributing to the debate on categorising shared sanitation facilities as 'unimproved': An account based on field researchers' observations and householders' opinions in three regions, Tanzania. *PloS one*, 12, e0185875.
68.

Mayoux, L. (2012). Gender mainstreaming in value chain development: Experience with Gender Action Learning System in Uganda. *Enterprise Development and Microfinance*, 23, 319-337.
69.

Mayring, P. (2015). Qualitative Inhaltsanalyse. 12., überarb. Aufl. Weinheim: Beltz.
70.

Mazeau, A. & Reed, B. (2010). Assessing people's views of infrastructure: methodologies to study urban shared sanitation. In: *World Wide Workshop for Young Environmental Scientists: 2010*.
71.

Mazeau, A., Reed, B., Sansom, K. & Scott, R. (2014). Emerging categories of urban shared sanitation. *Water and Environment Journal*, 28, 592-608.
72.

Mazeau, A., Tumwebaze, I., Lüthi, C. & Sansom, K. (2013). Inclusion of shared sanitation in urban sanitation coverage? Evidence from Ghana and Uganda. *Waterlines*, 32, 334-348.
73.

McFarlane, C. (2008). Sanitation in Mumbai's informal settlements: State,'slum', and infrastructure. *Environment and planning A*, 40, 88-107.
74.

McGranahan, G. (2007). Improving water and sanitation services in deprived urban neighborhoods: avoiding global distractions and pursuing local priorities. *GLOBAL URBAN POVERTY*.
75.

McGranahan, G. (2013). Community-driven sanitation improvement in deprived urban neighbourhoods: meeting the challenges of local collective action, co-production, affordability and a trans-sectoral approach. SHARE.
76.

McGranahan, G. (2015). Realizing the right to sanitation in deprived urban communities: meeting the challenges of collective action, coproduction, affordability, and housing tenure. *World development*, 68, 242-253.
77.

McGranahan, G. & Mitlin, D. (2016). Learning from sustained success: how community-driven initiatives to improve urban sanitation can meet the challenges. *World Development*, 87, 307-317.
78.

McKenzie, D.J. (2005). Measuring inequality with asset indicators. *Journal of Population Economics*, 18, 229-260.
79.

Mitlin, D. (2011). Pathfinder Paper: Equity and gender 52.
80.

Morgan, D.L. & Krueger, R. (1998). The focus group kit Thousand Oaks. Beverley Hills, CA: Sage Publications.
81.

Mukherjee, N., Robiarto, A., Saputra, E. & Wartono, D. (2012). Achieving and sustaining open defecation free communities: Learning from East Java. *Water and Sanitation Program*.
82.

Napitupulu, L. & Hutton, G. (2008). Economic impacts of sanitation in Indonesia. *Hanoi: World Bank*.
83.

Nederhof, A.J. (1985). Methods of coping with social desirability bias: A review. *European Journal of Social Psychology*, 15, 263-280.
84.

Nelson, K.B., Karver, J., Kullman, C. & Graham, J.P. (2014). User perceptions of shared sanitation among rural households in Indonesia and Bangladesh. *PloS one*, 9, e103886.
85.

Nilsson, M. & Olsson, L. (2014). Sanitation in an Informal Settlement–A User-Oriented Study on Sanitation Solutions and Factors Influencing Decisions for Implementation in Cochabamba, Bolivia. MS thesis, Chalmers University of Technology, Gothenburg, Sweden. http ….
86.

Norman, G. (2011). When are communal or public toilets an appropriate option. *Topic Brief*.
87.

Obeng, P.A., Keraita, B., Oduro-Kwarteng, S., Bregnhøj, H., Abaidoo, R.C. & Konradsen, F. (2015). The latrine ownership ladder: A conceptual framework for enhancing sanitation uptake in low-income peri-urban settings. *Management of Environmental Quality: An International Journal*, 26, 752-763.
88.

Okurut, K. & Charles, K. (2014). Household demand for sanitation improvements in low-income informal settlements: A case of East African cities. *Habitat international*, 44, 332-338.
89.

Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge university press.
90.

Ostrom, E. (1996). Crossing the great divide: coproduction, synergy, and development. *World development*, 24, 1073-1087.
91.

Ostrom, E. (2002). Reformulating the commons. *Ambiente & sociedade*, 5-25.
92.

Ostrom, E. (2008). Institutions and the Environment. *Economic affairs*, 28, 24-31.
93.

Ostrom, E. & Ahn, T.-K. (2009). The meaning of social capital and its link to collective action. *Handbook of social capital: The troika of sociology, political science and economics*, 17-35.
94.

Parkinson, J. & Lüthi, C. (2014). *Sanitation 21: A Planning Framework for Improving: City-wide Sanitation Services*. IWA.
95.

Pokharel, K. (2018). Availability of WASH Facilities for Effective Menstrual Hygiene Management at Home for Kenyan School Girls.
96.

Potter, A., Klutse, A., Snehalatha, M., Batchelor, C., Uandela, A., Naafs, A. *et al.* (2011). Assessing sanitation service levels. *IRC: The Hague, The Netherlands*.
97.

Prüss-Ustün, A., Wolf, J., Bartram, J., Clasen, T., Cumming, O., Freeman, M.C. *et al.* (2019). Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low-and middle-income countries. *International journal of hygiene and environmental health*, 222, 765-777.
98.

Rheinländer, T., Keraita, B., Konradsen, F., Samuelsen, H. & Dalsgaard, A. (2013). Smell: an overlooked factor in sanitation promotion. *Waterlines*, 32, 106-112.
99.

Rheinländer, T., Konradsen, F., Keraita, B., Apoya, P. & Gyapong, M. (2015a). Redefining shared sanitation. *Bulletin of the World Health Organization*, 93, 509-510.
100.

Rheinländer, T., Konradsen, F., Keraita, B., Apoya, P. & Gyapong, M. (2015b). Redefining shared sanitation. *Bulletin of the World Health Organization*, 93, 509-510.
101.

Sahoo, K.C., Hulland, K.R., Caruso, B.A., Swain, R., Freeman, M.C., Panigrahi, P. *et al.* (2015). Sanitation-related psychosocial stress: a grounded theory study of women across the life-course in Odisha, India. *Social science & medicine*, 139, 80-89.
102.

Satterthwaite, D., McGranahan, G. & Mitlin, D. (2005). *Community-driven development for water and sanitation in urban areas: Its contribution to meeting the Millennium Development Goal targets*. Iied.
103.

Satterthwaite, D., Mitlin, D. & Bartlett, S. (2015). Is it possible to reach low-income urban dwellers with good-quality sanitation? SAGE Publications Sage UK: London, England.
104.

Schouten, M. & Mathenge, R. (2010). Communal sanitation alternatives for slums: A case study of Kibera, Kenya. *Physics and Chemistry of the Earth, Parts A/B/C*, 35, 815-822.
105.

Scott, P., Scott, R.E. & Cotton, A.P. (2017). Urban sanitation: where to next?
106.

Shakya, H.B., Christakis, N.A. & Fowler, J.H. (2014). Association between social network communities and health behavior: an observational sociocentric network study of latrine ownership in rural India. *American Journal of Public Health*, 104, 930-937.
107.

Shiras, T., Cumming, O., Brown, J., Muneme, B., Nala, R. & Dreibelbis, R. (2018a). Shared latrines in Maputo, Mozambique: exploring emotional well-being and psychosocial stress. *BMC international health and human rights*, 18, 30.
108.

Shiras, T., Cumming, O., Brown, J., Muneme, B., Nala, R. & Dreibelbis, R. (2018b). Shared sanitation management and the role of social capital: Findings from an urban sanitation intervention in Maputo, Mozambique. *International journal of environmental research and public health*, 15, 2222.
109.

Simiyu, S. (2015). Socio-economic dynamics in slums and implications for sanitation sustainability in Kisumu, Kenya. *Development in practice*, 25, 986-996.
110.

Simiyu, S., Swilling, M., Cairncross, S. & Rheingans, R. (2017). Determinants of quality of shared sanitation facilities in informal settlements: case study of Kisumu, Kenya. *BMC public health*, 17, 68.
111.

Sinha, A., Nagel, C.L., Schmidt, W.P., Torondel, B., Boisson, S., Routray, P. *et al.* (2017). Assessing patterns and determinants of latrine use in rural settings: a longitudinal study in Odisha, India. *International journal of hygiene and environmental health*, 220, 906-915.
112.

Sonego, I.L. & Mosler, H.-J. (2014). Why are some latrines cleaner than others? Determining the factors of habitual cleaning behaviour and latrine cleanliness in rural Burundi. *Journal of Water, Sanitation and Hygiene for Development*, 4, 257-267.
113.

Sparkman, D. (2012). More than just counting toilets: the complexities of monitoring for sustainability in sanitation. *Waterlines*, 31, 260-271.
114.

Surya, A., Vyas, A., Krishna, M. & Abidi, N. (2017). Identifying Determinants of Toilet Usage by Poor in Urban India. *Procedia computer science*, 122, 634-641.
115.

Tembo, F. (2015). Improving service provision: Drawing on collective action theory to fix incentives. *A Governance Practitioner's Notebook*, 281.
116.

Thys, S., Mwape, K.E., Lefèvre, P., Dorny, P., Marcotty, T., Phiri, A.M. *et al.* (2015). Why latrines are not used: communities' perceptions and practices regarding latrines in a Taenia solium endemic rural area in Eastern Zambia. *PLoS neglected tropical diseases*, 9, e0003570.
117.

Tidwell, J.B., Chipungu, J., Chilengi, R. & Aunger, R. (2018). Assessing peri-urban sanitation quality using a theoretically derived composite measure in Lusaka, Zambia. *Journal of Water, Sanitation and Hygiene for Development*, 8, 668-678.
118.

Tidwell, J.B., Chipungu, J., Chilengi, R., Curtis, V. & Aunger, R. (2019a). Theory-driven formative research on on-site, shared sanitation quality improvement among landlords and tenants in peri-urban Lusaka, Zambia. *International journal of environmental health research*, 29, 312-325.
119.

Tidwell, J.B., Terris-Prestholt, F., Quaife, M. & Aunger, R. (2019b). Understanding demand for higher quality sanitation in peri-urban Lusaka, Zambia through stated and revealed preference analysis. *Social Science & Medicine*, 232, 139-147.
120.

Tsinda, A., Abbott, P., Pedley, S., Charles, K., Adogo, J., Okurut, K. *et al.* (2013). Challenges to achieving sustainable sanitation in informal settlements of Kigali, Rwanda. *International journal of environmental research and public health*, 10, 6939-6954.
121.

Tumwebaze, I.K. (2014). Prevalence and determinants of the cleanliness of shared toilets in Kampala slums, Uganda. *Journal of Public Health*, 22, 33-39.
122.

Tumwebaze, I.K. & Mosler, H.-J. (2014). Shared toilet users' collective cleaning and determinant factors in Kampala slums, Uganda. *BMC public health*, 14, 1260.
123.

Tumwebaze, I.K. & Mosler, H.-J. (2015). Effectiveness of group discussions and commitment in improving cleaning behaviour of shared sanitation users in Kampala, Uganda slums. *Social Science & Medicine*, 147, 72-79.
124.

Tumwebaze, I.K., Niwagaba, C.B., Günther, I. & Mosler, H.-J. (2014). Determinants of households' cleaning intention for shared toilets: case of 50 slums in Kampala, Uganda. *Habitat International*, 41, 108-113.
125.

Tumwebaze, I.K., Orach, C.G., Niwagaba, C., Luthi, C. & Mosler, H.-J. (2013). Sanitation facilities in Kampala slums, Uganda: users' satisfaction and determinant factors. *International journal of environmental health research*, 23, 191-204.
126.

UNICEF (2013). GIZ Field Guide: The Three Star Approach for WASH in Schools. Retrieved from New York, USA: https://www. unicef. org/wash/schools/files ….
127.

Vyas, S. & Kumaranayake, L. (2006). Constructing socio-economic status indices: How to use principal components analysis. *Health Policy and Planning*, 21, 459-468.
128.

Wegelin-Schuringa, M. & Kodo, T. (1997). Tenancy and sanitation provision in informal settlements in Nairobi: revisiting the public latrine option. *Environment and Urbanization*, 9, 181-190.
129.

WHO (2013). Post-2015 WASH targets and indicators. World Health Organization Switzerland, Geneva.
130.

WHO (2016). Core questions and indicators for monitoring WASH in Schools in the Sustainable Development Goals. *WHO Library Cataloguing-in-Publication Data*.
131.

WHO (2018a). Core questions and indicators for monitoring WASH in health care facilities in the Sustainable Development Goals. *WHO Library Cataloguing-in-Publication Data*.
132.

WHO (2018b). Core questions on drinking water, sanitation and hygiene for household surveys: 2018 update.
133.

WHO (2018c). Guidelines on sanitation and health.
134.

WHO (2019a). *Progress on household drinking water, sanitation and hygiene 2000-2017: special focus on inequalities*. World Health Organization.
135.

WHO (2019b). Water, sanitation, hygiene and health: a primer for health professionals. World Health Organization.
136.

Wilson, D.S., Ostrom, E. & Cox, M.E. (2013). Generalizing the core design principles for the efficacy of groups. *Journal of Economic Behavior & Organization*, 90, S21-S32.
137.

Wolf, J., Bonjour, S. & Prüss-Ustün, A. (2012). An exploration of multilevel modeling for estimating access to drinking-water and sanitation. *Journal of Water and Health*, 11, 64-77.
138.

WSUP (2018). High-quality shared sanitation: how can we define that? Water and Sanitation for the Urban Poor (WSUP).