Sanitation sustainability, seasonality and stacking: improved facilities for how long, where and whom?

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1. Introduction

Despite high-profile efforts to 'reinvent the toilet' (Gates Foundation, 2014) and 'end open defecation' (UNICEF, 2016a), WHO/UNICEF, (2017) estimated that in 2015, 2.3 billion lacked access to improved sanitation and 892 million practised open defecation (OD). This has been associated with severe environmental and health impacts (Coffey, 2014; Rees, 2014; UNICEF, 2016a) which could worsen if climate change-induced flooding or extreme events facilitate the spread of water-borne disease (McMichael, et al. 2006; Papworth, et al. 2015).

Although an estimated 2.1 billion gained access to improved sanitation between 1990 and 2015 (WHO/UNICEF, 2015a), the extent to which this translated into 'an improvement in the adequacy of provision' (Satterthwaite 2015,5) varies greatly over space, by season and between user groups. In 2015, 56% of India's population lacked basic sanitation and 40% practised open defecation although rural-urban and socio-economic variations were significant (WHO/UNICEF, 2017). These figures almost certainly over-estimate sanitation coverage as most household-level census, Demographic and Health Survey (DHS) and Multiple Indicator Cluster Survey (MICS) data used to inform sanitation tracking do 'not include informal urban settlements or slums, which are often not considered in official data collection' (WSSCC, 2015:3). Dry season bias in household survey data collection (Pullum, 2008; Wright et al., 2012) coupled with seasonal shifts in sanitation practices (Routray et al 2015; Sahoo et al 2015) are likely to create further distortion. Focus on the *presence* of particular sanitation technologies (as proxies for sanitation access), meanwhile, can conceal significant health threats in the absence of checks on whether their quality or use is sufficient to reduce health risks (Gine et al., 2011).

1.1 Limitations of Millennium Development Goal (MDG) target 7c.

MDG target 7c which sought to halve the proportion of the population without sustainable access to basic sanitation by 2015 was missed by around 700 million people (WHO/UNICEF, 2015a). During the MDG era, 'basic' or 'improved' sanitation was defined as a facility that 'hygienically separates human excreta from human contact' (WHO/UNICEF, 2016a) and the monitoring of progress towards target 7c was based on access to such facilities.[1] From 2008, the WHO/UNICEF Joint Monitoring Program for water and sanitation (JMP) devised a four rung 'sanitation ladder' (WHO/UNICEF, 2016b) to allow more refined analyses of access to 'improved' as opposed to 'shared' or 'unimproved' facilities (see figure 1).

The ladder concept implies that people move, over time, from open defecation (OD) towards simple 'unimproved' sanitation facilities and then to more hygienic 'improved' facilities (WHO/UNICEF, 2016b). Since its adoption, however, the sanitation ladder along with the JMP's definitions of 'improved' and 'unimproved' facilities have been criticised (Kvarnström et al., 2011). Their lack of consideration for quality, reliability, seasonality and longer-term sustainability issues meanwhile, (especially where target-let approaches promote inappropriate designs with poor sustainability of use and function) can result in over-optimistic coverage estimates (Gine et al., 2011; Hueso and Bell, 2013). Although the ladder concept's failure to consider simultaneous or seasonal use ('stacking') of options from different rungs

has been highlighted for fuel and cookstove use (Masera et al., 2000)[2] and may be equally relevant for the sanitation sector, this was not explored in MDG (or subsequent) monitoring mechanisms.

Figure 1: The sanitation ladders used for MDG (left) and SDG (right) monitoring.

Sources: WHO/UNICEF (2016a), WHO/UNICEF (2016d), WHO (2017).

Additional complications include variations in sanitation access over space and by socio-economic status, gender, age and disability; often with user priorities failing to reflect health or technology-based understandings of 'improved' sanitation (Barnard et al., 2013; Routray et al., 2015; O'Reilly et al., 2016). Women's and girls' lived experiences of poor access to safe, usable toilets coupled with socio-cultural norms surrounding acceptable sanitation practices, female mobility and status often combine to create 'toilet insecurity' and associated 'psychosocial stress' (Caruso et al., 2017; O'Reilly, 2016; Sahoo et al., 2015). Socio-cultural and environmental

restrictions on where they can safely defecate, coupled with additional menstrual hygiene management-related (MHM) challenges, frequently (but not always; O'Reilly et al., 2016; Sahoo et al., 2015) mean that women and girls value the convenience, safety, privacy and dignity of well-built, functional toilets (Jewitt, 2011; Jewitt and Ryley, 2014; Mehta, 2011; O'Reilly, 2016). Latrine use by small children (Dombroski, 2015; Sahoo et al., 2015) and disabled or frail elderly people, meanwhile, can present significant practical and cultural challenges that may result in persistent OD (Wilbur and Jones, 2014). As MDG monitoring systems have not routinely collected gender or age-disaggregated data, however, there is limited baseline knowledge of such trends (Brocklehurst, 2012).

Sustained latrine use by all community members can also present significant challenges for initiatives seeking to end OD (Caruso et al., 2017; Wilbur and Jones, 2014). Latrine owners may restrict access to certain individuals, while some people actively prefer OD over latrine use (Bardosh, 2015; Barnard et al., 2013; Coffey et al., 2014; O'Reilly et al., 2016). Poorly constructed or maintained facilities may be quickly abandoned as users revert to OD (Hueso and Bell, 2013; Routray et al., 2015). Building on the fuel/stove stacking analogy (Masera et al., 2000), meanwhile, the presence of good sanitation at home does not imply good sanitation at work, school or elsewhere (World Vision, 2017). In rural areas, for example, latrine-owning households routinely practise OD whilst undertaking field-or forest-based work (Bardosh, 2015; O'Reilly et al., 2016).

In analysing the factors that contribute to successful sanitation adoption, O'Reilly and Louis (2014:44) emphasise the importance of 'proximate social pressure' (increased exposure to toilets and toilet users) coupled with 'multi-scalar political will' as 'legs' in a tripod of sanitation enablers. Their third leg comprises 'political ecology' factors including land use change or unequal access to natural resources. Examples include increased urbanisation limiting availability of private and safe OD sites or the influence of environmental factors (seasonal flooding, freezing, water availability, water table levels and soil type/porosity) on latrine access, use, sustainability and durability (*ibid*; Caruso et al., 2017; Halvorson et al., 2011; Routray et al., 2015; Sahoo et al., 2015). Reflecting this, stacking as well as movement up or down the sanitation ladder may occur as people's circumstances change.

1.2 Sustainable Development Goal 6 sanitation targets and monitoring

In an effort to address some of these problems and data gaps, the JMP facilitated a consultation process to develop measurable, achievable and ambitious Sustainable Development Goal 6 (SDG6) WASH targets that would address MDG shortcomings and unfinished business (WSSCC, 2015). Reflecting this process, SDG6 target 6.2 placed particular emphasis on 'access for all' (UNICEF, 2016b) and reducing inequalities between sub-groups (see table 1). While the JMP (2015) recognises the importance of developing alternatives to household surveys for measuring such inequalities, this is seen as a 'long term prospect' (18) although they will 'support development and testing of questions that could be included in future household surveys' (5). In the short term at least, then, sanitation access monitoring seems set to keep its largely technology-oriented focus with the sanitation ladder being retained (see figure 1). A key difference is the addition of a new 'safely managed' top rung, although the definitions of 'improved'/'unimproved' facilities are broadly similar and shared sanitation remains a separate category.[3]

Table 1: SDG target 6.2's aim, key emphases and monitoring approaches.

Target	To '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' by 2030 (UNICEF, 2016b).
Indicator	• The 'proportion of population using safely managed sanitation services including a handwashing facility with soap and water' (WHO/UNICEF, 2016d:2).
Key emphases	• To achieve 'access for all' which implies facilities that are 'suitable for use by men, women, girls and boys of all ages including people living with disabilities' (WHO, 2017:1) and 'can be easily reached and used when needed' (WSSCC, 2015:2). • To realize the Human Right to Water and Sanitation (HRWS) progressively by monitoring accessibility, quantity, quality and affordability and promoting more equitable WASH access (JMP, 2015; WSSCC, 2015).
Tracking	• 5 rung sanitation ladder (see figure 1) as the service ladder concept is seen as consistent with the progressive realization of HRWS (JMP, 2015).
Key monitoring tools	• Household surveys and censuses anticipated to 'remain the primary source of data for monitoring targets 6.1 and 6.2' (WHO/UNICEF, 2016b:3) • Longer term emphasis on alternatives to household surveys for measuring 'intra-household inequalities such as sex, age, or disability' (WSSCC, 2015:3) • Shift from monitoring infrastructure-related outputs to behavioural/quality-related outcomes (IRC, 2013) • Shit flow diagrams.

While it is recognised that universal coverage of 'safely managed' sanitation may not be realistic in countries still seeking to achieve 'basic' services, the need to identify whether basic sanitation systems are working properly is acknowledged (GEMI, 2016). This is reflected in criteria used for verifying the status of 'open defecation free' (ODF) villages under India's flagship 'clean India' Swachh Bharat Mission (SBM) programme (MDWS, 2017) as well as in tools designed to track progress towards 'safely managed' sanitation (GEMI, 2016). These include 'shit flow diagrams' (SFD) which estimate the proportion of faecal waste that is safely contained (including in-situ disposal), transported and delivered to treatment plants (Peal et al, 2014; Susana, 2017).

Despite prominence given to addressing the 'unfinished business' of the MDGs and ensuring that 'no one is left behind' (UN, 2016), concerns have been raised that SDG6 contains 'little or no mention of context' as the 'entire statistical base for assessing progress defines improved provision the same way for all areas' (Satterthwaite, 2015:7). This underlines the importance of geographically-informed approaches for implementation and monitoring of this ambitious agenda. Drawing on data from a peri-urban village with good sanitation access in Guwahati, Assam, this paper illustrates key drawbacks with global sanitation monitoring whilst highlighting

gaps between user-based and JMP definitions of and priorities for 'improved' sanitation. It also identifies implications for the verification of 'safe technology' options under the SBM which seeks to end open defecation by 2019 (MDWS, 2017).

Arguments are made for the need (and potential means) to monitor seasonal fluctuations in the status of 'improved' and 'private' facilities in areas where this may affect their use, functionality and safety. Attention is also drawn to the importance - in terms of promoting sanitation 'access for all' (WHO, 2017) of capturing data on sanitation 'stacking' to complement information collected in DHS phase 7 and MICS 6 monitoring on facilities that households *usually* use. Section 2 will provide an overview of the study village and the methodologies used. The research findings are presented and discussed in Section 3. Section 3.1 outlines sanitation facilities in the study site and section 3.2 focuses on changing sanitation practices and latrine uptake since the village's establishment in 1992. In Sections 3.3 ('improved for how long?') and 3.4 ('improved for where/when?'), emphasis is placed on sustainability concerns associated with pit emptying, poor construction and seasonal flooding, with SFDs being used to illustrate variations arising from the use of different monitoring criteria. Section 3.5 ('improved for whom?') explores context-specific user-based sanitation preferences and how these combine with seasonal flooding to promote the 'stacking' of sanitation practices including OD.

Given high (93.4%) sanitation coverage alongside persistent OD in the study village, the influence of different legs of O'Reilly and Louis's (2014) 'toilet tripod' will be investigated. As the SBM has yet to reach the study area, evidence of 'multi-scalar political will' will be explored in connection with latrine building under its predecessor, the Total Sanitation Campaign (TSC).[4] 'Proximate social pressure' will be investigated through the identification of key drivers for sanitation adoption alongside factors responsible for persistent OD among certain households. The influence of political ecology is explored primarily through investigations of how local environmental conditions (and the capacity of households to respond to these) promote increased sanitation 'stacking' on a seasonal basis and contribute to persistent OD.

The paper's originality and rigour lies in its use of village-level data and newly-developed sanitation SFD tools to highlight how the functionality and safety of sanitation facilities can be affected by seasonal shifts between 'improved', 'unimproved' or shared status as well as by poor design or maintenance. The attention drawn to sanitation 'stacking' at different times/places is under-researched and novel within the sanitation sector yet has significance, along with user preferences, for tracking and monitoring access 'for all' (WHO 2017). The findings are relevant for researchers and practitioners working on water, sanitation and public health; especially those with interests in or responsibility for sanitation monitoring.

2. Study area and Methodology

Fieldwork was undertaken in a peri-urban village in Guwahati, Assam in Northeastern India settled by a diverse mixture of Nepali, Bengali, Assamese, Bihari, Bodo and Rabha families. The village, which is located on a low-lying and regularly flooded site, is somewhat unusual having been formed when around 70 households from a larger elevated village surrounded by forest were relocated there in 1992. The village has since grown to 137 households and achieved sanitation access levels

fairly typical for the area, providing an opportunity to explore how households adapted their sanitation practices following re-location.

Participatory mapping exercises provided information on sanitation and water access, key services, natural resources and household details for the whole village. More detailed quantitative and qualitative data on sanitation facilities and practices were obtained from 45 household surveys coupled with direct observation of latrine conditions, semi-structured interviews, group discussions and participatory exercises. These data were used to develop the SFDs in sections 3.3 and 3.4. Field visits were conducted in both dry and wet seasons (July-August, 2015, winter 2015-16 and July 2016) and one author remains in regular contact with villagers. Longer-term perspectives on changing sanitation practices were gained from village elders. Survey respondents were selected purposively to cover different latrine types owned by a range of ethnic and socio-economic groups. Their responses are anonymized.[5]

3. Results and Discussion

3.1 Latrine classification

There were no sewered latrines in the village and on-site facilities were classified locally as '*pukka*' 'semi-*pukka'* and '*kucha'* (see table 2). Interview responses and direct observation were combined to map these classifications onto those used by the JMP (WHO/UNICEF, 2016a). *Pukka* facilities fall into the 'improved' category as they are pour-flush latrines discharging to septic tanks or pits with a concrete plinth and pan, and a solid superstructure comprising of brick, timber, metal sheets, a roof and a solid door. Semi-*pukka* latrines also fall into the 'improved' sanitation category as they have a concrete plinth with a pan and single or twin soak pits. *Kucha* latrines fall into the 'unimproved' category and generally comprise of an earthen hole with no 'squatting slab, platform or seat' (JMP 2015:20).

Table 2: Types of sanitation system in the village

Types of sanitation system	Number	Remarks
Improved ('*pukka*') pour flush latrine with two pits/tanks	84	'Improved' facilities built by individual households or government-built latrines later improved by individual households.
Improved 'semi-*pukka*' pour flush latrine with two pits	44	'Improved' latrines with non-durable superstructure (often no door) and extra soak pit constructed by households.
No latrine (includes abandoned '***kucha***' latrines).	9	Mostly practise OD but some household members share neighbours' latrines.

The superstructures of most semi-*pukka* latrines are flimsily constructed causing them to lack durability, security and privacy. This contributes to sanitation insecurity (Caruso et al., 2017) and - although not part of current 'improved' sanitation definitions at household level – fails to meet SDG6 and HRWS concerns about safety and dignity; especially for women and girls (JMP, 2015). Although two *kucha* latrines were identified in the sample, we re-classified these as 'no latrine' as their owners had abandoned them due to flooding and were practising OD. In total, 93.4% of households were classified, using JMP criteria, as having 'improved' sanitation.

3.2 Changing sanitation practices and latrine uptake in the study sites

In the village's previous location, many households had built their own unimproved latrines while others practised OD in surrounding woodlands. The privacy and distance that these woodlands provided were important for intra-village harmony given disapproval of OD amongst numerically-dominant Nepali and Assamese households. Following relocation in 1992, the loss of private OD sites coupled with greater pressure on habitable space created 'proximate social pressure' (O'Reilly and Louis, 2014) to develop new sanitation systems. Some households built *pukka* latrines as early as 1993 while others gradually upgraded from OD to *kucha* latrines and improved their pits and superstructures when savings allowed. Others were forced by financial constraints, coupled with difficulties in maintaining their latrines, to revert to OD.

Even though 'below poverty line' (BPL) households were eligible for subsidised sanitary slabs costing Rs.150 under the TSC scheme (so long as they dug their own latrine pit), uptake was limited as the slabs soon developed cracks and were abandoned. Reflecting the importance of 'multi-scalar political will' (O'Reilly and Louis, 2014) in making sanitation accessible to the poor, corruption surrounding BPL designation was mentioned as a limitation on sanitation access by low income households. Of the 9 survey households with BPL cards, only one earned less than Rs.5000/month while 7 earned Rs.5-10,000 and one earned Rs.10-15,000. The three other households earning under Rs.5000/month said that they could not afford the bribes needed to obtain BPL cards. As in other areas of India (Barnard et al., 2013; Hueso and Bell, 2013; Mehta, 2011), this type of corruption helps to perpetuate existing socio-economic inequalities whilst limiting low income non-BPL cardholders to poorly-constructed latrines requiring further investment.

In 2008-9, another phase of TSC toilet construction commenced and having seen the resulting latrines elsewhere, many respondents were hoping that a TSC subsidy would enable them to build (and use) better quality facilities. Frequent references by recipients to the low cost (Rs.300) and quality of the latrines built and the limited number of households (not all of them BPL) initially informed about the scheme, however, hinted at corruption by local government functionaries. According to a local mason, TSC latrines in Guwahati were normally constructed using 500 bricks (for the latrine plinth and pit lining), 3 bags of cement, sand, a toilet pan, pipework and bamboo sheets for the superstructure. State-level TSC guidance, meanwhile, recommends that in areas liable to flooding, latrines should be built on sites 'raised to a considerable height' with the pan and squatting plate placed directly over the pit (DDWS n.d.).

In the study village, recipients were given just one bag of cement, 150 bricks, sand, pipework and a sanitary pan. They were expected to dig a soak pit and build the superstructure themselves but limited funds and short notice of the commencement of building work prevented many households from elevating their latrine sites. The latrine plinths, pans and pipework were constructed by government-employed masons. Approximately 27 households benefited from this scheme but high levels of 'proximate social pressure' in the village linked to strong disapproval of OD by the village's Nepali and Assamese families encouraged other households to upgrade existing *kucha* latrines or invest in brick *pukka* latrines with solid doors and double

pits. Most did this gradually, using their own funds and labour, but between 2010-2015, four households took out micro-credit loans for this purpose.

3.3. Improved for how long?

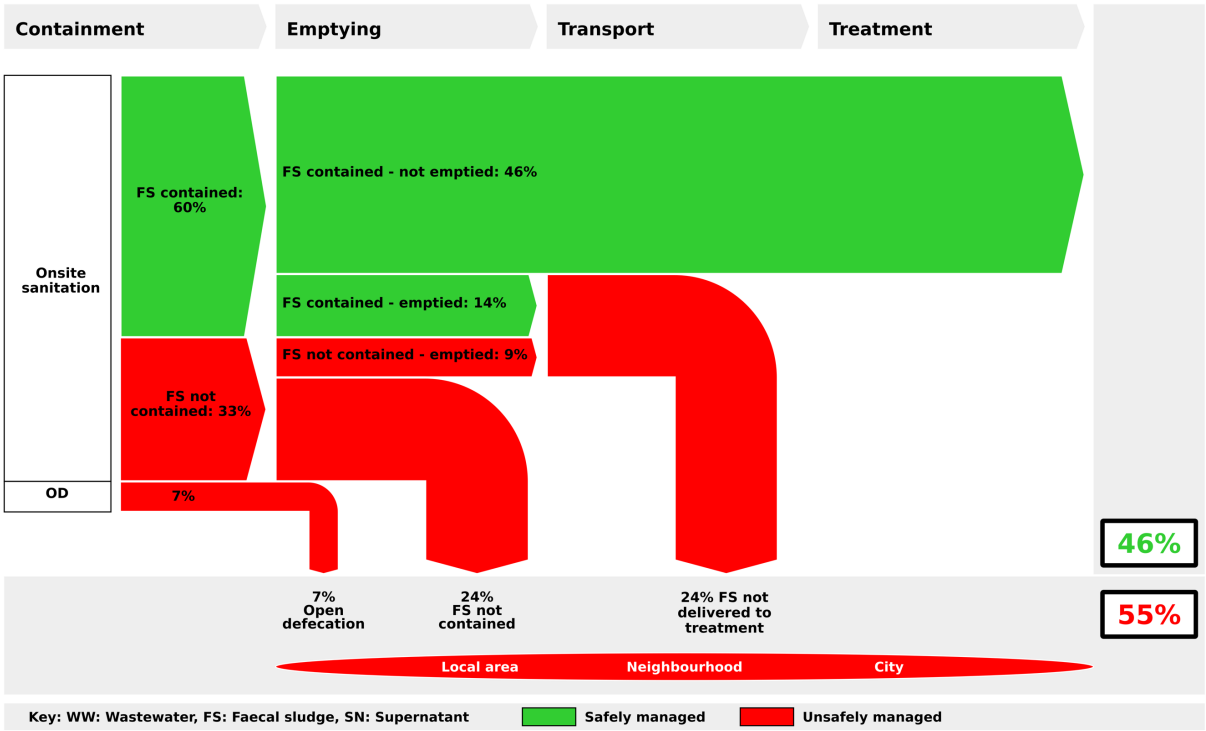
Despite the TSC's apparent success in extending 'improved' sanitation access, interviews and group discussions highlighted problems related to poor planning and construction that echo findings elsewhere (Barnard et al., 2013; Hueso and Bell, 2013; O'Reilly et al., 2016; Routray et al., 2015). Many respondents described how government-employed masons were concerned about funds and materials for latrine construction being withdrawn suddenly, so they worked very fast, completing five to seven latrine plinths per day. Some cracked because the earth underlying them was not properly compacted. This forced households to make their own repairs, although the quality was variable. Echoing SDG6's recent emphasis on 'sustainably managed' sanitation (JMP, 2015), another concern by TSC beneficiaries centred on how long their single soak pits would take to fill and what they would do when they did. Reflecting a desire to avoid the unpleasant task of emptying them[6] coupled with 'proximate social pressure' linked to the spread of privately-built *pukka* latrines with two tanks/pits, all TSC latrine owners went on to build additional tanks/pits; often at significant cost.

When prompted for information about the nature of their sanitation systems,[7] TSC beneficiaries and private pour-flush latrine owners all said that these discharged to either septic tanks or underground pits with soakaways. As latrines bordering marshland were often obscured by thick vegetation and boggy ground, it wasn't until we visited an island hamlet that we observed several above-ground tanks with effluent pipes discharging into seasonally-flooded marshland. Further exploration revealed that such systems were common in homes backing onto village wetlands. Unless emptied very frequently (which appeared not to be the case), these facilities cannot 'hygienically separate human excreta from human contact' (WHO/UNICEF, 2016a) for long and will slip from 'improved' to 'unimproved' as their pits fill. Significantly, however, MICS, DHS and similar household surveys do not currently differentiate between functioning and non-functioning septic tanks including 'septic tanks that are damaged…flooded or where the effluent outlet is connected to an open drain' (ibid:7). This likely creates over-estimates of 'improved' sanitation coverage as well as having implications for monitoring quality of service under SGG6.2, as survey timing may prevent enumerators from detecting this status change (Pullum, 2008; Wright et al., 2012).

In order to explore this further, we collected more information on effluent disposal and pit/tank characteristics in the village and created SFDs to estimate the proportions of faecal sludge and septage classed as safely and unsafely managed. In the process, we drew on village survey data to estimate pit emptying frequency and Guwahati-wide data on groundwater levels. As can be seen in figure 2, using an assumption of groundwater depths exceeding 5m in the dry season,[8] 46% of the village's faecal waste is estimated as 'safely managed' reflecting poor effluent disposal practices coupled with open defecation. This compares very unfavourably with technology-based estimates of 93.4% 'improved' sanitation using seasonally-insensitive JMP criteria, but has similarities with SBM methods for verifying 'open defecation free' (ODF) status which emphasise safe sanitation and septage management (MDWS, 2015). Indeed, if the village sought to eliminate OD in future

and all nine latrine-less households constructed them, poor effluent disposal would (*if* proper verification occurs; The Economic Times, 2017) prevent the award of ODF status.

Figure 2: Dry Season Shit Flow Diagram



3.4. Improved for where? And when?

A related sustainability issue that highlights the need for context-specific sanitation monitoring (Satterthwaite, 2015) concerns the low-lying and seasonally inundated nature of most respondents' homestead plots. Dwellings typically occupied the most elevated land, with latrines located a short distance away on lower-lying land. While households with privately-built latrines usually invested significant time and resources in raising their latrine sites, the sudden onset of TSC latrine construction resulted in sub-optimal location choices. Initially, most functioned well but over time, the construction of more substantial compound boundary walls changed village drainage patterns, and at least 20 latrines - many TSC funded - regularly become flooded or inaccessible for 2-6 months yearly (see table 3 and figure 3). In addition, regular inundation caused the earth soak pits of many TSC latrines to disintegrate. Both situations have implications for excreta containment and monitoring as facilities shift seasonally in and out of 'improved' status. Their owners, meanwhile, face significant downstream costs associated with repairing or re-building their latrines with many opting for seasonal sanitation 'stacking'.

Figure 3: A *pukka* latrine built on raised ground to replace a dysfunctional phase 2 TSC latrine (left) and two seasonally flooded TSC latrines (centre and right).

Table 3: Seasonal changes in sanitation patterns

	Non-Monsoon	Monsoon
Households using *pukka* latrines	84	81
Households using semi-*pukka* latrines	44	27
Latrines out of use due to flooding	0	>20
Total usable latrines	128	<108
Latrines shared with neighbours/relatives	2	8+
Households with latrines practising OD	2	7
Households with no latrines practising OD	9	9
Total HHs with members practising OD	11	16

Ten sample households described having addressed flood-related latrine damage and access problems by raising the surrounding ground level using earth fetched in bamboo baskets or delivered for Rs1500/truckload. When the 20 sample households that still have seasonally-flooded latrines were asked where they defecate during the monsoons, they all reported using relatives' or neighbours' latrines. In some cases, 7-8 households reported using a single neighbour's latrine, but as many had to walk some distance to reach these facilities, they wouldn't meet the 'easily reached and used when needed' (WSSCC, 2015:2) criterion under SDG6.2's 'access for all' target.

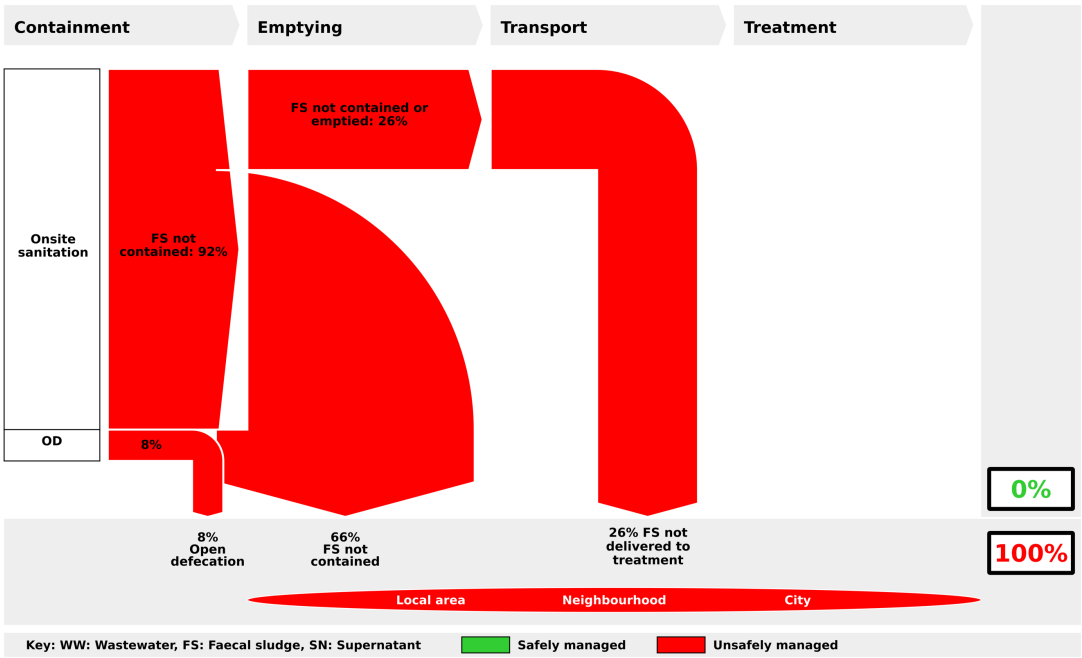
Given villagers' concerns about latrine pits filling, we were surprised by the willingness of some households to share latrines. On inspection, most of the 'shared' facilities had large septic tanks with effluent pipes discharging into marshland; this reduced the need for emptying. Several respondents mentioned that in an effort to minimise disturbance to neighbours (and pressure on their tanks), they only used their latrine for defecation; preferring to urinate in their own compounds. Significantly and despite strong disapproval within the village, four respondents with seasonally-

flooded TSC latrines said that some of their household members preferred OD during the monsoon. In part, this reflected high levels of demand for the unflooded latrines - especially in the mornings - so OD was considered more convenient. Nevertheless, even households that routinely used neighbours' latrines mentioned that family members sometimes also practised OD when they couldn't wait their turn. Others practised OD as they felt uncomfortable about imposing on their neighbours. According to one female respondent:

'During the monsoon, although I along with my two children use our neighbour's latrine until the water recedes completely, my husband uses their latrine only as a last resort. He starts using our own latrine even if it is half submerged, dangerous and slippery.'

In order to capture these seasonal shifts in sanitation use and the implications of seasonal flooding on excreta containment (McMichael et al., 2006), a monsoon-season SFD was created. Unlike the JMP classification, SFDs are not affected by shifts from individual to shared status as the focus is on containment, transport and treatment rather than the nature of the user platform. They are affected by groundwater level, however, so this SFD assumes groundwater depths of under 5m (with flooding inundating 20 pits) and a slight increase in OD. As can be seen in figure 4, under these conditions 100% of the village's faecal waste is classed as unsafely managed providing an even greater contrast with the JMP's technology-based estimate of 93.4% access to 'improved' facilities. SBM ODF verification methods, meanwhile, would only detect a change if verification took place while flooding was present (which access difficulties may prevent) as information on seasonal flooding or groundwater is not required. Yet as figure 4 illustrates, this makes the question about safe septage disposal rather redundant.

Figure 4: Monson Season Shit Flow Diagram



3.5. Improved for whom?

The willingness with which even longstanding latrine users sometimes revert to OD is interesting as it points to the limitations of 'proximate social pressure' (O'Reilly and Louis 2014). It also highlights important differences in sanitation preferences and lived experiences within communities, as well as between user-based and official priorities for 'improved' sanitation. Some (mostly Bengali) respondents mentioned a preference for OD on the grounds that they had done it since childhood and felt comfortable whereas most Nepali respondents maintained that their family members do not defecate in the open, even when their latrines are submerged. Amongst the 16 households that regularly went for OD, 9 did so because they had no functioning latrine.[9] As one female respondent told us: 'We built a *kucha* latrine 20 years ago but it was damaged by water 5 years ago and we have gone for OD since then,'

Amongst the 7 latrine-owning households with family members that practised OD during the monsoon, three mentioned that both male and female family members sometimes went for OD because they found it more 'comfortable' and 'convenient.' When pressed on this, they elaborated that OD reflects 'too many members in a household against one latrine' with some family members in large households preferring OD to waiting their turn during the morning toilet rush.

The remaining four households practising OD owned seasonally-flooded TSC latrines but preferred OD to queueing for their neighbour's latrine. Nevertheless, they told their teenage daughters to use the latrine as 'they had grown up' and 'their security was important'. One respondent reported that his family members sometimes also practise OD in the dry season as a result of preference/convenience rather than necessity. He mentioned walking some distance to defecate near marshland during the dry season but admitted to defecating closer to the settlement during the monsoon; sometimes by the roadside and to the consternation of others.

Although socio-economic status was not the major influence on OD in the village, capital and time constraints frequently intersected with socio-cultural and environmental influences on sanitation insecurity (Caruso et al., 2017). In particular, they influenced households' abilities to construct additional pits (or empty the original one), build good superstructures, repair poorly-constructed TSC latrines and either improve drainage or create earth barriers to prevent seasonal latrine flooding. This in turn affected the extent to which their latrines met different user perceptions of 'improved' sanitation, which had far less to do with an ability to contain excreta than with year-round accessibility, convenience, dignity and privacy. These have yet to be effectively monitored at household level (JMP, 2015) and currently form no part of census/MICS/DHS-based household surveys or SBM ODF verification.

As with TSC programmes elsewhere (Barnard et al., 2013; Routray et al., 2015), a key shortfall identified by many beneficiaries was the lack of a sound superstructure. Given their limited resources, most villagers 'made do' with bamboo or wooden frames covered with a range of readily available - but non-durable - materials such as coconut leaves, plastic sheeting, cardboard and old clothes. Many semi-*pukka* latrines also lacked doors and provided limited privacy (see figure 3). This was particularly problematic for women and girls; especially when managing menstruation.[10] Access was also difficult for frail, elderly and very young household members with many facilities failing the 'easily reached and used when needed'

(WSSCC, 2015:2) criterion during the monsoon. As one female respondent explained, considerations of time, convenience and safety also influenced decisions to allow children under the age of 5 to defecate in the household compound:

'Small children in the household defecate in the open which is convenient as the women get busy with household chores in the morning and cannot take kids to the toilet which is located in the far side of the compound and is often submerged.'

When questioned about these practices and OD generally, it was apparent that there were low levels of awareness about the potential health risks associated with improper disposal of faecal matter.

4. Conclusion

Although the Swachh Bharat Mission and associated health education initiatives are yet to reach the village, 'proximate social pressure' has been important in overcoming limitations associated with the **'**multi-scalar political will' and 'political ecology' legs of the toilet tripod (O'Reilly and Louis, 2014). Particularly important in creating this pressure has been the lack of private OD sites coupled with increased housing density, land use change and longstanding preferences for latrine use. Despite the low upfront costs of TSC latrines appearing to benefit poorer households, poor construction and design - especially single earthen soakpits – created large downstream expenses for participants (Hueso and Bell 2013). Particularly significant were the funds, labour and materials required to build additional soak pits, repair cracked plinths and pits damaged by seasonal flooding and construct basic superstructures (although some of these problems have also affected owners of privately-built latrines). The willingness of non-flooded latrine-owning households to share them during the monsoon with up to 8 additional households testifies to the strength of commitment to latrine use in the village. Nevertheless, context-specific lived experiences and environmental conditions coupled with user-based sanitation preferences (including stacking) can still challenge locally-accepted sanitation practices and assumptions of a desire to address sanitation insecurity (Caruso et al., 2017).

The public health implications of such challenges are significant as habitual and sustained sanitation use by all is necessary to maximise its benefits (Satterthwaite 2015). In contrast to assumptions about on-site storage and disposal being safer in less densely populated areas with more space (JMP, 2015), however, findings from a peri-urban village with just these characteristics illustrate how seasonal flooding can cause non-sewered latrines to shift regularly from 'improved/basic' to either 'shared' or 'unimproved' categories with significant implications for safely managed sanitation (McMichael et al., 2006).

The fact that these shifts and associated sanitation 'stacking' occur seasonally and may not be detected in household surveys (Pullum, 2008; Wright et al., 2012) is concerning given that censuses and household surveys will 'remain the primary source of data for monitoring targets 6.1 and 6.2' (WHO/UNICEF, 2015b). As these tend to be 'less reliable when it comes to assessing technical dimensions of service quality as they are implemented by non-specialists' (JMP, 2015:13), there is a risk of producing significant over-estimations of 'basic' sanitation provision (Gine et al., 2011; Khale and Dyalchand, 2011). Even when mechanisms for monitoring 'sustainably managed' services come on stream, most data on excreta stored on-site

or emptied from tanks/pits look likely to be estimated by service providers rather than collected from households (GEMI, 2016; WHO/UNICEF, 2015b), so may not accurately account for the types of issue identified in the study area.

By contrast, the emphasis of household-based SBM verification on safe septage disposal – if conducted properly – seems likely to prevent villages like the one studied from being declared ODF-free without substantial investment by latrine-owners as well as households practising OD. Indeed, given that the septage disposal systems we observed are not unusual (Khale and Dyalchand, 2011; Susana, 2017), it is hard not to question recent data (or their verification; The Economic Times, 2017) indicating that 149 Indian districts, five entire states and over 205,000 villages have been declared ODF free (MDWS, 2017). And as our monsoon-season SFD illustrates, the SBM's emphasis on safe septage is unlikely to prevent health risks associated with onsite storage in seasonally-flooded or high groundwater areas, calling into question recent data indicating that 93% of rural Indian on-site sanitation systems are considered 'safely managed' (WHO/UNICEF, 2017).

GEMI's (2016,12) suggestion that 'household surveys could be extended' to include questions on functionality, emptying of on-site containers, transport and disposal implies that in time, this information will feed into datasets on safely managed sanitation. Given the expense and issues of comparability associated with additional DHS/MICS questions,[11] some of this information could come from expanded WASH question sets of the type already designed for WASH monitoring in Schools (WHO/UNICEF, 2016e). In addition to asking what toilet facility household members *usually* use, these could potentially capture data on sanitation 'stacking' by household members at different places or times; shedding light on the extent of regular sharing or seasonal OD and providing a truer picture of the extent of OD. Such questions would also have the advantage of collecting data on sanitation arrangements used away from home (World Vision 2017); helping to comply with SGD6's emphasis on access 'for all' (WHO 2017).

Country or region-specific questions could also be considered for collecting WASH data on service levels and quality in different environmental or seasonal contexts (improved for where/when?) as well as on continuity of access and functionality as part of SDG6's commitment to monitor quality of service (improved for how long and for whom?). The SBM's ODF verification and monitoring questions ask about toilet use (rather than access), whether it is fly-free, septage disposal and whether any household member sometimes goes for OD, but would also benefit from querying whether (and if so why) access or functionality has been interrupted over a specific timeframe. Similarly, more gender- and disability-specific questions could be asked about privacy, access and queueing (for public and shared toilets); and slightly refined descriptions of sanitation types could account for the nature of latrine superstructures and whether all users have year-round access.

Given wide variations in shared sanitation access (WHO/UNICEF, 2017) the addition of prompts on core questions or country-specific WASH questions about shared facilities might provide valuable information on whether a facility is regularly (or ever) shared with other households and, if so, how often and by how many households. This would identify seasonal sharing that might otherwise go undetected, providing more accurate data on 'limited' versus 'basic' service levels. Additional core

questions on periodic inaccessibility would highlight seasonal variations as well as complementing efforts to collect water-related 'availability' data to monitor continuity of access (JMP 2015,22; Wright et al. 2012). For SDG6 implementation and monitoring purposes, such approaches would be valuable for providing more disaggregated, context-specific data that embed gender, age and community-sensitive measures of sanitation insecurity (Caruso et al., 2017; O'Reilly, 2016) and help to identify gaps relating to seasonality of service, poor functionality and 'stacking'. If improved sanitation for all is a serious goal, the development of approaches for obtaining better quality data on spatial variations in sanitation access, practices, safety and sustainability is an urgent priority.

Notes

1. Some sources characterise 'improved' facilities as 'those which by their construction are *likely* to ensure hygienic separation of human excreta from human contact' (WHO/UNICEF, 2016d) (our emphasis).
2. Linear progression up the fuel/cookstove ladder often fails to accompany rising socio-economic status. Instead, households use a range of fuels/stoves simultaneously or shift between them depending on fuel availability or price, culturally-specific cooking norms (or the type of food being cooked) and environmental influences such fuelwood collection being limited in the rainy season (Masera et al., 2000; Akintan et al., 2018).
3. The lack of epidemiological evidence to define a threshold for acceptable sharing coupled with human rights concerns about privacy and risk of assault resulted in a decision to continue reporting shared facilities on a separate rung (JMP, 2015).
4. The Total Sanitation Campaign launched in 1999 with the goal of improving access to sanitation facilities in rural areas and eradicating open defecation. Key interventions included subsidies for the construction of individual household latrines, school sanitation and hygiene education and the development of rural sanitary marts (Government of India, 2013).
5. Ethical approval for the study was obtained from the School of Geography, University of Nottingham. All participants gave informed consent before taking part in the research.
6. Villagers described doing this manually and dumping the waste in nearby marshland.
7. Using guidance for enumerators provided in the JMP's core WASH question module (WHO/UNICEF, 2016c).
8. Given much of the village's low-lying position, dry season groundwater levels may be above 5m in places, in which case the estimated proportion of unsafely managed faecal waste would increase.
9. Four have flooded latrines, two have no latrine and three have latrines but practise OD.
10. Despite proposals to monitor menstrual hygiene management at the household level, current efforts are focusing on monitoring this in health facilities and schools (WHO/UNICEF, 2016b).
11. Current DHS and MICS household questionnaires ask about the type of toilet facility household members usually use, whether it is shared, with how many people and where it is located. The women's questionnaire asks about the disposal of children's stools (DHS, 2017).

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