PLOS WATER

REVIEW

Neglected second and third generation challenges of urban sanitation: A review of the marginality and exclusion dimensions of safely managed sanitation

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Citation: Bhatkal T, Mehta L, Sumitra R (2024) Neglected second and third generation challenges of urban sanitation: A review of the marginality and exclusion dimensions of safely managed sanitation. PLOS Water 3(6): e0000252. https://doi.org/10.1371/journal.pwat.0000252

Editor: Guillaume Wright, PLOS: Public Library of Science, UNITED KINGDOM

Published: June 14, 2024

Funding: This study was funded by the UKRI (UK Research and Innovation) Collective Fund: Global Challenges Research Fund (GCRF) project 'Towards Brown Gold: Reimagining off-grid sanitation in rapidly urbanising areas in Asia and Africa' (Project code: ES/T008113/1). All authors were funded for this research by the funder. The support of the Economic and Social Research Council (ESRC) is gratefully acknowledged. The funders had no role in the design, data collection, analysis, decision to publish, or preparation of the manuscript.

Competing interests: The authors have declared that no competing interests exist.

Abstract

Sanitation is fundamental for health and wellbeing yet cities, especially in the global South, face challenges in providing safely managed sanitation systems. Global and national sanitation campaigns tend to focus on the visible aspects of being 'on grid' in terms of toilet construction and connections but rarely address the dangerous, invisible aspects of being 'off grid' such as poor or unsafe excreta disposal and inadequate faecal sludge management (often considered to be second or third generation sanitation challenges). These, however, tend to disproportionately affect poor and marginalised people in off-grid locations in rapidly urbanising areas. This review paper engages critically with the growing literature on the challenges of faecal sludge management and circular economy solutions. Through the lens of exclusion and marginality, we review debates regarding access to safely managed sanitation, the burden of sanitation workers and safely recovering value from shit. We argue that sanitation systems often reproduce and exacerbate existing societal hierarchies and discriminations in terms of unequal access to safely managed sanitation and the burden of maintaining sanitation infrastructures. It is thus important for future research on faecal sludge management and resource recovery from shit to focus on issues of marginality and exclusion.

1. Introduction

Sanitation is one of the most pressing global challenges and is pivotal for human wellbeing, productivity and health. Lack of safely managed sanitation leads to the deterioration of health and nutrition, marginalisation of women and girls, and children out of school [1–5]. Yet, as of 2020, only 20% of the urban population in low-income countries and 42% of the urban population in lower-middle income countries had access to safely managed sanitation [6], defined as sanitation facilities that are not shared and where excreta is safely disposed of in situ or treated off-site [7]. Moreover, research has found that progress on the international sanitation ladder is often over-estimated, without substantive progress in low-income urban settings [8–10].

Although there is wide literature on sanitation and cities, there is little focus on the 'urbanisation of the sanitation crisis' [5:1239]. With increasing urbanisation, it is not only that a growing number of people across the urban global South lack access to safely managed sanitation, but also that the sanitation crisis is massive in these towns and cities. Although sanitation provision in urban areas presents complex challenges, these often remain neglected by local governments [11]. Most toilets in the urban global South are not connected to sewer systems; instead, on-site sanitation systems with pit latrines or septic tanks are pervasive. In the absence of sewers, on-site faecal sludge management places responsibility on households and often informal private providers to safely manage sanitation, with unaffordable sanitation options often resulting in risky sanitation practices [12]. Thus, in dense urban environments, improvements in household sanitation infrastructure and practices have limited positive impacts on population health as breakdowns in containment, emptying or transportation of faecal sludge could create substantial environmental public health challenges [12–14].

Yet while mainstream discourses on sanitation have been shaped by the modern infrastructural ideal of the "networked" city [15], in recent decades, researchers, activists and even governments have questioned the network ideology as the experience in the urban global South has highlighted the limits of centralised sanitation provision [16–18]. Many have argued that it is unrealistic to assume that rapidly growing cities and towns can be connected to a network in the foreseeable future. Thus, there is increasing emphasis on the need to consider the role of technological diversity and non-networked infrastructures [19,20] and for sanitation; more generally [15,21–26].

While global and national sanitation campaigns tend to focus on the visible aspects of being 'on grid', in practice, untreated or partially treated faecal sludge is at risk of leaking at various points in the sanitation service chain in many cities of the global South [11,14,27]. In particular, marginalised groups tend to be the worst affected by unsafe systems, making marginality a neglected dimension of safely managed sanitation, a gap our paper seeks to address. This article demonstrates that in the case of sanitation, marginality is not only about unequal access but also relates to a range of exclusions and discriminations stemming from but going beyond sanitation access. These include wider social and power hierarchies of caste, ethnicity and gender [28]. Compounded by economic and geographical disadvantage, poor and disempowered groups - in particular migrants, lower castes, and landless slum-dwellers - are often exposed to significant vulnerabilities, and trapped into endemic cycles of poverty and ill being and denied their human rights to safe water and sanitation [17,29]. This social differentiation manifests not only in poor or unequal access to safe sanitation, but the impacts of this denial also affect issues such as work and time burdens and increases risks of sexual harassment and violence for women,[30,31]. Vulnerable and marginalised people's lack of access to safely managed sanitation does not only refer to the obvious aspects such as lack of access to toilets, but also in terms of a violation of their basic rights to water, health, and dignity in work. This is because they are most often not only users of poor services but also often service providers of high-risk, poor quality sanitation infrastructure [32,33]. Thus, while the axes marginalization may vary in nature and severity across cultural and geographical contexts, this paper outlines some of the ways in which marginalities and discriminations produced at the intersection of gender, class, caste, and ethnicity are maintained and perpetuated through sanitation infrastructures.

While many national sanitation drives such as India's Swachh Bharat Mission (Clean India Mission) have largely tended to focus on toilet construction they have tended to neglect second and third generation issues of sanitation. Second generation sanitation challenges relate to ensuring safely managed sanitation and clean water, while third generation challenges relate to more complex issues involving broader environmental and social considerations such as inequality, sustainability, resource recovery and reuse, resilience to climate change and

environmental justice. The shift in focus from increasing toilet access to safely managed sanitation has led to increased attention on faecal sludge management (FSM) and circular economy solutions through resource recovery and reuse (RRR). These are often framed as panaceas whereby waste and shit are seen as a future resource [34]. The idea of circular economy aims to redefine the traditional "take-make-dispose" linear economic model of resource consumption and production to better manage and use resources to maximise value from resources and minimise waste. While there are multiple principles of circular economy, debates and innovations in the sanitation chain have focused on recovering value from wastewater and faecal sludge, given the significant environmental and health risks posed by inadequate and improper faecal sludge and wastewater management.

Here too, as we demonstrate in this article, while the rhetoric around the circular economy has focused on the environmental gains and economic potential of waste recovery to incentivise and fund sanitation infrastructures, questions remain about both its ability to deliver on these promises [35], as well as how practice is shaped by existing social relations and power asymmetries [36]. While a variety of innovations around faecal sludge management and circular economy solutions have been introduced in recent decades, the diverse ways in which infrastructures are experienced by marginalized groups as users and providers of these infrastructures, and their intersections with various social, political and economic hierarchies (such as gender, class, sexuality, age, ethnicity, caste, ability and religion) remain underexplored.

Urban sanitation has been studied across academic fields including development studies, health, urban political ecology, and sustainability studies. While sanitation is closely entwined with social power relations, questions of marginality and exclusion remain underexplored in academic and policy debates on second and third generation issues of faecal sludge management [19,37–39]. On the one hand, within WASH and development studies scholarship, there has been consensus that a focus on equity is crucial to ensure sanitation systems address inequalities [40,41]. Existing scholarship has provided useful insights into the limitations of ongoing approaches [12,42], but has largely focused on technical or development policy approaches to safely managed sanitation [43–47]. On the other hand, while urban political ecology and environmental justice literature has enumerated inequalities and highlighted issues of socio-political exclusion, marginalization and human rights violations [48,49] it has tended to focus on access to sanitation facilities and sewage networks rather than the wider sanitation chain and faecal sludge management in non-networked areas.

Given this background, this narrative review article thus draws on research undertaken through UKRI-funded GCRF project Towards Brown Gold: Re-imagining Off Grid Sanitation in Rapidly Urbanising Areas in Asia and Africa and critically analyses the literature on safely managed sanitation, faecal sludge management and emerging innovations relating to resource recovery through the circular economy through the lens of marginality in the urban global South. We ask: What happens to the faecal sludge and wastewater in decentralised systems including pits and septic tanks, especially when they fill up? And how do socio-political inequality and marginality relate to second and third generation sanitation challenges, including faecal sludge management? In particular, we focus on ways in which inequality and marginalisation are reproduced through infrastructures of urban sanitation, and the extent to which these are discussed in the literature. This article thus synthesizes and aims to provide a comprehensive context of the academic perspectives, debates and theories from the multidisciplinary literature on these neglected dimensions of urban sanitation in the global South with a focus on the ways in which these infrastructures are shaped by marginalisation and power relations. Through this review, the article also identify key gaps in both the academic literature as well as public policy and discourse, and makes a case for the need to focus squarely on issues concerning equity and inclusion while addressing the second and third generation challenges of urban sanitation.

2. Inequitable access to safely managed sanitation

An extensive literature examines inequalities in access to sanitation, highlighting how unequal urban sanitation particularly affects poor and disempowered groups such as migrants, lower castes and landless slum-dwellers, who are often considered 'illegal' and 'invisible' [29,32,50–52]. The existing literature also elaborates on how institutional complexities intersect with challenges related to poverty including tenure insecurity, social marginalisation and political discrimination [5,53–58] and power relations through neo-colonialist neglect of subjugated populations and notions of purity and pollution to exacerbate unequal access to sanitation [28,59]. A growing scholarship also sheds light on women's sanitation experiences [32,31,60], highlighting the ways in which intersecting inequalities relating to age, ethnicity, migrant status, class, caste and religion mediate sanitation access [55,61–64]. Recent research calls for a shift beyond toilet availability and emphasises sanitation as a fragile infrastructure needing maintenance and repair [22,65], focussing on the disproportionate unpaid labour of low-income women in addressing sanitation failures [66–68]. However, as with sanitation campaigns including community-led total sanitation [69], this literature has typically focused on inequalities in access, use and usability of toilets.

Inequality and marginality in the case of sanitation are not merely restricted to unequal access to sanitation facilities but also inequities in the ability to enjoy safely managed sanitation which includes the containment, emptying, transportation and treatment or disposal of faecal sludge and wastewater. About 60% of the urban population in low-income countries and 41% in lower-middle income countries live in slum settlements that routinely lack safely managed sanitation [70]. They are disproportionately exposed to high disease burdens due to inequitable urbanisation processes [43,71–73]. The construction of onsite sanitation and improved access to latrines without proper emptying and sludge removal services hampers development interventions aiming to reduce inequalities [74,75]. Yet relatively less attention has been paid to marginality issues in 'beyond the toilet' debates, in terms of the inter-connectedness of socio-political marginality and localised environmental disadvantage which disproportionately impacts poorer groups.

Urban dwellers in the global South often rely on shallow boreholes for drinking water, but poor-quality pit latrines leave the groundwater susceptible to faecal sludge contamination [76,77]. Many cities and small towns lack proper faecal sludge management plans or treatment plants, due to which most onsite systems dispose faecal sludge directly into water sources [45,47]. In pit latrines, wastewater often infiltrates into the groundwater due to improper or absent lining to prevent leakages or overflows during rainy seasons, causing significant groundwater pollution [78,79]. Thus, many communities in the urban global South face challenges of high levels of environmental pollution and disease prevalence due to poor containment and disposal of faecal sludge [80,81]. These risks are only compounded by the non-uniform distribution of urban disaster risks across cities as extreme events such as floods disproportionately affect vulnerable urban areas which often house socio-politically marginalised groups [82–84]. Thus, marginal spaces and places are often entangled in and produced through wider socio-politics of environmental and ecological inequalities which render poor and marginalised groups susceptible to significantly higher risks.

The viability of on-site sanitation technologies depends on adequate management of faecal sludge, but increased urbanization under limited infrastructure growth, which is typical in low- and middle-income countries, means that large amounts of faecal sludge remain uncollected [85]. There is a need for holistic evaluation of social dimensions such as quality of life, equity, diversity, governance etc to the circular economic practices including waste management which has been highlighted by [86] through a capability approach. Even where efforts to

expand sanitation to the urban poor are proposed, these rarely acknowledge the underlying sources of inequality and marginalisation that underpin inequitable sanitation systems. In practice these approaches have often been characterised by new public governance approaches through enterprises offering sanitation services [87–89] which critics argue depoliticizes sanitation rather than focusing on expanding access [90,91].

A key challenge is the high economic burden that sanitation places on poor households, as a public investment for the poor, is generally ignored. For instance, in a study across 20 cities in sub-Saharan Africa, Lerebours et al (2021) found that less than half of the cities had some pro-poor measures (such as subsidies to upgrade toilets, type and quality of containment or to empty toilets). Moreover, in about 44% of these cases, pro-poor measures are not implemented in practice. Local governments with limited budgets often pass costs on to residents [92,93], meaning urban poor communities often lack access and face the worst burdens of unsafe sanitation [94].

Due to high service costs, a majority of slum dwellers resort to relatively cheap but unhygienic measures of manually emptying and burying faecal sludge within the living environment, or informally employing cesspool trucks that discharge the sludge into nearby drains or land for a lower fee [47,75,95]. It is notable that, in urban areas, it has been demonstrated that faecal sludge management technologies have overall annualized capital and operating costs that are five times less expensive than conventional sewer-based solutions [96]. However, households served by on-site sanitation technologies pay significantly more of their annual incomes for this service than households served by sewer-based systems (ibid.). For instance, Boot and Scott (2009) find that in Accra, Ghana, the cost to poor households for emptying their latrine is 10 times more than the percentage of household income considered to be equitable for sanitation services. Thus, although the private sector may fill a gap in service provision, such service is not affordable for the urban poor [95,88]. And subsidies around FSM are rare [97].

Although the literature on marginality in sanitation beyond toilet access remains sparce, some emerging literature has framed the provision of safely managed sanitation in terms of 'sanitation justice' [98] or 'technology justice'[99]. Rusca et al (2018) stress the connection between safely managed sanitation and dignity, arguing that analyses of sanitation inequalities must consider not only access to infrastructure, but also the necessary services to support infrastructure and crucially their impact on individual dignity. Similarly, de La Brosse et al (2017) view faecal sludge management a 'technology justice' issue, revealing how disparities in access to appropriate technologies relate to misaligned drivers of innovation that result in the neglect of sanitation systems for poor and marginalised groups.

In sum, access to safely managed sanitation and faecal sludge management is shaped by existing social power relations and inequalities. Concerns relating to marginality and exclusion have rarely been analysed within scholarship and policy debates on faecal sludge management. Instead, FSM debates have largely tended to focus on operational and technical aspects [57,100,101] for critiques. Thus, there is scope for further scholarship bringing in critical social science lens to the second and third generation sanitation challenges.

3. Faecal sludge management and the burden on sanitation workers

Local governments in the urban global South, especially in small towns, are often severely resource constrained and heavily dependent on central government transfers [102,103]. They often lack the technical, managerial and financial capacity to plan and implement water and wastewater management infrastructures according to local priorities and needs [104,105].

Consequently, private agencies play a central role in sanitation and faecal sludge management [97]. A critical part of addressing marginality in sanitation requires addressing concerns around the ways in which faecal sludge is managed, particularly in terms of the impacts on sanitation workers.

Manual emptying is illegal in many countries [106–108], yet many governments turn a blind eye to it. Many sanitation workers rely on the limited and irregular income from this work, and have few alternative and viable livelihood options [106]. Operating outside institutional frameworks, manual emptiers often experiencing social stigma [106,109] and risk of violence and abuse from local police and authorities as well from residents and others that own the land where faecal sludge is dumped [110].

In addition, manual toilet pit and septic tank emptiers often work with basic tools and little protection, facing high health risks [75,108,111]. The wearing of personal protective equipment (PPE) is uncommon among manual pit emptiers due to it being unaffordable, uncomfortable or unsuited to the task or climate, and/or as emptiers are unaware of its benefits [106]. This means that manual emptiers often come into direct contact with human excreta and other items found in latrine pits, including sanitary products, sharp objects and other solid waste, leading to adverse health impacts [112]. Without adequate personal protections, sanitation workers are exposed to severe ailments and even fatalities due to the build-up of toxic gases in toilet pits [114,114]. While pit emptiers face the risk of prosecution by the government during their work, their illegal status prevents them from being able to access loans to adopt safer technologies [115].

Moreover, sanitation workers typically belong to marginalized, low-income, class, caste backgrounds or religious minorities [116], and often remain an invisible and unrecognised labour force working in unsafe environments and facing high levels of stigmatisation [107,113,116–118]. The case in South Asia is of particular concern, where the continuing practice of manual scavenging is implicated in social stratification based on caste hierarchies and oppressions [119,120]. This is a critical dimension of marginality within sanitation as identity is deeply bound to the division of labour and working and living conditions of sanitation workers. Women working in sanitation also face particular challenges, often doing the worst paid work and working long hours without access to sanitation services themselves, deterring their physical and mental health [121,122].

In many cases, even where there has been progress from manual scavenging, practices related to emptying pits and septic tanks in off-grid towns and cities continue to perpetuate caste hierarchies and prejudices across cleaning and transporting of faecal sludge [123–125]. Yet, FSM policies and guidelines often neglect these socio-political dimensions [126]. The misaligned drivers for innovation in sanitation mean that too little attention is paid to the inhuman working conditions of informal pit emptiers [99].

Mechanical operators such as vacuum truck operators are safer, but require considerable investment [127,128] and are thus often limited to large urban centres. Moreover, the introduction of FSM vehicles also has unforeseen repercussions for traditional sanitation workers that belong to marginalised caste groups in South Asia. They often fear being displaced from their 'traditional' jobs due to the mechanisation of FSM since suction trucks require fewer workers than manual sanitation work [108,129]. Zaqout et al (2020) find that government employees and self-employed groups are both deprived of basic rights, and while they fear losing their income due to mechanisation they struggle to access alternative livelihoods due to their caste position.

Whilst human rights activists have highlighted the predicament of sanitation workers, it is only recently that their health, safety and dignity has been discussed within WASH research, policy and practice. Although major challenges associated with occupational and

environmental hazards, weak legal protections, financial insecurity and discrimination exist [130], there is limited information about the challenges faced by informal sanitation workers in terms of their health, safety and dignity in low- and middle-income countries [126,131,132], and their concerns are often excluded from discussions around sanitation inclusion. Critically, while the literature has considered issues relating to occupational health and safety [132–135], Bhakta et al (2022) argue that it continues to overlook the diverse lived experiences and priorities of sanitation workers with some exceptions, e.g. [126] that warrant greater attention.

We now turn to look at debates around waste recovery and re-use and how these address issues concerning inclusion and marginality.

4. Looking beyond a magic bullet: Circular economy for sanitation

The 'circular economy' has become a powerful buzzword in political and academic debates to achieve sustainability and economic development [136–139] as companies, governments and communities seek to convert different kinds of waste into valuable resources. The starting point for sanitation is that millions of tonnes of shit generated every day and collected as faecal sludge from on-site sanitation systems are rich in nutrients and organic compounds [140,141]. A circular economy for sanitation could include the reuse of shit and wastewater to generate materials, energy, and water, including biogas, liquid or solid fuel, and agricultural products such as compost, organic fertilisers and soil conditioners [142–144]. Circular economy principles are often cited as a means to fund sanitation systems, with the newly generated economic value used to equip and sustain sanitation facilities [145,146]. Indeed, the safe (re)use of shit and wastewater that unlocks its potential as a resource as 'Brown Gold' could have massive economic and social gains [147]

Yet, existing studies highlight difficulties in implementing circular economy solutions for sanitation. For instance, in the case of biogas, challenges to collecting sufficient faecal sludge to ensure viability are common [146,148,149]. Use as fertiliser is the most common form of faecal sludge reuse, and it mostly viewed as a means to faster returns [110]. Yet, it has lower economic value [149]. This is due to the absence of supportive policies to produce and use faecal sludge-derived fertilizers, such as through certification and incentives for farmers. Thus, the market for these products has been poor [148,150]. Many faecal sludge co-composting schemes also fail due to inadequate consideration and analysis of demand and local incentives [145,151,152]. Thus, while the concept of circular economy has been welcomed, its practice has been more contested.

A related limitation is that the literature analysing circular approaches to sanitation has primarily focused on technical and economic challenges of technologies, leaving socio-political challenges, power dynamics and cultural change underexplored [86,137,144,153–155]. By overlooking socio-cultural and political considerations, circular economy research proposing technological paths to sustainability has been criticized by critical scholars for being overly optimistic regarding the speed of technological transitions and societal acceptance of innovations [156–159]. It is important to consider trade-offs and synergies, including the ways in which it risks reproducing the marginalisation and inequities perpetuated through conventional sanitation systems – both in terms of access to circular economy solutions and in terms of the burden on sanitation workers.

Socially, there is potential to enhance the livelihoods and agency of marginalised off-grid urban residents who could use products such a biogas and fertilizer to improve their energy and food security. Yet, it is unclear whether and the extent to which this will lead to greater social equity and poverty alleviation [144,160]. Critical scholarship has cautioned against the propagation of a depoliticised notion of circular economy to gain widespread support in the

short term, arguing that this does not tackle systemic socio-ecological challenges [35,153,161]. Informal practices involving the use of untreated faecal sludge in agriculture can lead to excreta-related infections through direct contact [162]. At the same time, some have argued that the idea of the circular economy is often adopted a means of greenwashing by both the public and private sectors [35,163–165].

Practitioners see cultural barriers as a key obstacle to a circular economy transition [166]. Excreta reuse often has negative associations in terms of smell, hygiene, quality, and low economic benefit [150,167] though this is culturally specific. Socio-cultural issues are often addressed through commercial approaches, such as new business models rather than from the perspective of transformative social and solidarity economy [136,168,169]. Countries across Asia, Africa and Latin America have implemented household biogas programmes, but face resistance towards toilet-linked anaerobic digestors in most cases despite financial incentives based on stigmas and associations that they reinforce low socio-economic status in South Asia [170]. Thus, it is important to recognise the ways in which social inequalities and power relations shape acceptance of circular economy products from sanitation, which often get lost within a wider umbrella of 'cultural barriers'.

Finally, while some have advocated for a shift in sanitation incentives to 'back-end users' [152] to create demand for treated wastewater and fertilisers, these debates rarely address the challenges faced by the workers producing and maintaining these infrastructures. Workers maintaining recycling systems often have to sort and handle waste and human faeces, which poses substantial risks to including exposure to waterborne contaminants [149,171]. As with FSM more broadly, the neglect of workers' protection aggravates health risks to workers that maintain these systems, and misses out on opportunities to address power imbalances. Building developments based on the deep knowledge of workers can avoid expensive innovations which are not fit for purpose [87].

Emerging literature should therefore explore and highlight the impact and urgency of addressing concerns relating to marginality within academic debates as well as incipient policy and practice based on circular economy principles towards (re)use of shit and wastewater. As these technologies are beginning to gain visibility in infrastructure innovations, policy and academic debates, it is critical that the technical, socio-cultural, political, economic and environmental processes along the sanitation chain are addressed simultaneously while paying attention to social justice for vulnerable users as well as sanitation workers.

5. Conclusion

There is growing recognition by sanitation practitioners, policymakers and researchers that solutions to the global sanitation crisis must not repeat past mistakes of building socially inappropriate infrastructures, or using engineering techniques and technologies that benefit wealthier, more powerful groups over others [69,172]. Similarly, there is now acknowledgement of the limits to a toilets-only approach and the need to focus on second and third generation challenges of sanitation relating to safe containment, faecal sludge management, and resource recovery and (re)use of shit and wastewater. While inequalities in access to sanitation have received attention in a critical social science literature across urban studies, political ecology and WASH, most literature and policy debates focus on inequities in access to sanitation facilities. This review paper has outlined some of the risks within existing policy approaches and debates of reproducing marginality as well as socio-economic and political inequalities around labour and in access to sanitation chain infrastructures and services. It is thus important for academic, policy and practical debates to focus squarely on issues concerning equity and inclusion while addressing the second and third generation challenges of urban sanitation.

Acknowledgments

The authors gratefully acknowledge the support of the Economic and Social Research Council (ESRC). The authors also extend their gratitude to the editors and reviewers.

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