



Research Paper


Understanding the role of informal pit emptiers in sanitation in Nairobi through case studies in Mukuru and Kibera settlements

Adrian Mallory , Lilian Omoga, Domenic Kiogora, Joy Riungu, Dorothy Kagendi and Alison Parker 

ABSTRACT

Achieving universal sanitation in informal settlements will depend on improved onsite sanitation, as sewer systems are unlikely to be viable solutions due to technical and political constraints. In Nairobi, Kenya, 60% of the population live among its 150 informal settlements, occupying only 5% of its total residential land. This research assessed the role of informal pit emptiers in providing sanitation in Mukuru and Kibera, two of the largest informal settlements in Nairobi, and the barriers to achieving improved services. Through qualitative data collection, the research found that pit emptiers are institutionally and physically outside of the current paradigm of sanitation service delivery. There is no infrastructure available to remove waste from informal settlements, except for a transfer station that is being piloted by Sanergy, and instead waste ends up disposed in the community. The pit emptiers also face violence and intimidation from competitors or locals claiming ownership of territory. Providing improved sanitation in such areas will depend on the provision of new infrastructure, but this can only succeed with a detailed understanding of the competing and vested interests that can enable or undermine a project.

Key words | faecal sludge management, informal sector, Kenya, pit emptiers

Adrian Mallory 
Lilian Omoga
Alison Parker  (corresponding author)
 Cranfield University,
 Cranfield Water Science Institute,
 Cranfield,
 UK
 E-mail: a.parker@cranfield.ac.uk

Domenic Kiogora
 School of Pure and Applied Sciences,
 Meru,
 Kenya

Joy Riungu
Dorothy Kagendi
 Meru University of Science and Technology,
 School of Engineering and Architecture,
 Meru,
 Kenya

HIGHLIGHTS

- Informal pit emptiers are still a large part of sanitation service delivery.
- Lack of infrastructure and recognition often leads to disposal in water bodies.
- 'Cartels' and vested interests often use violence to control areas or prevent new technology.
- Infrastructure and legal recognition are needed to enable emptying from settlements.
- Power dynamics and local interests need to be understood to do this safely.

INTRODUCTION

Achieving Sustainable Development Goal (SDG) number 6, universal access to sanitation, is going to depend on

This is an Open Access article distributed under the terms of the Creative Commons Attribution Licence (CC BY 4.0), which permits copying, adaptation and redistribution, provided the original work is properly cited (<http://creativecommons.org/licenses/by/4.0/>).

doi: 10.2166/washdev.2020.193

increased coverage of safe onsite sanitation (WHO & UNICEF 2017). Onsite sanitation are systems where the excreta is stored on the plot where they are generated such as pit latrines or septic tanks (Tilley *et al.* 2008). Systems such as this are likely to be increasingly important in urban areas in low-income countries where

sewerage is unlikely to be a viable option by 2030 (Tilmans *et al.* 2015).

Safe sanitation provision involves interlinked stages that are required to deliver a safely managed sanitation service across the value chain. Starting with the containment of faecal sludge (FS), emptying, treatment and then safe reuse or disposal, each of these stages needs to operate effectively to ensure that the faecal sludge management (FSM) operates optimally. However, it remains an extensive and complex challenge in urban areas, mainly in low- and middle-income countries (Peal *et al.* 2014), because it is characterised by poor or fragmented services and weak or non-existent policies and regulatory frameworks. In cases where policies do exist, enforcement is weak or non-existent (Simiyu Swilling & Cairncross 2017). These challenges are further compounded by the fact that space is much more limited and land ownership is unclear thereby limiting incentives to invest in more permanent toilet systems (Moya Sakrabani & Parker 2019).

Due to persistent failures by municipalities and public utilities to provide sanitation services in slums, informal small-scale service providers often fill the gap in service particularly for pit emptying. Lack of proper road access in slum settlements limits the use of vacuum trucks, and as such, most of the pit emptying service is provided by informal manual pit emptiers. Even where road access is available, slum dwellers tend to prefer manual emptiers as their charges are considerably lower than mechanical emptiers.

Despite the critical role played by informal pit emptiers in the sanitation value chain, their work, especially the manual ones, is often ignored by government policymakers and donors (Bongi & Morel 2005; Hawkins *et al.* 2014). They usually have no access to government financing or donor funding and thrive by providing services that residents are willing to pay for (Bongi & Morel 2005). Pit emptying is often regarded as a non-lucrative business due to limited business models that guarantee return on investment and limited funding (Murungi & van Dijk 2014). Pit emptiers are also often threatened and associated with a social stigma (Eales 2005). Often pit emptiers conduct their work without personal protective equipment due to its discomfort or a lack of awareness of the benefits (Nkansah *et al.* 2012). In a study in Bangladesh, it was found that manual pit emptiers did not meet the criteria for 'decent' work and were often

deprived of basic rights, and faced social and financial insecurities. The support of government and NGOs was able to improve the status of emptiers in certain cases, and identified a need to study the role and livelihoods of pit emptiers in different contexts (Zaqout *et al.* 2020).

The aim of this study was to understand the role of informal pit emptiers in contributing to the provision of urban sanitation. Specifically, the study sought to answer the following further questions focused on this context: (1) What is the role of informal pit emptiers in providing sanitation services in informal settlements? (2) What is the form and extent of the relationship between informal pit emptiers and other stakeholders in sanitation service provision?

METHODS

Study area

This study was focused on Kenya as the rapid population growth and high rates of urbanisation place a strain on the provision of basic services including safely managed sanitation services (Schouten & Mathenge 2010; Corburn & Hildebrand 2015). The urban population living in slums worldwide is in excess of 1 billion, of which about 238 million are in sub-Saharan Africa (Lucci *et al.* 2015). Nairobi has faced rapid population growth over the last decade (KNBS 2019). With the rising population coupled with low-income levels, the demand for affordable housing has also been on the increase resulting in the creation of large informal settlements in the outskirts of the city. The city of Nairobi has over 150 informal settlements (UC Berkeley & University of Nairobi 2017), which house 60% of the urban population, despite occupying only 5% of its total residential land (NCWSC/AWSB 2009).

This study was carried out in two different informal settlements, Kibera and Mukuru, in Nairobi, Kenya. The locations of Mukuru and Kibera were chosen because pit emptiers are the main sanitation providers and new enterprises are piloting new models of working with pit emptiers. Mukuru is Kenya's second-largest informal settlement, located on the edge of the city's industrial area and stretching along Nairobi's Ngong River (UC Berkeley & University of Nairobi 2017). The slum is divided into eight

villages; the two largest ones are Mukuru kwa Reuben and Mukuru kwa Njenga. Mukuru was initially established as a dumping site for industrial waste but later developed into a settlement for the majority of low wage workers. Kibera is the largest informal settlement in Kenya and is composed of 12 villages covering 250 ha (Schouten & Mathenge 2010). Whilst there is a sewer line passing through Kibera, connectivity is limited and most households rely on pit latrines (Seal Bown & Parker 2018). Informal settlements in Nairobi are characterised by dense dwellings, lack of land recognition and poor sanitation (Thieme 2010; Corburn & Hildebrand 2015). The informal pit emptiers who work here lack licencing, equipment or training and often work at night (Aquaya and WSUP, 2019). Whilst there are formal manual emptiers, their activity is often limited as they charge higher prices (Aquaya and WSUP, 2019).

This study focused on two organisations that are working on sanitation in these two informal settlements. Sanergy is a private company, who provide container-based sanitation services in Mukuru with regular emptying. A typical container-based sanitation system captures waste in an easily removable container instead of more traditional pits or septic tanks (Tilmans *et al.* 2015). With regular emptying, this means that the toilets take up less space which is often a major constraint to any infrastructure project (Oduro-Kwarteng Awuah & Nyarko 2009). The waste Sanergy collects is treated and reused as fertiliser and animal feed (World Bank 2019). Sanergy installed a transfer station in Mukuru kwa Njenga which provided a disposal point for pit emptiers. The pit emptiers were partially formalised through this relationship as they also gained access to protective clothing at a subsidised price as well as a shower, soap and drinking water. Umande Trust also provides ‘bio-centres’ which are public toilets that have anaerobic digesters producing biogas that is used for cooking; they also work with informal pit emptiers in Mukuru and Kibera (Binale 2011).

Data collection and sampling

This study adopted a qualitative approach and data in this aspect of the study came from three main sources: interviews, observations and reports. Interviews were conducted face to face at the place of work for all participants, except residents who were interviewed at home.

Semi-structured interviews were used with an initial set of prompts and questions to elicit answers and further discussion. Interviewees included sanitation entrepreneurs involved in resource recovery, formal and informal manual pit emptiers, members of landlords and tenants’ associations, public officials working in water and sanitation agencies and residents as summarised in Table 1.

Sample numbers were chosen to maintain consistency across the Mukuru and Kibera case studies, whilst achieving data saturation. It was not possible to have exactly matching sample sizes across both cases, as in Kibera there were no suitable resident groups to organise for focus group discussions and in Mukuru there were no groups of pit emptiers for focus group discussions. Where it was not possible to have a consistent amount of interviewees and focus group discussions across both cases data collection was done pragmatically to get as close to saturation as possible. Key informant interviews were conducted with Sanergy and Umande Trust employees who worked with pit emptiers or had a direct role in sanitation provision in Mukuru or Kibera. This was to understand their role and relationship with pit emptiers, and the intention and effect of interventions with pit emptiers. Pit emptiers were sampled purposively. In Mukuru, ten pit emptiers were interviewed, five who worked with Sanergy and five who did not. This was to contrast the work of the more formalised and informal pit emptiers and the impact of the transfer station. In Kibera, ten pit emptiers were interviewed in a focus group discussion and follow-up interviews. Focus groups were selected pragmatically with existing groups that could be arranged to meet, which was not possible in Mukuru. To understand the perception of sanitation from residents, the sampling

Table 1 | Table of interviewees

Stakeholder	Number interviewed
Nairobi Water and Sewerage Company Employees	3
Landlords and Tenants Association Members	2
Sanergy Employees	1
Umande Trust Employees	2
Public Health Officers	1
Residents	12
Manual Pit Emptiers	20

focused on those who use private or shared pit latrines and regularly use informal manual pit emptiers when their latrines are full. Snowball sampling was again used to identify households using the same services. In Mukuru, observation was done with pit emptiers who worked with Sanergy, as they operated in the day, and transport routes were mapped. Mapping and observation was not possible with other pit emptiers in Kibera due to the danger involved in the work in the night, but mapping with them in the day to identify where they had last disposed.

Data analysis

Interviews were recorded and transcribed, and those done in Swahili were translated into English. Consent for data collected including audio recordings and field notes and its use was obtained from all respondents before the commencement of the interviews. Privacy and anonymity of the participants were ensured by avoiding asking for any identification details while informed consent was also sought from the participants. Respondents were also informed of the purpose of the research and assured of confidentiality. The research received ethical approval from Cranfield University Research Ethics CURES/9448/2019 and from Kenya National Commission for Science, Technology and Innovation NACOSTI/P/19/1503. Following each day of interviews and observations, detailed field notes were compiled for each interview and site. Field notes and the transcripts were analysed thematically by the first author using Nvivo (QSR International 1999), according to guidelines set up by Robson & McCartan (2016). These themes were triangulated with the other authors to ensure agreement. This process follows an iterative process of data familiarisation, code generation and integration. This process was done iteratively until the data were organised into a set of codes that were verified by the co-authors and represented the data collected.

RESULTS AND DISCUSSION

Role of informal pit emptiers

Overall pit emptiers had only been in the job for a short time, often less than 6 months, and had started due to a

lack of alternative employment. About 50% of the pit emptiers in Mukuru Kwa Njenga have at one point interacted with Sanergy as the organisation constructed a disposal site in their area of operation. In contrast, none of the pit emptiers from Mukuru kwa Reuben and Mukuru Kayaba had ever engaged with any other sanitation actor.

In Kibera, pit emptiers also worked with Umande Trust. Pit emptying activities are characterised by limited demand and a lack of co-ordination leading to limited income. Houses that are located next to drains empty their toilets out to the drain during rains, creating a health risk and undermining any potential for FSM.

'The work is very erratic. Can get a gig. Then nothing. People might want something but then the emptier is not there as we've given up.'

– Manual Pit Emptier, Kibera.

Pit emptiers working with Sanergy pay a fee of USD 0.50 per drum when discharging faecal waste at the transfer station; in return, they have access to a shower, soap and clean drinking water. Pit emptiers not working with Sanergy discharge the waste in open drains and rivers. These areas were mapped in Kibera as shown in Figure 1. This puts them at risk of arrest by police and violence from cartels who demand payments for discharging faecal waste at the sites they claim to own. Pit emptiers said they resorted to unsafe disposal because there was a lack of safe disposal points available. Whilst pit emptiers working with Sanergy receive personal clothing and some training, none of the pit emptiers have any support at the government level.

'We can be recognised and organised but if we have to pour it we will always be at fault. As long as there is no place it will always be illegal.'

– Manual Pit Emptier, Kibera.

Stakeholder co-ordination and roles in sanitation

Interviews with manual pit emptiers as well as residents and community groups indicated that sanitation stakeholders work in isolation due to their varying business models and interests with no apparent overall coordinator of sanitation services. Manual pit emptiers in Mukuru had no idea on

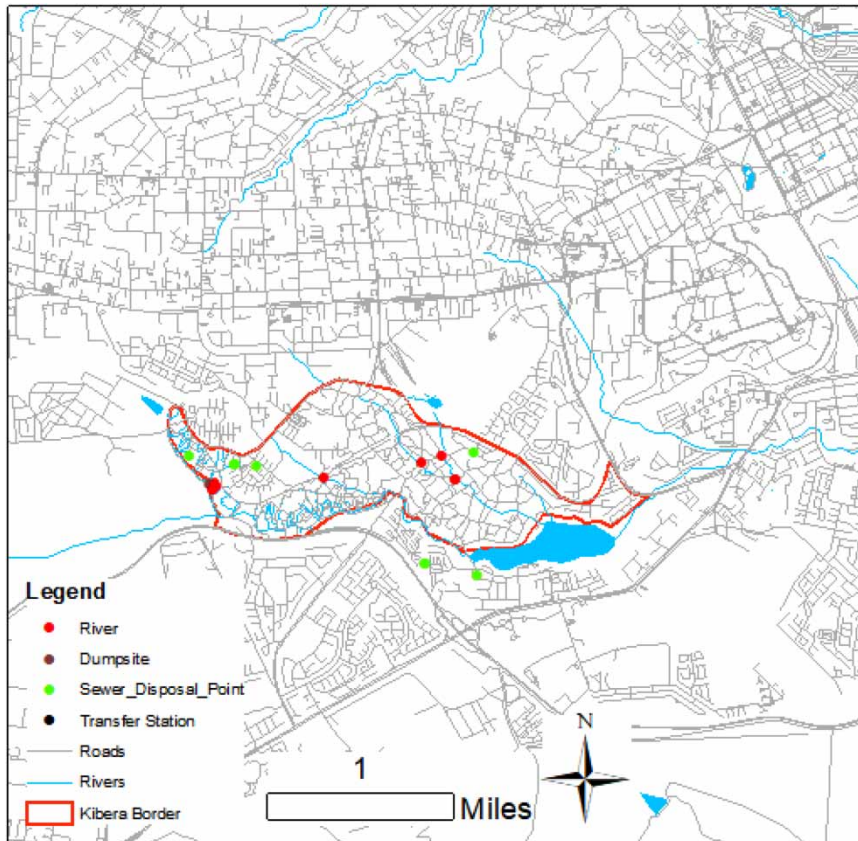


Figure 1 | Dumping site locations in Kibera.

what changes could be made at the management level since they are not even aware which entity is mandated to manage sanitation services. In Kibera, pit emptiers emphasised the need to form a group to be able to co-ordinate activities.

Interviews with government officials corroborated the point that sanitation matters are handled by various government departments with no single ministry or department being in charge of sanitation services. Since the water act of 2016 sanitation provision is now a devolved responsibility to counties (Mansour Islam & Akhtaruzzaman 2017). There are still overlaps in responsibilities between water service boards and county governments (Mansour Islam & Akhtaruzzaman 2017). The Water and Sewerage Companies are being renamed to Water and Sanitation Companies by the Ministry of Water to reflect this enhanced remit. Current regulations do not have any stated goal or targets for non-sewered sanitation. There is still a predominant focus on sewerage as the main form of sanitation. According to the slum residents, the only benefit they receive from the utility

company is the supply of water, which is still inadequate and is low quality due to frequent pipe bursts. On their part, the Ministry of Water and Sanitation indicated that their support to the sector is hampered by lack of adequate financial resources from national government budgets.

Interviewees acknowledged that valuable products could be generated from sanitation waste based on the little experience they had from interacting with the two leading sanitation entrepreneurs (Sanergy and Umamde Trust) working in the informal settlements. While most of the residents were aware of the possibility, few knew the technology involved in producing resources such as compost, biogas or animal feeds. Before Sanergy had operated in Mukuru, there were already examples of biogas being derived from faecal waste:

‘Amusha youth organisation used to produce biogas, which we used for cooking our meals cheaply for USD 0.2 per meal if the technology revives and other such

centres are introduced, faecal disposal cannot be a nuisance and also minimise our sufferings to accessing clean and safe toilets'

– Manual Pit Emptier.

'We used to collect faeces and deliver to a project using the peepoo bags. We were told it was being used to produce fertilizer and generate money. However, when the project stopped coming for the waste, it piled there and we had nothing to do with it any more as we did not know how they used to make it into fertilizer. So we also wound up'

– Mamokinda Self Help group representative in Kibera

Whilst the presence of Sanergy and Umande has introduced the concept of resource recovery, pit emptiers felt they did not benefit from the process and often complained about the need to pay for usage of a transfer station in Mukuru. Although many pit emptiers said they only disposed of sludge illegally due to a lack of infrastructure, even basic infrastructure may still be too costly for their marginal businesses. Local governments need to provide financial support to make the infrastructure viable; however, often there is no clear responsibility for this (Mansour Islam & Akhtaruzzaman 2017), and utilities and local government are often reticent to provide services in informal settlements that could be seen to recognise their legitimacy (McGranahan 2015; Bercegol & Monstadt 2018).

Violence and cartels

Violence was the most commonly cited difficulty of pit emptying in informal settlements. The illegality of the work means that they are often exposed to threats from government and local police. Often households called representatives from the National Environmental Management Agency (NEMA) to prevent pit emptiers passing through their area. Similarly, the land is often controlled by local 'groups' or 'cartels' who threaten pit emptiers and either take a bribe or rob the pit emptiers:

'You have to look tough to prevent the violence. When doing work I'm not scared. Sometimes I even face them as they want to pick the money I've taken. You will find

out if they are a coward. If they are a coward you can solve.'

– Manual Pit Emptier, Kibera.

'Sometimes we are forced to release our pay at gunpoint.'

– Manual Pit Emptier, Kibera.

This poses a risk to pit emptying as the illegality and social stigma of the work forces them to work at night and thus expose themselves further to robbery and violence. Pit emptiers working with Sanergy are able to carry out their work in the day reducing this risk somewhat. This shows an example of how NGOs may be able to improve the livelihoods of pit emptiers who are responsible for sanitation services, by increasing the dignity and safety of the work.

Further, in Mukuru, emptiers who use the transfer station have received threats from sanitation cartels such as private toilet owners, private vacuum truck operators and emptiers who discharge the waste directly into the river body as they feel that the transfer station will interfere with their business income. Interventions by external organisations can often disturb and challenge local interests resulting in violence and resistance. Projects that look to provide sanitation services or infrastructure without understanding how local interests can mobilise are likely to struggle for this reason. In Kibera, there were different examples cited of transfer station projects or sewer disposal points that had ended up closing due to disputes over land or management.

Transfer stations and formalisation

Most of the manual pit emptiers stated that increased safe discharge of faecal waste would be improved by the provision of transfer stations or disposal points. Hence, they all advocated for multiple placements of transfer stations near the residents to reduce travel distances to alternative disposal sites. Manual pit emptiers push their heavy carts on often narrow and challenging roads over long distances up to 3 km. Inaccessibility of some desludging sites during the rainy season was also highlighted as a significant challenge. They also state that once the additional discharge points are constructed, the time saving would enable them to service additional households. This makes the case of

Sanergy's transfer station interesting. Combined with the formalisation, PPE and washing, it has enabled pit emptiers to dispose waste safely and conduct their work in the day with more dignity and less violence. The provision of such infrastructure is unlikely to be a total solution, however, as some of the pit emptiers still complained about the disposal fee and discharged into the rivers anyway.

Previous attempts had been made to put transfer stations or safe disposal points in Kibera and Mukuru before Sanergy's transfer station. In Kibera, these are now all abandoned. A previous transfer station used a manhole to directly dispose sludge into a sewer line passing through a village. Various explanations were given for its failure. One aspect was that the owner of the property who had provided access for the manhole decided to cover it and rent out the property instead. Another said an extra NGO came in and provided a public toilet on top of the access point, preventing access to pit emptiers. The final story suggested that the local group that had a role in managing the site had disbanded, leaving little management. Whilst it was not possible to get a clear sense of which narrative was true or if it was a combination, a clear theme of vested interests and a lack of co-ordination emerges. These examples show that the technology interventions alone will not impact pit emptiers' livelihoods or ability to contribute to safely managed sanitation. They need to be implemented with a sustainable plan for management in the future and a clear understanding of the risks and local interests that could be affected by changing the sanitation ecosystem.

'After the donors left we would give KES50 (~ \$0.50) per pour. She resolved this was very little and closed it up. The gulper and the other equipment were stolen.'

– Manual Pit Emptier

Implications for pit emptying services

There was a limited co-ordination of stakeholders and policy-making for sanitation services. The results of this study support the notion that conventional sanitation policies and legislation tend to focus strongly on sewerage systems, leaving non-sewered sanitation as the responsibility

of households and unregulated service providers (Peal *et al.* 2014). The prevailing institutional and policy environment has contributed to the belief among slum dwellers that the national and county governments have no interest in prioritising sanitation services in the slums. Weak and unclear institutional mandates have further reinforced this belief as the provision of sanitation services has mainly been the subject of uncoordinated and unregulated operations of residents, landlords and informal service providers except in a few cases where the private sector has intervened. There are ongoing institutional changes, such as the mandate of sanitation to be provided beyond sewerage and the introduction of non-sewered sanitation targets by the regulator that could contribute to improving this in the future. The new provision of a Department for Sanitation within the Ministry of Water could also provide a clear oversight. These examples give potential starting points for how governments can begin to integrate onsite sanitation into their mandate. Any new policies on onsite sanitation need to have a clear delineation of responsibilities and mandates to ensure buy-in and accountability.

As noted by Trémolet Kolsky & Perez (2010), just as with housing, on-site sanitation (OSS) is mostly viewed as a private good and beneficiaries bear the primary responsibility of providing and managing such systems. In informal settlements where often the occupiers are renting, the responsibility of provision falls to landlords who are quite often absent (Mazeau *et al.* 2014). Given the prevalence of OSS, primarily pit latrines in such settlements, manual emptying using unregulated informal manual emptiers remains the cheapest option and is widely practised (Blackett & Hawkins 2017). These informal emptiers often operate on low margins and without safe disposal options resort to illegal disposal that has many associated health risks. A recent study found that none of the pit emptiers in different cases in Bangladesh met the ILO criteria of 'decent' work (Zaqout *et al.* 2020). More focus is needed to ensure that achieving universal sanitation is not at the expense of decent fair livelihoods for pit emptiers. Attempts to provide infrastructure or to change the behaviour of pit emptiers are fraught with risk due to vested interests and the potential of violence within informal settlements. Whilst the transfer station in Mukuru is promising as a route to safer disposal, it is still undermined by pit emptiers and toilet operators who feel

their business is threatened. One difference seen with the example of Sanergy is the ability of social enterprises to provide some aspects of a decent living through a safe place to dispose of sludge and clean water access for washing. The previous failure of transfer stations and bio-centres in Nairobi shows that achieving safe sanitation is not simply a question of infrastructure and technology. There are also other examples where government and NGO attempts to provide infrastructure are undermined by violence and resistance from vested interests in settlements (Reback 2007; Bercegol & Monstadt 2018). In Mathare, another informal settlement in Nairobi, the attempts to upgrade housing and services failed as they neglected and displaced the existing landlords who in turn protested and violently resisted new housing. Similarly, in Kibera, the attempts of national government to provide new electricity connections are undermined by local interests (Bercegol & Monstadt 2018). Attempts to provide new infrastructure to enable improved pit emptying and transport of FS will be doomed to failure without understanding the local interests that may resist it.

Some pit emptiers did not use the transfer station saying that the disposal fee was too high and instead they disposed illegally. This shows the difficulty of improving service provision when pit emptiers operate on such fine margins. If there is a disposal fee but no accompanying regulation to provide an incentive, there will still be some who take the more financially beneficial option of unsafe disposal. The state needs to take a more active role in creating a conducive environment for pit emptiers and sanitation workers to provide safe sanitation whilst still being able to make a financially secure living.

CONCLUSION

This research sets out to find the role of pit emptiers in sanitation and the extent to which local sanitation stakeholders collaborate with pit emptiers in the provision of sanitation services in two settlements in Nairobi, and the effects of new attempts to work with pit emptiers. The study has shown that informal pit emptiers form a key section of the sanitation chain but due to a lack of recognition and infrastructure they may dispose of sludge illegally. Without recognition and support of the role they play it is unlikely

that safe sanitation can be achieved in such settlements, though this needs to be done with consideration of the local contexts and risks of violence. This may call for a complete paradigm shift among all the stakeholders from the current one where sanitation service provision is a purely private matter (especially in the informal settlements) to one where sanitation is a public good to which all have a right.

DATA AVAILABILITY STATEMENT

Data cannot be made publicly available; readers should contact the corresponding author for details.

REFERENCES

- Aquaya and WSUP 2019 Assessing the market for safe fecal waste emptying services in low-income areas of Kisumu, Kenya. Policy Brief. Available from: <https://www.wsup.com/content/uploads/2018/10/Kisumu-Market-Assessment-brief-June-2019-v3.pdf> (accessed 16 September 2020).
- Bercegol, R. D. & Monstadt, J. 2018 *The Kenya slum electrification program. Local politics of electricity networks in Kibera. Energy Research & Social Science* **41**, 249–258. doi:10.1016/j.erss.2018.04.007. Elsevier.
- Binale, A. 2011 Umande trust bio-centre approach in slum upgrading. In: *Les Cahiers D'Afrique de L'est*, pp. 167–186. Available from: <https://halshs.archives-ouvertes.fr/halshs-00755905/document> (accessed 30 July 2015).
- Blackett, I. & Hawkins, P. 2017 *FSM Innovation: Case Studies on the Business, Policy and Technology of Faecal Sludge Management*. Available from: http://www.susana.org/_resources/documents/default/3-2760-7-1503648345.pdf.
- Bongi, S. & Morel, A. 2005 Understanding small scale providers of sanitation services: a case study of Kibera. WSP field note, Nairobi, Kenya.
- 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**. doi:10.1155/2015/209505.
- Eales, K. 2005 *Sanitation Partnerships Series: Bringing Pit Emptying Out of the Darkness: A Comparison of Approaches in Durban, South Africa, and Kibera, Kenya*, p. 9. Available from: <http://www.ircwash.org/sites/default/files/Eales-2005-Bringing.pdf>.
- Hawkins, P., Blackett, I., Heymans, C., Evans, B. & Peal, A. 2014 The missing link in sanitation service delivery: a review of fecal sludge management in 12 cities. *Water and Sanitation Program: Research Brief* 1–8. Available from: <http://documents.worldbank.org/curated/en/2014/04/19549016/targeting-urban-poor-improving-services-small-towns->

- missing-link-sanitation-service-delivery-review-fecal-sludge-management-12-cities.
- KNBS 2019 *Kenya: Sanitation Policy and Planning Framework Case Study for Discussion Table of Contents List of Figures*.
- Lucci, P., Bhatkal, T., Khan, A. & Berliner, T. 2015 *What Works in Improving the Living Conditions of Slum Dwellers*, pp. 1–40.
- Mansour, G., Islam, W. & Akhtaruzzaman, M. 2017 *Situation Analysis of the Urban Sanitation Sector in Kenya*.
- Mazeau, A. P., Wellington, N., Drabble, S., Asante, F. & Awantungo, D. 2014 Bringing toilets back to Kumasi's compound houses: landlord and tenant behaviours and motivators. 37th WEDC International Conference, Hanoi, Vietnam, 15-19 September 2014.
- 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. doi:10.1016/j.worlddev.2014.12.008.
- Moya, B., Sakrabani, R. & Parker, A. 2019 Realizing the circular economy for sanitation: assessing enabling conditions and barriers to the commercialization of human excreta derived fertilizer in Haiti and Kenya. *Sustainability* **11**, 3154. <https://doi.org/10.3390/su11113154>.
- Murungi, C. & van Dijk, M. P. 2014 Emptying, transportation and disposal of faecal sludge in informal settlements of Kampala Uganda: the economics of sanitation. *Habitat International* **42**, 69–75. doi:10.1016/j.habitatint.2013.10.011. Elsevier Ltd.
- NCWSC/AWSB 2009 *Strategic Guidelines for Improving Water and Sanitation Services in Nairobi Informal Settlements*. Available from: http://www.wsp.org/sites/wsp.org/files/publications/Af_Nairobi_Strategic_Guidelines.pdf.
- Nkansah, A., Fisher, J. & Sohail, M. 2012 Manual pit emptying as a sustainable livelihood in Ghana. *Proceedings of the Institution of Civil Engineers: Engineering Sustainability* **165** (3), 215–221.
- Oduro-Kwarteng, S., Awuah, E. & Nyarko, K. B. 2009 Shifting from public shared toilets to home toilets in urban settlements: implications of household demand in Kumasi, Ghana. In: *Water, Sanitation and Hygiene: Sustainable Development and Multisectoral Approaches – Proceedings of the 34th WEDC International Conference*, pp. 1–8. Available from: <https://www.scopus.com/inward/record.url?eid=2-s2.0-84891404866&partnerID=40&md5=4ee614ac613141a1b7823436d99c5657>.
- Peal, A., Evans, B., Blackett, I., Hawkins, P. & Heymans, C. 2014 Fecal sludge management: a comparative analysis of 12 cities. *Journal of Water, Sanitation and Hygiene for Development* **4** (4), 563. doi:10.2166/washdev.2014.026.
- QSR International 1999 *NVivo Qualitative Data Analysis Software [NVivo 12]*. Available from: <https://qsrinternational.com/nvivo/nvivo-products/>.
- Reback, A. 2007 *Slum Upgrading Case Study: Nairobi's Mathare 4A September 2007 Andrew Reback*, pp. 1–24.
- Robson, C. & McCartan, K. 2016 *Real World Research*, 4th edn. Wiley, Hoboken, NJ, USA.
- Schouten, M. A. C. & Mathenge, R. W. 2010 Communal sanitation alternatives for slums: a case study of Kibera, Kenya. *Physics and Chemistry of the Earth* **35** (13–14), 815–822. doi:10.1016/j.pce.2010.07.002. Elsevier Ltd.
- Seal, D., Bown, R. T. & Parker, A. H. 2018 Penetrometer tests on 109 pit latrines in Kibera, Nairobi, Kenya. *Water SA* **44** (3), 459–463. doi:10.4314/wsa.v44i3.13.
- Simiyu, S., Swilling, M. & Cairncross, S. 2017 Decision-making on shared sanitation in the informal settlements of Kisumu, Kenya. *International Journal of Environmental Health Research* **27** (5), 377–393. doi:10.1080/09603123.2017.1350261. Taylor & Francis.
- Thieme, T. 2010 Youth, waste and work in Mathare: whose business and whose politics? **22** (2), 333–352. doi:10.1177/0956247810379946.
- Tilley, E., Lüthi, C., Morel, A., Zurbrügg, C. & Schertenleib, R. 2008 *Compendium of Sanitation Systems and Technologies*. EAWAG; Sandec, p. 158. Available from: http://www.eawag.ch/organisation/abteilungen/sandec/publikationen/publications_sesp/downloads_sesp/compendium_high.pdf.
- Tilmans, S., Russel, K., Sklar, R., Page, L. N., Kramer, S. & Davis, J. 2015 Container-based sanitation: assessing costs and effectiveness of excreta management in Cap Haitien, Haiti. *Environment and Urbanization* **27** (1), 89–104. doi:10.1177/0956247815572746.
- Trémolet, S., Kolsky, P. & Perez, E. 2010 *Financing On-Site Sanitation for the Poor: A Six Country Comparative Review and Analysis*, p. 172.
- UC Berkeley & University of Nairobi 2017 *Situation Analysis: Mukuru kwa Njenga, Kwa Reuben and Viwandani*, p. 55.
- WHO and UNICEF 2017 *Progress on Drinking Water, Sanitation and Hygiene 2017*. Available from: <https://washdata.org/sites/default/files/documents/reports/2018-01/JMP-2017-report-final-highlights.pdf>.
- World Bank 2019 *Evaluating the Potential of Container-Based Sanitation: Sanergy in Nairobi, Kenya*. Washington, DC. Available from: <http://documents.worldbank.org/curated/en/661201550180019891/Evaluating-the-Potential-of-Container-Based-Sanitation-Sanergy-in-Nairobi-Kenya>.
- Zaqout, M., Cawood, S., Evans, B. E. & Barrington, D. J. 2020 Sustainable sanitation jobs: prospects for enhancing the livelihoods of pit-emptiers in Bangladesh. *Third World Quarterly* **0** (0), 1–19. doi:10.1080/01436597.2020.1810560. Routledge.

First received 16 September 2020; accepted in revised form 20 November 2020. Available online 9 December 2020