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EXAMINING LINKS BETWEEN NATURE, SOCIETY

AND MODES OF SANITATION IN KAMPALA

A DISSERTATION APPROVED FOR THE DEPARTMENT OF GEOGRAPHY AND

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TABLE OF CONTENTS

Acknowledgements iv
TABLE OF CONTENTS v
List of Tables vii
List of Figures vii
Chapter 1: Introduction 1
1.1 Purpose 1
1.3 Research Gap 3
1.4 Research Aim and Questions 3
1.5 Theoretical Framing 4
1.6 Methodology 7
1.6.1 Context of Kampala city and study sites 7
1.6.2 Research design 13
1.6.3 Sampling 14
1.6.4 Data Collection 14
1.6.5 Data Analysis 16
1.7 Significance of the Dissertation 21
1.8 Structure of the Dissertation 22
Chapter 2: Toilet Risk Experiences of Human and Non-Human Relations in Kampala 25
Abstract 25
2.1. Introduction 26
2.2 Literature Review 29
2.2.1 Environment-Society Relations and urban sanitation 29
2.2.2 Urban Sanitation Risk 33
2.3. Methods 35
2.3.1 Description of sanitation sites 37
2.4. Findings 40
2.4.1 Experiences of risks from sanitation technologies in Kampala 40
2.4.2 Individual and community action to avert risks. 49

2.5. Discussion 57
2.6. Conclusion 61
Chapter 3: Sanitation Practices of Commuters and Non-Commuters in Rapidly Changing Kampala 64
Abstract 64
3.1. Introduction 66
3.2. Literature Review 68
3.2.1 Everyday practices around sanitation provision and access in Global South Cities 68
3.2.2 Sanitation Access for commuter and non-commuter groups in Kampala 70
3.3 Methodology 73
3.3.1 Geographical Context 73
3. 3.2 Description of participants 73
3.3.3 Data Collection Methods 74
3.3.4 Data Analysis 75
3. 3.5 Ethical Considerations 75
3.4. Findings 76
3.4.1 Access and Availability of toilets 76
3.4.2 Quality and Cleanliness 78
3. 4.3 Perceptions and Attitudes 79
3. 5. Discussion 80
3.6. Conclusion 82
Chapter 4: Socio-Spatial Configurations from Sanitation Provisioning for Students Living with Disabilities in Kampala 83
Abstract 83
4.1 Introduction 84
4.2. Literature review 86
4.2.1 Marginalization from Urban Infrastructure 86
4.2.2. Urban Sanitation for PLDs 88
4.2.3. Access to spaces of higher education for PLDs in Uganda 90
4.3.1 Context 92
4.3.2 Methods 94

4.4.1 Access to Toilet Facilities at Makerere University 96
4.4.2 SLD's experiences with sanitation infrastructure 99
4.4.3 Friends' assistance to meet sanitation needs. 100
4.4.4 Foregoing friends' assistance even when it's needed 102
4.5 Sanitation zones 104
4.6. Conclusion 112
Chapter 5: Conclusion 114
5.1 Summary 114
5.2 Limitations 118
5.3 Recommendations 119
5.4. Future Directions 120
5.5 Reflections on researcher's growth 121
References 122
Appendices 146
Appendix A: Semi-Structured Interview Guide 146
Appendix B. FGD Question Guide 150
Appendix C: Key Informant Interview Guide 154

List of Tables

Table 1: Summary of research participants 13
Table 2: Summary of research methodology 18
Table 3: Summary of how data was coded 21
Table 4: Summary of respondents' descriptions used associated with categories of primary and secondary toilets 105

List of Figures

Figure 1: Map of Kampala city showing study sites..... 8

Figure 2: Extent of KCC and GKMA..... 10

Figure 3: Water spread across the floor of a stance in the toilet facility at the gym..... 43

Figure 4: A yellow 3-liter jerrycan used to scoop water from a 100L water barrel beside it for flushing the toilet..... 50

Figure 5: A nursery bed business operated in a sewage-flowing drainage channel along Bombo Road..... 56

Figure 6: Signage showing the University's support for SLDs near the main gate..... 93

Figure 7: A graphic representation of the rating of primary and secondary facilities..... 107

Figure 8: A thematic map of the university's sanitation zones..... 109

Abstract

This dissertation is motivated by calls for further analysis of the concept of infrastructural heterogeneity by focusing on environment-society relations and urban sanitation. The dissertation aims to determine how communities make use of sanitation technologies to respond to environmental risks and describes the socio-spatial configurations that result from interventions to reduce that risk. To achieve this, the researcher set three research questions which are answered in the three core chapters of this dissertation. These chapters focus on i) how community practices and narratives around environmental risks are conveyed in relation to sanitation technologies, ii) how community practices and narratives around sanitation technologies align with changing urban environments and iii) what socio-spatial configurations are created by differential provision and access to toilets. By employing a qualitative research approach with methods including semi-structured interviews, key informant interviews and focus group discussions, the researcher engaged fifty participants to answer these questions. These methods were used to collect and analyze data on the lived experiences of individuals and groups; the social, cultural, and institutional context within which their experiences are shaped at two study sites in the city. Data was analyzed through Content and Spatial analyses, generating themes and spatial visualization of areas prone to safe and unsafe sanitation. Findings showed major risk factors like water outages, vectors, and odors that impacted respondents' use of the toilet and their general environment. There were individual and collective actions of adapting to and mitigating risks although some groups of people and particular spaces were more vulnerable to the risks. Analyzing practices and narratives helped to place sanitation infrastructure within layers of power, relationship dynamics and socio-economic status that impact mitigation of risks. The dissertation, therefore, expands the analysis of heterogeneous infrastructure configurations by focusing on how they shape and are

shaped by human-environment interactions. It concludes that despite the presence of some modern infrastructure, there remain highly interconnected links between humans, the environment and modes of sanitation in Kampala.

Chapter 1: Introduction

1.1 Purpose

The purpose of this dissertation is to further analyses of the links between the environment, society and modes of sanitation. Sanitation infrastructure configurations provide a critical and changing lens through which to consider how people and the environment interact with each other. On one hand, studies confirm that knowledge from the modern era attempted to create a dichotomy between people and the environment under the premise of public health (Melosi 2000). On the other hand, scholars concerned about complex environmental challenges today trouble this dichotomy. They argue that sustainable solutions to environmental challenges require an urgent and clearer understanding of relationship between people and the environment and, perhaps, closer everyday relationships that enable people to see and respond to environmental change. While the idea of being more connected to the environment might sound appealing to some, what this means for infrastructure is not entirely clear. For sanitation, infrastructure is typically understood to be precisely about separating people from potential harm rather than, for example, a way to recycle nutrients. This dissertation study aligns with and extends recent studies using the framework of heterogeneous infrastructure configurations (HICs) to analyze how modes of sanitation infrastructure help to grapple with the dichotomy between society and the environment by explicitly considering the environment as part of a sanitation configuration. It considers how, for both modern and non-modern infrastructure configurations, the environment is not separate, but continues to shape people, practices and technology.

1.2 Background

Urban sanitation is a critical issue that intersects environmental sustainability, public health, infrastructural development, and social equity. As cities grow, particularly in the Global South,

the challenges of providing adequate sanitation infrastructure become increasingly complex, necessitating more critical analyses among various stakeholders to arrive at sustainable solutions. In keeping with wider practices of modernity, modern sanitation (which in this case means networked sewers, universally and uniformly provided by the state, see Lawhon et al., 2023) aims to reduce public health risks by eliminating human contact with urine and feces and preventing the spread of water-borne diseases like cholera (Davenport et al., 2019; Melosi, 2000). However, the dichotomy between environment and society underpinning these interventions has never really been able to be fully formed, for as urban political ecologists have argued, people and the environment are always, somehow, connected (Heynen et al., 2006). Further, imagining sanitation as separating people from the environment limits our understanding of sanitation risks, often treating them as purely infrastructural issues rather than environmental concerns. Across cities in the Global South, access to sanitation is shaped by complex interactions between infrastructure, governance, socio-spatial inequalities, and everyday human and non-human interactions (Lawhon et al., 2018; Smiley 2020). This dissertation builds on and extends this literature by considering the link between environment, society and modes of sanitation through three distinct yet interconnected chapters: i) the role of human and non-human interactions in shaping sanitation risks, ii) the everyday practices of urban dwellers in navigating sanitation challenges, and iii) the socio-spatial configurations that arise from differentiated access to sanitation services. This dissertation therefore provides a broader understanding of how urban sanitation operates as a system of social and environmental relationships, revealing patterns of adaptation, power asymmetries and marginalization in urban spaces.

1.3 Research Gap

This work is motivated by the need to expand the concept of Heterogeneous Infrastructure Configurations (HICs) by focusing on society-nature relations, a gap that remains underexplored in current research. Anchored in situated Urban Political Ecology (UPE), studies employing HICs framing, such as Smiley (2020) and Alda-Vidal et al. (2023), have demonstrated the potential of everyday practices to reveal the power dynamics and social relations embedded in infrastructure. However, there is limited understanding of how sanitation interventions aimed at mitigating environmental risks produce configurations of social, spatial and environmental elements in urban settings. This dissertation addresses the gap by investigating how people incorporate sanitation technologies into their everyday practices to manage or reduce environmental risks.

1.4 Research Aim and Questions

The main aim of this dissertation is to examine the practices and narratives through which people relate with sanitation technologies to manage or reduce environmental risks in Kampala. To do this, the dissertation asks the following questions:

(a) What community practices and narratives around environmental risks are conveyed through sanitation technologies in Kampala?

(b) How do community practices and narratives around sanitation technologies align with changing urban environments?

(c) What socio-spatial configurations are created by differential provision and access to toilets in Kampala.

1.5 Theoretical Framing

This section gives an overview of the theoretical approach that the research employed, giving a synthesis of studies that inform this dissertation. The research was framed through Heterogeneous Infrastructure (HICs) framing by Lawhon et al. (2018), which stems from Urban Political Ecology (UPE). Before elaborating on HICs, an overview of UPE is necessary.

Urban Political Ecology

UPE is a field of critical urban environmental research (Heynen et al., 2006) derived from the broad fields of Political Ecology and Urban Studies. UPE engages with issues of urban governance and non-human agency by looking at the socio-ecological inequalities embodied in and shaped by the production and reproduction of capitalist urbanization (Gabriel, 2014). The field is used to examine the ways in which cities shape and are shaped by socio-environmental dynamics (Heynen et al., 2006). Scholars here reckon that urban environments are not merely collections of buildings and infrastructure, rather, they're sites where power, nature, and capitalism constantly collide and interact. In this way, UPE broadens our understanding of urbanization, showing it's not just a matter of growth or planning but a political and ecological process (Swyngedouw, 2015).

UPE emerged because early political ecologists focused too narrowly on rural landscapes, leaving out cities entirely (Rademacher, 2015) allegedly for not being natural. The rapid and unequal urbanization in parts of Africa, Asia, and Latin America significantly contributed to the growth of the subfield. More influential was Swyngedouw's (2004) study of water in Guayaquil, Ecuador, which Gandy (2022) and Gabriel (2014) acknowledge for introducing the idea of *socio-nature* to urban political ecology. This is in recognition that materials like water remain natural, even as they're commodified and transformed by human labor. Swyngedouw (2004) argues that in the city, water is captured, treated, sold, consumed, and eventually turned back into waste. This endless

cycle of transformation reveals who controls water, who benefits, and who pays the price, and is therefore political. The study brings into focus how water and sanitation systems not only provide essential services but also reproduce long-standing inequalities and struggles. In African cities, studies like Smiley (2020) and Simone (2011) respectively use UPE to reveal the partial and uneven distribution of water and sanitation services in Kampala, showing how rapid urban growth leaves many behind and uncovers the complex informal economies shaping sanitation in Kinsasha, challenging the idea that these cities are somehow marginal or irrelevant.

Indeed, UPE also expands the scope of urban debate in cases of Africa, moving beyond city centers to consider peri-urban settlements and small towns that sprawl outward from urban cores (Angelo and Wachsmuth, 2015), elaborating socio-environmental metabolism and capitalist flows. By framing these as more than technical problems, UPE situates sanitation within global capitalism's uneven processes by showing how urban growth pulls in resources and discards waste in ways that entrench old inequalities and create new ones through power relations and networks of labor.

Different authors have highlighted that the field is wrought with limitations. Scholars call for, for example, provincializing UPE, politicizing urban environments and reviewing methodological city-ness (Lawhon et al. 2014; Angelo and Wachsmuth, 2015). Doing so involves among other things, employing methods beyond grounded theory which many UPE studies rely on. This dissertation draws emphasis on the use of everyday practices that closely reflect the realities of southern urbanism and therefore adopts the Heterogenous Infrastructure Configuration framing.

Heterogeneous Infrastructure Configurations (HICs) framing

This is a framework that centers everyday practices in the study of African cities through Urban Political Ecology. The concept was introduced by Lawhon et. al., (2018) as an analytical framework to compare different configurations especially in thinking through risk and power. This

effort was propelled by their earlier work in which they called for a provincializing Urban Political Ecology through situatedness that starts from everyday practices (Lawhon et. al., 2014). Heterogeneous infrastructure configurations that draw on Science and Technology Studies view infrastructure as a social-technical system of different but interrelated elements that may complement each other and carry with them risks, opportunities, and power relations. As such, it elaborates on what many other scholars have observed about infrastructure of the south where disruption and uncertainty are part of the normal working of infrastructure hence making it not so modern. It looks at networked infrastructure as one of many forms of infrastructure provisioning in the city. It recognizes that technologies are not static, and neither is their mode of operation as they change through different situations and across different actors. Configurations carry with them risks, opportunities and power relations. Bhan (2019) emphasizes being careful with vocabulary that could misalign with realities of the Global South. Therefore, Lawhon et. al., (2018) prefers to use configurations as opposed to systems because the latter often negate unpredictable and non-linear flows and yet these are inherent in the working of African infrastructure. This unpredictability is not problematic, as Myers (1994) argues from the case of housing infrastructure in Zanzibar city, that people in Africa are intentional and logical in their everyday practices, embedding the influence of traditional cohesion and religion. This disorder may also hold economic and environmental benefits for some.

1.6 Methodology

This section outlines the sampling techniques, geographical context of study area, methods of data collection and analysis used for this dissertation. Data was collected during the summer (June, July and August) of 2022 at two study sites shortly after a long COVID-19 induced lockdown had been lifted in Uganda.

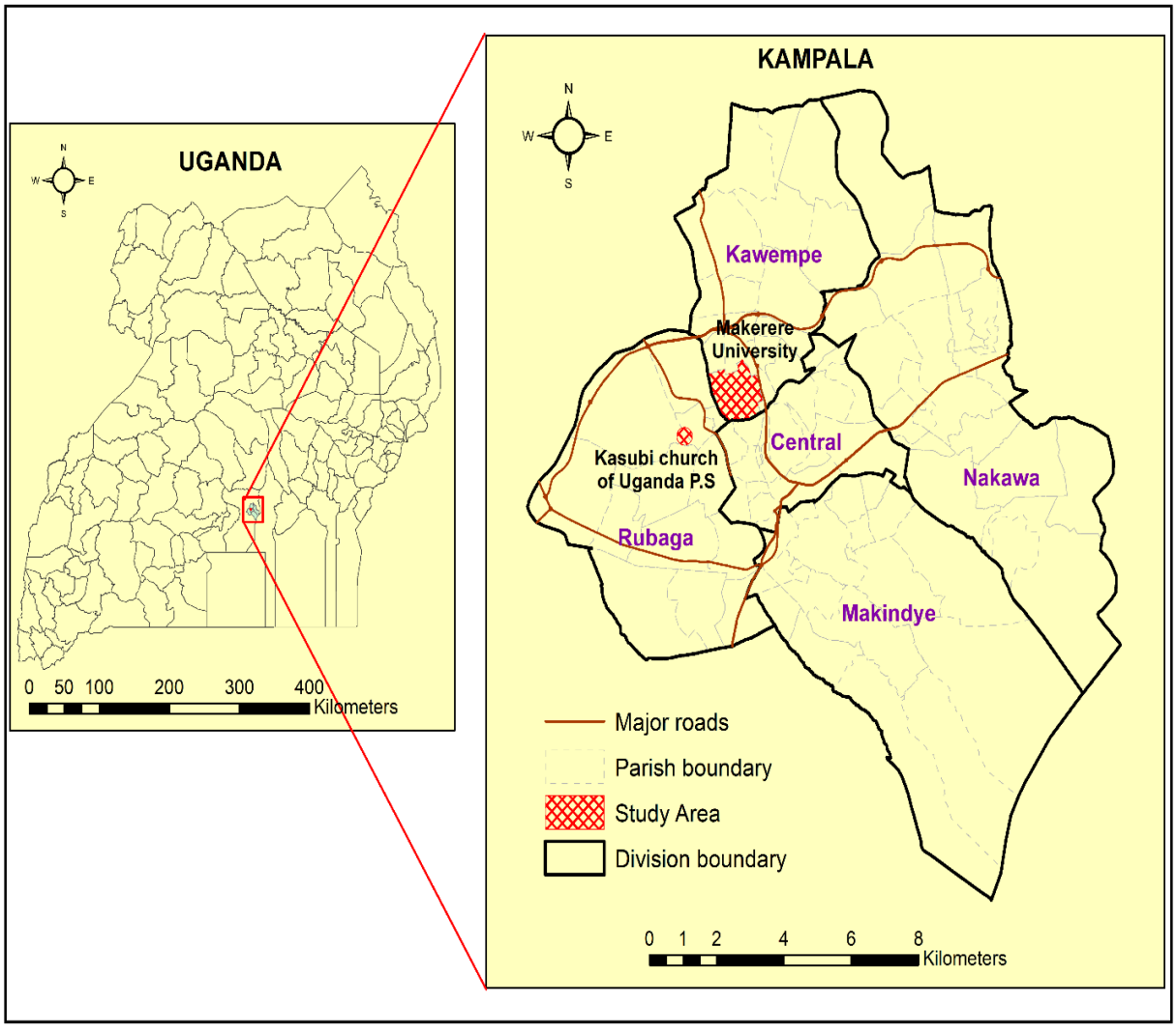
1.6.1 Context of Kampala city and study sites

Kampala City (henceforth referred to as Kampala Capital City or KCC) is Uganda's capital, and it is located on the north shore of Lake Victoria (Nalubaale) in East Africa. The city lies along 0°18′ 49″ N, 32° 34′ 52″ (KCCA 2019) with a total expanse of 189.3 sq. KM (73 Sq. Mi) of which 172 sq. K (68 Sq. Mi) is land and 13 sq. KM (5.3 Sq. Mi) is water (MLHUD, 2012). The city lies within a tropical climate subdivision and experiences two rainfall seasons and one dry season a year. Kampala is built on several hills and has an elevation of 1190 meters above sea level. The city's highest point is the summit of Kololo Hill close to the city center and the lowest point is in the South on the shore of Lake Victoria.

KCC has five political divisions: the Central Division, Lubaga Division, Kawempe Division, Makindye Division and Nakawa Division. Each division also has subdivisions called parishes and micro-subdivisions called villages. There are a total of 76 parishes and 3615 villages (KCCA 2019) across the five divisions and the dissertation references the divisions and where possible, the parishes but not villages.

The two study sites were Makerere University located in University Parish of Kawempe Division and Kasubi Church of Uganda Primary School in Kampala City in Kasubi Parish of Lubaga Division. The study sites are marked in the Northwest part of Figure 1 on page 8.

Figure 1: Map of Kampala city showing study sites



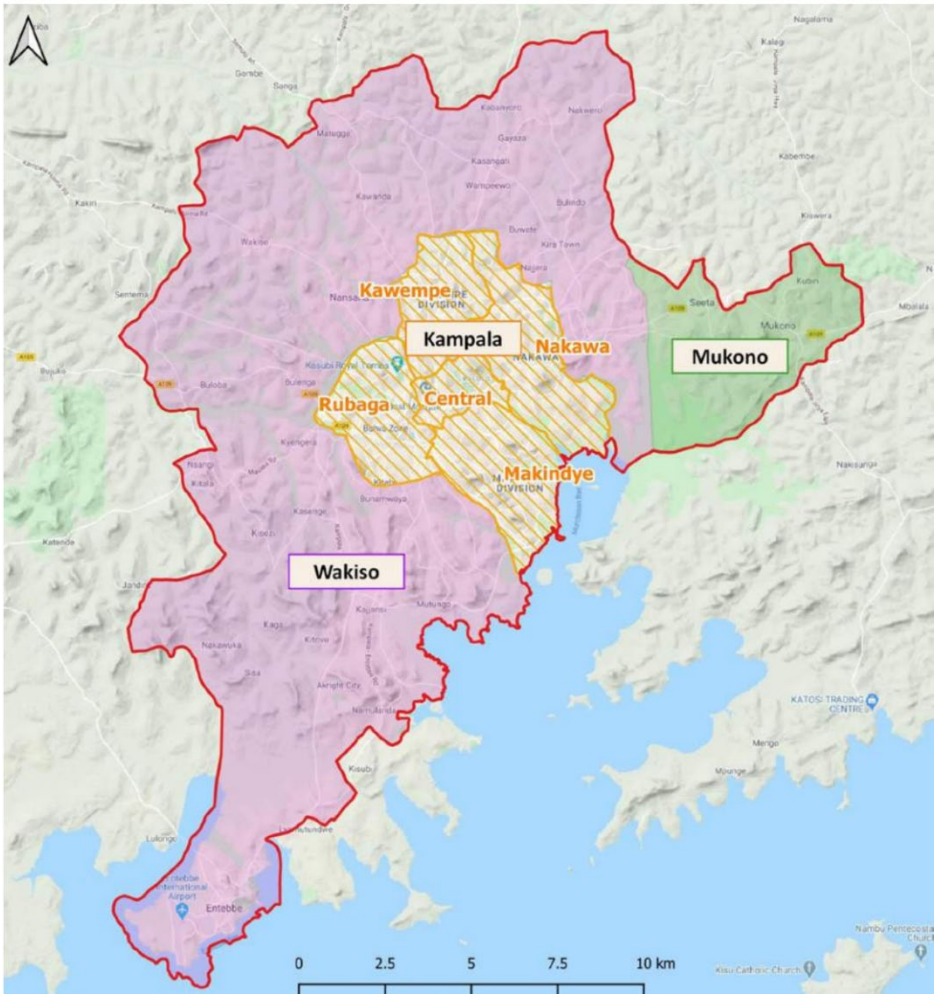
Politically, each division has its own mayor and municipal council representing the various parishes. Then, KCC has a designated title of the Lord Mayor who is the political head of the city and works with lord councilors who are also elected by community members to represent parishes at the City Council headquartered at the City Hall along Apollo Kaggwa Road (KCCA 2017).

There were several legislative changes for Kampala City in the decade ending 2010. The changes included establishing an Authority called Kampala Capital City Authority (KCCA) with eleven directorates of urban services to replace Kampala Capital City (KCC) in technical administration of the City. KCCA is headed by an Executive Director (ED) directly appointed by the President (KCCA 2017). KCCA is also headquartered at the same premises as the City Hall. The urban sprawl and daily urban influx also necessitated administration of areas outside the city from where workers commute daily. As such, the Greater Kampala Metropolitan Area (GKMA) also called Greater Kampala was born and it consists parts of Wakiso district, Mukono district and Mpigi district including their municipalities like Nansana, Kira, Makindye-Ssabagabo, Mukono and Entebbe (Office of the President, 2025). Figure 2 (reproduced from Salian, et al., 2020) below shows the extent of KCC and GKMA.

Figure 2: Extent of KCC and GKMA

A ministerial office called the Ministry of Kampala Capital City and Metropolitan Affairs with a cabinet ministerial position was formed under the office of the president to oversee activities in the GKMA (https://op.go.ug/ministries/ministry-kampala-capital-city-and-metropolitan-affairs). The head of this ministry is also appointed by the president. In a nutshell, Kampala has political, technical and administration offices including the Office of the Lord mayor with lord councilors, ED of KCCA and the Ministry of KCC and Metropolitan Affairs.

Muwanga et al. (2020) attributes these changes to efforts of the central government (headed by the NRM political party) to regain its political power over the city that it has lost in elections to opposition political parties for at least two decades now. The executive branch of the government



justified this move as geared towards service delivery to match the fast-paced urban changes. This wider political change is part of the context that the case study operates in, but this dissertation does not directly engage with the wider impact of formal politics and its impact on sanitation.

Kampala city's sewer network accounts for not more than 10% of sanitation provision to its residents, mostly in the Central Business District (CBD). About 90% of residents use onsite technology options that vary in terms of containment and treatment. There is evidence of investment and improvements along the sanitation value chain (GoU, 2016; Hopewell and Graham, 2014). KCCA came up with minimum sanitation standards for households and companies offering sanitation services (see KCCA, 2017) to accommodate and regulate these technology options. The rationale is to guide the development of the different modes and technologies of sanitation as short-term measures while retaining the larger ambition of total sewer coverage in a bid to make Kampala an attractive, vibrant, and sustainable city. These standards have considerations for aspects of the physical environment, including water and spaces that define the city aesthetics, of which communities are also aware (Nakyagaba et al., 2021; Lawhon et al. 2023). This context, in which off-grid sanitation is legal and increasingly supported by state and non-state actors, makes Kampala a particularly compelling site for investigating heterogeneous infrastructure configurations. The dissertation focuses on two sites: one with sewered sanitation and another with off-grid services detailed in the following sections.

Sewered sanitation: Makerere University

Makerere University is one of Kampala's landmarks and was connected to the national sewer line before the country's independence in 1962. This means that the sanitation services here are provided by the public monopoly NWSC. However, the services are not modern infrastructure but instead better understood as a heterogenous infrastructure configuration. For example, water from

pipes is supplemented by small incremental technologies including water barrels for flushing among others. The target participants for interviews and FGDs here were resident and non-resident students and staff.

Onsite: Kasubi Church of Uganda Primary School

Kasubi Church of Uganda Primary School is also under KCCA service jurisdiction, and its sanitation needs are met using a bio-toilet which also generates cooking gas used in the school kitchen. This facility was funded through the Corporate Social Responsibility of MTN Uganda, a telecom company, in partnership with KCCA. The target participants here for Focus Group Discussions (FGDs) and semi-structured interviews include staff members, while the maintenance team of this facility were engaged in a key informant interview.

1.6.2 Research design

The research was a cross-sectional qualitative study framed around narrative inquiry. A qualitative approach was preferred to allow a rich generation of data from the respondents' experience, an advantage that studies like Adeoye-Olatunde et al. (2021) and Tümen and Ahmed (2021) applaud. This research is focused on self-reported lived experiences of individuals and groups and the social, cultural, and institutional context within which their experiences are shaped (Clandinin and Rosiek, 2007). The dissertation research had a total of fifty participants and a summary of their aggregate description is presented in Table 1 below.

Table 1: Summary of research participants

Interview	No. of Participants	No. of men	No. of women	Employment type	Reside in KCC	Reside in GKMA
KII	5	5	0	Formal	4	1
Semi-structured	45	25	20	Formal, Informal, students	26	19
TOTAL	50	30	20	Formal, Informal, students	30	20

1.6.3 Sampling

Purposive and random sampling were used to identify participants. Purposive sampling is a technique in which a researcher selects study participants based on certain attributes (Ames et al. 2019). In other words, it is non-probabilistic because a specific section of the population is the target. In this research, purposive sampling was used to identify institutions with whom Key Informant Interviews (KII) would be conducted. Participants from the community were randomly selected to participate in the study. Random sampling, on the other hand, is probabilistic, and the researcher assumes any individual has a chance to participate in their study (Onwuegbuzie and Leech 2007). The participants for this dissertation study include resident and non-resident students, Students Living with Disabilities (SLDs), teaching and support staff who use the toilets found at the respective sites. The size of each sampling method is detailed under each of the three data collection methods elaborated in section 1.6.4 that follows.

1.6.4 Data Collection

a) *Semi structured interviews*: Adeoye-Olatunde et al. (2021) note that semi-structured interviews are preferable when the researcher's goal is to understand unique perspectives of their respondents due to flexibility in structure. During data collection, semi-structured interviews were administered to randomly selected adult participants using facilities at Makerere University and Kasubi Church of Uganda Primary School. The interviews consisted of open-ended questions about people's experience with environmental risks in relation to their sanitation needs and technologies at either Makerere or Kasubi and another facility they frequent away from these two. A total of forty-five semi-structured interviews were administered to male and female participants. The template of semi-structured interview questions is attached as Appendix A.

b) *Focus Group Discussions (FGDs):* These were used to gather collective information about sanitation technologies and environmental risks experienced at both sites. The researcher originally planned for two focus group discussions, one for males and females. Only respondents who participated earlier in the semi-structured interviews proceeded to participate in FGD upon consent. Some participants preferred to participate in FGDs that combined both male and female. Among the participants were SLDs and therefore the researcher found it necessary to conduct an FGD for them. These unanticipated yet crucial field circumstances resulted in a total of four FGDs: one for males, one for females and one with both males and females and one for SLDs. The general FGD template is attached as Appendix B, although additional discussion points were added as they emerged during each FGD.

c) *Key informant interviews (KII):* These were conducted with individuals identified as key in the narratives around sanitation technologies and those making decisions that shape sanitation interventions at various scales. A total of five key informants were involved in the dissertation study, and they include a representative from the KCCA directorate of Public Health, a representative from NWSC, a representative from MTN Uganda, which funded the bio-toilet at the primary school, the headteacher of Kasubi Church of Uganda Primary school, a college custodian (an employee who oversees the functioning of an assigned building) at Makerere University. The KII template used in this dissertation study is included in Appendix C.

1.6.5 Data Analysis

Basic information about respondents was aggregated and presented using descriptive statistics to ensure anonymity of respondents. Since qualitative data methods were used, the data was analyzed based on ability of responses to answer a specific research question, fill missing gaps, and support triangulation determined by repeated evidence in different interview responses. Therefore, Content Analysis (CA) was used to analyze data for the dissertation.

To analyze the data, semi-structured interviews, FGDs and key informant interviews were first transcribed, the content organized and coded. During transcription, attention was paid to respondents' choice of words (direct and implied) since CA relies heavily on direct and implied meanings of messages conveyed in text from unique contexts (Zang and Wildemuth, 2008). Data transcription was done in totality of the interviews and on the researcher's reflections of each interview process. Approximately one hundred two pages of data were derived from transcribing forty-five semi-structured audio interviews. This means that every interview averaged about two pages of data transcripts although it should be noted that some interviews were quite longer than others. The longest interview transcript was three and half pages being the longest interview and the shortest yielded just slightly over a page of transcribed data. Twenty-three pages of data transcripts were derived from the five KII while thirty-one pages of data transcripts resulted from the four FGDs described earlier

The organization of data involved unifying similar wordings from the interviews before assigning codes. For example, municipality, KCCA, and government meant the same thing for most of the time just as Kampala, town and *the city,* were synonymous with KCC whereas 'little' city and 'little' town meant a popular trading hub within the GKMA.

As literature on CA points to identifying themes that emerge from chunks of data, research questions were used to pre-determine themes and subthemes prior to data collection. After data collection and analysis, new themes and subthemes emerged from responses, and these were used to complement the predetermined ones. The emerging sub-themes noted during the analysis of transcripts included weather patterns and seasonal changes, socio-cultural norms enabling certain practices, regulatory penalties surrounding practices and resources enabling practices.

Other key considerations during data analysis were variations in reference to actors. For example, although people referred to political, cultural, familial, religious and institutional leaders with an umbrella generalization, the difference became clear after respondents highlighted the power exercised by each category of leaders. For instance, religious leaders advised (used soft power) while institutions such as KCCA and the university respectively coerced the community into subordination through arrests and expulsion. Furthermore, points of divergence, convergence, relationships between actors, patterns of weather, patterns of risk, toilet technologies, among other things, were noted to augment the subthemes. A summary of how data was coded is shown in Table 3 on page 21 below.

Finally, the themes that were generated more broadly spoke to issues of *urban environmental risks*, *urban change, spatial Justice* and informed the findings and discussions noted in the chapters of this dissertation. Similarly, summary tables of the methodology and how data was coded are provided in Table 2 and Table 3 that respectively follow below.

Table 2: Summary of research methodology

Question	Data points	Examples for Elaboration	Method of Data collection	Analysis
What community practices and narratives around environmental risks are conveyed through sanitation technologies in Kampala	Biophysical risks like odors, bugs Weather patterns associated with Sanitation options Actors behind those narratives Are the narratives different and why?	Some mentioned smoking their pit latrines toilets to kill bugs KCCA, NGOs, community leaders, knowledge bodies, cultural institutions, business enterprises	Semi-structured Interviews with community members FGDs with community members KII with KCCA, the university, MTN Uganda, Headteacher at the primary school	Emerging themes were environmental risks, sanitation technologies Found divergences and convergences in narratives Identified actors

How do community practices and narratives around sanitation technologies align with changing urban environments?	Specific environmental events How the events have changed over time Individual and collective actions in response to those trends Certain technologies responded to those changes	Disease outbreaks, sewer bursts and sewage overflows More prominent Called emptier, reported to the estates department, protested. Adaptive	Interviews with community members FGDs with community members Key informant interviews from Makerere, Kasubi, MTN, KCCA	Identified seasons of risk occurrence, explained patterns, organization around responses to risks Explicate appropriate and inappropriate technologies

What spatial configurations are produced through practices and narratives of mediating environmental risk through sanitation technologies in Kampala?	Friends help SLDs to find toilets Centers where effort is geared Places to be saved, sacrificed or the in-between	Some people chose to move to where they can manage their facilities than wait for institutional services Certain places are to be protected like institutions of learning, religious places Sanitary and unsanitary places	Semi structured interviews with community FGDs Key informant interviews with KCCA	Teased out interventions in certain places Highlighted differences in interventions Determined who bears burdens from sanitation interventions and environmental risks

Table 3: Summary of how data was coded

				SECTION 1					
RISK	*Pre-determined from research questions*			*Emerged from responses*					
Subthemes	Air-borne	Vector-borne	Water_borne	Structural	Blocked	Closed	Stagnant water	Spillage	COUNT
Frequency	26	4	23	4	1	3	8	10	79
				SECTION 2					
PRACTICES	*Pre-determined from research questions*			*Emerged from responses*					
	Individual	Community		Institutions					
Example	Smoking toilet		Toilet emptying	Community cleaning		Rituals	Enforcement	Education	Support
Actors	Household		Tenants, parish	NGOs		Religious	State	Education	Cultural
				SECTION 3					
NARRATIVES	*Pre-determined from research questions*			*Emerged from responses*					
	Socio-cultural								
	Political								
	Environmental			Variations within pre-determines ones.					

1.7 Significance of the Dissertation

This dissertation contributes knowledge relevant for achieving targets 6. 2, 6. 7 and 6.8 of Sustainable Development Goal 6, which the United Nations Development Program (UNDP 2023) respectively highlights:

‘‘By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.’’

‘‘By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programs, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.’’

‘‘Support and strengthen the participation of local communities in improving water and sanitation management.’’

The dissertation identifies existing gaps around inclusive sanitation for vulnerable groups of people to inform strategic actions and decision-making for sustainable sanitation by all actors in cities like Kampala.

1.8 Structure of the Dissertation

The dissertation starts with an introductory chapter (Chapter 1) that gives a broad overview of the study background, gap, aim, theoretical framing and methodology. The three chapters (2, 3 and 4) that follow address the research questions above and are written in the form of academic journal manuscripts. Chapter 2: *Toilet Risk Experiences of Human and Non-human Relations in Kampala*, challenges conventional sanitation frameworks that assume separation of people and the environment by examining the interplay between human and non-human actors in risk production and mitigation. It argues that urban sanitation risks are not merely technical challenges but are deeply embedded in the relationships between humans and non-human elements of the environment, such as animals, plants, and built structures (see Ahlborg and Nightingale, 2018; Teubner, 2006). By examining these relationships, researchers can better understand how risks are produced and mitigated in urban settings. Traditional approaches to risk often focus on the vulnerability of human populations to natural hazards, treating the environment as a passive entity to be controlled (Aven, 2011). However, the chapter argues that non-human elements, such as animals, plants, and built structures, have a role in shaping and reshaping sanitation risks (Brondízio and Moran, 2013; Fuchs, 2006) as well as mitigation measures. This perspective challenges the long-standing dichotomy between environment and society, suggesting that a more integrated approach is needed to understand today's complex urban environmental dynamics. It is the ambition of this dissertation that by recognizing the agency of non-human elements, scholars and practitioners can develop more effective strategies for mitigating sanitation risks in cities.

Chapter 3: *Sanitation Practices of Commuters and Non-Commuters in a Rapidly Changing Kampala*, highlights the role of everyday sanitation practices in shaping urban environmental change. In rapidly growing cities, particularly in Africa and Asia, informal settlements and slums often lack modern infrastructure, and instead communities often rely on innovative, grassroots solutions to address sanitation issues (Guma, 2020; Simone, 2013). The practices involved in these solutions intentionally or unintentionally contribute to urban change. Recognizing the potential of local solutions challenges dominant narratives of urban infrastructure development, which often prioritize large-scale infrastructural projects over the lived experiences of urban dwellers. Also, the challenges and subsequent practices offer urban residents the opportunity to narrate urban environmental change in their own perspective. This chapter therefore focuses on everyday practices of accessing toilets among commuters and non-commuters to analyze the changing urban environment of Kampala.

Chapter 4: *Socio-spatial Configurations from Sanitation Provision and Access for Students with Disabilities in Kampala*, explores how spatial and infrastructural differences create barriers to sanitation access for SLDs. It situates sanitation within broader discussions of marginalization and exclusion in urban infrastructure. Differential access to sanitation in many ways has been attributed to colonial legacies and deeply entrenched social stratification (Miraftab, 2012; Ranganathan, 2022). While governments have made efforts to improve accessibility through structural and technological adjustments, such as height-adjusted sinks and automated flushing mechanisms (Groce et al., 2018), these measures often fail to address the underlying socio-spatial inequalities that marginalize certain groups. They also presume that infrastructure always works and solely focus on technological rather without consideration for social responses. This chapter underscores the importance of understanding socio-spatial configurations that arise from differentiated

provision of sanitation infrastructure to creating livable and inclusive cities. By visualizing the spaces on the margins of urban services, this dissertation contributes to environmental and social justice scholarship, offering new insights into the socio-spatial configurations that shape access to sanitation.

Together, these chapters contribute to advancing understandings of urban sanitation as a service that links humans and their environment, and sanitation-related risk as a multifaceted issue that requires a nuanced approach to understand and address.

Finally, chapter five gives important highlights and a general summary of the dissertation.

Chapter 2: Toilet Risk Experiences of Human and Non-Human Relations in Kampala

Abstract

The major aim of modern sanitation is to separate humans from both risk and the environment. This dissertation chapter, based on findings from Kampala, shows that even where modern sanitation is present, sanitation risks are co-produced by human and non-human elements, such as vectors, odors, and effluent flows. It analyzes people's practices and narratives about urban sanitation risks to add to the understanding of human-non-human relationships. The study employs a qualitative research approach, utilizing semi-structured interviews, focus group discussions (FGDs), and key informant interviews. It identifies three primary sanitation risks associated with infrastructural failures: waterborne, vector-borne, and odor-related. Additionally, the study highlights individual and community-level mitigation strategies, including informal negotiations, protests, and alternative waste disposal mechanisms that shape sanitation governance. Drawing on perspectives from urban political ecology, it problematizes state regulations that emphasize infrastructural expansion without addressing the persistent systemic failures that exacerbate sanitation risks for urban residents. Risk, thus, is not merely a result of inadequate infrastructure but is actively produced by socio-political structures that dictate access to sanitation resources. A key conclusion drawn from the study is that the occurrence and mitigation of urban sanitation risk are deeply embedded in human and non-human interactions. It thus challenges the dichotomy that underpins modern sanitation infrastructure.

2.1. Introduction

Modern sanitation interventions comprise technical infrastructure developed to reduce risk to public health by eliminating contact between humans and feces, disposal of raw human excrement in the environment and mitigating the vulnerability of human social groups from the impacts of poor sanitation. For instance, the birth of networked sewers in cities such as London and Chicago intended to prevent transmission of water-borne diseases such as cholera and improve city aesthetics from poor disposal of human excrement (Davenport et al., 2019; Melosi, 2000). Studies have indeed linked improved public health, general well-being and productivity to improved sanitation and vice versa (Angelakis et al., 2023; Swyngedouw, 2004). In turn, these studies have influenced discourses of bodies like the World Health Organization (WHO), Centre for Disease Control (CDC), state agencies and Non-Government Organizations (NGOs) regarding public health and vulnerability that significantly shape the discussion of urban sanitation risks on local, national and international scales. In many cities, modern sanitation and safe sanitation are conflated, with laws requiring flushing toilets to be connected to sewers. Yet as this dissertation shows below, modern sanitation is not always without risk, and non-modern sanitation sometimes enables the mitigation of risk.

The researcher utilizes an approach to risk that enables analysis of human and non-human relationships to understand environment-society relations. Lowrance (1976) defines risk as a measure of the probability and severity of adverse effects from hazards. This definition is adopted in many risk analysis models. The researcher argues that the long-standing dichotomy between environment and society in fields like geography and planning propels a limited understanding of risk, particularly sanitation risk. According to Ross (2021), sanitation risk is an event that could result in humans or the environment being exposed to pathogens which are hazards. Despite these

definitions, policy and development projects do not treat sanitation as a mainstream environmental concern. Instead, they consider it an infrastructure while its related pollution in the environment continues to pose serious consequences for human and environmental health, as well as urban aesthetics.

Urban political ecologists have pushed back against the idea of the separation of people and the environment, drawing on wider scholarship that emphasizes that the built environment is still deeply connected to 'nature' (Heynen et al., 2006). This chapter contributes to the study of environment-society relations by articulating urban environmental risks associated with both modern and non-modern sanitation infrastructure. The researcher acknowledges but sees beyond scientific models that frame risk as a product of vulnerability of a given population in the occurrence of natural hazard (Aven 2011). The researcher then traces the origin of risk in the assumption underlying modernist infrastructural development that non-human elements of the environment are passive agents and otherwise should be tamed for the threats they present to humans (see Brondízio and Moran, 2013; Fuchs, 2006). This is a characteristic of the dualism of environment and society in which the environment is presented as an imminent danger to society. Non-human elements refer to living and non-living entities of the environment outside human form such as plants, animals, objects (Ahlborg and Nightingale, 2018; Menon Karthik, 2017; Teubner, 2006).

By elaborating on the interaction between human and non-humans in the access and provision of sanitation services at two sites in Kampala, the dissertation shows how risk comes about and how it is mitigated. It recognizes that non-human elements interact with humans in various ways to shape and reshape forms of risk associated with urban sanitation infrastructure. The dissertation therefore contends that non-human elements are not passive, cannot be fully tamed and their active

role in enabling risk and risk mitigation ought to be recognized. Further, the researcher argues that the environment-society dichotomy increases risks and that interventions focused on controlling non-human elements fail to account for the complexity of contemporary urban environmental dynamics. Scholars and practitioners can achieve a more thorough risk analysis by taking environment-society relations that include more than human elements more seriously.

Examining the nature of urban environments has, in recent decades, been useful in environment-society relations research for two key reasons. First, as Fuchs (2006) observes, cities display a mutual connection in a productive cycle of society. Second, cities make up only 1% of the land area on earth, yet more than 50% of the human population is concentrated in them (World Bank, 2023). This number is projected to increase by 1.5 times to 6 billion people by 2045 (World Bank, 2023). The organization for Economic Cooperation and Development (OECD, 2003) states that risks in the twenty-first century can reach magnitudes of harm unimagined in recent times. As the quality of urban environments across the world deteriorates due to pollution, poverty, natural disasters, political unrest among other factors, and the demands of a huge human population concentrated cities create an atmosphere for heightened exposure of people to these harms that affect their livelihoods and wellbeing, there is a need to better incorporate risk studies in environment-society relations research in cities.

The environment has not often been at the center of sanitation studies, but two different fields have begun to more closely consider the 'nature' of sanitation. The fields of Environmental Sanitation (ES) and Urban Political Ecology (UPE) both recognize the relationship between all layers of influence (human and non-human) such as vectors, built environment, management practices among others that impact water, sanitation and hygiene (Schertenleib, 2005), but draw from very different starting points. This dissertation resonates with such concepts that recognize both

environment-society relations and emphasize that the environment includes more than human actors which significantly influence the development and functionality of sanitation infrastructure. However, like many other modernist conforming concepts, ES emphasizes 'expert control of all factors in the physical environment that may exert harmful effects on the development and survival of humans.' (Sadiq et al., 2018; Melosi 2000) This perspective not only negates the varied forms of knowledge amongst humans that interact with infrastructure every day by centering the role of the elite, but it also subjugates the role of non-human actors in the environment. For these limitations of ES, the researcher adopts UPE because it refutes the dichotomy and, as Latour (1998) states, political ecology cannot be inserted in various niches of modernization but must be understood as an alternative to it. Therefore, in this chapter, the researcher examines urban sanitation risk through the lens of human-non-human interactions to challenge their dichotomy and explore how practices and narratives around this risk shape and are reshaped by these interactions.

2.2 Literature Review

This section provides conceptual foundation for the research context. A synthesis of reviewed literature is presented in sections 2.2.1 and 2.2.2 that follow below.

2.2.1 Environment-Society Relations and urban sanitation

Historical records indicate that humans always related with the environment in different ways when it came to toileting; some dug pits or holes in the ground which the buried after relieving themselves, others had set spaces where they also established thriving gardens while others resorted to riverbanks only for water to wash away their excrement downstream (Zeldovich, 2021). Humans have always looked to nature, interacting with its various forms to get rid of waste and to recycle nutrients. However, increasing population density and size of cities has made these simpler

ways of letting nature manage sanitation untenable. Thus, since the nineteenth century, sanitation interventions have purposely focused on public and environmental health (Spuhler et al., 2020; Onyango and Uwase, 2017) in ways that attempt to control nature (cf Peet et al., 2011; Swyngedouw, 1999) and create an environment-society dualism.

The argument for control of nature through sanitation interventions is often presented by highlighting the consequences of poor sanitation, including the growth and spread of pathogens, water and air pollution, as well as unpleasant conditions (Satterthwaite et al., 2019). Wald (2021), for example, compiled historical narrations of government interventions in cities such as London and Chicago in the nineteenth century, premised on environmental challenges such as the Great Stink from the Thames. While there were certainly debates at the time, as well as concerns about the costs of such major infrastructure construction, modern sewers emerged as the key response to urban sanitation. This approach was also exported via colonialization, although sewers were typically limited to 'white' areas of colonial cities. Crucially, while urban sewer networks were widely deployed, these technological interventions were wrought with unforeseen environmental consequences. For instance, sewage flowing into Chicago River and out to Lake Michigan polluted the city's drinking water which necessitated a mitigation engineering project which also successfully spread Chicago's filth to other cities downstream (Wald, 2021).

In recent years, the hegemony of the modern sewer network has come under scrutiny for both ecological and economic reasons (Lawhon et al. 2023). Onsite sanitation options have also gained popularity for being flexible and responding to some of the social and environmental challenges in ways including increasing sanitation access in cities where sewers are deficient and resource recovery (Spuhler et al., 2020; Trimmer et al., 2019; Simha et al., 2016). Some of these designs are rooted in explicit attention to how humans work with the environment, in contrast to modern

sanitation. For instance, black soldier flies and red earthworms (Wang and Shelomi, 2017; Lalander et al., 2013) are cautiously bred to feed on fecal matter in latrines negating the need to empty these, or where Urine-Diverting Dry Toilets (UDDTs) are redefining centralized waste treatment and supporting urban agricultural practices. Trimmer et.al (2019) shows how gas and agricultural input can be generated from recycling and reusing fecal waste while other toilet inventions are minimizing wastewater from flushing toilets to save it for more pressing needs in particular contexts. Spuhler et al. (2020) highlights, as an example, that cistern flush toilets to networks have potential for water recovery although the technologies at present use huge volumes of water. Such works highlight progressive knowledge on sanitation, which in the long run may have ecological as well as economic benefits that are much desirable in fast urbanizing places of the world. They also show an often-hidden connection between environment and society.

The problems of conceptualizing a dualism between environment and human practices is well acknowledged and a subject of rethinking for nearly half a century (Gunn and Owens, 2006; Kaika, 2005; Swyngedouw, 1999). Nonetheless, reconciling this dualism has become a favorable scholarly adventure even in fields where it was deeply entrenched (Breuste, 2022; Grove, 2018). Urban scholars, for example, demonstrate how, despite human attempts to control the environment, cities are integrated with myriad forms of non-human life that cannot simply be dismissed in intellectual thought and development.

A decade ago, over 800 million people were infected with parasitic worms found in places with inadequate or non-existent sanitation facilities (CDC, 2024). The study by Byrne and Wolch, (2009) on human and animal relations in the city, and that of Robbins (2007) on lawn care reveal the complex relations embedded in human-non-human interactions. The studies show that despite the use of chemicals to eliminate non-human living organisms, the latter still prevail. Robbins

(2007) questions whether the pressure for lawn care results from patterns that require consideration of relationships between actors involved and the political, economic and social communal bond between them. This way, the researcher interprets human practices in cities not only as products of people's choices but also of socio-economic and political factors with consequences.

Guthman and Mansfield (2013) have illuminated the interconnectedness of humans and the environment, noting that although the environment does not interact materially with human bodies, it affects behaviors in ways that manifest biochemically, for instance, in the form of sickness. As a result, humans may then resort to processes that create balance between the environment and their health including building healing spaces that significantly change environments. In this change, Byrne and Wolch (2009) argue for city environments, everything used is derived first as a raw material that undergoes transformation which is critical to analysis of relations between environment and society through human-non-human interactions such as the bodies of urban residents carrying microbes and sometimes parasites such as fleas.

Scholars have also been interested in the question of urban nature starting fundamentally with analysis of what urban nature is. In the city, the question of nature and society also goes beyond ecology to incorporate aspects of planning and governance and therefore sanitation is used to understand complex processes of exercising power and the nature of cities. Cities across the world are sites for commodifying nature (Tzaninis et al., 2021; Cook and Swyngedouw, 2012; Kaika and Swyngedouw, 2011) through human labor. Cities are also interconnected as a global urban socio-natural system of genetic, chemical, material, information, energy exchange (Byrne and Wolch 2009). This metabolism engages all forms of beings in the cities, resulting in a more-than-human assemblage (McFarlane 2011; Braun, 2006).

2.2.2 Urban Sanitation Risk

Although many risk analysis models adopt Lowrance (1976)'s definition of risk, some recent studies propose the adoption of uncertainty in the place of probability due to challenges of establishing probability (Aven 2011; Aven, 2010; Haimes 2009). Tobin and Montz (2009) characterize hazard, which is itself a potentially harmful event that results from biophysical processes interacting with human systems as a threat to society. According to Ross (2021), sanitation risk is an event that could result in humans or the environment being exposed to pathogens, the latter being the hazard. Mitchell et al. (2016) posit the health hazards include viruses, bacteria, parasites and other micro-organisms from exposure to fecal contamination.

Water scarcity, high population growth rates, and lack of provision and access to sanitation infrastructure, including public toilets, are some of the factors for heightened urban sanitation risk. Research on urban sanitation risk has focused on the impacts of climate change on the sanitation sector.

Diarrhea is one of the major effects of poor sanitation claiming nearly 500,000 lives of children below 5 years every year (World Health Organization, 2024). Wolfgang et al., (2013) noted that 26% of children under five suffering from diarrhea in Abidjan, while 61 out of 305 infants reportedly died of the same in Ethiopia (Mebrahtom et al., 2022). A study by Prüss-Ustün et al., (2019) revealed that ninety percent of the water, sanitation and hygiene disease burden falls upon children under five years. A notable surge in the world's seventh cholera pandemic has been realized with over 100,000 dying each year since the outbreak in 2021 (World Health Organization, 2023). Similarly, Issahaku et al., (2017) show that diarrhea and typhoid were the second and third highest disease burdens in a neighborhood of Accra, Ghana.

Studies confirm that these sanitation related illnesses are inequality markers and not necessarily the result of biophysical elements (pathogens) alone. For instance, Ilic and Ilic, (2023) report cholera as a marker of inequality affecting mostly the world's poorest. There is sufficient evidence that the burden of sanitation risk and disease in cities falls mainly upon those living in informal or unplanned settlements usually called the urban poor (Bhan, 2022; Truelove, 2019), women and girls (Alda-Vidal et al., 2023; McFarlane, 2019), children (Prüss-Ustün et al., 2019), migrant communities (Ranganathan, 2022). To clearly understand the processes that reproduce sanitation disease burdens among the same groups of people across various cities of the world, one needs to engage a more critical lens of analysis.

Studies in Political Ecology argue that sanitation-related diseases are the product of social and bio-physical change that simultaneously creates and destroys spaces, whether it be through technological networks or appropriation of nature within this complex landscape (Truelove 2019; Gandy 2006), as some are excluded and included in access to sanitation resources. Doshi (2017) interprets the exclusionary environmental actions of the elite as threatening the reproduction of a healthy life when their provision of poorly lit, unstable public toilets forces many poor Mumbai women to rather engage in open defecation than face the consequences of using such poor toilets. For political ecologists, risk stems from relations of urban capitalism alongside socio-political, economic and historical processes that (re)produce them (Cooper and Bulmer, 2013; Pelling, 1999). Biza et al., (2021) demonstrated the production of a less or undeserving class based on access to sanitation infrastructure as well as certain areas of Maputo being created and naturalized as inherently dirty through historical sanitation rationalities. The socio-spatial imaginaries of sanitation in many parts of sub-Saharan Africa that exist today are traced way back in pre-independence times (Hungerford and Smiley, 2016; Nilsson, 2006).

The interest of political ecologists in risk is also tied to power because the latter is a means for shaping the material and social world. Cooper and Bulmer (2013) suggest risks display an equalizing effect among those affected by them due to power relations. In sanitation then, the question of power is answered by examining the hierarchies and dynamics between institutional and individual actors in making sanitation decisions as well as their relations with non-human elements that shape the access to sanitation both in space and time.

Political ecology is also attentive to knowledge production as an act of power that asymmetrically distributes resources and risk. For Turnhout, (2018), in many policy interventions, elites determine whose and which knowledge counts. In these cases, then, risk arises not because of a lack of technical expertise but because of social-political structures that undermine all knowledge. Another means lies in what Pelling (1999) argued, namely, that, in the presence of various actors, knowledge plays an important role as vulnerable individuals and groups may resort to interacting with non-state actors to deal with their exposure to risk. Political ecologists then further the discussion of who benefits from risk.

2.3. Methods

Out of the total forty-five semi-structured interviews conducted for this project, results from only thirty-six semi-structured interviews provided data that supported analysis for this chapter. Data from four Focus Group Discussions (FGDs) from respondents at Makerere University Kampala campus in Wandegeya and at Kasubi Church of Uganda Primary School in Lubaga division of Kampala City contributed to the analysis of findings in this chapter. The participants engaged in semi-structured interviews and FGDs, both men and women were randomly selected. At Makerere University, these respondents included resident (living on-campus) and non-resident (off-campus) students, teaching and support staff, as well as small-scale business runners (like canteens and

eating areas within the university) who use the toilets at this institution. From the primary school, respondents included teachers, support staff and entrepreneurs running canteens at this school who also use the toilets here.

The interviews were initiated by probing respondents' views about risks presented by or to water, insects, and air for two of each respondent's most used facilities, one of which had to be any of the toilets at either of these sites. The second facilities were those considered as their most frequented toilet away from the study sites hence at home and off campus residences in the case of non-resident faculty, staff, business operators and university students. The most reported of the second facilities were pit latrines and flush toilets.

All respondents were at least bilingual, speaking English and respective first languages which varied significantly depending on one's tribe. Interviews were conducted in English but some of the aspects had varied meanings between languages spoken by every respondent, an important factor to which semi-structured interviews proved an admirable method as its questioning format allowed both respondents and researcher to seek each other's clarity by going in great detail on each question. Terms such as water, environment and risks had multiple meanings in most respondents' first language and therefore didn't always directly translate into a singular meaning to English and vice versa. Thus, the questioning format allowed them to elaborate these varied meanings until both researcher and respondent arrived at meanings that resonated with the research, and how these occur with their sanitation needs, particularly as risks. Also, cognizant that perceptions of risks may be subjective and depend on several factors, the researcher was attentive to references of cultural beliefs, daily experience, or medical advice that shaped these perceptions. These helped to finely tease out people's articulation of risks in their daily sanitation experiences, how these different sources of knowledge relate to each other and are negotiated. The

researcher was able to determine what sanitation technologies induced or reduced these risks along with response strategies, whether as individuals or groups.

Additionally, five key informant interviews were held with officials from the city's governing body Kampala Capital City Authority (KCCA), the country's only piped water and sewage serving company National Water and Sewerage Corporation (NWSC), as well as MTN Uganda, a mobile telecom company that partners with KCCA in Kampala's sanitation as its corporate social responsibility. These state agencies and business corporations are actors on the Kampala Water and Sanitation Forum that coordinates stakeholders to develop an integrated Water, Sanitation and Health (WASH) sector in this city (see KCCA, 2011-2024). All data was recorded by audiotaping and then transcribed by the researcher. The dissertation utilized a content-analysis approach because it relies heavily on direct and implied meanings of messages conveyed in text from unique contexts (Zhang and Wildemuth, 2009) to derive themes. Some themes were based on research questions that were determined prior to data collection while others were derived from interview responses during transcription and analysis. Those themes derived prior included how water, vectors and air exposed respondents to sanitation risk. The themes derived from interviews were mainly socio-economic and included how gender, disability, and income shaped respondents' experiences. Patterns of similarity and repetition were identified during the analysis and used as evidence to support themes.

2.3.1 Description of sanitation sites

Both study sites are public education institutions. Makerere University is Uganda's largest and oldest public university established in 1922 at Makerere Hill in Wandegeya, Kawempe division of Kampala city. From this point on, 'the university' shall be used to mean Makerere University. Today, the university has several campuses spread across the country, but the study was carried

out at the main campus in Kampala. In 2022, the university had a student population of about 35,000 and 3000 employees (CIVIS, 2024) who depend on what respondents referred to as few toilets. The university's sanitation infrastructure is officially off site since its establishment during the colonial era and is currently serviced by National Water and Sewerage Corporation (the government monopoly on sewage management) as well as the institution's maintenance body called the Estates Department. Nonetheless, there is a historical period during Amin's regime when onsite pit latrines were established for students, and their relics remain visible to this day.

It is important to clarify here that typically schools in Kampala and Uganda in general have separate toilet facilities for teachers and students which are also separated on the basis of male and female genders. This is an important factor to consider in the remainder of this chapter because it significantly influences practices and distribution of toiletries and water.

Kasubi Church of Uganda Primary school (from now on in the dissertation referred to as the primary school) was established in 1936 and is located at the edge of Kasubi Royal Tombs on Masiro Road in Lubaga division. It is a government-grant aided school receiving it through KCCA. It currently has a student population of 1500 supported by 50 teachers, 32 of whom are full-time employees, and the remainder are part-time. The school has depended on onsite facilities since its establishment to date. Pit latrines served the school's population for a long time until almost a decade ago when transformations started happening due to new by-laws. These by-laws, among other things, require public institutions in the city to have flushing (water-borne) toilets whether the waste goes off-site or remains contained on-site in a septic tank (KCCA, 2017).

KCCA also mandates flush toilets in public places to be squat-overs rather than sit-ons to reduce the risk of disease transmission (Ibid pg3). These new regulations are responsible for significant sanitation changes, particularly on toilet technologies happening across the city in which older

buildings, for instance, are replacing toilet seats with squat-over bowls. The KCCA requirement for public places and institutions to have water-borne toilets has made flush toilets more common in the city and accessible to many urban residents. Aside from the applauded modern transformation of Kampala's sanitation denoted by the presence of water-borne toilets, there is conflict surrounding the hygienic condition of these toilets in public places.

The primary school now mainly runs on pour-flush toilets directly connected to a septic tank (see Nakyagaba et al., 2023 for a description of pour-flush) and a biogas toilet. The biogas toilet eliminates waste in such a way that a limited amount of water has to be flushed down, taking the waste through a digester tank where fecal waste is turned into gas tapped in the school kitchen, and the residue goes to the septic tank. This biogas is only used by students from primary one to primary seven (ranging between 6 to 13 years) while kindergarteners, teachers and support staff use the pour-flush. Pit latrines at the primary school remain occasionally used by students and staff that reside on the premises in cases of emergency such as during water outages and after business hours when the flush toilets are cleaned and locked for the following day.

This dissertation analyzes different modes as they are used; this is important to the overall understanding of risks that usually go unnoticed, especially for offsite sanitation technologies that are considered standard solutions for sanitation challenges. Policy regulations, cultural beliefs and daily practices acted in concert to shape the way these consequences manifest. For instance, Kampala's by-laws make the state directly involved in people's sanitation behavior and decisions through inspection and enforcement of sanitation and public health policies and regulations.

2.4. Findings

This section presents the risks and conditions through which people are exposed to these risks in their interaction with sanitation infrastructure in the city.

2.4.1 Experiences of risks from sanitation technologies in Kampala

Sanitation interventions employed in Kampala are intended to guard against fecal contamination of water and its sources, trap disease vectors such as flies and cockroaches and to prevent odors because these elements interact with sanitation technologies, resulting in mostly negative consequences. Fifty-one percent of responses reflect risky experiences through one of three elements: water, air and vectors, interacting with humans and the sanitation infrastructure under varied socio-economic and political factors. Thirty-nine percent of responses also suggested some people were exposed to risk by all three elements and socio-economic as well as political factors. Approximately ten percent of all responses reflected no exposure to risk by any of the three elements regardless of the socio-economic and political influences. However, responses from users of the toilets at the university showed that they faced risk by all three elements. Those who had not experienced exposure to risk by the three elements in concert with socio-economic and political influences had used toilets at the primary school and or the second most used facility away from the two study sites. Respondents were exposed to these risks in and out of the toilet spaces. The risks and conditions are discussed below.

(a) Water-borne risks

Respondents associated water-borne toilets to risk production due to unpredictable water patterns in Kampala which included water outages, inconsistent pressure and spilling when manhole backflow or pipes burst, presenting threat of disease and poor aesthetics. NWSC, the state water and sewage monopoly, provides piped water on which the city depends at a fee by abstracting it

from Lake Victoria, and other ground water sources for Kampala residents. However, sometimes maintenance works and very low water levels from sources, mostly in the dry season, result in water outages in various parts of the city. For both the primary school and the university, the latter was more heavily impacted by water outages because of its higher population that depended exclusively on water-borne toilets which lacked water to flush during these times leaving them extremely unhygienic.

Water outages alone expose frequent toilet users to Urinary Tract Infections (UTIs) that many respondents attested they suffer from, and this reduces their preference for water-borne toilets in public places. All female and many male students lamented experiences of urinary tract infections (UTIs) believed to be contracted from shared toilets for instance, a female student narrated:

"I started feeling unwell and it lasted for days. I went to the university hospital and got diagnosed with UTI. I was prescribed medication and the doctor advised me to always flush the toilet I use before and after using it and make check in at the hospital again if the symptoms lingered.''

Similar narratives revealed medical advice is incorporated in practices aimed at averting risks or reducing risk exposures. The researcher neither confirm nor refute the accuracy of medical advice reported by respondents. A study by Kabugo et al., (2016) showed no statistical significance of public or private toilets among risk factors for community acquired UTIs in Uganda.

Students with disabilities, specifically the physically disabled and those living with blindness were highly vulnerable to getting in direct contact with feces when toilets were left unflushed. High water pressure in the pipes sometimes caused water to gush out of the toilet and splash the user when flushing toilets in the university's old buildings; this water would also spread and stagnate in toilet stalls as one resident female student narrated,

‘‘I usually flush the toilet before squatting and after use. Since the pressure is high, water gushes out with force and spreads on the floor sometimes. Whenever I pull the flush handle, I immediately run out so that the water does not splash on me. I am sure someone else has used the toilet before me and I don’t know whether they flushed or if the water is even clean.’’

The researcher observed water spread across the floor of a stall in the toilet facility at the gym, shown in Figure 3 below, possibly due to high water pressure after an outage. The wall paint in the unit was peeling and had water damage, reflecting that such flooding incidents are frequent in this facility.

Research studies have proved that stagnant waters enable breeding of the female anopheles’ mosquito that spreads malaria. Both Wolfgang et al., (2013) and Issahaku et al., (2017) show high incidences of malaria associated with poor water and sanitation in African cities. In this dissertation, respondents residing at the university reported an abundance of mosquitoes in their toilets that may be promoted by several environmental factors including stagnant water in the toilets.

For respondents who used water-borne at their second frequented toilet mainly at home, the impact of water outages although present was not particularly risky because there usually was a back-up pit latrine outside the house that did not require water, water was obtained from reservoir tanks on the premises or sourced outside the home from water vendors (see also Alda Vidal et al 2023). These respondents expressed relief for not connecting their water-borne toilets to the state supplied piped water system because they could still flush the toilets when there was a water outage and it did not pay huge water bills to the state.

Figure 3: Water spread across the floor of a stance in the toilet



(b) Odors and bad smells

Odors and smells were the most reported exposures to risk. Twenty-nine of the thirty-six interviews reflected respondents' experiences with odors and bad smells from at least one of the two toilet facilities they frequently used. The remaining respondents had either not experienced odors at any of the toilets they frequently use or declined to respond to the prompt because they were engaged in taking care of the toilets at the two sites. Respondents who reported the experiences with odors expressed that the bad smell negatively affected their wellbeing and sometimes health with issues like stomachaches, nausea, and loss of appetite. One female office administrator in a department at the university told the researcher,

''the stench gets so bad sometimes and I have to close the windows because it is very uncomfortable, and it has caused me an upset stomach several times.''

The prevalence of odors was reported to be high whenever there was no water to flush the toilets (for waterborne toilets), during the dry season for pit latrines that were shared by many people, during episodes of pit emptying (although this was deemed non-risky because it is expected and only lasts a short time), in the wet season particularly during or immediately after heavy downpours of rain, and when there is a spill of effluent from broken sewage lines.

Windy days during the dry season were emphasized in interviews to trigger odors from toilets at the university and at people's places of residence. In the latter case, most of which were pit latrines, the intensity of odors was linked to the proximity of their house to the toilet where the smell originated. A male respondent who is a graduate student at the university but living with his family about 7km north of the university said,

'I have slightly noticed the odor because my house is fifth from the toilet but the closer I get to the toilet the stronger it gets especially in the morning and evening when there is a breeze.''

In the wet season, respondents elaborated that the occurrence of odors signaled an illegal form of pit emptying in which the owners or caretakers of pit latrines tactfully punched a lose end (usually the size of a brick) or fixed open pipes into the fecal chamber to release any wastewater or loose feces from these toilets into drainage channels on rainy days. The bad smell then spread for as far as the water flowed. Such toilets are usually constructed on the edge of plots next to drainage channels such that the process of releasing waste into the channel is easy without leaving any marks on which this socially unacceptable and illegal practice can be traced. In a Focus Group Discussion, two respondents, one male and one female from the primary school live in places where this practice was quite common, and each one explained:

‘‘In Kansanga, one of my residence areas, some people place toilets side along drainages and release them when it rains. After heavy rain, the smell is terrible.’’ Narrated the male respondent.

‘‘I stay in Nabulagala and the place is overcrowded almost like a slum. The are many tenants on the block of houses that I stay at with my family and all the households share a single toilet. When it rains, many toilets in our neighborhood, including ours, are opened and release sewage into the main channel that goes through Kosovo to Busega. During a heavy downpour, the odor is terrible, but the landlords bribe the health inspectors.’’ Narrated the female respondent.

All the different toilet types were reported to exhume odors when conditions stimulated these were in place, but all users of pit latrines reported bad odors from these toilets. The odors come from the fecal containment chamber located directly underneath and the toilet keyhole on the slab. The smells reportedly got worse when toilets were used by many people like it used to be at the primary school, at off-campus rental accommodations that house many students and at homes with several rental units that some of the respondents stayed at.

The water-borne toilets produced odors when there was no water to flush feces away. The absence of water for several hours and sometimes at least two consecutive days or when pipes broke and there was a spillage at the university orchestrated odors for waterborne toilets here because waste would not be flushed away irrespective of the weather season. Even though the wet season allowed for alternative sources of water in reservoir tanks which at times overflowed after a heavy downpour, it made no difference if the water was not carried into the toilet spaces by the caretaker for reasons explained earlier. Spillages were a common occurrence at multiple points of the old sewage network at Makerere that quickly got blocked when users dumped or flushed down heavy solid materials which caused backflows. Students and cleaners at the university attributed dumping of solid materials down toilet drains to ignorance of some users of the toilets about which materials are friendly. Newspapers and rule paper from exercise books were often found in toilet holes. However, technical personnel interpret some of the user's actions as intentionally aiming to vandalize the toilet system especially during student protests against unpopular university policies. In a key informant interview, a custodian at the university explained,

''I find sanitary towels, plastic and glass bottles in the toilet bowls which block the system and hurt all of us. I also have eye-witnessed students throw pieces of tree branches, rocks and bricks in manholes during their strikes against certain policies on campus.''

This way, toilets are on the intersection for acts of resistance that produce risks for all parties involved as will be elaborated later in section 2.4.2 on individual and community practices and confirm the observation of Graham, (2006) that violence and inherently risk are centered on urban infrastructure.

At the primary school, odors came from the septic tanks of their water-borne and biogas toilets and now very rarely from the pit latrines when the facilities require emptying and during the

emptying process. Odors experienced during the emptying process were considered to not be of major concern because they are expected to happen at some point and only last a few hours on that day. Once the toilets being to smell prior to emptying, the school authority reports to KCCA which then sends a cesspool truck for the job.

(c) Vectors

Flies and cockroaches were rarely reported in flush toilets at off campus residences and at the primary school. At the university, however, these were rampant when there was a water outage, during the dry season or when excrement spilled from broken pipes. Under these circumstances, respondents feared that the vectors carrying fecal contaminants would spread to their food and make them sick. One graduate student expressed.

‘‘I suffered from typhoid three times during my undergraduate program when I was staying in the university halls of residence although I always got medical treatment. I am not sure what toilet it was, but I learned that I ingested food contaminated with feces. When there is no water to flush toilets the flies get on our food both in the dining area and in the rooms. This is serious because now you see many students with cannulas (intravenous ports) on their hands, and I am sure it is related to our toilet situation.’’

Although typhoid, a stomach infection caused by eating food contaminated with *Salmonella typhi,* cannot be limited to exposure from facilities at Makerere in particular, the fact that resident students spent most of their time at the university makes it highly plausible.

Effluence flowing over lawns and green spaces where students would ideally rest made it impossible to do so because smaller living organisms bred and infested in these spaces. Houseflies hatched maggots on the grass covered in effluent and the possibility of parasites cannot be dismissed. Makerere’s greenscapes were observed to be interceptors for sewage drains with many

septic tanks located on green spaces across the campus. A custodian explained that this was intentionally designed as back up for unavoidable circumstances such as when a spillage occurred although no logical explanation was provided as to why this was the only alternative for the said unavoidable circumstances especially because roots of trees were pointed out as causes of damage to the network.

The cost of toilet supplies like detergents to eliminate vectors, odors and bad smell presented significant budget strains for institutions, families and individuals. For example, the university and primary school have the duty to provide toilet supplies to keep their toilets clean and usable, but Makerere often went without providing basic hand soap in most of its toilets which compromised hygiene when people only washed with water (if the water was at all available). During Focus Group Discussions, students from different halls of residence generally agreed that they periodically met with administrators of their respective halls to discuss issues that arose including those related to water and toilets. In a focus group discussion with students from one male and one female halls of residence, students expressed,

‘‘We have health ministers in the student leadership of every hall. We report water and health issues to the person in this position. Students go to their health minister for a follow up and once he/she says the complaint was forwarded to the custodian, but we see no change, then students demand to go to the custodian in the presence of the health minister who initiates dialogue. Meetings like these are for emergency circumstances because the student leadership at every hall organizes periodic meetings with their custodian. If after a while nothing has changed, then students get angry, and they strike.’’

A student argued it was a luxury to eliminate flies, cockroaches, and preventable odors in Makerere's toilets following a disagreement over toilet supplies in one meeting between the custodian and several students at a hall of residence. At the meeting, students complained about vectors in their toilets and asked for fumigation services, but the custodian challenged them to have personal supplies (including toilet paper, disinfectants, and insecticide) because it was too expensive for the management of the hall to provide these supplies.

Similar to what was identified at the university, the biggest challenge for maintenance of water-borne toilets reported by respondents who use them at home is routine plumbing maintenance, the cost of purchasing, and accessing cleaning supplies. The cost of these supplies is relatively high because few households use water-borne toilets, which makes the demand low and costs high. In addition, retail shops in neighborhoods where most Kampala residents buy groceries do not usually sell cleaning supplies for water-borne toilets unless the shops are in areas where these toilets are common. Users of water-borne toilets will often have to go to supermarkets usually located outside their neighborhood or the CBD to buy these items, incurring additional transport or time costs. For many respondents, water-borne toilets are for the rich and affluent because they symbolize higher social and economic status.

2.4.2 Individual and community action to avert risks.

In the absence of water outage notification systems, many respondents at the university reported adopting a precautionary practice of flushing the toilet prior to use, to verify the availability of water for subsequent flushing. A non-functional flush on the first attempt was typically interpreted as an indication of a water outage. Respondents who commuted from off-campus locations, both male and female, reported that they would refrain from using the toilet when there was an indication of water outage. In contrast, on-campus residents, who often lacked viable alternatives,

proceeded to use the facilities despite the absence of water. The precautionary practice of flushing the toilet prior to use was also partly influenced by a common perception that pre-use flushing served to remove residual germs left by previous users. To mitigate the effects of water outages, both sites provided supplementary water storage in the form of 100-litre barrels and cans such as shown in Figure 4 to enable users to manually flush using the pour-flush method. The toilet users carefully bend low as they pour it into the toilets, so it does not splash back at them.

Figure 4: A yellow 3-liter jerrycan used to scoop water from a 100L water barrel beside it for flushing the toilet



Caretakers were responsible for ensuring that this water was consistently accessible within the toilet areas. They fetch this water from reservoir tanks which are filled with rain harvested water and occasionally by water bowsers (private or public mobile water distribution tanks). At the primary school, water was always available even when there wasn't a water outage but just in case situations warranted its immediate use. At the university, however, there was a large time gap between when the water outage occurred and when the alternative was provided.

This strategy of supplementary water storage was only fully effective at the primary school, and off-campus residences but not at the university.

The success at the primary school is attributed to the termly induction of students on toilet training including flushing geared to keep the biogas toilet functional. A huge amount of water is undesirable for the biogas toilet and therefore the caretaker usually fills the jerricans when she cleans toilets but may also assist children to do so.

At the university, the alternative was not very effective because continuous use of toilets by the high population quickly runs the water out, and in other circumstances, it is not provided at all in some facilities. Provision in some facilities and not others can be interpreted as water appropriation informed by a hierarchy of actor importance. For instance, water was never allowed to run out in faculty and staff toilets whereas in the student facilities, the barrels and cans were never refilled daily when they ran out. It was not clear why caretakers did this, but limited logistics are partly to blame and in older buildings many of which do not have elevators, caretakers found it difficult to carry large volumes of water to upper floor toilets continuously throughout the day.

This resulted in two consequences. First, most graduate students working as assistants that were interviewed gained access to staff toilets doubling between them and student ones when situations were warranted. Staff and faculty toilets were always locked, and every user required a key. These

graduate students, some of whom shared working space in their supervisors' labs and offices, got access to the keys and were thus able to use these toilets although they did not share the key with other students. Second, students who didn't have this opportunity roamed around different facilities both within and outside the university. Those in residential halls waited until the night when they could not be shamefully identified for using a dirty toilet and leaving it unflushed.

Shaming was a common tactic used to attack individuals who did not flush toilets even when there was no water in the toilets. One caretaker explained a case of the university faculty and staff toilets saying,

''because there are not many faculty sharing toilets it is easy to identify any person that didn't flush after use, and we subtly call them out. To avoid such instances, it is why we provide water in the barrels in their toilets.''

The unhealthy dynamic to the student population, however, leaves them at risk of disease and mental distress.

Collecting rainwater in basins, buckets and filling jerry cans was very helpful for individuals residing on the campus of Makerere during water outages but it was greatly challenged during the dry season when rains were rare. Students then fetched water outside the university as student leaders negotiated with the administration of their halls of residence. Once negotiations failed, students resorted to protests to demand for water and proper sanitation.

Campus protests were avenues through which students expressed resistance to what they regarded as oppressive policies and unfair treatment that the university administration did not address. One student recalled a proactive protest during which male students from his hall of residence marched across the university barely clothed with towels wrapped around their bodies towards a female hall of residence. The rationale for moving towards a female hall was to cause panic among university

administrators for fear of media attention against the university. The university administration was quick to hire water bowsers (water vending trucks) to provide water at the hall of residence which silenced the protest. Today, student protests at Makerere result in expulsions making students forge other self-help ways such as buying water from outside the university, temporarily moving in with family and friends for those with such support structures within the city until water is back at the university. Others fled their official campus residence halls for off-campus accommodation even though it is more costly.

Students with disabilities at the university relied on friends to fetch water for them, making social networks extremely important to their survival in this environment as the dissertation elaborates more in Chapter 4.

The estates department has a reporting line system in place for all custodians of different college buildings and halls of residence. This system is the only collective action available for responding to the university's malfunctioning sanitation infrastructure. At the bottom of this line are caretakers who primarily identify a blocked or spilling spot, which they report to their supervisor until it gets to the university's estates department. When the problem is too big for the estates department to fix or lie outside their jurisdiction, then they resort to NWSC.

The biogas toilet rallied several actors in the school's sanitation. Parents of the students were drawn to the sanitation needs of the school whenever they were invited to events, and as such gained information on the biogas toilet, which is still relatively new technology. Although parents must provide two rolls of toilet paper per school term for each of their children, the need to ensure proper function of the biogas toilet at school encouraged parents' efforts in the sanitation affairs at the school.

Farmers in the community around the school also play a vital role by joining the teachers and children to remove slurry from the digester before the KCCA cesspool emptier comes to remove the remainder of it and any other septage from other facilities on the school premises. Farmers and teachers scoop out amounts enough to compost the school's and participating farmers' gardens at zero cost. In this collective effort, participants calculate how much slurry is enough for their use and how much they should leave behind for the KCCA truck to take away. The collective effort is also attentive to the potential risks of disease transmission and food contamination. Therefore, protective equipment such as gloves, gumboots and masks are provided on site to the participants and the activities are conducted on weekends when school is off, and the kitchen is not in operation.

For their second most used toilets, respondents who were tenants required their landlords to provide a fully functional toilet system. The tenants and their households had the responsibility to sweep, mop and at times smoke the toilets to keep them clean, with the households often taking turns in these activities. To smoke toilets, respondents expressed that they set controlled fires on dried banana leaves in their pit latrines to eliminate odors and reduce insects. This method is a common practice amongst households in Uganda and is passed down from older to younger generations. But now with the reduction of banana gardens in the city, the method is increasingly challenged. Those who smoke their toilets have to roam through gardens in their neighborhoods to find dried banana leaves or rather buy them from farmer's markets.

Although these rules didn't have binding agreements, the expectation was based on property ownership. As such, landlords provided means to smoke pit latrines, repair broken pipes for those using flush toilets, emptying and other such required maintenance while tenants paid their rent timely to facilitate any maintenance that was required. Where landlords were absent, caretakers, mainly relatives of the landlord, assumed that responsibility.

Seven percent of respondents who were tenants reported that they have engaged in radical measures such as withholding rent if the landlord hesitated to care for the toilet at a usable standard. In other instances, there were negotiations between the landlords and tenants to cut back on the rent due if the tenant(s) met the toilet maintenance costs depending on how much was spent. Although tenants can report failure of their landlords to provide sanitary toilets to KCCA (which is which is considered a radical measure), most tenants including those who had engaged other radical measures before were however hesitant to report to KCCA on accounts of bribery of health inspectors and officials by the landlords, defeating the purpose of reporting to the authority and yet stirring strife between themselves.

Cleaning shared toilets presented challenges for users whose priorities about the state of their toilets didn't align or those whose schedules did not match. In such circumstances, more concerned users resorted to the use of padlocks to either shut out anyone that did not responsibly contribute to keeping toilets clean and safe or to force users of each padlocked toilet to ensure their toilet was clean. Again, guilt-tripping was indirectly used here since the padlocking system assigned users to particular toilets and therefore had to keep it clean or be shamed. Where the padlock system was not agreed, users resorted to shared monetary contributions to pay someone to clean their toilet(s) periodically.

Like farmers have benefitted from slurry out of the biogas toilet at the primary school, individuals operating tree nursery bed businesses have taken over hotspots where flowing effluents exits the university such as at the Eastern Gate along *Bombo* road and along *Muganzi Awongererwa* road in *Kukumi-kikum*i settlement in Wandegeya as shown in Figure 5.

Figure 5: A nursery bed business operated in a sewage-flowing drainage channel along Bombo Road



From these observations on the university campus and at the edge of the university, the researcher notes interaction between environment and society through economic labor and belief systems. Often, our interview respondents echoed that plants were useful 'absorbers' of urine and fecal excrement and quite acceptable where in the absence of well function toilets, excreting in gardens was the safest option for both the environment and people (with emphasis for women). Doshi (2017) observed a similar pattern where women in Mumbai opted for open defecation where public toilets were not safe for them to use.

2.5. Discussion

Evidence from the findings above indicates that the interaction between biophysical elements of the environment, humans and modes of sanitation in many ways presents risks but also helps to mitigate some of the risks. Although sanitation infrastructure was reported as a source of risks, the risk factors spread beyond the toilets and sewer line connections into open space causing risks and their effects to multiply.

Analysis shows that risk associated with Kampala's sanitation stems mostly from fluid waste flows enabled by weather patterns, user practices, management practices, political implications, and socio-economic conditions.

There are mainly two channels of human waste flows acceptable by the state namely, (i) through the network of sewer pipes from source directly to the sewage treatment plant called off site and (ii) the fecal sludge management chain for on-site sanitation which involves several interconnected stages from mechanized collection at a source up to dumping and treatment at the sewage treatment plant. The goal of these channels of waste flow is to reduce the chances of human interaction with fecal waste, avoid pollution of the environment with fecal waste and therefore minimize risk. However, some toilet technologies allow fecal waste to flow outside the two channels in both acceptable (for biogas toilets) and unacceptable ways (pit chambers). Other technology options that eliminate transport of fecal waste to treatment plants such as bio-toilets, and UDDT toilets (Nakyagaba et al 2023; Biza et al., 2021; Lalander et al., 2013). The ability of users to treat the waste requires some level of knowledge to protect themselves from disease pathogens that can be picked up when interacting with feces. Such practices therefore challenge expert knowledge of fecal handling at specialized locations in cities where only certified personnel work. The toilet

technologies significantly redefine risk and forms of risk posed when non-expert humans come into direct contact with waste.

In the case of water-borne toilets at the university, the flow does not often end at the desired destination when sewage pipes break and spill waste before it reaches the sewage treatment plant. Although this dissertation provides such evidence, other studies in Kampala have mainly concentrated on the barriers of fecal sludge transport to treatment plants for onsite sanitation such as pit latrines and septic tanks (see Cossio et al., 2020; Salian et al., 2020; Newton, 2003) without paying attention to discharge (and how much of it) from sewers does not end up at the treatment plants.

Moreover, KCCA and engineers of NWSC work under the assumption that sewage flows contained thoroughly through pipes from the source to the sewage treatment without interruption and therefore sanitation standards are rarely enforced for offsite sanitation technologies. This dissertation study posits that the blanket expectation of proper sewer function by these actors increases people's exposure to pathogens and its effects. Noteworthy, bureaucracy of the agencies and lack of expectation of all diverse materials in sewer conduits are underlying factors supporting the assumption that sewers will always work. Marvin and Medd (2006) however, elaborate the diversity of materials including fat, oil and rats that render sewers not to function as intended.

The health effects of foul toilet smells and odors open ways of thinking about transmission of sanitation related diseases and illnesses outside the fecal-oral route. Not all sanitation related diseases or illnesses are spread by vectors or involve ingestion of pathogens via water and food contamination.

UTIs, stomachaches, and mental distress that our respondents re-echoed have no transmitting vectors but are spread to people through infrastructural interactions with the environment- air

spreading foul smell, flow of waste over lawns and green spaces where people sit and stagnant water in toilet facilities. UTIs as reported in this dissertation also support the same argument that there are other transmission routes besides fecal-oral routes. However, the role of unhygienic and public toilets in contracting UTIs is debatable with many studies stating that it is negative. Still, Vyas et al., (2015) reported a high association of asymptomatic UTI infections among females who used public water-borne toilets with seats and those who did not clean the toilet seat before use. Kwiringira et al., (2014) also reported that unhygienic public toilets posed a risk of UTI infections to women and girls. Despite recognition of these multiple routes of disease transmission, KCCA's prevention strategies remain largely informed by the fecal-oral route which is also taught to students in primary school. Medical advice remains an important way that Kampala residents learn about transmission of sanitation-related diseases.

Since disruptions are very frequent and constantly pose high risk, Kampala residents maintain practices that mitigate sanitation risks even when infrastructure is functioning properly. This is because risk-averting practices have become embedded in daily sanitation behavior passed on through education at home, school, places of worship, medical advice and state regulations. Nonetheless, everyday practices of mitigating risk have not always been successful where an outage of water, lack of soap, or a combination of both prevented people from keeping basic hand hygiene and consequently getting sick. KCCA reports 43% of its schools alone in the city lack soap and water in the toilets (Salian et al., 2020 pg 6). This augments what Byrne and Wolch (2009) observe that human and non-human bodies are intertwined citing the survival of parasites on human bodies that often shape the nature of cities when parasites multiply, biochemical changes that manifest as sickness occur in humans which ultimately necessitate healing spaces. This allows

us to see firsthand how the environment and society and sharpen our understanding as to why public health discourse drives sanitation efforts and interventions.

Sanitation risks in Kampala attract myriad conventional and non-conventional responses from individual and collective actions. These responses in the form of practices and narratives are tied to existing social, economic, technological, cultural and political circumstances.

The state enforces laws and regulations that promote acceptable channels of waste flows by accepting and regulating appropriate technologies, inspecting communities to ensure compliance, connecting households to the sewer networks, maintenance services for sewer networks, removal and transporting of waste from facilities under city management as well as treating waste at the sewage treatment plants to safely discharge it back to the environment purposely to guard against water contamination. This is a state priority because an outbreak of sanitation diseases like cholera, dysentery, typhoid and diarrhea in the city would indicate failure of the state to its public health responsibility and commitment which would therefore reduce its legitimacy to the public. In addition, it is also a justifiable way for public spending that engages the city in global capital finance flow through donations from international funding institutions. Under the Kampala Sanitation Improvement and Financing Strategy (2020-2030) that among other things seeks improvement of fecal sludge management and sewer connections with the goal of achieving target 2 of UN Sustainable Development Goal (SDG) 6 (UNDP, 2023) running from 2020-2030, KCCA and NWSC have an estimated budget of USD 271.7 million financed by the government, development partners which are often times international donors like Bill and Melinda Gates Foundation and development banks (KCCA n.d, pg 68). In this strategy, the state lays emphasis on reducing the risk of water-borne diseases through various measures pertinent to the sanitation chain which once again overlook risks from the sewer.

Water-borne diseases are not the only risk to deal with. First of all, when effluent flows from the university, it ends in neighborhoods on the university margins where communities reside and operate businesses such as retail grocery shops, restaurants, and transport. The researcher observed that communities are left to deal with the odors and dirty landscapes from effluent flows. This is mainly because communities on the margins lack strong civil and political structures to engage with the university management on its poor sanitation management. The lack of political will or civil action by communities on the margins of Makerere to contend with the institution reveal a major collective disempowerment of people in their sanitation affairs. Swyngedouw (2004) argues that areas on margins are at low odds of favor with institutions in comparison to areas of the affluent who are not only able to politically challenge institutional decisions that are not in their interests but are also more vocal, better funded and better trained in the ways and means of lobbying and influencing decision-makers (pg 60). Then, student protests in demand for proper sanitation services and consequential counter actions by the state have a spillover effect beyond university borders. Now, there is a risk of civil unrest, physical and economic injury that further put these communities in disadvantaged positions when police respond with tear gas and rubber bullets to curtail protests. These counter actions also temporarily render sanitation facilities unusable due to safety concerns. And when students drop materials in interception manholes as acts of protests, it damages the network in the long run.

2.6. Conclusion

This chapter explored the risks posed by sanitation infrastructure in Kampala to better understand environment-society relations. Although infrastructure should help people in urban areas to prevent diseases, evidence from Kampala reveals that sanitation infrastructure (networked and

alternative sanitation options alike) exposes users to water-borne risks, vector attractions and odors even with modernist control through regulation in place.

As state regulations influenced the increase of flush toilets in institutions across the city and made them more desirable at household level, practical measures to keep these functional and usable are compounded by unreliable water supply in the city. Water patterns including outages and pressure exposed people to unsanitary toilets and increased their risk of illnesses such as urinary tract infections.

Similarly, vectors in toilets increased the risk of pathogens spreading from toilet spaces, contributed to food contamination resulting in typhoid infections and made toilets uncomfortable spaces for people to safely excrete. Odors also created nuisance environments unfit for human occupation. While these revelations are not new, the implication of these risk occurrences to people's daily sanitation practices and on steps that policy makers take to ensure proper and realistic implementation of policies that reduce urban sanitation risk remain unknown.

A crucial observation is that the cost of sanitation risks heavily falls on those without a political will to act against their risk exposures most of whom are also socio-economically disadvantaged as they live in marginal spaces and where collective agency is relinquished like the banning of protests in Makerere.

Mitigating sanitation risk in Kampala involves individual and collective effort. Our analysis presented practices and narratives of actors around mitigating risk to contextualize politicized urban environments that specifically highlight sanitation infrastructure within layers of power, relationship dynamics and socio-economic status. However, the biophysical conditions within which the infrastructure existed dictated the measure to which Kampala's sanitation infrastructure was politicized.

In sum, a combination of factors enabled by human and non-human elements of the environment such as flows of waste and pathogens, management practices and socio-economic conditions mediated through sanitation infrastructure contribute to the occurrence and mitigation of risk. An eminence of human control over non-human elements undermines a nuanced understanding of environment-society relations thereby leaving room for occurrence of urban sanitation risk.

Chapter 3: Sanitation Practices of Commuters and Non-Commuters in Rapidly Changing Kampala

Abstract

Infrastructure studies from Global South cities show the importance of everyday practices to urban change, pushing back against narratives that focus on large-scale development or policy reforms. While sanitation infrastructure remains a critical urban challenge, particularly in fast-growing cities, little research has examined how commuter and non-commuter populations navigate and adapt to sanitation deficits. This dissertation chapter addresses this gap by investigating everyday sanitation practices in Kampala, Uganda, highlighting how access to sanitation reflects broader trends of urban change and socio-environmental inequality. Using a qualitative approach, data was collected through semi-structured interviews and focus group discussions. Participants shared their experiences with sanitation facilities, and how these experiences shape how they narrate urban change. While commuters benefit from mobility and access to diverse sanitation options across multiple city locations, their experience is often constrained by high costs and limited availability of free, well-maintained public toilets. Non-commuters, on the other hand, have greater familiarity with specific facilities within their residential or workplace environments, but they often face overcrowding and poor maintenance. Cleanliness and quality were primarily influenced by the number of users and access restrictions, with private or limited-access toilets being generally cleaner than public facilities. The dissertation shows that sanitation practices are shaped by learned behaviors, social norms, and the broader infrastructural challenges of the city. The contrast between commuters and non-commuters underscores Kampala's fragmented urban environment, where access to sanitation depends on socio-economic status, mobility, and financial resources. This research concludes that understanding urban change requires an appreciation of how everyday

practices intersect with infrastructure, politics, and social inequalities. The dissertation contributes to the discourse on urban transformation by emphasizing sanitation as a key element in sustainable urban development for rapidly growing cities like Kampala.

3.1. Introduction

Scholars of the Global South have increasingly emphasized the importance of everyday practices in shaping urban environments. Urban change is not merely driven by large-scale infrastructural projects or policy reforms, but by the daily behaviors, decisions, and practices of both human and non-human actors (Pineo 2022; Truelove and Ruszczyk 2022). Human actors, through their routines, policies, and efforts to navigate challenges, contribute to the evolution of urban spaces, while non-human actors, such as animals and environmental factors, respond to and shape these environments in various ways. For example, animals and birds have been observed adapting to traffic flows in cities (Łopucki et al., 2021; Schell et al., 2020, while air, water, and soil are continually altered by industrial and natural activities, impacting urban quality (Moghimi Dehkordi et al., 2024).

Urban change is multifaceted, encompassing social, psychological, economic, political, and environmental dimensions. Central to these discussions is the recognition of the histories and infrastructures that contribute to urban transformations. In the 21st century, cities are increasingly fragile, facing mounting social, demographic, and environmental pressures. As global urbanization intensifies in regions like Africa and Asia, which are expected to see the fastest population growth in the future (Dimnwobi et al., 2021; Wambui 2020), urban geographers and sociologists are called to examine how these shifts affect cities' ability to sustainably adapt to changing conditions.

In African cities, slum development and informal settlements are projected to dominate the urban landscape in many parts of the continent, including Kampala. In these cities, infrastructural development also lags behind rapid urban growth. For example, urban sanitation coverage is still a particularly pressing issue although some studies such as Lawhon et al (2018); McFarlane and Silver (2017) elaborate how this gap provides opportunities for innovative solutions to sanitation

problems that the communities face. The creativity that people in underserved urban areas engage around infrastructure, especially in developing cities has attracted academic spotlight for understanding new forms of urban development. From Nairobi's settlements of Mathare and Kibera, Guma (2020) discusses progressions of telecommunication infrastructure through community-initiated distribution, maintenance and protection systems. Such cases of community projects that are parallel to formal systems provide employment, open up new community spaces of leisure and sustain livelihoods. For this reason, works such as Jaglin (2019); Simone (2013); and Echanove and Srivasta (2009) challenge dominant approaches to studying urban development and change, mainly from the global north by highlighting the resourcefulness of communities in developing cities, where long-term infrastructural dysfunction is a norm rather than an exception. The studies offer nuanced approaches to analyzing these unique conditions including among others, observing people's practices that emerge in response to urban challenges.

This dissertation reasons with the approach of analyzing people's everyday practices around the use of infrastructure. This chapter contributes to these discussions by investigating the sanitation practices of commuter and non-commuter groups in Kampala, exploring how these practices reflect broader trends of urban change. As a fast-growing city in Africa, Kampala faces numerous challenges while trying to meet development goals. Preliminary results of the recent 2024 national census show that the city hosts a little over two and a half million people during the daytime and nearly one million and nine hundred thousand people at night (UBOS 2024). The dissertation postulates that the daytime population hike presents unique dynamics in access to sanitation facilities in the city between these two groups. By examining these differences, in this chapter, the researcher sheds light on how sanitation practices, infrastructure, and community resourcefulness intersect to shape the lived realities of urban change in Kampala.

3.2. Literature Review

This section provides conceptual foundation for the research context. A synthesis of reviewed literature is presented in sections 3.2.1 and 3.2.2 that follow below.

3.2.1 Everyday practices around sanitation provision and access in Global South Cities

In the absence of reliable sanitation services, Simone (2004) introduces the concept of "people as infrastructure," arguing that everyday social and economic interactions form an informal system of adaptation. Studying these informal systems of adaptation reveals how communities make do with limited resources and inadequacies of formal sanitation infrastructure, particularly in rapidly urbanizing areas where population growth outpaces infrastructure development in ways that contribute to the sustainability of urban life. For instance, Furlong (2014) discusses how urban poor in Latin American cities create systems of informal water distribution, which have allowed them to survive prolonged periods without access to formal sanitation services. These practices are not just reactions to infrastructure failure; they represent alternative, often more sustainable, ways of organizing urban life such as self-built infrastructure through social networks and collective action (Desai 2012; Kooy and Bakker 2008).

Everyday practices also reveal how urban residents navigate inequalities in access to infrastructure as patterns of toilet use in urban settings vary widely depending on factors such as socio-economic status, technologies used, private, public or shared facilities and regulations governing access to sanitation infrastructure. Cairncross and Valdmanis (2006) demonstrate a clear distinction in quality and accessibility between public and private toilet facilities. People may rely on a mixture of private, shared, and public toilets, often paying for access to cleaner facilities. Kulabako, et al., (2010) reports such cases in settlements of Kampala where residents use all these avenues to access to adequate water and waste management services. Understanding these patterns helps identify

how various groups navigate the infrastructure in urban environments amidst socio-economic differences or inequalities and perhaps provide a basis for interventions.

McFarlane (2011) puts this into perspective by highlighting how slum dwellers creatively engage with inadequate sanitation systems in Mumbai by reusing wastewater or improvising latrine structures. These actions often challenge the idealized models of infrastructure imposed by city planners, who may be disconnected from the daily realities of urban life. Researchers can uncover more sustainable and context-sensitive solutions for infrastructure improvement, negotiations beyond the material resources but also knowledge exchange and spatial reconfigurations that constantly displace or replace formal infrastructure systems (McFarlane 2011; Simone 2004).

Whether these Heterogeneous Infrastructure Configurations (HICs) are positive or negative remains a subject of some debate. Pieterse (2011) and Roy (2011), however, raise a critical possible outcome of focusing on everyday practices, which is- detracting from state-led development responsibilities and accountability for vital urban services. Undoubtedly HICs are not always safe nor ecologically sustainable. Like all infrastructure they embody power relations. As Nakyagaba et al (2021) show, localized patron-clientele relations become strengthened through the control of community initiatives. While these patron-clientele relationships are important for understanding urban change, the practices shaping this relationship offer no explanation as to why the less powerful often interpret patronage as actions of care by those ranking higher in community initiatives, an argument that Truelove (2016) elaborates.

Further, some studies underpin that viewing everyday practices as reactions is an oversight to adaptation strategies of people. Kooy (2014) argues, in the case of Indonesia, that everyday practices are rooted in Indigenous knowledge systems that date before formal sanitation systems of the colonial and post-colonial eras. Similarly, Allen et al (2017); Desai (2016); Jones and

Murphy (2011) and Hawkins (2006) view everyday practices as community responses to environmental change, seeking autonomy from the state and the effects of public-private partnerships and not necessarily failure of formal infrastructure. This dissertation aligns with such arguments, noting that although everyday practices employed by people are apparent in situations of infrastructural deficit, they are embedded in people's behavior that transcends the presence or lack of the infrastructure. It acknowledges everyday practices without romanticizing them and acknowledges the failure of formal infrastructure without framing HICs purely as a reaction to this.

3.2.2 Sanitation Access for commuter and non-commuter groups in Kampala

Commuters are the section of the population who travel between a considerable distance within the Capital city and or between the Capital City and the Greater Kampala Metropolitan Area-GKMA daily. Non-commuters on the other hand are the section of the population who both work and live on the same premises. For this dissertation study, non-commuters were restricted to those within Kampala Capital City (KCC) limits.

Kampala city sanitation profile shows that only seven per cent of the population has access to safe sanitation (KCCA 2017) and has, in the recent past, been a hotspot for cholera and typhoid epidemics. Since its release, this alarming statistic has attracted critical studies on causes of this acute deficiency, while some show the potential that exists for Kampala's unsanitary conditions. Some studies on the latter subject are even influencing a sanitation paradigm shift in East Africa's second fastest growing city (see Lawhon et al., 2023; Gambrill et al., 2020). Those examining the causes of unsafe sanitation elaborate, among other factors, the roles of gender and spatial disparities set against especially women and those in low-income settlements (Ssemugabo et al.,

2021; Buyana et al., 2019) whose levels of toilet user satisfaction are reportedly very low due to various reasons.

Although insights of these studies are undeniably useful for understanding the sanitation infrastructure of the city, they are limited in scale as many are case studies of settlements within the city; they are limited in scope of Kampala's heterogeneous population focusing mainly on women missing other aspects like commuters and non-commuters. This dissertation focuses on everyday practices of sanitation access for commuters and non-commuters in Kampala city. By focusing on the everyday practices of these groups, the dissertation argues that participants in urban spaces are aware of the city's changing environment, which they narrate in various ways centered on resource distribution.

Operators of Kampala's dominant passenger service vehicles (fourteen-seater mini vans locally called matatus/taxi) staging at a stop along Kampala-Jinja road in the Central Division raised a public outcry over the health risks that a public toilet here presented to them and their clients. In response, the KCCA assured the population that the body was targeting to add fifty-three more public toilets across the city to address their sanitation concerns (NTV 2024). This scenario reflects issues of provision and access of sanitation services for those living and or working in the city. KCCA owns and operates a few sanitation blocks that are free to use for the public like at Wandegeya, west of Kampala Road, in the new taxi park on Baguma Road, at the City Square on Kampala Road, at Nakawa Market and one at Centenary Park on Jinja Road in Central Division that remains closed for over a year now. Considering the huge day population of the city, these toilets are very few, causing them to have a high volume of users and have also been reported for poor maintenance. Rutters et al., 2023 revealed that long wait times at hygienic facilities may force

some individuals to seek alternatives. This observation is true in Kampala, where open defecation remains a challenge when people cannot meet the cost of other toilet options like pay-to-use toilets. User fees for public toilets range from 200 to 500 Ugandan Shillings (an equivalent of USD 0.1) per visit per person, which can add up over time, leading some commuters to reduce their use of these facilities or look for free alternatives including open defecation (NTV 2024; Ssemugabo et al., 2021; Lawhon et al 2018; Schoebitz et al. 2017; Semiyaga 2016). The geography of transport stops vis-à-vis locations of free-to-use public facilities limit commuters onboard of transport means. These dynamics leave commuters with more options for pay-to-use toilets in the city, albeit with substantial financial implications for users.

Non-commuters, on the other hand, may not have to pay to use toilets as they are provided in residential areas but poor maintenance and sharing of facilities among several households are significant limitations (Ssemugabo et al 2021; KCCA 2017). In the long run, sanitation investment may be much higher for non-commuters. Studies, however, show that non-commuters and even operators of public toilets in the city have devised practices that reduce costs associated with sanitation in Kampala. Among these is manually flushing the toilets by pouring water into the toilet bowl from a jerrican instead of a cistern flush, a technique that Kampala residents report to save on water bills (Nakyagaba et al. 2023). Tumwebaze et al. (2013) also report on the coordination of cleaning schedules among those sharing facilities to reduce labor costs for maintenance. Other practices are not directly related to costs but are done by non-commuters, including the use of bedpans and buckets. Some commuters carry children's soiled diapers along with other household waste from their homes to workplaces from where it is channeled in formal solid waste systems (Nakyagaba et al. 2023). The dissertation highlights the need for serious consideration of these practices as part of knowledge systems that can help to address specific

challenges and develop more effective, sustainable and equitable urban sanitation infrastructure in Kampala.

3.3 Methodology

The sections of the methodology are detailed as follows.

3.3.1 Geographical Context

KCC is made up of five administrative divisions: Central division, Lubaga division, Kawempe division, Makindye division and Nakawa division. These five divisions fall under the Kampala Capital City Authority (KCCA) with headquarters in the Central Division at Apollo Kaggwa Road but for administrative purposes, each division has its own urban council, headquarters, mayor within its jurisdiction. The Greater Kampala Metropolitan Area (GKMA) also called Greater Kampala consists of parts of Wakiso district, Mukono district and Mpigi district including their municipalities like Nansana, Kira, Makindye-Ssabagabo, Mukono and Entebbe (Office of the President, 2025). Like all other parts of Uganda, KCC and GKMA consist of subdivisions in the respective order of Parishes and Villages.

3. 3.2 Description of participants

The study comprised a total of forty-five participants. Of these, twenty were women and twenty-five were men. The participants included full-time employees, small business operators and students at Makerere University. These participants were found in Lubaga and Kawempe divisions for semi-structured interviews and thereafter Focus Group Discussions (FGDs) for those who consented to the latter. Participants in Lubaga division were specifically found in Kasubi parish while those in Kawempe division were found in Wandegeya and Makerere Kikoni parishes.

The total study group comprised seventeen non-commuters. Twelve of these were resident students at Makerere University Kampala, two were on-site security officers at a primary school in Kasubi,

one was a premises administrator, two people who preferred not to state their occupation all in Wandegeya.

There were twenty-eight commuters. Nine of these commuted from areas within KCC such as Mengo, and Namungoona in Lubaga Division as well as Kabalagala in Makindye division. Nineteen participants commuted from parts of the GKMA such as Nansana, Kajjansi, Kakiri, Gayaza, Bweyogerere, Kyanja in Wakiso district. The participants in this category were identified as ten teachers at a primary school in Kasubi, two support staff at a primary school in Kasubi, seven members of the support staff at Makerere University, three small business operators from Wandegeya and Kasubi as well as six non-resident students of Makerere University.

3.3.3 Data Collection Methods

Semi-structured interviews and two Focus Group Discussions (FGDs) were used to collect data

Semi-Structured Interviews

Semi-structured interviews were conducted with both commuter and non-commuter participants to gather detailed personal accounts of their experiences with toilet use. This method allowed for flexibility in responses, enabling participants to discuss their views and experiences in their own words while ensuring that key topics are covered (Kvale and Brinkmann, 2009). The interviews were guided by a set of open-ended questions designed by the researcher for respondents to explain their commuting status; describe in their own terms how Kampala is changing, what they think about the sanitation in the city; the differences they notice between sanitation in the city (and places outside KCC where some come from); describe facilities they use; explain sanitation changes they notice or are aware of and finally what imagine about the future of Kampala based on their experiences of the (un)changing sanitation situation.

Focus Group Discussions (FGDs)

Focus group discussions were organized to facilitate collective insights and discussions about sanitation experiences and the changing urban environment. Two FGDs were conducted, one for each of commuters and non-commuters to capture group-level perspectives and identify common themes and divergences in experiences (Morgan, 1998). Each FGD consisted of an unequal number of men and women. The FGDs were held at a space in Makerere University and each lasted not more than 90 minutes.

3.3.4 Data Analysis

Content analysis was employed to analyze the qualitative data collected from interviews and FGDs systematically. The analysis process started with transcribing recorded interviews and FGDs, coding of results, identifying recurring themes, patterns, and categories related to toilet use experiences (Cavanagh, 1997) and then a detailed examination of the content to draw meaningful conclusions about the differences and similarities in experiences between the groups as well as current and future imaginaries of Kampala.

3. 3.5 Ethical Considerations

Prior to data collection, the research tools went through an internal review process as a study involving human subjects by the Internal Review Board at the University of Oklahoma. In the field, verbal consent was obtained from all participants, ensuring that they understood the purpose of the study as supporting academic achievement, their role, and their right to withdraw at any time without penalty (Bryman, 2016). Confidentiality was maintained for semi structured interviews and participants were informed prior and during the FGDs about the lack of guarantee on confidentiality in a group setting. In the analysis participant data was anonymized and results aggregated.

3.4. Findings

This section presents the results of the study after data analysis. The responses on experiences highlighted three major sub-themes, each with its own set of practices that were different between commuters and non-commuters. The sub-themes are access and availability of toilets, quality and cleanliness, and perceptions and attitudes. They are discussed as follows.

3.4.1 Access and Availability of toilets

Most non-commuting participants acknowledged that they were assured ease of access to toilets at their places of employment or school as they knew exactly where their toilets were located, and these were within a short walking distance. They were also aware of the requirements to keep the toilets usable, like to only flush soft tissue, and in some cases, where toilet stalls were assigned to individuals or households, users enjoyed the benefit of not sharing the toilets with the public. The latter was mostly reported by respondents, mainly employees of specific formal businesses and institutions who shared facilities with a limited number of people. One example is a support staff at a primary school who explained:

‘‘When I am on duty, I use the waterborne that all staff use and when off-duty my household uses the pit latrine stall assigned to us. The school has three different types of toilets: water-borne, biogas and Ventilated Improved Pit latrines (VIP). There are two water-borne sanitation blocks, one for staff and the other for children in the kindergarten section; the biogas is for all other students. The cleaners always close these facilities after school hours. The VIPs are used by staff that reside on the school campus, including myself and occasionally by students when there is a water outage and no water to flush their toilets. Pit latrines used by students are always left open but the resident staff each has an assigned stall that we lock.’’

Resident students at Makerere University, however, did not have this benefit as their facilities were openly accessible to anyone visiting or residing on campus. Although they reported that the facilities are conveniently located within a short walking distance from their rooms, this convenience does not mean that the toilets were usable all the time. One male student narrated his experience, saying, ‘‘Overall, the access is quite convenient as there are toilets on every floor in halls of residence and every building on campus, but they frequently break down for some reason, and one must search other buildings for a usable toilet. Some buildings and toilet facilities have restricted access for students.” Similarly, in a Focus Group Discussion, commuting participants generally agreed that finding public toilets during their commute was not difficult because there are plenty of public pay toilets and the free KCCA toilets as second option. In a semi-structured interview, one commuter narrated how they find and access toilets in the city.

‘‘It depends on where you are, your willingness to pay for a toilet and the time of day. Early morning is a bit difficult because of typical opening hours, so I make sure to use the toilet at my home before leaving or I go to the toilets around taxi parks because they open very early for commuters. Only the new taxi park has a free KCCA facility. Here at work, I know exactly where to find toilets, so it is not a struggle. I use the toilets at Wandegeya market, which I pay for, and then at the mosque around prayer time when it is open to the public to freely use for ablution because my business building does not have one of its own. When I am downtown to purchase my merchandise and need to use the toilet in a building I am not familiar with, I just look out for toilet signs, ask a security guard or anyone seated at any of the shops in the building to tell me which floor to find the toilet. I am certain that all storied commercial buildings in the city have public pay toilets.’’

3.4.2 Quality and Cleanliness

Two important observations from semi-structured interviews and FGDs regarding quality and cleanliness occurred. The first was that commuters who did not share their facilities with others (also called private toilets) were regarded as the cleanest and generally better maintained. Toilets with limited access came second with analysis showing they were likely to be cleaner than those without limited access. As mentioned in the last section, limiting access to toilets was enabled by assigning toilet stalls to specific users which they locked particularly at residential premises. At commercial buildings, payment was required and at institutions, proof of belonging was required to access toilets. For example, facilities at a mosque were permissible to Muslims. Muslims were known by the way they dressed with head covering. At Wandegeya, one participant who was Muslim explained that Muslims who worked in this area and attended the Wandegeya mosque formed a close-knit community known to one another and that new members or non-Muslims are easy to identify. In an FGD, the researcher inquired what would happen if non-Muslims went to use these facilities and responses strongly echoed it as disrespectful to the Muslim community although unique circumstances such as a polite request outside prayer time could warrant non-Muslims permission to use the toilets at mosques.

The second observation shows that commuters and non-commuters alike can only be sure of the cleanliness of toilets when they witness a caretaker cleaning or when the respondents themselves participate in cleaning the toilet(s) either at home or elsewhere. In Wandegeya, one university student who commutes lamented the unhygienic condition of toilets she uses in the city away from home saying,

‘‘Many parts of Wandegeya here have a terrible stench from broken sewer lines. Even when you don’t visibly see how dirty the toilet is, you can tell from the stench, and it is worse when they are

soiled. One can only trust the cleanliness of a toilet if the individual flushes, brushes the toilet themselves or at least witness it being done by others.''

People can usually flush toilets and brush out water before using public pay toilets if they are not satisfied with the level of cleanliness by the cleaner. More participants in the two FGDs held that every public toilet they had been to in the city had dedicated cleaners but that sometimes cleaning needed to be thorough.

3. 4.3 Perceptions and Attitudes

Responses of commuters and non-commuters revealed levels of disappointment and appreciation echoing that sanitation has changed differently in different parts of the city. Some commuters and some non-commuters applauded the effort of KCCA in improving sanitation by allowing for alternative toilet options and conducting sanitation campaigns in informal settlements. They held that sanitation challenges are bound to occur due to the high population. Still, there were dissenting opinions about KCCA efforts.

One teacher at a primary school mentioned that KCCA always inspects schools for hygiene standards, but the organization is still lacking in addressing actual toilet issues in informal settlements like the one where she resides. She added that KCCA did not care enough even in downtown Kampala where effluent from septic tanks of many buildings flooded the streets. Informal settlements formed a major point of this segment's discussion as participants raised that KCCA sanitation enforcement targets these low-income areas, yet part of the problems faced in settlements stem from areas outside them. For instance, the university's and the national referral hospital's breaking sewer lines often cause effluent to flow in nearby settlements like Katanga and Kikoni through people's businesses. Participants strongly blamed KCCA's failure to hold these public institutions accountable for poor sanitation in the city. A male participant cited that at his

residence, the construction operations of a neighboring fuel company compromised the quality of his toilet facility as it continuously released dust, and that vibrations from the heavy construction machines caused a crack in the toilet wall. These dissenting views invoked reflections on the helplessness of urban toilet users who suffer the effects of these unsanitary conditions as they argued that the government failed to hold itself responsible and discriminated against the poor.

Twelve participants attested that in a duration of one month, they walked through effluent-flooded streets in the city while trying so hard not to step into it, pulling their garments up and hoping they were not splashed by moving vehicles. The poor sanitation conditions expressed by respondents forced some to choose to reside outside the city to experience better sanitation conditions in the suburbs. Two of the nineteen commuters from suburbs of the GKMA moved there primarily because of the poor condition of toilets and the sanitation system in neighborhoods within the city where they formerly resided. Four others expressed relief from the filthy sanitation of the city. The relief came from not having to live in areas where toilets are too close to their houses, from not having to constantly smell the stench of effluent and alternative sources of water, including protected and underground wells that secure water availability. This, however, does not completely protect them from the risks of the city's filthy sanitation, as several have suffered from typhoid, which is commonly attributed to poor sanitation in the city where they come to work.

3. 5. Discussion

This examination of sanitation access in Kampala helps draw attention to a complex web of inequalities and adaptive practices. The mere availability of toilets across the city does not guarantee access for all residents. Access is an active process, requiring users to navigate specific social, spatial, and temporal dynamics. For both commuters and non-commuters, this means not only identifying the locations of facilities but also understanding their requirements, opening

hours, and the informal norms that govern who can use them. Access becomes a skill developed through relationships, lived experience and learned behavior over time, with each group adopting distinct strategies to meet their needs.

Commuters appear to have a distinct advantage due to their mobility and exposure to multiple locations, giving them more options and adaptability when sudden or significant changes affect sanitation infrastructure. However, this advantage is tempered by financial costs associated with pay-to-use toilets and the limited availability of free, well-maintained facilities. Non-commuters, in contrast, benefit from consistency and familiarity with the sanitation dynamics in their residential or workplace environments, although overcrowding and poor maintenance are recurring challenges. Notably, commuters who remain at specific workplaces for long periods develop the same familiarity with their surroundings as non-commuters, blurring the distinctions between these groups. Thus, the often-stated claim that commuters face greater difficulty accessing toilets may be overstated.

The quality and cleanliness of toilets is primarily influenced by the number of users and access restrictions. Private toilets or those with limited access are generally reported to be cleaner, while public facilities are prone to overcrowding, frequent breakdowns, and unpleasant conditions. This disparity reflects broader socio-environmental inequalities in the city. Residents' narratives reveal both frustration with the failure of urban management and a sense of resourcefulness in their adaptations.

The city emerges as a space of infrastructural negotiation, where optimism for community-driven solutions coexists with disillusionment about uneven state enforcement and persistent neglect in informal settlements. Ultimately, Kampala is imagined as a fragmented city, where access to basic

services depends on mobility, social status, and financial means, underscoring the deep intertwining of infrastructure, politics, and socio-economic dynamics.

3.6. Conclusion

This dissertation study sheds light on the complex and nuanced sanitation experiences of commuter and non-commuter groups in Kampala. Through a detailed analysis of access, availability, quality, and perceptions, this chapter uncovers critical disparities in urban sanitation practices alongside shared challenges faced by both groups. Our research highlights that commuters have greater access to diverse sanitation options due to their mobility across multiple city locations. However, this advantage is often undermined by financial constraints and the limited availability of free, well-maintained public facilities. Non-commuters, on the other hand, benefit from familiarity and consistency in accessing the same facilities within their residential or workplace environments. The dissertation underscores that sanitation practices, including hygiene strategies, are often shaped by individuals' learned behaviors, local norms, and socio-economic status. This dissertation, nonetheless, emphasizes that sanitation issues in Kampala transcend individual experiences, reflecting broader socio-environmental inequalities rooted in the city's sanitation infrastructure.

The dissertation also notes that challenges facing access to sanitation facilities by commuters as a singular category, as highlighted in many studies in Uganda, may be overstated and therefore need further scholarly attention. In summary, this dissertation chapter contributes insights into the discourse on changing urban environments, emphasizing the importance of sanitation as a cornerstone of rapidly urbanizing cities like Kampala.

Chapter 4: Socio-Spatial Configurations from Sanitation Provisioning for Students Living with Disabilities in Kampala

Abstract

Studies on sanitation in Global South cities show that environmental barriers and social stigma make it hard for Persons Living with Disabilities (PLDs) to access urban sanitation. This dissertation chapter examines sanitation experiences of Students Living with Disabilities (SLD) at Makerere University in Kampala to shed light on the relationship between sanitation infrastructure and spatial differentiation. Participants shared their experiences with two of their most-used toilets through semi-structured interviews and a subsequent Focus Group Discussion (FGD). The chapter is informed by studies of infrastructure in the global south that disrupt the binary that infrastructure works, or does not work, but instead show the everyday practices that go into making infrastructure usable. It contributes to the understanding of sanitation spatiality through providing a thematic map of sanitation zones and visual figure of the sanitation spaces. The analysis identified three fluid sanitation zones that can quickly evolve from one zone to another in space and time, requiring SLDs to adjust their mobilities and sanitation practices to match existing conditions. Often, these adjustments include getting help from other people, which is not always free or affordable for all who need it, and there can be tradeoffs between getting help, costs, privacy and dignity. The chapter, therefore, shows how heterogeneous infrastructure configurations work for SLDs and the human labor that helps make them work, but does not romanticize this as an ideal solution. Nonethless, given ongoing disruptions and the likelihood that sanitation access will continue to be uncertain and disrupted for many people in Kampala, this highlights the ongoing need to think beyond technological responses to improve sanitation.

4.1 Introduction

In cities, the development and provision of sanitation infrastructure are characterized by the production and reproduction of socio-spatial configurations that have significant and distinct consequences for access to sanitation services among individuals and social groups. Sanitation studies demonstrate spatially differentiated sanitation services provision by governments and actors involved in several cities, especially those still struggling with serious sanitation challenges (Westrate, 2023; UN-Habitat, 2023; Biza et al., 2019). For example, places without sewer coverage, many of which are located in reclaimed water catchment areas, often use various types of toilets and may also be targeting areas for experimental, innovative alternative solutions (UN-Habitat 2023). Similarly, the need for improved, safe, and dignified sanitation for vulnerable groups, including women, girls and PLDs, significantly influences the distribution and design of public toilet spaces in many cities of the world.

Colonial legacies of racialized spatial segregation and deeply entrenched social stratification are used in some cases to analyze differentiated provision resulting today in unequal provision and access (Ranganathan 2022; Biza et al., 2019; Miraftab 2012). For instance, Miraftab (2012) uses the case of the Cape Colony to show how ethnicity, race, and class interests shaped the sanitation discourse as Africans were relocated on a sewage farm which in turn produced urban inequalities of the twentieth century. Through such observations, scholars imagine sanitation as a power laden service that shapes urban spaces and bears important socio-spatial and political ramifications. For this chapter, the researcher draws on empirical data to identify socio-spatial configurations resulting from PLDs navigating sanitation infrastructure to access clean, safe, and usable toilets in an urban space.

As governments gear efforts to make their cities livable and inclusive for all, sanitary accommodations for PLDs have primarily focused on structural and technological adjustments like the provision of accessible toilets, height-adjusted handwashing sinks and soap dispensers, as well as automated toilet flushing mechanisms in sanitation facilities (Groce et al., 2018). This chapter resonates with scholarship in the Global South that provides evidence of frequent disruption of sanitation infrastructure and how people still acquire this service despite these conditions (Guma 2022; Silver 2016; Simone 2004). Such studies indicate that people engage in several arrangements to access sanitation during these disruptions.

This chapter seeks an understanding of the socio-spatial configurations employed by people under these circumstances. The researcher postulates that these socio-spatial configurations are products of differentiated spatial provision of sanitation infrastructure that affects the way and places specific groups of people in the city access sanitation service. In this case, then, it can be argued that socio-spatial configurations provide detailed insight into sanitation-related marginalization of certain individuals and groups in the city. If not well acknowledged and considered in sanitation solutions, the socio-spatial configurations can be barriers to efforts for livable and inclusive cities as well as the UN Sustainable Development Goal 6, which emphasizes increasing the provision and coverage of sanitation.

The focus here on socio-spatial configurations has two major goals. The first is to contribute to a nuanced discussion of marginalization and inequality in cities. The second is to enrich environmental and social justice studies through qualitative visualization of spaces on the margins of urban services and the implications these might have on planning for urban spaces. To do so, the researcher shows how marginalization stems from differentiated spatial sanitation provision. The researcher thinks through the spatial provision of sanitation infrastructure, the

individuals, institutions, technologies, and people's daily practices that shape the organization of space within which infrastructure is situated and, how these shape reported experiences of SLDs found at a university in Kampala, Uganda.

4.2. Literature review

This section provides conceptual foundation for the research context. A synthesis of reviewed literature is presented in sections 4.2.1, 4.2.2 and 4.2.3 that follow below.

4.2.1 Marginalization from Urban Infrastructure

McFarlane and Silver (2017), and Parnell and Robinson (2012) elaborate on the influence of colonial planning and post-independence economic policies on the current state of urban infrastructure in many Global South cities while arguing for transformative approaches to address the root causes of urban inequality. These inequalities, according to Dovey (2012) are exacerbated by rapid urban growth which overwhelms even distribution of services. Other perspectives trace this inequality in historical injustices, with Ernstson and Nilson (2022), Nilson (2016), and Allen et al., (2012) detailing the racial-based colonial distribution of sanitation services which have shaped the spatial inequalities of service provision that is evident today. This spatial inequality is further enabled by state power structures and neoliberal development practices that often result in community resistance, violence against urban groups, and marginalization of those who are less advantaged.

Allen et al., (2012), Loftus (2006), and McDonald (2002) elaborate the impacts of infrastructure investment processes such as privatization and cost-recovery measures in African cities. The studies hold that these measures often disproportionately affect low-income urban residents, benefiting wealthier areas while leaving poorer communities with inadequate services. Such studies cited above have significantly contributed to understanding the subject of marginalization

from urban infrastructure in mainly three ways. First, they illustrate the uneven distribution of environmental benefits and burdens. Swyngedouw and Heynen (2003) draw on both approaches to discuss how capitalist urbanization creates "urban metabolism" inequalities that disproportionately burden certain populations along racial and class lines. Similarly, Bakker (2007) explores how the commodification of urban water results in the exclusion of marginalized groups, further reinforcing socio-economic inequalities. Secondly, they recognize that infrastructure and communities are not passive victims but active agents in shaping and responding to injustices (Schlosberg, 2007; Bryant and Bailey, 1997). Studies aligning with this contend that urban infrastructure is not merely a neutral facilitator of urban life but a tool that reflects and reinforces existing social inequalities (Angelo and Wachsmuth, 2015; Heynen, Swyngedouw and Kaika, 2006; Pastor and Hipp, 2001; Swyngedouw and Heynen, 2003). Third, studies on the provision and access to sanitation infrastructure in the Global South are notable for their nuanced analytical frameworks, such as people as infrastructure (Simone, 2011), hybrid infrastructure (Jaglin, 2016), and heterogeneous infrastructure configurations (Lawhon et al., 2018) which provide diverse ways to understand disparities that lead to marginalization but also how those on the margins access infrastructure. They do this by examining historical legacies, power dynamics, and socio-economic conditions that impact environmental management and the uneven distribution of infrastructure as well as people's lived experiences.

This chapter examines people's lived experiences to better understand the dynamics around marginalization of SLDs in urban sanitation based on their everyday experiences. Studies on access to sanitation for PLDs mainly point out barriers and hardly focus on how PLDs manage to access sanitation. In so doing, the dissertation aims to provide insights to policymakers and urban planners to better identify and address the issues of marginalization root causes of marginalization,

leading to more effective and equitable interventions. For instance, addressing the needs of persons with disabilities (PWDs) in urban planning requires not only ensuring equitable access to sanitation infrastructure but also appreciating ways they overcome existing challenges in society.

4.2.2. Urban Sanitation for PLDs

Many sanitation facilities in urban spaces remain inaccessible to PLDs (Lang et al., 2011; Jones and Reed 2005) long after the adoption of the United Nations Convention on Rights of Persons with Disabilities and despite efforts of various programs and initiatives like *Accessible India Campaign and Sanitation for All* advocating for the right to dignified sanitation of PLDs (Groce et al., 2020; Government of India 2019; Jones and Reed 2005). Globally, an estimated 1.3 billion people experience significant disability, 80% of whom live in the Global South (WHO 2023; UNDRR 2023) where the functioning of infrastructure may not only be uncertain for everyone (Sultana 2020; Faldi et al., 2019; Wiig and Silver 2019) but also less likely to accommodate the needs of PLDs such as those with visual impairments (Siu 2008, pg441) and mobility impairments (Mactaggart et al., 2021; Banks et al., 2019).

Broadly, studies on barriers to sanitation access for PLDs flag environmental and socio-economic factors as responsible for the persistent exclusion of PLDs from basic sanitation services (Mactaggart et al., 2021; World Bank 2020; Desai et al., 2017; World Bank Group 2017, pg 27). The physical environment may render accessibility of sanitation infrastructure difficult or impossible at times due to haphazard layouts in slums, flooding and poor drainage. These limiting environmental factors, according to the World Bank (2017) and McFarlane and Söderström (2017), often reflect policy gaps, which can be explained by the lack of data on the specific sanitation needs of PLDs. The World Bank (2017, pg 61) indicated that while many countries including Uganda have policies aimed at improving sanitation access for PLDs, these policies are

often not effectively implemented or enforced leading to limited impact. Study cases from other cities of other global south such as Getahun et al., (2022); Scherer et al., (2021) and Manyanye (2015) reveal similar gaps which make it difficult for urban actors to provide toilets that meet the needs of all PLDs. The congregation of PLDs in only select spaces in the city is partly attributed to urban toilets being inaccessible to them which worsens their exclusion in urban life (Wiseman 2019; Siu 2008).

Wilbur et al., (2021) confirmed that the limited financial resources to invest in inclusive sanitation contribute to stigma towards PLDs in households and communities over their hygiene. PLDs are more likely to be unemployed and in cities of Indonesia, India and Tanzania, studies indicate high costs of accessibility toilets for many households (Daniel et al 2023; Wilbur et.al 2021; Mactaggart et al., 2018). Chambers and Myers (2016) and White et al., (2016) show that community-led sanitation programs including the involvement of local stakeholders in design and implementation of sanitation infrastructure have tended to relieve some of this stigma in limited extents as meager resources available may not cater to designs that cater for diversity of disabilities (Desai et al., 2017).

Individuals with visual impairments were found to struggle with the lack of Braille signage, inconsistent floor surfaces, and unmarked obstacles in sanitation facilities (Banks et al., 2019; Siu 2008). A study by Groce et al., (2020) in India showed individuals with cognitive disabilities found it difficult to maneuver toilets with complicated locking mechanisms and confusing layouts, just as the lack of simple, clear instructions made it difficult for them to navigate these facilities independently. They thus often required additional support to use public toilets. Daniel et al., (2023); Jones and Reed (2005) revealed that individuals with multiple disabilities faced exponentially greater challenges in accessing sanitation.

Even with the promise of growing technological innovations such as online reporting of sanitation conditions, automated flushing toilets and sensor-operated lids which are found to significantly improve the independence and participation of PLDs in sanitation (Dodge and Kitchin 2012; Bichard et al., 2005), the impact of political and economic structures of governance in spaces within which these interventions occur is critical. McFarlane and Söderström (2017) explain that state and corporate elites often drive innovative interventions through investments, partnerships, and knowledge production, which can overlook marginalized groups and increase inequalities. From their township cases in Cape Town, South Africa, they argue that although spaces in the Global South such as slums encounter digital technologies that are helpful for residents and activists in accessing urban services, the knowledge generated may be used for other causes that do not support the advancement of the marginalized urbanites thereby doing more harm than good.

4.2.3. Access to spaces of higher education for PLDs in Uganda

In Uganda, PLDs are recognized as a vulnerable group whose rights are protected by the constitution. Vulnerable groups are defined as populations with specific characteristics that put them at a higher risk of falling into poverty than others (Ministry of Education and Sports, 2020), and they include the elderly, persons living with HIV/AIDs, women, children, orphaned children and PLDs. Annually, the Government of Uganda, through its Public Universities Joint Admissions Board (PUJAB), awards sixty-four merit scholarships to SLDs who excelled in their national Uganda Advanced Certificate Exams (UACE) to pursue degree and diploma courses deemed of national interest at the five public universities. The scholarships to SLDs are available under the Disability Scheme and eligible students first undergo medical examination at selected hospitals to qualify. Some SLDs may be admitted under the Mature Age Entry scheme, which is a government scholarship for diploma and undergraduate degree programs for first-time college students above

twenty-five years. SLDs may also be admitted to these institutions as private-sponsored students for diploma, degree and graduate programs when they meet the required academic points for their preferred programs.

Education for SLDs, also called Special Education, was first introduced in 1952 by the colonial government, which established separate primary and secondary schools for children with disabilities (Guzu, 2014). This meant that SLDs could not pursue higher education. With the introduction of the Inclusive Education program in the late 1990s, all public education institutions were required to offer services without discrimination. Throughout the twentieth century, Makerere University and its affiliated Makerere University Business School, established in 1922 and 1997, remained the only public universities. However, there were other state institutes and colleges that offered specialized skills training and education.

As East Africa's oldest university, established under colonial rule, Makerere University provides education for local and international students from other African countries as well as exchange and collaborative programs with universities overseas. But the structural design of university spaces for decades did not accommodate mobility needs of PLDs. Makerere first introduced affirmative action for PLDs in 1998 following requirements for inclusive education. Of the 64 government merit slots set aside for Students Living with Disabilities (SLDs), Makerere University takes the most in addition to privately sponsored SLDs. However, the total number of students with disabilities enrolled in tertiary institutions in Uganda, including universities, is not known. According to a World Bank (2020) report, over a thousand SLD are estimated to enroll in these institutions annually (Emong and Eron 2016).

Despite its impact on the continent and improving strides toward inclusive education for SLDs, such as launching the Disability Law and Rights Centre at the university's School of Law launched

in 2020 and putting in place ramps to buildings, Makerere University remains challenged on issues of PLDs. Architecture presents a major challenge to accessibility as most of the university's buildings, mostly old and established during pre-independence years, lack indoor accessibility ramps and accessible toilets. The barriers to access to access of higher education for SLDs in Uganda have been raised (Kimoga et al 2016; Emong and Eron 2016; Emong 2014) and though helpful for pointing out deficiencies of infrastructure, the studies are not explicit on sanitation challenges which substantially thwart full participation of SLDs in academic spaces and hinder their potential.

4.3.1 Context

As one enters through the main gate of Makerere University, one can't fail to notice the signage which reads, ''Makerere University welcomes and cares for STUDENTS with DISABILITIES'' and goes on to list what devices, services and facilities are offered to them. The signage is shown in Figure 6 below. Among these, accommodation facilities come third on the bullet list appearing on that signage.

There are nine residence halls for undergraduate students residing on campus and one for graduate students. Six of the nine halls house male students, and they are Lumumba Hall, Livingstone Hall, University Hall, Nkrumah Hall, Nsibirwa Hall and Mitchel Hall. The remaining three house female students: they are Africa Hall, Complex Hall, and Mary Stuart Hall. Every student at the university, whether a resident or non-resident, is attached to a hall of residence as part of university solidarity. Accommodation is first granted to government-sponsored students as part of their scholarship package, and the remaining bed spaces are rented out to privately sponsored students.

Figure 6: Signage showing the University's support for SLDs near the main



The merit scholarship for SLDs comes with Uganda Shillings 200,000 (USD 55) that gradually decreases in the second and third year (Byenkya 2007) to help hire guides. The guides help SLDs to meet needs that may be difficult to meet on their own as they pursue higher education, such as navigating steep terrain, and guiding them to find classrooms, among other needs. These guides are called by different titles including *buddies, minders, protectors*. The dissertation adopts the term *friend* because sometimes students living without disabilities volunteer to assist their SLD counterparts and refer to each other as friends instead of their disability status. From here on, the researcher will specify whether the friend is paid or volunteering.

This chapter is informed by personal experiences that SLDs narrated in their access to sanitation facilities at Makerere University during data collection by the researcher in Kampala between June and August 2022. The government of Uganda had just officially re-opened academic institutions after nearly two years of intermittent lockdown between 2020 and 2022 following the spread and effects of COVID-19. The duration of this lockdown led Uganda to attain global media spotlight for the world's longest lockdown on academic institutions following the pandemic (Musinguzi and Dahir 2022; Aljazeera 2022).

It is also worth noting that Makerere University switched most toilets from seats to squat ones because the toilet cleaning staff heavily complained about misuse by some who stepped on toilet seats with the aim of squatting over them. This left toilet seats soiled and messy, raising concerns about easy transmission of infections, a common concern from the study participants as well. Squatting, as opposed to sitting, is the most common way people in Uganda use their toilets, the majority of which are dry technologies such as pit latrines. The concern fueled university management to replace toilet seats with squat bowls leaving room for one sit-on in each facility for people who need it (except at the Arts building). The switch has been incremental over about 10 years, starting with toilets at the College of Education between 2013 and 2014 and, more recently, in the halls of residence during the pandemic.

4.3.2 Methods

The researcher interacted with eight SLDs at Makerere University Kampala in semi-structured interviews about two of their most use toilet facilities. The participants included four people living with blindness or low vision, one of whom also was living with albinism and four people with ambulatory disability, three of whom used wheelchairs while one used a walking stick. Five of the eight participants consented to participate in a focus group discussion (FGD) after the semi-

structured interviews. One volunteering friend also joined the FGD making a total of six participants. The volunteering friend assisted two of the participating SLDs to come to the FGD but was known to all the participants prior to the research.

All participants were enrolled in various university programs, notably under the College of Education and External Studies (CEES) as well as the College of Humanities and Social Sciences (CHUSS). They had also completed at least the first year of their respective courses, meaning they had experience with Makerere University's toilets for a considerable amount of time. The SLDs were on-campus residents, and because of this, two of their most used toilet facilities (which they frequently altered depending on the prevailing conditions of each toilet facility) were within the geographical confines of the university. The research participants resided at Mary Stuart, Lumumba, University and Nsibirwa Halls. The volunteering friend who participated in the FGD resided outside the university. Participation was voluntary and all persons engaged were over the legal consenting age in Uganda.

The interviews and FGD were conducted in English, the official language in Uganda, although occasionally, translation of words and phrases into Luganda language was done for clarity. The interviews ranged between 30 and 45 minutes, while the FGD took about 75 minutes. After the semi-structured interviews and focus group discussions, the researcher also took field notes from personal observations visiting and using toilet facilities at the university mentioned by participants during the data collection process. A total of thirty-four sites, which included toilet facilities at halls of residence, college buildings, diners and even lawns, were reported by respondents. The researcher was only able to observe all facilities used by females, a few male facilities at halls of residence and the open spaces.

The data collected was transcribed and then analyzed through content analysis and a thematic map of sanitation zones was made. Gephi 10.1 Software was used to analyze and create a visual network linking facilities at different locations that respondents found safe or unsafe to use. The analysis resulted in findings presented here below.

4.4. Findings

The data yielded helpful information about access to toilet facilities at the university, the experiences of SLDs in accessing sanitation infrastructure, and sanitation zones at the university. The findings are broken down into sections and discussed as follows.

4.4.1 Access to Toilet Facilities at Makerere University

The dissertation study found that operational hours for facilities varied based on the purpose that the building of their location served, which means that not all facilities were open or available to be used for 24 hours or even every day of the calendar week. Toilet facilities at residence halls were the only ones open 24 hours per day on each day of the week. Toilet facilities in college buildings and stand-alone sanitation blocks were open from 6:30 a.m. to 7 p.m. Monday through Saturday, except when tests and exams were scheduled beyond 7 p.m. or on Sunday in which case facilities remained open until the end of exam period for the day. Administrative buildings were open Monday to Friday, 8 a.m. to 5 p.m., and on Saturday to 2 p.m., except for special events.

The researcher observed enclosures and lockable gates of entry on sanitation facilities of all sampled buildings, explaining how hours of operation for various facilities were enforced. Custodians of the different buildings opened the buildings and their facilities every morning ahead of working hours and closed every evening after working hours. The researcher ascertained that in addition to signage of male and female genders on public and community toilets including those at institutions of education such as Makerere University, policies of the city's governing body,

Kampala Capital City Authority (KCCA) require enclosures, as a minimal measure of privacy. The enclosure may have lockable gates.

In classroom buildings at the study site, the main entrances of facilities through the gates of entry were levelled, wide enough for wheelchair accessibility and barrier-free. However, there were also stand-alone sanitation blocks outside buildings like at the College of Education and External and at the Institute of Languages which were observed to be relatively new. These sanitation blocks had accessibility ramps without handrails. The entrances of sanitation facilities on storied buildings of most halls of residence like the Mary Stuart Tower were observed to have a step which made wheelchair accessibility difficult.

Past the gates of entry, entrances of most individual toilet stalls at the sampled administrative blocks and college buildings had elevated steps except for a few. Usually, one stall per either side of males and females did not have this step. For example, at the two-story Arts building, every toilet stall in male and female student facilities had an elevated step at the entrance. Student toilets were also only on the upper floor of this building, which was only accessible by staircases to the east and west of the building and, therefore, did not cater for the mobility of SLDs. However, there were male and female staff toilets on both floors of this building, and in each of them was also a step-free stall with a high sit-on toilet for accessibility despite not being labelled as accessible.

In most student facilities, the toilets also lacked soap for handwashing, toilet paper and walls were stained from wiping onto them. Non-toilet-friendly materials such as writing paper and plastic bottles were visibly thrown in the toilets. Toilet stalls in college buildings were narrow and without grab bars while hand wash sinks and urinals in men's toilets were out of reach for some SLDs. Additionally, at times, several days went by without water in the toilets and when it came back, it spread across or became stagnated on the toilet floors in some the halls of residence. Broken pipes

and overflowing manholes were not uncommon which covered road surfaces and green spaces in flowing effluent.

In newer buildings such as Central Teaching Facilities (CTF) 1 and 2, the toilets were easily accessible with support structures in place. These buildings also guaranteed clean toilets most of the time whenever they were open because they were multi-purpose serving other purposes, including Finance and Accounting Offices at (CTF 1), hence the presence of cleaning staff to cater to the sanitary spaces here. The stand-alone sanitation blocks at CEES and the Institute of Languages were equipped with foot pedals to aid flushing without hands. Facilities at selected blocks and floors in residence halls such as Mary Stuart, Lumumba and Complex halls were designed spaciously to meet the sanitation needs of SLDs.

The university's Senate Building has a few lecture halls and, therefore, necessitated student toilets. Although stall entrances were levelled, there were other significant accessibility barriers for all SLDs mainly because students were only allowed to use toilets in the basement. Since elevators on the building were not functional at the time of this fieldwork, the toilets were accessed via staircases; otherwise, students had to exit the building first and re-enter it directly through the basement, where entrance was restricted with approval. Students using wheelchairs and those living with blindness lost valuable time on time-sensitive business sought in this building such as academic records and writing exams. The toilet stalls were also soiled at the time of the researcher's observation.

During the FGD, participants mentioned other facilities which were neither primary nor secondary facilities, and the researcher refers to these as 'in-between'. These were drawn into the spatial configurations of quickly changing spatial decisions of SLDs (and their friends) due to voluntary or involuntary circumstances such as spending leisure time or taking tests and exams outside their

college buildings. A student from CEES for example, attested to taking Economics classes from the College of Business and Management Sciences. Other facilities were identified at the Central Teaching Facility 1 and 2, IT building, the Senate building, the gym and the Staff Canteen where the researcher and participants held the Focus Group Discussion.

4.4.2 SLD's experiences with sanitation infrastructure

Wheelchair-bound students reported that sit-on toilets at various locations where they spent time were easier when toileting compared to squat-over ones. However, the diversity among students with ambulatory disability revealed that sit-on toilets did not easily or favorably meet the toileting needs of all SLDs because they were too high to be reached. One respondent narrated during an interview,

''I cannot climb the sit-on toilet because it is too high. I already crawl on the ground, but it is scary in the toilet used by many people. I have an assisting friend who helps me get on the toilet.''

Similarly, steps at the entrance of toilet stalls restricted wheelchair access for users to access toilets conveniently. These students, therefore, are assisted by able-bodied students to access the toilets. During a water outage, SLDs engage in various socio-spatial configurations to navigate the sanitation infrastructure. For some, it is waiting patiently for the water to come back, as one student living with blindness residing at a female residence hall reported,

''There are times when there is no water at all in the hall like today and now all I have to do is wait until it comes back.''

For others, moving from one block to another in search of water and clean toilets became a norm. Another student, also living with blindness from a male's hall told the researcher,

''When there is no water to flush the toilets and I have none stored in my room, I have to go to other blocks to fetch some because when water is off on my block, it may still be running at another

block. I have mastered my way around here. but if there is no water all over the hall then I ask my friends to assist me fetch water like when Nsibirwa went 3 days without water.''

These narratives led the dissertation to establish patterns around water outages. Sometimes, it was a total outage across the university, whereas other times, the outage was site-specific. The reasons for the latter remain unclear, although some students blamed the university's old plumbing systems that date from colonial times.

Important to note from the quotes above, and as echoed from more interview responses, is that asking friends was the third form of socio-spatial configurations engaged by SLDs to navigate sanitation infrastructure. This habit was, however, explicitly applicable to instances in residential halls. Upon realizing that all blocks at one's hall did not have water and that it might need to be fetched from elsewhere, SLDs go to their friends' rooms to inform them about their needs.

4.4.3 Friends' assistance to meet sanitation needs.

Identifying, choosing and maintaining a friend is a complex task. In chapter three the researcher indicated merit scholarships for SLDs which include a payment package for a paid friend for SLDs whose medical examination results indicate the need for this kind of assistance. Students with visual disabilities, those with wheelchair mobility and those needing sign language are more likely than others to have a paid friend dedicated to each one of them, but the university does not assign friends. There is a condition, however, that paid friends should not be students themselves for commitment reasons. Paid friends and their assignees can sit together in class if necessary and often share the accommodation room at the hall of residence. There was one case where the paid friend was a fellow student taking the same program as the SLD under their care.

Owing to a high cost of living, most SLDs supplement the money meant to hire a friend to meet their daily basic needs and, therefore, end up with no committed person to assist them. Although

four of the interviewed participants had paid friends when they started their academic programs, only one still had a paid friend at the time of the research. To meet needs requiring assistance, SLDs turn to colleagues in their social and academic networks, such as discussion groups on campus, who become volunteering friends. Additionally, a few privately sponsored SLDs can afford to hire a friend and, therefore, rely on volunteering friends. However, assistance from volunteering friends is dynamic because it depends on location, availability, and time of the day. Different friends usually assist SLDs during class hours and at the residential halls. This is because volunteering friends may stay at different places from their SLD counterparts, take different elective classes and can only render assistance for the time of shared classes among other factors. Much as SLDs preferred to request assistance from a person they know as generally expressed in the FGD, during such circumstances, one male respondent said,

‘‘I request anyone to walk me when I have an emergency and without my friends. I endure the shame because although I want to be able to keep my privacy, I have nothing to do.’’

The analysis showed that *paid and volunteering* friends were needed and relied upon the most during total water outages. If a friend is not found in their room, then the SLD calls them on the phone, necessitating the former to move from where they may be and come to assist the latter in meeting the requested need.

‘‘He has called me only a few times to bring him water during an outage when his Jerry cans are empty. Usually, I first ascertain the locations within or outside the university with running water we can fetch. I may do this by walking to different water points or calling other colleagues to ask if they have water at their residences. Then I return to the residence hall to pick up a jerrican (of 5, 10 or 20-litre capacity, depending on how far we must fetch it from). If it is far or if the traffic

conditions are not conducive, we both agree that only I will fetch the water, but if it is closer, we can both go.'' Narrated the volunteering friend during the FGD.

4.4.4 Foregoing friends' assistance even when it's needed

Even when SLDs were aware of friends' willingness, they expressed extenuating circumstances under which they forego seeking assistance from paid or volunteering friends to meet their sanitary needs. For instance, during the focus group discussion, one female student with wheelchair mobility mostly relying on the assistance of volunteering friends elaborated,

''I am afraid to ask someone to take me for a short or long call because I think of it as an inconvenience to them. I shouldn't have to…you know! And…some days are different from others. Having to explain to someone to run you to the toilet several times an hour due to a running stomach isn't that easy, even though I know they may not say no. And how about the cold days when I may frequently pee? Asking a friend is one thing, but disrupting class or a discussion group is another.''

While they can boldly request assistance to fetch water from afar, students living with blindness and low vision were either embarrassed to ask their friends to check if toilets were clean and usable or to be moved from across blocks during school hours in search of a clean toilet or wanted to keep their privacy, particularly the female SLDs during their menstruation period who needed to clean up.

The relationship between SLDs and their friends (paid or volunteering) can sometimes be affected by disagreements. For instance, one paid friend caring for one of the participants in the semi-structured interviews did not want her to participate while the SLD wished to. The friend stormed away, leaving the SLD unattended while talking to the researcher. When asked if circumstances like these usually happen and affect their use of the toilet, the SLD expressed that these

disagreements have occasionally happened but not to the extent that the friend refused to render them assistance to the toilet. However, for another physically disabled student using a wheelchair and whose friend was volunteering, the case was different as narrated below.

‘‘There was one time I did not meet my obligation for a group coursework assignment, and it was my fault. My friend was mad at me because of the delay I was causing the group, so he left me for a couple of hours, I think, to calm himself down, which is understandable. I happened to need to use the toilet during that time the friend was away. The toilet stalls here have a step I normally cannot go safely past on my own. Thankfully, there was someone by the sink who when I asked for his assistance accepted.’’ elaborated the male student with a faint smile.

Some SLDs echoed that they were morally conflicted about the appropriateness of seeking assistance from (paid) friends to take them to the toilet during some nights of water outages when they already ascertained toilets were messed. SLDs wrestled with feelings of shame, questioning what their friends would think of them for using dirty toilets or deciding to risk an already messy situation by using dirty toilets. Many acknowledged having resorted to the latter.

‘‘I recall one night recently during the second lockdown of Covid-19 it was inevitable to use a dirty toilet because I had a running stomach. I didn’t even have the time to think about any options like I normally do, but afterwards, I wondered if anybody had seen me. I worry about asking for assistance at night. I keep thinking maybe my friends are sleeping. And it is also embarrassing, you know…to ask someone to escort you to the toilet. Even though I know my way to the toilet, it is just riskier at night, like when there is no water, poop piles in the toilet because students have no alternative,’ expressed one male SLD in an interview.

In an FGD, one male participant said, ‘‘At night when there is no water in the toilets, and I don’t have some in my room either, I just have to do with what is there.’’ Making do with what’s

available was a common phrase iterated by participants in both interviews and the FGD, and it implied using toilets, dirty as they might be, because there were no other viable options. Effluent flowing from various points of the sanitation network on campus added to the complexity of socio-spatial configurations for SLDs and their friends. SLDs altered their mobility pattern to avoid stepping in sewage. Unfortunately, students living with blindness reported that there were times they unknowingly walked through it and only to realize later when other students told them.

4.5 Sanitation zones

The researcher derived three sanitation zones from analyzing descriptions and characterization that respondents provided about their primary, secondary and in-between toilets through semi-structured interviews and FGDs. The three sanitation zones are safe, intermediate, and unsafe. Table 4 below summaries the percentage aggregate counts descriptions and characteristic to their matching sanitation zones.

Table 4: Summary of respondents' descriptions used associated with categories of primary and secondary toilets

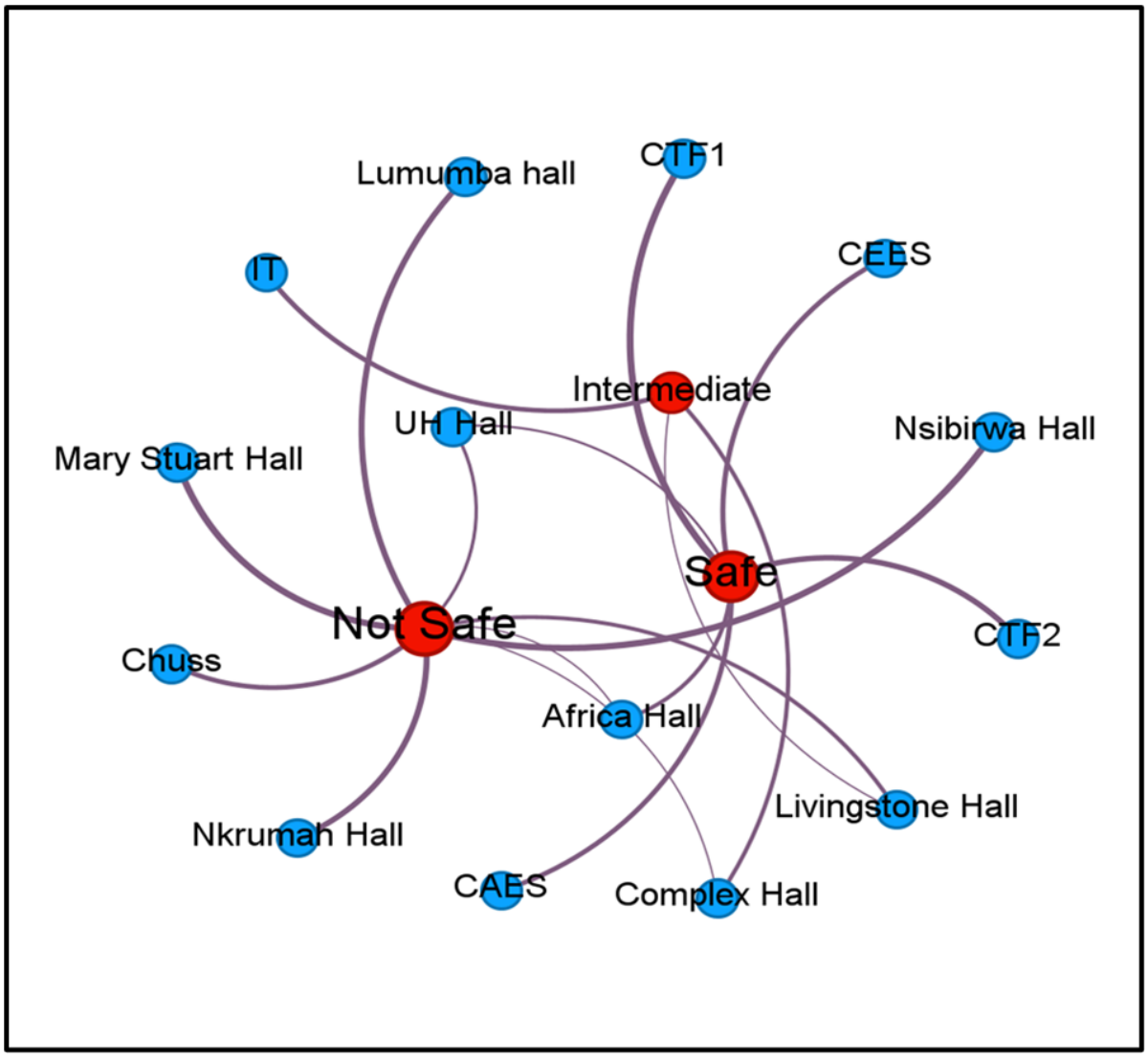
Category	Description	Aggregate count (%)
Safe	a. Facility is cleaned by maintenance staff most of the day b. Toilets remained unsoiled most of the day c. Stalls have flushing water in the cistern and or provided with alternative flushing water and a jerrycan to scoop water d. Facility is not stinking e. Toilet bowls do not have blocking objects, mainly plastic bottles or blocking objects are flushable f. Terrain to the facility is familiar to SLD g. Stall has an appropriate bowl h. Walkways are free of flowing effluent	14

Intermediate	a. Stall has a barrier at the entrance, but friends help get past it b. Water finally comes back after several hours c. Long queues at the facility especially after a water outage d. Facility has a tolerable odor, especially with long queues e. Tolerable insects in stall f. The floor may be wet but without stagnant water g. Users can only pee but not poop in bowl due to a blocking object	34
Unsafe	a. No flushing water for prolonged hours b. Stagnant water that makes walking and squatting/sitting difficult in facility c. Nights without water in facilities and halls. d. Flowing effluent even with familiar terrain to facility e. User navigates unfamiliar terrain alone to find a new clean toilet	51

The data in Table 4 above was manipulated in Gephi visualizing software to generate a network graphic showing levels for which specific facilities were described and characterized as safe, intermediate and unsafe. The output is shown in Figure 7 below where blue dots are locations of primary and secondary facilities. Each red dot represents one of the three sanitation zones while

the purple arc represents the descriptions that matched facilities to a zone. The thickness of the arc represents the count of incidents and events that respondents ascribed to descriptions for each facility that resulted in its associated sanitation zones. Thicker arcs mean high counts of incidents and events per facility resulting in its zone and vice versa.

Figure 7: A graphic representation of the rating of primary and secondary facilities



There were more facilities reported as unsafe with Mary Stuart, Lumumba and Nsibirwa residential halls leading in this category. The CTF 1 and 2 emerged as most safe based on descriptions in the table. Complex Hall and IT were intermediate.

More residential halls are associated with unsafe compared to non-residential buildings perhaps because they are open and accessible 24 hours in the seven days of a calendar week. This means that these facilities remain the only option for users for several hours and therefore succumb to even more risks.

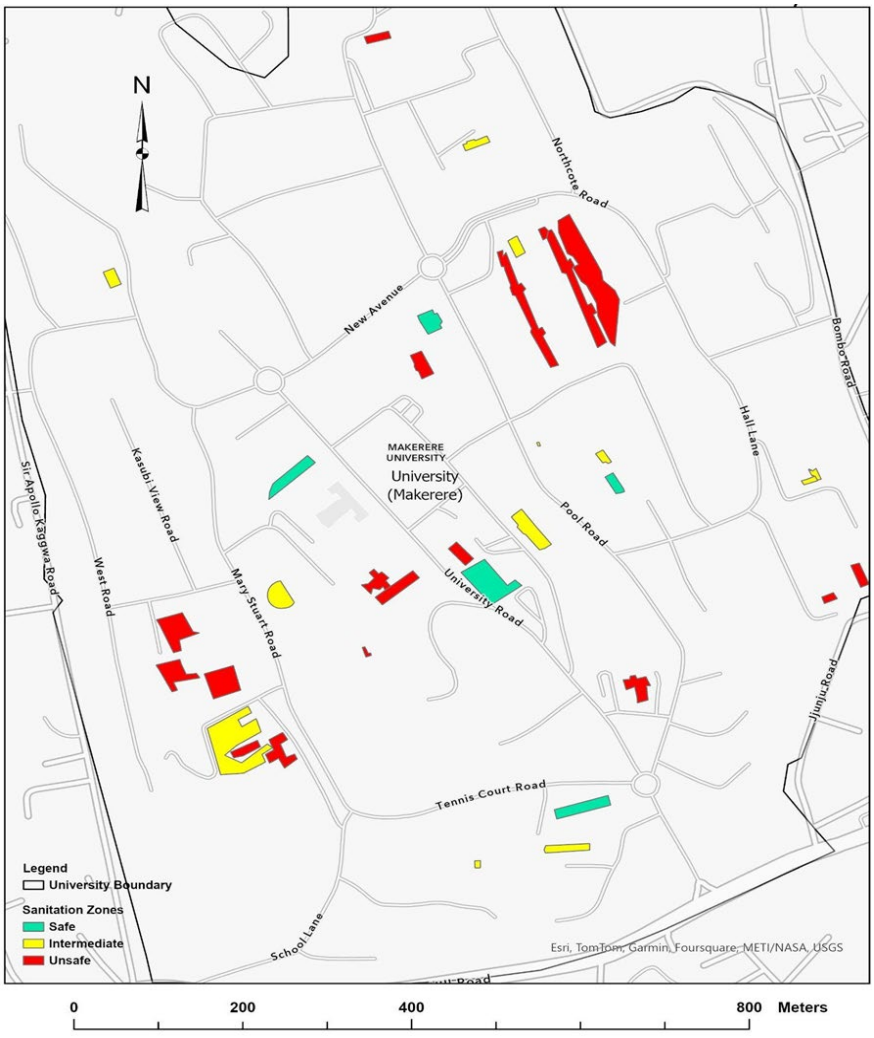
In the analysis, the researcher treated the variation in operational hours of facilities with importance when deriving sanitation zones. This is because operational hours significantly influenced the way respondents rated incidents and events that affected the use of their most used facilities. The variations included days when facilities were open to be used (such as seven days a week or only five out of seven days), number of hours a day (e.g some were open 24 hours while others were open for only eight hours). In this case, therefore, the standard 24 hours/ day or seven days/week was not used. Instead, the researcher adopted a working measure of hours and days corresponding to the context of specific facilities that respondents referred to. For example, Facilities at halls of residence were open a full calendar week, while facilities at some classroom buildings were only open for six out of seven calendar days of the week. Similarly, a 6-hour, 8-hour, 12-hour, and 24-hour period corresponded to a day for open facilities for 6, 8, 12, and 24 hours, respectively. It is important to note that respondents rated their toilet descriptions based on the duration for which the facilities normally remained open, as opposed to the duration respondents were physically on campus.

Figure 7 above also shows individual facilities such as Africa, Livingstone Hall and Complex Hall that were associated with two sanitation zones. The reasons for this are specific but tie into larger

spatial configurations of the search for clean toilets. For instance, the reputation that Africa Hall has of being generally clean and in this case safe makes it an attractive alternative for people whose primary or even secondary facilities cannot be used at a certain time. Complex Hall is also closest to the main gate, which makes it a stop facility for visitors and passersby, which may make it too dirty for SLDs.

Conversely, the variability of these conditions meant that sanitation spaces were constantly evolving between zones. The thematic map in Figure 8 below shows the three sanitation zones characterizing the primary, secondary and in-between facilities at Makerere University.

Figure 8: A thematic map of the university's sanitation zones



4.6. Socio-spatial configurations of sanitation access

This dissertation chapter shows that SLDs largely depend on assisted and spatial navigation, with wishes to have autonomy in access to sanitation in urban spaces. In some ways, they achieve this autonomy by memorizing toilet networks and sticking to familiar routes. However, an unexpected sewer spill frustrates even the ingenious protocols SLDs employ. For students living with blindness and low vision, to whom this pattern of networks is crucial for navigating the sanitation infrastructure on their own, an overwhelming level of attunement is required to adjust accordingly. This observation aligns with McFarlane and Soderstrom (2017), of how marginalized groups learn and place themselves in urban spaces. This ever-changing state of the infrastructure, however, means that toilets quickly fall from the safety zone to unsafety. With limited means to identify these changes, as one can only know so much about the existing conditions of every facility on campus time in real time, this autonomy is short-lived and assistance from friends becomes imperative. This assistance empowers SLDs to interact with infrastructure but the quick changes, in addition to physical barriers in the sanitation space, result in a near-permanent dependence of SLDs on friends to meet basic humane sanitation, which counters the essence of reducing marginalization. Once again, this shows the multifaced existence of marginalization.

The researcher noted that assistance from friends is labor that involves a lot of physical and virtual coordination across locations to assess facilities safe for SLDs. This labor is also not devoid of disagreements between SLDs and their friends, as was discussed earlier in the findings.

Despite these disagreements, paid friends must assist their SLD assignees; otherwise, payment will be revoked or, although less frequent, new friends will be hired. However, a social and moral understanding between SLDs and their paid or volunteering friends is evident during emergencies. For instance, when paid friends fall sick or must leave other responsibilities aside from those of

their SLD friends. The SLDs understand that they are not being abandoned, and the paid friends ensure they find someone to assist their assigned SLD. The labor of caring for the SLDs is then extended to volunteering friends and shifts from paid to unpaid. In most cases, volunteering is not a permanent position for any parties involved, as volunteering friends are under no assistance obligations. Anyone, including students with different disabilities, can be each other's volunteer for a few minutes or several days depending on their pending needs and abilities as well as the availability or willingness of somebody to volunteer.

The need for this labor in sanitation demonstrates that the structural environment and toileting practices of many users lack consideration for sanitary needs of SLDs which fosters more sanitation burdens on them even though the entire student population faces challenges of access to safe and clean toilets at Makerere University. The everyday state of water, stalls, toilet enclosures, staircases, effluent, and so on, which comprise the sanitation infrastructure, means that SLDs recreate the sanitation spaces by trying and failing to find a usable toilet.

Socio-spatial configurations, therefore, arise from the cumulative effect of the everyday state of primary facilities, secondary facilities and those in between and how these relate to SLDs familiarity with physical terrain, access to other facilities and social networks. Even though some facilities are considerably accessible structurally with functioning water utilities, the fact that they were not open to use all the time, or their accessibility cut off by flowing effluent, leads us to conclude that no toilet is definitively safe, unsafe or intermediate each day.

One can also argue that socio-spatial configurations are blurred when SLDs have no other option but wait through water outages. Such scenarios highlight the need to look beyond Makerere University, as water networks and sources are linked to other areas and depend on labor across the city.

In this chapter, the researcher highlights that in cities like Kampala, inadequacies of access to sanitation from structural barriers are mediated through labor, and this helps to reduce the total marginalization of SLDs. This labor is, however, not enough to fully mitigate the challenges of sanitation as it mirrors the inner conflict around dignity and challenges around inclusive sanitation without specifying whom this inclusivity is targeting.

4.6. Conclusion

This chapter contributes to the discussion of marginalization by analyzing socio-spatial configurations from differentiated spatial sanitation provision. Our findings highlight that historical exclusionary practices are perpetuated by environmental factors to create fluid sanitation zones that are mainly unsafe for SLDs in a public institution of higher education. This is an undeniable constitution of environmental justice in Kampala's sanitation infrastructure as our visual tools show halls of residence which SLDs stay at as places of unsafe sanitation. SLDs navigate these complexities through socio-spatial orders that encompass personal mobility, social and cellular networks, and physical labor. However, sometimes these are not constantly available and under certain conditions marginalize SLDs even further in sanitation access. This precarious state amplifies the burden on SLDs, particularly when compounded by challenges like water outages and sewer overflows, which disrupt memorized routes and established routines. Nonetheless, the labor invested by SLDs and their support networks proves the importance of concepts in Global South infrastructure scholarship that appreciate people as elements of infrastructure in alleviating immediate barriers of infrastructure provision and access.

The socio-spatial configurations in places like Makerere University also provide evidence of social destigmatization which contrasts social stigma as an exclusion factor that many studies on disability access to sanitation raise. The researcher notes that although not a permanent solution,

the labor of friends exemplifies incremental ways that SLDs can be included in access to urban spaces and services. In Makerere's case, it might mean sit-on and squat-over toilets with restricted accessibility. There is no standard approach to inclusive sanitation spaces; target social groups (such as elites), resources, policies, power structures, and social networks all significantly influence how and for whom sanitation spaces can be made inclusive. An imbalance of these means that marginalization is bound to occur.

Chapter 5: Conclusion

5.1 Summary

This dissertation expands the application of HICs to analyze how modes of sanitation infrastructure help to grapple with the dichotomy between society and the environment in Kampala. The researcher set three research questions that were investigated through a qualitative approach employing interviews and focus groups discussions among urban community members and key stakeholders in Kampala's sanitation sector. The questions were:

a) What community practices and narratives around environmental risks are conveyed through sanitation technologies in Kampala?

b) How do community practices and narratives around sanitation technologies align with changing urban environments?

c) What socio-spatial configurations are created by differential provision and access to toilets in Kampala.

The results are presented in three distinct chapters on sanitation, environment and society. They are informed by research questions in combination with thematic highlights of analyzed data. The dissertation is, thus, structured in three major parts: the introduction chapter, the three chapters presenting findings and discussions and finally the conclusion chapter which provides a summary of the dissertation study alongside limitations and recommendations.

The first chapter provides the background, motivation and main objective. It explains the conceptual framing of the dissertation, which is Heterogeneous Infrastructure Configurations stemming from the theoretical approach of Urban Political Ecology. The chapter also illustrates the methodology and the significance of the dissertation in light of UN Sustainable Development Goals.

The second chapter discusses key risk factors posed to people in Kampala using the plethora of toilet technologies available in different locations of the city despite modernist regulatory frameworks for sanitation infrastructure being in place. The factors experienced such as odors, vectors and water outages result from an interplay between biophysical conditions such as dry and wet weather seasons, socio-economic status, and power dynamics. Risk factors spread beyond modes of sanitation causing risks and their effects to multiply. The findings in this chapter lead to a critique of the modernist frameworks for two reasons. The first is for undermining the dynamic role of non-human elements leading to persistence of risk and the risk factors. The second is that working within these frameworks does not equate to eradication of sanitation-related risk. This critique resonates with infrastructure studies in both Global North and South cities that elaborate limitations of modern infrastructure ideals for its presumption of human mastery of the external environment. This chapter however shows that community members are aware of the role of these non-human elements with modern and non-modern toilets, not only in the persistence of risk but in mitigating the risk as well. People paid attention to patterns of weather seasons to determine if risk factors such as odors resulted from wind systems of the dry season or not to determine appropriate mitigation measures. Based on the results that address this research question, the researcher concludes that HICs enhance observations of people's daily interaction with their environment beyond the limitations of human control. It finds that urban residents are deeply connected to their environment, engaging in practices that operate both within and outside modernist frameworks.

The third chapter builds on the differences and similarities in risk factors and experiences identified in the second chapter, examining the diverse practices respondents use to navigate risks and how these practices align with their narratives of a changing urban environment. Interview data made

it clear that respondents' sanitation options were tied into their already existing mobilities and efforts to find less risky toilets. As a result, the researcher determined to analyze this data by categorizing respondents as commuters and non-commuters. This flexibility ties neatly in the HICs framing which recognizes people as heterogeneous rather than homogeneous, taking care to not divert from the major research question. The dissertation established that practices of commuters and non-commuters were intentional and often orchestrated socio-economic relationships tied to sanitation and thus, accords with Simone's (2004) analysis of people as infrastructure, for as infrastructure changes, so do the relationships forged around it and vice versa. These practices and relationships ultimately contribute to the discussion of urban change by challenging dominant narratives of urban development, which often prioritize large-scale infrastructural projects over the lived experiences of urban dwellers. Respondents were unaware that their own practices and relationships influenced urban change. This was evident in how they associated KCC's poor sanitation with only state service inefficiencies, while acknowledging better sanitation conditions in the GKMA. The chapter thus reinforces observations of incremental practices, and socio-economic relationships highlighted in Global South scholarship prevalent in cities like Kampala that support rethinking infrastructure as a relational and socio-political construct.

Drawing on the connections established in the third chapter, the fourth chapter explores the outcomes. Specifically, it examines the socio-spatial configurations of SLDs, and frames these as being shaped by issues like water outages and sewer overflows in urban areas. It calls attention to the need for empirical studies of marginalized groups, especially persons with disabilities in sanitation, in the global south. The literature on PLDs referenced in section 4.2.2 of this chapter often raised environmental barriers and social stigma as major hindrances to sanitation access for PLDs. Although environmental barriers were overall found to be true at the university, social

stigma was merely perceived by the SLDs as opposed to experiencing it. The socio-economic relationships between SLDs and *friends* neutralize social stigma or at least make it hidden. Again, this is an advantage of HICs as it magnifies nuances that often go unrecognized such as the labor of *friends*. In turn, this enables deeper scrutiny of what it means for certain groups to be marginalized. In essence, the socio-spatial configurations emerging from personal mobilities, social relations, cellular networks and physical labor to enable SLDs navigate hindrances to accessing sanitation mitigate against their marginalization in certain urban spaces.

In summary, the dissertation reinforces the analytical advantage of the HICs framing in analyzing and synthesizing urban risk. The dissertation gives further evidence to the argument that sanitation risks are not merely technical problems but are deeply embedded in socio-political, economic, and environmental dynamics that produce multi-layered effects for the urban population. This urban population is not homogeneous but rather diverse and therefore experiences, narrates, adapts to and mitigates sanitation-related risks both similarly and differently. It therefore urges stakeholders in the sanitation sector to learn from these practices to think about risk factors and their mitigation both within and beyond modernist frameworks, especially the role of non-human elements. It also provokes normative assumptions about groups marginalized by sanitation infrastructure by considering how relationships forged by the urban population reshape spatial configurations of access to toilets. The dissertation has expanded HICs by focusing on how they shape and are shaped by human-environment interactions. Despite the presence of some modern infrastructure, in Kampala there remains highly interconnected links between humans, the environment and modes of sanitation in Kampala.

5.2 Limitations

The researcher met the following limitations:

(a) Timing

The fieldwork was carried out when Uganda was coming out of the Covid-19 pandemic lockdown in 2022. Therefore, all applicable Standard Operating Procedures during fieldwork such as social distancing during interviews and FGDs, also being mindful that the research process could have been different if not for the effects of the pandemic.

(b) Sample

(i) The researcher wanted to have a key informant interview with a representative from the university's estates department. The researcher's interview requests were, however, not responded to by this department and therefore missed insights that could have enhanced the perspective of sanitation at the university.

(ii) Despite insights of the dissertation, the researcher recognizes that the sample size of interviews was small, consisting of fifty participants and only two sites. The sample size can be increased in future studies with more time and resource allocation. The research sites were both educational institutions, and results might differ if rooted in other spaces and institutions.

c) Data and analysis

(i) Since data about risk experiences were self-reported by respondents, the researcher cannot guarantee that responses were not biased and that participants did not purposely or accidentally share incorrect answers. This includes all data collected by semi-structured interviews, FGDs where responses were perhaps influenced by the opinions of others in the group and key informant interviews where participants were acting in some institutional capacity.

Nonetheless, during data analysis, the researcher labored to prioritize similar and repeating responses from all the data as a measure of accuracy and validity.

(ii) The findings of this dissertation may not be generalized to all places as it was only conducted in Kampala and future studies can cover other cities.

5.3 Recommendations

The findings and limitations of this dissertation invoke policy, institutional and research recommendations here below.

(a) Policy

(i) To address sanitation-related risks stemming from interactions of various biophysical elements of the environment, the researcher urges KCCA, the Ministry of Water and Environment, and other stakeholders to expand sanitation laws beyond solely protecting water sources. Public health laws have long focused on preventing fecal contamination of water. However, messages like "DO NOT URINATE HERE" are frequently seen on walls and fences across the city, including the eastern side of the university fence as referenced in the second chapter. These messages reflect public appeals for broader environmental sanitation efforts.

(ii) In light of the implications of modernity views on design, planning and delivery of sanitation infrastructure in KCC, this dissertation recommends to government agencies to integrate heterogeneous sanitation options into national sanitation policy. This can be attained by learning from KCCA's sanitation interventions at Kasubi Church of Uganda Primary School where there are cistern-flush toilets, a biogas toilet and pit latrines, alternative sanitation options can be considered for densely populated institutions like Makerere University in addition to water-borne toilets.

(iii)The dissertation suggests that planning for toilet facilities in spaces meant to be inclusive requires thinking through the vastness and diversity of groups of people to be included and integrating their lived experiences into policy frameworks of infrastructural development. Urban planners and managers must consider target social groups, resources, policies, power structures, and social networks, which significantly influence how and for whom sanitation spaces can be made inclusive in order to curb marginalization.

(b) Institutional

The dissertation shows that *friends* are critical for SLDs to navigate sanitation challenges but there are too few friends. The researcher encourages mutual interest between institutions of higher learning and bodies that support disabled persons, such as NUDIPU, to develop an active and dedicated '*friends*' program available on standby in the institutions of higher learning such as Makerere University to provide seamless support for SLDs.

(c) Research

The dissertation encourages more empirical evidence for the expansion of HICs in studies of environment-society relations including marginalized groups identified in many infrastructure studies.

5.4. Future Directions

The researcher wonders what the implications of KCCA's implementation of alternative sanitation options in public institutions like Kasubi Church of Uganda Primary School bear on government policies insisting on modern sanitation infrastructure.

The practices for recycling and reuse of treated soil from the biogas toilet at Kasubi Kasubi Church of Uganda Primary School piqued the researcher's interest in how the sanitation-energy-food to answer questions about food insecurity and energy poverty in Kampala City.

As this dissertation was publicly shared for comments and feedback prior to and during its defense, knowledge figures in political ecology suggested the potential of grounded theory to enrich this dissertation. Due to the limited scope and unique circumstances within which doctoral project was implemented, the researcher acknowledges this is a gap to explore. The researcher is inclined to use the approach to refine manuscripts derived from this dissertation.

5.5 Reflections on researcher's growth

My doctoral training has been intense and vital in sharpening my intellectual arguments around infrastructure studies and urban theory particularly the Southern Critique. Reading materials was only part of it; I learned to write annotated bibliographies, constantly wondered what my advisors meant by tightening the argument until it clicked and most importantly, I have learned from my own lived experiences of being an international student in an institution dominated with Northern/western ideas. Finding my own ground as an author from and for the global south presented a daunting challenge of articulating my research ideas and convictions to a foreign audience that over time ceased to be too foreign. I have learned so many lessons from mistakes and effort which has prepared me for the next steps of my career.

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Appendices

Appendix A: Semi-Structured Interview Guide

Section 1: Research Overview, Participant Rights and Consent

Hello, my name is Gloria Nsangi Nakyagaba. I am a Geography doctoral student at the university of Oklahoma-Norman studying urban sanitation. I am conducting research under the topic 'examining links between nature, society and modes of sanitation in Kampala.' Would you consider participating in this study? I'd like you to participate because you are in Kampala and perhaps familiar with the sanitation of this place. You have been randomly selected and neither targeted nor identified through secondary forms. I am conducting this research because I hope to learn about how people manage environmental risks through sanitation daily. I do this by asking questions about their toilet types and their experiences with insects like flies, odors and water contamination at Makerere University or Kasubi C/U Primary School and at places they frequently go to like at work, school, or place of worship. Approximately 39 people from the local community will participate. The study is non-discriminatory regarding religion, sex or disability status. If you agree to participate, I will ask to conduct a semi-structured interview with you at the place and time of your convenience between 9am and 5pm. I expect the interview to last up to 1 hour. I would like to do an audio-recording of our interview and take notes if needed. However, I will respect your wishes if you don't want to be audio recorded. Your participation in this research doesn't involve any direct risks or benefits to you. I will also not be compensating for your time. You would therefore be allowing me to interview you as a voluntary and willing research participant. All the information I'm collecting will be kept secure and confidential, and only I, the researcher and the University of Oklahoma – Norman Campus Institutional Review Board will be

able to look at it. You will be kept anonymous (using a pseudo name). I will not share your data or use it in future research projects. There will also be a Focus Group Discussion to gather additional data on the topic with other participants after all the interviews. Please be informed that audio-tapping risks accidental release of information which then compromises confidentiality. In-person contact during interviews also risks the spread of Covid-19. You have the right to withdraw your participation any time before, during or after the interview. If you have any questions about your rights, concerns, or complaints regarding your participation, you can contact me at +256775869318/+1 (405)595-7083 and at gloria.n.nakyagaba-1@ou.edu. You may also contact my advisor, Dr. Scott Greene at +1(405)325-4319 and jgreene@ou.edu or OU's IRB at 405-325-8110 and irb@ou.edu.

Do you agree to audio record your interview? (i) Yes (ii) No

May I contact you again to participate in a Focus Group Discussion? If yes, what is your preferred way of contacting you?

Oral consent: (i) Yes (ii) No (iii)withdraw

Section 2: Basic information

1. Sex: M/F.
2. Place of interview: (i) MUK (ii) Kasubi (circle)
3. Occupation: (i) Student (ii) Work (iii) Both Student and Work (iv) other
4. Place of Work…
5. Place of School…
6. Place of worship….

Section 3: Sanitation (Ideally all users would respond to these questions

7. What do you know about sanitation?

8. Describe the toilet or sanitation technologies you commonly use at home?

9. Describe the sanitation technologies you mostly use at other places you frequently go to like at work, school, place of worship

10. Why did you choose these technologies at home?

11. Do you have other toilet options at home or the place you frequently go to like at work, school, place of worship?

Section 4: Biophysical risks and toilet users' experiences

12. What do you think about the relationship of sanitation and environment?

13. How did you come think this way about it?

14. Tell me about environmental risks posed to the toilet

(i) at home (e.g flash flood, flood. (ii) you frequently go to at work, school or place of worship

15. Do you think these risks will get better with time?

16. Tell me about your experience with the following at the toilet (i) at your home (ii) you frequently go to at work, school or place of worship

a) insects such as cockroaches and flies

b) fecal matter spilling into drainage channels or open space

c) smells and odors

d) rain, storm water or flashflood

17. When did you start noticing these risks (e.g time, year, season, event)?

18. Why do you think you experienced any of the above issues in your toilet

(i) at home (ii) you frequently go to at work, school, or place of worship?

19. How have the above-mentioned risks affected your use (e.g limited your access temporarily or permanently) to the toilet

(i) at home? (ii) you frequently go to at work, school, or place of worship?

20. Do you remember ever getting sick because of the state your toilet at home or place you frequently go to?

21. Did you seek treatment at a health facility when you got sick at that time?

22. What actions do/have you take(n) to reduce, prevent those risks in the toilet at;

(i) home (ii) you frequently go to at work, school, or place of worship?

23. With whom do you take these actions (e.g family members, neighbors, school community)

24. How does your culture (e.g., religious, tribal values) influence the way think about sanitation technologies and environment?

25. How has your experience with environmental risks shaped the decisions you make around sanitation technologies?

Section 5: Technology interventions (users respond)

26. Are you aware of any or some toilet types or technologies that can address some/aggravate environmental concerns?

27. How did you know about these toilet types or technologies?

28. Is your toilet at home one of those toilet types or technologies that (attempt to) address some of the risks mentioned earlier (insects, odor, spillage)?

29. Have you made any modifications to your toilet at home to handle any of the risks mentioned? Please explain

30. How did you know about such modifications?

31. Is the toilet at your work, school or place of worship one of those that (attempt to) address some of the risks mentioned earlier (insects, odor, spillage)?

Appendix B. FGD Question Guide

Section 1: Research Overview, Participant Rights and Consent

Hello, my name is Gloria Nsangi Nakyagaba. I am a Geography doctoral student at the university of Oklahoma-Norman studying urban sanitation. I am conducting research under the topic 'examining links between nature, society and modes of sanitation in Kampala.' You previously agreed to be contacted during semi-structured interviews for the Focus Group Discussion. I appreciate your willingness to do this. Unlike the interviews where you shared information with only I, the researcher, FGDs gather a few more people. This means that your confidentiality is not 100% guaranteed. I suggest thinking through what you may want to share during these sessions to ensure your very private information is protected. I will also ask other participants to be respectful and not share other people's information after this but understand the difficulty of ensuring this. The FGD will also be audio-recorded, and I may ask to take a few pictures. The venue of the FGD and time of will be communicated and it will last no more than two hours. Your participation in this research doesn't involve any direct risks or benefits to you. I will also not be compensating you for your time. You would therefore be voluntarily participating in this session. You still have the right to withdraw your participation before and during the FGDs. Post the discussion, you will need to contact me to withhold all your statements taken during this discussion. All the information I'm collecting will be kept secure, and only I the researcher and the University of Oklahoma – Norman Campus Institutional Review Board will be able to look at it. You will be kept anonymous (using a pseudo name) during the session, and we will not share your data or use it in future research projects. If you have any questions about your rights, concerns, or complaints regarding your participation, you can contact me at +256775869318/+1 (405)595-7083 and at gloria.n.nakyagaba-1@ou.edu. You may also contact my advisor, Dr. Scott Greene at +1(405)325-

4319 and jgreene@ou.edu or OU's IRB at 405-325-8110 and irb@ou.edu. To preserve your responses, they will be recorded on an audio recording device and/or by taking notes.

Oral Consent: (i) Yes (ii) No

Written consent:……

Section 2: Specific environmental events (e.g disease outbreak, weather events)

1. What environmental events have you noticed in your community over time? (Name the event and year if possible)
2. How have these events impacted the community that you would remember them? (Characteristics of event including effects, severity, duration…)
3. Are there places that were more affected than others?
4. What made these places more prone to those environmental risks? (Could be wetlands, densely populated)

Section 3: Individual/collective actions in response to those trends

5. Were there any safe zones where people went (e.g., playground, place of worship)
6. How have these environmental risks influenced sanitation decisions?
7. How did you as an individual or your family go through these times (practices, changing habits to cope)
8. How did you as a community go through these events? (Community policing, sharing your private, landlords enforced rules, local leaders taught people)
9. How were sanitation needs of the vulnerable in the community (e.g., those without toilets, homeless) met?

10. 11. Were there financial costs associated with the individual/collective action (e.g. buying equipment)?

Section 4: Certain technologies responded to those changes

11. Have certain sanitation technologies helped you/community respond to these changes adequately?

12. Explain how such technologies have helped

13. When did these technologies come into the community?

14. How did you know about these sanitation technologies?

15. Who introduced them to the community?

16. What position do those people hold in the community?

17. What privileges have those people gained from introducing that technology in the community?

18. Do you know where such technologies came from (local or foreign place) before they came into this area?

19. Are there other technologies you used to respond to the same challenge before?

20. Did those technologies help? Please explain

Section 5: Actors and Narratives

21. How does your community (current residential area, village leadership) influence the way you think or act around sanitation technologies to respond to environmental risks?

22. Are there any practices or actions you do collectively as a community to alleviate environmental risks associated with your sanitation needs?

23. How does the government (KCCA/municipality) influence the way you think or act around sanitation technologies to respond to environmental risks?

24. How do NGOs contribute to the way you think or act around sanitation technologies to respond to environmental risks?

25. Have sanitation technologies you have used before and currently shaped the way you respond to environmental risks?

26. What places in your neighborhood do you know these efforts (including collective action, KCCA or NGO intervention) are done the most?

Appendix C: Key Informant Interview Guide

Section 1: *Research Overview, Participant Rights and Consent*

Hello, my name is Gloria Nsangi Nakyagaba. I am a Geography doctoral student at the university of Oklahoma-Norman studying urban sanitation. I am conducting research under the topic 'examining links between nature, society and modes of sanitation in Kampala.' Would you consider participating in this study? I'd like you to participate because you are in Kampala and perhaps familiar with the sanitation of this place. You have been purposively selected because of your capacity or role of your institution around sanitation in Kampala. I am conducting this research because I hope to learn about how local populations manage environmental risks through sanitation. I do this by asking questions about their toilet types and their experiences with insects like flies, odors and water contamination at Makerere University or Kasubi C/U Primary School and at places they frequently go to like at work, school, or place of worship. The study is non-discriminatory regarding religion, sex or disability status. About 8 key informants will participate. If you agree to participate, I ask to conduct a key informant interview with you at the place and time of your convenience between 9am and 5pm. I expect the interview to last up to 1 hour. I would like to do an audio recording of our interview and take notes if needed. However, I will respect your wishes if you don't want to be audio recorded. Your participation in this research doesn't involve any direct risks or benefits to you. I will also not be compensating you for your time, therefore, you would be voluntarily and willingly participating. All the information I'm collecting will be kept secure and confidential, and only I the researcher and the University of Oklahoma – Norman Campus Institutional Review Board will be able to look at it. You will be kept anonymous (using a pseudo name) in my research if you wish. We will not share your data or use it in future research projects. Please be informed audio-tapping poses accidental release of

information and thus compromise confidentiality. Face-face interviews also risk the spread of Covid-19. You have the right to withdraw your agreed participation before, during or after the interviews. If you have any questions about your rights, concerns, or complaints regarding your participation, you can contact me at +256775869318/+1 (405)595-7083 and at gloria.n.nakyagaba-1@ou.edu. You may also contact my advisor, Dr. Scott Greene at +1(405)325-4319 and jgreene@ou.edu or OU's IRB at 405-325-8110 and irb@ou.edu. To preserve your responses, they will be recorded on an audio recording device and/or by taking notes.

Do you agree for your interview to be to audio recorded? _____

May I contact you again in case of additional data requirements about this research?

Oral consent for participation……..

Section 2: Questions

1. How was the decision about the bio-gas toilet made?

2. Who made the decision to provide Kasubi C/U P/S with a bio-gas toilet?

3. How did your institution (MTN Uganda) come to be part of this decision for a bio-gas toilet specifically (e.g are you part of the Kampala Water and Sanitation Forum of KCCA, part of your company CSR)?

4. Do you think bio-gas toilets affected by environmental challenges including those related to water, insects, and odors? Please explain

5. Have you received reports of environmental risks associated with the bio-gas toilet? (such as effluent flows, odors, etc.?)

6. By whom are these cases reported?

7. How have these been handled?

8. Have you noticed any changing trends about these environmental risks over time?

9. How is this mode of sanitation attuned to address these risks in the future?

10. Do you expect to make any modifications about this mode of sanitation in the future?

11. What financial implications are associated with this mode of sanitation?