Everyday Life and Infrastructures: Situating Water and Sanitation Access Challenges in Lilongwe, Malawi

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Declaration

No portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

Copyright statement

Abstract

Central to this dissertation is a critique of developmentalist approaches in water and sanitation (WASH) research, and an argument that understanding everyday practices is necessary both theoretically and pragmatically for successful improvements in urban infrastructure. In the past decades social science scholarship has raised attention to the problematic of prevalent technocratic approaches in the WASH sector. As scholars have criticised, interventions to improve access to water have often been based on technological, governance and behavioural approaches and the use of universalised understandings of WASH challenges that do not reflect the everyday realities of the poor and marginalised residents framed as beneficiaries of water and sanitation projects (Li, 2007; Mehta and Movik, 2014; Simon et al., 2011). The call to take seriously the everyday realities of global South urban residents has also been made by urban scholars working 'from' the global South concerned with the uncritical application of universal explanations to global South cities (Kooy and Bakker, 2008; Lawhon et al., 2018; Silver, 2014). As these scholars have demonstrated the lens of the everyday is a helpful analytical device to challenge notions of urban infrastructures that do not reflect the realities at play in global South cities. Building on this scholarship, this dissertation aims to extend the understanding of water and sanitation access challenges in Lilongwe, Malawi through a detailed empirical exploration of the everydayness of Lilongwe's infrastructures. Specifically, the dissertation develops four themes i) the history and use of a dual sanitation system; ii) the socio-materialities of menstrual waste management; iv) the operation of the water kiosk system; iv) and the experiences of living with fragile sanitation infrastructures. The selection of these themes, and the academic literature mobilised to explore them, responds to the commitment to contribute to empirically driven theory making. For that purpose, the research adopted an inductive method to allow for the iterative zigzagging between theory and data. Data collection entailed participant observation, semi-structured interviews, group discussions, mobile-methods, and photo elicitation exercises with residents and different actors of the water and sanitation sectors. This data was supplemented with the review and analysis of urban plans, project documents, and other literature about Lilongwe's sanitation sector gathered through archival and desk-based research as well as secondary data analysis. The dissertation shows the multiple instances in which access to water and sanitation is challenged by failing infrastructures and reveals the historical legacies, social power relations, and cultural dynamics underpinning these failures. Intellectually, the dissertation contributes to scholarship theorising infrastructures from the global South by reflecting on the unequal experiences of failure across heterogeneous infrastructural landscape and intersecting social identities; the (intersectionally gendered) labours that keep infrastructures at work; and the locally grounded practices and solutions developed by residents to address different infrastructure failures. From a policy and practice perspective the findings call for making visible, and accounting for, water and sanitation failures as well as the labours and practices required to sustain access to water and sanitation. The dissertation suggests this can be achieved by reframing access beyond absolute presence/absence of infrastructures; integrating locally grounded solutions into governance structures; recognising the role infrastructural labours play in access; and considering the indirect harms produced by failing infrastructures.

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Abbreviations

CCODE	Centre for Community Organisation and Development
FSM	Faecal Sludge Management
HIC	Heterogeneous Infrastructure Configurations
JMP	WHO/UNICEF Joint Monitoring Programme for WASH
KMU	Kiosk Management Unit
LCC	Lilongwe City Council
LIAs	Low-Income Areas
LWB	Lilongwe Water Board
MHC	Malawi Housing Corporation
MHM	Menstrual Hygiene Management
MoE	Ministry of Education
NGO	Non-Governmental Organisation
SPoWD	Social Practices Analyses of Water Demand
SDG	Sustainable Development Goal
UPE	Urban Political Ecology
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organisation

Contents

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Rationale for Journal Format

The main body of this dissertation is comprised of three journal papers: an article that has been published in the Journal of Social and Cultural Geography (Chapter 5), an article that is currently at review and resubmit phase with positive comments from reviewers with Geoforum (Chapter 7), and an article that has been under review for over a year with the Journal of Urban Technology (Chapter 4). The fourth paper will be part of an edited book of the Gender, Feminism and Geography Series of West Virginia University Press (Chapter 6). Since the very early stages of my PhD I have had frequent discussions with my supervisors about working towards a Journal Format dissertation and I had always been more inclined towards this model rather than the traditional dissertation for the reasons I indicate below. However, the decision became firm when right after coming back from my first period of fieldwork I came across the call for papers for the edited book in Gendered Infrastructures for which one of the themes that emerged during fieldwork was an excellent fit. That call for papers gave me the opportunity to start writing the first PhD empirical chapter in the form of a standalone academic publication. Two main reasons (apart from the opportune call for papers) are behind the decisions to produce a Journal Format dissertation. First, the nature of the diverse and detailed data emerging from the two fieldwork periods enabled four distinct conceptually grounded empirical contributions to be made across different disciplinary and interdisciplinary academic debates. The Journal Format allows a postgraduate researcher with experience in fieldwork and writing journal articles to get research findings from the PhD out sooner than the traditional format (that usually requires to wait until the end of the PhD to then convert the dissertation into a book or a set of journal papers). This dissertation contributes to timely academic and policy and practice debates on infrastructures in global South cities, urban services provision in low-income neighbourhoods and inequalities in access to water and sanitation, publishing early enabled me to participate in and contribute to these debates as they were/are happening. Thirdly, in this area. Second, as an early career researcher building a track record of publications during the PhD is essential to access a highly competitive postdoctoral job market and a Journal Format dissertation provides the basis for it.

Chapter 1.
Introduction

1.1 The practical need for a more situated understanding of the challenges to access water and sanitation in global South cities

This dissertation reflects my ongoing personal wrestling with widespread approaches to intervene in the WASH (water, sanitation, and hygiene) sector as I was moving from working in the field as a young water sanitation professional (2007) to becoming a researcher in academia (present). In one of my first intern positions at a local NGO (Non-Governmental Organisation) in Bangladesh in 2007, I heard for the first time the widely repeated development trope that newly constructed latrines were being used as storage facilities instead of the purpose for which they were built - sanitation. Rather than pointing to stubborn beneficiaries who could not see the value of the infrastructure they were being provided just because it was granted at free cost as the formal narrative contended, to me it meant that a more contextually grounded understanding of the multiple, and often contradicting, meanings and values water and sanitation infrastructures have for users was needed within the context of development projects. This conviction of the importance of understanding these local knowledges and practices grew even greater over the following years when I worked as a water and sanitation young professional in Guatemala and Bolivia in big donor agencies. Much of the work we were undertaking was about implementing prescribed technological solutions and governance best-practices for WASH. There was little space for critical reflection on whether the proposed solutions matched local understandings or aspirations of what was needed (technologically, socially) or how these solutions integrated in the broader picture of the historical, political, economic, and cultural process at play locally.

Through the initial reading of political ecology and postdevelopmental engagements with water and sanitation in the context of development projects during my MSc in Water Services Management at UNESCO-IHE, I learnt I was not alone in this critique of existing approaches to WASH and development. I began engaging with the wide body of social sciences scholarship that has critiqued the prevalence of technocratic approaches within WASH development contexts. As this scholarship has argued, most interventions in WASH tend to be based on technological, governance and behavioural simplistic solutions that use and replicate universalised understandings of sanitation and hygiene (Li, 2007; Mehta and Movik, 2014; Simon et al., 2011). This is problematic because these universalised understandings do not reflect the everyday realities of the poor and marginalised residents framed as beneficiaries of water and sanitation projects (Bruns and Frick, 2014; Joshi et al., 2011; Li, 2007; Mehta and Movik, 2014; Simon et al., 2011).

For example, water insecurity has often been approached as a challenge to be solved by infrastructural interventions entailing the tapping of new water sources and the extensions of water systems rather than by engaging with the combination of social, environmental, and political processes that political ecologists have repeatedly argued produce unequal distributions of water from the city to the intra household scale (Swyngedouw, 2004; Loftus, 2015; Truelove, 2019). Similarly, the solution to the challenge of latrine adoption (introduced in the first paragraph) has often been framed as a matter of developing the right technologies (e.g. Reinvent the Toilet Challenge) and techniques (e.g. sanitation marketing) rather than a question of understanding the context specific meanings, beliefs and taboos, as well as the structural dynamics, social relations and gender norms that shape what is locally considered a desirable sanitation solution (Jewitt, 2011; Joshi et al., 2011; O'Reilly, 2010).

As a result of these techno-managerial approaches "poor and marginalised communities often bear the brunt of inadequately scoped or contextualised WASH projects" (Workman et al., 2021, p. 402). As many have pointed these approaches also contribute to the elusiveness of the fundamental goal to provide sustainable water and sanitation services for all (Akpabio et al, 2021; Bruns and Frick, 2014; Metha and Movik, 2014; Joshi et al., 2011; Wiegleb and Bruns; 2018; Workman et al., 2021). Despite the increased attention paid to water and sanitation services within the context of the Sustainable Development Goals (SDGs), 3.6 billion people still lack access to safely managed sanitation services and 2 billion people lack access to safely managed water services globally, a high proportion of which live in informal settlements in urban areas (JMP, 2021a).

The starting point of this dissertation is that a more situated approach is required to understand and address the water and sanitation challenges facing global South cities. Following recent scholarship theorising urban infrastructures from the global South (see Chapter 2 for review of this literature), I argue this 'situatedness' can be gained by placing the everyday lived experiences and practices of residents at the core of the analysis, and by examining such an analysis in close connection to the specific historical, political and cultural dynamics in which these challenges are produced.

1.2 The theoretical need for engaging with the everydayness of infrastructures

The relevance of understanding the everydayness of water and sanitation infrastructures is not only practical but also theoretical. In the last two decades there has been a growing number of scholars concerned with the ways in which global South cities have been approached and represented in urban theory. In urban studies, the global North has traditionally been the centre of global theory production, while the global South was regarded as a source of empirical material (Robinson 2006; Roy, 2014; Sheppard et al., 2013). As "the southern urban critique" (Lawhon and Truelove, 2020, p. 5) argues global theories developed based on a few global North case studies and presented as 'universal' have been repeatedly and uncritically applied to global South cities without attention to the diversity of urban life or the potential alternative readings of these global processes in Southern contexts (Robinson, 2006). Furthermore, most academic work with a focus on the urban global South, and particularly urban Africa, has approached Southern cities as an "object for developmentalists interventions" (Robinson, 2006, p. 2) and has had limited contribution to theory-making (Mbembé and Nutall, 2006; Lawhon, 2020). This shared concern with the need to build theory that reflects more accurately the experiences and processes at play in the urban global South has led to African urbanists and other global South scholars to take seriously the ordinary life in cities as a source of theory (e.g. Bhan, 2019; Caldeira, 2017; Pieterse, 2008; Simone, 2004a).

As part of this southern urban critique a growing number of scholars have used urban infrastructures and the lenses of the everyday as an entry point to decentre or provincialise urban theory (e.g. Furlong and Kooy, 2017; Kooy and Bakker, 2008; Lawhon et al., 2014). For example, most academic and planning debates were dominated by notions of urban infrastructures as networked, centralised and occult for users. These understandings were based on the modern infrastructural ideal that did not reflect the realities in global South cities. By engaging with the day-to-day experiences, practices and politics of infrastructures, scholars working from the South have not only been able to show the limitations of these inherited notions but also to produce new definitions and conceptualisations that better describe and explain the infrastructural landscapes of global South cities and beyond. Through a focus on everyday life, scholars have moved from notions of reliability and universality to fragmentation, diversity, coexistence, incompleteness, or inequality (Ahlers, et al, 2014; Guma, 2020; Lawhon et al., 2018; Truelove, 2011) as key concepts to engage with when thinking about infrastructures in Southern cities. Furthermore, a focus on everyday life has allowed a broadening of the

definition of infrastructures to account not only for the material elements (the pipes and taps) but also to include the socio-material practices and political decisions that contribute to the flow of resources (water, waste, energy) in cities (Simone, 2004b; McFarlane and Rutherford, 2008). This includes the daily negotiations residents engage in to access water such as "the request for a favour, or gift, or a temporary connection, or buying a small amount, agreeing on a delay in payment of the bill, organising labour to fetch, mend, fix, or pay" (Ahlers et al., 2014, p.6).

As the scholarship summarised here (and more in detail in Chapter 2) shows a focus on the everydayness of infrastructures is not only important from a practical perspective as suggested in section 1.1 but it is also crucial to unsettle taken-for-granted explanations and theoretical frameworks developed elsewhere.

1. 3 Why 'situate' water and sanitation challenges in Lilongwe?

Lilongwe was selected as location for this study for three main reasons. First, Lilongwe faces specific challenges that make it an interesting place to study water and sanitation (see Section 3.2 for details). Despite efforts from the water and sanitation actors' and donors, figures of access to sanitation remain very low. According to the JMP[1] (WHO/UNICEF Joint Monitoring Program) only 59.89% of the urban population in the country had access to safely managed, basic or limited[2] sanitation facilities in 2020[3] (JMP, 2021b). Figures of access to water are much better in comparison to sanitation (the JMP estimates that 96.73% of the urban population had access to safely managed or basic[4] drinking water (JMP, 2021b)). However, these numbers do not reflect the everyday realities of access experienced by residents (Adams and Smiley, 2018).

[1] The JMP collects data on and reports progress in WASH globally.

[2] The JMP classifies improved sanitation facilities (those that hygienically separate excreta from human contact) in Safely Managed (excreta is safely disposed and facilities are not shared), Basic (not shared facilities) and Limited (shared facilities) See https://washdata.org/ (accessed 10th of January 2022)

[3] The JMP does not produced disaggregated data by cities and there is no updated national data on access to water and sanitation for Lilongwe.

[4] The JMP classifies improved water sources (those with potential to deliver safe water) in Safely Managed (accessible on premises, available when needed and free from faecal and priority chemical contamination) and Basic (collection time is not more than 30 minutes for a roundtrip including queuing) See https://washdata.org/ (last accessed 10th of January 2022)

The landscape of water and sanitation infrastructures is highly fragmented and unequal (Rusca, Boakye-Ansah, et al., 2017). In the planned areas, most of the households have taps at home and use flush toilets connected to the piped sanitation system or septic tanks. Water scarcity has become a pressing issue in the city (World Bank, 2017). Supply is often erratic with more frequent and lasting shortages in Low-Income Areas (LIAs) (Alda-Vidal et al., 2017; Boakye-Ansah et al., 2016). Water and sanitation infrastructures in the city suffer a huge backlog in maintenance and upgrading. Even in planned areas, the lack of maintenance of sanitation infrastructures means that most of the wastewater is discharged untreated contributing to environmental pollution (World Bank, 2017). In the LIAs residents can buy treated water by buckets from a system of kiosks. However, kiosk-water is more expensive and of lower quality than that provided in the planned areas and frequently unavailable due to service interruptions (Boakye-Ansah et al., 2016; Pihljak et al., 2019; Velzeboer et al., 2017). For these reasons, residents of LIAs often turn to unsafe water sources such as boreholes, wells, or rainwater (Rusca, Alda-Vidal, et al., 2017, Velzeboer et al., 2017). Furthermore, most residents' use self-constructed pit latrines that do not manage excreta safely and are located nearby wells used for domestic consumption, risking the pollution of these water sources (Rusca, Alda-Vidal, et al., 2017). As residents have to bear the cost of latrine construction and maintenance, they often engage in practices that compromise the robustness of the structures and exacerbates the risks of environmental pollution (Chapter 7).

This short summary demonstrates the complexity of the water and sanitation challenges facing the city, and points to a variety of dimensions from the history of infrastructures planning and development to resident's everyday 'problematic' practices that I argue could benefit from a more empirically rich and context-based exploration. How would the understanding of these challenges change if we explicitly engage with the injustices and everyday politics at their core? What would it mean to understand the 'problematic' practices of residents within the everyday cultural and infrastructural logics in which they are embedded? What could be learnt from the locally grounded solutions of Lilongwe's residents if we let go of preconceived ideas of how infrastructures should work or what they look like? These are some of the questions this dissertation engages with.

Second, Lilongwe is a relatively under-researched city in urban, and water and sanitation, studies compared to other African cities. This is perhaps because Lilongwe's rates of urbanisation have been more modest than those of other cities in the region. Lilongwe has experienced rapid population growth since the independence of the country from British colonial rule in 1964 — from less than 20,000 inhabitants in 1966 to close to a million in

2018 (Tiwale et. al, 2018; NSO, 2018). Yet, the country is still very rural with only 16% of the population living in urban areas (World Bank, 2017). Malawi is also listed as one of the poorest countries in the world and is consistently ranked as one of the Least Developed Countries on the Overseas Development Assistance (ODA) lists[5], with 25% of the population living in extreme poverty (World Bank, 2017). Levels of poverty have been aggravated by recent climatic shocks and the COVID-19 crisis which has hit harder on populations living in urban areas (World Bank, 2021). By choosing Lilongwe as study site, I join proponents of the southern urban critique in their argument that African cities deserve attention not only based on their urbanisation or poverty rates but for their potential to provide insights into "diverse and distinctive ways of being urban" (Robinson, 2006 p. 90). Doing so can both help to make sense of the specific local conditions and challenges as well as to inform the understanding of the processes at play in other cities in the global South and beyond (Lawhon and Truelove, 2020; Robinson, 2006).

Finally, the decision to locate this study in Lilongwe was also a practical one. I could draw on my previous research and practical knowledge of the city, existing professional and personal networks and connections, and build on previous research on water and sanitation conducted from a similar theoretical background. Prior to starting my PhD, I was a Research Consultant in two research projects at IHE- Delft Institute for Water Education (UNHIDE - Uncovering Hidden Dynamics of Water Service Provision in Slum Environments and INHABIT cities – Investigating Natural, Historical, and Institutional Transformations). These projects aimed to investigate the formal and informal dynamics of water and sanitation provision in two Southern African cities (Lilongwe and Maputo).

Within the framework of these projects (2014 – 2016) I conducted three months of ethnographic fieldwork in Lilongwe exploring the practices of operation and maintenance of the water network (see Alda-Vidal et al., 2017). Back in the Netherlands I contributed to research in other project themes including explorations of Lilongwe's everyday dynamics of water pricing (Pihljak et al., 2019) and low-income residents' perceptions of health risks and hygiene practices (Rusca, Alda-Vidal et al., 2017). In 2015-2016 I co-supervised five students conducting fieldwork in Lilongwe for their MSc dissertations at the University of Amsterdam (see Baker, 2016; Caspers, 2016; Kral, 2016; Langkau, 2016; Maurits, 2016). These MSc dissertations investigated different aspects of Lilongwe's dynamics of sanitation service provision including the technological landscape, costs and

[5] https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/DAC-List-ODA-Recipients-for-reporting-2021-flows.pdf (accessed 10th of January 2022)

affordability of services, role of NGOs in service provision, power dynamics in the local sanitation sector, and everyday practices of hygiene in LIAs.

The two larger projects – UNHIDE and INHABIT - yielded important insights into the historical and political processes shaping Lilongwe's urban waterscape but also opened up new lines of inquiry not yet captured in the academic literature that provided the starting point for my PhD studies, and this dissertation. For example, while the five MSc dissertations provided preliminary insights into the dynamics of sanitation provision, they also pointed to the need for a more in-depth exploration of the everyday politics of sanitation (cf. Baker, 2016; Caspers, 2016; Kral, 2016; Langkau, 2016; Maurits, 2016), a topic that has been taken forward by this dissertation in depth. Similarly, the larger projects and MSc dissertations pointed to the gender and intersectional dynamics shaping unequal infrastructural experiences (Kral, 2016; Rusca, Alda-Vidal et al., 2017; Velzeboer, 2016; Velzeboer et al., 2017) and the importance of operation and maintenance in the production of uneven access to water (Alda-Vidal et al., 2017; Boakye-Ansah et al., 2016; Tiwale et al., 2018, Velzeboer et al., 2017). Despite being some of the first empirical contributions, a more in-depth exploration of these gendered dynamics, including engagement with feminist theories, was missing across these research literatures.

1.4 Research aim and questions

This thesis aims at extending the understanding of water and sanitation challenges in Lilongwe through a detailed empirical exploration of the everydayness of Lilongwe's infrastructures and an engagement with global South urban theory, in particular with recent contributions from social sciences work on urban infrastructures in global South cities (see chapter 2). The overarching research questions that this dissertation seeks to answer are:

- **How does an exploration centred in the everyday realities and experiences of residents with water and sanitation infrastructures extend our understanding of access challenges in Lilongwe?**
- **How does an exploration centred in the everyday realities and experiences of residents with water and sanitation infrastructures unsettle taken-for-granted explanations of, and prescriptions for, access challenges developed elsewhere?**

The dissertation answers these questions through the exploration of four themes. These are i) the use and history of a dual sanitation system (Chapter 4); ii) the socio-materialities of menstrual waste management (Chapter 5); iii) gendered operation of the water kiosk system in LIAs (Chapter 6); iv) the lived experiences of failing sanitation systems (Chapter 7).

These themes were not predefined prior to fieldwork. Rather they emerged as reaction to the interactions with research participants and the challenges I found in the ground. This was part of an underlining motivation to contribute to theory making (and policy) by starting from the everyday realities of residents (Lahown et al., 2014) that was operationalised through a research design broadly inspired in inductive methods for data collection and analysis such as Grounded and Abductive Theory (Charmaz, 2014; Glaser and Strauss, 1967; Timmermans and Tavory, 2012) (See Chapter 3 for more details).

1.5 Summary of contributions

1.5.1 Intellectual merit

This dissertation advances the understanding of the everyday challenges residents face to access water and sanitation in the context of heterogeneous and unequal infrastructural landscapes of global South cities. The dissertation reveals the multiple instances in which access to water and sanitation is challenged by failing infrastructures and the labours, practices, social relations, and technical solutions relied upon by residents to sustain access. Intellectually, this dissertation contributes to debates in infrastructures in the global South that are of importance for scholarship on water and sanitation geographies, global South urbanism, and critical development studies. More broadly, the dissertation contributes to the project of building-up urban theory more reflective of the conditions in the urban global South (cf. Lawon and Truelove, 2020, Robinson, 2015).

Firstly, this dissertation contributes to burgeoning body of work that using an everyday perspective has expanded the understanding of what urban infrastructures look like and how they work in global South and African contexts (Allen et al., 2016; Peloso and Morinville, 2014; Smiley, 2013). It does so by providing an empirically rich and detailed description of the technologies, practices, and relations that different urban residents use to ensure access to water and sanitation, as well as the dynamics of inclusion and exclusion embedded in these technologies, practices, and relations. Within this framework this

dissertation advances the notion of Heterogeneous Infrastructure Configuration (HIC) (Lawhon et al., 2018) and realises the call to examine the different sanitation infrastructures in the city in relation to each other (Lawhon et al., 2018). This is a novel approach as the majority of studies using an HIC framework have focused on describing heterogeneity and mainly considered sanitation infrastructures as individual artefacts disconnected one from another.

Second, this dissertation contributes to scholarship pointing to the limits of explanatory frameworks developed in the global North to explain global South infrastructures (Furlong 2014; Kooy and Baker 2008; Monstadt and Schramm, 2017). It does so by providing a new understanding of the logics and histories underpinning the diversity of sanitation infrastructures in Lilongwe that transcends the narrative of the failure of the modern infrastructural ideal. Specifically, this dissertation challenges previous implicit framings of coexistence of formal and informal infrastructures resulting from the absence or failure of modern infrastructure and provides a new understanding of how informal infrastructures emerge through a grounding in the analysis of local histories, contextual conceptualisations of responsibility in the provision of services, everyday practices and sanitation cultures. Furthermore, by engaging with notions of informality and hybridity, this dissertation challenges widespread imaginaries of urban sanitation that situate waterborne technologies (i.e. flush toilets, sewers) as superior to non-waterborne technologies (i.e. latrines), imply urban sanitation should evolve linearly from one technology to the other, and present sewers as a reliable, fixed and durable technology.

Third, the dissertation contributes to post-developmental critiques that have challenged development interventions for measuring local sanitation practices against global North understandings of what 'proper' and 'modern' sanitation entails (Bobel, 2019; Dombroski, 2015; Lahiri-Dutt, 2014; Rusca et al., 2017). It does so by moving beyond infrastructural ideals and developmental imaginaries of desirable practices to identify, contextualise and critically think through locally grounded solutions to situated water and sanitation challenges. This dissertation demonstrates how contextualising locally grounded solutions helps to gain a more nuanced understanding of why residents rely on these solutions even when they are externally framed as problematic. Simultaneously, it counters representations and imaginaries of global South cities as lacking resources and highly vulnerable and the characterisation of the practices of residents as backwards or wrong. By calling attention to locally grounded solutions this dissertation opens up new possibilities for redesigning water and sanitation interventions in locally attuned ways.

Fourth, this dissertation adds to feminist scholarship by examining how gender and other intersecting power relations materialise through infrastructures, (re)producing unequal urban experiences of access (Truelove, 2011; Sultana, 2020). Within this framework it specifically realises the call for more attention to the body and embodied experiences in the analysis of urban socio-ecological inequalities (Doshi, 2016) and extends the understanding of the gendered and intersectional dimensions of different types of infrastructural labours.

Fifth, the dissertation contributes debates on infrastructural failure, maintenance and repair, emphasising that infrastructural failure and breakdown are part of the everyday life and politics of sanitation infrastructures. Furthermore, the dissertation draws attention to the maintenance knowledge and practices of Lilongwe's residents and provides a more nuanced account of the logics of maintenance than that presented in most other studies on the topics.

Finally, the dissertation demonstrates the value of combining situated and feminist urban political ecologies (UPEs) and Social Practices inspired analysis of water demand (SPoWD). These two bodies of work present similarities in the conceptual and empirical understandings of water practices and a shared focus on everyday life. However, they have barely been used together in analyses of water and sanitation practices in global South cities.

1.5.2 Societal relevance

The aim of this dissertation aligns with the SDG 6 to ensure adequate, equitable, safe, and affordable access to water and sanitation for all by 2030[6]. Central to this dissertation is a critique of the use of universal technological, governance and behavioural solutions, and to the lack of engagement with the specific historical, political, and cultural dynamics that prevails in water and sanitation interventions in cities of the global South. This dissertation highlights the need for a more situated understanding of the challenges of access to water and sanitation facing global South cities such as Lilongwe to improve residents' living conditions. The dissertation argues that using the everyday experiences and practices of residents as a starting point, rather than explanations developed elsewhere, can help

[6] See https://sdgs.un.org/goals/goal6 (accessed 10th of January 2022)

increase the understanding of what is problematic, and why, from the perspectives of residents. For Lilongwe, such an approach calls attention to failing infrastructures as a major challenge to access and calls for WASH policy and practice to make visible, and account for, water and sanitation failures as well as the labours and practices required to sustain access to water and sanitation.

Specifically, this dissertation provides four important reflections for policy and practice. First, the dissertation highlights the importance of moving from the presence/absence of infrastructures as defining access to water and sanitation; rather encourages a questioning around under which conditions, and for whom, infrastructures are functional. For example, attention to the everyday experiences of Lilongwe's residents shows that even when toilets are present, these may not be temporarily functional (e.g. water shortages; see Chapter 4, latrines that are full; see Chapter 7) or they may be non-functional for specific groups of people (e.g. latrines that do not meet women's menstrual needs; see Chapter 5). Lack of functionality (maintenance, repair, design) deserves theoretical and empirical attention.

Second, the dissertation demonstrates the value of approaching global South cities as places where residents are already developing and using solutions to address their own challenges. For example, an examination of everyday practices of residents in Lilongwe shows a number of already-locally-working solutions (e.g. combined used of flush toilets and latrines; see Chapter 4 or borrowing latrines from neighbours; see Chapter 7). These already-locally-working solutions may not be perfect but should not be automatically rejected just because they do not match policy and infrastructural imaginaries and ideals (see Chapter 4 and 5). Rather, a critical examination of these solutions can help to identify whether there are elements of these strategies that can be built on or incorporated into water and sanitation interventions.

Third, this dissertation highlights the importance of paying more attention to the many types of (often gendered, invisible, and voluntary) labours that maintain the functionality of water and sanitation infrastructures. For instance, an exploration of the everydayness of Lilongwe's water and sanitation systems shows the key role played by kiosk attendants to ensure residents can get water in LIAs (see Chapter 6) or the importance of informal practices of latrine or sewer maintenance for access to sanitation (see Chapter 7). Water and sanitation policy and interventions should better account for these infrastructural labours by making them visible and providing the conditions for them to be completed in technically adequate ways, safe manners and fair terms.

Finally, the dissertation draws attention to the indirect social effects produced by failing infrastructures beyond the health and environmental implications produced by lack of access to water or unsafe management of human waste. Specifically the dissertation reveals that for Lilongwe's low-income women the failures of infrastructures intersect with social and gender power relations increasing emotional suffering (e.g. anxiety and fears); violence risks (e.g. women feared to be attacked when using outdoor latrines); unpaid labours (e.g. maintenance work); and broader discriminations (e.g. exclusion from citizenship).

1.6 Chapter outline

The reminder of the dissertation consists of a literature review chapter (Chapter 2) and an overarching methodology chapter (Chapter 3), followed by four empirical chapters (Chapter 4 to 7) that are in publication format, and finally a conclusion chapter that summarises key conceptual contributions, policy recommendations, and areas of future research.

Chapter 2 develops the theoretical underpinnings of the dissertation. The Chapter begins with a discussion of the so-called infrastructure and practice turn in social sciences, followed by an introduction to two bodies of intellectual work that have engaged, although from different disciplinary and often ontological positions, with the everyday life of water and sanitation infrastructures. These bodies of academic work are situated and feminist Urban Political Ecologies (UPEs) and SPoWD (Social Practices analyses of Water Demand). Next, the chapter presents the main intellectual contributions of a burgeoning scholarship theorising urban infrastructures from global South cities that has emerged in recent years. The next section of the chapter provides an overview of the global histories of hygiene from the role of hygiene in colonial agendas to contemporary critiques to WASH development policy. Finally, the chapter summarises the main academic gaps addressed in the dissertation.

Chapter 3 provides an overview of the research design and methodological approach used in this study which was inspired by postcolonial and feminist methodologies and underpinned by a commitment to contribute to empirically driven theory making. The chapter begins with the description of the main field study sites in Lilongwe followed by a description of research participants and an overview of the methods used for data collection. The chapter goes on to discuss the collaboration with local organisations in

Lilongwe followed by the main methodological adaptations undertaken throughout fieldwork, and a description of the data analysis process. The chapter concludes with some reflections on research ethics and on methodological limitations.

Chapter 4 is entitled: "On/Off-Network Sanitation Configurations: Local histories and current practices". The chapter investigates a context specific sanitation configuration used by some residents of Lilongwe that consists in the overlapping use of flush toilets and backyard latrines. The chapter situates this configuration within the water scarcity challenges, local infrastructural histories, everyday sanitation practices as well as urban infrastructure planning imaginaries and realities. From a conceptual perspective, the chapter advances the notion of Heterogeneous Infrastructure Configurations in two ways. First, the chapter demonstrates that there is more to the history of infrastructural heterogeneity than the history of the modern infrastructural ideal (Jaglin, 2014; Lawhon et al., 2018). Local sanitation configurations emerge not only as a response to the failure of networked service provision (e.g. water interruptions) but through local infrastructural histories, sanitation cultures and practices, and situated challenges and social relations. Second, the chapter highlights the importance of considering sanitation infrastructures relationally (Lawhon et al., 2018). As this chapter reveals in Lilongwe, residents do not rely on only flush toilets or only backyard latrines but on a configuration that include these two (and possibly other sanitation technologies). Exploring the logics behind these combinations of infrastructures sheds light on how they help residents to address different sanitation needs and challenges. From a policy and practice perspective the chapter emphasises that addressing water and sanitation challenges in global South cities requires urban actors to think beyond widely accepted infrastructural imaginaries and ideals and to pay attention to situated solutions that may be (although not perfectly) already working on the ground.

Chapter 5 is entitled "Absorbents, practices, infrastructures. Changing Menstrual Waste Landscapes". The chapter provides a practice-based account of the different strategies followed by women to handle menstrual waste in the context of changing absorbents, infrastructures, meanings, and interventions. As the chapter shows recent MHM (menstrual hygiene management) interventions have normalised new types of disposable and reusable absorbents. However these interventions have not paid enough attention to the implications related to reuse-disposal of new products and are passing on the responsibility for managing menstrual waste to women. At the same time the unequal infrastructural legacies of the city (i.e. socio-spatially segregated, masculinist) and the cultural meanings of menstruation complicate the options women have to deal with menstrual absorbents leaving 'no right'

solution for them. The chapter contributes to literature on local hygiene assemblages emphasising the importance of being cautious with the problematisation of sanitation practices within development interventions. As this chapter demonstrates menstrual waste management practices emerged and developed to serve specific purposes for women and these practices that are now framed as problematic continue to help women to meet different practical, cultural, and hygiene gendered needs. The chapter draws attention to the importance of making the needs and desires of women central to the planning of water, sanitation and solid waste interventions, infrastructures, and services.

Chapter 6 is entitled "Gender relations and infrastructural labours at the water". The chapter expands the understanding of infrastructural labours by exploring the gender and intersectional dynamics shaping the work of female kiosk attendants in LIAs. The chapter shows that the recruitment of women into this low-paid position is predicated upon the mobilisation of specific gender stereotypes that situate women as a 'natural' fit for the job. Despite work as kiosk attendant being an income opportunity for low-income women, the job also poses important challenges for them including working at night which increases their gender vulnerabilities. As the chapter shows, the low salary and flexible working hours of kiosk attendants play an important part in sustaining the 'successful' model of kiosk. Yet the challenges and concerns kiosk workers face on an everyday basis are not given much attention by water and sanitation partners. From a policy and practice perspective, the chapter draws attention to the need for a more critical consideration of the infrastructural work of women within the water kiosk system.

Chapter 7 is entitled "Living with sanitation failures: Embodied experiences of fragile infrastructures". The chapter explores the failures of two different types of infrastructures in two different parts of the city, namely the collapse of latrines in LIAs and the leaky sewers in Area 18. The chapter argues that these failures are better understood when we think about them not as isolated or coincidental events, but that failure is understood alongside the histories, everyday life, and politics of infrastructures. The chapter mobilises the concepts of infrastructural violence, labours, and citizenship to investigate different phases of the fragility of these infrastructures. Infrastructural violence points to the phase of infrastructural breakdown, infrastructural labours points to the phase of restoring the infrastructure, and infrastructural citizenship points to the phase of infrastructural transformation. By exploring these different phases and concepts the chapter shows that fragile infrastructures have different short and long-term impacts on different residents, and enrol them in maintenance activities unevenly, across the two neighbourhoods but also within them. For women in LIAs, latrines on the brink of collapsing pose a physical danger,

produce fear and anxieties, complicate women's' options to access sanitation, and requires women to engage in additional labours to maintain the infrastructures. From a policy and practice perspective the paper draws attention to importance of incorporating fragility, maintenance and repair in water and sanitation funding and interventions.

Chapter 8 reflects on the value of an exploration centred in the everyday realities and experiences of residents with water and sanitation infrastructures to extend the understanding of the challenges to access water and sanitation in Lilongwe; and of how such an approach can challenge taken-for-granted explanations of, and prescriptions for, access challenges developed elsewhere. The chapter begins reflecting on the main intellectual contributions of the empirical chapters in relation to the academic gaps identified in chapter 2. Next, the chapter presents an overall reflection around the research questions and research approach. The chapter goes on to elaborate the significance of the findings for policy and practice and provides a set recommendation for the WASH sector. Finally, the chapter concludes by identifying four avenues of future research that could build on the thesis. These include (i) access to sanitation for street traders, (ii) new dynamics in water and sanitation labours, (iii) solidarity and reciprocity in water and sanitation, (iv) and new water and sanitation imaginaries.

Chapter 2.

Water And Sanitation Infrastructures and Everyday Practices in the Urban Global South

2.1 Introduction

This chapter presents and elaborates the theoretical underpinnings of this dissertation. The selection of literatures presented in this chapter has resulted from the iterative zigzagging between theory and data through the different stages of the research project (see section 3.6) undertaken as part of my commitment to remain as inductively open as possible to insights from data from the field and to develop an empirically grounded theory making. As such, rather than providing a uniform and overarching theoretical framework, this chapter presents the various literatures that are mobilised across the four empirical papers, explains why these literatures have been selected, and how they have helped me to make sense of the multiple questions, themes and data encountered in the field. The theoretical debates presented here are more developed, and more specific research gaps identified, in the literature review sections of each of the empirical chapters.

The reminder of the chapter is structured as follows. Section 2.2 provides an introduction to the infrastructural and practices turns in social sciences that underlie the literatures used in this dissertation. Section 2.3 presents two bodies of intellectual work that have engaged, although from different disciplinary and often ontological positions, with the everyday life of water and sanitation infrastructures. These bodies of academic work are situated and feminist Urban Political Ecologies (UPEs) (2.3.1) and SPoWD (Social Practices analyses of Water Demand) (2.3.2). Section 2.4 presents specific intellectual contributions from global South scholarship to the emerging understandings of infrastructures introduced in section 2.2. The first part of the section (2.4.1) outlines the contribution from scholars working from the global South to the problematisation of the networked city ideal. Section 2.4.2 presents some of the key theoretical advancements in the conceptualisation of infrastructures from global South scholarship including the theorisation of infrastructures as heterogeneous, peopled, incremental as well as debates about informality, infrastructural citizenship and infrastructural breakdown and maintenance work. Section 2.5 provides an overview of global histories of hygiene, starting from a discussion of how colonial governments used hygiene to support agendas of segregation and disciplining of local residents (2.5.1), followed by the presentation of emergent critiques to WASH development policy and practice from postdevelopmental approaches (2.5.2). Finally, Section 2.6 takes together all these literatures and intellectual contributions to introduce the main gaps that the dissertation engages with in the empirical chapters.

2.2 The infrastructural and practices turns in social sciences

2.2.1 The infrastructural turn in social sciences

In the last 20 years urban infrastructures have become a central theme in social sciences disciplines (Addie et al., 2021; Carse, 2016). This theoretical development that is known as the infrastructural turn (Addie et al., 2021; Amin, 2014) emerged as a response to the relative lack of interest in infrastructures in academic work outside technical and managerial disciplines (McFarlane and Rutherford, 2008). As McFarlane and Rutherford argued in urban studies, infrastructures were long "relegated to an apolitical context or backdrop, as not worthy of attention, too hidden from view (physically and/or discursively), and/or as simply the purview of engineers or technocrats" (McFarlane and Rutherford, 2008 p. 364).

In urban studies the infrastructural turn meant the recognition of the central role of infrastructures in important questions for cities such as environmental sustainability and social justice, and of the bidirectional relation between the production of infrastructures and the constitution of cities (Coutard and Rutherford, 2016; McFarlane and Rutherford, 2016; Monstadt, 2009). These developments opened up an interest in urban infrastructures as an object of inquiry in itself and as an entry-point to understand urban societies (Addie et al., 2021; Amin, 2014; McFarlane and Rutherford, 2008). The infrastructural turn in urban studies drawn from disciplines such as "science and technology studies, actor–network theory and critical geography" (Addie et al., 2021 p. 11) to conceptualise urban infrastructures as socio-technical systems and to reveal the multiple ways in which infrastructures are political (Amin, 2014; Larkin, 2013; McFarlane and Rutherford, 2008)

These new developments in the understanding of infrastructures have been richly animated by the important contributions of scholarship from the global South. This scholarship has contributed to the problematisation of the modern infrastructural ideal and networked city model (see section 2.4.1 for more details) and documented the heterogeneity or hybridity of infrastructures in global South cities (Ahlers et al. 2014; Lawhon et al., 2018) and conceptualised infrastructures as peopled (Simone, 2002), incomplete (Guma, 2020), incremental (Silver, 2014) or laboured (De Coss-Corzo et al, 2019). These contributions are developed more in detail in section 2.4.2.

2.2.2 The practices turn in social sciences

Developing from the 1980s onwards, the practices turn has also influenced the evolution of many social sciences disciplines over the past two decades (Stern, 2001; Schatzki et al., 2001; Warde, 2005) including "philosophy, anthropology, organisational studies, psychology and education as well as science and technology studies" (Miettinen et al., 2009, p. 1311). The practices turn brought about a shared interest to understand the significance of practices for (theorisations of) social life within those disciplines (Schatzki et al., 2001; Stern, 2001). Common to these studies is taking people's practices as the main category or as the "point of departure" (Stern, 2008, p. 185) for empirical analysis and theorisation.

As defined by Reckwitz (2002) a practice is a "routinized type of behaviour which consists of several elements, interconnected to one other: forms of bodily activities, forms of mental activities, 'things' and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge" (Reckwitz, 2002, p. 249). As this definition points to, practices entail a complex interaction between individuals and social norms, knowledge and objects. Focusing on practices offers thus a way out of dualisms prevailing in social sciences theories such as those between subject-object and structure-agency (Miettinnen et al., 2009). Practices are a lens to see people's knowledge acting in interaction with, and not separate from, the environment or material world and to capture how "through actions, structures are both reproduced and transformed" (Miettinnen et al., 2009, p. 1313)

The practices turn has had a high purchase among scholars interested in understanding (sustainable) consumption and production (cf. Spaargaren, 2011; Warde, 2005), climate change and society (Shove, 2010), everyday life, design, infrastructure and materiality (cf. Evans, 2020; Shove et al., 2007). Further this body of literature and associated scholars at the research-policy interface have used practice theory to reframe policy and practice debates around behaviour change and sustainable consumption and production (Strengers & Maller, 2015; Watson et al., 2020). Further, a body of scholarship that has importantly influenced this study is the social practice-oriented research that focuses on the dynamics of everyday practices in relation to domestic water demand (expanded further in section 2.3.2).

2.3 Everyday practices and infrastructures

Despite the importance that urban infrastructures and everyday practices have acquired in social sciences scholarship through the infrastructural and practices turns, the exploration of urban infrastructures through an everyday life perspective has only started to gain traction recently (e.g. Graham and McFarlane, 2014). This dissertation builds on two different bodies of scholarship that have recognised the value of engaging with the everyday life of water and sanitation urban infrastructures. These are situated and feminist urban political ecologies and Social Practices inspired analysis of Water Demand (SPoWD). This section introduces the main conceptual advancements of these bodies of work and how they have informed the research project.

2.3.1 Situated and feminist urban political ecologies: everyday practices and diffuse power

Situated and feminist urban political ecologies have expanded and enriched the field of UPE through a focus on everyday life as a site in which urban socio-ecological inequalities are produced. As a field, UPE is concerned with traditional framings of cities as different or opposite to nature and explores instead socio-environmental relations in urban contexts (Heynen, 2014; Keil, 2003; Zimmer, 2010). The main centre of attention of UPE has been in unravelling the politics shaping the urbanisation of nature (Heynen, 2014; Keil, 2003; Zimmer, 2010). As part of this concern UPE has explored how social, economic, cultural and political dynamics shape flows of resources in cities (i.e. how these resources are brought in, move within and are ejected out of urban territories) that in turn produce new social, ecological and material relations and conditions (Heynen et al., 2006; Keil, 2003; Monstadt, 2009). This focus on understanding how power shapes urban resource flows has situated water infrastructures and in particular urban water networks as one of the main empirical and analytical entry points for UPE studies (Connolly, 2019; Lawhon et al., 2014; Loftus, 2009). Scholarship interested in the political ecologies of urban water has demonstrated how power relations produce unequal urban waterscapes as well as how water "itself" produces relations of power (Loftus, 2009 p. 954) through the investigation of the commodification and privatisation of urban water services (e.g. Bakker, 2003b; Loftus and McDonald, 2001; Swyngedouw et al., 2002) or the role of hydraulic infrastructures in the propagation of nation-state or modernity projects (e.g. Gandy, 2004; Kaika, 2005; Kaika and Swyngedouw, 2000; March, 2015; Swyngedow, 2007)

Different progress reviews have identified an evolving shift in UPE scholarship (Cornea, 2019; Heynen, 2014; Zimmer, 2010) towards "more local and everyday scales of analysis, drawing on post-structuralist and post-humanist perspectives" (Cornea, 2019 p.2). This 'second wave' of UPE studies (Heynen, 2014) contrasts with and extends traditional UPE approaches that were strongly influenced by Marxist frameworks and thus focused on macro power dynamics (e.g. macro political-economy) and top-down governance actors and processes to understand socio-environmental dynamics in cities (Cornea et al., 2017; Lawhon et al, 2014; Zimmer, 2010). Lawhon et al., (2014) advocated for what they call a more situated UPE as a way to challenge the universal assumptions contained in traditional UPE studies and to engage with the diverse realities at play in different cities (and in particular African and global South cities that had been underexplored in traditional UPE studies). They criticise traditional UPE studies based on three grounds. First, they argue that these studies give primacy to capitalism or neoliberalism as explanatory frameworks for urban socio-environmental inequalities. In doing so these studies leave other power and social relations underexplored. Second, they argue these studies have overly focused on how power flows through material infrastructures and in particular through urban networks. Third, they argue that traditional UPE approaches have tended to get stuck in the critique of these processes without attempting to devise transformatory pathways (Lawhon et al., 2014).

Inspired by the work of African urbanists such as Simone (2004) and Pieterse (2008), Lawhon et al. (2014) suggest engaging with the everyday practices of residents (and of other urban actors) as the starting point for more situated theorisations of UPEs in African cities. As they argue "the base for theorisation here is the ordinary practices of city-making, including how relations are formed and stabilized, how the city is made to work to secure livelihoods and identities and how people scale themselves through their networks to access resources and opportunities" (Lawhon et al., 2014, p. 507). Focusing on these everyday practices enables a more distributed and multi-layered understanding of power that recognises that power does not only operate top-down from high scale urban actors and that there are multiple social power relations (such as gender or race) beyond capitalism and neoliberalism operating in the production of uneven cities (Lawhon et al., 2014). Furthermore, as they argue "the everyday opens up new spaces through which to derive alternatives for understanding and creating change" (Lawhon et al., 2014, p. 510).

Studies using an explicit or implicit situated UPE framework have consolidated an approach to UPE that provides a more nuanced understanding of how unequal urban conditions are produced attending to the diversity of cities and life conditions. While water

and sanitation have remained an empirical and analytical entry point to study urban inequalities, scholarship using a situated UPE approach has moved from the focus on networked systems that are often not ubiquitous or provide services to a minority in global South cities to incorporating in the analysis the diversity of technologies, everyday practices and social relations relied upon by (a majority of residents) to access water and sanitation (e.g. Alba et al., 2019; Kooy and Walter, 2019; Lawhon et al., 2018; Nakyagaba et al., 2021). This scholarship mobilises post-structuralist understanding of power that reveal the multiple power relations underpinning water and sanitation injustices and the agency of different urban actors in reproducing but also transforming unequal conditions of access (e.g. Bartels et al, 2018; Desai et al., 2014; Karpouzoglou and Zimmer, 2016; Loftus, 2007; 2016; Ranganathan, 2014; Zimmer, 2015)

A related body of UPE scholarship that has often referred to as an example of this shift towards more situated and post-structuralist approaches is feminist UPEs (Cornea, 2019; Heynen, 2014; Tzaninis et al, 2020). Feminist UPEs draw on feminist political ecology which traditionally focused on understanding how gender shapes the relations between people and their environments, and in particular the unequal patterns of access and control over environmental resources (Rocheleau et al., 1996). Inequalities in access to, and control over, urban water and more recently sanitation or wastewater flows has been an area of particular interest of feminist UPEs (see for example Adams et al. 2018; Desai et al., 2014; Harris et al., 2017; Sultana, 2020; Truelove, 2011). Feminist UPEs were concerned with the lack of ability of UPE studies of urban water which focused on macro processes such as water commodification and privatisation to explain how and why residents "who share the same neighbourhoods, lanes and even households" (Truelove, 2019b, p. 4) have unequal water and sanitation experiences. Feminist UPEs focus their attention instead on how these unequal experiences are produced through everyday practices and relations (Elmirsth, 2011; Truelove, 2011).

As scholarship in gender and water has shown, gender and other social norms and relations shape inequalities in everyday water and sanitation practices and experiences at the intra-household level. In many global South societies gender norms situate women as primarily responsible for domestic water. As a result of these norms many women bear most of the unpaid, invisible and time-consuming labour and practices required to ensure water is available for the household such as waiting long queues to collect water at wells or kiosks, carrying water buckets, negotiating with sellers, neighbours or employers or participating in water committees (Peloso & Morinville, 2014; Truelove, 2011; Velzeboer et al., 2017). The sanitation practices of women are also marked by gendered norms that limit their

mobility and emphasise privacy and decency as well as by gendered risks of sexual violence and harassment (Desai et al., 2014; O'Reilly, 2016; Panchang, 2021). As WASH research has shown some women have specific bodily and sanitation needs during for example menstruation, pregnancy, or menopause that complicate their access to sanitation (Bhakta et al., 2014; Sahoo et al, 2015).

Feminist UPEs of water and sanitation have advanced the understanding of gender inequalities in water and sanitation by using the notions of intersectionality and embodied experiences. Intersectionality refers to how gender power relations are not experienced in isolation from other social inequalities (Collins, 1991; Crenshaw, 1991). Class, race, sexual identity, religion, position in the family, age, marital status, and other identities and relations intersect to shape different women and men's experiences with water and sanitation infrastructures (Hofmann, 2017; Sultana, 2020; Truelove, 2019b). Embodied experiences refer to the notion that social power relations and inequalities are not abstract ideas but intersect with the physical dimensions of water and sanitation such as the infrastructures that mediate access, and are lived through people's different bodies (Sultana, 2020; Thompson et al., 2017; Truelove, 2011).

The use of intersectional and embodied analyses has allowed these scholars to demonstrate that gender and other relations are productive of, and produced through, unequal water and sanitation embodied experiences (Truelove, 2011). For example, in her feminist political ecology analysis of urban water inequalities in Delhi, Truelove reveals that different "women's bodies encounter differing degrees of gendered hardships, physical labour, and public shame" (Truelove, 2011, p. 147) in navigating the different sources of water in the informal settlements part of the study. In these experiences gender identities intersect with other "situated position within families, communities, and class groups in the city" (Truelove, 2011, p. 147).

At the same time these unequal embodied experiences of water and sanitation work to reproduce and reinforce broader patterns of social differentiation. When water is not available, some low-income women engage in negotiations with employers to gain access to water, which makes them more vulnerable to labour exploitation (Truelove, 2011). When public sanitation infrastructures are not easily accessible, some low-income women may see their opportunities for mobility in cities further reduced (Datta and Ahmed, 2020) or have to turn to open defecation which may reinforce broader patters of stigmatisation or discrimination (e.g. caste-based in India) (Desai et al., 2014; Truelove and O'Reilly, 2020).

Situated and feminist urban political ecologies with their critical focus on everyday life provides an interesting framework to explore how social power relations intersect to shape the different ways in which residents of Lilongwe experience water and sanitation challenges across hierarchies of gender or income standing (see chapter 4, 5 and 7). It also enables a deeper analysis of the multiple ways in which residents and other actors of the city participate in the reproduction and contestation of unjust and unsustainable sanitary conditions (see chapter 4, 5, 6 and 7). The embodied approaches advocated by feminist UPEs (Doshi, 2016; Truelove, 2011; Truelove and Ruszczyk, 2021) have been useful to reflect on the bodily experiences and practices associated to selling water at the kiosk (chapter 6) and infrastructural failure and maintenance (chapter 7).

2.3.2 Social Practices Theories: socio-materialities of water demand

A different body of work that has placed the focus of attention into the everyday practices is SPoWD (Social Practices inspired analysis of Water Demand). SPoWD is a loose corpus of scholarship derived from cultural studies, social and cultural geography, the sociology of consumption and transdisciplinary sustainability studies that draws on Social Practice Theories, or engages with ideas of social practice but not directly from a Social Practice Theories approach, to analyse the domestic use of water for cleanliness, hygiene and sanitation and other everyday activities such as gardening (e.g. Allon and Sofoulis, 2006; Browne et al., 2014; Shove, 2003; Strengers, 2011; Yates and Evans, 2016).

SPoWD approach water as a resource that is not used just per se, but it is consumed "in the course of accomplishing important and valued practices" (e.g. showering) (Hand et al., 2005, para. 6.5). Practices such as showering depend for example on cleanliness standards (meanings), whether piped warm water or soap are available (materials), and knowledge on how to get clean (competencies) (Shove, 2003). Each of these elements cannot be understood as separate elements as they are all integral to the practice of showering (Strengers, 2011). For this scholarship, the focus on everyday water-using practices has been useful to counter the dominant understanding of water demand as a separate element from water supply (Strengers, 2011); and the emphasis on individual (rational) behaviour in driving demand (Browne, 2015). In this section I discuss some of the potential strengths SPoWD offer to analyse everyday water and sanitation practices in the context of Lilongwe. These strengths refer to SPoWD attention to the cultural underpinnings of domestic water

and sanitation practices and to the emphasis of SPoWD in using research insights to incrementally shift policy spaces.

SPoWD are concerned with understanding how cultural meanings, imaginaries, norms, values, or expectations associated to water and infrastructures shape people's water and sanitation routines on everyday basis. For example, Delaney and Fam (2015) identified that the use of rainwater for domestic cleanliness practices in Australia was restricted cultural imaginaries of the 'modern home' (Kaika, 2005). For the participants in the study using grey water for domestic activities threatened the symbolic construction of the home as a safe space that is locked to the outer world (Delaney and Fam, 2015; Kaika, 2005). A different example of the cultural underpinnings shaping the use of water for cleanliness and hygiene is provided in Jack et al. (2020). Jack et al. (2020) demonstrate that cultural meanings that associate middle to upper class, and higher caste, citizens with clean or hygienic bodies in India creates conditions for escalating patterns of water demand in the middle-classes (and those who aspire to be middle-class) households and increase the marginalisation of residents who do not have access to modern infrastructures (Jack et al., 2020).

SPoWD recognise that the meanings and other cultural elements shaping water and sanitation practices are not universal but change geographically (Maller and Strengers, 2013; Waitt and Welland, 2017) and over time (Hand et al., 2005). Examples of geographical variation in cultural values that shape how people use water is provided in Maller and Strengers's (2013) study of the changing practices of migrants in Australia. They describe how water practices of migrants from Southeast Asia to Australia were partially shaped by the dominant culture that valued not wasting limited resources in their countries of origin. In relation to temporal changes in cultures shaping water and sanitation practices, Hand et al. (2005) for example described the historical evolution of the meanings of personal cleanliness in Britain (e.g. changes in meanings of cleanliness as body regeneration to self-presentation) and how those meanings have changed cleanliness practices over time (e.g. from bathing to showering).

This focus on cultural aspects of SPoWD resonates with anthropological literature on WASH that has revealed the cultural dimensions of water and sanitation practices in different societies of the global South. The WASH scholarship has described different cultural attitudes towards faecal matter that define how human excreta can or cannot be disposed, spiritual notions of water (e.g. divine) that guide how it is to be used, social norms that shape water sharing practices or taboos and beliefs that influence menstrual practices

(Akpabio, 2012; Akpabio and Takara, 2014; Jewitt, 2011; van der Geest, 1998; Wutich et al., 2018). However, SPoWD are distinctive from this WASH anthropological literature in that they understand cultural elements not as a separate element but interrelated and co-constituted with the material elements of water and sanitation systems such as resources, technologies, or infrastructures (Shove, 2003). For example, within SPoWD why and how frequently one bathes or showers, varies based on the material infrastructures and resources that are available (e.g. is there uninterrupted supply of hot water, soap) but also on non-material elements such as the cultural meanings of bodily washing (e.g. whether one washes the body to look clean or for relaxation), and temporal rhythms of society and everyday life (Hand et al., 2005; Shove, 2003).

Furthermore, SPoWD like its application in the wider research on sustainable consumption and production, has a focus on using theory, analytical and empirical insights to influence policy and practice to assist society in shifting to more 'sustainable futures' (cf Browne et al., 2015; Watson et al., 2020). In proposing policy and practice interventions, SPoWD emphasise the distributed nature of water and sanitation challenges and seeks to generate incremental change (cf Browne et al., 2015; Watson et al., 2020). This distributed framework for example situates water demand as produced at the intersection of a complex socio-material system that encompasses "bodies, households, public spaces, water infrastructures, designers and manufacturers, beauty care industries, and regulatory systems; and what we do with these things, social and cultural images, and how it shapes the services water provides (family care, lifestyle, cleanliness and hygiene, health, comfort etc.)" (Browne et al., 2015 p. 13). In following a distributed framework SPoWD call for policy and industry interventions that go beyond traditional attempts to solve water and sanitation challenges through either the provision of technologies or through modifying individual 'problematic' behaviours (Hoolohan and Browne, 2018; Browne et al., 2015). SPoWD argue that distributed challenges require the problematisation, revaluation and redesign of the whole socio-material water and sanitation system and the (concerted) action of a wide range of actors involved (e.g. from water utilities to toiletry producers) (Alda-Vidal et al., 2021; Hoolohan and Browne, 2020; Strengers et al., 2015).

SPoWD have also called into question the professional practices of those within this distributed network of agents influencing water demand, calling for further interrogation of the professional practices that bring forth in imagination, maintain and replicate particular socio-technical imaginaries for 'users' within water systems (cf. Hoolohan & Browne, 2018; Sofoulis, 2011). For example, these scholars have shown that prevalent large-scale supply-driven water sector policies and interventions also contribute to create

and lock-in abundant-resource-seeking practices and users (Allon & Sofoulis, 2006; Kadibadiba et al., 2018; Strengers & Maller, 2012). Through a focus on the everyday practices of using water at the household, this scholarship has demonstrated people's capacities to adapt (and also adapt their domestic water infrastructures) to resource disruptions such as water shortages and advocated for water policies and interventions to recognise and embrace these capacities (Allon & Sofoulis, 2006; Kadibadiba et al., 2018; Strengers & Maller, 2012).

SPoWD have been useful in exploring the water and sanitation challenges of Lilongwe in three ways. First, SPoWD have allowed me to recognise the cultural underpinnings shaping different water and sanitation practices (e.g. meanings of menstruation in Chapter 5 or the cultural norms influencing the use of backyard latrines Chapter 4) and to understand these cultural elements not as external to water and sanitation systems but co-dependent with them. Second SPoWD have been helpful to reframe the challenge of menstrual waste as one of distributed nature and not the result of individual decisions or the outcome of inadequate technologies (Chapter 5) and to draw attention to the everyday water resilience practices of Lilongwe's residents (Chapter 4 and 5). Furthermore, by combining insights from SPoWD and situated and feminist UPEs (which rarely speak or cross-cite each other) I have been able to provide a set of reflections on the potential links between these different bodies of work (see section 2.6.6 and 8.2.6).

2.4 Theorising infrastructures from the global South

This section presents the main intellectual engagements of a burgeoning scholarship theorising urban infrastructures from global South cities that has emerged in the past fifteen years or so. This scholarship has contributed to produce descriptions and conceptualisations of infrastructures more reflective of the specific urban process and conditions at play in global South cities and contributed to problematise the universality of theorisations of infrastructures developed based on global North urban experiences. These concepts and intellectual advancements outlined in sections 2.4.1 and 2.4.2 have informed my understanding of water and sanitation infrastructures in Lilongwe and have been applied in different ways to analyse the data presented in chapters 4-7.

2.4.1 Cities in the global South: Beyond the modern infrastructural ideal

Scholars have documented the processes through which the modern infrastructural ideal (Graham and Marvin, 2001) — a model that entailed the integration and connection of urban spaces through the construction of large scale, centralised, and publicly regulated infrastructures such as municipal water supply and sewerage networks, became a standard of reference for metropolis across the globe (Coutard and Rutherford, 2015; Gandy, 2004; Graham and Marvin, 2001; Kaika and Swyngedow, 2000).

The important transformations undergone in global North societies since the end of the Nineteenth Century including advances in public health, new urbanism conceptualisations, emerging cleanliness conventions, changing notions of the water users to consumers, and increasing patterns of water consumption amongst other issues propelled the roll out of large-scale water and sewage networks in cities such as a Paris, London and New York (Benidickson, 2007; Gandy, 1999; Kaika and Swyngedow, 2000; Morales, 2016; Trentmann & Taylor, 2006). Soon these networked infrastructures started to proliferate in most Western European and North American cities and became inextricably linked with ideals of urban citizenship, progress and modernity (Graham and Marvin, 2001; Kaika and Swyngedow, 2000).

As networks of water pipes and sewer lines were constructed underneath the ground of global North cities over the first half of the twentieth century, infrastructures became invisible physically and symbolically (Kaika and Swyngedow, 2000). These infrastructures were hidden to the sight of urban residents and the services they provided started to be normalised and taken for granted (Kaika and Swyngedow, 2000). As Graham (2000 p. 184) describes this process created an imaginary of networked infrastructures as "unproblematic and 'closed' sociotechnical artefacts that could be relied on without much thought".

Over decades, the lack of critical engagements from an intellectual point of view with the modern infrastructural ideal contributed to the hegemony of the model. However, it was with the critical gaze of the infrastructural turn in social sciences (see section 2.2) and specifically the seminal work of Graham and Marvin (2001) that the networked city started to be problematised in global North and South contexts revealing that the modern city ideal had been and continued to be more "a deeply symbolic construction than a tangible, achievable [or even achieved] reality" (Graham, 2000 p. 185).

An important body problematising the networked city model has come from scholars working from the global South (e.g., Bakker 2003a; Kooy & Bakker, 2008, McFarlane,

2008). Building on the southern urban critique (see section 1.2), social sciences scholars engaged with urban infrastructures have questioned the significance of the modern infrastructural ideal to explain the development of infrastructures or to measure access to urban services such as water and sanitation in global South cities. As this scholarship has shown the networked city ideal was exported to global South countries as part of colonial projects. In many of the major colonial urban centres water and sewer networks were planned following the principles of the modern infrastructural ideal and western design styles and standards (Gandy, 2004; McFarlane, 2008; Monstadt and Schramm, 2017; Nilsson, 2006) without paying attention to local suitability (Nilsson, 2006). However, the ideal of universal access was never really fully pursued (Kooy & Bakker, 2008). Where constructed, networked water and sewerage systems were only meant to provide for white colonial residents and local elites and colonial governments decided to leave a majority of (often poor) urban residents to fend for themselves (Gandy, 2008; Kooy & Bakker, 2008; McFarlane, 2008). As the scholarship summarised in the section 2.4.2, most global South cities present infrastructural landscapes that are heterogeneous and unequal with a wide range of technologies providing different levels of service to different residents (Ahlers et al., 2014; Alba and Bruns, 2021; Alba et al. 2019; Silver, 2014). These infrastructures do not conform with the ideal of invisibility or reliability implicit in the imaginary of the networked city as they are often characterised by interruption and breakdown (Silver, 2016; Ramakrishnan et al, 2020).

Even if the networked city ideal was never achieved in global South cities this model has still been "politically and ideologically powerful" (Coutard and Rutherford, 2015 p.5) and has left important legacies. As Lawhon et al. (2018, p. 4) argue "the normative ideal of homogeneity and centralism continues to significantly shape the way residents, planners, governments and academics think about infrastructure". The modern infrastructural ideal has not only shaped the type of infrastructures that have been constructed in global South cities by privileging investments in networked infrastructures and restricting the options in contexts where diversity of infrastructures was the norm (Jaglin 2008; Monstadt and Schramm, 2015) but also limited the imaginaries of what is "possible and desirable" to a single model (Lawhon et al., 2018, p. 4).

In Lilongwe as in many other cities the networked city ideal has shaped the type of public infrastructures that have been constructed in the planned areas the city and still shape how governmental actors think a modern city should look like. However, the problematisations of the ideal described in the paragraphs above help to open the eyes to different

infrastructural histories and configurations that have nothing to do with this model (see Chapter 4).

2.4.2 Key concepts from global South scholarship on urban infrastructures

Heterogeneous infrastructure configurations

In line with the recognition that the modern networked city ideal has never been a reality in global South cities, and does not explain how residents access water and sanitation in these cities, in the past few decades there has been a prolific body of scholarship committed to provide a more accurate description of infrastructures in these cities. This scholarship has often engaged with the differentiated history of infrastructures of the global South and taken an everyday perspective to explore and explain "what is there and how it works – or how and for whom it fails to work" (Lawhon et al., 2018 p. 3).

This scholarship has produced a detailed documentation of the variety of formal and informal infrastructures existing beyond or coexisting alongside water and sewer networks and providing different levels of access in global South cities. In cities such as Mumbai, Maputo, Accra or Kampala water and sanitation municipal networks have low coverage. In these cities, the residents tend to rely on, and often combine, a range of other water provision modalities (including private boreholes, tankers, neighbours selling water or community based systems among others; Alba et al., 2019; Schwartz, et al., 2015; Velzeboer et al., 2017) and sanitation solutions (from defecating in a plastic bag to borrowing a flush toilet from an employer or using a communal latrine block; McFarlane et al., 2014; Terreni Brown, 2014). Rather than the homogeneity and uniformity defining the modern infrastructural ideal, coexistence, heterogeneity and diversity are better descriptors for the water and sanitation infrastructural landscapes of global South cities (Alhers et al., 2014; Jaglin, 2014; McFarlane, 2014; Lawhon et al., 2018).

The concept HIC (Heterogeneous Infrastructure Configurations) was developed by Lawhon et al. (2018) as an analytical tool to examine the diverse and coexisting infrastructures of global South cities. Lawhon et al. (2018) call to explore these diverse and coexisting infrastructures in global South cities not in isolation from each other but as part of a wider whole socio-technical configuration that involves "many different technologies, relations, capacities and operations, entailing different risks and power relations" (Lawhon

et al., 2018, p. 722). Using HIC as an analytical device entails examining the different options to access water and sanitation infrastructures that a resident from a low-income neighbourhood may have, and enables an exploration of under which conditions these different options may reduce risks and open conditions of possibility (Lawhon et al., 2014). As they present it, HIC is a device to explore the opportunities that infrastructural diversity may provide to imagine and construct more just and sustainable urban futures starting from what is already working (at least partially, or temporarily) for residents (Lawhon et al., 2018).

In this dissertation the concept HIC helps to trace the diversity of infrastructures that are available to different residents of Lilongwe from the women who use various type of sanitation technologies for menstrual waste disposal (Chapter 5) to the yard-latrines that provide access to sanitation to high-income residents in planned areas but also temporarily to domestic workers coming from LIAs, street vendors or visitors from rural areas (Chapter 7). HIC also inspires the analysis of these different infrastructures in relation to each other and the social relations that shape for whom they are available and when.

Informality and infrastructures

An important theme in this scholarship has been the relations between, and challenges in, governing formal and informal water and sanitation infrastructures (Ahlers et al. 2014; Allen et al., 2016; Ranganathan, 2014). As it has been widely recognised "so-called informal provision has historically, and continues to be, the form through which a large percentage (sometimes the majority) of urban residents in the South secure water" (Kooy, 2014, p.36). Examples of informal modes of water and sanitation provision in global South cities includes different type of small-scale water vendors (Alba et al., 2019; Schwartz et al. 2015), non-authorised latrine emptiers (Mallory et al., 2021) and also the use of illegal connections to the water or sewer system (Anand 2017; Ashipala and Armitage, 2011).

Inspired in postcolonial scholarship challenging formality/informality binaries (Roy, 2009; Yiftachel, 2009) scholars have shown that these informal infrastructures and practices do not operate in separate spheres to formal ones (Cheng, 2014; Kooy, 2014; Schwartz et al., 2015) and are not exclusive of unplanned, marginalised or non-networked spaces of the city (Anand, 2011; Hossain, 2011; Truelove, 2019a). These conceptualisations challenged the traditional framing of informal modes of water provisioning present in water literature

from a policy and practice perspective (e.g. World Bank, 2003). For example, Hossain (2011) describes the informal but institutionalised practices within the municipal water utility and the implications they have in producing unequal access. Truelove found that in a middle class authorised neighbourhood with access to the municipal water supply of Delhi, the use of illegal technologies such as water booster pumps, enlarged pipes, and tube wells bypassing the water system was rampant among residents who could afford them (Truelove, 2019a).

These ideas around formality and informality have been instrumental in identifying the existence of informal technologies and practices within the formal infrastructures and planned areas of Lilongwe (see chapter 4 and 7).

People as infrastructures

Following the academic move that has conceptualised infrastructures as socio-technical devices, scholars from the global South have looked not only at the material technologies that residents use to access water and sanitation but also to a range of practices and relations that enable access. Notions of people as infrastructure as coined by Simone (2004b) have been crucial to this development. In people as infrastructures Simone suggests moving from a focus on the physical elements of infrastructures "to people's activities in the city" (Simone, 2004b p.407). As Simone and others following him have argued, in global South contexts people's connections and relations constitute the "the central means through which materials flow in many cities" (Lawhon et al., 2014, p. 507).

Focusing on people as infrastructures reveals the social infrastructures that enable access to water and sanitation in the conditions of precarity, marginalisation and absence of state provided infrastructures of many global South low-income neighbourhoods (McFarlane and Silver, 2017a; Simone, 2004b). Studies on access to water and sanitation using notions of people as infrastructure have revealed the social relations that residents build on to secure access to water or toilets (e.g., Desai et al., 2017; Peloso and Morinville, 2014; Velzeboer et al. 2017). These includes borrowing water from neighbours, using connection with NGOs or churches to access a toilet, relying on informal plumbers to get an illegal connection to the sewer or water lines, using political connections to ensure a water kiosk is built close to one's living space among many other examples (Peloso and Morinville, 2014; Velzeboer et al. 2017). Using notions of people as infrastructures demonstrates that

water and sanitation infrastructures are deeply embedded in urban social relations (Lawhon et al., 2018, McFarlane and Silver, 2017a; Simone, 2004b).

This notion of people as infrastructures resonates with the contributions made by contemporary ethnographies of water and sanitation networks that have revealed the role of a wide range of everyday actors such as local politicians, bureaucrats, engineers, formal and informal plumbers, water vendors in shaping flows of water in cities (Anand, 2012; 2017, Björkman, 2014; Cohelo, 2004). As Anand (2017) shows in his ethnography of the water network of Mumbai, ensuring water flows into taps requires to engage not only with the hydraulic infrastructure but also "pressure these actors to make water flow to them" (Anand, 2017, p. 20).

In the context of Lilongwe, notions of people as infrastructures are useful to understand the social infrastructures used by residents in both planned areas of the city and LIAs to recover access to sanitation after the breakdown of infrastructures and shape the possibilities for civic action to fight against the government and services providers neglect of their respective neighbourhoods (See chapter 7). Using notions of people as infrastructures to examine the water and sanitation landscape also draws attention to the often ignored activities of female kiosk attendants (see chapter 5) and residents and sanitation workers' (see chapter 7) which are of exceptional importance for water to reach low income dwellers and for faecal matter to remain out of sight.

Incremental, incomplete, hybrid infrastructures

As opposed to the traditional conceptualisation of infrastructures, and in particular large-scale networks as stable, fixed or static systems (Hommels, 2005), scholars working from the global South have contributed to new understandings of infrastructures as incremental, incomplete, or always in-the-making to emphasise the malleability of infrastructures and how often they change through people's (frequently improvised) interactions with them (Baptista 2018; Guma 2020; Silva-Novoa Sanchez et al., 2019; Silver, 2014). Silver (2014) described how residents of informal settlement of Accra draw on improvisation and social collaboration to make incremental informal adjustments to infrastructures such as the electricity network and dwellings as a way to secure energy and living spaces. He argues incremental infrastructures, defined as "undergoing constant adjustment and intervention, and in a permanent state of flux" (p. 788), are the norm in global South cities. Baptista also

argues that "formal' infrastructures are as much 'precarious' or 'provisional' as 'informal' infrastructures" (Baptista, 2018, p. 12). She describes the electricity network of Maputo as always-in-the-making as it requires the constant engagement with the informal dynamics of the city to ensure the service keeps going (Baptista, 2018). Guma (2020) argues against lineal conceptualisations that assume infrastructures follow a progressive trajectory towards a predetermined outcome. Building on ideas of infrastructures as always emerging and shifting he demonstrates using incompleteness not as a pejorative term but as lens to explore the transition of mobile telephone infrastructures (from kiosks to stalls to ATMs) in Nairobi builds an understanding of the transiency, continuity and contingency of these infrastructures (Guma, 2020).

In referring to this malleability and openness to change of infrastructures, a concept that is useful in this thesis is that of hybridity. Hybridity has often been used to refer to the coexistence of formal and informal infrastructures in cities such as for example the coexistence of networked water infrastructures with other informal sources and systems of water supply (Jaglin, 2014). These hybrid systems have been mainly explored at the citywide and urban governance scale giving the impression that formal and informal systems coexist at city level but not household scale (see for example Allen et al., 2016; Jaglin, 2014; Monstadt and Schramm, 2015). An area that has been less explored in the literature on hybrid infrastructures has been how and why residents hybridise (or combine) infrastructures at household level and in particular how this is done for sanitation infrastructures. As scholars have shown in many global South cities residents supplement the formal piped water service with other solutions such as storage tanks, rain water collection systems, suction pumps, or bottled water (Button, 2017; Furlong, 2014; Nganyanyuka et al., 2014; Smiley, 2013). The choice to combine or hybridise water infrastructures goes beyond circumventing technical challenges such as water shortages in the network, but it also done for other reasons such as to maintain independence from state and service providers or reduce household expenditure in water (Furlong, 2014; Guma et al., 2019; Meehan, 2014).

Notions of incremental, incomplete, and hybrid infrastructures are mobilised in the dissertation to explore how and why residents of Lilongwe construct and maintain their sanitation infrastructures in ways that do not conform with the imaginaries of urban planners and water and sanitation actors (see chapter 4 and 7).

Infrastructural violence

Rodgers and O'Neill coined the term passive infrastructural violence to refer to the "socially harmful effects derived from infrastructure's limitations and omissions rather than its direct consequences" and distinguish it from the "active infrastructural violence that implies intent" (pg. 407). Rodgers and O'Neill and others who have used the concept have connected the denial from access to infrastructure to notions of slow (Nixon, 2011) or structural (Galtung, 1969) violence. In this way these authors highlighted that the lack of, or presence of poor-quality infrastructures "harm people by preventing them from meeting their basic needs" (Galtung, 1969, p. 180), the effects of the denial of access to urban infrastructures may not be obvious but work silently and repeatedly (Nixon, 2011). Notions of infrastructural violence have been mobilised to explore how in global South cities, the persistent denial of access to water and sanitation builds on multiple wider inequalities and discriminations (Datta and Ahmed, 2020; Desai, 2018; Mustafa et al., 2019; Rodgers and O'Neill, 2012; Truelove and O'Reilly, 2020).

For example, Desai (2018) uses the notion of infrastructural violence to explore the unjust policies for provision of water adopted in public housing sites constructed for low-income re-settled residents in Ahmedabad, India. She founds that despite water supply infrastructures were not designed to cause harm, the inadequate infrastructures produce "everyday deprivations, burdens, inequities, tensions and conflicts in residents' lives" (p. 89). This form of passive violence builds on the social disruption and vulnerabilities produced in first place by the urban resettlement projects that have dispossessed low-income residents from the ability to co-produce adequate water infrastructures as other residents of the city do (Desai, 2018). Other scholars have begun to explore the gendered dimensions of infrastructural violence related to water and sanitation (Datta and Ahmed, 2020; Truelove and O'Reilly, 2020; Truelove and Ruszczyk, 2021). Examples of these types of gendered slow infrastructural violence are "the long-term, chronic physical and emotional tolls associated with finding and transporting resources like water, as well as lost life and income opportunities that can result for time devoted to the everyday labour surrounding infrastructure" (Truelove and Ruszczyk, 2021 p. 8) suffered by the gendered bodies that substitute urban infrastructures.

Infrastructural citizenship

As these scholars have shown, infrastructures in global South cities are closely connected to constructions and experiences of urban citizenship (Anand, 2017; Lemanski, 2020; Rodina and Harris, 2016; Sultana 2020). The concept of infrastructural citizenship has been used to describe how state-citizen relations are mediated through material infrastructures (Lemanski 2020). Studies have shown that ideas around who is considered permanent citizens and who is seen as temporary dwellers or not belonging to the city are materialised in state's decisions to provide or deny infrastructures to specific groups of urban residents. For example, in cities such as Lilongwe or Cape Town, informal neighbourhoods have historically been denied public water and sanitation infrastructures on the grounds that these neighbourhoods and their residents had a temporary status (see Chapter 6 for Lilongwe and McFarlane and Silver, 2017b or Robins, 2014 for Cape Town).

More recently scholars have explored how citizenship identities are also experienced not only in relation to presence/absence but also in everyday encounters with infrastructures (Lemanski, 2020; Rodina and Harris, 2016). Infrastructural citizenship experiences and identities change in time and in relation to evolving interpretations of responsibilities in the provision and maintenance of infrastructures (Lemanski, 2020; Rodina and Harris, 2016). For example, Rodina and Harris (2016) show how the formalisation project carried out in Khayelitsha (an informal township in Cape Town, South Africa) resulted in narratives of the state as service provider and of compliance with their perceived responsibility to pay and conserve water as urban citizens among those residents who had been granted public housing.

As Sultana (2020) argues "claims to public water provision are thus both about citizenship as a form of recognition as well as claims to the material benefits that flow to citizens" (p. 5). Scholars have examined the different type of practices residents engage in to negotiate rights and responsibilities over infrastructures and to assert citizenship. This includes vandalising water and sanitation infrastructures, engaging in protests over services, participating in community structures for decision making, paying for water as a way to secure land tenure and thus ensuring citizen rights, or adapting public infrastructure to reassert citizen rights as homeowners (Lemanski, 2020; Ranganathan 2014; Wamuchiru, 2017; Wiltgen Georgi et al., 2021). Feminist scholars have shown that infrastructural citizenship experiences and practices are intersectional and gendered (Sultana, 2020; Wiltgen Georgi et al., 2021). Sultana (2020) shows that while women in low-income neighbourhoods of Dhaka have to engage in collective action such as participating in

community-based organisations to see their right to water recognised, the engagements of wealthier women with the state to access this right is much less laborious and limited to paying water bills (Sultana, 2020).

In Lilongwe, notions of infrastructural citizenship are useful to identify the different perceptions of responsibility over the provision of sanitation services residents of LIAs and planned areas have and the uneven paths residents from these different neighbourhoods have available to them to attempt transformative change in their sanitation conditions (see chapter 7).

Failure, maintenance, and infrastructural labours

As part of the debunking of traditional conceptualisations of infrastructures and networks that emphasised reliability and taken-for-grantedness of resource services there has been an increasing interest in, and engagement with, both infrastructural decay and break down as well as maintenance and repair (Graham and Thrift, 2007; Mattern, 2018; Jackson 2014). Infrastructural breakdown and decay are not exceptions but part of the everyday life of infrastructures (Graham and Thrift, 2007) and as Carse (2014) argues "without maintenance, infrastructures crack, rust, and crumble and the political projects, promises, and aspirations that they carried dissipate" (p. 219).

Scholars working from the global South have shown that infrastructural work including that of maintenance and repair is crucial to sustaining urban services. In water, this infrastructural work includes the activities of water network experts such as engineers and plumbers who incessantly open and close valves or mend leakages (Alda-Vidal et al., 2018; Anand, 2017; Bjorkman, 2018; De Coss-Corzo, 2020). This infrastructural work often relies on the unpaid labour of (often female) residents who engage in a myriad of practices to compensate for the failures of water systems such as turning on and off booster pumps or finding alternative sources of water (Truelove, 2019a). In global South cities "the fact that urban life is the result of continuous efforts of improvisation and repair is too overwhelming and visible to be ignored" (Graham and Thrift, 2007, p. 11).

However, infrastructural work and the people who perform it are often rendered invisible, with the importance and value of this work underestimated and belittled (Anand 2020; Fredericks, 2014; Mattern, 2018). Examples of how infrastructural work and workers are devalued are particularly vibrantly descried in the work of Fredericks and Anand. Fredericks (2014; 2020) describes how the urban waste disposal system in Dakar has

increasingly become a labour-intensive system in a context of austerity and draws on the voluntary work of specific groups of residents such as youth and women producing "invisible burdens of stigma and disease" in these groups (p. 533). Anand (2020) argues that in Mumbai's water system, the devaluation of the lives and work of the operators who maintain the system is possible in part because their activities are placed beyond sight.

Common across these studies is the recognition of infrastructural repair and maintenance as political practices (Barnes, 2017). Some scholars such as Barnes have shown that maintenance and repair practices are not only about fixing infrastructures and restoring flows, but that maintenance and repair can contribute to the reproduction of social power and order. Barnes (2017) examined maintenance decisions and practices in an irrigation system in Egypt showing that through these decisions and practices the "relations of power between state engineers and farmers and between more and less influential farmers are negotiated and, in turn, reinforced" (Barnes, 2017 p. 150). Other scholars have emphasised maintenance and repair as practices of care and that can be politically transformative (Bhan, 2019; Mattern, 2018; Millington, 2019).

Starting from a framework that highlights infrastructural breakdown and maintenance rather than reliability and taken-for-grantedness in Lilongwe, raises attention to the multiple ways in which the breakdown of infrastructures is part of the everyday life and politics of the city (chapter 7) and to the laborious but invisible human activities that enable the functioning of water and sanitation systems in both planned areas and LIAs (see chapter 6 and 7).

2.5 Global histories of water, sanitation and hygiene

This section provides an overview of global histories of hygiene from the role of hygiene in colonial agendas to contemporary critiques to WASH development policy.

2.5.1 Colonial sanitary histories

Scholars have documented how sanitation and hygiene were important areas of focus of colonial and civilising missions and used to support colonial agendas of segregation and disciplining of poor, local dwellers (Anderson, 1995; Burke, 1996; Gandy, 2008;

McFarlane, 2008; Morales, 2015). As Biza et al. (2021) argue "by conferring the authority to determine and assesses what and who was clean and hygienic on some privileged experts, sanitation became part of systems of governmental rule and power" (Biza et al. 2021, p. 3).

As Burke (1996) describes in his study of colonial and postcolonial cleanliness in Zimbabwe, the first white settlers in Africa considered the hygiene practices and standards that emerged in west European countries in the nineteenth century the epitome of civilisation. The lack of compliance with these practices and standards was used to classify African residents who were being colonised as dirty and uncivilised. Similar stories are found across colonial settlements in colonial Indonesia, Philipines, India, Mozambique, or South Africa where the perceived unsanitary practices of residents were used to emphasise difference between colonisers and those being coloniased and to construct racialised subjects (Anderson, 1995; Biza et al., 2021; Kooy and Bakker, 2008).

The alleged sanitary differences between colonisers and those being colonised were reinforced by the discriminatory policies and practices of colonialisers. For example, local Indigenous populations who were being colonised were often excluded from water and sanitation infrastructures, and often allocated to (peri)urban spaces where environmental conditions encouraged the spread of diseases (e.g. swampy areas) which in turn boosted further associations of these populations with so-called unsanitary practices and epidemics (Biza et al., 2021; Kooy and Bakker, 2008). For example, Kooy and Bakker (2008) described how in colonial Jakarta colonised residents were excluded from water and sanitation infrastructures based on the racist perception that they were "less modern" than white colonisers and thus they had "less need" for it (2008, p. 381). At the same time these residents were characterised as unhygienic and blamed for cholera and typhoid epidemics for using canals for bathing or drinking (Kooy and Bakker, 2008). These racists tropes that associated those being colonised with dirtiness and disease were used to justify racial segregation in many colonial cities. One of the most excruciating examples is provided by Swanson (1977) who demonstrated that the association of black South Africans with contagious diseases, in this case the Bubonic plague in colonial Cape Town, catalysed the creation of Apartheid. However, the implementation of policies that implied the confinement of local residents to specific spaces and controlled their mobility, allegedly to stop the spread of diseases, were common across colonial cities (Burke, 1996; McFarlane, 2008).

Health education programs became a strong element of the civilising mission of many colonial governments (Anderson, 1995; Burke, 1993). Armies of community health promoters and inspectors were sent to educate the locals in, and to police often using undignified or violent means, the adoption of 'proper' domestic hygiene practices, resulting in the progressive erasure of precolonial hygienic and sanitary practices (Burke, 1993). Many of these colonial health and hygiene projects were charged with gendered meanings and sought to actively engage local women and to propagate western ideals of femininity, morality and domesticity (Burke, 1993; Obrist, 2004). Women "became seen as main producers and reproducers of household health" (Obrist, 2004 p. 45) which increased their responsibilities and labours (Burke, 1993; Obrist, 2004).

Paying attention to colonial sanitary histories has been useful to begin to identify how the practices and meanings introduced by colonial sanitary projects have shaped the infrastructural landscape of Lilongwe (chapters 4-7) and permeated into current WASH policy and practice (see chapter 4, 5 and 7).

2.5.2 Postdevelopmental WASH futures

More recently scholars have criticised the discourses and practices of WASH interventions for reproducing these colonial histories of hygiene (e.g. Dombroski, 2015; Engel and Susilo, 2014; Toner, 2019) These critiques draw on critical development and postdevelopmental scholarship (e.g. Escobar, 1994; Ferguson, 1990, Sachs, 1997) that have "taken issue with the instances where development is portrayed as a one-way process, where the visions of development in the self-identified 'developed world' are imposed (however altruistically or unintentionally) through various mechanisms of power on 'undeveloped' peoples and places" (Dombroski, 2015 p. 3).

Dombroski (2015) mobilises a critique that WASH discourses tend to measure the sanitary practices of beneficiaries against western notions and habits, classifying those who do not comply with these notions and habits "in a category marked 'other', 'lacking' or 'wrong'" (Dombroski, 2015, p. 2). In doing so WASH discourses and interventions disregard and erase a variety of socially embedded practices and knowledges that have traditionally help to sustain hygiene locally or that are important to people (Dombroski, 2015; Lahiri-Dutt, 2014; Rusca et al., 2017). This is the case in Xining in China some residents may not use private toilets but rely on a number of local strategies to ensure hygiene (Dombroski, 2015) or Lilongwe, where NGOs focus on hand-washing disregards that "residents and women

in particular do a lot to keep themselves, their families and households clean under adverse conditions" (Rusca et al., 2017, p. 15). Others have criticised the tendency of WASH discourses and practices to responsibilise and moralise poor residents for their unhygienic practices without engaging with the social and political factors producing unsanitary living conditions in ways that resemble colonial practices (Engels and Susilo, 2014, Kotsila, 2017; Obrist, 2004).

An element of WASH in which authors have specifically criticised these dynamics is menstrual hygiene management (MHM; Bobel, 2019; Joshi et al., 2015; Lahiri-Dutt, 2014). As these scholars have pointed in MHM, local menstrual meanings and practices are often framed as problematic based on preconceived ideas of what constitute hygienic or appropriate ways of dealing with (e.g. using commercial absorbents) or understanding menstruation (e.g. biological condition) (Bobel, 2019; Joshi et al., 2015; Lahiri-Dutt, 2014). MHM has a fixation with saving global South women from practices such as using rags as menstrual absorbents (Bobel, 2019) or substituting local cultural meanings of menstruation (e.g. related to belonging to a feminine community or sexuality) with medicalised ones (Joshi et al., 2015; Lahiri-Dutt, 2014). In focusing on these elements MHM loses the opportunity to engage with the dynamics that produce (managing) menstruation as a negative or problematic experience in first place: "the forces that create the poverty, the neocolonial legacies, the sexist, classist, racial standards that circulate globally and collectively create girl's menstrual realities" (Bobel, 2019 p. 193).

Insights from these postdevelopmental critiques to WASH discourses and practices have been used in the dissertation to enable a different understanding, and a reframing, of some water, sanitation and hygiene practices of Lilongwe's residents. These ideas are used to situate the practices of dealing with menstrual waste that are not considered acceptable from an environmental point of view in the context of ongoing normalisation of new types of disposable and reusable absorbents and the masculinist understandings shaping Lilongwe's infrastructural legacies and futures (Chapter 5). These insights have also been used to explore sanitation solutions that do not match the imaginary of modern networked sanitation but still are relied upon by residents (Chapter 4).

2.6 Summary of the main intellectual gaps addressed in this dissertation

In this section I summarise the main intellectual gaps that are addressed in the dissertation. Each of these points are further justified and elaborated in Chapters 4 to 7 and in the conclusions chapter (8).

2.6.1 Informality and hybridity

A significant gap in the literature relates to the lack of explorations of informality and hybridity at the domestic scale (see section 2.4.2) and beyond informal or non-networked spaces of the city (Chapter 4). Most of the work exploring water and sanitation infrastructures in global South cities with an everyday approach has focused on infrastructures for water supply (e.g. Peloso and Morinville, 2014; Nganyanyuka et al., 2014; Smiley, 2013). The few studies that have explored everyday sanitation have focused on the examination of how residents access to sanitation in informal neighbourhoods where waterborne sanitation solutions are not the norm. These studies have documented a wide range of coexisting often informal strategies and technologies that provide a solution to the sanitation problem of residents. These includes from defecating in the open, flying toilets, and all sort of private, shared and community toilets among others. However, by focusing on non-networked spaces these studies have given the impression that coexistence and hybridity i) only emerges in off-the-grid or informal neighbourhoods and ii) are thus result of the failure to extend water and sanitation networks (i.e. failure of the modern infrastructural ideal; see section 2.4.1).

The lack of engagements with waterborne sanitation systems from an everyday life perspective also reinforce the perception of these technologies as durable, fixed, and reliable infrastructures that has been widely problematised by scholars working from the global South for other infrastructures. The lack of studies problematising conceptualisation of networked sanitation as highly stabilised or unmalleable sits in contrast with the insights from emergent literature on water supply from an everyday perspective in this regard. This literature has demonstrated that residents tinker, adjust or combine water infrastructures to circumvent various challenges (see section 2.4.2 *Incremental, incomplete, hybrid infrastructures*). In doing so this scholarship has shown that everyday strategies including the use of redundant solutions are also present in networked and formal spaces of the city

and that hybridity and coexistence not only emerge as a result of the failure of water networks to provide affordable or continuous supply but for multiple other reasons (e.g. Furlong, 2014; Guma et al., 2019; Meehan, 2014). There remains a need to apply these insights into analyses of urban sanitation infrastructures and in particular waterborne sanitation systems to challenge widespread presumptions around these infrastructures.

2.6.2 Using HIC as an analytical tool

Another intellectual gap relates to the use of HIC as an analytical tool (developed mainly in Chapter 4 but also 7). As Lawhon et al. (2018) have highlighted most of the recent academic work engaging with the heterogeneity and diversity of water and sanitation infrastructures in global South cities have focused on describing the infrastructural landscapes and the relations of power that they entail. They propose to extend these performative descriptions by using HIC as an analytical tool (see section 2.4.2). This type of approach implies moving from the common focus of previous studies in infrastructures as isolated technologies to exploring them relationally or in other words focusing on how different technologies, sometimes located far from each other are part of broader urban configurations put in place by residents that "involve many different technologies, relations, capacities and operations, entailing different risks and power relations" (Lawhon et al., 2018, p. 722). This approach, they argue, can provide fruitful insights on the possibilities and potentials that heterogeneous infrastructures offer to construct more just and sustainable access to water and sanitation. To date there have been very few studies using HIC as an analytical tool (see Alba et al., 2020 for an exception).

2.6.3 Embodied experiences and gendered infrastructural labours

Further, this dissertation engages with two gaps in feminist explorations of urban infrastructural inequalities. The first relates to the growing recognition among feminist scholars to the need to pay more attention to the body and embodiment in analyses of urban socio-ecological inequalities (Doshi, 2016; Truelove, 2019b) (see chapter 7). As part of this recognition there have been a few very empirically rich feminist UPEs studies exploring unequal embodied experiences and politics of access to water and sanitation in different South Asian cities (Desai et al., 2014; Sultana 2020; Truelove, 2011b, 2019).

However, these studies could be extended by exploring other phases in the everyday life of infrastructures such as infrastructural failure and by engaging with the empirical realities of other global South cities. A different way in which embodied analysis could be deepened is through engagement with other concepts such as infrastructural violence, infrastructural labours, and infrastructural citizenship. While these concepts indirectly evoke embodied experiences and bodily practices in different ways, I argue they could benefit from more explicit or extended attention to the body and embodiment in their analysis.

The second and interrelated research gap relates to the limited attention of literature on infrastructural maintenance to gender and intersectional difference (see chapter 6 and 7). Feminist UPEs have highlighted the gendered and intersectional dynamics shaping the unequal division and toll of the domestic (physical and emotional) labour required to secure water for households (Harris et al., 2017; Sultana, 2009; Truelove, 2011). Yet to date there has been very little interrogation of how other labours required to sustain water and wastewater flows and infrastructures in cities (e.g. maintenance, operation) are shaped by gender and intersectional power relations.

2.6.4 Failure and maintenance

In engaging with the last point related to the lack of attention to how gender and intersectional relations shape unequal embodied experiences of failure and unequal engagement in maintenance labours, this dissertation addresses a few other specific gaps in academic work on infrastructural failure and maintenance (see Chapter 7).

First, recent work in social sciences has called to recognise infrastructural failure as the norm, and as part of the everyday life and politics of infrastructures (not only but especially when exploring infrastructures in global South cities) (Graham 2009; Lawhon et al., 2018; Ramakrishnan et al., 2020). This is important because the way sanitation failures and breakdown are approached in the water and sanitation sector often gives the impression that these are isolated events (e.g. recurrent maintenance cost are not considered in projects (Daudey, 2018, Foster and Briceño-Garmendia, 2010)) or emphasise technical or natural origins (e.g. collapse of latrines is caused by floods or weak structures (e.g. Cole et al., 2012)). Second, most studies exploring infrastructural labours of maintenance have focused on the role of those who perform maintenance labours as part of income generating activities (Ramakrishnan et al., 2020) and celebrate the role of maintenance in recomposing the infrastructure (Barnes, 2017). However, these studies have barely explored the role of

other urban actors in maintenance and there is a need to approach the practices of maintenance in more nuanced ways.

2.6.5 Understanding locally grounded practices and solutions

Further, this dissertation extends postdevelopmental critiques that have highlighted that too often WASH policy and practice come with preconceived ideas of what 'proper' and 'modern' sanitation entails; often based on global North experiences that result in the marginalisation of locally grounded knowledges and practices of residents (Dombroski, 2015; Engel and Susilo, 2014; Kotsila, 2017; Toner, 2019). However, these critiques could benefit from engagement with work on urban infrastructures in the global South and from specific attention to how global North infrastructural ideals and developmental imaginaries of desirable practices invisibilise and disable locally grounded infrastructural configurations that are useful for residents (see Chapter 4, 5 and 7).

2.6.6 Potential links between situated and feminist UPEs and SPoWD

Finally, this dissertation provides some reflections on the potential links between situated and feminist UPEs and SPoWD (Chapter 4 and 5). Despite the similar emphasis in the socio-material dimensions of (waste)water flows and shared focus on everyday practices, these literatures have barely been used together in everyday analysis of water and sanitation infrastructures in global South cities. Such a combination can be fruitful in different ways.

On the one hand SPoWD offers possibilities to extend situated and feminist UPEs of water and sanitation through attention to the cultural underpinnings shaping water using practices; the conceptualisation of water and sanitation challenges as challenges of distributed nature; and the interrogation of the role of professional imaginaries in locking-in water demanding systems (see section 2.3.3). SPoWD pushes more deeply the dynamics around cultural imaginaries, than debates in situated and feminist UPE literature by recognising the multiple ways in which cultural elements shape and are shaped by water practices and infrastructures. Further, while situated and feminist UPEs recognise the role of a wide range of actors in shaping everyday water and sanitation experiences and challenges, SPoWD mobilises interdisciplinary and transdisciplinary approaches to both research and research dissemination that is committed to shifting the practices of these

distributed actors (cf. Hoolohan & Browne, 2020; Watson et al., 2020). Integrating insights from both bodies of work helps to think about how incremental change can be activated by centring policy inquiry in the everyday practices of people and thinking through distributed responsibilities of water and sanitation systems of provision.

On the other, SPoWD can also benefit from more diversity in case studies and from more theoretically and empirically situatedness in the global South, with a greater focus on dynamics of power and infrastructural heterogeneity (see section 2.3.2). As opposed to feminist and situated UPE, SPoWD do not explicitly engage with power or social inequalities, although some have (e.g. Jack et al., 2020) and many are not completely oblivious to it (Watson, 2016). Watson (2016) argues that this lack of engagement of practice theory literatures results from the ontological limitations of these literatures to grapple with structuralist definitions of power (i.e. power as an object). A way for this scholarship to account for power is to engage with relational and diffuse definitions of power (Watson, 2016) such as those mobilised by situated and feminist UPEs. Furthermore, most of the SPoWD studies have largely been produced based on case studies in the global North mainly western Europe or Australia but there has been very limited engagement with global South contexts (with some exceptions such as Browne (2016) China, Jack et al. (2020) - India or Kadibadiba et al. (2018)- Botswana). As Browne (2016) argues there remains a need to diversify SPoWD "to engage with conceptual and empirical developments within the Global South; to consider the local geographies of practice and how these are evolving in ways that are influencing sustainability; and how we can conceptualise and mobilise change beyond the lessons on sustainable consumption research and policy so far learnt in the Global North" (Browne, 2016b, p. 7).

Chapter 3.

Methodology

3.1 Introduction

The purpose of this chapter is to provide an overview of the research design and methodological approach used in this study. The engagement with postcolonial and feminist scholarship required careful consideration of research design and the development of a methodological approach that does not reproduce extractive dynamics of knowledge production; challenges the 'othering' and mainstream representation of global South subjects; remains aware of power relations within fieldwork and with participants; and acknowledges one's subject position through self-reflexivity (England 1993; Moss et al, 2002; Nagar 2002; Staeheli and Lawson, 1994). These have remained as main principles shaping the methodological approach and selection of methods in this dissertation.

This project was designed following an inductive approach broadly inspired by methods such as Grounded Theory and Abductive Analysis (Charmaz, 2014; Glaser and Strauss, 1967; Timmermans and Tavory, 2012). Following scholarship theorising infrastructures from the global South (see Chapter 2) I adopted a research approach that was centred in the exploration of the everyday realities of residents as a source of theory making (Lawhon et al., 2014). As such, the project did not start from a rigid analytical framework and a set of hypotheses to be tested as I wanted the data to lead in the production of theory (cf. Charmaz, 2014; Glaser and Strauss, 1967). However, I did not wait until the end of the project to engage with the academic literature as pure Grounded Theory proposes. Rather I adopted an Abductive Analytical approach in which theory and data were iteratively put into conversation with each other throughout the project (cf. Timmermans and Tavory, 2012). To ensure I would remain inductively open to insights from the data, and to allow for data-analysis-theory zigzagging, the project was designed with different iterative phases showed in Table 1.

Table 1 Description of research project phases

Phase	Activity	Period
Phase 1	Project proposal + Review of scholarly literature + Secondary data analysis	Sep. 2016 - Sep. 2017
Phase 2	Fieldwork part 1	Sep. – Dec. 2017
Phase 3	Preliminary analysis + Review of scholarly	Jan. – Apr. 2018

	literature + Refining part II fieldwork plan	
Phase 4	Fieldwork part II	May – Jul. 2018
Phase 5	Core analytical phase + Assembling of theoretical framework + Drafting of chapters	Aug. 2018 – Jul 2019
Phase 6	Final writing of chapters + Further analysis + Refining final theoretical framework	Sep. 2020 – Jan. 2022

The project adopted a qualitative methodology inspired by ethnographic approach field research and postcolonial and feminist epistemologies to explore the everyday life of water and sanitation infrastructures of Lilongwe. A qualitative methodology was selected because it can provide the detailed and rich description and the attention to context, experiences, and difference required for this study (McHugh, 2014; Moss et al., 2002). Ethnographic research was deemed a suitable methodology as "ethnographic research has developed out of a concern to understand the world-views and ways of life of actual people in the contexts of their everyday lived experiences" (Crang and Cook, 2007 p.60), objectives that matched with those of this study.

Data collection entailed participant observation, semi-structured interviews, group discussions, mobile-methods, and photo elicitation exercises with six categories of participants (see section 3.5). The selection of methods was inspired by participatory research and responds to my commitment to undertake a less extractive research process and to reduce the power imbalances of fieldwork and in knowledge production, as participatory research approaches participants not as passive objects of the research but as co-participants in the production of knowledge (Gubrium & Harper, 2016). Furthermore, fieldwork activities were supplemented with the review and analysis of urban plans, project documents, and other literature about Lilongwe's sanitation sector gathered through archival and desk-based research and the gathering and analysis of media coverage of the Area 18 water contamination event. Secondary analysis of data collected in the framework of UNHIDE and INHABIT projects has also been conducted (See Table 2 for outline of data collection methods).

As indicated above fieldwork was undertaken in Lilongwe for a total of six months in two different periods (see Table 1). While most of the research activities were conducted in three field sites: Area 56, Area 50 and Area 18, fieldwork was mobile not only in using mobile methods but also in its approach. As O'Reilly (2009) described a mobile ethnography "pursues links, relationships and connections" beyond predefined spatial and temporal borders (O'Reilly 2009, p.146). My mobile approach to fieldwork entailed zooming into the three field sites, and zooming out to the city scale, to seek these connections between the field sites (see Chapter 7) and with other spaces, infrastructures, knowledges, and experiences in the city (cf. Streule, 2021).

The remainder of the chapter is structured as follows. Section 3.2 describes the main field study sites. Section 3.3 provides a detailed overview of the selection of participants (3.3.1) and methods used for data collection (3.3.2 to 3.3.8). Section 3.4 discusses the collaboration with local organisations and section 3.5 gives information about the main methodological adaptations undertaken throughout fieldwork. The process followed for data analysis is described in section 3.6. Section 3.7 outlines some important ethical considerations and section 3.8 presents the main methodological limitations of the research. Further summary and details pertaining to research design and methodology that underpin the analysis chapters/papers can be found across Chapters 4 – 7.

3.2 Description of field sites

This section provides a brief description of the history and infrastructures of the city of Lilongwe (3.2.1) and of the three neighbourhoods in which most fieldwork activities where conducted. These neighbourhoods included LIAs: Area 56, Area 50 (3.2.2), and the planned city: Area 18 (3.2.3) (see Figure 4 for a map locating the neighbourhoods). The reasons underpinning the selection of these neighbourhoods as main field sites are also discussed in section 3.2.4

3.2.1 Lilongwe

Lilongwe, located in the central region of Malawi is the largest city in the country with a population close to a million residents (NSO, 2018). Lilongwe has been the capital of the country since 1975 when the government headquarters were relocated from Zomba by Dr

Kamuzu Banda, the first president after independence of British colonial rule in 1966. The city presents a highly socio-spatially differentiated landscape that originated during the colonial regime (see differentiated city landscapes in Figures 1, 6, 8 and 9).

Figure 1 Lilongwe. Commercial area. Image: Author's own.

The colonial town was originally founded on the western bank of Lilongwe River in 1924 (Englund, 2002; Kalipeni, 1999). At the time, the colonial power displaced African residents to the eastern bank of Lilongwe River along with Asian residents, leaving the west side, with more favourable environmental conditions, for white colonisers (Englund, 2002; Kalipeni, 1999). The city was further segregated during Banda's rule as his government commissioned the planning of the new capital to a South African architecture firm which proposed a City Garden model strongly inspired by colonial and apartheid urban ideologies (Kalipeni, 1999; Myers, 2011; Potts, 1985). Low-density areas of the city were developed with access to modern infrastructures such as piped water and sanitation networks and other public services and amenities and populated by wealthier, and often foreign, residents (Kalipeni, 1999; Myers, 2011; Potts, 1985; Rusca et al, 2017). Poor and working-class black African inhabitants were marginalised in high-density areas (now LIAs) separated from the rest of the city by physical barriers such as "vacant land, swampy lowlands, tree belts, and streets" (Rusca, 2017 p. 141).

Following its designation as capital of the country, the city has undergone fast urban development growing from less than 20, 000 inhabitants in 1966 (Englund, 2002) to close to a million residents in 2018 (NSO, 2018). The policies adopted by Banda and the

subsequent governments favoured informal development and the concentration of investments in infrastructure in the low-density areas of the city (Rusca et al, 2017; Tiwale et al, 2018). As a result of these developments the city presents a heterogeneous landscape of water and sanitation infrastructures that provides unequal levels of service (Rusca et al, 2017).

The city's water network is operated by a municipal water utility, Lilongwe Water Board (LWB) under two service modalities (Figure 2). In the first modality LWB provides water through in-house water connections (44% of the population, mainly in the middle- and high-income areas of the city) (Pihljak et al., 2019). In the second, LWB cooperates with seven WUAs to provide water to LIAs through a networked system of water kiosks (see Figure 9) (Pihljak et al., 2019). WUAs are community-based organisations that manage and operate the kiosks (See Chapter 6 for more details).

Figure 2 LWB offices. Image Source: Lejla H. Pihljak, 2013 Used with permission.

The city's water supply is often erratic, stopping without warning from anything between a few hours to a few days (Alda-Vidal et al., 2018; Tiwale et al., 2018). Residents have developed different strategies to cope with water shortages (See Figures 4 and 12 and Chapter 4 for more details). Water shortages are more frequent and last longer in LIAS (Tiwale, et al., 2018, Velzeboer et al., 2017) in part because of the everyday operation practices of LWB that prioritise customers in the high and middle-income areas (Alda-Vidal et al., 2017). Furthermore, due to construction and operation practices of LWB the water kiosks receive water of lower quality than that provided at taps in the planned areas of the city (Boakye-Ansah et al., 2016). This lower quality is further exacerbated by

residents' practices of collection at the kiosk and storage of water at homes (Boakye-Ansah et al., 2016). Finally, the price of water is higher for the low-income residents who buy it at the kiosk than for those residents who have in-house connections (Pihljak et al., 2019)

Figure 3. Coexisting infrastructures in the planned areas of Lilongwe. House with water tank to supplement network supply (left), backyard latrine and bathroom (right) and septic tank (front). Image: Author's own.

The piped sanitation system was initially constructed during the relocation of the capital city and has received very little investment in upgrading and extension since then (See Chapter 7). The sewer network collects wastewater from a few planned areas of the city (around 5% of the urban population) and takes it to Kauma plant where it is treated (World Bank, 2017). The system is aging and working over capacity and faces a severe lack of maintenance which results in most sewage being discharged into the environment untreated, contributing to environmental pollution (World Bank, 2017). Over the past few years there has been a controversy between LWB and LCC (Lilongwe City Council) over responsibility for the management and operation of the network. Apart from the sewage, the most common sanitation infrastructures are pit latrines (70% population, mainly in LIAs) (See Figure 10) and septic tanks (25% of the population, mainly in planned areas) (World Bank, 2017).

Figure 4 Field sites in Lilongwe. Produced by author based in © 2021 Google Maps

3.2.2 LIAs: Area 56 and Area 50

Most of fieldwork activities were conducted in two LIAs: Area 56 and Area 50. Area 56 has a population of 66.574 inhabitants (NSO, 2018) and is located in the west-end of the city about 6km from the City Centre (CCODE, 2012a, 2012b).

Figure 5 Landscape Area 56. Image: Author's Own

Figure 6 House with water tap in Area 56. Image: Author's Own

Area 50 has a population of 82.820 inhabitants (NSO, 2018), and is located in the North-west at around 3km from the City Centre (CCODE, 2014) (See Figure 4 for location of the two neighbourhoods).

Figure 7 Landscape Area 50. Image: Author's Own

Figure 8 Main Road in Area 50. Image: Author's Own

LIAs such as these two have experimented rapid population growth. Over the years, public authorities have failed to provide access to housing in the planned city for the growing low-income population (Kalipeni, 1997; Mwathunga & Donaldson, 2018). Area 50 and 56 were originally small villages located outside the city boundaries and have informally grown over the decades. Low-income residents found a solution to housing shortages in these areas where they could acquire more affordable land from chiefs (CCODE, 2012a; 2012b; Refstie, 2013). The areas were incorporated to the city when the boundaries were extended in the 1990s, which was reflected in the election of local councillors. Despite the

neighbourhood being officially located in urban land, and in principle administered by LCC, they have been neglected in the provision of infrastructures and services and, for the majority, residents are expected to organise by themselves to provide their own services and upgrade the situation of the area (Refstie & Millstein, 2019).

Both areas have similar infrastructural landscapes and service configurations (see Figures 2, 7, 11, 22, 23 and 24). The areas receive water from WUA managed kiosks where residents can buy treated water by buckets (See Figure 9). At the kiosks, shortages are common, and water is costly, which are the reasons many residents turn to other sources of lower quality such as wells, rainwater, or streams (Velzeboer et al. 2017). Most of the households burn their waste or dispose of it in open spaces, as there is no municipal waste collection in these areas. Dug pit latrines, constructed and maintained by residents, constitute the most common form of sanitation infrastructure (World Bank, 2017). These latrines are poorly constructed and present several challenges such as the contamination of nearby water sources. This and other sanitation challenges facing LIAs are more detailed described in the empirical chapters.

Figure 9 Water kiosk in Area 56. Image: Author's Own.

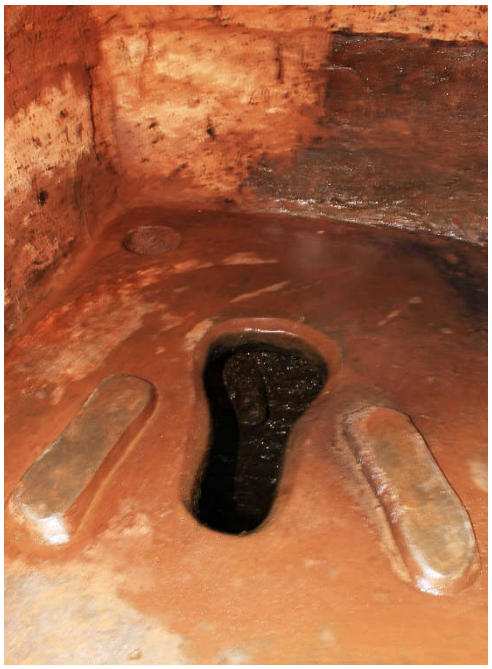

Figure 10 Latrine Area 56. Image: Author's Own

Area 50 and 56 were selected as field sites for different reasons. These include their history and status as informal areas, diversity of infrastructures, and challenges to access water and sanitation faced by residents among other dynamics. Other practical reasons also shaped their selection. Both areas were easily accessible from the city, and I could draw on my and field assistants' familiarity with these areas (myself and one of the field assistants had previously conducted research in Area 56 and another field assistant lived in Area 50). This helped in dealing with community gatekeepers and recruiting participants for the study.

3.2.3 Area 18

Area 18 has a population of 8,717 inhabitants (NSO, 2018) and is located in the northwest part of Lilongwe, not far from Capital Hill, the site of the government and political centre of the city (See Figure 4). In the 1970s, the Malawi Housing Corporation (MHC), the state-owned housing agency, developed the area as a medium-density residential neighbourhood to house government employees at strongly subsidised prices (Potts, 1986; LCC, 2010). The neighbourhood was planned to receive municipal piped water and sanitation services from the start, and it has remained a special case ever since. Area 18 is the city's only neighbourhood where every home is connected to the sewage system (Baker, 2016).

Various reasons led to the development of Area 18 as an anomaly with full access to modern infrastructures. The neighbourhood was built in a time of exceptional economic growth (Kayuni, 2011). The postcolonial state was concentrated on "mobilising resources for national infrastructure development" including urban modern water and sanitation systems to support the building of the new postcolonial nation (Tchuwa, 2018, p. 8). Furthermore, after the country's independence senior civil servants, such as those hosted in Area 18, viewed the provision of high standard government housing (including access to modern water and sanitation services) as a colonial era privilege to which they were entitled (Anders, 2009). The construction of this type of housing could be seen as part of Banda's strategy "to keep the bureaucratic elite of the country in line" (Anders, 2009, p. 56).

Over the years population and status of the neighbourhood has changed. Many of the government workers who first inhabited the area are now retired and live there with their extended families, and some of the houses have been sold and are now accommodating new populations from different income segments (Baker, 2016). Furthermore, after the public sector reform pushed by international donors, government workers do not hold the status and privileges they once had (Anders, 2009).

Residents of Area 18 have taps at home that receive water from LWB and use flush-toilets connected to the municipal piped sanitation system. Waste is collected door-to-door once a week by municipal workers (LCC, 2010). Despite having access to modern infrastructures and relatively good services, the area faces important challenges that are described more in detail in Chapter 7. Water shortages are frequent, and the sewer system is aging and strained. Sewer blockages and wastewater overflows have been common over the past years. In 2017, a sewage spillage infiltrated into a water pipe where LWB was conducting maintenance works and made its way into the taps of neighbouring houses where it was consumed by residents (see Chapter 7).

Figure 11 Water storage bucket next to non-functioning flush toilet in Area 18. Source: Ralph Ndalama, 2021. Used with permission.

Area 18 was selected as a field site for different reasons. The recent water contamination incident provided an interesting research topic (See Chapter 7). The history of the area as a planned public housing neighbourhood, and its status as an exception in the city with access to networked water and sanitation, made it an interesting location. Furthermore, one of the field assistants lived in the area which facilitated access to participants.

3.2.4 Other locations in the city

The decision to follow a mobile fieldwork approach (see section 3.1) meant that I also conducted some fieldwork activities in other areas of the city apart from the three neighbourhoods described above. The adoption of mobile methods meant I followed sanitation workers in their daily activities across the city and occasionally I conducted interviews with residents in the locations we visited (see section 3.3.4). I also conducted a few interviews with kiosk attendants in other LIAs where a pre-paid water payment for kiosk was being piloted.

3.3 Selection of participants and methods for data collection

Table 2 provides an overview of the participants and methods used for data collection in the study. The table also provides information of what data has been used in each of the empirical chapters. Section 3.3.1 provides more details on each of the categories of participants as well as the rationale for including them in the study. The section also discusses the participation of field assistants in recruiting participants and more broadly supporting the development of fieldwork. Sections 3.3.2 to 3.3.8 describe each of the data collection methods draw upon during fieldwork.

Table 2 Overview of data collection methods, objectives, participant types, participant numbers, and where data is used throughout empirical chapters

Method	Objective	Participants	Number	Chapter
Participant observation	To gain understanding of the infrastructural landscape of the city and everyday practices of residents beyond participants verbal accounts	N/A	N/A	Chapter 4, 5, 6, 7
	Participant observation in film debates was conducted to deepen the understanding on the challenges kiosks attendants and water users face on day-to-day basis	Stakeholders Residents	3 film debate sessions	Chapter 6
Semi-structured interviews	To gain in-depth understanding of the infrastructural landscape of the city and of the everyday challenges sanitation workers face in their job from their own accounts	Sanitation workers	20 interviews	Chapter 4, 5 and 7
	To gain in-depth understanding of the everyday experiences and challenges that kiosk attendants face in their work from their own accounts	Kiosk attendants	5 interviews	Chapter 6
	To understand the role of different governmental and non-governmental actors in shaping the planning and operation of water and sanitation infrastructures as well as of their understanding of water and sanitation challenges in the city from their own accounts	Stakeholders	26 interviews	Chapter 4, 5, 6, 7

	To gain a better understanding of the history of the field sites as well as the main challenges and infrastructures present in the field sites from the accounts of participants	Community leaders	15 interviews	Chapter 4, 5, 6, 7
	To gain an in-depth understanding of the everyday water and sanitation experiences of residents including what challenges they face and what solutions they have for them from the accounts of participants	Residents	50 interviews	Chapter 4, 5, 6, 7
	To gain an in-depth understanding of the water and sanitation challenges for residents of LIAs and how these were approached from a health and hygiene promotion perspective from the account of participants as well as to compare the perspectives and knowledge of health workers on the matter with that of residents.	Health workers	5 interviews	Chapter 5 and 7
	To gain a specific information that could not be provided by the other categories of participants	Other	5 interviews	Chapter 5
Mobile Methods	To see participants at work and elicit further discussion about their everyday challenges as well as to observe the diversity and spatial distribution of infrastructures in the city (included observation, talking while walking, and video and photo documentation of the activities and spaces and the writing of fieldnotes)	Sanitation workers	10 fieldwork days	Chapter 4, 5 and 7

Group discussions	To prompt the sharing and comparison of experiences among women	Female residents	5 group discussions	Chapter 5
	To gain preliminary insights into the experiences and challenges working at the kiosks	Kiosk attendants	1 group discussion	Chapter 6
Photo-elicitation	To elicit further discussion about the everyday experiences of participants and to obtain visual evidence that could be used in dissemination activities	Residents	5 residents	Chapter 7
		Sanitation workers	2 sewer workers	Chapter 4 and 7
Desk research	To gain in-depth understanding of policy context and of the history of infrastructures in the city	Policies, urban and infrastructure planning project documents, etc.	31 documents	Chapter 4, 5, 6, 7
	To support understanding of the contamination incident and how it was experienced by residents of Area 18	Media coverage of Area 18 water contamination incident	18 online articles	Chapter 7
Secondary data analysis	To gain a deeper understanding of the everyday experiences and challenges that kiosk attendants face in their work	Data collected in the framework of UNHIDE and INHABIT	5 interviews	Chapter 6
	To gain preliminary understanding of the sanitation landscape and challenges in Lilongwe and to identify main research gaps and topics that could be further explored	Data collected in the framework of UNHIDE and INHABIT	MSc thesis and transcripts of interviews	Chapter 4, 5, 6, 7

3.3.1 Field assistants and recruitment of participants

Fieldwork was conducted with the support of four field assistants Charles Mkula, Emmie Ngosi, Muyopi Tchuwa and Diana Nkomba. All field assistants had experience supporting ethnographic research and a good knowledge of the communities where fieldwork was conducted. The role of field assistants was essential in building trust with participants and included gaining permission from community gatekeepers (community leaders), recruiting participants, ensuring informed consent, and guiding conversations in a positive, non-judgemental, and culturally sensitive way. Informal conversations with field assistants, reflected in field notes, were also crucial to gain deeper understanding of local cultures and practices.

Research participants included seven categories (although some of them wore different hats in the study) who were enrolled into different research activities (see Table 2). The category (1) Residents included women and men living in the three field sites of the study and a few participants in other locations of the city. The category (2) Stakeholders included governmental and non-governmental actors involved in the water and sanitation sector. Examples of participants under the category stakeholders are government officials from LCC, various Ministries, and representatives of service providers such as LWB or WUAs, and NGOs such as CCODE (Centre for Community Organisation and Development). The category (3) Sanitation Workers included masons involved in the construction of sanitation infrastructures, private plumbers, latrine emptiers, tankers, public toilet operators and sewer workers. The category (4) Community Leaders included various customary leaders (e.g. chiefs or village headmen) and municipal council members from Area 56. The category (5) Health Workers included participants involved in health and hygiene promotion in LIAs, some of them hold paid positions while others conducted these activities on voluntary basis. The category (6) Kiosk Attendants included women hired by WUAs to operate the kiosks in LIAs. Most of the interviews with kiosk attendants were conducted in Area 50 and 56 but I also conducted interviews in other LIAs (Area 21 and 23 where the kiosk electronic pre-paid system) was being piloted (see Chapter 6). Finally, the category (7) Others included a variety of participants with whom I conducted interviews to get specific information that could not be provided by the other categories of participants. The category Others include for example producers of sanitary pads, or grocery store attendants (see Table 2).

Participants have been anonymised throughout the dissertation, pseudonyms used when necessary and attention has been paid to only include non-identifiable information.

Interviewee identifiers for direct quotations include the following elements: Type of fieldwork activity from which the data has been draw, Category of participant, Gender, and Fieldwork period (e.g. Photo-elicitation, Resident LIA, Woman, 2018). When possible and relevant, but not revealing of identities to include more details, more information about the organisation and position of professionals has also been provided (e.g. Interview, Stakeholders, LCC engineer, Man, 2017).

Field assistants played a crucial role in the identification and recruitment of participants. Participants from the category Community leaders were the main gatekeepers in LIAs and thus approached at the beginning of the Phase I of fieldwork. To identify community leaders, I drew on the knowledge my field assistants had of LIAs and my previous contacts with WUAs. Participants in the category Residents were recruited through the networks of field assistants and using snowball sampling approach. Participants from the category Stakeholders were contacted with the support of Charles Mkula who had a wide network of connections in the local water and sanitation sector, CCODE, and through my previous contacts in Lilongwe. Participants from the category Sanitation Workers were recruited through the networks of field assistants or via their superiors (gatekeepers) at organisations in charge of the sewer (MHC and LCC). Contacts of independent sanitation workers (masons and emptiers) were provided by the local NGOs that support their work. Participants from the category Kiosk Attendants were recruited through WUAs and networks of field assistants. Participants from the category Health Workers were referred by community leaders, stakeholders, and field assistants.

3.3.2 Participant observation and fieldnotes

Participant observation has been described as the main method in ethnographic research (O'Reilly, 2009) and requires "researchers to engage in the 'systematic description' of events and interactions, as framed by a research question, to produce a rich and detailed record of the observed reality" (Manolchev and Foley, 2021, p.1). Participant observation and development of fieldnotes was undertaken at field sites and during mobile methods. During the fieldwork period I spent entire days getting familiar with Area 50 and 56, visited the infrastructures and 'hung out' with participants before and after conducting interviews with them. I also followed sanitation workers in their daily activities fixing blockages, emptying tanks, or constructing latrines. When possible, I jotted notes on the go or described the events and encounters as much as possible once back home in the evening.

These observations have been used as supporting material in all the empirical chapters (see Table 2).

I also conducted participant observation in a number of film debates sessions held in connection to the local launching of the documentary *'Lilongwe Water Works?'* (Rusca, 2017). The documentary was an output of the previous research projects I was involved in and was filmed and produced by the project lead (Dr Maria Rusca, then Kings College London, now University of Manchester). The video documentary explores Lilongwe's water kiosk system, focusing on the experiences of the residents who buy water at the kiosks, and of the community associations that run them. Three film debate sessions were organised with representatives of the water and sanitation sector (June 2018; 25 participants, all men) (see Figure 13); representatives of WUAs and community members in Area 50 (June 2018; 16 women and 9 men) and Tsabango (June 2018;16 women and 10 men) (see Figure 12). The sessions had two parts: In the first part, participants watched the documentary. In the second part, participants were given the opportunity to comment on what they had seen and to discuss how the water supply situation had changed or not since the filming of the documentary. Topics discussed included the challenges produced by constant water interruptions, the insecurity faced by attendants and users when collecting and selling water at night, or why WUAs are spending revenues on new buildings. These discussions helped to deepen the understanding on the challenges kiosks attendants and water users face on day-to-day basis. Participants in the session with the water and sanitation sector were invited by the organising team. Participants in the rest of the sessions were selected by WUAs and community leaders with recommendations on the proportion of community leaders/community members/WUA representatives made by the organising team. During the sessions I took detail notes of the discussions that have informed the empirical sections of Chapter 6.

Figure 12 Film debate in LIA. Image: Author's Own

Figure 13 Film debate water and sanitation stakeholders. Image: Author's Own

Apart from note-taking, participant observation also entailed photography and video documentation. Photographic and video documentation are methods that consider images are "accurate records of what was in front of the camera" (Rose, 2016, p. 130). Photography and filming have been used to document what is visible of urban environments but also to interrogate invisible processes such as the aesthetic and sensory aspects of urban experiences (Rose, 2016). In this research, photographic and video documentation have been used with two purposes. First, to obtain evidence of the different infrastructural configurations and experiences that can be used to support findings and second, to obtain

visual inputs that can be used in the dissemination of results. Photographic and video documentation was conducted in a non-systematic manner as part of participant observation and to document working practices of sanitation workers (see 3.3.4).

Figure 14 Latrine slabs sold by masons next to Area 56. Image: Author's Own

Figure 15 Market toilets in a LIA and toilet operators. Image: Author's Own

3.3.3 Semi-structured interviews

Interviews provide "unique access to the lived world of the subjects, who in their own words describe their activities, experiences and opinions" (Kvale, 2008, p. 9). Semi-structured interviews were the main data collection method of this research. In line with the feminist and postcolonial epistemology shaping this study, I approached interviews as a process in which content and meanings were co-produced by the participants in the interview (in this case research participants, field assistants, and myself) and shaped by the situated power dynamics among these interlocutors (cf. Moss et al. 2002). Semi-structured interviews were conducted with all the categories of participants (see Table 2).

Interviews followed a flexible thematic guide that was adjusted for each of the participants category. For example, interviews with participants from the category Residents focused on their everyday experiences and challenges to access water and sanitation while interviews with participants from the category Stakeholders was structured around their professional expertise and experience. Interviews were conversational in style, with open-ended questions to allow participants freedom to formulate their responses. Interviews usually started from broad themes to the more specific, and new more specific questions were incorporated as fieldwork progressed. Some interviews lasted an hour, and some consisted of shorter interactions. At the beginning of the interviews, participants were provided information about the project and informed consent was acquired (See Appendix 1). Participants were given the opportunity to ask questions and space to shape the direction of the interview and to bring up topics of their own interest. Interviews were conducted in English or Chichewa and translated to English by field assistants. Notes were jotted down during interviews. In addition, some interviews were tape-recorded, and some video recorded. All interviews have been transcribed from the English translation. At the end of fieldwork, I selected a set of interviews and asked field assistants who had not been involved in conducting the interview to transcribe the conversation directly from the recording in Chichewa as a quality control tool. Results were very similar to the on-the-go English translation which reasserted my confidence in the reliability of field assistant's translations.

3.3.4 Mobile methods

Mobile methods are a "hybrid between participant observation and interviewing" (Kusenbach, 2003, p. 463). In this type of methods, researcher and participants move together across space while they talk. Mobile methods can be enacted while walking or using a means of transport and the route can be more or less guided by the researcher or the participant (Bergeron et al., 2014; Evans & Jones, 2011; Kusenbach, 2003).

Mobile methods were conducted with sanitation workers and included field visits in which the purpose of the activity was to show the researcher around and go-along exercises in which participants were accompanied by the researcher in their everyday activities. These activities included visits to water and sanitation infrastructures such as the wastewater treatment plant or failure hotspots along the sewer network; accompanying sewer workers to planned areas of the city where they were conducting sewer maintenance and repair activities; and visits to customers who required the emptying of tanks or latrines. Mobile methods entailed observation; talking while walking; video and photo documentation of the activities and spaces (see Figures 17 – 19 for examples of documentation of visits undertaken with sanitation workers); and the writing of fieldnotes (see section 3.3.2). During these journeys I also conducted a few interviews with relevant participants across the city (e.g. customers).

Figure 16 Latrine emptiers with gulper pump next to latrine in a LIA. Image: Author's Own

Figure 17 Sewer worker going into a manhole. Image: Author's Own

Figure 18 Septic tank emptier. Image: Author's Own

3.3.5 Group discussions

Focus group discussions "are a useful research strategy when exploring awkward, and socially taboo, research encounters around everyday practice" (Browne, 2016a, p. 6). Five small-group interviews (4-8 participants, 21 total, all women) were conducted with women living in LIAs who had not participated in individual interviews. The objective of these small-group interviews was to create a friendly space to prompt comparison of menstrual waste management experiences, and to validate some of the information collected during individual interviews. Furthermore, a brief group discussion was organised with kiosk attendants and inspectors (8, all women) to introduce the research and researcher and to gain some preliminary insights into their experiences and challenges working at the kiosks. These focus groups discussions have informed the empirical sections of Chapter 5 and 6.

3.3.6 Photo-elicitation

Photo-elicitation is a method that consist in inserting photos taken by participants "into a research interview" (Harper, 2002, p. 13) and has been widely used in social sciences research (e.g. Lombard, 2013; McLees, 2013; Young & Barrett, 2001). The objective of the photo-elicitation exercises was to gain more insight into the everyday experiences of participants. Photographs produced by participants can help the researchers to see the topic of research through the participants' own eyes and perspectives and provide important evidence that can be used for analysis or documentation (Harper, 2010; Rose, 2016). In comparison to semi-structured interviews, the advantage of this method is that it allows more freedom for participants to bring up topics of discussion as well as to move away from the direction of the researcher (Harper, 2002; Rose, 2016). In addition, photo-elicitation exercises are helpful to provoke more detailed and emotional discussions about everyday life experiences (Rose, 2016). Participants often enjoy talking about the photographs they have taken and explaining why they took them. This helps to elicit aspects and elements of their experiences which would have, otherwise, remained unnoticed.

Photo-elicitation exercises were conducted with five participants from the category Residents and two participants from the category Sanitation workers. After the first set of semi-structured interviews, participants who had agreed to take part in the exercise were handed disposable cameras and asked to take photos around a specific set of topics. These topics were broadly formulated, and instructions reduced to the minimum possible to

enhance participants' creativity and freedom. Basic ethical guidelines for the exercise were discussed with participants and those participants who needed it were provided with simple instructions on how to use the cameras (see Appendix 1 for consent form and instructions sheet). A new appointment was made a few days later for the collection of the cameras in order to print the pictures. After the collection of the cameras, a new interview was scheduled to discuss the photos taken by participants. Interviews were tape recorded and transcribed. At the beginning of the interview, participants were handed the set of printed copies and offered the opportunity to remove any image that they did not feel comfortable talking about or sharing. The rest of images were numbered to facilitate the identification. During the interview, participants were asked questions about each of the images (e.g. what images mean to them or what they wanted to show with that particular image). At the end of the interview, sharing permissions and implications of use were discussed with participants. Only images that had been released by participants for use and clearly adhere to the ethical requirements have been used in this research. Some examples of the images taken by participants in photo-elicitation exercises are provided in Figures 20 – 24.

Figure 19 Picture taken by sewer worker as part of photo-elicitation exercise showing materials found in blockages

Figure 20 Picture taken by resident in LIA as part of photo-elicitation exercise to show the well where water is collected.

Figure 21 Picture taken by LIA resident as part of photo-elicitation exercise to show the toilets he uses.

Figure 22 Picture taken by LIA resident as part of photo-elicitation exercise to discuss the cleaning of toilets

3.3.7 Archival and desk research

The project included the gathering and analysis of the main urban plans (e.g. urban plans) and water and sanitation project documents (e.g. project reports) and policies over the last fifty years as well as other grey literature (e.g. NGO reports) (See Appendix 2 for a list of documents reviewed). I reviewed these documents to gain a deeper understanding of the history of the water and sanitation infrastructures in the city and the different process shaping the current configuration and challenges. These documents were retrieved online, and from university libraries in the UK (University of Loughborough, University of Nottingham) and South Africa (University of Cape Town), organisational archives in Lilongwe (archives of LWB, LCC and Ministry of Lands) or provided by participants.

Desk research has also entailed the gathering and analysis of online media articles about the water contamination incident in Area 18. This included 15 articles from main online newspapers and media outlets: Nyasa Times, The Nation Online, Malawi24, The Maravi Post, Malawi News Agency Online and Times Group Malawi (see Appendix 3 for the full list of articles). I used key words such as ‘sewage’, ‘contamination’ or ‘Area 18’ using Google News or the online journals’ internal search browser to trace the reporting of the incident.

3.3.8 Secondary data analysis

Secondary data analysis "involves investigations where data collected for a previous study is analysed – either by the same researcher(s) or different researcher(s) – to explore new questions or use different analysis strategies that were not a part of the primary analysis" (Ruggiano and Perry, 2017, p. 82). This project used data collected in the framework of UNHIDE and INHABIT projects in two ways. First, data collected by the five MSc students of the project I co-supervised (see section 1.3) was reviewed and explored in search for research gaps and themes that could be further explored. This includes their MSc dissertations and the transcripts of the interviews conducted by Baker and Langkau. Through this first analysis I gained preliminary understanding of the sanitation challenges in Lilongwe that was used to build-on my own programme of research. For example, Baker and Langkau noted the different perceptions of sanitation responsibilities (Baker, 2016; Langkau, 2016), the presence of wastewater contamination in Area 18 (Baker, 2016) and the existence of latrines in planned areas (Langkau, 2016). Recognising the research and evidence gaps on these topics, I developed a programme of research that ensured a greater empirical and conceptual exploration on these topics as reflected in the empirical chapters. Second, a set of 5 interviews with kiosk attendants conducted in the framework of the filming of the documentary *Lilongwe Water Works?* has been used to support the development of Chapter 6. All secondary data used has been properly attributed and referenced throughout empirical chapters.

The lack of control over rigor and ethics of data collection are two of the primary concerns of conducting secondary analysis of qualitative datasets (Irwin, 2013; Ruggiano and Perry, 2017). However, the data in itself and collection procedures and context were not new to me as I had collaborated with the projects at different stages and co-mentored the MSc students in the design of their research proposals and throughout the data collection and analysis process. Furthermore, a decision was made to draw on these already existing data sets to supplement the primary data collection outline in this section and Table 2. I knew such data existed and it as more ethical to reuse already existing data on everyday practices, than to engage new participants in time consuming data collection methods around information that I knew existed and had access to. As Ruggiano and Perry (2017, p. 83) indicate, using secondary data sets "relieves the burden of participation from research participants and community partners who collaborate with researchers to identify, access, and recruit research participants" which aligns with the ethics of care for research participants called by the feminist and postcolonial epistemology informing this study. Due to this commitment to reduce research burdens for participants – particularly research about

everyday life for those facing various challenges such as infrastructural/resource precarity or access inequalities - such secondary data analysis is becoming more common within geographical and allied social science disciplines (cf. Head et al., 2016; Middlemiss et al., 2019).

3.4 Collaboration with local organisations

During my two fieldwork periods I collaborated with two local organisations: CCODE and Hyphen-Media Institute. CCODE is Malawian non-profit organisation and affiliate of Slum Dwellers International. CCODE has been working on sanitation issues in LIAs for two decades including the implementation of a revolving fund for the financing of sanitation infrastructures for low-income residents. Hyphen Media Institute is a training, research, advocacy, and awareness raising NGO founded by one of my field assistants, Charles Mkula. Engagements with these local organisations were helpful to build connections, gain a deeper understanding of the local context and to discuss research findings and fieldwork challenges with people with large expertise in sanitation and/or community development in LIAs while also supporting some of their activities.

During the second part of fieldwork CCODE offered me desk space and referred me to research participants. In exchange, I supported them in tasks such as the proof reading of a grant proposal and the prospecting for funding opportunities. Hyphen Media Institute has played an important role in supporting the dissemination of research findings from this dissertation. Charles has used materials collected within the fieldwork to inform his journalistic writing on topics related to water, hygiene, and sanitation in Lilongwe (e.g. https://www.mwnation.com/whose-interest-is-toilet-business), informally shared research findings at different local stakeholder meetings, and disseminated research outputs (PhD papers and the ‘water kiosk’ cartoon Appendix 4) through Hyphen Media Institute social media platforms.

Initially, I had also planned a closer involvement with the Chancellors College, University of Malawi through Professor Wapu Mulwafu who had been the academic partner of UNHIDE and INHABIT. However, the location of the campus in Zomba (five hours drive from Lilongwe) made the collaboration impractical.

3.5 Adaptations to the research proposal

Different scholars have raised attention to the need to remain flexible when conducting fieldwork (e.g. Billo and Hiemstra, 2010). Billo and Hiemstra (2010) suggest it is important for PhD students to "learn to think about the proposal as an adjustable, evolving template in the field, instead of a finished document" (p. 317). They also note a reflexive approach is required to "assessing the acceptable limits of possible changes" (p. 314). Flexibility was particularly important for a project like this that centred the everyday realities of residents at the core of data collection and analysis and aimed to remain as much inductively open as possible to insights coming from ongoing interactions with research participants. As fieldwork progressed, I saw the need to make three main adjustments to the project proposal I developed during my first PhD year. These adjustments were discussed with my supervisors and made within the framework of the ethical clearance and risk approval received from the Faculty of Humanities at the University of Manchester prior to departure.

The first adaptation relates to the scope of the research. Initially, I had planned to focus on everyday experiences and practices to access water and sanitation and thus in my initial plan the fieldwork activities with residents had more weight than those with other participants. In Phase I of the fieldwork, interviews with residents soon revealed that challenges with water and sanitation did not depend on presence/absence of infrastructures but also related to how infrastructures were constructed, operated, and maintained (see Chapters 4 - 7). I had initially planned to conduct a few fieldwork activities with water and sanitation workers. However as those early stages of fieldwork progressed, this group of participants gained importance and so did the weight of their enrolment in data collection methods. In response to what I was finding in the field, I therefore conducted more activities with workers than initially planned.

A second adaptation relates to the location of the research activities. Initially the plan was to conduct most of the fieldwork activities in LIAs and particularly in Area 56 because this was the neighbourhood I was more familiar with. However, as I was moving throughout the city with sanitation workers, I realised that infrastructures (even on-site) were not bounded by neighbourhood limits and that multiple connections and disconnections existed between different infrastructures across various areas in the city. I also learnt that sanitation challenges were not only present in LIAs but also affected residents of planned areas. This meant the initial emphasis on Area 56 was expanded to incorporate other parts of the city such as Area 18 (see Chapter 7) and water and sanitation challenges were explored at citywide scale. Furthermore, one of my field assistants lived in Area 50 which meant I

could rely on her knowledge of the area and her networks of connections in the neighbourhood. For this reason, I decided to incorporate Area 50 as one of the field sites of the study.

A third adaptation relates to methodology. In the fieldwork plan I developed during my first PhD year I planned a very ambitious methodology that included a combination of traditional methods (semi-structured interviews, archival/desk-research, participant observation) with visual, and cartographic methods drawn from participatory research (GPS tracking, group discussions, auto-photography, photographic and video documentation, go-along interviews, sketches, and mental maps). These creative participatory methods were selected because they offered the possibility to put the knowledges and experiences of participants at the centre of the research (Gubrium & Harper, 2016). The exercise of planning the methodology expanded my knowledge about different methods that could be used in ethnographic research beyond the traditional semi-structured interviews and observation. Gaining ethical approval for this expanded set of methods, I explored the possibilities of these different methods during the first weeks of my fieldwork. However, as fieldwork was progressing, I decided to adapt the methodology by reducing the number of methods and focusing on those with which participants felt more comfortable and those that were yielding more interesting findings. For example, some participants felt hesitant when I requested that they draw mental maps of their water and sanitation infrastructures or sketches of their everyday water and sanitation practices which was the reason for dropping the of use of these participatory creative methods. GPS tracked walks in LIAs also was experienced at to exposing for both participants and myself as a researcher, which was the reason that this method was dropped from the final list. As a result of attuning to participant and researcher responses to methods, and a testing and trialling of methods used versus interesting findings gained, the initial selection of methods was reduced to those described in table 2 and this previous section.

3.6 Data analysis

Data analysis was inspired in inductive methodologies such as Grounded and Abductive analysis (Charmaz, 2014; Glaser and Strauss, 1967; Timmermans and Tavory, 2012) in three main phases (i.e. two preliminary phases and a core data analysis phase) to allow for iteration between theory and data (see Table 1).

The first stage of data analysis was conducted during fieldwork. Transcripts of interviews were preliminary read during fieldwork in search for interesting and surprising themes, as well as for information gaps, that could then be followed up in further iterations of data collection. These themes and gaps were continuously fed back into new interviews and data collection activities, shaping the direction of the research. A second phase of data analysis was conducted in the period of time between the first and the second part of fieldwork. In the second phase of data analysis all data collected in the first part of fieldwork was explored and a list of themes identified for further exploration in the second part of fieldwork. These themes were i) infrastructural pasts and futures, ii) infrastructural work/labours, iii) infrastructural failures, and iv) gender and infrastructures. The objective of these two phases of data analysis was thus to identify patterns and thematic areas to be reiterated into further fieldwork activities rather than to only interpreting findings.

The main phase of data analysis was conducted between 2018 and 2020 and was inspired by systematic thematic analysis approaches (Nowell et al., 2017). Analysis begun with an initial phase of immersion in the data in which all interview transcripts and other materials were carefully read and reviewed. In this stage I did not code the data, but I focused on identifying patterns and produced a preliminary list of descriptive codes that were further developed into more analytical codes in the following phase. The core analytical phase was dedicated to the iterative generation of bottom-up codes and themes using NVivo. In this phase four main themes were selected to be developed as the empirical chapters of this dissertation i) on/off-network sanitation configurations; ii) menstrual waste management; iii) gendered work at water kiosks; and iv) failing sanitation systems. These themes were explored in connection to the literature and the theoretical debates developed in Chapter 2 were selected in consequence to make sense of the data that was emerging from the field. Analysis did not finish at this stage, but it continued throughout the writing of each of the empirical chapters/papers. During the writing process I came back to the data several times with new, and with more refined questions as starting point for further analysis.

3.7 Ethical considerations

This research received ethical clearance by Faculty of Humanities at the University of Manchester (on advisement, it was not required to go through the full University Research Ethics Committee – UREC – process) and by the University of Malawi. Following this ethical framework, informed consent was acquired from all participants. I initially prepared

project information sheets and consent forms in English and Chichewa and always took printed copies with me to the field sites. However, after conducting a few interviews I realised these tools were intimidating for some participants living in LIAs many of whom were not able to write or read. Field assistants recommended to substitute printed forms for the recording of oral consent as a more suitable option for this context (as is common in research with low-literacy populations and in contexts where there are cultural preferences for verbal rather than written agreements see for example Tindana et al., 2006). At the beginning of the interviews, I introduced myself and the research project and verbal consent was recorded. Following the information on the information sheet and consent form, I explained to participants what was required from them, participants were given the opportunity to ask questions, and they were informed that they had freedom to refuse participation at any time. Written consent forms were still used consistently when deemed appropriate.

To ensure confidentiality, all participants have been anonymised by removing direct and indirect identifiers during the data collection phase. All names used in the dissertation are pseudonyms. In some cases, interview excerpts required information about the professional identity of participants (e.g. type of organisation they belong to or whether they were in a managerial vs operator role). However, this information has been provided in ways that does not make identification of participants possible by being cautious about the description of their professional roles, and organisational affiliations. Visual materials (e.g., photos in the previous sections and throughout the chapters) have been edited to ensure no identifying information is visible.

Prior to starting fieldwork, I thought sanitation practices could be a difficult topic to discuss as I thought that participants may feel shy or uncomfortable sharing this type of information. However, in practice this was not the case. My experience was that participants were very welcoming of our talk, open in their answers and willing to share their experiences even when I thought some of the questions may be received as 'awkward'. Previous discussions with field assistants were key to identify local taboos and cultural issues and helped to anticipate uncomfortable situations. Furthermore, field assistants made all possible efforts to create a friendly and non-judgemental environment which had very positive effects in the interaction with participants.

I acknowledge the importance of considering the ethics of research beyond institutional formalities (c.f. Sultana, 2007). Rather than approaching ethics as a questionnaire to fill prior to fieldwork, or forms to fill in while in the field, I have been inspired in postcolonial

feminist researchers to adopt a reflexive approach to ethics throughout the whole PhD journey (e.g. England 1993; Krusz et al, 2019; Moss et al, 2002; Nagar 2002; Sultana 2007; Staeheli and Lawson, 1994). This includes a careful consideration of power relations that shape ethnographic fieldwork as well as a continuous reflection on the effects of my positionality in research outcomes, questioning my role in reproducing dominant politics of knowledge production and considering the potential implications of my work in, and responsibilities with, research participants (during and beyond data collection).

3.8 Methodological limitations

The main limitations of this research project are as follows. The first limitation is related to my positionality as a female white foreign researcher from a British university conducting fieldwork in the LIAs of Lilongwe which produces fieldwork power relations that need to be accounted for during research design and in the reflection about the research outcomes (cf. Kwame, 2017; Wolf, 1996). This positionality situated me as an outsider in relation to research participants in LIAs but also granted me access to some spaces and discussions that a Malawian researcher may have not had access to while restricting others. For example, women in LIAs were curious to speak to a foreigner but reticent to share information about the cultural meanings of menstruation for fear a foreigner may be prejudiced or not understand them.

The second main limitation is related to my lack of knowledge of Chichewa, the language in which most the interviews were conducted. At the time I conducted fieldwork I had a basic knowledge of Chichewa that allowed me to greet participants, introduce myself and describe the main topic of research which was welcomed by participants and helped to create a good environment and rapport with them. However, I had to rely on field assistants for the translation of the conversation which may have limited the depth and richness of the discussion.

The third limitation relates to conducting ethnographic work with 'research fatigued' communities (Kalinga, 2019). While Lilongwe and Area 56 and Area 50 cannot be characterised as over-researched locations, most participants had previous contacts with foreign researchers or development workers (whom they often lump all together in one category). As Kalinga (2019) identifies participants from such communities may grow in frustration after several encounters with foreign researchers or development workers that

have not had improved their situation. These previous encounters may impact the type of responses they give in interviews (e.g. giving rehearsed answers) (Kalinga, 2019). To work around these three limitations, I drew on the support of field assistants and tried to create a space for continuous and sincere communication with the participants. I was also honest with participants, emphasising that my role as an academic/researcher was different than that of a development worker i.e. understanding the challenges rather than bringing solutions. It was also this awareness of extractive research and research fatigue that led to the engagement with secondary data analysis presented in the previous section.

However, this approach of emphasising my positionality as research and not development worker did not mean I did not seek ways for the research to be engaged and make a difference where it can. The project was underpinned by an interest to produce research around water and sanitation that could contribute to theoretical contributions to ongoing scholarship theorising urban infrastructures from the global South (see Chapter 2) and at the same time responsive to local realities and needs (cf. Ernstson et al., 2014). However, a further limitation in this regard relates to the short nature of the project bounded by the timeline of a PhD and limited funding that made it difficult to sustain long-term engagement with participants and local stakeholders. For example, timeline, budget, a period of maternity leave and infant childcare, and restrictions for travel during the Covid-19 pandemic constrained the possibility to conduct a planned final trip to Lilongwe for in-person dissemination of results among stakeholders and feeding back to communities. However, as described in section 3.4 other strategies were adopted to ensure that the research was disseminated in a way that could influence local debates and activities. For example, Charles Mkula has played a key role in identifying the policy spaces and public debates in which the findings of the research could be useful. In our collaboration while I have focused on developing academic outputs, he has been able to write up or articulate the data in suitable and meaningful ways for different local audiences (e.g. participated in water and sanitation local forums and meetings with communities) or use it to inform his journalistic writing.

Despite the limitations that have reduced my possibilities for participating actively in the dissemination of results in Malawi, I have produced two dissemination pieces with the aim to spark debate on the research findings among non-academic actors. These include a creative piece and a blog. The cartoon entitled Gender relations and infrastructural labours at Lilongwe's Water Kiosks was developed in collaboration with an artist (Catalina Medarde) and presents the findings developed in Chapter 6 (see Appendix 4) and was published in a non-academic magazine (De Coss-Corzo et al., 2019) and selected to be part

of the Illustrating Anthropology Online Exhibition supported by the Royal Anthropological Institute (https://illustratinganthropology.com). The blog was co-written with Deljana Iossifova as part of the University of Manchester 2020 World Water Day Campaign (see Appendix 5) and reflects on some of the dissertation findings in a lay style.

In relation to the specific themes explored, I found two main limitations. First, while sanitation was a topic easy to talk about with participants (previous section), menstruation (Chapter 5) is considered an intimate experience and surrounded by cultural beliefs and stigma which required extra efforts from my and field assistants' side to creating a space of trust and care for participants in interviews. Second, the Area 18 sewage contamination incident (described in Chapter 7) was being litigated in the High Court of Malawi during the fieldwork period. The residents of Area 18 who I approached feared that information disclosed could be used against their case and refused to be interviewed. To minimise this limitation, I have used secondary data (publicly available and data collected by the research team of the previous projects I was part of) and conducted a few informal interviews that I have used as background information.

Finally, the outcomes of the research have also been shaped by the design of the project following an inductive methodology. Fieldwork was designed to ensure I would remind inductively open to insights from the data. This means that the themes of the empirical chapters and papers were only decided after fieldwork was completed. While somewhat mitigated by use of secondary data analysis and collection and analysis f policy and other archival and online evidence, a critique of this approach is that it means that each of the themes of the empirical papers could have been explored more in-depth had the interviews and other data collection methods been designed with these specific themes as the starting point. However, the strength of this design is that it allows a bottom-up theorising and the alignment of research outputs with the interests of participants and related stakeholders who invested in the research process.

3.9 Overview of empirical chapters

Chapters 4 to 7 explore the history and use of a dual sanitation system; the socio-materialities of menstrual waste management; the operation of the water kiosk system; and the experiences of living with fragile sanitation infrastructures. Together these chapters show the multiple instances in which access to water and sanitation is challenged by failing

infrastructures. These failures include temporal malfunctioning such as interruptions in the service or the collapse of latrines (Chapter 4, 6 7) or the inability to meet specific (gendered) cultural or bodily needs (Chaper 6 and 7). The chapters reveal the historical legacies, social power relations, and cultural dynamics underpinning these failures and expose the unequal experiences of failure across heterogeneous infrastructural landscape and intersecting social identities; the (intersectionally gendered) labours that keep infrastructures at work; and the locally grounded practices and solutions developed by residents to address different infrastructure failures.

Chapter 4.

On/Off-Network Sanitation Configurations: Local Histories and Current Practices

4.1 Publication information

Authors contribution: Cecilia Alda-Vidal (90%), Alison L. Browne (5%), Deljana Iossifova (5%)

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4.2 Abstract

In the face of recurrent water shortages middle- and high-income residents of Lilongwe have developed a locally grounded solution to partially inoperative flush toilets. Through a focus on lived experiences, we explore how this dual infrastructural configuration, consisting of the combined use of indoor flush toilets and backyard latrines, is challenging professional imaginaries of urban sanitation, and how it helps residents to address different risks and sanitation needs. Drawing on the experience of Lilongwe, we reflect on what can be learnt from this infrastructural configuration in terms of planning for more resilient water and sanitation services in global South cities and beyond.

4.2 Introduction

Extreme droughts such as those suffered since the beginning of the century in Australia, Brazil or South Africa have signposted the serious risk climate change poses for urban water and sanitation infrastructures. Different social sciences scholarship concerned with how to secure water and sanitation services have remarked the importance of paying attention to everyday life as a source of information for climate change water and sanitation services adaptation (Kadibadiba et al., 2018; Rodina et al., 2017). Examples of this approach are SPoWD in high income countries that have shown how the lived experience of scarcity prompts the adoption of water saving practices and strategies (Allon & Sofoulis, 2006; Head & Muir, 2007; Lindsay & Supski, 2017; Sofoulis, 2015; Strengers & Maller, 2012) and challenged systems of service supply focused on creating the illusion of abundance for their role in disabling the adaptative capacity of water users (Sofoulis, 2005; Strengers & Maller, 2012). From a global South perspective scholarship inspired in African Urbanism has called attention to the importance of considering situated adaptative knowledges and practices as a starting point to reimagining more locally-grounded paths

for urban (water) resilience (Rodina et al., 2017; Ziervogel et al., 2017). These approaches resonate with existing scholarship documenting the heterogeneity of water and sanitation infrastructures in global South cities and producing explanatory frameworks that are more situated and grounded in local everyday realities (Ahlers et al., 2014; Furlong & Kooy, 2017; Lawhon et al., 2018; Monstadt & Schramm, 2017).

Residents of Lilongwe, the capital of Malawi, suffer intermittent water supply that not only compromises household water security and health (Adams, 2017; Rusca, Boakye-Ansah, et al., 2017; Velzeboer et al., 2017) but also complicates the operation of waterborne sanitation systems. In these conditions, middle and high-income residents have developed a dual sanitation infrastructural configuration to cope with water shortages that consists of the combined use of on/off-grid infrastructure (i.e., indoor flush toilets and backyard latrines)[7]. Through an analysis of the everyday lived realities and experiences of this dual infrastructural configuration we contribute to scholarship explaining how infrastructures work in global South cities beyond the western models such as the networked infrastructural ideal (Jaglin, 2014; Lawhon et al., 2018) and the call to examine "different artefacts in relation to each other and social relations" (Lawhon et al., 2018, p. 7).

The resultant configuration of sanitation infrastructures is far from perfect (latrines are proven to be problematic for public health in high density contexts) but provides a more realistic vision of how sanitation infrastructures work for these residents and sheds light on the diverse functions different on/off-grid sanitation technologies fulfil beyond the management of human excreta. We do not intend to argue in favour of a particular technology or infrastructural configuration. Rather we remark how important it is for urban planning to acknowledge that the provision of resilient urban services in many contexts requires compromises (latrines are not the safest but could help in situations of water scarcity and to address different social and bodily sanitation needs) and that it is essential to seek ways to incorporate locally-grounded solutions of residents instead of ignoring or rejecting them because they do not match infrastructural imaginaries and ideals (Rodina et al., 2017; Ziervogel et al., 2017).

The paper is structured as follows. Section 2 introduces the resilience and other challenges of water-based sanitation systems and sets our conceptual framework inspired in three main bodies of academic work: SPoWD, contributions to urban (water and sanitation) resilience

[7] This type of on/off-grid sanitation configuration has been documented in other Malawian (Tchuwa, 2014) and African cities (Marks et al., 2020)

from African Urbanism, and everyday analyses of water and sanitation infrastructures in African cities. Section 3 and 4 describe our methodology and introduce the landscape of water and sanitation infrastructures in Lilongwe. In section 5 and 6 we explore how this locally grounded adaptation has emerged and the multiple functions it fulfils for residents. We show how in seeking solutions for water shortages and partially inoperative flush toilets residents challenge professional imaginaries of urban sanitation. We conclude with a set of reflections on what can be learn from this locally grounded sanitation infrastructural configuration for the planning of more resilient water and sanitation services beyond infrastructural ideals.

4.3 The challenges of water-based sanitation systems

Conventional water-based urban sanitation systems (flush toilets connected to a sewer network or to a septic tank) have been classified as the sanitation technologies with lowest climate-resilience (Howard et al., 2010; Luh et al., 2017). Flush toilets are one of the most water-intensive devices in households consuming between 6 to 10 litres per flush and 15,000 litres per capita/year (Jewitt, 2011). Conventional sewers require a continuous input of water (from flush toilets) to ensure the correct operation of the system as low flow produces "blockages, odour and degradation of the wastewater in the conveyance systems and operational and compliance issues at the plant" (Water Research Commission, 2018, p. 14). There are also questions around the risk of pollution produced by the untreated discharge of sewage in water bodies across the world (SDGs Knowledge Platform, 2019). In global South contexts sewer networks present further challenges. The huge investments required to put them in place are constrained by lowering trends of financial aid and the opportunities for utilities to recover costs. Furthermore, retrofitting sewers in areas that have already been developed (e.g. informal areas) also presents difficulties related to the material characteristics of this infrastructure (e.g. large pipes, design that ensures gravity flow).

Social sciences research on the topic has shown that alternatives to waterborne sanitation systems are limited by the materiality of infrastructural legacies and the social practices and expectations generated around them (Fam et al., 2009; Morales et al., 2014; Nilsson, 2006). Sewer systems present high path-dependency and inertia (Hommels, 2005; Star, 1999) and the high sunk costs incurred in these infrastructures complicate their substitution for other technologies (Nilsson, 2006). Moreover, the social meanings associated to flush

and discharge systems (i.e., modernity, wealth, urbanity, citizenship, etc.) exclude other technologies from residents' definitions of what constitutes appropriate urban sanitation (Morales et al., 2014). Initiatives as the 'Reinvent the toilet' challenge have attempted to diversify sanitation technologies through technological innovation in off-grid solutions that do not require connections to water lines or sewers. However, these are still incipient and urban and sanitation planners often prioritise, or have long term aspirations over, the construction of piped sanitation systems[8], particularly in planned urban areas, as many off-grid technologies do not provide an easy solution for grey water and require citywide systems to collect, transport and treat the faecal sludge.

4.4 Water resilience through SPoWD and African Urbanisms lenses

Our conceptual framework is inspired by three bodies of social sciences scholarship that have recognised the value of engaging with everyday water and sanitation practices. First, SPoWD exploring how practices change in response to resource disruption. This body of work emerges from a range of theories of social practice which explore the socio-materialities and practices that underpin water demand (derived from cultural studies, social and cultural geography, the sociology of consumption). As a corpus, this scholarship has linked the emergence of household adaptative capacities such as the adoption of less water intensive practices or water saving technologies to residents encounters with drought and past lived experiences of resource scarcity (Allon & Sofoulis, 2006; Head & Muir, 2007; Strengers & Maller, 2012). The majority of this work has been developed in the context of high-income countries such as Australia, and focuses on the adoption of water saving strategies for gardening and the use of water storage tanks (Lindsay & Supski, 2017; Maller & Strengers, 2013; Sofoulis, 2015; Strengers & Maller, 2012).

Less attention has been paid to household adaptative capacities in relation to sanitation and to explore what households do with one of the most water intensive devices - the flush toilet - when exposed to recurrent or intense water shortages. The exception is a study conducted by Kadibadiba et al. (2018) who used a social practice approach to document a

[8] This prioritisation and long terms aspiration are visible in the many projects to extend sewer systems that have recently been signed in urban Africa e.g. Lilongwe (World Bank, 2017) and urban master plans that project the long term expansion of centralised sewer systems e.g. Lilongwe (LCC, 2010)

range of different toileting strategies adopted by Gaborone's residents during a long-term event of drought. These included avoiding urination, reducing flushing (with an associated reduction on toilet cleanliness standards), using rainwater and grey water from bathing and laundry or purchased recycled water to flush the toilet (Kadibadiba et al., 2018). Similar coping practices were documented during the Cape Town's water crisis, where higher income people with access to flush toilets tended to limit to a one-flush a day or used similar water recycling strategies to flush the toilet (Shepherd, 2019). This focus on everyday coping or adaptative practices and strategies has been helpful to challenge mainstream policies that attempt to secure water and sanitation service provision through infrastructural interventions that maintain an illusion of endless supply, and to advocate for policies that incorporate the existing resilience skills of water users (Allon & Sofoulis, 2006; Kadibadiba et al., 2018; Strengers & Maller, 2012).

A focus on the everyday adaptative capacities of urban residents has also been advocated by scholarship examining water resilience intervention from an African Urbanism perspective. This scholarship has highlighted that resilience interventions are dominated by expert-driven approaches developed "based on the experience and practices of cities in the global North" and often not attuned to the realities of other context where they are applied arbitrarily (Ziervogel et al., 2017, p. 123). In the context of lack of infrastructure and prevalence of informal services, situated adaptative capacities emerge out of necessity (Grasham et al., 2019; Rodina et al., 2017; Ziervogel et al., 2017) as people are "forced to encounter and respond to multiple threats and relentless challenges" (Ziervogel et al., 2017, p. 12). As this scholarship argues, it is important to pay attention to these grounded and experiential adaptive knowledges and other locally embedded sources of urban water and sanitation resilience beyond western infrastructural imaginaries (Rodina, 2019; Rodina et al., 2017; Ziervogel et al., 2017) and to "how these can be enabled and empowered, rather than eroded" (Ziervogel et al., 2017, p. 133).

This focus on everyday life resonates with the work of scholars exploring urban water and sanitation infrastructures in African and global South cities. Taking the everyday practices of urban residents as starting point, they have questioned the validity of Northern explanatory frameworks such as the Modern Infrastructural Ideal and preconceived ideas of formality/informality to understand how infrastructures work and what they mean for urban life and politics in global South contexts (and beyond) (Bakker, 2003a; Furlong & Kooy, 2017; Lawhon et al., 2014, 2018; McFarlane & Silver, 2017).

This scholarship has documented the "plethora of ownerships, users, technological artefacts, usages and temporalities" (Lawhon et al., 2018, p. 9) that constitute urban sanitation provision. In cities such as Lilongwe, Kampala, or Maputo rates of coverage of waterborne networked sanitation are under 10% (Brown, 2014; Weststrate, Gianoli, et al., 2019). The vast majority of urban residents (often poor and inhabiting informal spaces) combine a wide range of non-networked sanitation technologies (e.g. from different types of latrines, to portable toilets, to buckets and plastic bags) and service provisioning arrangements (e.g. from self-help, to community based, to entrepreneur provided) (Ahlers et al., 2014; McFarlane et al., 2014). They have revealed the power relations that shape residents' access to sanitation (Desai et al., 2014; Mcfarlane & Silver, 2016) demonstrating that for residents sanitation means more than the management of human excreta (Mcfarlane & Silver, 2016; Morales et al., 2014). As they have shown, sanitation technologies are often entrenched in ideas of modernity and economic success (Botha, 2018; Gandy, 2004; Iossifova, 2015; Morales et al., 2014) and entangled in low-income residents aspirations for political recognition and a better life (Desai et al., 2014; Mcfarlane & Silver, 2016; Penner, 2010; Robins, 2014).

However, most of the work on sanitation infrastructures in global South cities with an everyday approach has examined access to sanitation in spaces beyond the network, in informal spaces or at the margins. This contrasts with research on water supply that has shown that everyday strategies including the use of redundant solutions are also present in networked and formal spaces of the city. In these areas, those who can afford it supplement the piped water service with storage tanks, rain water collection, suction pumps, water tankers, or bottled water (Alba et al., 2019; Button, 2017; Furlong, 2014; Nganyanyuka et al., 2014; Smiley, 2013). Some of these overlapping strategies have implications in terms of reproducing urban inequalities. For example, the use of suction pumps or storage tanks may reduce the flow of water to those users at end of pipe locations (very often in periurban or informal areas) (Anand, 2012; Björkman, 2018; Talozi, 2018; Truelove, 2019a). However, coexistence of piped water with other sources also allows users to sustain access during recurrent water shortages or chronic infrastructural failure and enables them to maintain independence from providers and reduce costs (Furlong, 2014).

Exploring the sanitation configuration developed by Lilongwe's residents through these three bodies of work provides different insights on how and why this infrastructural configuration has been produced and maintained beyond infrastructural ideals; for whom it works; and how it could be made to work in order to support more resilient urban water and sanitation services.

4.5 Methodology

Data collection for this project was undertaken in two three-month periods during 2017 and 2018. Methods involved participant observation, semi-structured interviews, mobile-methods, and photo-elicitation. Participants included residents in planned areas and Low-Income Areas (LIAs) (50 interviews), stakeholders (26 interviews), sanitation workers (20 interviews), health workers (5 interviews), and community leaders (15 interviews). Furthermore, the main urban plans (e.g. urban plans, zoning schemes, municipal standards) and water and sanitation project documents (e.g. project reports, master plans, feasibility studies) over the last 50 years were gathered and reviewed through archival and desk research. These data collection methods provided an overall understanding of the history and landscape of sanitation infrastructures, as well as the main sanitation challenges as lived by residents and perceived by other sector actors.

The design of the research project was inspired by inductive approaches such as Grounded and Abductive (Charmaz, 2014; Glaser and Strauss, 1967; Timmermans and Tavory, 2012). Data collected was preliminary coded during fieldwork in search of specific surprising, interesting, or recurrent themes that became the basis for further exploration and were re-iterated into more specific research questions and used to assemble the theoretical framework of the project. One of these themes related to the effects of water shortages in water-based sanitation systems and the use of a locally grounded sanitation solution to these water scarcity challenges. The decision to explore this topic further was also prompted by the interest of the first author. The dual configuration of flush toilets and latrines was commonly discussed in interviews while at the same time completely absent in formal descriptions of the sanitation infrastructures in the city. As a water and sanitation expert this infrastructural configuration challenged her own assumptions of how waterborne sanitation works and what infrastructures can be expected in different urban spaces.

Interviews were conducted with the support of field assistants in English or Chichewa and translated to English. Some interviews were tape recorded and transcribed directly from the English translation, and some interviews summarised from handwritten notes. Participant names have been anonymised to preserve confidentiality.

4.6 Lilongwe's infrastructural landscape

Water and sanitation infrastructures and levels of service provision are highly differentiated between the planned areas and the LIAs (Alda-Vidal et al., 2018; Rusca et al., 2017; Tiwale et al., 2018). In the planned areas most households are connected to the municipal piped water system operated by municipal water utility (Lilongwe Water Board, LWB) and make use of water-based sanitation technologies. Of these, the majority of households have a flush toilet connected to a septic tank (25% of the urban population) and only a few are connected to the piped sanitation network that provides coverage to some of the planned areas of the city (5%) (World Bank, 2017). Although water-based sanitation technologies are usually considered improved sanitation, in Lilongwe, the lack of maintenance of septic tanks and the dilapidated state of the sewer system and the wastewater treatment plant result in most sewage being discharged into the environment untreated, contributing to environmental pollution and compromising the public health gains of these technologies (World Bank, 2017).

In LIAs most residents buy water from kiosks and combine it with other sources such as boreholes, wells or rainwater (Velzeboer et al., 2017). Only a few households receive piped water at home (Rusca, Alda-Vidal, et al., 2017; Velzeboer et al., 2017) and could thus potentially install an onsite flush and discharge sanitation system. Self-constructed dug pit latrines are the most common sanitation technology in these areas, providing access to 70% of the total urban population (World Bank, 2017). The inadequate construction and maintenance of latrines pose an important hazard for public health. Latrines are often located nearby wells used for domestic consumption, risking the pollution of these water sources (Rusca, Alda-Vidal, et al., 2017). Pit emptying services are scarce and expensive and some residents opt for adding water regularly to avoid the filling of the latrines with the increased risk for groundwater pollution. Furthermore, many of the latrines do not have a roof which is problematic during the rainy season when faecal sludge may be washed away by the rains and contribute to residents' exposure (Rusca, Alda-Vidal, et al., 2017).

4.7 The production of Lilongwe's water shortages and their implications for the urban waterborne sanitation systems

Lilongwe has experienced rapid population growth since the relocation of the capital after the independence of the country: from 20.000 inhabitants 1966 to close to a million in 2018

(Tiwale et. al 2018; NSO 2018). As Tiwale et al. (2018) describe, over fifty years, tremendous and never-ending efforts have been put into constructing and upgrading the municipal water infrastructures to keep up with population growth. Municipal water supply capacity has increased from 2,250 m3/day to 125,000 m3/day[9] through investment in large scale infrastructures such as dams, treatment plants and water towers and tanks. As they argue, the volume of total water produced by the city's centralised water supply system is enough to ensure universal access to all urban residents (Tiwale et al., 2018). Yet only 44% of the population enjoy in-plot or in-dwelling water connections (NSO, 2018). Furthermore, supply is often erratic, stopping without warning from anything between a few hours to a few days (Alda-Vidal et al., 2018; Tiwale et al., 2018). Water shortages are more frequent and last longer in LIAS (Tiwale, 2015, Velzeboer, 2015).

The water scarcity (or its unequal distribution) is underpinned by a conglomerate of socio-technical dynamics. These include seasonal dynamics affecting abstraction capacity from Lilongwe river (low flow in dry season, stilting during rainy season) (World Bank, 2017), the high rate of system water losses (World Bank, 2017), the unequal historical development of the network (Rusca, Boakye-Ansah, et al., 2017; Tiwale et al., 2018), and the prioritisation of customers in planned areas in LWB everyday operation and maintenance decisions and routines (Alda-Vidal et al., 2018). Distribution of water through the network is complicated by the increasing national energy security challenges. The municipal water system requires continuous power supply to pump water all the way from the river to the balancing reservoirs. Over 95% of the energy of the country was generated from hydropower plants. The low rainfalls registered in 2016 and 2017 meant a reduction of up to 40% in the national electricity generation capacity (ESCOM, 2017). As a result, a strict load shedding program was put in place in the second half of 2017 seriously compromising the distribution of water. During interviews, LWB operators explained that due to electricity rationing program some pumping stations remained inoperative for up to 24 hours. Malawi has been suffering severe droughts with increasing frequency and the country has been ranked as highly vulnerable to climate change (World Bank, 2017). Demand for water is only expected to grow in the coming years and water (and electricity) shortages to become more severe (World Bank, 2017).

Intermittent supply has important implications for the urban waterborne sanitation systems. As explained by a sewer operator, "the sewer system requires a continuous flow of water. When water stops for several days and toilets are not flushed, the solids in the sewer lines

[9] Although only 90,00 m3/day are operational (World Bank, 2017)

are not washed away and produce blockages" (Go-along, Sewer worker, Man, 2017). Furthermore, water shortages mean that flush toilets remain non-operational for hours or days, interfering with residents' toileting routines. A resident of area 18 explained that when there is no water supply, they avoid using the toilet as much as possible (Interview, Resident Planned Area, Woman, 2018). As a participant explained "our flush toilet needs water, without water the toilet stinks" (Interview, Resident Planned Area, Woman, 2018). A different participant commented, "when there is no water the house smells because of unflushed toilets, unwashed items and all other things that require cleanliness" (Interview, Resident Planned Area, Woman, 2018). As elaborated in more detail in Section 4.8 and 4.9, many residents store water to be flushed down the toilet during water shortages and those who can afford it are opting for constructing back up latrines to avoid the annoyances of non-functional and smelly toilets, and the increased labour and cost of bringing and storing water to be flushed down the toilet.

4.8 Formal and local histories of urban sanitation infrastructures development

4.8.1 Professional expectations and imaginaries of sanitation development

The review of urban sanitation planning documents and the interviews held with municipal officials reveal, there is a contradictory discourse about the use of latrines as a suitable sanitation solution for the city, and in particular for planned areas. The last Urban Master Plan recommends avoiding sanitary latrines in areas with population density above 10 persons/ha "to ensure the prevention of pollution to the surrounding environment" (MoLGRD, 2010, p. 8-2). Current urban densities are over 30persons/ha this means these technologies are not seen as a desirable solution as they present high risk of contamination (MoLGRD, 2010). However, as this and other urban and sanitation planning documents show the acceptability of this sanitation technology in a particular location depends less on technical dimensions (risk of contamination, population density) and more on how these plans value the adequacy of different technologies to different urban spaces and ways of life.

While not framed as a desirable solution (MoLGRD, 2010), in the 2010 Urban Master Plan and the last Lilongwe City Development Guidelines and Standards (2014)[10], latrines are recommended as a temporary solution in LIAs due to the lack of ability of residents to afford any other technology or the capacity of LCC to extend the sewer there in the mid-term (MoLGRD, 2010). As shown in Table 3 the draft Guidelines and Standards incorporate a range of different sanitation technologies that are considered suitable for both the planned City and the LIAs (from improved latrines, to composting toilets, to septic tanks or centralised sewer) (LCC, 2014). However, these technologies are hierarchically organised (i.e., waterborne sanitation is considered the best possible solution) and differentiated across urban spaces (i.e., Improved latrines only accepted in in LIAs).

Table 3 Practical wastewater management options by area type
(Extracted from LCC, 2014, p. 3-3)

Area Type		Recommenced Wastewater Treatment and Sanitation Options
Residential * Note 1	Low Density	Septic Tank (or sewer connection where septic tank cannot function well and where they already have branch sewers at adjoining roads) * Note 2
	Middle Density	
	High Density (Other than THA and Quasi-Residential)	
	THA	Septic Tank if having individual water connection (or sewer connection where septic tank cannot function well and where they already have branch sewers at adjoining roads); otherwise Improved Latrine + Graywater Treatment Facility
	Quasi-Residential (originally unplanned area)	Septic Tank if having individual water connection; otherwise Improved Latrine + Graywater Treatment Facility

* Note 1: In residential areas, composting latrines with above ground vaults (e.g. Sky Loo) may be used where septic tank or other types of on-site sanitation with soil absorption cannot function well due to low permeability of soil, high groundwater level, water logging, steep terrain, etc.

Interviews show that municipal sanitation professionals would ideally like to see the sewer system extended to the whole city, including LIAs,

> *"We look at sewer as the best option, especially in the high-density areas. Unfortunately, there are some cases where, as of now there is no way you can go and connect them to sewer because they have already built there"* (Interview, Stakeholder, LCC official, Man, 2017).

Paradoxically, public investments in urban sanitation have been very limited in the past 50 years and mainly focused in the planned areas of the city. As the LCC official later

[10] This is a draft document and has not been officially adopted yet.

explained, there is certain expectation that residents' in LIAs would naturally move from basic sanitation technologies to waterborne sanitation as their financial situation improves:

> *"We leave the process run itself, whereas the town expands people see also the need to coming up with better structures than what they are using. Even the structures of those areas do not come through an application as in other areas people do. The time the areas are growing people is using better methods. Even in informal settlements there is people using septic tanks."* (Interview, Stakeholder, LCC official, Man, 2017).

This acceptance of latrines in LIAs contrasts with the approach in planned areas. In planned areas the construction of latrines is restricted by the 1987 Town and Country Planning Guidelines and Standards, still in in use today. As the guidelines indicate "in urban areas all permanent developments must have waterborne toilet facilities drained to a septic tank and soakaway within the plot or to a sewer, to the approval of the local authority" (Government of Malawi, 1987, p. 2–15). The lack of compliance with these requirements or the inclusion of infrastructures that do not meet these requirements in the projects such as latrines would mean the local authority, in this case, LCC would not consent the project. This is illustrated in an interview excerpt with a LCC official conducted by Langkau (2016):

> *"So, as we look at the plan, we will look at the workability say in terms of traffic flow, positioning of septic tank, if you want it at the back of your house, is it possible to empty it when it is full? How is the storm water drainage within your plot...? And if you put in this plan a pit latrine you will not be allowed [to carry on with the construction]"* (Interview with LCC official as quoted in Langkau, (2016, p. 42).

Although interviews show that sanitation engineers know backyard latrines are widespread in use, this sanitation solution is not accounted for or even mentioned in any urban or sanitation planning document and the official approach is that their existence should not be accepted. As an MHC official stated:

> *"MHC does not have pit latrines, some people might have because of the water problems we have, but we do not advocate for that (...) Even people building their own houses in MHC plots, they need to bring their plans to MHC and LCC… There are standards… MHC has estate officers moving*

around and checking that there are no pit latrines" (Interview, Stakeholders, MHC official, Man, 2017).

As shown in this section, Lilongwe's urban planning, as most urban planning through the 20th Century, has been guided by a Technocratic Perspective that privileges expert knowledge and expectations of urban development (Moroni, 2018). As we will further describe below the sanitation imaginaries (lineal, hierarchical) held by planning documents and municipal officials do not match the everyday trajectories and realities of sanitation development in the city. These imaginaries are rendering invisible a sanitation infrastructural configuration that while not devoid of challenges is also providing a solution to different sanitation and water scarcity problems.

4.8.2 The local histories of a dual sanitation system

Participants explained in planned areas, backyard latrines are a legacy of the colonial architectural landscape of the city. In Lilongwe and other cities in sub-Saharan Africa, the so-called *Boys or Servants' Quarters* were built to host (African) domestic workers employed by colonial masters and still remain a common architectural feature in middle- and high-income areas (Ginsburg, 2000; Hansen, 1992; Harris & Hay, 2007) (see figure 23).

Figure 23 Aerial view of Middle-Income Area Lilongwe. Main houses and Boys Quarters. Produced by Alda-Vidal based in © 2020 Google Maps.

Over time Boys Quarters have acquired new uses, they may be constructed to host domestic servants or to be used as a guest wing, storage space, or as self-contained rental. Many are also now fully plumbed and integrated to the main house (waste)water system, while others

are still constructed with access to basic sanitation technologies (outdoors latrine and yard tap).

As explained by one of the interviewees,

> *"Once you have bought a place the first thing is to see where the person who will be looking after it will be staying, let's say, building a small house or we can say a Boys Quarter and a latrine for him to be using it"* (Interview, Resident Planned Area, Woman, 2018).

Backyard latrines are usually built in empty plots during the construction of new houses by masons for their own use, and later retained by plot-owners for houseworkers or as a secondary toilet. A participant who got a latrine constructed in his empty plot for the use of construction workers explained,

> *"When constructing a house, it is a must to have a latrine for the people who have been hired to be working on the place to use it and after the house is constructed, it is when the owners have to decide whether to leave or close the latrine"* (Interview, Resident Planned Area, Woman, 2018).

More recently some residents have started purposely opting for including these combined sanitation configurations (backyard latrine and indoors waterborne system) in newly constructed houses as a response to water challenges. This was the case of a participant who constructed a new house a few years ago in a middle-income residential area in the outskirts of the city. Like other neighbours he decided it was a good idea to have a latrine constructed in the backyard along with the septic tank since he started planning the new house. As he put it "*if you rely only on one type of toilet it will be a problem, so you have to construct both*" (Interview, Resident Planned Area, Man, 2018).

In LIAs the history of the dual system follows a different trajectory. Some wealthier residents have been able to invest in upgrading their sanitation infrastructures and installed waterborne sanitation systems (flush toilet and septic tanks). As we will further elaborate in the next sections, the convenience of having an indoors sanitation facility as opposed to having to use the outdoors latrine and bathroom, (whilst possibly not the only reason) featured high in the explanations provided by residents as to way the decided to invest in a

water-based system. However, interviews show that upgrading to a new type of technology does not imply latrines are abandoned. In interviewees residents explained that household sanitation upgrading is often done incrementally. Residents started with a pit latrine and as houses were being renovated or extended, septic tank and inside bathrooms were constructed and the sanitary plumbing installed progressively over years according to their savings. This was the case of one of the participants. The house where she and her family lives in Area 56 was constructed in 2004 and at that time the family used the outdoors latrine and bathroom. Ten years later when they renovated the house, two indoors bathrooms and a septic tank were constructed. As she explained, it was planned that both bathrooms, the one in the master room and a second bathroom, meant to be used by the children, would be connected to the septic tank. However, the money ended, and the second bathroom was never completed remaining to date non-operational.

Similarly interviews revealed that flush toilets and septic tanks were often installed before the municipal water network arrived in the area. This means, in some cases, residents have operated the flush toilets by pouring water manually for years. This was the case of a Participant who moved to Area 56 20 years ago when there were very few people living there. As she recounted, the family decided to construct a permanent house with indoor bathrooms and a septic tank even though the LWB water pipes had not reached her neighbourhood yet. Despite installing an indoors waterborne system the families of these participants, like other families, had continued using the outdoors latrine.

These local histories of domestic sanitation infrastructures show that often infrastructures do not adjust to formal plans. In Lilongwe, upgrading of household sanitation is done incrementally and implies the use of redundant technologies. The way these infrastructures are constructed challenges widespread professional assumptions emphasising linear development in sanitation from low to high standard artefacts (from latrines to flush toilets). As we will further elaborate in the next sections, residents instead gravitate from one technology to the other as they fulfil different bodily and social needs. Furthermore, these everyday histories of sanitation infrastructural construction reinforce what others have shown: infrastructures (even presumably obdurate and stable waterborne sanitation systems) are often in a permanent state of incompleteness and open to be adapted to the changing needs of residents.

4.9 The everyday experiences of using a dual system

4.9.1 Dealing with uncertainty

Interviews show that due to increasing water shortages, many residents in planned areas have had to resort to storing water for drinking and other domestic purposes, including flushing the toilet. Many households collect water in containers of different types and sizes during service hours while some wealthier residents are opting for constructing storage tanks. However, household storage capacity is not always enough. When shortages last longer than expected, some residents must look for alternative sources. As Agnes, a domestic worker who is employed in a house in Area 18, where they have a flush toilet connected to the sewer system, explained: when LWB water stops she must walk down the road to an area where there are vegetable gardens and ask for permission to collect water from a well where she is given the water for free. She then carries back a 20 litre bucket up the road to ensure everybody can use the toilet normally. Bringing water to flush down the toilet adds to the gendered households' labours bore by low-income women. Furthermore, while Agnes gets the water for free many other residents may have to pay for it.

This was the case for a Participant. The family has a flush toilet connected to a septic tank and backyard latrine. When there is no water supply, they get it from a nearby borehole. However, as she explained, at the borehole there are often long queues, and they must pay for it. For this reason, they only use borehole water in the toilet for emergencies or at night when they cannot use the backyard latrine.

Even wealthier residents who have been able to afford a storage tank are facing challenges to keep toilets working. As a participant, who has a storage tank at home explains, it is never certain when the water supply will be restored and for that reason, they "*try to be careful using the stored water and prefer to save it for other purposes rather than using it to flush the toilet*" (Interview, Resident Planned Area, Man, 2018). Coping with frequent and long water shortages was the reason why apart from the storage tank his family decided to construct a backup latrine in the yard. As this shows, in a context of intermittent water supply the combined sanitation system becomes for some residents' part of the range of household artefacts and practices to deal with long term water uncertainty.

For interviewees, this dual system helps not only with the uncertainty produced by erratic water supply but also to avoid unexpected water bills. As a participant explained, "*when you use the flush toilet, you use the water that is in the cistern. That means five litres each*

time" (Interview, Resident Planned Area, Woman, 2018). She feels this is a cost she can save sometimes by using the outdoors latrine. As interviews with residents revealed, some families decide to completely shift from one technology to the other or to restrict the use of the flush toilet to certain members of the family (children are sent to the latrine) or times of the day (flush toilet is only used at night) depending on their economic situation and other reasons.

4.9.2 Convenience, accessibility, and safety

While outdoors latrines provide an important solution when water stops, participants explained that given their design and location, indoor flush toilets are more convenient for some members of the household or at sometimes of the day. This was illustrated by an elder woman who lives in Area 18 in a house with a backup latrine in the yard. She explained that as an older person it is more comfortable for her to use the flush toilet (where she can sit down) than the pit latrine (where she must squat). A similar example was given by a woman who lives in a planned area. She has 3-year-old child who is still being potty trained, and the child only uses the indoor toilet under supervision regardless of whether there is water or not. As these examples show, outdoors latrines may be less accessible for children, people with difficulties to move such as the elderly, people with disabilities or those who are sick.

Interviews show that indoor waterborne facilities are also more convenient at night when visiting the latrine may be unsafe. Residents explained they fear to be assaulted on the way to the outdoors latrine or that thugs can take advantage of that moment to enter in the house (Interview, Resident LIA, Woman). For example, a woman who lives in a LIA, explained she was attacked by someone throwing stones at her when she was on her way to the outdoors latrine the middle of the night. She was so scared that when they moved to the new house, she decided they should construct an indoor bathroom. As feminist work in sanitation has pointed women depending on outdoor sanitation facilities often experience increased risk for gender violence including harassment and sexual assault (O'Reilly, 2016; Schmitt et al., 2018).

4.9.3 Urban social relations and cultural meanings

Interviews show that outdoors latrines fulfil important functions in relation to urban social relations and cultural meanings of sanitation. The location and design of the flush toilets restricts who is allowed to use this facility. As a participant explained,

> *"The (indoors) toilet is for the family, if someone ask to use it... we only allow people we know, people we are related to or friends only... if we don't know them, we don't allow them (to use it) because you never know if they are here to use the toilet or maybe they want to steal from us"* (Interview, Resident Planned Area, Woman, 2018).

Often this means domestic workers such as maids, watchmen, or gardeners who are not considered part of the family are required to use the latrine in the backyard. This was justified based in the different spaces of the house these workers have access to. As a participant explained: "*For the security guard, we all know that his duties are done outside at night, so we told him to use the (outdoors) latrine since he is already outside*" (Interview, Resident Planned Area, 2018). Other participants referred to the differentiated sanitation practices of domestic workers:

> *"{discussing about blockages in the septic tanks} Yeah, we have those problems with the workers but even maybe sanitation issues, most of the workers we employ come from the villages, even if you teach them how to use the toilets you still have problems… like in our place we have a flush toilet outside for the workers but we have been having problems with the usage, how they use it, sometimes after using it they do not clean it and that is why most of us have backup pit latrines"* (Interview, Resident Planned Area, Man, 2017).

The combined system of flush toilets and latrines reflects a class dimension in the reproduction of wider urban inequalities with workers (who usually come from and live in periurban areas) having access to infrastructures that are located lower in the service hierarchy. Yet through the interviews with residents in LIAs it was demonstrated that this configuration is also a vital component of houseworkers' geographies of access to sanitation; and that to avoid sanitation challenges in the area where they live, workers often adapt their body rhythms, waiting to use the toilets in the houses where they work. An illustration of these was provided by a resident who works as a night watchman in a house

in a planned Area and lives in a LIA with his wife and children. In an interview he explained that the latrine they use had collapsed the last rainy season and the family is currently using the toilet of a relative. Using someone else's toilet requires maintaining good relations with the owners of the toilet one has been allowed to use which is not always an easy task (See Chapter 7). When possible, he waits until the evening to use the toilet at work instead of using his relative's. This was also a recurrent topic in discussions with women in LIAs who frequently mentioned in interviews how they are more affected by sanitation access challenges as the toilets they use are often shared with too many people or are collapsed, while men often have other options like using the toilets at work.

With very few public toilets in the city, interviewees revealed how backyard latrines may also be an important sanitation facility for street vendors. This was described by one of the participants:

> *"The latrine is used by my family, the security guard, and some other people that we know, like street vendors, they travel a lot so when they ask for a toilet, we allow them, we cannot object them… (The latrine) is outside our house, we know them, we are around there, nothing can happen… we do not allow strangers to use the toilet inside for security reasons"* (Interview, Resident Planned Area, Woman, 2018).

Furthermore, latrines play an important role in enabling situated forms of social life; with interviewees explaining how outdoors latrines become an important element of the household when they hold large gatherings. As a participant explained, the latrine "*help us when we have functions like wedding or parties instead of just allowing people to use flush toilet inside the house, we advise them to use the latrine*" (Interview, Resident Planned Area and Community Leader, Woman, 2018). This was a topic of discussion among participants who were urban chiefs. Urban chiefs have an important role in local governance and often hold large community events such as funerals or receive community members. For example, a participant, who was a female urban chief in a LIA explained that one of the reasons why she decided to construct a latrine outdoors was because she received a lot of visitors and "*did not want them queuing inside the house to use the toilet*" (Interview, Resident LIA and Community Leader, Woman, 2018). A different participant, who lives in Area 18 and was also an urban chief explained that "*visitors prefer to use the toilet outside for privacy*". According to her the house where her family lives is small and "*if we are in a meeting in the living room, visitors might feel shy to ask for permission to go to the toilet or to go in front of everybody. It is just easier to sneak out and use the latrine*

in the back of the house" (Interview, Community Leader and Resident of Planned Area, Woman, 2018).

Backyard latrines are also useful in terms of accommodating the differentiated and (culturally specific) needs of women related to handling menstrual waste (reference to be added). As a participant explained:

> *"The latrine in the yard is useful for us ... we are five females at the house, this toilet helps us to dispose used pads ... we cannot throw them in the flush toilet, they would block it and we cannot keep them in the house, they would smell so the easiest way is disposing them in the latrine"* (Interview, Resident of Planned Area, Woman, 2018).

4.10 Conclusions

In this article we have examined a locally grounded sanitation infrastructural configuration consisting of the combined use of flush toilets and backyard latrines. Through a focus on the lived experiences of residents we have shown that despite being invisibilised in formal urban infrastructural accounts (i.e., planning documents and interviews with urban planners) this dual configuration is not only common (rooted in the architectural customs), but also fulfils multiple functions for residents. Exploring two different sanitation technologies relationally, considering not only the relations between sanitation artefacts (flush toilets and backyard latrines), but also how these connect and disconnect residents and urban spaces, has enabled us to show how this dual configuration helps residents: from ensuring a more consistent access to sanitation within water scarcity conditions, to responding to unevenness of socio-technical access, to accommodating urban social relations and a range of different sanitation needs beyond the management of human excreta.

From a theoretical perspective the paper contributes to literature on heterogeneous infrastructure configurations, documenting the diversity of sanitation infrastructures in global South cities and thinking through this diversity. First, we contribute with a deep description and analysis of the different trajectories of infrastructure development in global South cities. We move from the well-known municipal infrastructural ideal to show how heterogeneous infrastructural configurations emerge through local histories and situated

challenges and social relations. Second, we extend examinations of urban sanitation infrastructures with a heterogeneous infrastructure configuration perspective highlighting the existence of informal sanitation infrastructures within networked and planned spaces of the city; as well as conceptualisations of infrastructures (even presumably obdurate and stable waterborne sanitation systems) as always uncomplete and adaptable to the needs of residents.

Third, combining notions of heterogeneous infrastructure configurations with Northern and African and Global south debates on water resilience we have highlighted the importance of understanding the type of everyday and domestic adaptation arrangements that are already working to secure water and sanitation at household level and reflecting on whether and how these adaptations can be integrated into wider sanitation service delivery and governance structures. This is particularly important in global South contexts where research and policy emphasising high vulnerability and lack of resources dominate. Without falling in a romanticisation of poverty and informality within infrastructural access, it is important to look critically at the multiplicities, possibilities, and limitations of already existing residents' everyday adaptations that often happen informally.

In Lilongwe, planners and planning documents recognise the diversity of sanitation infrastructures that conform the city including the waterborne systems in the planned areas, and the waterless and low-cost alternatives in the LIAs. However, guided by Northern infrastructural ideals, they fail to formally recognise that heterogeneity as a characteristic of southern infrastructures transcends the boundaries between urban spaces (planned/unplanned; formal/informal) providing solutions to the everyday challenges and risks of residents (e.g. water scarcity). By deauthorising an informal but longstanding infrastructure such as backyard latrines municipal officials are not contributing to solve the potential environmental and public health challenges of this structures, rather they are invisibilising and even disabling the potential contributions to improve urban sanitation provision. A more progressive sanitation planning would entail, accepting that sanitation infrastructures rarely follow urban plans and regulations, that waterborne sanitation systems may not always work, and that dual systems exist, and people rely in practice on both on grid and off grid (informal) sanitation infrastructures. It would also entail allowing and encouraging residents to construct and maintain sanitary latrines in a safe manner in the planned spaces of the city. This leads to a call for more transdisciplinary research processes, that puts the lived experiences, socio-ecological and socio-technical conditions and needs of sanitation users at the centre of household, community, and public sanitation planning.

By thinking relationally between artefacts, residents, and urban spaces this paper complicates the boundaries between the house and the city – it shows how domestic toilets fulfil public functions key to low-income and informal workers (e.g. street traders). If there is a policy commitment to reduce the use of pit latrines for ensure public and environmental health, this then invokes the need to consider more seriously the need for safe and sufficient public or community toilets rather than the responsibility for this provision being pushed to the household scale.

Chapter 5.

Absorbents, Practices, and Infrastructures: Changing Socio-material Landscapes of Menstrual Waste Management

5.1 Publication information

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5.2 Abstract

In contexts of limited access to urban infrastructures and restrictive cultural norms, managing menstrual waste has important sustainability implications and complicates the menstrual experiences of women. However menstrual waste management has remained largely under-researched. To address this research and policy-practice gap we combine postcolonial and African feminist scholarship with social practice theory to explore the socio-materialities of menstrual waste management in a global South context. Drawing on ethnographic research conducted in Lilongwe, Malawi we provide a practice-based account of the different strategies followed by women to handle menstrual waste in a changing socio-material context (including changing absorbents, infrastructures, meanings, and interventions). We demonstrate that interventions normalising new types of disposable and reusable absorbents have not incorporated considerations for the implications related to reuse-disposal of new products. Such approaches pass on the responsibility for managing menstrual waste to women and leave them with no 'right' solution as they deal with the unequal infrastructural legacies in the city (i.e., socio-spatially segregated, masculinist). We conclude by setting an agenda for research and policy: one that posits that the socio-environmental challenges presented by menstrual waste can be better accounted for by making the needs and desires of women central to the planning of water, sanitation and solid waste interventions, infrastructures, and services.

5.3 Introduction

Women[11] in global South countries are experiencing a rapid shift in access to menstrual absorbents; often referred to as the Menstrual or Sanitary Pad Revolution (Bloom, 2018; Venema, 2014). The increased interest of development actors in the last decade has helped to situate MHM in the public health agenda (Lahiri-Dutt, 2014; Sommer et al., 2015). MHM interventions have endorsed commercial one-use or washable absorbents, boosting the menstrual care industry (Bobel, 2019; Lahiri-Dutt, 2014). Other common dynamics in global South cities - rising urbanisation, incomes, mobility - are contributing to growing demand for commercial products (Elledge et al., 2018). These are now increasingly used to substitute, or in combination with, traditional options (e.g. cloths) (Elledge et al., 2018; Scorgie et al., 2016; Sommer et al., 2013). In the context of limited access to urban infrastructures and services, and restrictive cultural norms, managing menstrual waste has important sustainability implications and complicates menstrual experiences. However menstrual waste management has been a largely neglected topic of research (Elledge et al., 2018; Sommer et al., 2013).

Drawing on ethnographic research conducted in Lilongwe, Malawi, we explore how broader changes in socio-materialities of menstrual cultures shape the possibilities of women to handle menstrual wastes. We first review recent literature on menstrual waste management and present our theoretical framework (Sections 5.4 and 5.5). We draw on social practices theory to explore how practices of handling menstrual waste are embedded in a complex socio-material system (Shove, 2003), including gendered norms, beliefs, meanings, values; materialities of absorbents and water /waste infrastructures; imaginations of urban services; and development interventions. To understand how these socio-materialities play out in Lilongwe (and potentially other global South contexts) we engage with the work of African and postcolonial feminist scholars who have provided important insights on the politics of (menstrual) hygiene development interventions. We then present our methodology (Section 5.6). Through detailed analysis we then show how the landscape of MHM in Lilongwe is changing and the implications these changes have for women who have to adapt their menstrual waste management practices to comply with narratives of personal hygiene, individual and public health, environmental pollution, or infrastructural sustainability, as well as cultural mandates of hygiene, secrecy, or privacy (Section 5.7 and 5.8). We use this exploration to reflect how menstrual waste can be better accounted for in urban theory, planning and policy by making the needs and desires of

[11] We acknowledge that not only, and not all, women menstruate. However, through the paper we refer to 'women' instead of 'people who menstruate' to align with the vocabulary of MHM.

women central to the design and implementation of water, sanitation and waste interventions, infrastructures and services (Greed, 2016) (Section 5.9).

5.4 Menstrual waste management

Earlier definitions of MHM already acknowledged the importance of menstrual waste management as part of a positive menstrual experience (Hennegan et al., 2019). However, menstrual waste management and women's preferences for disposal have largely remained under-researched topics within MHM literature (Elledge et al., 2018). Recent work on these topics has revealed the complexity of the challenges facing women and girls to handle used absorbents (Elledge et al., 2018; Hennegan et al., 2019; Scorgie et al., 2016). Cultural norms and deeply engrained beliefs play an important role in shaping these challenges. For example, due to lack of privacy women have to wash absorbents at night and dry them in hidden spaces (Bhor & Ponkshe, 2018; Garg et al., 2001; Hennegan et al., 2019); toilet bins are avoided because they make menstrual absorbents visible to others (Scorgie et al., 2016); incineration is often unacceptable in communities where the burning of menstrual blood is thought to cause infertility (Kumar & Srivastava, 2011). This literature discusses how in the context of a lack of appropriate infrastructures and restrictive cultural norms women have to turn to practices that are deemed unsafe, unsustainable, or unhealthy. Documentation of these practices includes dumping (in open spaces, rivers, ponds, drains, ditches), open burning, burying, flushing down the toilet, or discarding them in latrines (Bhor & Ponkshe, 2018; Garg et al., 2001; Kaur et al., 2018).

Currently, there is no consensus or guidance on what constitutes appropriate and safe management of menstrual waste (Elledge et al., 2018). Some studies have focused on the implications of mechanisms of disposal for the sustainability of infrastructures, the health of individuals or the environment. In many global South cities, the use of municipal solid waste streams as mechanisms to handle menstrual absorbents is problematic as services are precarious and often provided by informal waste pickers for whom these products pose risks in terms of health and further stigmatisation (Bhor & Ponkshe, 2018; Elledge et al., 2018; Vaughn, 2020). When flushed down the toilet, used absorbents build up blockages that bring substantial costs in terms of maintenance and repair and can produce public health and environmental pollution problems during sewer floods (Alda-Vidal et al., 2020; Sommer et al., 2013). Operation and maintenance issues also arise when absorbents are discarded in septic tanks and latrines complicating emptying and cleaning, and reducing

operational life-times of these facilities (Elledge et al., 2018; Sommer et al., 2013). When discarded improperly menstrual absorbents are a health risk for sanitation workers who often lack protective gear (Bhor & Ponkshe, 2018; Elledge et al., 2018). Burning menstrual absorbents in open fires can produce different toxic emissions depending on the materials they are made from (Elledge et al., 2018).

The majority of work exploring women's individual preferences for disposal or the challenges they face in handling menstrual waste have focused on institutional settings such as schools (Mchenga et al., 2020) or community and public toilets (Yeasmin et al., 2017), and emergency contexts (vanLeeuwen & Torondel, 2018). From a practical perspective this research has helped to design infrastructural solutions such as female friendly toilets (Schmitt et al., 2018). Less attention has been paid to the practices, needs, (and potential solutions) of menstrual waste disposal at a household level.

As these literatures show planning for menstrual waste requires consideration of the whole socio-material system in which women's practices are embedded from cultural norms, to product availability, to infrastructural systems (Elledge et al., 2018). In the next section we elaborate how a practice theory inspired analysis could help to provide more contextually grounded understanding of the practices of menstrual waste disposal.

5.5 Practice theory in a post-developmental context

Social practice theories encompass a diversity of approaches that have in common the use of practices as a category of analysis or as a point of departure for empirical work (Miettinen et al., 2009; Stern, 2008). In this literature, practices are defined "a routinized type of behaviour which consists of several elements, interconnected to one other" (Reckwitz, 2002, p. 249). What people do cannot be understood as the result of rational, individual decisions but as part of a complex interaction of bodies, material elements, resources, conventions, meanings, spatiality, temporality, and more (Hand et al., 2005; Reckwitz, 2002).

Social practice theories have been widely applied to the study of everyday habits of cleanliness and hygiene such as laundry and showering in global North contexts (Hand et al., 2005; Hitchings et al., 2017; Jack, 2018; Shove, 2003). Common to these studies is the understanding of sanitation and hygiene practices as underpinned by knowledge about health and shared social values, meanings, and conventions around what is normal and

appropriate (Jack, 2018; Shove, 2003). Ideas of normality and appropriateness that shape hygiene and sanitation practices are not static but change geographically and over time (Jewitt, 2011; Shove, 2003). In such analyses material objects are also important, as artefacts, technologies, resources, and infrastructures not only provide the means to conduct the practice but also actively shape it (Shove, 2016; Strengers & Maller, 2012).

The emphasis on the interdependencies between the material and non-material elements that constitute cleanliness and hygiene practices enables a moving away from simplistic interventions restricted to single elements (e.g. interventions that focus only on infrastructures, on women, or on access to absorbents) in the complex system (Browne, 2015; Evans et al., 2017). When starting from social practices the entire system in which the practice is embedded must be problematised, re-evaluated and redesigned (Browne, 2015; Wakefield-Rann et al., 2018).

To date the application of practice theory in global South contexts to understand water, sanitation and waste practices has been very limited (Kadibadiba et al., 2018). Practice theory inspired analysis has been put to work to show how in spaces framed as not meeting policy expectations of sanitation and hygiene, situated assemblages of hygiene practices have been developed to sustain hygiene in locally appropriate ways (Dombroski, 2015; Rusca et al., 2017).

To inform our analysis of the socio-material landscape of menstrual waste in Malawi we also draw on the work of postcolonial and African feminisms. This broad and diverse scholarship has challenged simplistic and monolithic constructions of African (and global South) women as always in need, and their societies and cultural practices as backwards (Mohanty, 1984; Vengenai, 2017; Win, 2004). African feminisms argue for a more critical and complex engagement with the diversity of African women's lived experiences (Nnaemeka, 2005; Pellerin, 2012). This type of engagement requires situating African women's struggles at the intersection of race, gender, class, urbanity as well as past and recent (post)colonial histories (Crenshaw, 1991; Hudson-Weems, 1993; Oyěwùmí, 2005; Steady, 1981; Tamale, 2020; Zerai, 2000).

These critiques demonstrate that MHM overemphasises the lack of means of women to deal with their periods and the potential of western scientific knowledge and technologies to liberate women from their menstrual challenges including menstrual shame and stigma (Bobel, 2019; Joshi et al., 2015; Lahiri-Dutt, 2014). As these scholars have pointed out in the MHM literature, local menstrual practices are often decontextualised from the everyday cultural and infrastructural realities in which they are embedded. Women's practices are

measured against preconceived ideas of what is appropriate and presented as "'[in]sanitary', 'poor', 'incorrect', '[in]appropriate', and 'deficient'" (Joshi et al., 2015, p. 53).

These MHM approaches risk building on a colonial legacy of the use of hygiene policies and discourses to disciplining those who present as not complying with colonial cleanliness and hygiene standards across African countries (Burke, 1993; Tamale, 2005). These approaches delegitimise and erase local experiences, disabling the opportunity to build upon women's experiential knowledge (Dombroski, 2015; Joshi et al., 2011; Kotsila & Saravanan, 2017) and practices that "may be equally effective or even better suited to specific social, cultural or environmental contexts" (Lahiri-Dutt, 2014, p. 1164).

A combination of social practices scholarship with African and postcolonial feminist engagements with MHM prioritises consideration of a diversity of women's practices as they are embedded in changing social, cultural, and infrastructural contexts, while paying attention to the politics of these changes. This, we argue, can provide important insights on what, and how, different elements of the MHM socio-material system could be challenged to improve menstrual waste management.

5.6 The study

The overall project from which this article emerges, aimed to investigate the everyday life of sanitation infrastructures in Lilongwe. The research project was broadly inspired by inductive approaches to data collection and analysis (Charmaz, 2014; Glaser and Strauss, 1967; Timmermans and Tavory, 2012), with the data collection and analysis not led by a specific theoretical framework. Interesting patterns and themes that emerged during data collection became the basis for further exploration and were re-iterated into more specific research questions. These patterns and themes were coded and used to assemble the theoretical framework of the project. This article develops one of the recurrent themes: the socio-materialities and patterns of menstrual products use and disposal.

Ethnographic and field research for this project was undertaken in two three-month periods during 2017 and 2018 in Lilongwe by the first author. Nineteen adult women (Participants Category Resident) participated in semi-structured interviews. Interviews usually started by discussing broader everyday hygiene and sanitation challenges and moved progressively to menstrual practices. To capture a diversity of experiences, participants included women

living in LIAs (Low Income Areas, 11) and living or working in planned areas of the city (8) with access to different type of water and sanitation infrastructures. Of these nineteen women, four acted as puberty counsellors for adolescent girls at menarche in their LIAs communities[12]. Discussions with these senior women were important to understand how menstrual knowledges and practices are changing intergenerationally. Five small-group interviews (4-8 participants, 21 total) were conducted with women living in LIAs who had not participated in individual interviews. The objective of these small-group interviews was to create a friendly space to prompt comparison of experiences, and to validate some of the information collected during individual interviews (Browne, 2016a). Participants in semi-structured interviews and small group discussions were recruited through snowball sampling via the networks of field assistants.

Field assistants were part of a network of local connections cultivated over years. They had previous experience supporting ethnographic research and a good knowledge of the communities where fieldwork was conducted. Their role was essential in building trust with participants and included gaining permission from community gatekeepers (community leaders), recruiting participants, ensuring informed consent, and guiding conversations in a positive, non-judgemental, and culturally sensitive way. Informal conversations with field assistants, reflected in field notes, were also crucial to our understanding of local cultures and practices.

Interviews with different governmental and non-governmental actors that intervene in MHM (10) (Participant Category Stakeholders), producers of absorbents (2, a local company that manufactures disposable pads and an international social business that manufactures reusable pads), and grocery store attendants (3) deepened understanding of the broader landscape of menstrual hygiene in Lilongwe (Participants Category Others). Interview based data was supplemented with the review and analysis of urban plans, project documents, and other literature about Lilongwe's sanitation and MHM sector.

Information about the implications of disposal of menstrual absorbents for sanitation infrastructures and workers was collected through semi-structured interviews and follow-along methods with sanitation workers (sewer cleaners, masons, and emptiers) (all male, 13 interviews). Contacts of independent sanitation workers (masons and emptiers) were provided by the local NGOs that support their work. Access to sewer cleaners was gained

[12] Counsellors are an informal social institution that connects with the Chewa tradition of the Anamkhungwi, a female instructor for girls' initiation rituals (Kaspin, 1996). As explained by participants, in urban areas young girls who reach puberty are provided with sexual education including on menstrual hygiene practices by senior women.

via the governmental agencies in charge of the municipal sewer systems. Information provided by sanitation workers was used as prompts in interviews with women.

Interviews were conducted in English or Chichewa and translated to English. Some interviews were tape recorded, some video recorded (both transcribed directly from the English translation), and some interviews and group interviews summarised from handwritten notes. Participant names have been anonymised to preserve confidentiality.

Locally, menstruation is considered an intimate experience and surrounded by cultural beliefs and stigma thus creating a space of trust and care for participants was particularly important. We acknowledge our limitations in this task, given the positionality of the first author as a white foreign researcher who does not speak the local language, the short term nature of the project bounded by the timeline of a PhD program, and a context of research fatigued communities (Kalinga, 2019). To work around some of these limitations we draw on the support of field assistants and tried to create a space for continuous and honest communication with them. One of the field assistants also used anonymised material collected within the fieldwork to inform his journalistic writing on topics related to water, hygiene, and sanitation in Lilongwe (c.f. Mkula, 2018)

5.7 Changing landscapes of menstrual hygiene in Lilongwe

5.7.1 Materials: traditional and commercial menstrual absorbents

In Malawi, women have traditionally relied on locally available materials such as folded pieces of cloth or pieces of cotton to deal with their menses. Worn out pieces of cloth are cut, folded, and fixed to the body with a string tied around the waist as a bottom layer of underwear. This washable locally made menstrual absorbent is called Nyanda.

In recent years the market of menstrual products has expanded. The products commercialised by the international personal care corporations were not affordable for the majority of urban low-income women. New social business dedicated to the production of reusable products and local producers of low cost disposable pads have emerged with the intention to fill the low-income market segment (Kambala, 2020).

MHM interventions (mainly directed to school girls) have focused on the free provision of commercial disposable and reusable pads at schools and the fabrication of hand-made

reusable pads through women and girls groups (Chindime, 2012; Kambala, 2020) contributing to the popularisation of these absorbents. As an interview with the representative of a recently established company focused on producing low-cost pads exposed, these interventions have opened the market for, and pushed the sales of, such products (Interview, representative manufacturer disposable pads).

Despite disposable absorbents being more available than ever before, many participants in both LIAs and planned areas use the Nyanda. This choice was not always connected to the inability to afford disposable absorbents. For example, among older women, Nyanda carries meanings of tradition and culture. As an elder woman explained *"we as Malawians it is our culture, it is our tradition to use the fabrics, the sanitary pads are coming from western cultures and that is why people are interested in sanitary pads"* (Interview, Resident LIA, Woman, Chimwemwe, 2017). Others may prefer disposable absorbents but consider the Nyanda a convenient solution when they are at home (Emmie, Interview, Resident planned area, 2017).

5.7.2 Infrastructures: unequal water and sanitation services

As further described in the next section, women's everyday routines and choices of how to deal with used menstrual absorbents are importantly shaped by the water and sanitation infrastructures available to them. Infrastructural inequalities have their origins in the colonial and postcolonial planning of the city that segregated spaces and dwellers (based on initially race and afterwards class) (Kalipeni, 1997; Myers, 2003). LIAs, (where 75% of population, mainly low-income, lives), have been disadvantaged in the historical development of infrastructures and the everyday provision of services in relation to planned areas (where 25% of more affluent population live) (Alda-Vidal et al., 2018; Rusca et al., 2017; Tiwale et al., 2018).

LIAs receive municipal treated water through a system of water kiosks where residents buy water by buckets. Kiosk water is expensive and often unavailable because of interruptions in the service. Residents tend to combine it with other sources of lower quality water such as shallow wells, boreholes, and streams (Rusca et al., 2017).

Self-constructed dug pit latrines (with or without a slab) constitute the most common form of sanitation in LIAs (World Bank, 2017). In the past when latrines were full, residents would close them and dig new structures. This practice is increasingly becoming more

challenging. The failure of authorities to provide housing in planned areas for low-income populations has resulted in an increasing demographic pressure over these areas (Kalipeni, 1997; Mwathunga & Donaldson, 2018). More people are sharing dwellings and toilets and therefore latrines fill more quickly. At the same time the availability of vacant space to dig new facilities is decreasing (Chunga et al., 2016).

This contrasts with levels of service provision in planned areas, where the majority of the households have taps at home, water quality is better and shortages less frequent (Alda-Vidal et al., 2018; Boakye-Ansah et al., 2016; Tiwale et al., 2018). In these areas households have flush toilets connected to either the municipal sewer system or individual soak-away septic tanks. Municipal waste collection is limited to some planned areas of the city where household waste is collected, door-to-door or from communal open skips, once a week (LCC, 2010). In practice the majority of households in the city dispose waste in pits dug in the backyard that are buried or burnt when full (LCC, 2010).

As described in the next section transformations of water and sanitation infrastructures in the city complicate the possibilities of women to handle used absorbents. While recent urban water and sanitation projects include gender considerations, these have not translated into infrastructural designs that would accommodate the differentiated needs related to menstruation (e.g. World Bank, 2017). Interventions in menstrual waste management have focused on school settings where some service providers have included menstrual waste management educational components or have installed female friendly toilets and incinerators (Kambala, 2020; Mchenga et al., 2020). However, these types of infrastructures have not been extended to the private space of the household.

Furthermore, in recent years local sanitation systems are shifting towards a Faecal Sludge Management (FSM) approach through the promotion of the emptying and transport of faecal sludge by private operators from latrines and septic tanks to the municipal wastewater treatment plant (World Bank, 2017). In LIAs an FSM approach means moving from a ‘build then close’ to ‘build, empty, maintain’ model. In these areas the lifespan of latrines is on average five years (World Bank, 2017) but can be considerably reduced if the facilities are used for disposal of solid waste such as menstrual waste. As we will discuss in the next section, this new system has important implications for the practices of menstrual waste management of women.

5.7.3 Meanings: Traditional and medicalised notions of menstruation

In the local traditions menstruation is connected to fertility and sexuality and surrounded by taboo and secrecy (Kaspin, 1996). The secret and taboo character of menstruation is visible in the varied superstitions and cultural beliefs attached to menstruation (Pillitteri, 2011) that include the association of menstrual blood with magic and witchcraft practice:

> *"There are some people who look for Nyanda to use it for black magic. Women who are careless end up having complications or may die (…) so it is very important to keep the Nyanda in safe places to avoid being bewitched"* (Interview, Resident LIA, Woman, Rudo, 2017).

Connections to magic are not parochial curiosities but lived by many urban Malawians as part of their cosmology and spiritualty. They are present on their everyday lives, from mundane conversations, to national politics or media newscast (Ashforth, 2015; Englund, 2007; Lipenga Jr, 2017) and in this case shape the menstrual experiences of many women.

Beyond fears of witchcraft, for many women and men everything surrounding the menstrual cycle holds an intimate character for its connections to sexuality and sexual life (Perianes & Ndaferankhande, 2020). This was visible in interviews with puberty counsellors whose advice to young girls linked menarche with the beginning of sexual life and was strongly oriented to prevent the risks and shame of pre-marital relations and pregnancies.

Coexisting with traditional meanings of menstruation there are scientific and medicalised meanings circulating (Joshi et al., 2015; Lahiri-Dutt, 2014). These have been widely promoted as part of MHM interventions that use reproductive health language and emphasise menstruation as a natural bodily function and the importance of hygiene as the crucial element driving menstrual practices (e.g. *Puberty Book Girls*, 2013). In spaces such as paediatric clinics, community health clubs, or mother's groups, women are provided with education in MHM that has informed their narratives of hygienic menstrual practices:

> *"Apart from ensuring that menstrual materials must always be kept and disposed in a hygienic way, our personal bodies as women too, are supposed to be kept clean and in hygienic condition"* (Interview, Resident planned area, Woman, Victoria, 2018).

These connotations of intimacy, secrecy and hygiene shape the social mandates to handle used absorbents with modesty, privacy, and considerations of cleanliness.

5.7.4 Interventions: responsibilising women for their menstrual waste

As practices of handling menstrual waste are shaped by the choice of menstrual product, the presence of new absorbents has important implications for women's decisions. While the use of disposable absorbents is being increasingly normalised, there has not been effort to consider implications related to disposal.

Despite transnational and local corporations benefiting from the emerging market for sanitary pads, their actions in the matter of waste management have been very limited (i.e., incorporation of recommendations in packages to discard the sanitary pads following the household solid waste stream). Furthermore, the lack of national regulations in terms of extended producer responsibility has allowed the industry to pass on end-of-life product responsibility to women as final users. This was illustrated by the comment of the representative of a local brand of disposable pads, "*we understand the correct thing to do is disposing the pads in the waste bin. We cannot ensure women will do it so we just trust they will do the right thing"* (Interview, Others, Representative disposable pads manufacturer, Man, 2018).

While MHM interventions have normalised the use of new absorbents, there has not been effort to consider implications related to disposal or practices of reuse of such products at the household level. Some MHM interventions with components on menstrual waste management have been recently documented (e.g. Kambala, 2020). However, interviews revealed that usually interventions focus on facilitating access to sanitary products as the first objective. As the representative of a local NGO explained, *"As long as they have access to pads, we are happy, we let the girls dispose them in the best manner they feel comfortable"* (Interview, Stakeholders, Representative local NGO, Man, 2017). Some MHM school interventions have been accompanied by the construction of incinerators to eliminate menstrual waste (representative Ministry of Education (MoE))\(see also: Mchenga et al., 2020). Within domestic settings, decisions about used absorbents were framed as an individual responsibility that women and girls have to find a solution for.

In the past, throwing menstrual absorbents in latrines was seen as an acceptable solution by some actors working on sanitation and MHM (Interview, Stakeholders, representative

of local NGO, and representative of MoE, 2017). The discard of pads in latrines helped to avoid potential environmental and public health problems as it prevented the soiled materials from being discarded in other open spaces such as streets or open drains (representative, disposable pads manufacturer). As menstrual absorbents were contained inside the latrines, which were closed and buried when filled, the problem of menstrual waste was rendered invisible (other than for the women who had to deal with them). This implicitly meant that there had been no identified policy need to look for alternative waste management solutions.

The current move to an FSM approach has brought sectorial attention to the practices of menstrual waste disposal, and concerns over implications for the health of sanitation workers, environmental and infrastructural sustainability have been raised. Various MHM sector actors and sanitation workers identified that disposal of pads in latrines reduced their lifespan and made the task of emptying latrines harder and more time consuming for sanitation workers (who also articulated fear of catching diseases from contact with the discarded materials). The official message was to avoid disposal of menstrual absorbents in all sanitation infrastructures (LCC, 2014; MHC, undated). Yet the alternatives for how women might appropriately dispose of these materials was never discussed.

Introducing new absorbents as only a dynamic of access, and not exploring the dynamics of MHM as a socio-material system spanning use-reuse-disposal, has aggravated the environmental and infrastructural challenge of menstrual waste in the city and increased the burden of responsibilities for disposal onto women. Yet, as we argue in the next sections, an in-depth examination of the strategies followed by women can provide a useful entry point to understand how menstrual absorbents can be dealt with in challenging cultural and infrastructural contexts.

5.8 Practices of handling menstrual waste in context

5.8.1 Handling menstrual waste in LIAs

While latrines are not designed to cope with menstrual waste, interviews show that women have appropriated these infrastructures to serve their menstrual waste management needs. Discarding used pads in latrines was the preferred strategy for the women interviewed as the practice fits with women's culturally specific needs to keep used pads out of reach and

sight of other people: "*These are very private things that are held in secrecy, so we throw them in the latrine to avoid anyone from seeing*" (Interview, Resident LIA, Woman, Alinafe, 2018).

Concerns over water scarcity, the price of soap, and the challenge of maintaining hygiene standards when using the Nyanda and other washable absorbents were elements pushing some of the women living in LIAs to shift from these types of absorbents to disposable pads and thus increasing latrine disposal practices.

For women, having readily available water at home is important to wash absorbents immediately after changing them. As women explained, blood is more difficult to wash when it has dried in the fabric and produces a bad smell when the cloths are stored dirty. Furthermore, washing the absorbents immediately after changing reduces women's anxiety in relation to others finding soiled clothes and related witchcraft risks. During menstruation water consumption is not only needed for washing the absorbents but also for personal washing. A woman explained:

> *"When you are experiencing your menses, you need to bath regularly. For example, you don't just throw away the used pad without taking a bath. If you have changed the pads or cloth four times it means taking a bath*13 *four times"* (Interview, Resident LIA, Woman, Happiness, 2017).

This need for personal washing is particularly felt when using some washable absorbents. Unlike some commercial reusable pads, Nyanda or handmade reusable pads do not have a layer to absorb and separate the blood from being in contact with the skin (representative manufacturer of reusables). As a woman explained, when using Nyanda she feels like she has "*blood all around her bottom"* (Interview, Resident planned area, Woman, Madalitso, 2017). Thus, women who use traditional absorbents experience the need to wash more frequently.

In planned areas of the city women may have more opportunities to use and wash reusable absorbents in ways that comply with menstrual hygiene standards. In the adverse conditions of LIAs many women are forced to adapt their menstrual hygiene practices or even choose between them. These decisions are made following socio-culturally embedded hygiene hierarchies in which personal hygiene and clean appearance rank high for their role in self-

[13] Participants used the word Kusamba, usually translated as bathing. The local practice of bathing entails the use of water buckets that are scooped and poured on the body.

esteem and in helping to avoid social exclusion and stigmatisation (Rusca et al., 2017). As a woman explained when some women prioritise personal washing over the washing of absorbents:

> *"Of course, some women may not be able to do this [follow the standard rules regarding washing and bathing] because of water problems. They keep the used cloth in a bucket. Some women wash the private parts only. This happens because of water scarcity."* (Interview, Resident LIA, Woman, Happiness, 2018).

When there is no soap, women wash absorbents only with water (Notes from group interview 4, 2017) and when there is not enough water to wash the absorbents, women may choose to burn them or throw them in the pit latrine as they do with disposable absorbents (Interview, Resident LIA, Woman, counsellor, 2017). Alternatively, women may shift to using commercial disposable pads that are more expensive but more practical in situations of water insecurity. *"Sometimes I use pads because of water scarcity. When there is no water, it is ideal to use pads because we simply dispose them in a pit latrine"* (Interview, Resident LIA, Woman, Happiness, 2018).

Throwing absorbents in the latrine was considered also a more practical and less time-consuming practice than washing or burning, and more adapted to modern lifestyles. A puberty counsellor explained "*I usually advise to use cotton or pads and not Nyanda, because it gives you less work, after using them you can just throw them"* (Catherine, Interview, Resident LIA, Woman, counsellor, 2017). Beyond water scarcity, the convenience of disposal in latrines as compared to washing is also shifting how some women handle their traditional absorbents and avoiding washing was the reason given to change from Nyanda to pads *"which I easily dispose of after using"* (Interview, Resident LIA, Woman, Agnes, 2017). Similarly, many women who can afford it (i.e., have enough pieces of cloth) use Nyanda only once and then throw it in the latrine to avoid having to wash it (Interview, Resident LIA, Woman, counsellor, 2017).

The continued preference of women for disposal in latrines (as discussed, previously supported by some sanitation and MHM actors) contrasts with increasing concerns by the sanitation sector over this practice. When confronted with these concerns, women's responses varied. For some women, it was not clear the rapid filling rate of latrines was due to the disposal of sanitary pads. A woman said (to the agreement of the rest of the group interview 1): "*it is only once a month so it cannot fill (the latrine)"*. According to her, "*if*

you are renting and sharing a toilet with five women this can make a problem", however, she had never heard of such a thing happening (notes from group interview 1). Other women had shifted to burning their pads: "*I do not throw them into the latrine because they may end up filling up the pit latrine faster than we expected*" (Interview, Resident LIA, Woman, Rose, 2017). Yet it was clear that given the option there was a preference for disposing pads in latrines. This means concerns over latrine maintenance and sustainability are pushing some women to abandon their preferred strategy to deal with menstrual waste.

5.8.2 Handling menstrual waste in planned areas

In the planned areas of the city, many women have shifted from traditional to disposable absorbents. Despite infrastructures in these areas providing higher service standards than in LIAs (taps at home, flush toilets, some waste collection) the alternatives for managing menstrual waste are still very limited.

From the perspective of participants, municipal waste collection and the household waste stream are not (culturally) appropriate alternatives to deal with menstrual waste. This perception is importantly shaped by the different cultural meanings of menstruation. For some women disposing a used pad in a bin is *'not hygienic'* (woman, group interview). For others discarding sanitary pads in the waste bin means losing control over what will happen to these used products. In the houses where waste is burned, sanitary pads would lay (often for days) on the burning pit on the yard with the rest of the waste until it is fired up. In the few areas where waste is collected, household waste is placed outdoors in a waste can on the morning of the day it will be collected; often street dogs spread the content over the street disclosing whatever it was inside (Interview, Resident planned area, Woman, Madalitso, 2017). In both cases, the risk of exposure of the pads prompts different concerns over hygiene, fears of witchcraft, or anxieties over the shame and stigma surrounding menstruation (Interview, Residents planned area, Women, Madalitso and Emi, 2017).

In these areas, burning menstrual waste is common practice. In women's accounts a mix of concerns for hygiene, cultural beliefs, infrastructural concerns, and the lack of alternatives featured as motivators for the choice for burning. For some women burning as a practice emerged as a response when they shifted from traditional to disposable materials or moved from areas where they had latrines to handle this type of waste. As a participant explained, *"the good thing is just to put them in the pit latrine but when you do not have the facility when you do not have a latrine that is when I burn them"* (Interview, Resident planned

area, Woman, Chileso, 2018). For some women such as Chisomo the realisation that flush toilets would not work for this type of materials led them to look for other solutions: "*I just thought about it when I realised that I could not flush it down the toilet and I could not throw it in a rubbish pit… I then started burning them*" (Interview, Resident planned area, Woman, Chisomo, 2018).

In fact, despite sanitation workers blaming 'inconsiderate women' as responsible for the frequent blockages in the sewer (sanitation workers 4, 10, 11) women seemed to be aware of the implications of flushing pads down the toilet and avoided the practice. One of the participants mentioned the costs of fixing blockages; another said she had done it in the past but had now stopped over concerns of being reprimanded by sewer operators.

For other women burning has been a longstanding practice, described as hygienic solution to eliminate "*the germs*" associated with menstrual flows (Interview, Resident Planned Area, Woman, Stephanie, 2018), or an end to worrisome materials ("*After burning the pads you do not have to worry anymore about them"*, Emie, planned area) shaped by cultural beliefs: "*I no longer believe in this (…) but I think the warnings still ring in the back of my mind and that is why I burn my stuff for fear someone might pick them and use them for black magic*" (Interview, Resident Planned Area, Woman, Victoria, 2018).

As women revealed in the interviews, burning absorbents is more involved than latrine disposal. As a woman living in one of the planned areas of the city described, during her bleeding days she keeps the absorbents carefully hidden in her room to avoid anyone finding them. When she has finished bleeding that month, she puts them in a plastic bag and burns them outdoors. Others explained the plastic bag containing the used pads is burnt in the waste pit, or somewhere else in the yard. Burning is practiced outdoors "*to avoid the bad smelly smoke in the house*" (Interview, Resident Planned Area, Woman, Masozi, 2018). Paraffin and charcoal, or pieces of paper, are used to ease the process as the plastic bag and the pads are hard to burn.

As elaborated in interviews, the reasons for storing pads and not burning them right after use are both pragmatic and cultural. Burning sanitary pads right after changing them is time consuming, as burning pads is more difficult when they are wet, and women have to move from the bathroom to the outdoors of the house and spend time burning them. As pads are being burned outdoors women feel exposed as anyone can see what they are doing. The lack of privacy together with the high cost of paraffin seems to limit the adoption of this practice in LIAs.

5.9 Discussion: Learning from women's local practices, planning for menstrual waste

In this article we have provided a practice-based account of menstrual waste management practices of women living in LIAs and planned areas in Lilongwe, Malawi. We show how practices of washing, burning, or disposing pads are shaped by both the mandates attached to traditional and medicalised meanings of menstruation as well as the different infrastructures available in different spaces of the city (a result of historical legacies of racial and class-based segregation). In a context of increasing variety of menstrual absorbents, women have no 'right' solution to manage their menstrual waste. The design, construction and maintenance of infrastructures has historically been based on masculinist understandings that neglects the different bodily needs that menstruating women have and the different practices of use-reuse-disposal that emerge as a result of those contextual conditions.

The disconnection between women's needs and infrastructure is particularly obvious in some spaces of the city. The provision of water supply in LIAs clearly does not meet the minimal requirements and expectations for women to handle absorbents and menstrual hygiene. During periods of water scarcity, particularly in LIAs, women are left choosing whether to use their heavily laboured water collected from kiosks to wash their own bodies or to wash their reusable absorbents. Furthermore, the sanitation sector overlooks that toilets fulfil an important function for waste from menstruating bodies beyond the task – handling faeces and urine - they were designed for. Women have adopted latrines (and flush toilets according to sanitation workers) as a solution to hide and remove used absorbents.

The ways women wash, burn, or dispose used pads in latrines/toilets challenges policy imaginaries and prescriptions of proper MHM. In particular practices of disposal in sanitation systems now render infrastructures supposedly dysfunctional (e.g. blocked, incompatible with emptying), despite latrine disposal previously being supported by some sanitation and MHM actors. As we show these practices have emerged and developed in this particular context to serve specific purposes for women and these now 'problematised' practices continue to help women meet different practical, cultural, and hygiene gendered needs. Far from just positioning the handling of menstrual absorbents as a private and individual practice, a socio-material approach which prioritises and centres the everyday

practices of women and girls as the start of empirical, policy and planning enquiry, will ensure a more distributed responsibility across actors in urban design, infrastructural planning and product manufacturing (cf. Evans et al., 2017).

In Lilongwe, improving conditions of access to water in LIAs is essential. This would ensure the particular needs of women during their menses (i.e., more water, readily and continuously available at home) are met. In relation to sanitation infrastructures, a more progressive approach to planning and design would adapt to the preferred practices of women, instead of expecting women to adapt their preferred practices and absorbents to default infrastructures. There is a need to abandon designs based by default on bodies that simply 'defecate' (i.e., the male body) and to recognise that toilets and latrines fulfil additional functions for menstruation (Greed, 2016). Options to be explored could include testing of technologies to facilitate emptying of faecal sludge mixed with menstrual waste, technologies that would allow pads to be disposed in toilets in a culturally sensitive way, or the modelling and design of latrines or sewers to cope with the disposal of absorbents.

In the last decades the global South has become a burgeoning market for the menstrual hygiene industry (Bobel, 2019; Lahiri-Dutt, 2014). This industry has an important role in terms of extended producer responsibility and could do more to support the development of infrastructures and services for menstrual waste management. Product innovation would also be essential to ensure practices of use and disposal connect with infrastructural and cultural particularities of these new markets such as materials that are easier to wash and dry, more quickly disintegrable in latrines, are easier to burn and non-toxic when burnt.

Using postcolonial and African feminist theories alongside social practices has enabled us to recognise the diverse experiences of urban women dealing with menstrual waste across class and urban location. These experiences are delineated by the unequal legacies of infrastructures in the city (i.e., socio-spatially segregated, masculinist). In a context of increased commodification of menstrual hygiene, women in Lilongwe are invested in the management of their used absorbents. Despite the limitations, they have been able to make use of the infrastructures that are available to them in ways that accommodate varied coexisting meanings of menstruation and their different practical, cultural, and hygiene gendered needs.

As long as the patriarchal norms that define the male body as the neutral default and demand women deal with their periods in concealment and secrecy are not challenged; these dynamics will continue shaping women's menstrual experiences regardless of the absorbent they use or the infrastructures that are made available to them (Bobel, 2019). The

question of how to challenge deeply embedded cultural beliefs without contributing to the historical erasure of African cosmologies or to the reproduction of colonial discourses that situated local hygiene traditions as always backwards and wrong is also a crucial one to be considered (Steady, 1981; Tamale, 2005; Vengenai, 2017).

In examining how these dynamics play in Lilongwe, we have attempted to open up a deeper discussion of how menstrual waste can be dealt with in an increasingly challenging infrastructural context. It is essential to start from what is already working locally for women, or could be made to work, in attempts to maintain menstrual health and wellbeing instead of starting from developmental imaginaries of desirable practices (Dombroski, 2015; Rusca et al., 2017). We hope that the research community continues to place analytical advances from practice theory alongside advances in postcolonial and situated feminist theory in order to elucidate (conceptually, analytically) the gendered and political lived experiences of evolving (postcolonial) hygienic imaginaries and practices more clearly.

Chapter 6.

Gender Relations and Infrastructural Labours at the Water Kiosk System

6.1 Publication information

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6.2 Abstract

In this paper we explore the gender and intersectional dynamics shaping the work of female kiosk attendants in LIAs. The paper shows that the recruitment of women into this low-paid position is predicated upon the mobilisation of specific gender stereotypes that situate women as a 'natural' fit for the job. Despite work as kiosk attendant being an income opportunity for low-income women, the job also poses important challenges for them including working at night which increases their gender vulnerabilities. As the chapter shows, the low salary and flexible working hours of kiosk attendants play an important part in sustaining the 'successful' model of kiosk. Yet the challenges and concerns kiosk workers face on an everyday basis are not given much attention by water and sanitation partners. From a policy and practice perspective, the chapter draws attention to the need for a more critical consideration of the infrastructural work of women within the water kiosk system.

6.3 Introduction

As part of the infrastructural turn, scholars have conceptualised infrastructures as socio-technical assemblages and underlined the multiple ways people engage in the everyday making and remaking of infrastructures (Lawhon et al. 2014; Silver, 2014; Simone, 2004b).

Following this approach different studies have drawn attention to the manual labour needed to sustain functional services (e.g. drain cleaners, waste pickers, water network operators) (Anand, 2017; Fredericks, 2014) and the role it plays in the politics of urban infrastructures. Infrastructural jobs have often been part of the promises (of economic growth, progress or modernity) brought about by new infrastructural investments (Anand et al., 2018; De Coss-Corzo et al., 2019). At the same time, its day to day character often remains invisible and devalued (De Coss-Corzo et al., 2019; Fredericks, 2014). Yet, as scholars have shown the everyday activities of workers are deeply implicated in the configuration of urban infrastructural systems and the reproduction, or contestation, of uneven access to services (Anand, 2017; Fredericks, 2014). As part of this emerging body of work, gendered and feminist questions of labour and urban infrastructures have been little interrogated. Here we reflect on the theoretical and empirical potential of an engagement with feminist water scholarship, which has extensively documented the gendered dimensions of the day-to-day endeavour of ensuring access to water for household needs across different urban global south societies (Sultana, 2009; Truelove, 2011). This examination, we argue, significantly adds to our understanding of infrastructural labour by revealing how many widely spread infrastructures, such as water kiosks, are sustained through gender relations and the undervalued labour of women.

Kiosks are water selling booths in which residents can purchase water and carry it home using containers (Figure 1). They can be privately or publicly owned and the water may be supplied via centralised network or boreholes (Kariuki & Schwartz, 2005). As each facility is usually meant to serve many households (LCC, 2014) they have been instrumental to increase figures of access to water in the low income areas (LIAs) of urban Sub-Saharan Africa (Goetier et al., 2009). Kiosks have been presented as a low-cost and easily scalable solution by donors (Klawitter et al., 2009), claiming they offer a quick fix for unserved low income populations in cities in the global South. For example, a recent study estimates that around 60% of households in Lilongwe's LIAs use kiosks as a primary source of water (Adams, 2017). However, as we show in this chapter, the continued reliance on water kiosks and its framing as a successful model of water supply conceals the gendered power relations and meanings built into this water infrastructure.

In reflecting on the gendered dimensions of women's work and social relations shaping the function of water kiosk systems, the chapter also brings attention to important policy implications. Governments and development partners are increasingly called to invest in the construction of on-premises water facilities in the framework of the Sustainable Development Goals (SDGs) (JMP, 2017). Yet, the task is challenging and kiosks are likely

to remain a prominent technology for urban water supply in LIAs (Adams et al., 2019; Contzen & Marks, 2018). A deeper interrogation of the gendered politics and labours involved in these infrastructures is essential given the prevalence of kiosks in cities in Sub Saharan Africa, their importance for resident's household water security, the multiple labours of women within this kiosk system, and the significance of kiosks in the global achievement of water security and gender equality.

6.4 People as infrastructures and infrastructural labours

Urban geographers have theorised infrastructures as the combination of material configurations, social systems, and socio-material practices that enable everyday urban life (Amin, 2014; Farias, 2011; McFarlane, 2011; Mcfarlane & Silver, 2016). This approach provides a more lively (Amin, 2014) conceptualisation of infrastructures and reveals the infrastructural role played by people's connections and activities (Simone 2004b) as they constitute "the central means through which materials flow in many cities" (Lawhon et al., 2014, p. 507).

As part of a growing interest in people's everyday engagements with urban infrastructures, scholars have drawn attention to the infrastructural labour required to maintain functioning systems (De Coss-Corzo et al. 2019; Jackson, 2014; Star, 1999). Fredericks has defined waste infrastructures as composed of "labouring bodies" to refer to how waste collection systems are sustained by the manual work of municipal personnel, volunteers, and informal pickers and recyclers (Fredericks, 2014, p. 532). Other scholars have animated water or energy physical systems by exploring the activities of engineers, plumbers, water vendors or sellers of prepaid electricity tokens (Alda-Vidal et al., 2018; Anand, 2017; Baptista, 2018).

Examinations of the activities of workers and the conditions in which these are performed have contributed to further understanding of infrastructural and urban politics. For example, scholars have revealed how decisions and practices of workers in the operation and maintenance of infrastructures contest or reproduce broader processes of urban differentiation by redirecting flows (of water, energy) in the city to include or exclude particular residents from them (Alda-Vidal et al., 2018; Anand, 2017; Baptista, 2018). Infrastructural jobs are often a political tool, celebrated as part of the promises of progress attached to new investments in infrastructures (Anand et al., 2018). Workers and their

activities can also be conveniently rendered invisible, devalued, or used as 'cheap' solutions. Waste economies, for instance, often rely on the underpaid labour of informal and precarious workers who have limited opportunities to benefit from waste value (Fredericks, 2014; Millington & Lawhon, 2018).

As part of this emerging body of work there is a recognition that a feminist approach attentive to issues such as lived experiences, embodiment or the productive/reproductive work divide could make an important contribution to the study of infrastructural labour (De Coss-Corzo et al., 2019). However to date, the gendered dimensions mediating the work that maintains functioning urban infrastructures have been little interrogated (with some exceptions: Fredericks, 2009, 2018). We now turn to review the work of feminist political ecologies of water and explore the explanatory potential this body of work offers to explore these questions.

6.5 Feminist political ecologies of water

As feminist scholars of water have shown, gender stereotypes and constructs are at the centre of prevalent divisions of labour that determine who does what in relation to water and how different water activities are valued (Zwarteveen & Bennett, 2004). This divide, on the one hand, situate women as primarily responsible for (unpaid) reproductive water work: ensuring and managing water for multiple domestic needs (Harris et al., 2017; Sultana, 2009; Truelove, 2011). On the other, it excludes them from the 'real' productive work, associated to men, by underplaying or devaluing their (paid or unpaid) participation in these activities (Ahlers & Zwarteveen, 2009; Alda-Vidal et al., 2017).

Feminist political ecologies of water have revealed how, in the context of fragmented and unreliable infrastructures, women's everyday work plays a fundamental role in ensuring the flow of water into households. This includes unpaid and often invisible activities such as locating alternative sources of water, waiting long queues at public sources, hauling water buckets across neighbourhoods, or negotiating with tankers, neighbours, or sellers (Peloso & Morinville, 2014; Truelove, 2011; Velzeboer et al., 2017) as well as other household infrastructural practices that compensate for failures of urban water systems (e.g. constantly checking taps at odd hours to find out if water is back and turning on and off domestic suction pumps when the services has been re-established (Truelove, 2021). These water practices and labours are integrally corporeal with emotional and physical

consequences for women. Illustrative of these are the physical fatigue, deformities and illnesses caused by carrying large amounts of water (Sultana, 2009; Truelove, 2011), the stress, fear, frustration and anxieties produced by water insecurity (Cole, 2017; Sultana, 2011, 2015; Wutich, 2009)

However, the nature and implications of water work are not the same for all women. The use of intersectional analysis has revealed how gendered power relations overlap with other social inequalities and multi-layered relations (e.g. class, race, religion, position in the family, age, marital status, etc.) (Collins, 1991; Crenshaw, 1991; Zerai, 2000) in shaping women's struggles with water (Hofmann, 2017; Sultana, 2020; Truelove, 2019b). As Truelove argues water infrastructure engages particular "gender, raced, and classed bodies" for water to reach households (Truelove, 2019c, p. 27)

Integrating notions of infrastructural labours and feminist water scholarship shapes different analytical insights into the water kiosk as a socio-technical assemblage, and makes visible at the expenses of whose bodies, work and relations, the kiosk system becomes a successful mode of water provision for Lilongwe's LIAs.

6.6 Case study and methodology

Currently, there are over a thousand kiosks in the city (Interview, Lilongwe Water Board (LWB), 2017) and the majority are located in the low-income areas (LIAs), at the outskirts of the city that give shelter to 76% of the urban population (UN-Habitat, 2011). Most of these kiosks are operated by Water Users Associations (WUAs) who exclusively employ women as kiosk attendants to deal with the daily operation of the infrastructure (Adams et al., 2018). These services configurations provide an important entry point to examine gendered division of labour in urban water infrastructures. Low-income areas served through water kiosks are characterised by high levels of poverty and unemployment, further complicating labour relationships. Last, this location allowed us to build on a longer history of research conducted in Lilongwe.

Two three months fieldwork periods were conducted in 2017 and 2018 in different LIAs and included different data collection methods. Semi-structured interviews (N=5) and a group interview with kiosk attendants were conducted to understand the conditions and experiences of work at the kiosk, including the risks and challenges attendants face and their relations with customers. Interviews with representatives from the LWB, WUAs and

NGOs (N=10) (Participant Category Stakeholders) and users of kiosks (N=20) (Participants Category Residents) allowed grasping the broader context of Lilongwe's kiosk system and the challenges to access water in LIAs. Interview based data was supplemented with the review and analysis of urban plans, project documents, and other literature about Lilongwe's water sector.

Five further interviews with Kiosk Attendants were conducted during the filming of the documentary *Lilongwe Water Works?* (Rusca, 2017) (February-March 2016) and analysed as secondary data. Participant observation was conducted during three public screenings and film debates organised in June 2018 with representatives of the water and sanitation sector (June 2018; 25 participants, all men); representatives of WUAs and community members in Area 50 (June 2018;16 women and 9 men) and Tsabango (June 2018;16 women and 10 men). The documentary focuses on exploring the water kiosk system of Lilongwe. It delves into the experiences of the residents who use the kiosks and of the members of the WUAs who are in charge of the management and operation of the kiosks. The film was instrumental in eliciting and deepening discussions on the experiences of kiosk attendants and customers.

6.7 The water kiosk system in Lilongwe's LIAs

Kiosks were first built in Lilongwe during the relocation of the capital in 1968. Until 2006, these infrastructures were directly operated by the LWB or private operators. Yet, the LWB was concerned with the high staffing costs for the direct operation of kiosks (Chirwa & Junge, 2007), whilst private operators were failing to pay their bills to the LWB (Rusca & Schwartz, 2012). In 2006 the community-based Water Users Associations (WUAs) were established as a response to these challenges (WaterAid, n.d.). Under the current operational model, the LWB is in charge of delivering the bulk water and of the maintenance of the network pipes up to the kiosk meter, while the WUAs are responsible for the operation of the kiosks and revenue collection. At the LWB, the Kiosk Management Unit (KMU) oversees the functioning of the kiosk system and the WUAs.

WUA's 'success' in managing the kiosks is measured in terms of their ability to sustain acceptable levels of access to water for LIAs' residents while repaying the LWB. As a representative of the LWB explained,

> *"All the money is being collected, taken to office, banks, water bills are being paid. In Areas were WUAs are getting enough water, members of the community are able to receive their salaries, also other members receive salaries with no problem. Extensions are being done and kiosk built with water sales"* (Interview, Stakeholders, Representative of the KMU LWB, Man, 2017).

As the interview excerpt shows, part of this 'success' is that WUAs generate local livelihoods. This was one of the main considerations when the model was selected (Chirwa & Junge, 2007). In LIAs the informal sector provides the main source of income for residents (UN-Habitat, 2011). Local formal job opportunities are very limited and many residents work in other parts of the city as gardeners, watchmen or domestic and construction workers (CCODE, 2012a, 2012b; UN-Habitat, 2011). Within LIAs income generating activities encompass some small scale informal businesses such as small shops and market stalls, hair salons, driving cycle-taxis or urban farming (CCODE, 2012a, 2012b; UN-Habitat, 2011). Access to a stable source of income is even more difficult for women who in general have lower levels of formal education and are often responsible for household and child care (Castel et al., 2010).

In the conditions of poverty and unemployment that exist in LIAs, being part of a WUA can be both an income generating activity and a source of status and prestige. Yet, WUAs are hierarchical organisations and the benefits of working for one are not equally distributed among the members. The organisational structure of WUAs reveals a first form of gendered division of activities, privileges and profits that is also intersectional, reproducing class or community status. The WUA managing bodies are populated by a majority of influential male community members, such as religious, political, and traditional leaders, or local businessmen. While a few women have been able to enter these masculine spaces, they also usually are part of community elites. Members of WUA managing bodies receive a monthly honorarium for their advisory role and are entitled to other economic benefits such as funeral allowances. They also hold decision making power on how to invest profits from water sales, what to prioritise in the negotiations with the Lilongwe Water Board, or whom to hire to fill WUAs vacancies.

At the bottom of WUA's hierarchy there are the workers engaged in the everyday activities of water provisioning. At present more than eight hundred women are employed as kiosk attendants and inspectors (Interview, Representative of KMU LWB, Man, 2017), making up the majority, if not the totality, of the labour force for kiosk operation (Adams et al.,

2018). They are responsible for opening and closing the taps, controlling customers do not draw more water than they pay for, and gathering the payments from customers. They are also in charge of ensuring that kiosks and the surroundings are kept clean; often help clients to lift the buckets; and mediate in potential conflicts between customers. Kiosks attendants work at the kiosk eight to nine hours a day with a break in the middle of day (from around 6 to 10-11am and from 2-3pm to around 6pm) seven days a week (*Lilongwe Water Board Tariff Review and Willingness to Pay Study. Affordability and Willingness to Pay Report*, 2014). Once a week, attendants bring the money collected from water sales to WUA offices where revenues are compared to the meter reading done by a kiosk inspector. Kiosk attendants receive a monthly salary but have little participation in decision making activities and, therefore, lower status and fewer privileges than members in managing bodies. Yet not all women who work as kiosk attendants share this same low status. While kiosk attendants are recruited into post from the LIAs resident communities and are usually low-income women, WUAs managing bodies often use their hiring power to reward prominent community members giving the job to female relatives of local leaders who have donated the land for the construction of the kiosk (Interview, Kiosk Attendant, Woman, 2017).

As we will further discuss, this gendered and intersectional hierarchical structure has implications for the working conditions of kiosk attendants and the challenges they face in their jobs.

6.8 Gendering infrastructural work: reproducing subjectivities

In Lilongwe, kiosks are constructed as gendered sites of water labour through the mobilisation of gender discourses and subjectivities. From an operation perspective, women are considered essential at both ends of the kiosks due to their domestic responsibility of fetching water and their labour in kiosk operation. As in many other contexts, due to gendered social norms, water collection is perceived as a female responsibility. As women bear most of this burden and kiosks are more frequented by women they are also framed as female spaces. This framing used to explain the prevalence of women in kiosk operation

> *"It is the nature of their job, they sell fellow women, very few men go there. And also men are not trustworthy in keeping the money, they can drink it (...)*

> *In the past we used to have some men selling water, but men feel shy to serve women, and we had a lot of problems with missing money."* (Interview, Stakeholders, WUA administrator, Man, 2017).

These types of discourses reinforce hegemonic femininities and masculinities and naturalise women's positions as more appropriate to the role while excluding men from it. As the interviewed suggests an important part of the smooth operation of kiosks depends on cordial relations between attendants and customers. This requires qualities that are often stereotyped as feminine such as patience, empathy, and reliability in dealing with money situating women as 'naturally' more suitable to the job. For example, one of the reasons for not hiring men is that they are "*short tempered so when a woman wastes water*[14] *they would beat a woman for that"* (Interview, Kiosk Attendant, Woman, 2017). Another participant suggested that *"sometimes men are too rude they do not understand women, so it is a problem to put men in that kiosk"* (Interview, Stakeholders, member of WUA managing body, 2017). On the other hand, female kiosk attendants and customers have, WUAs' management argues, a shared embodied experience of suffering for the lack of water. Similarly stereotypes that present women as more honest when dealing with money were used by interviewees to rationalise why women fit better in this job. As a WUA member explained referring to the times when men were employed as attendants "*sometimes they would be turning the meter and for two three hours they would be selling the water and pocketing themselves women do not do that, they cannot do that, they are shy*" (Interview, Stakeholders, member of WUA managing body, Man, 2017).

Furthermore, the way the job is structured contributes to the reproduction of particular female subjectivities (e.g. house carer, mother, wife) and contributes to its framing as a natural female activity. For example, the working schedule allows women to take care of household chores in the mornings and be back at home for lunch. Moreover, kiosks attendants are often assigned working locations nearby their houses to facilitate their back-and-forth movement and offered the possibility to bring kids to work so their caring responsibilities are not constrained by the job (Interview, Stakeholders, WUA network representative, Man, 2016).

However, as we further elaborate in the next sections the naturalisation of the kiosk attendant job as a gendered activity veils the power dynamics explaining why almost all

[14] Wasted water here refers to water that runs out of the kiosk tap but cannot be accounted for in the price paid by the customer as for example the water that is used to wash the bucket or spillages during collection

people working in this position are women and the material implications that the gendering of the water kiosk attendant role has for these women.

6.9 Women's infrastructural labours subsidising low-cost infrastructures

Reflecting on the history of the water kiosk as a formal node of provision within the centralised water system of Lilongwe demonstrates that women's bodies and labours have implicitly been relied upon to increase access to water in the city while keeping the public investment in water infrastructures low. For example, in the late 1980s considerations were made about the possibility to substitute LIA's kiosks with in-house piped connections. Maintaining the system of kiosks was suggested as a strategy to "control water demand" and to "delay capital and operating expenditures" such as in water source development or network infrastructure extension (Stanley, 1986, p. 4). Despite the role of women in both substituting for the lack of pipes and enabling the possibility to postpone investments in new infrastructure (as they were already filling the gap) this strategy completely overlooked the implications for their lives. Concurrently, as we go on to discuss, this broader 'success' of kiosks as a key water infrastructure in Lilongwe conceals the risks and challenges women face when performing these activities as well as the role they play in making up for important inefficiencies of the system.

The story of success of kiosks in LIAs has come to be framed in relation to the important opportunity this system provides for women's employment. The success narrative is pushed by LWB, WUAs and other partners who consider employment of women as attendants as evidence of commitment to women's participation and empowerment within the LIAs (Interview, Stakeholders, Representative of KMU LWB, 2016). Undoubtedly, having few employment opportunities in their communities, these jobs do represent a unique and highly sought-after prospect. Beyond a source of income, the kiosk offers a space to create and cultivate social networks and connections. Kiosk attendants do not have the power and status of members of WUA managing bodies. However, at the kiosk, attendants constantly interact with other neighbours, and in particular with fellow women, who come to buy water. In this way, beyond providing a wage, the relations cultivated at work allow them to expand their social capital within the community. Through their position at the kiosk some attendants have been able to make money on the side by selling charcoal or soap or have been offered the opportunity to participate in NGO initiatives such

as saving groups or trainings (Interview, Stakeholder, local NGO representative, Man, 2017). Kiosk attendants also hold a relative position of power and authority in relation to customers that can be put to work to their own interests. For example, they may allow friends and relatives to draw water on credit, give them priority during water-shortages or quarrels at the waiting line (Velzeboer et al., 2017) or may even deny access to particular customers after having an argument with them (Interview, Resident LIA, Kiosk user, Woman, 2018).

Yet, women's vulnerability in terms of access to jobs has translated into an opportunity for the WUAs to recruit cheap labour. As a WUA representative explained,

> *"When we opened this [the WUA managed kiosk system] we needed people who can work as employee who can accept low salaries, and those are women. We wanted to help those people that are in need and most people that are in need are women, so by employing women we are helping people. That is why women accepted, men would have not."* (Interview, Stakeholders, WUA representative Member, Man, 2017).

The way cheap labour is rationalised as a success hides the centrality and reliance on women's naturalised and low-cost labour to make kiosks a financially viable infrastructure. In 2019, the starting monthly salary of attendants was MKW 30000 (28 GBP) but had for years consistently remained under the minimum wage established by the government. Keeping wages low allows WUAs to use revenues from water elsewhere within the association (e.g. construction of offices, purchasing of cars, and other activities to consolidate their presence and status in the community, see Pihljak et al. (2019)).

As kiosk attendants explain, their low wages only cover small family expenses like paying for school fees (Interview Kiosk Attendant 1, 2017 and Interview KI1, 2016) or buying shoes for the children (Interview, Kiosk Attendant 1, 2017) but it is not enough to sustain the household. As a WUA representative acknowledges *"[wages] are too low, they [Kiosk Attendant] want more money, at least that they can afford to raise their families. That is the problem."* (Stakeholders, WUA representative Member, Man, 2017). These financial conditions contrast significantly with the economic incentive members of the managing bodies receive. On average the monthly wage of kiosks attendants working on a full time basis is only one-third higher than the monthly honorarium of these members, who have an advisory role that involves attending four meetings per year (Pihljak, 2014). This situation is perceived as frustrating by kiosk attendants (Velzeboer, 2015), who as reported by

Adams et al. (2018) have seen their demands for better conditions repeatedly ignored by the managing bodies (populated by mainly powerful men).

At the same time, those linking the success of kiosks to women's employment do not hesitate to disavow attendants. Their salaries are increasingly regarded as too costly and ways of reducing the reliance on women's labour are being explored. At present an electronic system of water prepayment at kiosks is being piloted. As a representative of the LWB explained to a local journal, the objective of this new project is to reduce dependence on attendants:

> *"Previously people were accessing water through our kiosk which were being run by attendants; one could only buy water from those traditional kiosk if the attendant was around to serve them, meaning people in low-income could only have water during some hours of the day."* (Interview with Representative of LWB as quoted in 'Lilongwe Water Board Partners TNM on E-Madzi Initiative, Customers Pleased', 2017)

Pre-paid kiosks, it is argued, will reduce the cost of water by cutting down the operational costs associated with kiosk attendants. Strikingly there is no consideration of the implications that other WUAs expenses (e.g. the so called developmental activities or the construction of high standard buildings and cars) have for the final price of water (see Pihljak et al., 2019). A recent consultancy report indicates that "*the reason for the large mark-up on the bulk water price is the wage of the water seller*" (ECA, PEM Consult and TM associates, 2014; p. 36). As the LWB explains, "*The plan is to have this (system) with no kiosk attendants. The same way an ATM works, there is no cashier there. So, the salary for the cashier will bring the price down"* (Interview, KMU LWB, 2017). When confronted with the loss of employment and what this will mean for women, LWB explains that WUAs are aware but "*they have accepted the idea and all they have said is that they are interested in seeing the price going down. They know people will not be employed but their interest is that the price should go down and the access should improve"* (Interview, Stakeholder, Representative of KMU LWB, Man, 2017).

A different way in which women's labour is 'subsidising' the inefficiencies of the system is through the expectation for kiosks attendants to work on flexible hours. The technical characteristics of the network, together with everyday decisions on its operation, have led to a highly uneven water distribution in the city, with LIAs suffering from frequent service interruption (Alda-Vidal et al., 2018; Boakye-Ansah et al., 2016; Tiwale et al., 2018). Kiosk

attendants must adapt their schedules to the erratic tempos of water supply. When pressure is low, they have to extend their working hours in order to allow for all customers to fill their buckets. When the water stops, attendants go home but must quickly return to their post when water is back, even when this happens in the middle of the night. This has important implications in terms of gendered temporalities and spatialities as service interruption disrupts women's routines and constrains their spatial mobility to the proximity of kiosks.

Attendants adaptability was seen as a major advantage of the WUAs Kiosk model (Chirwa & Junge, 2007). In this perspective, flexibility is not only important to ensure access to water but is also crucial to the financial sustainability of WUAs. To sustain their fixed operational costs WUAs should sell a minimum water volume every month. During water supply interruptions WUAs cannot sell water, opening the kiosks at night compensates for the selling hours lost during the day. In this way the financial risks of WUAs as organisations are passed on to kiosk attendants who as further elaborated in the next section have to assume the personal and physical risks of working odd hours.

6.10 Emotional water labours: risks and distress during water shortages

The frequent interruptions and shortages of water in LIAs make the job of kiosk attendants challenging in both emotional and physical terms. Attendants are also residents of LIAs and familiar with the struggles of fellow women to secure water for household needs. This position allows them to empathise with customers, to the point that as an attendant explained, for her *"the most difficult part of the job is when there is no water"* as that means she cannot open the kiosk and she knows her neighbours will suffer (Interview, Kiosk Attendant, Woman, 2017).

Often in LIAs water only flows at night and attendants are exposed to risks of robbery and violence. Situations in which customers and attendants have been target of thieves are common. As an attendant explained, "*we face the risk of meeting thieves. They think we have money and want to rob us. Also, customers buying water at night* [usually women] *face the same risk*" (Interview, Kiosk Attendant, Woman, 2016). Different cases have been reported of attendants violently assaulted by thugs or harassed by drunk men (Velzeboer, 2015). Women describe these night encounters as traumatising experiences. For example, one of the kiosk attendants explained, "*At the kiosk I worked before there was water only at night and I had a lot of problems. Once I met a ghost on my way home. Sometime men*

throw stones at me, once I could not even see who was throwing the stones" (Interview, Kiosk Attendant, Woman, 2016). The darkness makes also counting money complicated: "*I cannot check if they are giving me the right amount. Once they gave me a broken 1000 bill I didn't know because it was folded so I gave the change*" (Interview, Kiosk Attendant, Woman, 2016). This adds to the anxiety of attendants who are expected to pay any imbalances in the collection of payments from their own pocket.

Working night hours also has other implications. First, attendants and customers must assume the extra burden of walking to the kiosk during their evening resting hours. As an attendant explained, *"even if I had a tiresome day instead of resting and sleeping, I am required to go work"* (Interview, Kiosk Attendant, Woman, 2017). Further, it clashes with other responsibilities women have at home and, as such, leaving the house in the middle of the night to attend work on short notice may lead to tensions and household conflicts. As a WUA representative engaged in counselling a number of attendants and their families explained:

> *"At whatever time the water comes the kiosk attendant is supposed to go, to leave the family behind and go to attend the customers. So, it means that it does not allow for the time needed to attend to the family. If there are school children, she does not have time to feed them or to bathe them before they go to school. She does not have time for the husband."* (Participant observation, Film debate WUA Area 50, Community leader, Woman, 2018).

Concerns are intensified for women who leave their children alone at home when they go to the kiosk:

> *"Selling water and night is difficult sometimes women come to my house and ask me to sell them water, we go there together but then they draw water and leave me there alone, I wait until morning and think of my kids that I left home alone, anything can happen"* (Interview, Kiosk Attendant, Woman, 2016).

This intersects with other wider labour issues and conditions in local neighbourhoods, for example, in households where men work night shifts as security guards and have to travel away from home to work in the higher income residential areas.

Leaving the house at night often means a breach of social expectations of modesty imposed in women. For some attendants this is a source of anxiety and can even translate into conflicts with husbands who may have suspicions of infidelity.

> *"When water stops coming and resumes at night, our families are at risk. When our wives leave at night to get water, some women might take advantage of this problem and use that time to meet other men. Also, such families can easily break up because there might be cases of men fighting over suspicions that the other man had slept with another mans' wife."* (Participant observation notes, Film debate Area 50, community member, 2018).

In examining the success of this model, water utility staff, donors, and high-ranking members of the WUAs underplay or overlook the multiple challenges faced by women who are responsible for selling and buying water at the kiosks. The odd working hours, the physical burden, the everyday violence, as well as the emotional fatigue associated to this task are concealed in discourses of success, measured in terms of high revenue collection and employment rates.

6.11 Conclusions

In this chapter, we have shown that women's labours are fundamentally interwoven into the formal planning and running of the water infrastructure in LIAs. Water kiosks have proven to be a financially sustainable solution to extend and ensure access to water in LIAs. This success hides their reliance on their construction as gendered spaces of water labour. Not only are they perceived as female spaces because they are more frequented by women who have traditionally been responsible for the domestic labour of water collection but also the labour required for its operation is framed as being more suitable to women. The feminisation of these water labours has material implications for women working as kiosk attendants who despite having an income opportunity and the possibility to build on social relations have to deal with low paid jobs, reduced decision-making power in WUAs, and the physical and emotional risks of working odd hours to ensure both, neighbours' access to water and the financial viability of the system.

Integrating literatures on infrastructural labours with insights from feminist political ecologies of water has enabled us to bring into discussion questions around the (in)visibility of women's infrastructural labour. As we have shown the story of success of Lilongwe's water kiosk system is predicated on women's bodily and emotional labour. The low-cost work of kiosk attendants, while unrecognised in the formal story of the water kiosks, is relied upon to make up for the inefficiencies of the system, and is integral to the functioning

of the infrastructure. Paradoxically, women's labour is simultaneously alleviating and exacerbating forms of gendered inequalities, and making women more visible and less visible. On the one hand, working as a formally contracted kiosk attendant opens up spaces to be part of that 'real' productive (water) world, from which women are often excluded (Meinzen-Dick & Zwarteveen, 1998; Zwarteveen & Bennett, 2004, Alda-Vidal et al., 2017). On the other, the gendering of water kiosk labour and the naturalisation of women's positions as more appropriate to the role places women at the bottom of the hierarchical structure of the WUAs and results on the exploitation of women's vulnerabilities and risks and the perpetuation of unjust working conditions. Concurrently, women's labour is made visible as a means to discursively produce the success of the WUA model and the promise of kiosks as inclusive water supply infrastructures (see also Anand et al., 2018; O'Reilly, 2006). Performance of this success, however, relies on concealing the frequent water shortages and, in turn, bodily experiences and emotional stress of dealing with water discontinuity (Cole, 2017; Rusca et al., 2017; Sultana, 2011, 2015; Wutich, 2009). In other word, the success of the model requires making female bodies invisible.

From a policy and planning perspective, a more critical consideration of the infrastructural work of women within the kiosk system is essential given how significant kiosks are becoming as water provision infrastructures in Global South cities. This starts by making visible the reliance of this infrastructural system on women's labours and ultimately requires moving beyond the current 'tokenist' approach that celebrates the recruitment of women as attendants to addressing their demands for just and safe working conditions. Furthermore, as we have shown, in Lilongwe there are indications that digitisation of water services and a shift to pre-paid kiosks may potentially supplant women's low-cost labour, further cutting down the operational costs by designing out the requirement for kiosk attendants from the infrastructural system. As the water supply system transitions to a new technology, kiosk attendants become disposable, while WUAs' management is likely to play an important role in the pre-paid kiosk system. Being already excluded from negotiations and decisions making processes within the water system, women's rights and interests are also unlikely to be heard and protected within this digital transition. Continued attention will be needed to gendered and labour dynamics of these water kiosk digitisation projects, as they are trailed and tested.

Chapter 7.

Living with Sanitation Failures: Embodied Experiences of Fragile Infrastructures

7.1 Publication information

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7.2 Abstract

This paper extends conceptualisations of infrastructural fragility within the embodied politics of urban infrastructures. Drawing on empirical material collected through ethnographic and archival/desk research in Lilongwe, we describe how the different sanitation configurations and understandings of responsibilities for the provisions of sanitation services in Area 18 and Low-Income Areas have developed linked to the postcolonial and colonial histories of the neighbourhoods. As a result of passing maintenance costs and labours on to residents, infrastructural fragility has become a persistent challenge read within the urban fabric that transverse the life of residents in violent ways. Through a feminist and embodied approach and by engaging across the intersections of the concepts of infrastructural violence, labours, and citizenship the paper demonstrates how sanitation systems at the brink of failure affect and engage bodies along intersecting hierarchies of income/social standing and gender. We demonstrate: i) the uneven (corporeal, emotional) harmful consequences of fragile sanitation systems and how those build on broader social and gender inequalities; ii) the role of non-expert and gendered labours and bodily practices in maintaining sanitation systems at the brink of failure and how these intersect with gendered subjectivities; and iii) the different possibilities urban residents have to claim infrastructural or hygienic citizenship *vis a vis* or on the margins of the state.

7.2 Introduction

On July 8th, 2017, Madalitso[15] , a woman who lives in Lilongwe's Area 18, woke up early in the morning to start her household chores. She opened the tap to drink a glass of water. She followed her routine and did not pay much attention to the colour or smell of the water flowing out of the tap. To her disgust, she would later discover that spillage from a burst sewage pipe had made its way into the local water supply network and her and her neighbours' water taps. On a different day, Chisomo was using the outside toilet in the low-income area (LIA) where she lives to relieve herself. It had been a heavy rain night. She felt the ground moving and suddenly plummeted into a four-meter-deep latrine hole. The latrine platform had fallen with her, protecting her from getting soaked in faeces. She was quickly helped out and taken to the hospital. She was lucky she only had small wounds.

Building upon these vignettes, this paper uses a feminist and embodied framework to question how these sanitation failures are produced, maintained, and unequally experienced in Lilongwe, Malawi. Doshi (2016, p. 125) calls for a more "rigorous treatment of the body as a material and political site" in urban political ecology studies. She argues that the body is frequently "mobilised in conceptualisations of cities and infrastructure despite the fact that material embodiment remains under-studied and disparately theorised in the subfield" (Doshi, 2016, p. 125). Authors have used a feminist and intersectional lens to demonstrate the central role of the body and embodied experiences in the politics of infrastructures (e.g. Desai et al., 2014; Sultana 2009; 2011; 2020; Truelove, 2011, 2019b). However, within the field of (feminist) urban political ecology, embodied approaches remain marginal and focus empirically on urban South Asia.

We start from the notion of infrastructural fragility to escape widespread approaches in the sanitation literature that tend to frame the challenge of urban sanitation in terms of coverage or the absolute presence or absence of toilets (see Lawhon et al., 2018 or Satterthwaite 2016 for more on this critique). We build on a burgeoning body of work that takes failure and breakdown as a starting point to rethink infrastructures (Ramakrishnan et al, 2020; Jackson, 2014). Following Ramakrishnan et al. (2020), we use the term fragility to emphasise that failures and breakdowns are only the tip of the iceberg in the ordinary vulnerability of infrastructures. To operationalise an understanding of fragility beyond punctual moments of breakdown, we build on three concepts that help to understand sanitation failures within the everyday life and politics of urban infrastructures: infrastructural violence (Rodgers

[15] Vignettes constructed from interviews with residents

and O'Neill, 2012), labours (Fredericks, 2014), and citizenship (Lemanski, 2020). While these concepts indirectly evoke embodied experiences and bodily practices in different ways, we argue they could benefit from more explicit or extended attention to the body and embodiment in their analysis.

In developing our arguments, we draw on empirical material collected through ethnographic and archival/desk research in Lilongwe. The current sanitation landscape of Lilongwe consists of a variety of infrastructures providing different levels of service, namely pit latrines (70% population), septic tanks (25% of the population), and piped network (5% of the population) (World Bank, 2017). The distribution of these infrastructures reproduces the socio-spatially segregated patterns outlined by discriminatory planning practices (Alda-Vidal et al., 2018; Rusca et al., 2017; Tiwale et al., 2018). To engage with this fragmented, heterogeneous and unjust landscape we focus on two urban spaces with different trajectories of urban and infrastructure development. These are the LIAs[16] of Lilongwe, where dwellers mainly use self-constructed pit latrines, and Area 18, a middle-income planned neighbourhood connected to the municipal networked sewerage system.

By engaging across these literatures and rich empirical material, the paper extends our understanding of the embodied politics of urban infrastructures, demonstrating how sanitation systems at the brink of failure affect and engage bodies along intersecting hierarchies of income/social standing and gender. In doing so, the paper makes two important contributions. First, we contribute to conceptualisations of infrastructure failures and breakdowns as part of the long-term ordinary life and politics of urban infrastructure, rather than fortuitous exceptions. By redirecting the attention from failure to fragility and using the concepts of infrastructural violence, labours, and citizenship, we advance the understanding of how infrastructural vulnerabilities are (re)produced, maintained, lived, and fought against on an everyday basis. Second, by zooming into the bodily scale and thinking through the relations between embodied experiences and the concepts of infrastructural violence, labours, and citizenship within the specific fragile sanitation systems of Lilongwe, we demonstrate that an embodied approach is crucial to recognising the intersectional and gendered dimensions of these concepts.

[16] Fieldwork was conducted in Area 56 and Area 50. We use the general term LIAs to refer to these two neighbourhoods for brevity, acknowledging that different LIAs may have different sanitation trajectories and histories.

The paper also has relevance for how we think through water infrastructures globally by highlighting i) that water and sanitation challenges go beyond absolute presence or absence of taps or toilets and encompass multiple risks and moments of failure along the life of infrastructures; ii) the significance of maintenance and repair, not just building, for WASH projects in broader funding environments where recurrent costs of infrastructural maintenance are not well received by donors and governments alike and are often passed on to poor urban residents (Foster and Briceño-Garmendia, 2010); and iii) that a more nuanced and in-depth discussion of systematic exclusions and injustices produced by failing sanitation infrastructures is needed, including who can claim (or at least has the political expediency to fight for) sanitation and hygiene as citizenship rights.

We start introducing the literature on relations between bodies and infrastructures (7.4) as well as emergent work on infrastructural violence, labours, and citizenship (7.5) followed by a description of the methodology (7.6). Findings are divided in four sections. Section 7.7 explores how different sanitation infrastructures and practices are shaped by postcolonial histories and differing definitions of sanitation service provision and responsibility. Section 7.8 reveals the harmful consequences of fragile systems. Section 7.9 describes the embodied, corporeal, and gendered infrastructural labours of fragile infrastructural maintenance. Finally, 7.10 explores the production of different embodied experiences of infrastructural or hygienic citizenship. In section 7.11, we conclude by discussing how, in the context of persistently fragile sanitation systems, an embodied approach to infrastructural violence, labours and citizenship allows to extend these concepts in different ways and contributes to the understanding of the embodied politics of urban infrastructures.

7.4 The embodied politics of urban infrastructures

The recent call to pay attention to the scale of the body and embodiment in the analysis of urban socio-ecological processes and inequality aligns with a broader move in feminist theory (Doshi, 2016; Sultana 2009; Truelove 2019). Taking issue with disembodied theorisations of social difference, feminist scholars shifted the attention to the intersection of the symbolic and the material in the production of social subjectivities (Grosz, 1998; Longhurst, 1997; Butler, 1997). As Sultana (2009 p. 435) argues, “subjectivities are not abstract notions but are lived in bodies, in spaces, through practices and have materialities that need attention”. Embodiment drives attention to how different intersecting forms of

social power are internalised and (re)produced through everyday bodily, spatial, and material practices (Elmhirst, 2011; Hawkins et al, 2011; Nightingale, 2011; Sultana, 2009)

Few scholars use a bodily or embodied approach to explore embodied experiences and inequalities of water and sanitation infrastructures (Desai et al, 2015; Truelove, 2011; 2019b; Sultana, 2009; 2011; 2020). By zooming into the scale of the body and thinking through the relations between bodies and infrastructures, these scholars make several important conceptual contributions. We highlight here the three contributions that we draw on in this paper.

First, these scholars situate the body at the centre of the micropolitics of infrastructures by showing the various ways in which infrastructures are lived through bodies and how embodied experiences actively shape everyday decisions about what infrastructure to use and how. Examples in which the corporeality of infrastructural practices becomes evident are the "headaches, backaches and bodily deformities from hauling heavy loads of water" (Sultana, 2009, p.435) from distant waterpoints; "the physical experience of criminalisation for illegal [infrastructural] practices" (Truelove, 2011 p. 147); the emotional distress and suffering resulting from navigating complicated infrastructural landscapes for accessing water (Sultana 2011; 2020); or the disgust provoked by having to use dirty public toilet blocks (Desai et al, 2015). The last two examples drive attention to the importance of emotions and visceral reactions as part of embodied infrastructural experiences (Anderson and Smith, 2001; Sultana 2011).

Second, these scholars reveal that gender and other social power relations are productive of, and produced through, embodied infrastructural practices (Truelove, 2011). For example, how much different women are involved in different infrastructural practices (such as waiting for water tanks) depends on their "situated position within families, communities, and class groups in the city" while at the same time reinforcing "gendered and classed social differences" (Truelove, 2011; p. 147).

Finally, these scholars articulate the multiplicity of connections between embodied infrastructural experiences and broader urban processes of social differentiation (Desai et al., 2014; Truelove, 2011; Sultana 2020). For example, Sultana (2020) situates the different embodied infrastructural experiences of low- and high-income women in Dhaka within processes of state dispossession-recognition of citizens' rights.

7.5 Infrastructural Violence, Infrastructural Labours, and Infrastructural Citizenship

In considering other literatures that help to explore the multiple ways different bodies are impacted and engaged by fragile infrastructures, we cover three bodies of work that invoke the embodied experiences of urban infrastructures: i) infrastructural violence, ii) infrastructural labours and iii) infrastructural citizenship.

The term infrastructural violence refers to the various ways in which material infrastructures can enact violence (Rodgers and O'Neill, 2012). Reading the effects of the lack of, or presence of poor-quality, infrastructures through notions of infrastructural violence calls us to think beyond the most obvious and immediate hardships produced by the denial of access to basic services such as water, sanitation, energy or transport; and rather to explore how the silent and repeated deprivation of these basic needs builds and facilitates multiple structural inequalities (Datta and Ahmed, 2020; Desai, 2018; Mustafa et al, 2019; Rodgers and O'Neill, 2012; Truelove and O'Reilly 2020). In particular, feminist scholars have shown how the 'limitations' and 'omissions' of infrastructures are tied to, and reinforce, gender discrimination and gender-based violence suffered by urban low-income women (Datta and Ahmed, 2020; Truelove and O'Reilly, 2020). This work resonates with literature that links gender-based violence and sanitation insecurity (Caruso et al, 2017; O'Reilly, 2016).

There is growing academic interest in infrastructural maintenance and repair practices (Mattern, 2018; Jackson 2014). Scholars use the concept of infrastructural labours to draw attention to the essential but often invisible and devalued human work required to keep urban systems functional (Fredericks, 2014). This scholarship highlights how erosion, breakdown and decay are part of ordinary living with infrastructures (Anand 2020; Graham, 2010; Jackson 2014; Ramakrishna et al, 2020). The labours, practices, and expertise of carers and maintainers emerge as essential in reproducing material and social order (Barnes, 2017) or producing adaptive, innovative, and incremental change (Bhan, 2019; De Coss-Corzo, 2020; Jackson, 2014). Much of this work calls for the recognition of the valuable work of "expert" fixers or those who repair and maintain infrastructures within the logics of formal or informal income generating activities (e.g. Anand 2017; Anwar, 2020; Ramakrishnan et al, 2020).

Work on infrastructural citizenship explores how urban residents develop different notions and understandings of citizenship, including expectations around rights and responsibilities

in service provision (Rodina and Harris, 2016). These understandings and expectations are shaped by historical legacies and legal frameworks but also by everyday encounters with uneven and changing infrastructures (Rodina and Harris, 2016; Lemanski, 2020). Emerging work on infrastructural citizenship using a feminist lens shows that embodied experiences of citizenship are highly differentiated not only across urban spaces with different access to infrastructures, but also along intersecting axes of social difference such as gender, income, race, etc. (Sultana, 2020; Wiltgen Georgi et al, 2021). Most of the work on infrastructural citizenship explores the practices through which different urban residents engage with the state in different ways to claim rights and belonging, from grassroots participation (Wamuchiru, 2017), confrontation and protest (McFarlane and Silver, 2017b) to other everyday practices of citizenship (Lemanski, 2020; Ranganathan, 2014). Less explored is how citizenship is expressed in conditions of poverty and marginality in which residents have very little expectations of the state in service provision and "the value of citizenship is barely visible" (Silver and McFarlane, 2019 p.22).

7.6 Methods

In developing our analysis and arguments, we draw on desk-based and ethnographic research conducted in two three-month periods during 2017 and 2018 in Lilongwe by the first author. Data collection included participant observation, semi-structured interviews, mobile methods, and photo elicitation exercises conducted with formal and informal sanitation workers; semi-structured interviews with residents of LIAs and Area 18, representatives of the governmental and non-governmental local sanitation sector, community leaders, and health workers. Interview-based data was supplemented with the review and analysis of urban plans, project documents, and other literature about Lilongwe's sanitation sector gathered through archival and desk-based research as well as analysis of secondary data.

Interviews were conducted in English or Chichewa and translated to English with the support of local research assistants. Some interviews were tape recorded and transcribed directly from the English translation, and some interviews and most of the discussions during field visits with sanitation workers were summarised from handwritten notes.

The sewage contamination incident was judged in court during the fieldwork period. The topic was seen as sensitive by residents and most people approached did not want to be

formally interviewed for fear that any information disclosed could be used against their case in Court. This has been an important limitation that we have tried to minimise by using secondary data, such as the coverage of the event in local media, the final Court Judgment made public in 2020 as well as data collected as part of a previous project in which the first author was involved. Furthermore, a few informal interviews, summarised in handwritten notes, and observation during field visits were used as background information.

7.7. The uneven sanitation trajectories of Lilongwe

In this section, we show how infrastructural fragility is produced from the colonial and postcolonial histories of Lilongwe, evidencing who is responsible for the construction, maintenance, and repair of fragile infrastructures.

7.7.1 Area 18 sewerage: a public and underfinanced service

Area 18 is a neighbourhood located in the northwest part of Lilongwe, relatively close to the political centre of the city. The area was developed by the state-owned housing agency as medium density residential neighbourhood in the 1970s to house government workers at heavily subsidised rents (Potts, 1986; LCC, 2010). It was originally designed to receive municipal piped water and sanitation services and has remained a privileged exception since. The production of this anomaly should be read as part of the first post-colonial president's state-building strategies. These included gaining the support of the "bureaucratic elite of the country" (Anders, 2009, p. 56) and constructing modern infrastructures for national development (Tchuwa, 2018). Currently, the piped sanitation system only provides service to 5% of the population (World Bank, 2017). Area 18 is the only neighbourhood of the city in which all houses are connected to the system (Baker, 2016).

The sewer system is aging and working over capacity. Area 18 has been suffering recurrent problems of blockages and wastewater overflows since the 1990s (Baker, 2016; Nippon Jogesuido Sekkei, 1994). Only one major project to update the sewer network has been conducted in over 50 years and the lines serving Area 18 have not been upgraded since the construction of the system. As a municipal sewer worker indicated:

> *"It is a small pipe engaging a lot of people. That one was constructed a long time ago; it was estimated for the few people who were there at that time. The area has been expanding, more people have come to live in, and they are using the same sewer line"* (Interview, Sanitation Worker, Sewer operator, Man, 2017)

Different and overlapping legal documents in Malawi's sanitation governance framework conceptualise the responsibilities for service provision as both public and private. How these responsibilities are operationalised depends on the type and location of sanitation infrastructures (sewerage vs latrines).

Archival and desk research show that historically, sewerage services were publicly financed and seen as a public responsibility by local and national governments[17]. The legal framework assigns overlapping responsibilities to Lilongwe City Council (LCC) (Local Government Act of 1998 and also the Public Health Act of 1969) and Lilongwe Water Board (Water Works Act of 1995). However, actors do not wish to take charge of a service for which they are unable to recover costs due to the lack of a tariff system (Langkau, 2016; LCC, 2010). The lack of accountability was summarised by a resident:

> *"There has been a blame game with MHC and LCC throwing responsibilities to each other. LWB too says we are not responsible because we don't deal with sewerage"* (Interview, Resident Area 18, Woman, 2018)

In interviews, LCC representatives used difficulties in recovering operational costs to justify the neglect of the sewage system. As explained by a municipal engineer:

> *"That [the collection of fees] has been one of the major challenges. We have been using locally generated funds from other council activities. That is why for major rehabilitation has been quite difficult to manage, mostly, we work on the minor affairs of maintenance"* (Interview, Stakeholders, LCC engineer, Man, 2017)

The consequences of lacking investment in maintenance are experienced by sewer workers and residents on an everyday basis. Sewer workers claim to be under-resourced and overburdened by the huge amount of work required to sustain the system. Fieldwork

[17] In recent years, due to low public investment in the sewerage system, private developers have constructed sewer lines that were handed over to LCC (Langkau, 2016; LCC, 2010)

observations and interviews revealed a persistent shortage of personnel and the lack of protective equipment, replacement parts and fuel to drive around the system. Workers perform most of the work manually, often requiring them to rely on historical knowledge of the system rather than (non-existent) infrastructural maps. Residents of Area 18 complain of recurrent blockages and sewage floods and that service providers take long time to respond (see next sections).

Despite the obvious abdication of responsibilities by service providers, the malfunctioning of infrastructure is often blamed on residents who damage it by informally connecting to it, flushing, or disposing of waste into toilets and manholes (See Chapter 5), stealing manhole lids, and engaging in informal maintenance and repair practices (see section 4.3.1).

7.7.2 LIAs: urban fragmentation and private sanitation

The LIAs that are part of this study originated during the relocation and construction of the new capital after the independence of the country. The design of the new capital city followed an Apartheid inspired order that segregated poor and working-class African residents into high density LIAs (Potts, 1986; Myers, 2003). LIAs were separated from the rest of the city by physical barriers such as "vacant land, swampy lowlands, tree belts, and streets" (Rusca, 2017 p. 141). In LIAs, low-income residents could informally acquire affordable land from chiefs (CCODE, 2012a; 2012b; Refstie, 2013) and escape the first post-colonial government's harsh policies against squatting (Myers, 2003). Over subsequent decades, the failure of public authorities to provide housing in planned areas for growing low-income populations resulted in pressure over affordable land in informal neighbourhoods (Kalipeni, 1997; Mwathunga & Donaldson, 2018).

The construction and maintenance of latrines in LIAs is traditionally considered a homeowner's responsibility. As a local leader reflected, this understanding is not new:

> *"Every household was supposed to be kept clean. Of course, most of these came with the British colonial rulers. It was an offense to have a house without a line to hang cloths. It was an offense not to have place to dry kitchen utensils and cutlery. You had to have a toilet, a bathroom, and a rubbish pit. There we had court workers supervising villages to see how compliant people were. If*

found with an offense you were arrested and made to pay a fine." (Interview, Resident Area 56 and Chief, Man, 2017).

As per the Local Government Act of 1998, the LCC is responsible for sanitation in LIAs located within the city limits. However, in these areas the involvement of the local government and most NGOs working on WASH replicates the colonial practices described in the quote. A few NGOs started microfinancing schemes or built toilets in schools, but domestic sanitation activities are mostly restricted to hygiene education and monitoring:

"Government health officials visit the neighbourhood and advises the chief to ensure that good health and hygienic practices are implemented." (Interview, Resident Area 50, Man, 2018).

As stated by representatives from the local government, the understanding is that construction or maintenance of latrines is the responsibility of each household according to their financial possibilities:

"As engineering department of LCC our mandate doesn't go as far as pit latrines are concerned, our main mandate [in LIAs] is monitoring and providing standards. We leave the process run itself, whereas the town expands people see also the need to coming up with better structures than what they are using." (Interview, Stakeholders, LCC representative, Man, 2017).

"This is their responsibility. If there is someone who was able to construct a house with a whole family sleeping why should they fail with the latrine. They should be able to construct the latrine that they can afford. If it collapses, they should be able to construct another one." (Interview, Stakeholders, District government representative, Man, 2017).

This approach is aligned with the dominant view in the international sanitation sector that the provision of free-of cost (or heavily subsidised) latrines should be discouraged because it leads to poor use and maintenance (See section 1.1).

Residents also perceive sanitation as their responsibility and construct and maintain their own infrastructures. This is illustrated in the low percentage of households in LIAs with no

access to sanitation (NSO, 2018). However, most households cannot afford to construct a toilet using durable materials:

> *"Most of the people have pit latrines but not slab or cement. Most of us we are low-income earners. We cannot afford to construct a toilet using permanent materials. Even in our houses, we cannot spend more money in the toilet than in the house."* (Interview, Resident Area 56, Man, 2018)

As the quote indicates, residents in LIAs have very small budgets for sanitation. To avoid costs they use local materials and engage in self-construction practices. As a woman from the area explained:

> *"I dug the toilet pit and my brother finished with the construction. Most of us who do it alone it is because we don't have the money to hire help."* (Interview, Resident Area 56, Woman, 2018).

These strategies to reduce the costs of construction and maintenance (see7.8.2) produce very weak structures that easily collapse, especially during rains.

7.8 Embodied risks and violences of fragile infrastructures

The neglect of sanitation infrastructure by those responsible for its provisions has produced a persistent set of risks traversing the life of residents in violent ways. Enacted by fragile infrastructure, these violences are differently embodied by residents across and within neighbourhoods and build on the vulnerabilities and inequalities experienced along income and gender hierarchies.

7.8.1 Area 18's sewage discharges: disgust and diseases from living with wastewater

Due to recurrent blockages and failure in the wastewater network, some residents of Area 18 have been living in the proximity of sewage for many years. The recurrence of blockages and sewage spillages was summarised by a resident:

> *"I would say the bursts have been happening for about 10 years now. The problem is how authorities respond to urgent matters and alarms. People have been reporting. They come but provide short-term solutions. It happens again. The same things happen."* (Interview, Resident Area 18, Man, 2017)

For some residents, living with wastewater has become a part of their everyday lives to the extent that the drinking water pollution incident did not come as surprise. As a participant explained,

> *"At first, I thought the smell was coming from outside the house, we all thought it was the manhole that was blocked again."* (Interview, Resident Area 18, Woman, 2018).

The persistent presence of raw sewage produces different visceral reactions and embodied experiences in the residents of the neighbourhood. Baker (2016) reports the experience of a woman who has been affected by recurrent sewage spillages in her backyard for over five years:

> *"The sewage attracts a lot of flies, and the smell is very bad, especially when the wind is blowing, it means that the smell is blowing towards the house. There are faeces outside my house, and I don't feel comfortable with this, it is bad for our health."* (as quoted in Baker, 2016, p.46 from an Interview with Resident of Area 18)

As the quote shows, the smell and sight of sewer discharges not only degrading and disgusting, but a health risk. Wastewater creates a breeding ground for waterborne diseases (World Bank, 2017). For those in Area 18 (who drunk water polluted with sewage - Madalitso, introductory vignette), the risks suddenly materialised with important health implications. As reported in local newspapers, many families claimed to have suffered bacterial infections that *"caused them vomiting, diarrhoea, weakness, fever and abdominal pains"* and some were admitted to hospital (Sangala, 2018, para. 5). However, the implications went beyond immediate health problems, provoking new embodied reactions and anxieties over sewer and water infrastructures. The crisis was described by the residents approached by journalists in very visceral terms, "*degrading, disgusting, noxious, and incomprehensible to make human beings consume human excreta*" (Gwede, 2017, para 3.). Recurrent blockages and sewage spillages acquired a new embodied dimension as they could now be immediately associated to the revulsion and longer-term impacts of drinking sewage.

The physical and emotional hardships produced by the presence of wastewater in yards and streets and the event of water contamination pose an additional toll on women:

> *"Normally it is the woman who has the responsibility to take care of the family and the household surroundings. If anything, without a proper understanding of what actually happened, people would unfairly apportion the blame of sickness to the woman as being unhygienic."* (Interview, Resident Area 18, Woman, 2018)

As the quote suggests, the presence of wastewater in backyards or in tap water not only increases the domestic labours of women (see section7.9.1) but also constrains their ability to fulfil gender subjectivities such as those related to being a good homemaker or mother. A filthy yard, a smelly house or a sick family may be seen by others as the shameful failure to take care of domestic hygiene, thus creating an additional emotional burden for women.

7.8.2 Bodily threats of and anxieties over toilets collapsing in LIAs

The collapse of Chisomo's toilet described in the introductory vignette was not an isolated incident. In fact, some of the residents told us they had faced this challenge on numerous occasions:

> *"This is not the first time it [the toilet] has collapsed. When it first happened, we tried to construct the floor with wood planks, metal bars and burnt bricks but here we are, it also collapsed, of course not all of it. We still use it by carefully squatting so that we don't further weaken the side that was already affected. At first, we were afraid to use it but now we are used."* (Interview, Resident Area 56, Woman, 2018)

Using a latrine at the brink of falling poses an obvious bodily threat. Chisomo, whose story was narrated at the beginning of the paper, was only injured, but the incident could have been fatal. Residents are well aware of these bodily risks, having had previous experiences themselves or heard of neighbours who were injured: "*Many people had their toilets collapsing. I know me and my neighbour who had toilets collapse[ing] while we were inside" (Interview, Resident Area 50, Woman, 2018).* The continuous exposure to this bodily threat produces frustrations and anxieties. For example, a woman whose toilet was affected by recent floods describes her emotions:

> *"I would have loved to dig another hole, that is if I had the money. You know this one is scary because a lot of water got inside during the floods. But no, I will have to use the same hole though I know it can still sink."* (Interview, Resident Area 56, Woman, 2018)

Not all residents experience fragile infrastructures in the same way. Gendered rules increase vulnerability for many low-income women in preventing them from investing in a new toilet in advance of failure. For example, women are often the ones who know when a toilet requires maintenance as "*the mother is the one who knows whatever happens and is needed around the house since the father is always away to work.*" (Interview, Resident Area 56, Woman, 2017). However, decisions on when to invest in a toilet are often made by men: "*It's the husband [decision]. He also ensures people are hired to dig the pit and to do the actual construction" (* Interview, Resident Area 56*,* Woman, 2018). Furthermore, because they often have to outsource the labour typically borne by male family members, female-headed or women-only households experience greater difficulties in reconstructing a collapsed latrine. As a resident put it: "*Most women have husbands who can dig the pits, but I don't*" (Interview, Resident Area 56, Woman, 2018). This unbalance in sanitation decision-making results in women having to use unsafe toilets.

Having to use a facility that can sink unexpectedly produces emotional reactions that are lived through the body. This is illustrated in the story of Chileso, whose latrine sunk while she was using it:

> *"I was traumatised with the experience. In fact, it got a point that I never even wanted to visit a toilet. If anything, I would go only two times in a week."* (Interview, Resident Area 50, Woman, 2018)

Apart from the discomfort and potential health implications of holding bodily needs, her fear meant she had to find an alternative solution for herself and her children. This is particularly challenging for low-income women as gender inequalities in mobility and employment restrict their access to safe alternatives. For example, men in the neighbourhood are able to access safer toilets when at work in the planed areas of the city (See Chapter 4). Other strategies used by men, such as sneaking into someone else's toilet without permission, are impracticable for women due gendered social norms about (night-time) mobility, modesty, and privacy.

Because of these gender inequalities, low-income women have fewer options, leaving them more exposed to physical risks and emotional hardship. Women are either limited to the

continued use of at-risk sanitation facilities at home; or they have to arrange extended access to a neighbour's toilet (see 7.10.2). This strategy has its own gendered implications as it often increases the (emotional and physical) labours of women and their gendered vulnerabilities.

7.9 Embodied knowledges and labours for the maintenance of fragility

Through living with fragile infrastructures, residents have developed the embodied knowledges required to repair, extend the life of, or compensate for non-fully functional infrastructures. These improvised maintenance practices require unpaid physical labours that intersect with gendered subjectivities.

7.9.1 Area 18 material practices of infrastructure maintenance: Clearing blockages and cleaning water

Residents of Area 18 experience the fragility of the sewer system on an everyday basis as they deal with the blockages that turn their toilets non-operational and flood their yards and streets. Neighbours are frustrated with the slow response of service providers and often resort to repairing blockages on their own:

> *"It is just that the people cannot stand the sight and the smell. So, the best is just to do away with the problem after all when you report they come after a week."* (Interview, Resident Area 18, Man, 2018).

Some residents hire private plumbers to fix blockages while others (to save costs and time) do it by themselves. They do not need professional training or a map of the system for this purpose. By seeing wastewater overflowing from manholes, they know where the most problematic pipes are. By observing operators at work, they have learnt the techniques to fix them. Clearing a blocked pipe often entails removing the manhole cover and entering through the manhole to introduce any locally available tools, such as long sticks or electricity wires, to push the materials blocking the sewerage. The process was described by a resident:

> *"I have seen the operators doing it, so I copied what they do. I open the manhole cover and work with one of those [pointing to a tree branch in the ground of the garden] and pull whatever is blocking the pipe."* (Fieldnotes, Mobile Method, Resident Area 18, Man, 2018).

At times, these strategies are successful in restoring the flow of wastewater in the system. However, often materials blocking the system are pushed further down the sewer pipes to affect neighbours; or tools get trapped in or break the sewer lines, adding to the disrepair of the system.

New infrastructural labours with gendered implications have also emerged after the water pollution incident happened. Despite the area receiving treated tap water from the LWB, the fear of contaminations resulted in the adoption of resource, labour, and financially intensive water-related practices in the neighbourhood. The shift in practices is illustrated in this quote from one of the affected residents included in the Court Judgement:

> *"The People within the affected area are still in a shock and cannot trust tap water anymore. Those that can afford are now relying on bottled water, which is too expensive".* (Quoted in Leonard Yankho Phiri & Others v. Lilongwe City Council & 2 Others (2020, p. 12)

As indicated in the quote, many residents have lost confidence in the quality of the water provided. At the time of the interviews, many residents used bottled or boiled water for drinking and other domestic needs. Securing access to water is seen as part of women's household responsibilities. As the quote below shows, the incident increased the emotional and physical labours attached to securing water:

> *"I only drink tap water because I don't have money to buy from the shops. But to say the truth I don't trust tap water. I drink it because I don't have any option. Boiling water is usually done on a charcoal stove. This eats your time lighting the fire. If it is on electricity you have to brace for huge electricity bills. Buying the water means that you have to forego another household necessity."* (Interview, Resident Area 18, Woman, 2018).

7.9.2 LIAs material practices of maintenance: increasing risks through maintenance

The everyday maintenance of latrines in LIAs is part of the female domestic labour: "It is done by females on the compound. The tenants in that house are all bachelors and bachelors don't participate because this is culturally considered work for women" (Resident LIA, woman). As the health personal who visit the area and other sanitation actors reminds residents, cleaning regularly the latrines is part of the maintenance responsibilities of each household to ensure safe sanitation.

> *"For those without a toilet we advise them on the benefits of having one. For those with mud floors we advise them to buy slabs, this is important to avoid accidents of people falling into toilets. We further advise on how to clean toilets using chlorine"* (Interview, Government health worker LIA, Woman, 2017).

Common maintenance tasks include keeping the roof and walls (often constructed with locally available materials) in good condition. As a woman explained, this is important to ensure the long life of the latrine as well as for the privacy of women:

> *"The toilet faces the road but does not have a door just a sack cloth. Some naughty people would position themselves out there so that they have a better view when we enter the toilet. It was shameful and embarrassing. During the last harvest season, we collected the corn stalks to erect this temporal wall, but it is worn out already"* (Photo-elicitation exercise, Resident Area 56, Woman, 2017)

Other maintenance strategies, specifically directed to avoid the filling-up of latrines and the associated costs of emptying or replacing them, include digging holes as deep as possible and the regular flushing of water. As a resident explained, with the water, "*the urine and the faeces go deeper and are washed away*" (Interview, Resident Area 50, Man, 2017). This can be done by regularly adding water manually: "*every week you have to pour three 20 litre buckets of water"* (Interview, Resident Area 56, Woman, 2017). However, this practice may be time-consuming, as women need to collect water from local sources (e.g. wells, kiosks) at high prices. A different way of getting water into the latrine is by connecting the outlet of the bathroom *"so the water you use in the bathroom goes to the pit"* (Interview, Sanitation Worker, Mason, Male, Area 56).

While these maintenance strategies are considered very effective by residents, they have negative implications for the environmental health of the neighbourhood and the safety of latrines. They contribute to the contamination of nearby water sources by faecal matter and weaken the inner structure of the latrines, thus compromising their stability and increasing the likelihood of collapse. For example, a woman explained that the practice of flushing water into the latrine to avoid it filling backfired because it affected the stability of the pit:

> *"It brought more problems because the pit walls softened up and that will force us to construct another toilet.*" (Interview, Resident Area 50, woman, 2018).

7.10 Infrastructural citizenship labours to maintain fragile sanitation systems working

Shaped by the differing understandings and lived experiences of infrastructural citizenship, different forms of civic engagement have emerged in Area 18 and LIAs in response to infrastructural neglect and failure. They are as much about maintaining material infrastructures as they are about reasserting rights to public services or ensuring survival on the margins of the state. We show that civic engagements depend on the investment of time, physical and emotional labours, and social connections. They are gendered, classed and exclusionary in different ways.

7.10.1. Area 18 citizens' collective action

As we have shown in section 4.1.1, the provision of sewerage services had formally been a public duty since the time of construction. The following quote from a newspaper reporting on the Area 18 contamination incident illustrates that residents continue to feel entitled to the right to appropriately maintained public sewerage services:

> *"Residents have bemoaned that the MHC and LCC despite collecting rates from them rarely rectify sewer leakages which have turned the area into a sewage site ballooned in filthy stench not befitting the status of the area."* (Area 18 Red Alert, 2017 para. 2).

As the quote suggests, this right is associated with the privileged historical treatment of the neighbourhood (i.e., status) and the dutiful payment for public services, including sewerage (i.e., city rates).

The perception that infrastructure maintenance is a public responsibility is evident in the approach taken by residents to address constant system failures. Residents affected by a blockage, or a sewage overflow turn first to formal channels and legitimised spaces to demand intervention:

> *"You have got [to make] several calls to the services providers, they don't come to fix it, the problem is there for a week. Sometimes we call the Block Leader to organise a meeting and come together to discuss and see how best we can do"* (Interview, Resident Area 18, Male, 2017).

As the resident explains, when a problem arises, the first reaction is to call the sanitation workers of MHC or LCC or seek a solution through active participation in the local neighbourhood governance branch. However, rather than triggering the sought response from providers, in mediated neighbourhood meetings the responsibility for fixing the problem is delegated to neighbours:

> *"There is often more than one house affected, someone from the group goes door by door and collects around perhaps 500 MKW each: 'guys there is a blockage, and we need to fix it'"* (Interview, Resident Area 18, Male, 2017).

When the water contamination incident happened, residents once again turned to formal governance channels and legitimised spaces for the provision of services. They organised neighbours' committee meetings, designated a community spokesperson and held peaceful demonstrations. These actions illustrate that residents continued to believe in the transformative possibilities of engaging in a dialogue with authorities. As a resident explained:

> *"People protested and went to present a petition to the city council. We want them to take responsibility of their negligence and apologise with compensation."* (Interview, Resident Area 18, Woman, 2018).

The residents' long-standing neighbourhood bonds and social networks and capital were key in facilitating the collective action. Residents could rely on the social infrastructure developed through a history of coming together to solve sanitation and other challenges in

the neighbourhood. This reliance on the bonds between neighbours was anecdotally illustrated in the High Court Report on the incident:

> *"I got out of the bathroom and narrated to my wife the experience. My wife then communicated to her fellow women around the area through a WhatsApp group women created to communicate to each other within the area."* (Quoted in (Leonard Yankho Phiri & Others v. Lilongwe City Council & 2 Others, 2020, p. 12).

As the quote and a report published by the Malawi Human Rights Commission (MHRC) reflect, "*most of the complainants that approached the Commission were women*" (MHRC, undated p.2). The women of the neighbourhood may have played a crucial role in facilitating the collective action through their personal connections with female neighbours (illustrated in the previous quote), but also through investment of time and labour.

The long-standing social networks and political connections of residents were also important in opening formal channels for civic engagement. Residents managed to attract media attention and the support of MHRC (MHRC, undated). Legal and human rights language and procedures were mobilised and residents were able to present the case as one in which "*people's rights to clean and safe drinking water, right to good health and right to human dignity were violated*" (Longwe, 2018 para. 8). A public hearing was held, and the case taken to the High Court of Malawi, which ruled in favour of the residents affected by the contamination incident and awarded damages (Leonard Yankho Phiri & Others v. Lilongwe City Council & 2 Others, 2020).

The collective mobilisation propelled important changes. Water tests were conducted immediately after the event (Public Health Institute of Malawi, Undated). A task force was constituted by Malawi's president and given the mandate to complete an investigation (Office of the President and Cabinet, 2017). Area 18 was designated as priority area for maintenance activities.

In this case, reasserting the neighbourhood's rights to a well-maintained sewerage system had required significant individual and collective effort. As we demonstrate, this included mobilising time and labour (to participate in meetings and other activities), economic resources (to engage in legal action) and social capital and networks. The presence of these elements in Area 18 was instrumental to the concretisation and success of the collective action. However, it cannot be taken for granted elsewhere.

7.10.2 Toilet (exclusionary) solidarity in LIAs

Despite the lack of support from public authorities in the construction and maintenance of facilities in LIAs, there is a strong understanding among residents of what constitutes good hygienic citizenship. A "*shared morality around cleanliness and what constitutes good and hygienic behaviour for individuals and households*" shape everyday sanitation practices (Rusca et al., 2017 p.12). This includes the "*responsibility to own and maintain sanitation facilities*" (p.8) established by the National Sanitation Policy of 2008. Therefore, when latrines become dysfunctional, engaging with public authorities is considered pointless. Instead, LIAs residents turn to one of the multiple cooperative modes of survival to ensure good hygienic citizenship behaviour.

Interviews show that the sharing of toilets with neighbours in need is a frequent practice that often emerges as a temporary solution when a toilet collapses and extends in time due to challenges to construct a new facility. This was the case for one of the interviewees whose family had been using a friend's toilet for over a year:

> *"Our toilet collapsed because of heavy rains in 2017 and we sought permission to use our neighbours' toilet."* (Interview, Resident Area 56, Woman, 2018).

Although spontaneous and disorganised, we label this practice civic engagement because it aims at ensuring communal survival and has its roots in bonds between neighbours and informal rules of solidarity and reciprocity. Among other reasons to allow neighbours access to one's latrine, residents mentioned kinship and friendship connections. Some residents granted access because they were *"helped by other people"* in the past (Interview, Resident Area 56, Woman, 2017) or because they thought that they may *"need a toilet in the future"* (Interview, Resident Area 56, Woman, 2018). However, implying both the moral dimension as well as the possibility of exclusion, Masozi emphasised that *"it is just as good neighbours you allow them to use (your toilet) but not a rule"* (Interview, Resident Area 50, Woman, 2017). Instantiating this, a resident reported of a neighbour who, to avoid them using it, started "*locking his toilet*" as soon as their neighbour's latrine collapsed (Interview, Resident Area 50, Woman, 2018).

Gaining extended access to someone else's toilet requires established social networks and is therefore not an option for everyone. As Agnes explained, *"it is a problem if you don't have friends or relatives in the area"* (Interview, Resident Area 56, Woman, 2018). Arrangements often depend on sustaining good relations with the owners of the 'borrowed'

toilet. This requires emotional and physical labours that are often gendered. As we have shown in section 4.2.2, women have fewer alternatives and feel greater distress when latrines become dysfunctional.

Furthermore, those borrowing a toilet have to deal with the constant worry that the owners "*would eventually get fed up and tell them to construct their own*" (Interview, Resident Area 56, Woman, 2018). As a resident explained, "*you should expect to be accommodated for not more than a week otherwise you become a nuisance"* (Interview, Resident Area 56, Woman, 2018). The cleanliness of the facilities, a task in which women play a major role (see section 4.3.2), is a common source of conflict and anxiety:

> *"We have a big role in cleaning to show appreciation for being granted permission of use"* (Interview, Resident Area 56, Man, 2018)

At times, residents have to walk long distances to use the toilet of a friend or relative, highlighting that borrowed access to latrines depends on social relations. Chileso explained that when her toilet collapsed, she

> "*couldn't go to the nearest neighbour because they sell alcohol, and we are not even friends. There are a lot of drunkards there."* (Interview, Resident Area 50, Woman, 2018).

The quote points to how borrowing a friend's toilet often increases gendered vulnerabilities. Women may have to enter someone else's private space or walk at night. This was the case of Alice, who arranged for her family to use a friend's toilet along the same road after her latrine collapsed. However, at night:

> *"We use tins which we empty in the morning. Because we are afraid to come out at night. We live along the road. Anything can happen.*" (Interview, Resident Area 56, Woman, 2018).

7.11 Concluding discussion

An embodied approach to explore infrastructural violences, labours and citizenship in the context of persistently fragile sanitation systems has allowed us to situate immediate sanitation failures, such as the collapse of a latrine or a wastewater leakage, within the long-

term politics of Lilongwe's water and sanitation infrastructures. Using these concepts, we have shown how the gendered violence of fragile infrastructures is produced; whose maintenance labours are mobilised through approaches taken by the sanitation sector and with what consequences; and who claims infrastructural citizenship, and through which means.

The experiences of residents presented in the paper illustrate different forms of violence associated with fragile sanitation infrastructures and their gendered and intersectional effects (Datta and Ahmed, 2020; Rodgers and O'Neill, 2012). An embodied approach to infrastructural violence emphasises the short and long-term corporeal (physical and emotional) consequences of persistent denial of or presence of poor-quality sanitation infrastructures in different bodies. The collapse of a latrine or the pollution of drinking water are clear illustrations of one-off instances of violence enacted by sanitation infrastructures with immediate and obvious visceral and corporeal consequences, such as the diseases produced by drinking contaminated water or the injuries or fatalities caused by a latrine sinking. As we show, the violent effects of living with infrastructures on the brink of failure produce embodied emotions in the long term. Anxieties and stress are suffered by residents who have to live with the revolting smell of wastewater, drink water that may or may not be contaminated, or live in continuous fear that the latrine they are using can sink at any moment.

Attending to these visceral and corporeal hardships, and how they affect different bodies, is important to understand how infrastructural violence reproduces urban inequalities across the scales of the neighbourhood, household and body (Desai et al., 2014; Truelove, 2019b) and contributes to other forms of structural social injustices (Datta and Ahmed, 2020). Gender emerges as an axis of social differentiation in each of the neighbourhoods. For example, the stress of living close to sewage poses a greater (emotional and physical) hardship for women in Area 18 who are seen as responsible for keeping the domestic environment clean and ensuring access to clean water. However, showing how income or class intersects with gendered experiences of infrastructures. Infrastructural violence also works at deepening the socio-spatial and infrastructural divide between Lilongwe's planned and informal areas (Rusca et al., 2017). Infrastructural fragility poses greater hardship for the low-income women of LIAs in exacerbating the multiple gendered sanitation insecurities they experience on a day-to-day basis (Desai et al., 2014; O'Reilly, 2016; Truelove & O'Reilly, 2020; O'Reilly, 2017). For example, gendered inequalities increase low-income women's exposure to the risk of latrines collapsing while the use of

alternative solutions such as using a neighbour toilet may increase women's gendered labours and exposure to other violences).

An embodied exploration of everyday labours of maintenance helps to reveal the non-remunerated but vital manual work that keeps infrastructures functional in cities. By drawing attention to the everyday bodily practices of residents, we show the often-gendered nature of invisible maintenance labour and help to "expand the realm of fixers beyond the "experts" (Ramakrishnan et al., 2020, p. 12). We emphasise the importance of unpaid residents and their situated knowledges and bodily engagement for the maintenance of fragile sanitation systems. We show that many maintenance tasks intersect with gendered subjectivities (e.g. good hygienic homemaker) and amplify the emotional and physical burden already borne by (low-income) women (Sultana, 2009; Van Houweling, 2016).

In LIAs, the everyday maintenance of latrines is considered part of women's everyday domestic chores. When latrines collapse, the burden of finding and negotiating access to alternative infrastructures more frequently falls on women. The contamination of the water supply in Area 18 revived gendered water roles and increased the domestic labour of women. Women voluntarily put to work their social networks and took the leadership in social mobilisation to combat infrastructural neglect. Women ensured a safe supply of water through a new set of chores, such as boiling tap water or finding alternative sources. Through these empirical insights, we extend the work of feminist scholars who have shown the fundamental role of low-income women in maintaining and restoring household connections to (waste)water flows (Truelove, 2021). We also show that that even when failing, infrastructures are still functioning in part because of the bodily and emotional labour of women.

Rather than celebrating maintenance as an act of creativity and care and the role of maintainers in recomposing and producing new infrastructures (Barnes, 2017), we show the maintenance practices of residents in Lilongwe reproduce a sanitation infrastructural landscape that is always on the brink of failure. We demonstrate that the maintenance and repair practices of residents fix failing infrastructures only partially or temporarily, and that these practices work to exacerbate everyday infrastructural risks and violence. Maintenance here follows a logic of endurance and survival, not care. As illustrated by the example of residents in Area 18 using improvised tools to displace blockages further down the sewer lines, maintenance can become a self-serving act, displacing the annoyances of and risks associated with a sewage-flooded-bathroom or yard. In LIAs, residents engage in a range of maintenance practices to avoid the filling-up of their latrines. These practices work not

only eroding the material infrastructure on the long run but also their own health and safety as well as the time, labour and income invested in the construction of the facilities. Both cases point to the inevitable fate of infrastructural failure.

Concerning infrastructural citizenship, we demonstrate that the embodied understandings of rights and responsibilities in the provisions of sanitation, everyday encounters with the bodily risks posed by fragile infrastructures, and the social infrastructures available to residents shape the options for civic engagements in the city. Formal practices of civic action are not considered an option for some – and the most obvious route to establishing claims to basic services for others.

The paper draws attention to the gendered and intersectional nature of embodied experiences and practices of infrastructural citizenship (Sultana, 2020). These are differently along class/social standing and gender divides. In particular, this paper demonstrates that in the absence of the state, notions of citizenship are also absent, thereby extending emerging work on embodied notions of infrastructural and hygienic citizenship on the margins of the state (Biza et al, forthcoming, Silver and McFarlane 2019). We show that in LIAs the state may have been absent in the construction and maintenance of infrastructures. However, locally embedded notions of hygienic citizenship in some areas enable continued access to these services. Although the practice of accessing sanitation through neighbours may be a laboured, volatile, and exclusionary solution, it points to the multiple modes of collaboration and mutual support that work to improve the living conditions of some low-income residents.

Chapter 8.

Conclusions

8.1 Introduction

Most literature on water and sanitation in global South cities has taken a developmentalist approach and failed to be grounded in, and contribute to, theory making from the global South. This dissertation has sought to extend the understanding of the challenges residents of Lilongwe face to access water and sanitation through an exploration centred in their everyday experiences and the engagement with global South theorisations of infrastructures. Chapters 4 to 7 explore the history and use of a dual sanitation system; the socio-materialities of menstrual waste management; the operation of the water kiosk system; and the experiences of living with fragile sanitation infrastructures. Together these chapters show the multiple instances in which access to water and sanitation is challenged by failing infrastructures and reveal the historical legacies, social power relations, and cultural dynamics underpinning these failures. The chapters expose the unequal experiences of failure across heterogeneous infrastructural landscape and intersecting social identities; the (intersectionally gendered) labours that keep infrastructures at work; and the locally grounded practices and solutions developed by residents to address different infrastructure failures. These findigs have allowed me to contribute to different ongoing academic debates and to produce a set of reflections for policy and practice.

The concluding sections of Chapter 4 to 7 discuss the individual conceptual and empirical contributions of each chapter as well as the policy and practice implications. These contributions are further elaborated and connected in a more comprehensive way in this chapter. The chapter is structured as follows. Section 8.2 presents the main conceptual and empirical contributions of the dissertation connecting them with the theoretical gaps identified in section 2.6. Section 8.3 presents a set of overall reflections around the research questions and research approach. Section 8.4 elaborates the significance of the findings for policy and practice. Finally, Section 8.5 outlines some areas for further research.

8.2 Key Conceptual Contributions

This dissertation has contributed to different ongoing academic debates about infrastructures in global South cities by:

- Problematising sanitation imaginaries that presume linear sanitation trajectories and frame waterborne sanitation as fixed infrastructures; and explanatory

frameworks that emphasise informality as resulting from failure to extend networked water and sanitation systems (8.2.1);

- Demonstrating the value of considering sanitation infrastructures relationally (8.2.2);
- Revealing the uneven (bodily and emotional) harmful consequences of fragile sanitation systems and how those build on broader social inequalities; as well as the gender and intersectional dynamics shaping infrastructural labours of operation and maintenance (8.2.3);
- Emphasising failure as part of the everyday life and politics of Lilongwe's infrastructures; drawing attention to the maintenance knowledge and practices of Lilongwe's residents; and providing a nuanced account of these practices (8.2.4);
- Emphasising the need for a deeper engagement with the local sanitation histories and cultures to understand the logics behind residents' practices that are often framed as problematic by sanitation interventions (8.2.5).
- Demonstrating the value of combining situated and feminist urban political ecologies (UPEs) and Social Practices inspired analysis of water demand (SPoWD) (8.2.6);

Each of these contributions are now elaborated upon in turn.

8.2.1 Informality, hybridity and waterborne sanitation technologies

This dissertation contributes to recent conceptualisations of informal and hybrid infrastructures that have mainly focused on water supply infrastructures and explored informality and hybridity in informal spaces where access to networked services (e.g. waterborne sanitation technologies) is not the norm (see 2.6.1 Informality and hybridity). This dissertation extends these literatures by exploring informal and hybrid practices and solutions in relation to waterborne sanitation (see Chapter 4 and 7). The dissertation makes different contributions in this regard.

First, the dissertation emphasises informality is not exclusive of marginalised, poor or off-the-network neighbourhoods (Anand, 2011; Hossain, 2011; Truelove, 2019a). Chapter 4 illustrates that informal sanitation infrastructures (i.e. backyard latrines) are not only present in LIAs but also exist in planned spaces of the city, and are used and maintained in

combination with waterborne sanitation solutions. Similarly, Chapter 7 shows how residents and informal plumbers of Area 18 (a planned area of the city where there is access to municipal sanitation services) engage in a wide range of informal practices to gain access to sewer lines and to maintain the sewer system.

By emphasising that hybridity and informality does not only exist in informal or non-networked spaces of cities, this dissertation helps to challenge the assumption that informality and hybridity are the result of the failure of the modern infrastructural ideal. A dominant narrative of the modern infrastructural ideal that permeates development discourse is that hybrid and informal infrastructures would not exist if water and sanitation networks were in place and working properly. As I have shown in Chapter 4 residents construct backyard latrines for multiple reasons. One of these reasons is that the municipal waterborne sanitation services do not always work. However, backyard latrines are deeply engrained in the local architectural and social relations and life customs of the city and would probably continue to exist even in the absence of water shortages or if the municipal water system did work round the clock.

By engaging with notions of informality and hybridity, this dissertation has challenged widespread imaginaries of urban sanitation that situate non-waterborne technologies (i.e. latrines) as inferior to waterborne technologies (i.e. flush toilets, sewers), imply urban sanitation should evolve linearly from one technology to the other, and present sewers as a reliable, fixed and durable technology. I have demonstrated that these imaginaries do not match the everyday trajectories and realities of sanitation development (at least in Lilongwe and possibly in other cities). As has been consistently shown throughout this dissertation, waterborne sanitation is not always preferred over other technologies, sanitation infrastructure development does not always follow a lineal trajectory, and unreliability, incompleteness, and flexibility are productive concepts to take as starting point when thinking about sewer systems.

8.2.2 Using Heterogeneous Infrastructure Configurations as an analytical tool

This dissertation extends emergent scholarship that has documented the diversity of water and sanitation infrastructures that are present in global South cities and how these infrastructures work "– or how and for whom they fail to work" (Lawhon et al., 2018, p.

3). The empirical chapters of this dissertation provide a rich account of Lilongwe's infrastructural landscape for water and sanitation. This includes the description of a variety of technologies, practices and relations that enable access to water and sanitation, the histories through which these have emerged, how these infrastructures are used, and who is included or excluded from them. Chapter 4 describes a context specific hybrid sanitation configuration that has not been explored in previous research, despite there being evidence that this hybrid sanitation configuration exists in Lilongwe and in other cities. Chapter 5 provides a detailed description of the menstrual waste management infrastructures and practices available to women in different areas of Lilongwe. Chapter 6 describes the gendered labours and relations that sustain access to water at LIA's kiosks. Finally, Chapter 7 describes the practices and relations that enable residents of LIAs and planned areas to sustain access to sanitation in the long run. Together these chapters contribute to extend the understanding of the diversity everyday politics of infrastructures of cities in the global South.

However, the dissertation goes beyond the documentation of these heterogeneous infrastructures and relations and explores the possibilities and potential that using HIC (Heterogeneous Infrastructure Configurations) as an analytical tool offers (Lawhon et al., 2018). This is a novel approach as notions of HIC have frequently been used to describe infrastructures in global South cities, but the analytical potential of this concept has been barely explored (see Alba et al., 2020 for an exception). The dissertation applies HIC as an analytical tool for sanitation technologies not in isolation but relationally; by thinking through how these infrastructures together connect and disconnect urban spaces and urban residents. The benefits of using HIC as an analytical tool is more evident in Chapter 4 which explores waterborne sanitation technologies and latrines not as separate technologies but as part of a sanitation configuration put in place by residents to enable ongoing access to sanitation. This HIC analysis reveals that heterogeneous infrastructural configurations are not only important to those who live in the premises where the infrastructures are constructed but also to residents and workers who work in, or move through, various parts of the city and work far apart from their own homes and sanitation infrastructures (e.g. workers or street vendors).

This approach of considering infrastructures relationally has also been used in Chapter 5 where women's strategies and constraints to deal with used menstrual absorbents are explored in relation to different sanitation infrastructures of the city. The chapter shows women's strategies to deal with menstrual waste encompass a variety of infrastructures (water supply infrastructures for washing, flush-toilets, latrines, burning pits and municipal

waste collection) that they configure according to different challenges and needs, and cultural conventions. Chapter 7 also takes a relational approach by exploring sanitation failure in two different types of infrastructures (latrines and sewerage), demonstrating how fragility is produced across the boundaries of urban spaces.

As these chapters, and in particular Chapter 4, demonstrate thinking of sanitation infrastructures as a configuration through HIC analysis allows us to see how hybrid and/or heterogeneous infrastructures help residents to cope with different risks and challenges in their everyday lives (cf. Lawhon, 2018). Residents combine flush toilets and backyard latrines to deal with different situated needs and challenges such as to avoid water scarcity problems, to solve toileting needs of domestic workers or visitors, to reduce water bills, or for convenience, comfort, or security reasons. This type of configuration may not be perfect (e.g. presents groundwater pollution risks and entails power relations) but it does work for residents and it is worth considering how such hybrid configurations could be made to work in mores sustainable and just ways.

Thinking of sanitation infrastructures as a configuration also helps to challenge the binary of presence/absence of toilets that is often emphasised in WASH policy and practice to understand and measure access to sanitation. As Chapter 4 (but also Chapter 7 in a different way) demonstrates, access to sanitation cannot be equated to the sole indicator of 'having a toilet at home' that is often used in WASH policy. This question of the mismatch of indicators and realities of access and the important policy and practice implications it opens up are elaborated in section 8.3.1.

8.2.3 Embodied experiences and gendered infrastructural labours

This dissertation contributes to two gaps in feminist explorations of urban infrastructural inequalities. First, the dissertation extends the work of feminist UPEs that has highlighted importance of the body and embodied experiences in water and sanitation inequalities (Desai et. al, 2014; Sultana, 2020; Truelove, 2011, 2019b). Chapter 7 contributes to the understanding of how failure reproduces broader gender and intersectional inequalities by revealing the unequal embodied impacts of sanitation failures across and within neighbourhoods and households in Lilongwe. Using an embodied and intersectional approach the chapter emphasises the corporeal and emotional consequences that failing sanitation systems have in the short and long-run for residents. Examples of bodily hardship include the diseases produced by drinking contaminated water, while the continuous fear

that the latrine one is using can sink at any moment illustrates the type of emotional consequences produced by failing sanitation systems. The concept of infrastructural violence has been useful to think about how these negative consequences exacerbate other violence and discrimination that affects in particular low-income women. Chapter 7 shows that although sanitation failures are common and persistent across different neighbourhoods of the city, the impacts and implications are different for men and women in the same household but also vary across different women. In particular, the chapter shows that sanitation failure exacerbates the challenges women in LIAs face in accessing sanitation which increases their gendered labours, vulnerabilities, and discrimination. For example, gendered inequalities increase low-income women's exposure to the risk of latrines collapsing while the use of alternative solutions such as using a neighbour toilet may increase women's gendered labours and exposure to other violences.

Second, the dissertation extends feminist UPEs of water and sanitation by exploring the understanding of how gender and intersectional relations shape the labours required to sustain water and wastewater flows and infrastructures in cities. This is an underexplored area in comparison to the attention paid by feminist scholars to the gendered responsibilities and hardships associated to the work of securing water for households (e.g. Harris et al., 2017; Sultana, 2020; Truelove, 2011). Chapter 6 and Chapter 7 reveal that low-income women play a fundamental role in keeping water and sanitation infrastructures going in Lilongwe. The work of women is both taken-for-granted and invisible in the formal accounts of water and sanitation infrastructures of Lilongwe (i.e. not mentioned or accounted for but implicitly relied upon). As the chapters demonstrate, the unequal engagement of women in voluntary or low-paid maintenance and operation activities is predicated upon the mobilisation of particular gendered subjectivities (e.g. good-natured for selling water; good hygienic homemaker) that normalise and render these activities as 'naturally' suiting women. Chapter 6 demonstrates that the water kiosk system of Lilongwe is sustained through gender relations and the undervalued labour of the women who work as kiosk attendants. The success of the system depends on the enrolment of women as cheap labour and on women assuming the bodily risk and emotional hardships associated with the requirement to adapt working-times to the erratic water supply. As Chapter 7 shows in the absence of the state (or neglect of responsibilities) keeping sanitation infrastructures functional becomes an ongoing gendered struggle that disproportionally falls on (low-income) women. It is low-income women who suffer the most when sanitation infrastructures fail. Thus they are 'naturally' enrolled in maintenance work, and experience corporeal suffering when it is not done (but also when they do it).

Exploring water and sanitation operation and maintenance from a gendered, feminist and intersectional perspective extends an understanding of maintenance labours into activities beyond the manual work of fixing material infrastructures. These gendered activities are often not considered part of water and sanitation infrastructural maintenance in research studies on the topic, nor are they talked about by many involved in water and sanitation governance and maintenance as a form of labour. This is most strongly illustrated in Chapter 7 where a number of physical and emotional labours required to combat infrastructural neglect are described as organising, requesting information, or building relations with neighbours. The labour of coping with social injustice as a result of an absent state emerges in this chapter as part of the labours required to maintain functional infrastructures. However, Chapter 6 also shows that operating kiosks requires attendants to assume not only the activities described in formal accounts of the job (i.e. opening and closing taps, keeping the kiosk clean and serving customers) but also a range of other physical and emotional labours to 'subsidise' for the inefficiencies of the system.

8.2.4 Infrastructural failure and maintenance

Apart from exploring how gender and intersectional relations shape unequal experiences of failure and engagement in maintenance labours, the dissertation contributes to other debates on infrastructural failure and maintenance. First, the dissertation emphasises sanitation failure and breakdown are part of the everyday life and politics of sanitation infrastructures (Graham, 2009; Lawhon et al., 2018; Ramakrishnan et al., 2020). Drawing from Ramakrishnan et al. (2020), Chapter 7 mobilises the concept of fragility to emphasise that failure (interruption, breakdown) is just a temporary phase in a continuum: the ordinary vulnerability of infrastructures. By starting from fragility the chapter also shows that failure is not fortuitous and that sanitation infrastructures fail because they are made fragile by a range of actors, practices, and relations.

Specifically analysing the failures of the latrines of LIAs and sewer system in Area 18, by mobilising a combination of concepts spanning literatures on infrastructural violence, labours and maintenance makes visible the different phases of sanitation infrastructures in which embodied experiences, knowledges, practices and power relations are at play. Mobilising infrastructural violence enables the analysis to point to the specific moment of failure (e.g. collapse of a latrine) connecting this 'moment' or 'event' to the long term and cascading harmful implications infrastructural failure has for residents. Engaging with

infrastructural labours points the analysis to a phase of maintenance prior to, or after, failure in which residents rely on situated knowledges and practices to ensure infrastructures continue working. A feminist reading of this also enables a more nuanced analysis of the diverse forms of physical and emotional labour that is enrolled in keeping these infrastructures working. Finally, infrastructural citizenship points to a phase of battling for transformation in which residents draw on different social relations to make the infrastructures less fragile, and their neighbourhoods more liveable. In connecting infrastructural violence, labours and citizenship in parallel conceptually and analytically in Chapter 7 I can clearly demonstrate and argue that these three phases (the violence of failure, the labours of maintenance, and the battles for trying to leverage systematic transformation of rights to functioning infrastructures) are all just part of the same temporal continuum of infrastructural vulnerability.

This dissertation also contributes to literature on infrastructural maintenance by drawing attention to the maintenance knowledge and practices of Lilongwe's residents. This is a novel because most studies have focused on the knowledges and activities of those considered experts on infrastructural maintenance or those who engage with them as part of income generating activities (Ramakrishnan et al., 2020). Chapter 7 emphasises the importance of the situated knowledges and bodily engagement of residents (labours that are also voluntary and gendered) for the maintenance of fragile sanitation systems. As the chapter shows, sanitation infrastructures require endless maintenance. As soon as they are constructed, or repaired, infrastructures begin to decay and require maintenance again. In the neglect or absence of responsibilities from service providers and the state, these activities and responsibilities are shifted onto residents (and in particular women) who become 'experts' in fighting the fragility of infrastructures.

A different contribution of Chapter 7 is that it provides a more nuanced account of the logics of maintenance than that presented in most other studies on the topics of infrastructural construction, failure, maintenance and repair. As Barnes (2017) suggests, in emergent work about infrastructural failure and maintenance there is a tendency to emphasise maintenance as an act of creativity and care and to celebrate the role of those who maintain the infrastructures in recomposing and producing new infrastructures. The practices of sanitation maintenance described in Chapter 7 are more reflective of logics of endurance and survival than they are of care for the infrastructures. Furthermore, even if these practices attempt to recompose the system, the outcomes are often only partial or temporal. These results show that there needs to be caution in the academic literatures around valorising those involved in the maintenance of infrastructures, particularly when

the focus is only on those who 'formally' maintain infrastructure as part of their professional capacities and employment. Doing so hides an ultimate failure of the system, that is, that the need for maintenance and repair is not planned for within current sanitation and water imaginaries by service providers and the state. Further, current ways of planning for sanitation infrastructures in particular hide the situated knowledges and labours of residents – and often women - in such maintenance and repair.

8.2.5 Understanding locally grounded solutions

Finally, this dissertation contributes to postdevelopmental critiques to WASH policy and practice. It does so by emphasising the need for a deeper engagement with the local sanitation histories and cultures to understand the logics behind residents' practices that are often framed as problematic by sanitation interventions. The dissertation reveals that practices framed as inappropriate in the sanitation literature such as the disposal of menstrual absorbents in latrines (Chapter 5), the construction of latrines in planned areas (Chapter 4), or toilet maintenance practices such as the practice of pouring water into latrines (Chapter 7) have developed through residents' encounters of specific situated sanitation access challenges, sanitation histories and cultures, and serve specific needs. As the empirical chapters show, examining such practices from the perspective of residents, and as potentially valid, helps to reveal why these infrastructures and practices are relied upon even when they may be problematic from a sanitary or environmental point of view. Such an approach opens up new insights and spaces for designing interventions that attempts to overcome the moralising and reponsibilisation of residents in WASH development approaches that is criticised by postdevelopmental scholars.

8.2.6 Reflections on the potential links between situated and feminist UPEs and SPoWD

Despite situated and feminist UPE and SPoWD presenting similarities in the conceptual and empirical understandings of water practices and a shared focus on everyday life, these two bodies of work have barely been used together in analyses of water and sanitation practices in global South cities. In following the arguments presented in section 2.6.1 that both bodies of work could learn from each other, this dissertation has combined insights

from situated UPEs and SPoWD, leveraged in different ways across the different empirical papers, to analyse some of the everyday water and sanitation challenges faced by Lilongwe's residents.

A SPoWD framework directs attention to the cultural underpinnings shaping water and sanitation practices. In the case of Lilongwe, this attunement in data collection and analysis has been helpful to identify how the existence of this configuration is influenced by cultural legacies (e.g. colonial custom to build accommodation for domestic workers in affluent dwellings), situated forms of social life (e.g. backyard latrines are required for urban community life) or toilet etiquette (e.g. emphasis on privacy when using the toilet). By engaging with situated and feminist UPE that points to the multiple and intersecting social relations that are produced and reproduced in everyday water and sanitation practices (Lawhon et al. 2014; Truelove, 2011), I have been able to provide a more nuanced view of how this dual configuration is situated in the (micro)politics of water and sanitation of the city. In particular, such an analysis reveals how this configuration contributes to improve sanitation access for residents from LIAs (e.g. by providing access to workers or street vendors coming from LIAs) while at the same time reproducing unequal relations (e.g. workers are granted access to infrastructures that are located lower in the service hierarchy).

Similarly in Chapter 5 combining situated and feminist UPE with SPoWD has been useful to explore the menstrual waste challenge of Lilongwe (Chapter 5). In particular, I have drawn on SPoWD attention to the cultural underpinnings of water and sanitation practices to reveal the cultural mandates attached to traditional and medicalised meanings of menstruation (e.g. different concerns over hygiene, fears of witchcraft, or anxieties over the shame and stigma surrounding menstruation). By engaging with situated and feminist UPEs I have demonstrated how these cultural meanings create different experiences for different women as they intersect with the unequal (i.e. gendered, socio-spatially differentiated) infrastructural configuration of the city (e.g. different challenges for women in LIAs who dispose in latrines than there are for women in planned areas who burn used absorbents).

A different aspect of SPoWD that has been useful to explore the locally grounded sanitation configuration developed by some Lilongwe's residents relates to the experience of this body of work in identifying possibilities for incremental changes in policy and practice. Specifically, some SPoWD have noted that by emphasising particular infrastructural and water imaginaries (e.g. imaginaries of endless supply of water and homogeneity implied in the modern infrastructural ideal) policy makers often reduce everyday domestic capacities

to adapt to water scarcity (Allon and Sofoulis, 2006; Kadibadiba et al., 2018; Strengers and Maller, 2012). To counter those imaginaries SPoWD have advocated for policies that that incorporate the existing skills of water users (Strengers and Maller, 2012). The insights that a practice theoretical analyses reveal have been useful to identify how in their emphasis on lineal and homogenous imaginaries of sanitation infrastructures, Lilongwe's municipal officials and other water and sanitation actors are restricting the potential contributions to improve urban sanitation provision and to cope with current problems to water scarcity that this infrastructural configuration offers.

Inspired by the call for more flexible and creative thinking in interventions to address water scarcity (Strengers and Maller, 2012), in Chapter 4, I suggest incorporating the sanitation configuration entailing the combined used of flush toilets and backyard latrines in the sanitation infrastructural system (and imaginary) of the city. Doing so I argue will not only enable a minority of residents to cope with water scarcity (those who can afford to have flush toilets and backyard latrines) but may also improve the conditions of access to sanitation for populations such as domestic workers or street vendors whose needs are not usually planned for in sanitary imaginaries in cities. Moreover, SPoWD framing of water challenges as a distributed responsibility (see Browne et al., 2014; Evans et al, 2017) enabled analytical attention in the menstrual waste chapter to be redirected from a focus on women as responsible for the challenges produced by menstrual waste, towards a wider range of actors including those involved in urban and infrastructural planning or product manufacturing. By centring the everyday practices of women as the start of policy enquiry (advocated by situated UPE and global South scholars) and thinking through distributed responsibilities (advocated by SPoWD) I have been able to suggest a number of actions that can be explored in order to adapt the infrastructural landscape and material design of absorbents to the context specific needs of women in Lilongwe (see section 5.9 for more details). Exploring the possibilities in these forms of intervention exemplifies the type of pragmatic incremental change centred in the everyday realities of residents of global South cities advocated by situated UPE and more broadly by scholars working from the global South (Alba et al., 2019; Bhan, 2019; Ernstson et al., 2014; Lawhon et al., 2014).

Together, these Chapter 4 and 5 provide insights into the potential links between SPoWD and situated and feminist UPEs can be beneficial beyond the specific case of Lilongwe and themes explored in each of the chapters. The chapters demonstrate that situated and feminist UPE analysis of how social power relations are (re)produced through water practices can be extended through a specific exploration of how the cultural underpinnings of these practices (e.g. toilet etiquettes or taboos related to menstruation) contribute to

produce unequal experiences along intersecting axes of social differentiation. At the same time, situated and feminist UPE conceptualisations of power as relational and diffuse and operating through everyday practices can help SPoWD to consider how social power relations are produced through mundane domestic water use and the implications that has for sustainability agendas. This aligns with a broader call to engage more explicitly with power including gender power relations from scholars using Theories of Practices in their analysis (e.g. Watson, 2016, Mechlenborg and Gram-Hanssen, 2020). Furthermore, SPoWD in particular can be enriched by empirical and theoretical situatedness in the global South where water and sanitation challenges transcend those traditionally framed as of sustainable consumption.

8.3 Reflecting on the research questions and research approach

Together the empirical and conceptual contributions presented in the previous sections have demonstrated the importance of recognising and designing research approaches that situated the everyday realities of residents at the centre of the data collection, analysis and theorisation. The dissertation shows the potential of an inductive research design based on iterative zigzagging between data and theory (see chapter 3). For this dissertation such an approach has been crucial to open up a set of new themes and findings that may have remain hidden, had the research started from policy definitions and imaginaries of what the challenges to access to water and sanitation are. Such an approach has also allowed me to critically link the data to, and to deepen ongoing academic and policy debates.

Overall this dissertation highlights that in Lilongwe water and sanitation challenges go beyond, or differ from, those challenges identified in policy and practice. For example, it is has revealed that in Lilongwe access to water and sanitation does not only depend on the presence of infrastructures as it is usually measured in policy circles (see 8.4.1). As the dissertation shows, even when infrastructures are present, they often fail temporarily (e.g. collapse of latrines) or fail to meet specific (bodily, cultural) needs (e.g. menstruation). Access to water and sanitation is challenged not only by the absence of water and sanitation infrastructures but also by these various failures. The dissertation has also emphasised the importance of recognising, and designing research approaches that reflect, that the challenges produced by failing infrastructures do not happen in a vacuum. For example, in revealing that the ‘inappropriate’ disposal of menstrual absorbents is a result of a complex

interaction of corporate interests, infrastructural legacies, cultural dynamics, gender and other social relations, neglect of municipal service providers, and individual decisions.

The dissertation has revealed that Lilongwe's water and sanitation access challenges transcend spatial and infrastructural boundaries. As the dissertation shows, similar failures exist across different spaces of Lilongwe, although they are differently lived and have different implications for different residents (e.g. sanitation failures have different consequences for LIAs' women than they have for men in Area 18). Similarly, water and sanitation infrastructures, even those that may be far apart or not usually considered part of the same system are connected through people's relations and needs (e.g. backyard latrines and flush toilets are part of the same broader configuration).

Paying explicit attention to the injustices and everyday politics at the core of the different infrastructure failures explored in each of the chapters shows how power relations operate through Lilongwe's water and sanitation infrastructures. For example, the research revealed the historical injustices that have left LIAs underserved by infrastructure, or the gendered constructions that frame low-income women as naturally more suitable for specific infrastructural practices. Further it has revealed the unequal lived experiences of Lilongwe's water and sanitation failures and how they reproduce other social inequalities and discriminations (e.g. the fragility of latrines builds on broader vulnerabilities and discriminations facing low-income women).

Focusing on everyday practices also emphasises the agency of Lilongwe's residents in finding solutions the challenges produced by failing infrastructures. Despite the infrastructural and governance difficulties, residents have - through their everyday encounters with water and sanitation challenges - developed situated knowledges and strategies that help them to circumvent these challenges even if at times only partially, temporally (e.g practices of maintenance of latrines) and to make their neighbourhoods and city more liveable (although at times in exclusionary ways) (e.g. practice of sharing a toilet with a neighbour or a street vendor).

Together the empirical and conceptual contributions presented in the previous sections also demonstrate how centring the exploration of water and sanitation challenges in the everyday realities and experiences of residents of Lilongwe (and other global South cities) enables to identify mismatches between widely accepted explanations and prescriptions and the everyday realities of residents. As well as interesting conceptual and empirical insights, this also has implications for policy and practice, which will be addressed in the next section.

8.4 Implications for policy and practice

The empirical chapters of this thesis have been deeply informed and contributed to extend global South urban theory. These theoretical engagements have also allowed to provide a set of practical reflections and implications in each of the chapters that have the potential to contribute to urban water and sanitation policy and practice. These include:

- Drawing attention to the need to reframe the challenge of access to water and sanitation beyond absolute presence/absence of infrastructures (section 8.4.1);
- Highlighting the opportunity to integrate locally working solutions into wider sanitation service delivery and governance structures (8.4.2);
- Critically reflecting upon infrastructural labours and the role they play in access to water and sanitation (Section 8.4.3);
- Drawing attention to the indirect effects produced by failing water and sanitation systems (8.4.4).

Each of these policy and practice implications are now elaborated upon in turn.

8.4.1 Reframing the challenge of access: beyond absolute presence/absence of infrastructures

This dissertation highlights that the complexities of access to sanitation in Lilongwe cannot be captured in metrics focused on whether a household has a toilet. Other scholars have problematised this before with a specific focus on a critique of the use of such metrics and in particular for water access (see for example Satterthwaite, 2016 or Jewitt et al., 2018). However, the dominant approach to measuring and monitoring access to water and sanitation (such as that of the SDGs) is based on the use of household surveys that collect information on main type of water point or toilet facility used by the members of the household (JMP, 2018a; JMP, 2018b). These types of household surveys provide a static snapshot of the facility that residents have at home (or the one they most frequently use) that does not account for some of the dynamics highlighted by this dissertation. Chapter 4 and 7 demonstrate that residents rely in multiple strategies and solutions beyond the household toilet to fulfil different sanitation needs (e.g. residents may borrow neighbours or employers' toilets) and have to cope with different risks and moments of failure along

the life of infrastructures. As the dissertation reveals it is important to pay attention not only to the type of facility that a household uses but also to the social relations and terms in which access to infrastructures (e.g. the toilet) is granted or to the multiple situations in which infrastructures may become non-functional from the perspective of users. This includes water shortages that temporarily interrupt the use of flush toilets, latrines that get full and are not usable until emptied, or latrines that are at the brink of collapsing.

This dissertation has also shown that it is also important to pay attention to how infrastructural failures affect urban residents in uneven ways. As Chapter 5 shows, perfectly functional infrastructure may at times be non-functional for specific individuals such as in the case of latrine or flush toilets designed based on masculine bodies and thus are successful dealing with some types of bodily waste (urine, faeces) but cannot cope with the increasing presence of menstrual materials (e.g. sanitary pads) and the needs of people that bleed.

Chapter 4 and 7 also points to issues of accessibility and safety. As the chapter shows backyard/outdoor latrines are less accessible for elderly people, children and potentially people with mobility issues and/or disabilities. Backyard latrines may be a completely safe and accessible facility during the day but increase exposure to risks in particular for women when used at night. As Chapter 7 shows, infrastructural risks and failures affect disproportionately low-income women due to existing gender discriminations that make more difficult for them finding alternative solutions. Although dominant approaches to conceptualise and measure access to sanitation such as that used by the SDGs are increasingly recognising the need to account for intrahousehold and in particular gender inequalities (see for example Caruso et al., 2021), there is still a long way to go in this regard.

8.4.2 Integrate locally grounded solutions into wider sanitation service delivery and governance structures

The challenges highlighted in this dissertation call for a more progressive sanitation policy making and planning that recognises the type of local solutions that are working on the ground and builds on them by accommodating or facilitating the incorporation of these solutions in the service delivery and governance structures. As scholars have pointed out, WASH interventions often push predefined understandings of what the challenges or needs

of residents are; and what sanitation infrastructures and hygiene practices should look like. As a result of this, WASH interventions risk offering up solutions that do not reflect the everyday realities of residents, and further marginalise context specific knowledges and practices (Dombroski, 2015; Engel and Susilo, 2014; Kotsila, 2017; Toner, 2019).

Examples of locally grounded solutions in place in Lilongwe are using sanitation infrastructures to get-rid of menstrual materials (Chapter 5), the combined used of flush toilets and backyard latrines (Chapter 4), or borrowing a toilet from a neighbour (Chapter 7). These solutions may not be perfect (and at time they may be environmentally problematic). However, these solutions do contribute to residents being able to cope with situated challenges like water scarcity and to sustain hygiene in locally appropriate ways (Dombroski, 2015; Rusca et al., 2017). These hybrid configurations should not been automatically ignored or dismissed because they do not match policy and infrastructural imaginaries and ideals (Rodina et al., 2017; Ziervogel et al., 2017).

Identifying and integrating in policy what-is-already-working-locally is not easy task as it requires a critical gaze to avoid romanticising local practices or adaptations; and to challenge widely accepted imaginaries and ideals around what infrastructures should look like and how they should work that have often become an uncontested departure point for professional practice. This dissertation highlights the potential of an ethnographic methodology centred in everyday realities to this task. The potential of rich context specific empirical material (such as the one produced by this study) to inform WASH policy has been highlighted by other scholars (Rusca et al., 2017; Weststrate, Dijkstra, et al., 2019). However, this type of data is not always well-received in WASH policy circles that are more used to work with quantitative data and policy prescriptions that can be applied globally.

This dissertation provides examples of how the learnings from an analysis that puts the everyday realities of residents at the centre can help to reframe or propose WASH interventions that are more locally attuned. Chapter 4 suggests allowing and encouraging residents to construct and maintain sanitary latrines in a safe manner in the planned spaces of the city. Chapter 5 suggests adapting to the preferred practices of women, instead of expecting women to adapt their preferred practices and absorbents to default infrastructures.

8.4.3 Recognising the importance of infrastructural maintenance and infrastructural labours for access to water and sanitation.

This dissertation has emphasised the importance of maintenance and repair activities for access to water and sanitation and points to the need to pay more critical consideration to the cost of these activities, and not just the costs of constructing infrastructures. This is important because infrastructural maintenance and operation often accounts for larger investments than those required to construct infrastructures. For example, Mara and Evans (2018) note that "over the lifetime of a sanitation facility, the costs of running the service to support its operation and maintenance may constitute up to 80% of the total costs" (p. 9). These costs tend to be underestimated and neglected by those planning and managing water and sanitation infrastructures (Daudey, 2018, Foster and Briceño-Garmendia, 2010; UN, 2018). Operation and maintenance costs are often passed onto residents through water and sanitation services tariffs. However, tariffs are often not well designed (UN Water and WHO, 2014) and even when they are, there are important questions around affordability of tariffs, with many residents in global South cities struggling to pay for the cost of water and sanitation services (Beard and Mitlin, 2021).

A widely spread principle in the water and sanitation sector is that sustainability is more likely if low-income residents bear with the costs and burden of constructing and maintaining their own sanitation infrastructures. However as Chapter 7 shows in Lilongwe residents struggle to afford these costs, and to reduce them as much as possible they engage in a number of strategies that paradoxically increase the health and environmental risks and reduces the potential longevity of their facilities. If water and sanitation partners really want the sanitation facilities that get constructed in LIAs to be sustainable and last in time, more attention should be paid to funding strategies to ease the burden of maintaining infrastructures for LIAs residents.

Relatedly, this dissertation highlights the need for a more critical consideration of the labours that keep water and sanitation infrastructures at work and to the conditions in which these are performed. As this dissertation has revealed, in Lilongwe, water and sanitation infrastructures require the engagement of manual workers such as plumbers, pit emptiers, sewer cleaners, kiosks attendants and often also residents, in operation and maintenance activities. Despite being crucial to ensure functional services, operators and maintainers conduct their activities in very precarious conditions. Even those in formal jobs such as the sewer cleaners and kiosk attendants raised attention to the important challenges, they face

in their day-to-day activities and to the lack of attention from their superiors to these challenges.

The dissertation has also revealed that in Lilongwe, women play a crucial role in operating and maintaining water and sanitation infrastructures and making up for different inefficiencies of these systems. However, women often participate in these activities voluntarily, or for low salaries, as they get drawn into these activities through their association with particular notions of femininity (e.g good hygienic housewife). To avoid the overburdening of women, water and sanitation actors should start by making visible the reliance of water and sanitation services on women's work and reduce their voluntary involvement (e.g. ensuring sanitation infrastructures are well maintained so women do not have to add sanitation maintenance activities to their already tight domestic burden) or provide the means for these activities to be conducted in safe and economically just conditions (e.g. attending the demands of kiosk attendants for higher salaries and safety).

8.4.4 Considering the indirect social effects produced by failing water and sanitation systems

Finally, this dissertation adds to recent work pointing that, in particular for low-income women, the consequences of lack of access to water sanitation goes beyond the direct health and environmental implications produced by lack of water or unsafely managed human waste (Caruso et al, 2017; O'Reilly, 2016). This dissertation reveals that for the low-income women of Lilongwe failing infrastructures intersect with other social and gender inequalities producing anxiety and fears (e.g. as those produced by privacy concerns); increases exposure to violence (e.g. women feared to be attacked when using outdoor latrines); increases gendered labours (e.g. women perform unpaid maintenance work); and builds on broader discriminations (e.g. exclusion from citizenship). While these important indirect effects of lack of access to water and sanitation are being increasingly recognised in the WASH sector (e.g. see violence, gender and WASH toolkits House et al., 2014; House and Cavill, 2015), more needs to be done for water and sanitation projects to incorporate gender transformative actions that help to address not only inequalities in access but also these broader gender and social power dynamics (Caruso et al, 2017; O'Reilly, 2016).

8.5 Areas for further research

Throughout the process of writing this dissertation I have identified four important challenges in Lilongwe that point to different areas for further research. (i) access to sanitation for street traders, (ii) new dynamics in water and sanitation labours, (iii) solidarity and reciprocity in water and sanitation, (iv) new water and sanitation imaginaries. These four areas for further research are elaborated upon in turn.

Sanitation and street traders: This dissertation shows that backyard latrines fulfil public functions key to sustain urban social life and supporting the needs of the city's mobile workers such street traders. Access to water and sanitation in the workplace was identified as an important area for research and action in the context of the SDGs (e.g. Toilets and Jobs was the World Toilet Day theme in 2016). Street trade are some of the most common informal income generating activities in global South cities, particularly for women for whom these activities are important sources of employment (WIEGO, 2021). Emergent work shows that inadequate access to WASH affects vendors earnings (eg. as they have to pay the recurrent cost of toilets; goods that are stolen if they are left unattended to visit the toilet) and their wellbeing (e.g. stress of having to queue for a toilet several times a day) with "long-term consequences that may further entrench workers' poverty and exclusion" (WIEGO, 2021, p. 23). More research is needed to understand how street traders and in particular women vendors access sanitation in global South cities and the specific barriers they face. The topic of access to sanitation for mobile workers is of relevance also for global North countries where there is an increasing number of transport workers such as drivers or delivery workers as the launch of the ITF sanitation charter in 2019 has illustrated (ITF, 2019)

New dynamics in water and sanitation labours: Water and sanitation provision in global South cities is undergoing important transformations. Chapter 4 pointed that in Lilongwe the municipality is shifting towards an FSM (faecal sludge management) approach that will entail the participation of a wide range of local sanitation entrepreneurs who will be responsible for the emptying and transport of faecal sludge from latrines and septic tanks to the municipal wastewater treatment plant (World Bank, 2017). This type of approach to service provision that is gaining traction in many other global South cities means there will likely be an increasing number of jobs in activities related to the provision of sanitation. Despite the essential service provided by sanitation workers, they face important risks for their health as well as of stigma and discrimination (World Bank et al., 2019). However, the working and living conditions of those who are involved in these activities are often

not accounted for in the planning of FSM approaches and these new jobs are not subjected to work or health and safety protocols or regulations (World Bank et al., 2019). A different theme that requires further research is the changing labour relations brought about by the digitisation of water and sanitation services. For example, Chapter 6 points to an undergoing transition to shift to pre-paid water kiosks that may have important implications for the role and working conditions of kiosks attendants in LIAs. These types of digital transformations such as the introduction of prepaid systems or smart solutions are increasingly being implemented in global South cities (Amankwaa et al., 2021) and as in the case of Lilongwe's kiosk system they may have an impact in labour relations that requires attention. Finally, this dissertation has demonstrated that particular infrastructural labours intersect with gendered subjectivities resulting in the enrolment of women in voluntary or low-wage jobs often related to the maintenance and care of infrastructures. More attention is needed to how gender stereotypes are reproduced by water and sanitation projects to situate women in these activities and on how gender dynamics play to invisibilise and devalue maintenance and care activities that are key to sustain functional water and sanitation services (see Chapter 7).

Solidarity and reciprocity in access to water and sanitation: The dissertation has shown that different forms of solidarity and collaboration between residents play an important role to ensure access to sanitation services. For example chapter 4 shows that street traders or domestic workers from LIAs rely on the empathy of residents of planned areas to access toilets during working hours and chapter 7 shows that rules of solidarity and reciprocity among neighbours enable those whose toilets have broken down to access other people's toilets. These findings resonate with recent research that has documented cross-cultural patterns of household water sharing often underlined by culturally shared norms around reciprocity and morality, local water ontologies or religious beliefs (Wutich et al., 2018) and reflected on the importance of this practice for the survival of low-income household in challenging conditions (Wutich, 2011, Wutich et al., 2018). As this research on water sharing points, it is important to understand the role of community sharing rules in enabling access to water and sanitation and the "complex harms and benefits potentially involved" (Wutich et al., 2018 p. 11) in these dynamics of access.

New water and sanitation imaginaries: this dissertation has shown that in Lilongwe urban and infrastructure planners are strongly influenced by western ideals around how urban sanitation infrastructures should look like and how they should work (i.e. western ideal of waterborne sanitation). The backyard latrines constructed by residents in planned areas are rejected for not conforming with this ideal of modern infrastructures. Technological

controversies as such (waterborne vs off-grid technologies) are not only about the suitability of different technologies but also about the underlying visions or imaginaries of society these different technologies imply (Jasanoff and Kim, 2015). For example scholars have revealed the imaginaries of connectivity, modernity and growth underpinning the construction of networked infrastructures (Graham and Marvin, 2001). However there is need for more research about the societal and urban imaginaries embedded in new sanitation technologies or models of service provision (e.g. offgrid) (Lawhon et al., 2021).

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Appendices

APPENDIX 1: Project information sheet and informed consent form

Participant Information

We would like to invite you to participate in a research. The research will be about sanitation and hygiene in the Low-Income Areas of Lilongwe. Before you decide if you want to participate, it is important that you understand

- why we are doing this research
- and what you will be asked to do

Please, take time to read the following information carefully. You can discuss it with others if you wish. Please let us know if there is anything that is not clear or if you would like more information. Take all time you need before making a decision. Thank you for reading this.

Who will conduct the research?
Cecilia Alda Vidal
PhD student
Email: cecilia.aldavidal@postgrad.manchester.ac.uk
School of Environment, Education and Development, The University of Manchester
Oxford Road, Manchester, M13 9PL, United Kingdom
Local telephone number: 099 871 44 64

Title of the Research
Lived infrastructures. Mapping everyday sanitation and hygiene in the Low-Income Areas of Lilongwe, Malawi

What are we trying to do?
This research wants to understand

- how you go about your everyday sanitation and hygiene routines
- How you use the infrastructure in your neighbourhood for that

Why have we selected you?
We have selected you as participant because this study wants to learn from the experience and knowledge of people living in your neighbourhood. If you know anyone else who would be willing to participate, please let us know.

What will we ask you to do?
Interviews

- We will ask you to participate in an interview
- The researcher and a research assistant will ask you questions.
- Those questions will be about your sanitation and hygiene routines and the infrastructures you use
- Interviews will take around one hour

Group discussion

- We will ask you to participate in a group discussion
- There will be between five to ten other people
- Group discussions will be conducted by the researcher and a research assistant and will take around two hours

Photo-elicitation

- We will ask you to participate in a photo exercise over two weeks
- We will give you a camera and ask you to take pictures that represent your everyday sanitation and hygiene routines
- Once you have finished, the researcher will print the pictures and discuss them with you in an interview

Sketches

- We will ask you to make a drawing that represents your day-to-day sanitation and hygiene routines.
- The researcher and the research assistant will ask you questions about what you have drawn and why
- This exercise will take around one hour

Go along interviews

- We will ask you to participate in a walking interview
- The researcher and research assistant will ask you to walk her through any daily sanitation and hygiene routine of your choice
- They will walk with you and ask questions
- If you allow, they might take photos or film and track the path you follow to represent it in a map
- This exercise will take around one hour

Will the outcomes of the research be published?

The results of the study will be made public in a variety of ways. This includes academic journals, chapters, books, policy documents, case studies, blogs, news articles, and a PhD thesis. The results will also be presented at conferences and workshops. A short documentary will be produced, and other visual materials make public through a project website.

How will we maintain confidentiality?

The research team takes confidentiality and privacy seriously. Only the research team will have access to the information you provide. We will make sure that you cannot be recognised, and other people will not know that you have participated in the research. We will keep your personal information in a safe and locked location, and the information will be stored in a safe online service. All other storage mediums (US flash/hard drives, laptops and transcription files) will be coded thoroughly and will be backed up in a personal password protected device to ensure data safety. Unless you grant us permission to use your real name, we will always use a false name. Data will be kept for 5 years. Confidentiality is a priority. Yet we may be required to inform authorities if a participant commits a serious or harmful crime in our presence, or indicates their intent to do so in future.

What happens if I do not want to take part or if I change my mind?

It is entirely up to you to decide whether or not to take part. If you do decide to participate, we will give you this information sheet to keep and we will ask you to sign a consent form. If you decide to participate you are still free to withdraw at any time. We will not ask you why you have made the decision to quit, and it will not have any consequence for you.

Will I be paid for participating in the research?

No payment (monetary, gift, or service) is offered as remuneration for your participation.

What is the duration of the research?

The researcher will ask a series of question in the interview which should take between 60-90 minutes to complete.

The total period for research project is from September 2017 to September 2019.

Where will the research be conducted?

Interviews will be conducted in a location that we agree in the neighbourhood where you live.

Who has reviewed the research project?

This project has been reviewed by the University of Manchester Research Ethics Committee

What if something goes wrong?

If there are any issues regarding this research that you would prefer not to discuss with members of the research team, please contact the Research Governance and Integrity Team.

Postal Address: The Research Governance and Integrity Manager, Research Office, Christie Building, The University of Manchester, Oxford Road, Manchester M13 9PL, UK. Email: Research.Complaints@manchester.ac.uk. Telephone: +44 (0)161 275 7583 or 275 8093

Contact for further information

Cecilia Alda Vidal	***Research assistant contact details***
PhD student *Email:* cecilia.aldavidal@postgrad.manchester.ac.uk School of Environment, Education and Development The University of Manchester Oxford Road, Manchester, M13 9PL, United Kingdom Local telephone number: 099 871 44 64	

Participant consent forms

If you are happy to participate, please complete and sign the consent form below.

1. I agree to participate: In a face-to-face semi-structured interview about themes related to the topic of this research according to the details provided in the information sheet. In a focus group composed of up to 10 other people to discuss themes related to the topic of this research according to the details provided in the information sheet. In a photographic diary exercise over two weeks and participate in a follow-up interview with the researcher according to the details provided in the information sheet. In a drawing exercise in which I will be asked to make a sketch related to the themes of interest of this research according to the details provided in the information sheet. In a walking interview, according to the details provided in the information sheet.	
2. I confirm that I have read the attached information sheet on the above project and have had the opportunity to consider the information and ask questions and had these answered satisfactorily.	
3. I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving a reason and without detriment to any treatment/service.	
4. I understand that the activity will be audio-recorded, and I consent to this	
5. I agree that any data collected (including anonymous quotes) may be published in anonymous form – including academic books, journal publications, and a doctoral thesis	
6. I understand that the data collected during this interview will be stored for 5 years by the researcher team in an encrypted digital storage device, and I agree to this	
7. I give my consent to the images produced and released by me to be reproduced for educational and/or non-commercial purposes, in reports, presentations, publications, websites and exhibitions connected to the research project. I understand that real names will NOT be used with the images. ☐ I agree to the transfer of copyright to the researcher for subsequent use ☐ The content should be attributable to me	

I agree to take part in the above project

Name of participant	Date	Signature

Name of person taking consent	Date	Signature

APPENDIX 2: List of documents consulted

National Policies and Regulations (chronological order)

- Government of Malawi. (1969). Public Health Act. https://malawilii.org/mw/consolidated_legislation/3401
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Lilongwe urban planning (chronological order)

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Water and sanitation project documents, engineering studies & consultancy reports (chronological order)

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APPENDIX 3: List of newspaper articles consulted to inform understanding of water contamination incident in Area 18 (chronological order)

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- Gwede, W. (2017, August 1). Area 18 Residents Hold Demo Over Sewage Horror: Demand Compensation from Lilongwe Water Board. *Malawi Nyasa Times.* https://www.nyasatimes.com/area-18-residents-hold-demo-sewage-horror-demand-compensation-lilongwe-water-board/
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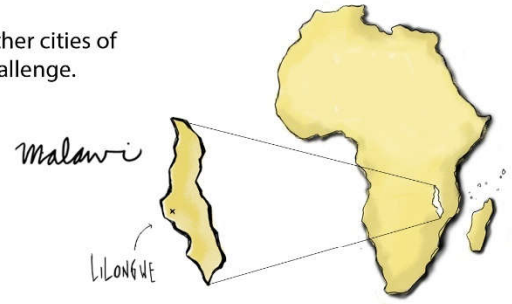
APPENDIX 4: Cartoon – Gender relations and infrastructural labours at Lilongwe's Water Kiosks

Gender relations and infrastructural labours at Lilongwe's water kiosks

Researched and written by Cecilia Alda-Vidal, Alison Browne & Maria Rusca
Illustrated by Catalina Medarde

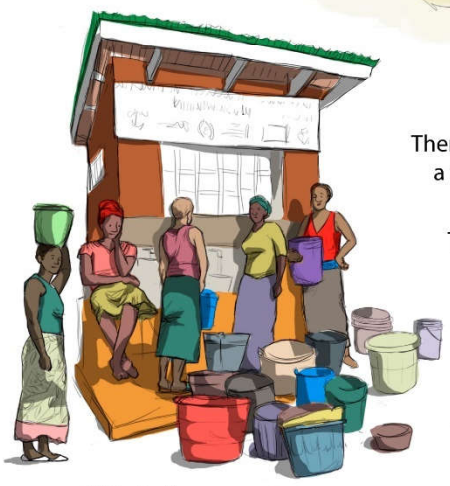
In the periphery of Lilongwe, as in many other cities of sub-Saharian Africa, access to water is a challenge.



In the city center people have taps at home, here we buy water from kiosks. Before we used wells and suffered from cholera and other deseases.

Water from the kiosk is better, but expensive. And there are frequent shortages.

There are over a thousand kiosks here.



Water kiosk

They are managed by Water User Associations (WUAs) and part of the wider urban water system of the Municipal Water Utility.

Due to gendered social norms water collection is perceived as a female responsibility. More than 800 women are employed as kiosk attendants making up the totality of the labour force for kiosk operation.

The system of kiosks depends on women whose bodies and work fill in for the absence of piped water connections to homes.

In each kiosk there is an attendant, we have to make sure kiosks are open on time and collect the payments from customers.

Working as a kiosk attendant is a unique opportunity for women to earn an income, but the WUAs also rely on women as cheap labour.

I'm happy because before I couldn't find a job, at least now I can pay for school fees and buy shoes for my kids, but the salary is not enough.

To say the truth, they claim that men misappropiate funds and are short tempered with customers, but they are aware that men won't accept a salary of few kwacha. This is why only women become attendants.

Opening hours and proximity to their homes make the job compatible with women household chores.

The kiosk offers a space to cultivate social networks.

Attendants are expected to adapt their schedules to the frequent shortages to ensure their neighbours access water.

Selling water at night is difficult. When I'm at the kiosk I think of my kids that I left home alone, anything can happen.

At the kiosk I worked before there was water only at night and I had a lot of problems. Once I met a ghost on my way home. Sometimes men throw stones at me.

We face the risk of meeting thieves, they think we have money and want to rob us.

When water stops coming and resumes at night, our families are at risk. When our wives leave at night we don't know if they use that time to meet other men.

At whatever time the water comes, the kiosk attendant is supposed to go, to leave the family behind. If there are school children she does not have time to feed them. She does not have time for the husband.

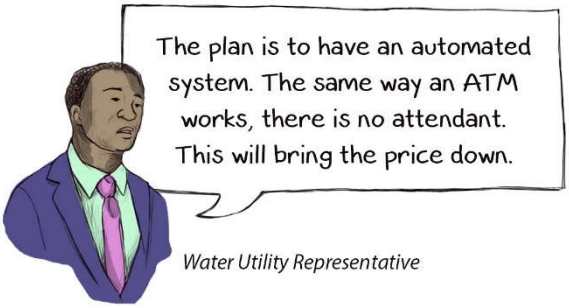
To sustain their operational costs WUAs should sell a minimum water volume every month. Opening the kiosks at night compensates for the selling hours lost during shortages.

WUAs are managed by an elected group of powerful members of the community who are usually men.

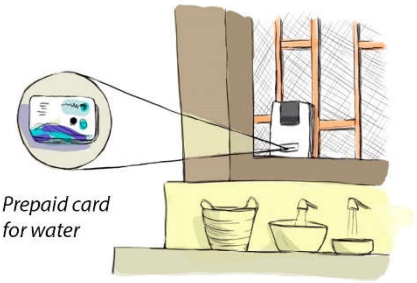
It is not fair that the board and the executive committee receive monthly salaries. They just get their money and don't consider the people burnt by the sun at the kiosks.

As quoted in Velzeboer, 2015

The employment of women is celebrated as part of an empowerment agenda.
Paradoxically, ways of reducing reliance on womens' labour are being explored.



Water Utility Representative



Prepaid card for water

Women, and their roles within water kiosks, are invisible but taken for granted in the planning and running of water infrastructures in the Low Income Areas (LIAs) of Lilongwe. A deeper consideration of the gendered politics and labours involved in these infrastructures is essential given the significance of kiosks in the global achievement of water access and gender equality.

Based on: Alda-Vidal, C., Browne, A.L., and Rusca, M. (forthcoming) Gender relations and infrastructural labours at the water kiosks in Lilongwe, Malawi.
To learn more about the system of kiosks and the challenges to access water in Lilongwe's LIAs
- Watch the documentary Lilongwe Water Works?
- Or visit here.

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The University of Manchester

This research was conducted in the framework of the PhD project of the first author, funded by the Sustainable Consumption Institute, University of Manchester. The cartoon has been partially funded by the Society and Environment Research Group in the University of Manchester's Geography Department.

CATALINA MEDARDE ILLUSTRATION

APPENDIX 5: Failing Water infrastructure in Malawi - World Water Day Blog UoM

(Link to original website: https://www.manchester.ac.uk/collaborate/global-influence/clean-water/sub-saharan-africa/failing-water-infrastructure/?utm_campaign=uom&utm_content=article&utm_medium=social&utm_source=email)

MANCHESTER 1824
The University of Manchester

Failing water infrastructure in Malawi

To mark World Water Day 2021, Cecilia Alda-Vidal, a PhD student in Human Geography at The University of Manchester, discusses her research in Lilongwe, Malawi, which is demonstrating how difficult it is to strike a balance where water is scarce and resources limited.

Sewers provide one of the safest and most convenient ways of dealing with wastewater. However, we often forget one of their most important challenges: they require water to work properly. Research at Manchester highlights how important it is to pay attention to the solutions developed by residents themselves, and to reflect on whether (and how) these can be integrated into wider infrastructure systems.

Inequalities in Malawi's water infrastructure

Malawi has been suffering severe droughts with increasing frequency and is considered highly vulnerable to climate change. In Lilongwe, the capital city, water shortages are common and can last from a few hours to several days. Shortages affect more intensively informal settlements where more than 66% of the urban population live.

In informal settlements, access to water and sanitation is precarious as a result of discriminatory infrastructure development practices and the prioritisation of more affluent neighbourhoods in the provision of services. Most households in informal neighbourhoods collect water from kiosks and use self-constructed pit latrines. When water stops in these areas, residents must turn to unsafe water sources and face serious health and hygiene challenges (https://journals.sagepub.com/doi/full/10.1177/0956247817700291).

Water storage tub next to non-functional flush toilet in Lilongwe, Malawi. Photo: Ralph Ndalama, 2021

This contrasts with the situation in the richer parts of the city, where residents have water taps and flush toilets at home, and many have been able to afford storage tanks to cope with service disruptions. However, water shortages in these areas have other indirect challenges. When water supply stops for several days and toilets aren't flushed, the solids in the sewer lines aren't washed away and produce blockages that can pollute the environment and threaten the health of residents.

Water shortages also mean that flush toilets remain non-operational for hours or days, interfering with residents' toileting routines. In order to avoid the nuisance of having to collect and store water to keep their flush toilets operational, some residents have taken to constructing traditional latrines in their backyards. This is interesting because the traditional pit latrine constitutes the main mode of sanitation in informal settlements and may therefore be considered a step down on the 'sanitation ladder'.

Although municipal officials are fully aware that backyard latrines are in widespread use in parallel to flush toilets, their existence is not acknowledged in official urban or sanitation planning documents.

We are linking up with multi-national agencies and initiatives, such as the World Toilet Organization (https://www.worldtoilet.org/), to help develop and design interventions that take into account local needs.

Recommendations for the future

For decades, investments in water and sanitation have prioritised the construction of large-scale infrastructures. An example of this is a new $100 million project (https://www.worldbank.org/en/news/press-release/2017/12/20/malawis-capital-city-gears-for-better-water-supply-and-sanitation) that includes the expansion of the piped sanitation system. While upgrading the municipal sewer may be considered a priority that will benefit 90,000 people, the project also raises critical questions around water security.

Can investment in technology be considered socially and environmentally just if it redirects scarce financing and water to a small, privileged minority to allow them to flush their toilets? Are other more equitable ways forward possible? An alternative could be to acknowledge water shortages as the 'new normal' and to accept that therefore, flush toilets will not always work, backyard latrines will continue to exist and be relied on. Allowing and encouraging residents to construct and maintain backyard latrines in a safe manner may not be a perfect solution, but equitable development requires compromises.

Development-oriented investment in Malawi (https://journals.sagepub.com/doi/full/10.1177/0956247817700291) should focus on reducing health-related risks and improving the lives of the urban poor. We work with local universities and organisations, for instance the Urban Research and Advocacy Centre (URAC) (https://www.uracmalawi.org/) and Hyphen Media Institute (https://www.facebook.com/pages/category/Media-Agency/Hyphen-Media-Institute-759198807492391/), to support knowledge creation and encourage appropriate action.

This feature was co-written by Dr Deljana Iossifova, Senior Lecturer in Urban Studies.