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Sanitation Governance and its Implications on Environmental Health in Nakuru City, Kenya

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Abstract

Sanitation and proper disposal of human waste are key to a dignified life. The importance of maintaining reasonable standards of sanitation is acknowledged in the United Nations' Sustainable Development Goals (SDG target 6.2) as well as in the Art. 43, I b from the Constitution of Kenya (Government of Kenya, 2010). However, the integration of sanitation policies, their associated legislations and lived practices, and their implications for the environment and human health remain opaque. Understanding is particularly limited regarding sanitation governance in Kenya's fast-growing secondary cities, where responsibility for sanitation has only recently been devolved from the national to the county level. Our study examines these complex interactions, shedding light on how power relations constitute a determining factor in shaping the access to sanitation and its unequal socio-environmental hybridities. Empirically, we focus on three sub-locations in Nakuru City. Nakuru City has been described as a role model in the Kenyan context. Our research design combines both a quantitative, georeferenced household survey and qualitative, semi-structured interviews with actors at various levels. Our descriptive, regression and qualitative content analyses of the collected data reveal that levels of political interest vary considerably. Collaboration along the on-site sanitation service chain and with other sectors, such as solid waste management, presents numerous challenges, and a significant discrepancy exists in degrees of access to safe sanitation between and within sub-locations. As value-driven leadership at a time of heightened political attention has made Nakuru's role as a "sanitation champion" possible, we believe that many of these challenges can be overcome with increased collective awareness and a more substantial political commitment to realise the constitutionally guaranteed right to sanitation.

Contents

Figures

Tables

Boxes

Abbreviations

CHV	community health volunteer
CSO	civil society organisation
CWIS	citywide inclusive sanitation
EU	European Union
FGD	focus group discussion
IDOS	German Institute of Development and Sustainability
KfW	Kreditanstalt für Wiederaufbau (German development bank)
Ksh	Kenyan shilling
NACOSTEC	Nakuru Countywide Sanitation Technical Steering Committee
NAWASSCO	Nakuru Water and Sanitation Services Company
NEMA	National Environment Management Authority
NGO	non-governmental organisation
RQ	research question
SAP	Structural Adjustment Program
SDG	Sustainable Development Goal
SFD	sewage flow diagram
UN-HABITAT	United Nations Human Settlement Programme
UNICEF	United Nations International Children’s Emergency Fund
VEI	Dutch water operators’ initiative
VIP latrine	ventilated improved pit latrine
WASH	water, sanitation, and hygiene
WSUP	Water and Sanitation for the Urban Poor
WHO	World Health Organization
WSP	water service provider
WWTP	wastewater treatment plant

1 Introduction

Access to safe sanitation and water is fundamental to human health and well-being. Sanitation not only plays a crucial role in preventing disease outbreaks, but it is also essential for living a dignified life in a clean environment. Over the past few decades, substantial progress has been made globally with the support of the Millennium Development Goals and, since 2015, the Sustainable Development Goals (SDGs). Access to drinking water and sanitation is a fundamental human right. Achieving universal, adequate and equitable access to safely managed water and sanitation services is at the core of sustainable development. This is reflected in SDG 6 under targets 6.2 and 6.3 – ensuring access to adequate sanitation for all, and to improve the treatment and reuse of wastewater by 2030 (United Nations General Assembly, 2015). As a result of these commitments, by 2020, an estimated 54 per cent of the global population had access to safely managed sanitation, up from 47 per cent in 2015 (World Health Organization & United Nations International Children's Emergency Fund [WHO & UNICEF], 2021). However, at the current rate of progress, only 67 per cent of the global population will have access to safe sanitation by 2030 – leaving 2.8 billion people behind and falling short of the SDG targets (WHO & UNICEF, 2021). A substantial funding gap continues to hinder accelerated progress (World Bank, 2017), and many commonly implemented sanitation interventions have proven ineffective (Garn et al., 2017). Moreover, existing measurements of sanitation access often overestimate real progress due to flaws in the design and local implementation of monitoring systems (Herrera, 2019).

Sanitation is fundamental to public health, preventing the spread of diseases such as cholera, diarrhoea and hepatitis A. Inadequate sanitation remains a major contributor to child mortality in low-income countries (Duncan, Lane, Scott, & Trouba, 2010). Human faeces carry high concentrations of pathogens, and contact with contaminated water and food causes more than 1.3 million diarrheal deaths annually – mostly among children (Liu et al., 2016). Improved sanitation infrastructure, such as for sewer systems, can reduce diarrheal disease by up to 60 per cent in high-risk areas (Norman, Pedley, & Takkouche, 2010). Poor sanitation also enables the spread of neglected tropical diseases such as trachoma and helminth infections, which impair physical and cognitive development (Albonico, Montresor, Crompton, & Savioli, 2006; Emerson et al., 2004). Despite their impact, prevention efforts receive less attention than treatment (Saravanan, Ayessa Idenal, Saiyed, Saxena, & Gerke, 2016). Women and girls face disproportionate risks from inadequate sanitation. Shared or unsafe facilities increase vulnerability to harassment and violence, especially in informal settlements (Caruso et al., 2018; Corburn & Hildebrand, 2015). The lack of privacy during menstruation contributes to school absenteeism and mental stress (Kayser, Rao, Jose, & Raj, 2019). Links between sanitation and child development are increasingly being studied. Repeated infections from inadequate sanitation hinder nutrient absorption and contribute to stunting (Checkley et al., 2008). Studies have demonstrated that such causality is heavily dependent on local contexts (Clasen et al., 2014; Duflo et al., 2015; Null et al., 2018). A growing body of research calls for integrating environmental and social factors into sanitation planning. Poorly maintained systems attract animals and pests, increasing the risk of zoonotic disease (Delahoy et al., 2018; Murray et al., 2020). Yet, the links between sanitation, animal exposure and human health remain underexplored (Matilla, Velleman, Harrison, & Nevel, 2018). Addressing sanitation holistically is essential for achieving sustainable health outcomes. These insights prompt the integration of sanitation research with the broader health literature. Advocates argue that the condition of human societies and the natural environment is fundamentally shaped by the health status of each (Whitmee et al., 2015). As discussed above, this integration offers a promising path forward for improving sanitation outcomes by addressing social and environmental feedback loops previously neglected in research (Cole, 2018; French et al., 2021).

There is a growing shift in the approach to sanitation governance: from a purely technical, infrastructure-focused approach to a more holistic understanding of sanitation – one that

recognises its deep interconnections with social and environmental systems. The success of sanitation interventions often hinges on their alignment with local norms, behaviours and practices – factors that have historically contributed to the failure of many initiatives (Dwipayanti, Rutherford, & Chu, 2019; Novotný, Kolomazníková, & Humňalová, 2017). Inadequate sanitation can lead to the widespread contamination of water and soil (Wolf et al., 2019), posing long-term public health risks. For example, shared or poorly designed facilities may expose users to animal faeces, increasing the likelihood of zoonotic disease transmission (Delahoy et al., 2018). Moreover, environmental changes – such as declining rainfall, rising water tables and more frequent extreme weather events – can undermine the functionality and resilience of sanitation solutions (Howard, Calow, Macdonald, & Bartram, 2016). Recently, more attention has been given to the enabling environment – policy, governance, institutional regulation and funding. This has led development agencies to adopt the citywide inclusive sanitation (CWIS) approach (Schrecongost, Pedi, Rosenboom, Shrestha, & Ban, 2020). CWIS does not reject centralised sewer systems but complements them with non-sewer technologies (Mitra, Narayan, & Lüthi, 2022), emphasising reuse and recycling to reduce ecological impact (Lüthi, Hoffmann, & Willetts, 2020). CWIS promotes a combination of centralised and decentralised systems, hybrid technologies, diverse business models, and a focus on health and the environment across the entire sanitation chain. This comprehensive framework presents an opportunity to strengthen sanitation governance.

To explore sanitation governance in depth, our team selected Nakuru City, Kenya, as a case study. The Republic of Kenya enshrines the right to sanitation in its constitution (Government of Kenya, 2010) and has set ambitious targets to expand access and improve sanitation quality, as outlined in Vision 2030 (Government of Kenya, 2007). However, challenges remain. As a rapidly growing secondary city in a lower-middle-income country, Nakuru faces issues that include inadequate infrastructure, unequal access and environmental pressures. Nonetheless, local government actors are showing a strong commitment to inclusive and innovative sanitation strategies. For these reasons, Nakuru has the potential to serve as a model for an “inclusive sanitation approach that can be replicated” (Department of Health Services & Department of Water, Energy, Environment, Natural Resources, and Climate Change [DoHS & DoWEENR], 2019, p. 7) elsewhere in Kenya and beyond.

Objective and research questions

The primary objective of this research is to identify both the opportunities and challenges for strengthening sanitation governance in Nakuru City, Kenya. Specifically, the study addresses the following research questions (RQs):

1. *How do policies and legislations at the national, county and city levels govern sanitation in Nakuru City?*

This question focuses on the policy frameworks and administrative structures that underpin sanitation governance in the city. It explores the extent of cross-sectoral coordination and the roles and responsibilities of governmental actors involved in sanitation management.

2. *How is sanitation governance practised at the city and household levels in Nakuru City?*

This question investigates the implementation of sanitation policies and the lived experiences of stakeholders along the sanitation service chain. The first component examines how administrative bodies operationalise policy directives and how regulations are translated into practice. It also seeks to identify key actors involved in practice, including those who may not be formally represented in official documents. The second component explores the lived sanitation practices of actors in three selected sub-locations, beginning with intra- and inter-household behaviours. This includes examining access to sanitation facilities, the maintenance and cleaning of toilets, emptying of on-site facilities and the transport of human waste to

treatment sites. These sub-locations were selected during a kick-off workshop held in Nakuru City in mid-February 2023, in collaboration with the local water and sanitation service provider – a key research partner.

3. What are the implications of these sanitation practices for environmental and human health?

This question assesses the impact of inadequate sanitation on environmental contamination, the prevalence of communicable diseases and the pollution of Lake Nakuru. It considers how these issues affect residents and highlights the gaps in the city's current sanitation governance.

4. What factors influence lived sanitation practices in Nakuru City?

This question adopts a critical perspective to examine the determinants of everyday sanitation practices. It considers the influence of coordination among various actors, socio-economic and political inequalities, and power dynamics that shape sanitation governance in the city.

This study explores the opportunities and challenges of sanitation governance in Nakuru City, Kenya. Section 2 reviews the history of sanitation, its links to health and the environment, and current debates on sanitation in the Global South. Section 3 outlines the existing sanitation conditions in Nakuru City and identifies knowledge gaps that inform the project's RQs. Section 4 describes the research design and details the methods of data collection and analysis. Section 5 presents findings from the policy review, examines sanitation practices, and discusses their implications for the environment and health, as well as the key determinants shaping sanitation practices in the city. Section 6 highlights the project's limitations. Section 7 summarises the main results and provides recommendations for policy and future research to strengthen sanitation governance in Nakuru City.

2 Citywide inclusive sanitation: a comprehensive approach for the Global South

Sanitation refers to the safe management and disposal of human excreta, encompassing the processes of emptying, transport, treatment and either the safe reuse or discharge of faecal matter. Over the past centuries, the concept and practice of sanitation have evolved significantly through five distinct phases (see Box 1). In the pre-industrial era, particularly before the Industrial Revolution, human waste was commonly regarded as a resource, and sanitation infrastructure was primarily managed privately, often correlating with wealth and status. The onset of widespread cholera outbreaks in the 19th century prompted a paradigm shift, wherein governments – particularly in Europe and the United States – assumed control of sanitation as a public health imperative. In colonised regions, however, infrastructure investments predominantly favoured European settlers, thereby institutionalising enduring inequalities. The third phase, emerging in the 20th century, was characterised by an engineering-centric approach, which led to significant improvements in water and sanitation infrastructure in the Global North. In contrast, many post-colonial cities in the Global South inherited underdeveloped or fragmented infrastructure systems, thereby perpetuating sanitation disparities. The fourth phase coincided with the rise of privatisation, promoting cost recovery mechanisms and market-based solutions. These approaches, however, often failed to extend adequate services to urban poor populations. Currently, under the framework of the SDGs, sanitation is increasingly approached as a business opportunity. Nonetheless, service provision remains highly inadequate and uneven across regions. The historical trajectory of sanitation reflects a complex shift: from individual to collective responsibility, from informal to formal systems, from public to private management and from a narrowly technological focus to a more comprehensive, systems-based approach.

Box 1: Five phases of sanitation evolution

The history of sanitation can be divided into five phases, each reflecting evolving perceptions, technologies and governance structures.

1. Pre-industrial period

In pre-industrial societies, faeces were not seen as hazardous but as a useful fertiliser. The "night-soil men" collected and sold the sanitation waste to the farmers. Sanitation was largely a private concern, accessible mainly to the wealthy.

2. Sanitation revolution

Triggered by urban cholera outbreaks in 19th-century industrial Europe and the United States, sanitation became a public health issue. Municipalities began managing waste systems, and urban drainage, water supply and flood control became priorities. Legislative reforms and the rise of sanitary engineering significantly improved public health infrastructure in Europe and the United States.

3. Colonial sanitation and post-independence legacies

The public health ideals from Europe were exported to colonies but implemented unequally. Colonial cities were divided, with colonisers living in well-serviced areas and locals relegated to poorly planned settlements. Infrastructure investments aimed more at protecting colonisers' health rather than the broader population. This created a dual urban economy, laying the foundation for today's slums and informal settlements. Post-independence governments often preserved this structure, leading to continued inequality in sanitation access.

4. Engineering expansion and privatisation

Mid-20th-century developments emphasised water purification, waste treatment and environmental protection. However, infrastructure growth, especially in the Global North, came at a high public cost. This triggered a shift towards privatisation, with neoliberal principles such as "polluter pays" and "full cost recovery" guiding sanitation investment. Infrastructure debt increased, and responsibility shifted from the public to the private sectors.

5. The SDG era and sanitation economy

Sanitation became a global agenda in the 21st century. The current phase emphasises entrepreneurial and market-based solutions to sanitation, especially in the informal urban areas of low- and middle-income countries. In this phase, waste is viewed as a resource to be recycled and reused, and private actors – including philanthropic foundations – are invited to play an important role in sanitation service delivery.

Source: Brugger (2021) and Swyngedouw et al. (2002)

In recognition of the persistent global sanitation crisis and the limited success of previous interventions, a new paradigm for urban sanitation planning is being advanced. The World Bank, alongside other multilateral and non-governmental organisations (NGOs), advocates for a comprehensive model known as "citywide inclusive sanitation" (CWIS). This framework seeks to address systemic gaps in sanitation provision, particularly in low- and middle-income countries (Gambrill, Gilsdorf, & Kotwal, 2020; Narayan & Lüthi, 2019). CWIS consolidates diverse disciplinary perspectives and practical experiences under a unified approach to urban sanitation. Its origins can be traced back to a 2016 sanitation conference held in Atlanta, during which a coalition of key stakeholders – including the Bill & Melinda Gates Foundation, Emory University, Plan International, the University of Leeds, WaterAid and the World Bank – issued a Call to Action (Narayan & Lüthi, 2019). This initiative culminated in the articulation of the Manila Principles, which emphasise the importance of comprehensive, inclusive planning. At its core, CWIS advocates a sector-wide approach that prioritises stakeholder engagement, intersectoral collaboration, and inclusivity in service design and delivery (Schertenleib et al., 2021; Schrecongost et al., 2020). This model is particularly attractive to national governments and

international development agencies seeking sustainable and equitable sanitation solutions. Importantly, CWIS marks a substantive departure from traditional infrastructure-driven strategies. Whereas earlier interventions focused predominantly on constructing physical assets – such as toilets, centralised sewerage networks and wastewater treatment facilities – CWIS emphasises service provision, the professionalisation of informal sector workers and the development of a robust enabling environment (Gambrill et al., 2020; World Bank, 2021). As such, CWIS represents a shift towards a more holistic and adaptable sanitation framework capable of addressing the complex challenges of contemporary urban environments. To realise the intended outcomes of CWIS, the framework identifies three essential system functions for public service entities (Schrecongost et al., 2020):

- assigning a clear mandate for safe and inclusive sanitation management to designated authorities;
- ensuring accountability by making the performance of these authorities transparent and subject to monitoring;
- planning and allocating the necessary resources – including personnel, infrastructure and financial capital – in alignment with the implementation of their mandate.

Achieving these functions necessitates the integration of sanitation into broader urban planning processes, the development of coherent regulatory policies and the establishment of cross-sectoral partnerships. CWIS thus seeks to foster connections across sectors – such as storm water management, public health, energy, housing and transport – to mitigate the fragmentation often observed in public policy and decision-making.

These cross-sectoral linkages may take the form of formal collaborations, such as the establishment of an integrated urban water unit, or informal partnerships that address various sanitation-related issues, including storage, treatment, distribution, recycling, reuse and disposal (Schrecongost et al., 2020). In doing so, sanitation is positioned as a central pillar of urban governance. Although CWIS principles are not legally binding, they serve as a set of general guidelines designed to promote knowledge exchange, build institutional capacity and raise awareness through the global dissemination of experiences. This comprehensive and adaptive framework has been embraced by numerous development agencies, governmental departments and service providers, many of whom are increasingly aligning their work with CWIS principles (Gambrill et al., 2020). However, awareness and understanding of the CWIS approach remain limited among many policy-makers and practitioners within the sanitation sector.

The overall outcome of our research is intended to identify opportunities to improve sanitation governance in Nakuru City and the derivation of recommendations to reinforce future sanitation interventions. Nakuru City is the capital of Nakuru County. It is the fourth largest city in Kenya with a population of more than 570,000. The city exemplifies a rapidly growing secondary city facing increasing pressure on its social infrastructure, including water supply, housing, sanitation and health care systems. These challenges are particularly acute in low-income neighbourhoods inhabited by vulnerable populations (Simiyu, Chumo, & Mberu, 2021). In collaboration with international development partners, local authorities have formulated strategies at both the national and county levels to implement CWIS principles (see Section 3.2). One outcome of this process is the Nakuru Countywide Strategic Sanitation Plan (DoHS & DoWEENR, 2019). Despite these developments, there remains limited understanding of how different stakeholders interact and collaborate to govern sanitation services within Nakuru City.

This gap presents a compelling opportunity for further research. Our study aims to examine the governance landscape of sanitation in Nakuru City, drawing on support from key institutional partners, including the Nakuru Water and Sanitation Services Company (NAWASSCO) and Egerton University. The combination of active local stakeholders, experienced partner

organisations and Nakuru's evolving socio-economic context makes the city a particularly promising case for investigating inclusive sanitation governance. In recent years, extensive research has been conducted on urban and rural sanitation systems in Nakuru County, Kenya. For instance, scholars in business and public administration have examined the organisational performance of NAWASSCO (George, 2015; Gitonga, 2013). Other studies have investigated the implementation of NGO-led projects (Omondi, 2017), the role of private-sector actors (Muchiri, Mutua, & Müllegger, 2010), households' willingness to pay for sanitation services (Peletz et al., 2021) and community mobilisation initiatives (Muringi, Stevens, Mwanzia, & Pasteur, 2015; Mwanzia & Misati, 2013). A particularly relevant qualitative study explored the challenges of faecal sludge management in informal settlements in Nakuru City (Simiyu et al., 2021). Building on these studies, we place sanitation in a broader historical context to understand its construction and implementation of policies and legislation in the city (see RQ 1). Second, with a focus on everyday practices, we understand the spatial and temporal practices and discourses of power relations and societal practices shaping sanitation governance in the city (see RQ 2). Finally, we examine the implications of the above practices on the environment, health and determinants of inequalities across sanitation services in the city (see RQs 3 and 4).

3 Sanitation governance in Nakuru

Nakuru City was the preferred choice for operationalising CWIS from the federal government and the World Bank, which is intended to serve as a model for other counties (DoHS & DoWEENR, 2019). Nakuru is an exemplary secondary city with a rapidly expanding population and robust economic growth, exerting pressure on already overstretched social infrastructure and services such as water, housing, sanitation and health care. This situation is especially pressing in low-income neighbourhoods with vulnerable inhabitants (Simiyu et al., 2021). In cooperation with international development partners, the authorities have developed national- and county-level strategies to manage sanitation through CWIS (see Section 3.2). One result of this process is the Nakuru Countywide Strategic Sanitation Plan (DoHS & DoWEENR, 2019). Unlike the World Bank, Nakuru County preferred to take a countywide approach towards sanitation governance.

The study seeks to uncover how these actors contribute to sanitation governance. It is informed by Bevir's (2012) broader conception of governance, which includes formal and informal processes, norms and networks. The study aims to map the sanitation status quo, identify effective practices and highlight areas needing improvement to support the city's sanitation agenda. In our study, we understand governance as follows:

> Governance refers, therefore, to all processes of governing, whether undertaken by a government, market, or network, whether over a family, tribe, formal or informal organisation, or a territory and whether through laws, norms, power, or language. Governance differs from government in that it focuses less on the state and its institutions and more on social practices and activities. (Bevir, 2012, p. 1).

Thus, sanitation governance comprises several actors, including public officials from Nakuru County, NAWASSCO, private truck operators and households, as well as written documents and lived social practices. The concept helps us understand how sanitation systems work, at what cost and for whom. It designates the continuous renegotiation of sanitation practices by diverse actors across different spaces. Our cross-cutting analysis aligns with Nakuru City's objective to develop its sanitation agenda. It may deliver important insights into the status of sanitation, emphasise well-functioning practices and highlight possible opportunities for improvement in the sanitation governance of Nakuru City.

Nakuru city is administratively divided into three constituencies – Nakuru Town West, Nakuru Town East and a few wards in Nakuru North (County Government of Nakuru, 2018). The fast growth of the city is also driving economic growth. The main economic sector in Nakuru County is agriculture, contributing 48 per cent of household income. Other sectors present in the area are mining, industry and tourism (Government of Kenya, 2016). For 2019, the annual per capita income in the county was estimated to be at around USD 4,770,[1] thus ranking seventh out of 47 counties in Kenya (Kenya National Bureau of Statistics, 2022). The city is located 160 kilometres north-west of Nairobi in the Rift Valley, with Lake Nakuru being one of Kenya's national parks. The city's elevation is 1,850 metres above sea level (County Government of Nakuru, 2021b). In the city, the elevation decreases from north to south by 350 metres. Low-lying areas of the city are thus often flooded during the rainy season from March to May and November to December (Furlong, 2015). Hydrologically, Nakuru is located within the Rift Valley Catchment Area, which is characterised by saltwater lakes, including the area surrounding Lake Nakuru (Kenyan Ministry of Environment, 2013). Lake Nakuru is located 2 kilometres south of Nakuru City, at the centre of the national park. The lake serves as a habitat for many endangered bird species, but it is threatened by pollution from the surrounding area (Kiogora et al., 2021). The average temperature in Nakuru is 15 degrees Celsius, and the average annual precipitation is 1,250 millimetres. However, temperature and precipitation are projected to increase as a result of climate change (Government of Kenya, 2016). Due to rapid urbanisation and the inability to provide adequate housing, especially for lower-income populations, Nakuru City hosts numerous informal settlements. Major informal areas include Lake View, Manyani and Bondeni in the east of Nakuru City, and Ronda, Kaptembwo and Gituima in the west (County Government of Nakuru, 2018). The living conditions in these areas are characterised by a lack of public service provision and poor quality of water supply and sanitation (County Government of Nakuru, 2018). More than half of Nakuru City's population lives in low-income neighbourhoods (County Government of Nakuru, 2018).

Established by the county government, NAWASSCO is responsible for collecting, treating, and managing wastewater and sludge in the city. However, the emptying of on-site sanitation facilities is left to homeowners, and the management from NAWASSCO mainly includes the provision of wastewater treatment plants (WWTPs). There are two WWTPs in Nakuru with different specialisations. The Njoro WWTP receives primarily industrial wastewater, while the Old Town WWTP treats domestic wastewater and faecal sludge. Both WWTPs currently operate below their capacity. The Old Town WWTP releases its effluent into Lake Nakuru (Furlong, 2015). However, the two WWTPs are threatened by the rising water levels of Lake Nakuru. The lake has expanded significantly in the last decade due to increased rainfall and runoff, and its water level rises approximately 70 centimetres per year. As the Old Town WWTP is located at the shore of Lake Nakuru, its lower levels are inundated, resulting in limited operational capacity. The Njoro WWTP could also be affected if the water levels continue to rise. The relocation of both WWTPs is recommended to ensure full functionality (Kiogora et al., 2021). NAWASSCO's responsibilities also include providing drinking water: 80 per cent is abstracted from boreholes, while 20 per cent stems from surface water. The groundwater has a high fluoride content and requires treatment (Gevera & Mouri, 2018). Groundwater levels in Nakuru are typically between 20 and 40 metres in depth; however, in boreholes, the water table is often 6 to 10 metres higher (Furlong, 2015).

The rising water levels of Lake Nakuru also have other effects on sanitation. Informal settlements on the north-western shore are susceptible to flooding; approximately 677 households have been affected since 2021. Toilets overflow and potentially contaminate the drinking water, leading to waterborne diseases. Other damage caused by the lake's expansion includes the destruction of roads and facilities of the National Park. Furthermore, the electric

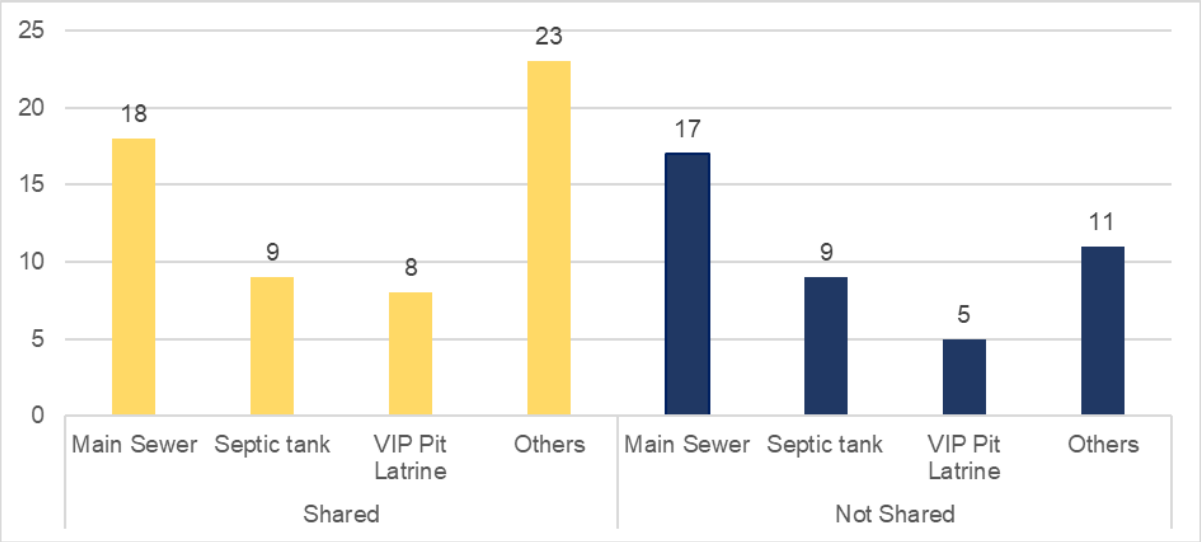
1 The US dollar value was calculated using the IMF's implied purchasing power parity conversion rate for 2019 (International Monetary Fund, 2022).

fence surrounding the park had to be turned off, increasing the possibility of conflicts between humans and the wildlife (Kiogora et al., 2021).

Sanitation systems in Nakuru

Nakuru City has a diverse sanitation infrastructure that includes two WWTPs – to which the sewage system and off-site facilities are connected – and multiple on-site facilities. Broadly, the 2019 census data reports sewer-based sanitation, septic tank-based sanitation, ventilated improved pit latrines (VIP latrines) and other categories (see Figure 1). The “other” category includes covered and uncovered pit latrines, cesspool toilets, bush toilets and bio-digesters. Approximately one-third (35 per cent) of the city’s total households have access to sewer-based sanitation facilities. Septic tank-based sanitation, VIP latrines and other facilities were reported among 27 per cent, 13 per cent and 34 per cent of households, respectively. Many of these facilities are shared toilets, accounting for 58 per cent of all toilets in the city, and non-shared toilets accounting for 42 per cent (see Figure1). These facilities are spatially unevenly distributed across different sub-locations within the city (see Figure 2). The 2019 census data is distributed by location and sub-location, not by administrative ward. These differences create confusion in the spatial merging of the locations. The sewer-based sanitation facilities are distributed in Langalanga, Githima, Afraha, Baharini, Kivumbini and Free Area sub-locations in the northern central part of the city. The on-site facilities are distributed in the surrounding sub-locations of the city. The “other” category of facilities is predominantly distributed in the sub-locations in the western and eastern parts of the city.

Figure 1: Types of sanitation facilities in Nakuru City 2019 (in %)



Source: Kenya National Bureau of Statistics (2019)

3.1 Off-site sanitation facilities

Looking at the spatial distribution of sanitation services in Nakuru City, it is noticeable that access to sewerage is reserved for the neighbourhoods around the two WWTPs, the Njoro Sewage Treatment Plant and the Old Town Sewage Treatment Plant, which are situated in the city centre at the northern part of the lake (see Figure 2). Off-site sanitation facilities are mostly flush toilets that are connected to the sewerage network. In these sub-locations, on-site facilities are correspondingly less represented. Conventional sewerage systems are the most advanced technology option in processing human waste. They require a regular water supply, as well as routine treatment and maintenance. For this reason, they are especially suitable for narrow

urban areas. However, they are expensive and often only installed if beneficiaries can afford to pay for them, which is why they are mainly located in high-income areas (Daudey, 2018; Furlong 2015; McConville, Kvarnström, Maiteki, & Niwagaba, 2019). The current sewer network of Nakuru City can be seen in Figure 2.

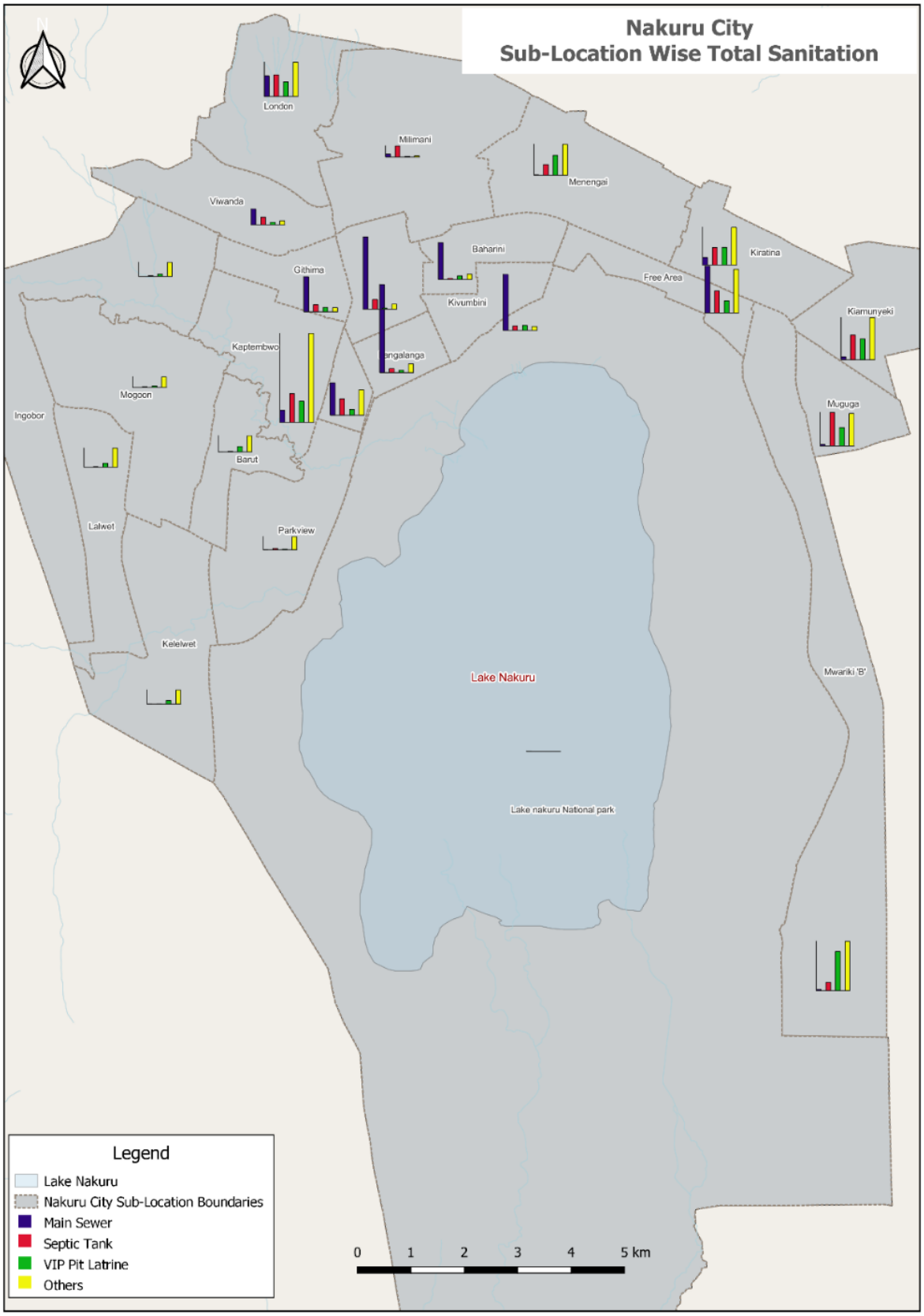
3.2 On-site sanitation facilities

On-site sanitation facilities are prevalent in the sanitation infrastructure of Nakuru City. In low-income settlements, there are few, and they are mostly shared between households (Simiyu et al., 2021). In 2015, 84 per cent of households shared their sanitation facilities with at least three other households (Furlong, 2015). The main types of non-sewer toilets in Nakuru City are basic pit latrines, improved pit latrines and septic tanks. In low-income neighbourhoods, NAWASSCO also promoted using EcoSan, a dry toilet separating urine and faeces. Since the coverage of EcoSan facilities in Nakuru City was low as of 2015, it is not included in the sewage flow diagram (SFD) (Furlong, 2015).

The most common types of toilet in Nakuru City are pit latrines, which are holes in the ground that are either unlined or lined “with a reinforcing material” (Orner, Naughton, & Stenstrom, 2018, p. 3), such as bricks, concrete, timber or stones to contain human excreta. The lining is needed when the soil on which the latrines is built is unstable and the pit needs to be emptied regularly. Although recommendations vary, pits should not be dug deeper than 2 metres above the groundwater level. This is advised so as to avoid contaminants in the water supply, as the water table rises seasonally (Banks, Karnachuk, Parnachev, Holden, & Frengstad, 2002; Franceys, Pickford, & Reed, 1992; Reed, 2010). Pit latrines are considered full when excreta levels are 0.5 to 1 metre below the ground surface. Depending on the design of the latrine, this can take several years. Many pit latrines are used for a maximum of five years before they need to be emptied or covered (Brouckaert, Foxon, & Wood, 2013; Franceys et al., 1992; Orner et al., 2018). Usually, they are equipped with a squat slab or a toilet seat. A superstructure is used to provide privacy (Orner et al., 2018).

More than half of the population live in low-income neighbourhoods where pit latrines are used (County Government of Nakuru, 2018; Gudda, Moturi, Oduor, Muchiri, & Ensink, 2019). Nevertheless, pit latrines can be found in all sub-locations of Nakuru City. They are also present where neither sewer pipes nor septic tanks are common and “other” forms of sanitation equipment provide the infrastructure (see Figure 2).

Figure 2: Distribution of types of sanitation across sub-locations in Nakuru City



Source: Compiled from the Kenya National Bureau of Statistics (2019)

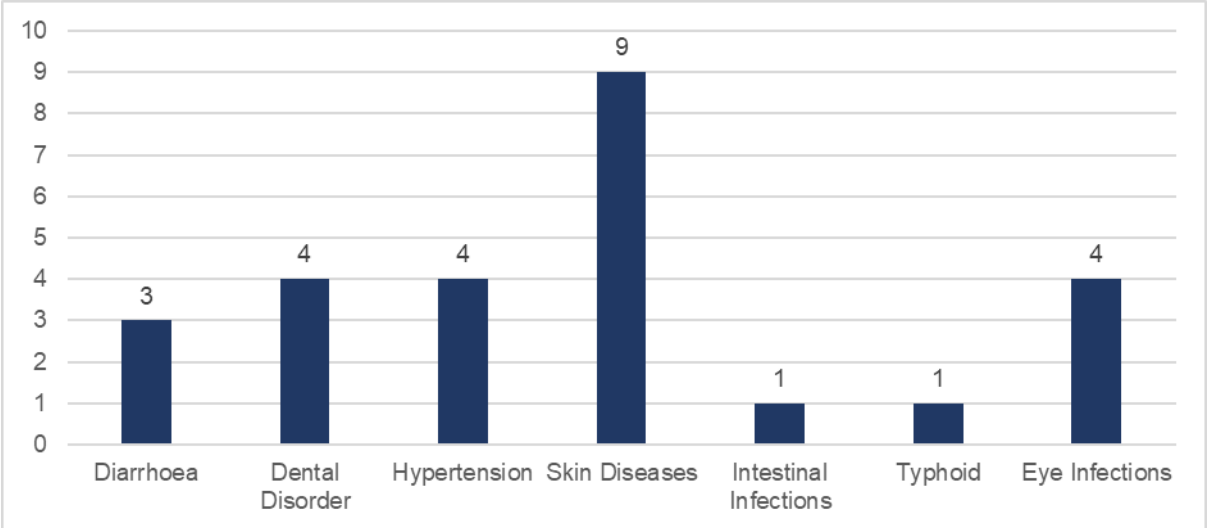
Figure 3: Sewer network of Nakuru City

Source: Nakuru Water and Sanitation Service Company (2023)

Linkages to diseases

The distribution of major diseases in Nakuru City in 2021 may also indicate inadequate sanitation facilities, as these diseases are linked to inadequate sanitation (see Figure 4). Skin diseases are reported to occur among nine individuals per 1,000 population. Diarrhoea, dental disorders, hypertension and eye infections were reported among four individuals per 1,000 population. Intestinal infection and typhoid were reported among one individual per 1,000 population. The extent to which the emergence of certain diseases is related to the sanitation situation in Nakuru City is currently unknown and will be assessed in our research.

Figure 4: Incidence rates of major diseases in Nakuru City in 2021 (per 1,000 population)

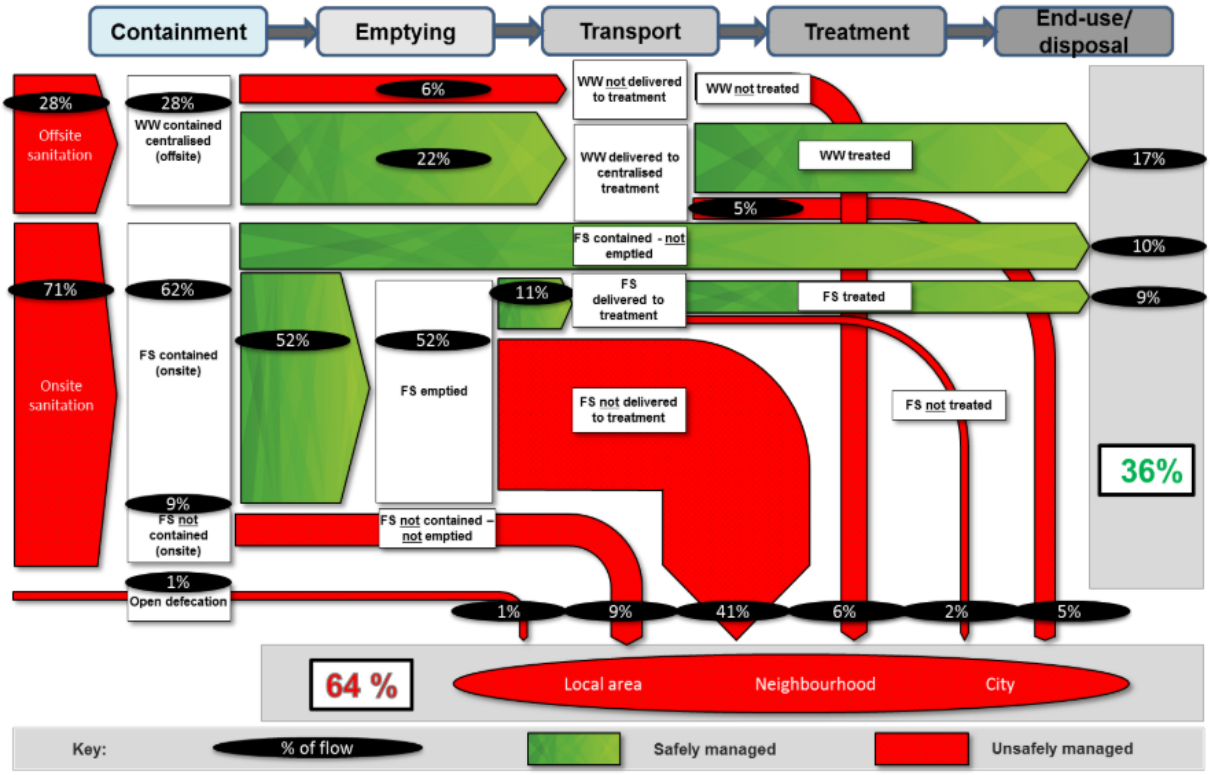


Source: Government of Kenya Department of Health (2022)

In 2015, the county government prepared an SFD for Nakuru in cooperation with Loughborough University and Water Sanitation for the Urban Poor (WSUP), Kenya (Figure 5). The SFD – also

called excreta or shit flow diagram – illustrates the flow of wastewater and faecal sludge along the sanitation service chain, which is split into different sanitation facilities (Furlong, 2015). The arrows represent the proportion of faecal sludge from the city's population and indicate the route of excreta through the system. The SFD provides an initial overview of the occurrence and performance of existing types of sanitation and sanitation practices in Nakuru City. Since the data was collected in 2015, the illustrated sanitation situation needs to be updated in our research. Additional government documents, census data from 2019 for Nakuru City and a recently conducted qualitative study of the sanitation service chain in low-income settlements of Nakuru City (Simiyu et al., 2021) can help to predict the future sanitation situation in the city.

Figure 5: Sewage flow diagram of Nakuru City



Notes: WW = wastewater; FS = faecal sludge

Source: Furlong (2015, p. 1)

The sanitary infrastructure of Nakuru City is shaped by a mix of sewer and non-sewer-based systems, also referred to as off-site and on-site sanitation, with the latter predominating (71 per cent in total). Even if more than half of the wastewater collected off-site in centralised sewer systems is treated (17 out of 28 per cent), the diagram does not indicate why 6 per cent of the contained wastewater is not delivered to treatment sites, and why 5 per cent of the wastewater delivered to treatment plants is nevertheless released untreated into the environment.

Although most of the faecal sludge contained on-site is emptied, it is not transported onward for treatment (41 out of 52 per cent). According to the SFD, this practice generates the largest share of unsafely managed sanitation, distributing excreta untreated into the urban environment; 9 per cent of faecal sludge is not contained at all. Around 1 per cent of defecation is practised openly. Open defecation can even occur when sanitation facilities are theoretically accessible. A qualitative study in Nakuru City reveals that open defecation can arise as a response to overcrowded or unclean sanitation facilities (Simiyu et al., 2021). The statistic indicates that either access to adequate sanitation facilities is not yet available to the entire population, or they are not being appropriately used. It can be concluded from Nakuru City's SFD that, as of 2015, 64 per cent of human waste flow does not follow the designated sanitation service chain,

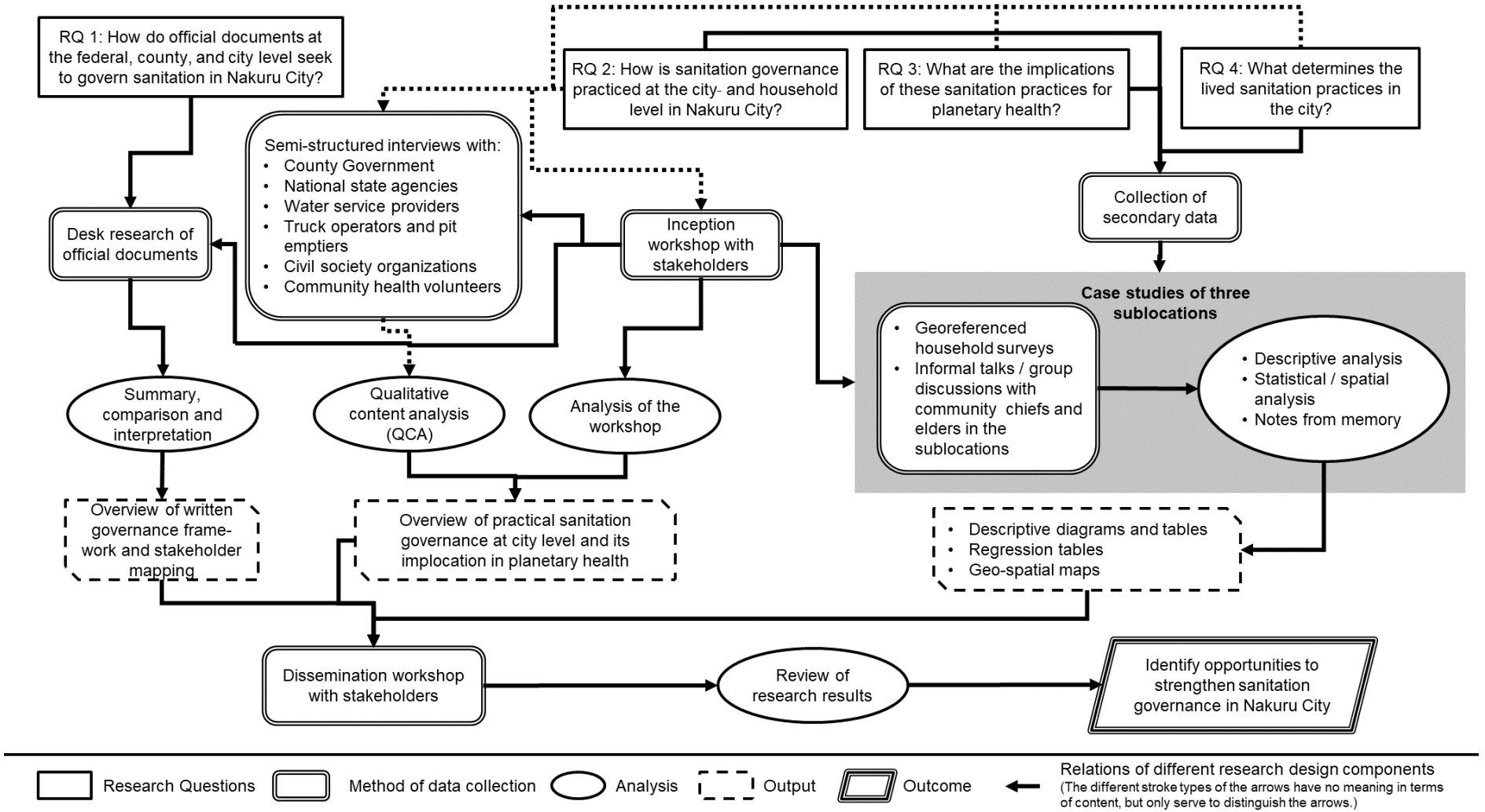
remains untreated in the city's wastewater system, and thus, is not safely managed. There appears to be great potential along the sanitation service chain for enhancing safe sanitation, which should be evaluated in the context of our on-the-ground research. Based on reports in the local media in 2015, Nakuru City's SFD assumes a leakage rate of 20 per cent (Furlong, 2015; Ogembo, 2015). Leaks were primarily attributed to poor sewer system maintenance and clogged sewers resulting from solid waste. More recent media reports likewise confirm ongoing leaks in the sewer pipes (Wanja, 2018). This could explain why shares of wastewater are, according to the SFD, collected and contained in centralised sewers, but not delivered to treatment plants. Moreover, both WWTPs operate below their design capacities, which could explain why 5 per cent of the wastewater is not treated, despite being delivered to the WWTPs (see Figure 5).

4 Research design

The research project aims to assess how sanitation governance is practised by and for people in Nakuru City and its impact on human health and the environment. Ultimately, it seeks to identify opportunities to strengthen sanitation governance in Nakuru City. We applied an interdisciplinary research approach with a mixed methods research design combining qualitative and quantitative methods at multi-scale, with a focus on households. The team applied quantitative methods (i) to analyse large-N data gathered from a household survey in a descriptive manner and (ii) to quantify and map relationships between different variables through hypothesis testing. The qualitative methods offered (i) explorative ways to gain insights where there was little existing knowledge; and (ii) to derive possible explanations for a causal relationship from the household survey.

Figure 6 illustrates the linkage between the research questions, the research methods, the expected outputs and the outcomes. We describe these in detail in the following sections, in the order of the methods of data collection. We start by explaining the desk research and analysis of official documents as well as the collection and analysis of secondary data, followed by a description of the inception and dissemination workshop with stakeholders. Next, we turn to the sub-location case studies and a description of the methods used to conduct them: First, we state how we selected the sub-locations. Second, we explain the georeferenced household survey. Lastly, we discuss the semi-structured interviews with relevant actors in the sanitation sector; these interviews are an important complement to the household survey data.

Figure 6: Schema of research design



Source: Authors

4.1 Desk research and analysis of official documents

To examine the policies and legislations governing sanitation in Nakuru City (RQ 1), we reviewed the relevant official, written documents from different government departments at the national, county and city levels. We focused on documents on sanitation management and governance, and we took into consideration related policy sectors such as the environment, health and water, as sanitation is closely intertwined with other public-sector services, such as solid waste management and water supply (see Section 2). Official documents were found through internet research and shared with us by our stakeholders. The results from the inception workshop with stakeholders were another source with which to identify the relevant documents.

By summarising, comparing and interpreting these official documents, we aimed to gain an overview of the written governance framework in Nakuru City. This gave us insights into the interplay between different official documents at different levels of government and from different policy areas, and it enabled us to assess the extent to which they are consistent or not. In doing so, the analysis allowed us to understand the responsibilities and competencies of different actors, as defined in the official documents.

4.2 Collection and analysis of secondary data

In preparation of the case studies and the semi-structured interviews, we researched and evaluated existing secondary data on access to sanitation, different types of sanitation facilities, socio-economic situations, health status and prevalence of diseases in Nakuru City. Existing data on access to sanitation and the health status of residents in Nakuru City was only available at an aggregate level. Therefore, this data was not sufficient to answer our research questions about sanitation practices, their implications on environmental health or their determinants on the individual household level (see RQs 2 to 4). Hence, the secondary data mainly served as background information. A particularly relevant data source was the census data, which we used to inform the selection of sub-locations for the case studies.

4.3 Inception and dissemination workshops with stakeholders

In order to comply with the standards of interdisciplinary research, we organised two workshops with stakeholders – one at the beginning of our stay in Nakuru and one at the end. Both workshops allowed us to gain insights from stakeholders into sanitation practices in Nakuru City, to develop a common understanding of its challenges, to disseminate results and to identify opportunities to strengthen sanitation governance.

Our first workshop (inception workshop) took place at the Ole-Ken Hotel, Nakuru, on 23 February 2023. In cooperation with NAWASSCO, we invited several actors of importance in the sanitation sector. The workshop was attended by 28 participants, ranging from government officials of Nakuru County and community representatives to our project partners from NAWASSCO and Egerton University. The workshop aimed to gain first-hand information from the stakeholders about their views on promoting inclusive sanitation, the opportunities to strengthen intersectoral coordination and ways to monitor sanitation progress. The workshop was divided into two parts: First, we presented the research design and the results from the inception report. After a subsequent discussion on this presentation, the participants worked on different questions in randomly arranged breakout groups, the results of which were presented in the plenary session using flipcharts to record the results (Annex 1). The workshop was moderated by a NAWASSCO representative and one of our team members. The breakout group work tasked the participants with sharing and discussing their personal perspectives on one of

the following topics: i) the most important developments in the sanitation sector in the city in the past five years; ii) the impacts of the sanitation situation in Nakuru on human health and the environment and how actors can address them; and, iii) the distribution of responsibilities for the most relevant policies on sanitation on the national, county and municipal levels. This offered insights into how sanitation is governed in Nakuru City (RQ 2) and allowed us to gather insights on its possible implications on health (RQ 3) and reasons for the emergence of these practices (RQ 4). The results of this workshop served as background knowledge for the construction of the survey and the design of the structured and semi-structured interviews in our research.

The second workshop (dissemination workshop) took place at the Ole-Ken Hotel, Nakuru, on 25 May 2023. In cooperation with NAWASSCO, we invited representatives of stakeholder groups to whom our recommendations are addressed. We also invited people who were directly involved in our research, such as interview partners and representatives from the three sub-locations of our case studies. In the end, 35 people participated in our workshop, ranging from government officials of Nakuru County to community representatives as well as our project partners from NAWASSCO and Egerton University. The workshop was arranged to share and validate the preliminary results of our research project and discuss opportunities to strengthen sanitation governance in Nakuru. For this purpose, our presentation of the preliminary findings during the workshop was followed by a discussion with the workshop participants (Annex 2). Like the inception workshop, the dissemination workshop was moderated by a NAWASSCO representative and one of our team members. The results of this exchange were recorded as a protocol written by the team members and allowed for the revising of results and recommendations when writing the present report.

4.4 Sub-location case studies

Addressing RQs 2, 3 and 4 requires an in-depth understanding of the sanitation governance and processes in Nakuru City. This, in turn, suggests a combination of qualitative and quantitative methods, as described at the beginning of this section. However, due to the time and resource constraints of the project, such a comprehensive scientific approach could not be applied to the entirety of the city. Instead, it was necessary to reduce the geographic scope of this element of the research. A promising approach was to select specific, exemplary administrative units within the town indicative of the different types of sewered and non-sewered sanitation solutions and, relatedly, the socio-economic conditions within the city (Saravanan, Mavalankar, Kulkarni, Nussbaum, & Weigelt, 2014; Saravanan et al., 2016). This way, a more complete and multifaceted picture of sanitation governance in Nakuru City could be created.

The team, relying on the support of research assistants, conducted case studies in three different sub-locations of Nakuru City. Although originally wards were envisaged as the administrative level for the case selection, they turned out to be too expansive in area for the survey exercise to be feasible. Instead, the team chose sub-locations, which are subunits of wards. The three sub-locations were, for one, selected based on the predominance of particular types of sanitation facilities, as described in the 2019 census (Kenya National Bureau of Statistics, 2019). The spatial mapping of sanitation facilities (see Figure 2) based on the census identified three clusters of sanitation facilities. Areas in the north-central part of the city have many households accessing sewer-based sanitation. The north-eastern part of the city shows a large proportion of the population with access to septic tanks and VIP latrines. Finally, the western part of the city shows a large number of households with access to “other” types of sanitation facilities, including covered and uncovered pit latrines, cesspools and bush toilets. These broad impressions were supplemented by anecdotal information from partners that the team met on the ground, and through site visits of the team members.

Equally decisive for successfully administrating the survey was the willingness of the local administration and community to grant permission for the research. Some information regarding

this aspect was collected during the inception workshop, and some was gathered by making enquiries to the chiefs and elders of the sub-locations in question. Administrators either actively lobbied for participation in the survey during the workshop or were very amenable to our request and supported the endeavour by offering advice and assigning village elders to those survey teams operating in insecure settings.

Based on these criteria, we selected the Baharini, Kaptembwo and London sub-locations as the locations for the survey. Baharini was chosen due to its predominantly sewered sanitation facilities and relatively good connections to public infrastructure. Kaptembwo, in contrast, represents the vast and growing settlements on the western outskirts of the city, where service provision is poor and simpler on-site facilities such as pit latrines are more prevalent. London, lastly, was chosen as a particularly heterogeneous area, where both lower- and higher-income populations reside, and where the steep gradient often renders septic tanks the best choice for sanitation facilities. Thus, the three major types of sanitation facilities were represented, alongside a wide variety of income classes and degrees of public service provision.

4.5 Georeferenced household survey

There is a substantial research gap on sanitation governance in Nakuru concerning the availability of quantitative data (Simiyu et al., 2021). The norms and everyday practices of households as end-users in the sanitation service chain are only known on an anecdotal basis. Data on sanitation infrastructure and disease prevalence are also only available at the aggregated ward level. Our project seeks to address this gap and provide household-level data from the three selected sub-locations. A georeferenced large-N survey (Annex 3) was conducted to estimate the distribution of sanitation practices and their environmental health impacts in the city. The team interviewed members of 375 households over a time span of about three weeks in March 2023. Due to the inadequacy of secondary information on the socio-economic status of the households, the team adopted random spatial grid sampling: A 250 by 250-metre grid was laid over each sub-location. Within the grid cells, randomly placed spheres with 30-metre radiuses were scattered to guide the surveyors' household choice. The interviewers randomly chose households located within the spheres. The number of spheres per cell depended on the size of the sub-location and grid cell, ranging from one to six.

This approach allowed for a random selection of households while also providing a certain degree of flexibility that was required to reach our target sample size within a limited period. We used the Kobo Toolbox interface to conduct the georeferenced survey. The questionnaire design was informed by the research questions – which were aimed at the causes and consequences of sanitation practices and their health impacts – the kick-off workshop and the personal interactions with local stakeholders, which included exchanges with NAWASSCO and County Health Department representatives. The survey was pretested for one day in the Kaptembwo sub-location and subsequently revised. To overcome the language barrier, the research assistants mainly focused on conducting the household survey. Large parts of the population felt more comfortable answering in Swahili. However, the assistants were accompanied by team members at least for one day in each sub-location, and often also by local village elders if there were security concerns.

The survey data, in turn, serve as a source to address RQs 2 to 4 after cleaning. RQ 2 seeks to reveal the current sanitation practices in Nakuru City. Although official census data provide a broad overview of the situation, they are not available at the individual or household level. Therefore, to provide a quantitative descriptive overview regarding access and practices in the three chosen sub-locations in the city, the newly collected household survey data was processed for descriptive statistics on sanitation access and practices. Comparisons with official census data will serve as a benchmark for quality control on the aggregate level. Moreover, the georeferenced data will allow a visual mapping of the incidence of specific indicators of

sanitation practices within the wards, for example on the type of sanitation facility used by the households.

RQ 3 will allow for statistical modelling of the effect of sanitation practices on the environment and human health and well-being. Multivariate regression will be a starting point (Wooldridge, 2015) to trace environmental and health outcomes back to sanitation governance while controlling for other relevant covariates such as household wealth and access to health care. Moreover, the georeferenced survey will make it possible to illustrate the spatial co-occurrence of specific features of sanitation governance and disease prevalence in maps and models (Darmofal, 2015). Similarly – and in conjunction with evidence from the qualitative elements of the case study – analyses of the survey data will help identify specific behaviours' determinants and, thus, answer RQ 4.

4.6 Semi-structured interviews with relevant actors

To complement the findings of the sub-location case studies, we conducted semi-structured interviews with relevant actors to gather expert knowledge of practices, implications on health and power relations within the sanitation sector. Conducting expert interviews was, therefore, crucial to get an overview of local sanitation norms and practices, as well as subjective perceptions of developments and challenges. This first-hand knowledge provided vantage points for answering RQs 2 to 4. We further aimed to juxtapose the everyday work of public and private-sector representatives against the legal framework analysed with the (desk) review of official documents. It is important to gain this information as practices may diverge from official documents. Semi-structured interviews were useful in this context due to their versatility and flexibility (Kallio, Pietila, Johnson, & Kangasniemi, 2016).

To conduct the interviews, several steps were taken. First, a preliminary interview guide was created and subjected to pilot tests as a second step. On this basis, the semi-structured interview guide was finalised (Annex 4) so that the interviews could be conducted. Based on the main interview guide, which can be found in Annex 4, the sub-questions were partly adapted to the respective interviewees, and thus the interview guides varied from interview to interview. In preparation for the interviews, we sent the participants an information sheet, the project flyer and a consent form that needed to be signed before the interview could start (Annex 5). Participation in the interviews were voluntary for all interviewees. The face-to-face interviews were conducted depending on the preference of the interviewees and always with two team members, with one being the main interviewer. The interviews were recorded with a voice recorder and afterwards transcribed with the transcription software f4x, in line with content-semantic rules (Dresing & Pehl, 2018) (see Annex 6). The interview transcripts were then anonymised, that is, the personal data of the interviewee was replaced with placeholders so that it is no longer possible to draw inferences about the interviewee.

The resulting transcriptions were analysed using qualitative content analysis with the software Atlas.ti. As put forward by (Mayring, 2022), qualitative content analysis is well-established in the literature and allowed for a systematic analysis of the interviews. Before starting with the analysis, we also needed to define coding and context units, which are the minimal and maximal sections to be attributed to a category, for example a sentence and a complete response to a question (Mayring, 2022, pp. 64-65). The first part of the analysis comprised inductively developing a coding scheme. Going through the first third of our material, we continuously developed new categories and assigned units to them. Assigning the units, we built on manifest and latent meanings; sometimes a category was not explicitly mentioned but derived out of context. Categories were continuously refined. Systematically, they were defined, explained with "anchor examples" and complemented with coding rules. The second major part of the analysis comprised the evaluation and (re)structuring of the coding frame. In the third part of the analysis,

the coding frame was deductively applied to the rest of the material (Mayring, 2022, pp. 81-92). The coding guidelines are illustrated in Section 6.2.

5 Findings

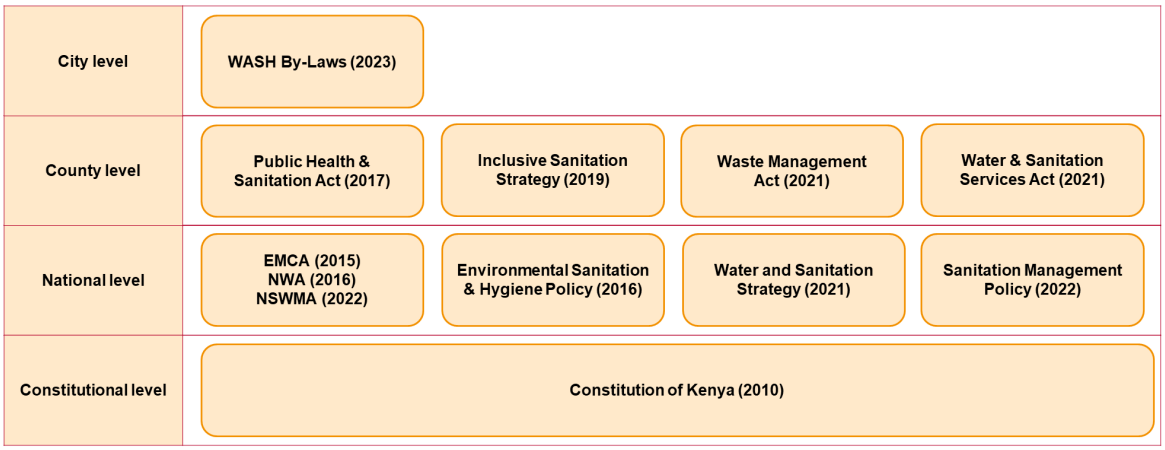
5.1 Policy and legal documents

Our analysis of policy and legal documents revealed considerable differences in the extent to which they address sanitation for all and its positive implications for society, human health and the environment, as demanded in the Constitution of Kenya (Government of Kenya, 2010, Art. 43, I (b)). The national government's Vision 2030 reaffirms its commitment under its social pillar, particularly in the context of infrastructure development and environmental protection (Government of Kenya, 2007). The responsible line ministries also explicitly acknowledge that marginalised groups are particularly affected (Ministry of Health [MoH], 2016a; MoH, 2019; Ministry of Water, Sanitation and Irrigation [MoWSI], 2022) as well as the interconnectedness between sanitation, human health and the environment (MoH, 2016a).[2] A major political objective has been to eliminate open defecation nationwide (MoH, 2016b). Following some ambiguity regarding the responsibility for urban on-site sanitation, all sanitation-related matters are now clearly allocated to the Ministry of Water, Sanitation and Irrigation (2018).

Favourable conditions can also be found on the county level, to which sanitation was devolved under the new constitution. In Nakuru County, both the parliament and the county government's responsible departments of health and water (County Assembly of Nakuru, 2017; DoHS & DoWEENR, 2019) recognise the sanitation–health–environment nexus. The county assembly has adopted extensive regulations governing sanitation services, public health and waste management, including the required sanitation standards for buildings and methods for disposing of solid and liquid waste (County Assembly of Nakuru, 2017, 2021a, 2021b). It has also established a multi-sectoral Nakuru County Water Sector Forum and a Nakuru Countywide Sanitation Technical Steering Committee (NACOSTEC) – chaired by the directors of water and sanitation from the two departments – to facilitate institutional coordination (County Assembly of Nakuru, 2021b). Furthermore, the county assembly has adopted regulations on public involvement and reporting, and it has bookmarked sewer levies to be used exclusively under expenses related to sanitation (County Assembly of Nakuru, 2021b). The county government has reaffirmed its commitment to inclusive sanitation in both its integrated development plan and subsequent policies (County Government of Nakuru, 2018; DoHS & DoWEENR, 2019). Finally, the newly established city board is poised to enact its own water, sanitation and hygiene bylaws (Nakuru City, 2023). An overview of key policies and legislation is given in Figure 7.

2 See also the "One Health Strategic Plan for the Prevention and Control of Zoonotic Diseases" (Ministry of Agriculture, Livestock and Fisheries & Ministry of Health, 2021), which, however, barely addresses sanitation.

Figure 7: Sanitation policies and legislation



Source: Authors

However, challenges persist on all policy levels. One cross-cutting issue is the uneasy coexistence of rights-based approaches to sanitation together with market-based approaches. Several official documents primarily focus on market-based solutions and public–private partnerships to improve sanitation, overlooking marginalised populations that cannot afford these services. This is exemplified by the frequent reference to servicing consumers rather than endowing citizens with rights (MoWSI, 2021; Nakuru City, 2023). In policy and legal documents, declarations of inclusiveness co-exist alongside the common omission of manual pit emptiers and truck exhausters. Additionally, sanitation receives less attention from ministries and is inadequately addressed in legislations. For instance, the Environmental Management and Co-ordination Act touches upon sanitation only briefly in its regulation for sewer effluents (National Assembly of Kenya, 2015), the National Water Act barely discusses on-site sanitation (National Assembly of Kenya, 2016) and the recent National Sustainable Waste Management Act (Government of Kenya, 2021) does not regulate liquid household waste or even mention sanitation (National Assembly of Kenya, 2022). Moreover, the responsible ministries have been raising the issue of legal and institutional fragmentation at least since 2016; they have been suggesting the establishment of a national sanitation regulatory body, so far without success (MoH, 2016a; MoWSI, 2022).

At the county level, the responsibility for on-site sanitation between the Department of Health Services (DoHS) and the Department of Water, Energy, Environment, Natural Resources, and Climate Change (DoWEENR) remains unclear (County Assembly of Nakuru, 2017, 2021b). There is a general interest in sanitation governance, and national funding remains crucial for its implementation at the county and city levels (County Government of Nakuru, 2022). After some time, the city board's context-specific expertise was finally included, but the board is mostly limited to planning, must conform to regulations at the county level and has little independent influence (National Assembly of Kenya, 2011).

5.2 Sanitation governance in practice

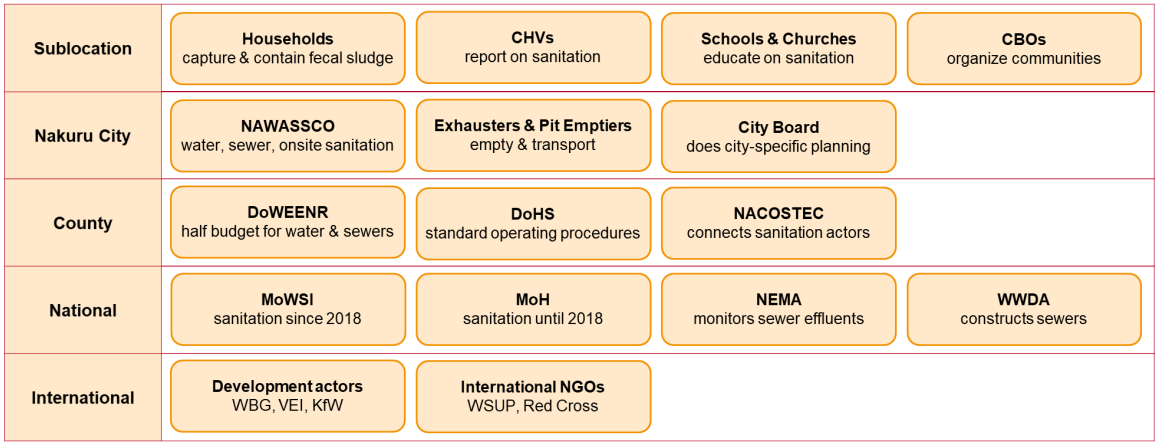
Kenya has made significant progress in strengthening its legislative, policy and institutional frameworks to address sanitation challenges, supported by administrative devolution and close collaboration with international partners. Over the past two decades, the country has introduced key reforms through the Water Act of 2002 (revised in 2016), the Constitution of Kenya (Government of Kenya, 2010), and subsequent policies that have decentralised responsibilities for water and sanitation services to county governments. This devolution has enabled local

authorities to design and implement sanitation strategies that reflect local realities while aligning with national goals and global commitments such as SDG 6.

Building on this national momentum, Nakuru County has taken proactive steps to prioritise sanitation, both at the county and city levels. The county has integrated sanitation into its development agenda through initiatives such as the Nakuru County Sanitation Strategy and partnerships with NAWASSCO and other stakeholders. In Nakuru City, these efforts have translated into practical interventions – ranging from expanding sewer networks and improving faecal sludge management to promoting inclusive access to sanitation in informal settlements.

A diverse array of actors operates across different levels of the sanitation system, forming a complex but coordinated governance network (see Figure 8). At the national level, ministries and regulatory bodies provide oversight and policy direction. At the county level, departments and utilities such as NAWASSCO handle service provision and infrastructure development. Meanwhile, NGOs, community-based groups and international development partners contribute through technical support, advocacy and capacity-building. Together, these actors form a multi-tiered governance structure that underpins sanitation planning and implementation in Nakuru.

Figure 8: Key sanitation actors in Nakuru City



Source: Authors; see also DoHS and DoWEENR (2019)

At the sub-location level, households construct (off-site) toilets within or outside their house and direct the domestic wastewater to sewer networks. Community health volunteers (CHVs) under the DoHS as well as schools, churches and community-based organisations advise them regarding hygiene and its usage. At the city level, NAWASSCO is a county-owned enterprise that provides water, sewer and on-site sanitation services, reporting to the County Executive.[3] For on-site sanitation, it is households that construct toilets and dispose of the domestic waste through truck operators and manual pit emptiers. The newly established city board does city-specific planning, which includes sanitation. At the county level, the DoWEENR allocates half of its budget for water and sewer services, with on-site sanitation managed mainly by the DoHS, which has issued standard operating procedures for NAWASSCO in this regard. Furthermore, the Department of Lands, Physical Planning, Housing and Urban Development also plays a crucial role in planning sanitation infrastructure in tenured land. In most cases, these are off-site sanitation facilities connected with sewer networks that have limited coverage concerning septic tanks. NACOSTEC is then tasked with bringing together sanitation actors from different sectors. National actors such as the Ministry of Water, Sanitation and Irrigation, which took over responsibility from the Ministry of Health in 2018, the National Environment Management

3 It also has a subsidiary under the name NAWASSCOAL, which processes human waste into briquettes.

Authority (NEMA) and the Central Rift Valley Water Works Development Agency (2022), are active in the funding, construction and monitoring of sanitation infrastructure in Nakuru City as well.[4] International actors also play a significant role: Governmental development agencies such as the World Bank Group, the Dutch water operators' initiative VEI and the German KfW development bank are important actors for financing and consultation. Non-governmental organisation such as Water and Sanitation for the Urban Poor (WSUP) and the International Red Cross and Red Crescent Movement also contribute funds and technical expertise.

This diverse landscape of actors gives rise to complex interactions. In the following sections, we analyse these interactions – situated against the backdrop of official documents – and as operational practices along the on-site sanitation service chain.

5.3 Administrative practices

The varying levels of political interest shown in official documents are also reflected in how sanitation policies are carried out. Although some policies and regulations are quite ambitious, they are only partly implemented in practice.

Our interviews revealed a mixed picture. On one hand, many respondents felt that official sanitation measures were being implemented effectively. The DoHS was often mentioned for its active role in monitoring disease outbreaks linked to poor sanitation and for raising public awareness (CPH2 2023; CHV1 2023; PWP1 2023; PPE3 2023). NAWASSCO was said to regularly follow the standard operating procedures for on-site sanitation set by the DoHS (PWP1 2023; WSP3 2023) and to have improved its communication in recent years (CHV1 2023). Community health volunteers explained that they report to and sometimes inspect sanitation facilities together with public health officers. Respondents across all levels reported improved coordination among sanitation actors (PWP1 2023; NEN1 2023; CPH2 2023; WSP3 2023; CHV1 2023).

On the other hand, the same respondents also described ongoing challenges. Many questioned the depth of the County Government of Nakuru's commitment and its capacity to provide adequate sanitation for all residents (PWP1 2023; CHV1 2023). A lack of funding was seen as a major obstacle (WSP1 2023), with the national government still providing most of the financial support for sanitation (NEN1 2023) (County Government of Nakuru, 2022). Unclear responsibilities between the DoHS and the Department of Water, Environment, Energy and Natural Resources (DoWEENR) also make implementation difficult, since funds are only given to offices with clearly defined roles (WSP2 2023). Certain regulations have also had unintended consequences. For instance, high garbage disposal fees have led some residents to illegally dump solid waste into toilets instead (FGD1 2023) (County Assembly of Nakuru, 2021a). These issues highlight poor coordination between sectors (NEN2 2023; WSP3 2023).

Finally, cooperation with private actors and communities remains weak. NAWASSCO is seen by many pit emptiers as an unattractive and sometimes inaccessible partner (WSP3 2023; PPE4 2023; CHV1 2023). Public authorities are also described as reluctant to work with civil society groups (NEN2 2023; WSP3 2023). Overall, the differences reflected in official documents regarding political priorities continue to shape how sanitation policies are put into practice.

NACOSTEC, which is supposed to coordinate sanitation efforts, has not met since the last county election because its members have not yet been appointed by the County Executive Committee Member for Water, Environment, Energy and Natural Resources. This raises doubts about whether there is a shared long-term sanitation strategy at the county level.

4 Furthermore, the Water Services Regulatory Board plays an important role in the regulation of water and sanitation tariffs and the Water Sector Trust Fund is an important body for funding sanitation R&D.

5.4 Sanitation service chain

Nakuru City has seen different elements of the sanitation service chain change substantially over the last years, beginning with the containment facilities. As the majority of households continue to rely upon on-site sanitation solutions, the expansion of sewer infrastructure is at the centre of attention for many stakeholders. However, as our analyses show, the widespread practice of sharing toilet facilities among multiple households has many more important implications for the users than whether the facility is connected to sewers or not, leading to dirtier, less safe and less satisfactory toilets. Meanwhile, an infrequent and unreliable water supply continues to be a challenge for many households, which also affects the safe management of their sanitation.

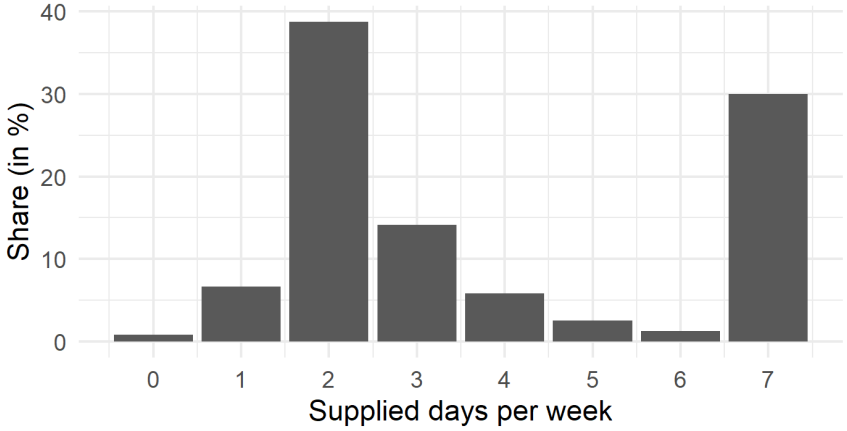
Pit emptiers and truck operators are responsible for emptying and transporting waste from on-site facilities. In recent years, NAWASSCO has attempted to better integrate both of these parties into its work, with varying degrees of success. Although cooperation and communication with truck operators have significantly improved, pit emptiers are still mostly working unofficially, which jeopardises the safety of the service chain. While strict monitoring and the imposition of fines by the county government – as well as paid access to the WWTP – encourage truck operators to transport the collected human faeces there, most pit emptiers lack the necessary incentives and means to do so, often discharging the collected sewage into the environment. Additionally, the existing sewer infrastructure is not without flaws; blockages and leakages in sewer lines are highlighted as another challenge. Incomplete treatment processes at the Old Town WWTP result in highly loaded effluents being released into Lake Nakuru, where nutrient levels exceed the permitted limits. This potentially harms the unique ecosystem and destroys biodiversity. Portions of the transported faecal sludge are reused for charcoal production, which is used for households' cooking and heating at NAWASSCOAL, the offshoot company of NAWASSCO.

5.4.1 Water access

Before examining the sanitation service chain in detail, it is essential to first consider water access in the city, since water and sanitation are closely linked. Waterborne diseases from unsafe sanitation often spread through the contamination of drinking water. In addition, many sanitation systems – such as flush toilets – depend on a steady water supply to function effectively.

In Nakuru, water access remains complex and challenging. According to our survey, 64 per cent of respondents rely on tap water provided by NAWASSCO for drinking. Among them, 27 per cent have water piped directly into their homes, while 36 per cent access it from shared taps located in communal yards (Figure 9). However, the tap water supply faces major difficulties, particularly due to water rationing, which makes the supply unreliable and irregular.

Figure 9: Tap water supply frequency per week



Source: Authors' findings from household survey

As shown in Figure 9, most households that depend on tap water for drinking receive it only a few days each week. Nearly 60 per cent reported getting water on fewer than four days per week, posing a serious challenge for daily life. Residents often have to store water in containers for the remaining days or rely on alternative sources, posing a significant health threat due to unhygienic storage methods. For those using shared taps, water collection can be time-consuming, as long queues form and low water pressure slows the process. This unreliable supply also makes flush or pour-flush toilets difficult to use in many areas of the city.

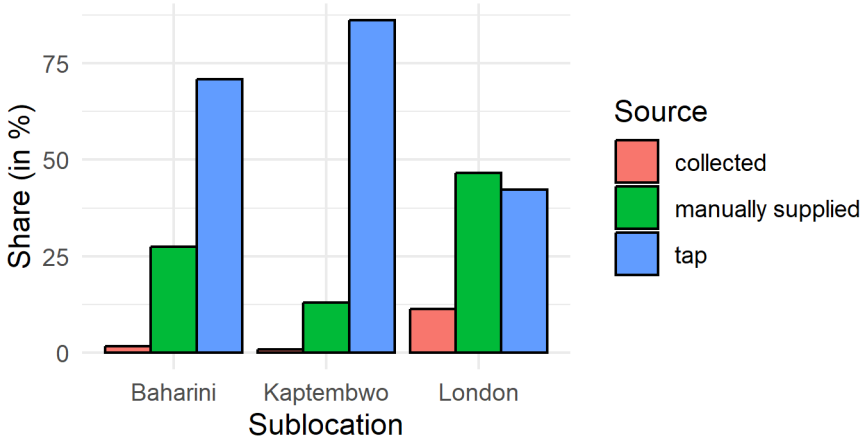
The figure also highlights significant levels of inequality in tap water access. While more than half of the surveyed households experience irregular supply, only about 30 per cent receive water daily. This difference may partly be explained by the fact that some households use both piped and manually supplied water (Figure 10). In such cases, stored water – often delivered by truck and pumped into rooftop tanks – serves as a backup when tap water is unavailable. Some respondents may not have clearly distinguished between these sources when answering the survey.

However, our qualitative interviews indicate that the water service provider tends to prioritise higher-income clients:

> You'll find [NAWASSCO] provides water more in the high-end or middle-income [areas] because these people will be able to pay instantly for sustainability of the utility as compared to low-income or informal settlements. (WSP3 2023)

These findings point to a highly unequal distribution of tap water supply in Nakuru City, reflecting broader socio-economic disparities in access to essential services.

Figure 10: Main drinking water sources by sub-location



Source: Authors' findings from household survey

Topography also plays a major role in Nakuru's water access challenges. For example, large parts of the London sub-location have little or no access to tap water, and therefore rely on alternative sources such as bottled water or collected rainwater. This is largely due to the area's steep elevation gradient, which rises from south to north. The higher-elevation areas, where water pressure problems are most severe, are also home to many lower-income households. In contrast, the flatter areas of Baharini and Kaptembwo are better connected to the water network.

Unreliable supply is not the only issue affecting drinking water. Regardless of the source, respondents also reported problems such as salty taste (26 per cent), contamination with dust or sand (17 per cent), and excessive chlorination (16 per cent). However, these household reports overlook other, less visible issues such as high fluoride levels in Nakuru's water and the continued use of asbestos pipes in NAWASSCO's infrastructure. Additionally, 39 per cent of tap water users noticed pollution in their water after heavy rainfall, suggesting that, under certain conditions, unsafe water may enter the pipeline system and increase the risk of sanitation-related contamination. Despite these challenges, 75 per cent of all respondents (and 70 per cent of tap water users) consider their drinking water safe to consume without treatment. About 30 per cent treat their water in some way before drinking it. Overall, the issues described above led 28 per cent of respondents to report being somewhat or very dissatisfied with their access to drinking water.

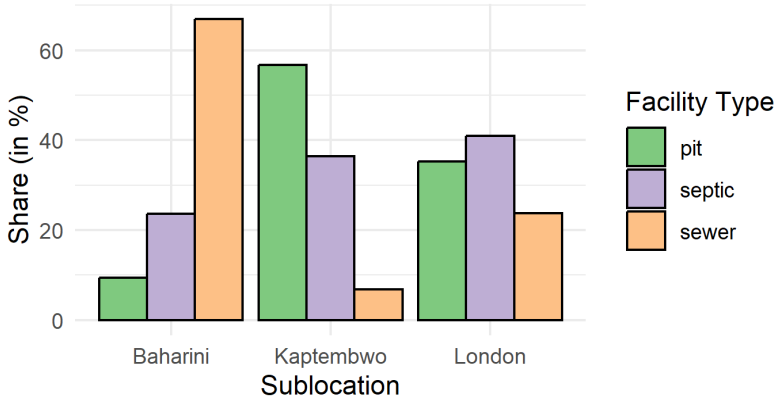
The following section presents an analysis of the five components of the sanitation service chain in Nakuru City, based on both quantitative and qualitative data.

5.4.2 Phase 1: sanitation containment and facility use in the city

Containment represents the first stage of the sanitation service chain, where different types of toilets are used to collect and contain human waste. For this stage to function safely, both the physical infrastructure and the related social practices are crucial.

For simplicity, sanitation facilities in Nakuru can be grouped into three main categories: those connected to pit latrines and septic tanks – the two dominant forms of on-site sanitation – and those linked to the sewer system. This classification provides a quick overview of the main containment approaches used in the city. It should be noted, however, that this typology does not capture other important aspects such as the convenience or usability of facilities for households.

Figure 11: Sanitation facility types by sub-location



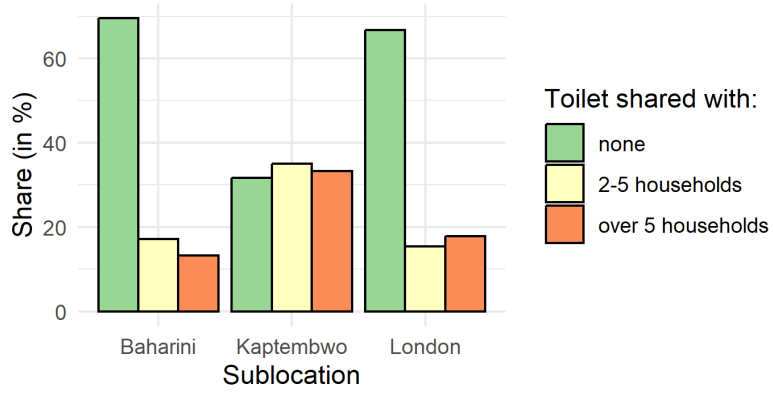
Source: Authors' findings from household survey

Overall, 66 per cent of survey respondents rely upon on-site sanitation facilities, with roughly half using pit latrines and the other half septic tanks. About 33 per cent of facilities are connected to the sewer network, and thus qualify as off-site systems. However, these aggregate figures mask substantial variations between different sub-locations in Nakuru City. Figure 11 illustrates these differences at the sub-location level, revealing distinct patterns across areas.

In Baharini, sewer-connected toilets are by far the most common (more than 60 per cent), followed by septic tanks, with pit latrines being relatively rare. Kaptembwo presents almost the opposite pattern: Pit latrines dominate, followed by septic tanks, while only a small minority of households are connected to the sewer system. London, in contrast, shows a more diverse mix, with all facility types present but septic tanks being the most widespread (used by just over 40 per cent of households). This overview highlights that sanitation infrastructure varies widely within the city, creating very different challenges for maintenance, waste transport and safety across sub-locations.

The number of available toilets per household – reflecting whether facilities are shared or private – also differs significantly between areas (see Figure 12). In Baharini and London, more than 60 per cent of households have private toilets for their exclusive use, whereas in Kaptembwo, shared toilets are the norm, often used by five or more households. Even in the better-served areas, a notable minority of respondents report sharing facilities. The practice of sharing has important consequences for hygiene, privacy and overall sanitation quality.

Figure 12: Sharing of toilets by sub-location



Source: Authors' findings from the household survey

According to the World Health Organization (WHO) classification, a facility is considered *improved* if it safely separates human waste from contact and is not shared between multiple households. Based on this definition, only 54 per cent of surveyed households in Nakuru have access to improved sanitation, meaning nearly half do not. The main reason for unimproved classification is not poor construction – since only 2.4 per cent of respondents use open pit latrines and only one reported open defecation – but the widespread practice of sharing. This is especially evident in Kaptembwo, where 69 per cent of facilities are considered unimproved, compared to 32 per cent in Baharini and 37 per cent in London. As the following sections show, sharing practices also have broader implications beyond this formal classification.

When asked about challenges with their toilet facilities, respondents most frequently mentioned a lack of cleanliness (20 per cent), inconvenience of use or maintenance (16 per cent) and insecurity or risk of harassment (10 per cent). Privacy concerns (7 per cent) were often linked to this sense of insecurity, while technical issues (5 per cent) and costs (4 per cent) were reported less frequently.

Statistical analysis (see Table 1) sheds light on the factors associated with these issues. Model 1 shows that the likelihood of reporting dirty toilets increases significantly with the number of households sharing the same facility. Households with private toilets are the least likely to face this issue, while those sharing with more households report much higher levels of dirtiness. Holding the facility type constant at “pit latrine”, the predicted probability of dirtiness being reported rises from about 2 per cent for private toilets to 35 per cent for those shared by two to five households, and up to 65 per cent for facilities shared by more than five. This pattern suggests that cleaning becomes increasingly difficult to organise as more households share a toilet, creating a collective action problem. Dirtiness is also less common in septic tanks than in pit latrines, though there is no significant difference between pit latrines and sewer-connected toilets.

Model 2 examines the second-most common issue – *inconvenience* – and finds it to be significantly influenced by both the type of facility and sharing practices. Households with septic tanks or sewer connections are less likely to report inconvenience. Interestingly, the effect is stronger for septic tanks than for sewered toilets, which runs counter to the traditional assumption that sewer connections are inherently superior. Although the survey data do not explain this result, technical issues such as clogging in the sewer system may play a role. As with cleanliness, the likelihood of reporting inconvenience increases with the number of households sharing a toilet.

Table 1: Logistic regressions of challenges with toilet facilities on facility features

	Dependent variable			
	Lacking cleanliness	Lacking convenience	Lacking security	Satisfaction with toilet
	(1)	(2)	(3)	(4)
Facility type: septic	-0.829**	-1.589***	-1.086*	0.836
	(0.409)	(0.469)	(0.589)	(0.537)
Facility type: sewer	-0.401	-0.855**	0.153	0.355
	(0.398)	(0.403)	(0.443)	(0.502)
Toilet shared with: none	-3.171***	-1.898***	-2.390***	2.607**
	(0.640)	(0.509)	(0.678)	(1.099)
Toilet shared with: over 5 households	1.240***	1.023***	0.588	-1.948***
	(0.342)	(0.370)	(0.418)	(0.492)
Constant	-0.601**	-0.798***	-1.605***	2.292***
	(0.280)	(0.294)	(0.354)	(0.450)
Observations	366	366	366	366
Log likelihood	-115.855	-115.577	-89.186	-76.710
Akaike Inf. Crit.	241.710	241.155	188.372	163.419

Note: *p<0.1; **p<0.05; ***p<0.01
Standard errors in parentheses. The baseline category for the facility type variable is pit latrine, for the toilet-sharing variable it is “shared with 2-5 households”.

Source: Authors

Model 3, which examines perceptions of insecurity, presents a pattern similar to that observed in Model 1. Once again, not sharing a toilet significantly reduces the likelihood of experiencing insecurity. However, unlike with cleanliness, the risk does not increase markedly with the number of households sharing the facility. Still, the differences in predicted probabilities remain considerable. Assuming the facility type is a pit latrine, households with private toilets face a probability of insecurity of less than 2 per cent, which rises to 17 per cent when the facility is shared by two to five households.

Importantly, more than 80 per cent of respondents who reported insecurity as a major challenge were women. Our interviews confirm that toilet-sharing particularly undermines women’s privacy and dignity (CSO1 2023). The absence of individual or gender-segregated facilities often leaves women feeling uncomfortable and exposed when using the toilet. In many cases, poorly maintained doors, weak locks or missing partitions further compromise their sense of safety. Inadequate lighting and unsafe surroundings around shared toilets also heighten risks, especially at night. The lack of separate facilities can increase women’s vulnerability to harassment, assault and other forms of gender-based violence.

Furthermore, shared toilets often fail to meet women’s menstrual hygiene needs. The absence of clean, private spaces for changing, washing or disposing of sanitary products creates serious barriers to maintaining proper hygiene, leading to discomfort, embarrassment and potential health issues. The problem of insecurity – manifested as fear, lack of privacy and indignity when using shared toilets – is clearly a gendered one, in Nakuru as in many other contexts (Caruso et al., 2017). Unsurprisingly, the technical type of facility does not have a strong effect here; the minor negative association with septic tanks is statistically weak and likely coincidental.

Model 4 explores how these various factors affect respondents' overall satisfaction with their toilet facilities. Although households with septic tanks or sewer connections report slightly higher satisfaction than those using pit latrines, the difference is not statistically significant. In contrast, the effects of sharing are both significant and substantial. The issues associated with shared toilets – dirtiness, inconvenience and insecurity – clearly contribute to less overall satisfaction, and dissatisfaction increases the more households share a single facility.

This finding underscores a consistent pattern across the analysis: For households at the containment stage, the type of toilet facility – often the focus of public debate – is rarely the main source of dissatisfaction. Instead, the more pressing challenges are those linked to sharing, particularly cleanliness and security, which disproportionately affect women. In Nakuru City, shared toilet use stands out as the most critical sanitation concern for households.

However, one important limitation should be noted. This analysis focuses on users' perceptions of their facilities and therefore does not capture the technical risks that households may overlook. For instance, poorly constructed pit latrines may fail to safely contain human waste, contaminating soil and groundwater without residents' awareness. Likewise, the analysis does not consider what happens after containment – such as leaking sewer pipes, unsafe sludge management or inadequate treatment – which may threaten public and environmental health at later stages of the sanitation chain. These aspects are addressed in the following section.

5.4.3 Phases 2 and 3: emptying and transport

The second and third phases of the sanitation service chain – emptying and transport – are particularly relevant for on-site sanitation systems. Once these facilities are full, they must be emptied. In Nakuru City, most households across the three sub-locations rely on truck operators or manual pit emptiers to remove excreta from their sanitation facilities. The frequency of emptying varies according to usage and capacity, ranging from a few months to several years (WSP3 2023). As these activities present viable business opportunities, the segment is largely operated by private actors (PPE4 2023) (Simiyu et al., 2021). The following sections describe the practices, organisation and challenges faced by both truck operators and pit emptiers.

Truck operators

In 2015, only five truck operators were licensed in Nakuru City (Furlong, 2015). Today, between 12 and 15 registered trucks operate (WSP1 2023; WSP3 2023). However, registration is not always regular, as licences must be renewed monthly (WSP2 2023; WSP3 2023). Truck operators, typically organised as private companies, empty both septic tanks and pit latrines (PEX1O 2023). Emptying is only feasible for lined and structurally stable pits, as unlined pits risk collapse – especially given Nakuru's loose soil conditions (WSP3 2023). Accessibility also determines feasibility: Suction hoses can reach facilities only within 20 metres of a road (PEX1O 2023). Consequently, in densely built-up or informal settlements, truck access is often impossible, forcing households to abandon full pits or rely on manual pit emptiers. A preliminary site inspection, usually by a co-driver, determines whether a truck can empty the facility (PEX1O 2023). The actual emptying process is typically carried out by two workers, though some companies employ a third (PEX1O 2023).

Truck operators usually gather daily at Area 58, one of Nakuru's main commercial zones, to receive orders. In addition to telephone bookings, customers often negotiate in person for better rates (PEX1O 2023). Clients with larger facilities prefer 20,000-litre trucks, which offer faster and cheaper emptying per volume, though most trucks in operation have a 10,000-litre capacity. High competition among operators keeps prices low, with emptying costs between 5,000 and 6,000 Kenyan shillings (Ksh) for a 10,000-litre truck, and between 7,000 and 8,000 Ksh for a 20,000-litre truck (PEX1O 2023; PWP1 2023). During the rainy season, operators complete up

to 30 jobs per week, while demand drops during drier months when facilities fill more slowly (PEX1O 2023).

Emptying typically takes 10 to 20 minutes, depending on facility size and hose length (PEX1O 2023). Solid waste that is disposed of in toilets frequently clogs hoses, requiring manual removal while exposing workers to excreta. Although operators acknowledge the importance of protective gear (PEX1O 2023), safety practices are inconsistently followed. Observations and informal interviews revealed that protective gear is often unavailable, expensive or stolen, and that awareness of occupational health risks remains limited.

Encouragingly, the number of licensed operators and cooperation with public authorities have increased significantly. In the past, illegal dumping of waste – on land, in water bodies or on customer premises – was common, but today strict monitoring by NEMA and the county government has largely eliminated such practices (WSP3 2023; PEX1O 2023; NEN1 2023). Operators now require five licences to operate legally:

1. a business registration licence;
2. a truck inspection licence from the National Transport and Safety Authority;
3. a branding licence ensuring trucks are visibly marked as exhausters;
4. a transport licence from NEMA; and
5. a monthly disposal licence from NAWASSCO (WSP2 2023).

The NAWASSCO licence grants access to the wastewater treatment plant and is essential for operations. Most domestic waste is discharged at the Old Town WWTP, while the Njoro WWTP handles industrial waste. A flat fee of 15,000 Ksh per truck per month provides unlimited access from Monday to Saturday, 8 a.m. to 5 p.m. (PEX1O 2023). However, operators have requested a differentiated fee structure reflecting truck capacity, as smaller 10,000-litre trucks face a competitive disadvantage (PEX1O 2023). They also noted insufficient communication between relevant agencies and the need for improved coordination on licence procedures and policy updates.

Pit emptiers

Manual pit emptiers, alongside truck operators, form the second major group responsible for emptying and transporting human excreta. Unlike truck operators, they traditionally rely on manual methods to empty toilets. They service septic tanks and all types of pit latrines, including those in densely populated areas inaccessible to vacuum trucks. After prior inspection, even unlined pit latrines at risk of collapse may be emptied. Pit emptiers also remove solid waste that often accumulates in pits and must be cleared before sludge extraction. In addition, some are involved in servicing blocked sewer pipes (NEN2 2023; PPE3 2023).

In 2015, an estimated 37 pit emptiers operated in Nakuru City (Furlong, 2015). The current number, however, remains unclear to city officials (WSP2 2023; WSP3 2023), largely because the work has not been formally recognised and manual emptying is technically illegal. Over recent years, several groups of pit emptiers have formed to pool their human and financial resources. Despite fluid group structures, at least three active groups of between three and fifteen members were identified in our research (PPE3 2023; PPE4 2023).

To improve working conditions and practices, NAWASSCO, in collaboration with international development partners, has conducted training sessions for pit emptier groups. These sessions emphasise occupational safety measures such as wearing protective gear (masks, gloves, boots), cleaning the workplace after emptying and using mechanised equipment alongside

traditional manual methods such as buckets – still the most common tool (PWP1 2023) (Furlong, 2015; Simiyu et al., 2021). The trainings aimed to pave the way for long-term cooperation through formal affiliation with NAWASSCO. However, due to limited compliance with NAWASSCO's regulations, this goal has only been partially achieved. Currently, only one group operates under NAWASSCO's auspices (WSP3 2023).

Since there is no official licensing system for pit emptiers, affiliation with NAWASSCO represents the only path to formalisation in Nakuru City. Under this arrangement, groups receive mechanised emptying equipment, protective gear, vaccinations, transport trucks and access to the WWTP. The provided equipment includes a mechanical desludging unit and a PuPu pump – lightweight machines that use suction pipes for sludge extraction, similar to vacuum trucks but suitable for narrow or densely populated areas (Practica, 2023). Mechanised emptying improves both efficiency and safety.

Nevertheless, the cooperation model poses financial and operational challenges. NAWASSCO retains 60 per cent of the revenue, while 40 per cent goes to the group, arguing that this split is necessary for cost recovery (WSP2 2023; WSP3 2023). Additionally, affiliated pit emptiers receive payment only at the end of the month, unlike independent operators, who are paid immediately after each job. Consequently, most groups find the financial terms unattractive and prefer to continue working independently, prioritising immediate earnings over formalised, safer conditions – "it's day earn income" (PPE4 2023). Negotiations between NAWASSCO and pit emptier groups are ongoing.

A major challenge remains identifying and incorporating all informal pit emptiers into a safe faecal sludge management framework (PWP1 2023; WSP3 2023). Interviewees suggest that, beyond the three identified groups, many individuals continue working unregistered and under unhygienic conditions, though their exact number is unknown (WSP3 2023; PWP1 2023; PPE3 2023; WSP2 2023).

Because their work is considered illegal and subject to fines by the county government, informal pit emptiers typically operate covertly at night:

> Usually for those ones who are doing privately, they do it, say, at night […] even the Department of Health knows these jobs are supposed to be done under NAWASSCO's umbrella and not with private persons. (WSP3 2023)

They use basic manual tools such as buckets or rudimentary pumps, often prone to leakage (WSP3 2023; PPE3 2023). Although many strive to maintain basic safety standards, they face significant limitations regarding tools and protective equipment (PPE4 2023). Their work has become increasingly difficult as NAWASSCO-affiliated groups gain organisational and technological advantages – "they're challenging us, they have the machinery, they have the strength, they have the power" (PPE4 2023).

Since only pit emptier groups affiliated with NAWASSCO are granted access to Nakuru's WWTPs, informal pit emptiers are usually denied entry. With no alternative safe disposal options, most of these workers are assumed to discharge sewage into manholes or directly into the environment (PPE3 2023; PPE4 2023):

> Most of them, when they do it on their own, they dispose in the open drains or sometimes like, no one cares. Even the landlords themselves, they don't really care as much as their toilet is serviced. (WSP3 2023)

This challenge was already noted several years ago (Furlong, 2015). While one group reported delivering sewage to the WWTP without formal affiliation, a common practice among unofficial pit emptiers is "dig and bury", when faeces are buried on the same plot where the sanitation facility is emptied (PPE3 2023; PPE4 2023). Such practices pose significant health risks to both

the workers and the wider community, highlighting a critical safety gap in Nakuru's sanitation service chain.

Proposed interventions for citywide, safely managed sanitation include establishing multiple designated deposit points for collected faeces, providing regular training for all pit emptiers and supplying protective gear (Simiyu et al., 2021). However, these measures remain largely unimplemented. Unaffiliated pit emptiers are often unknown even to NAWASSCO's pro-poor unit, making them difficult to engage, and the terms of cooperation with NAWASSCO are generally considered unattractive. A flexible cooperation model – such as offering centralised disposal services at treatment plants for a fixed fee, alongside full affiliation – has yet to be established, which limits safer sanitation practices.

Unlike truck operators, pit emptiers have no central location for client contact, relying primarily on self-marketing and word-of-mouth. For groups affiliated with NAWASSCO, the company facilitates customer access. Emptying services typically cost between 5,000 and 15,000 Ksh, depending on facility depth and the need to remove solid waste, but prices are negotiable. In contrast to truck operators, pit emptiers require several hours to complete a job, even when working in teams (PPE3 2023).

Collaboration between truck operators and pit emptiers also occurs: A pit emptier may first remove solid waste before a truck vacuums remaining sludge, or a truck may extract residual liquid from a facility previously emptied manually. Jobs are often divided according to the skills of each worker (PPE4 2023; PEX1O 2023).

5.4.4 Phase 4: treatment

Old Town WWTP receives faecal sludge and household wastewater from the entire town, while Njoro WWTP primarily handles industrial waste. Our study focused mainly on Old Town WWTP (see Figure 3), as it is currently the main site for human wastewater. Old Town WWTP was constructed in the 1950s and upgraded in the 1970s in cooperation with the Japan International Cooperation Agency.

The plant faces several challenges. Due to low sewer coverage, it is underutilised and does not operate at full capacity. Leakages in the sewer lines further reduce the volume of wastewater reaching the facility. Additionally, the treatment process is incomplete. Rising water levels in Lake Nakuru have submerged the grass plots, which serve as the final treatment step to reduce nutrients in the wastewater. As a result, the biological oxygen demand in the effluent remains high, exceeding national standards:

> The treatment is not complete […] these grass plots are meant to remove the nutrients so that we have only potable water. But even if you go to NAWASSCO now, if they say the sewage treatment plant is working, ask them if they can take a glass of the water and drink it. Of course, they would refuse. (NEN2 2023)

The WWTP has a limited capacity to filter sewage; if incoming sludge and wastewater are heavily loaded with nutrients or pollutants, only about 80 per cent can be removed during treatment (WSP2 2023). High pollutant loads also threaten the biological treatment process (WSP2 2023). At times, wastewater must be diluted to prevent damage to the plant (NEN2 2023; WSP2 2023). Additionally, low water availability due to Nakuru's water supply deficit increases maintenance costs (NEN2 2023). Maintaining off-site sanitation infrastructure is generally expensive, and not all revenue from sewage charges is reinvested in the sector:

> Unfortunately, we have also not been ring-fenced in […] sewerage and sanitation. So, some of the money from sewerage is also used for other purposes. (WSP2 2023)

The WWTP requires an operating licence from NEMA, renewed annually. Consequently, effluent quality is measured quarterly and reported to the authority (NEN1 2023). Staff are also expected to inspect exhauster trucks arriving at the plant to ensure no illegal material is deposited (WSP2 2023). However, during our visits to Old Town, we did not observe such inspections taking place.

The future of Old Town WWTP remains uncertain. Further flooding could render continued operation impossible. The KfW Lake Nakuru Biodiversity Project plans to expand Njoro WWTP, decommission large parts of Old Town, increase sewer coverage and drill additional boreholes by 2046, which will bring significant changes to wastewater management in Nakuru City. Another option under discussion is to retain Old Town as the main facility for on-site sewage. Therefore, the long-term role of Old Town WWTP remains unclear.

5.4.5 Phase 5: reuse/disposal

Reuse and disposal were not the primary focus of the research project; therefore, only limited data on these stages of the sanitation service chain could be collected.

Reuse

To create beneficial end-uses as the final stage of the sanitation service chain, NAWASSCO is collaborating with Egerton University to fabricate products from faecal sludge and urine. NAWASSCOAL, a spin-off company of NAWASSCO, reuses faecal sludge from the WWTPs to produce briquettes. The process begins with drying the sludge for one to two weeks. It is then carbonised – burnt and ground – to eliminate odour and pollutants. Afterwards, the sludge is milled into fine particles and mixed with charcoal dust or sawdust before being formed into round briquettes. These briquettes are sold to end-users for cooking and heating at a price of 40 Ksh per kilogramme (Nzuve, 2022). NAWASSCO aims to improve production efficiency and reduce emissions of smoke and dust, which remain ongoing challenges (Simiyu et al., 2021). Once Old Town WWTP is restructured under the KfW Lake Nakuru Biodiversity Project, the NAWASSCOAL facilities are expected to remain on-site and continue operations.

Some biodigesters are also distributed across the town to locally reuse human waste, though these remain pilot projects. Agricultural use of faecal sludge and urine is another potential option, as is the reuse of treated wastewater for irrigation:

> Sewage treatment ponds, they should be modernised so that all the waste can […] be recovered and the […] wastewater can be recycled back into agriculture or other consumption. (CSA1 2023)

In general, moving towards a circular economy – not only for human waste but for other waste streams as well – could offer both economic and ecological benefits.

Disposal

In theory, truck operators and pit emptiers are obliged to safely dispose of faecal sludge and sewage at the WWTPs. However, as noted earlier, pit emptiers sometimes discharge waste into the environment due to economic constraints:

> Let me tell you the truth […]. Some people are doing desludging at night, and by morning they have bread and breakfast at their table because when they follow the proper channels, they face many barriers. (PPE4 2023)

This practice can lead to the pollution of soil, groundwater and Lake Nakuru. Solid waste manually removed from pits is also transported to the WWTP and burned there. Effluents from

Old Town WWTP are released into Lake Nakuru, while Njoro WWTP discharges into the Njoro River. Insufficient treatment at these facilities therefore has immediate consequences for the National Park ecosystem.

5.5 Impacts of sanitation practices on environmental health

In this section, we address RQ 3, focusing on the implications of sanitation practices for environmental health. As discussed in Section 2, environmental health encompasses both human and environmental dimensions, highlighting the critical role of society in fostering a holistic understanding of these interconnections. Accordingly, this section examines the human and environmental health effects of current sanitation practices in Nakuru City, as well as the interactions between them. While this section briefly touches on the societal implications of these effects, sub-section 5.6 explores the societal determinants of current sanitation practices in greater detail.

5.5.1 Effects on human health

The link between sanitation practices and human health emerges clearly from both the qualitative and quantitative data. Approximately 70 per cent of survey respondents believe that wastewater or sewage affects the health of household members, regardless of the sanitation facilities they use or their level of education (see Figure 13). This widespread awareness is also reflected in the qualitative interviews, where most respondents first mention health impacts when asked about the effects of the current sanitation situation in Nakuru City:

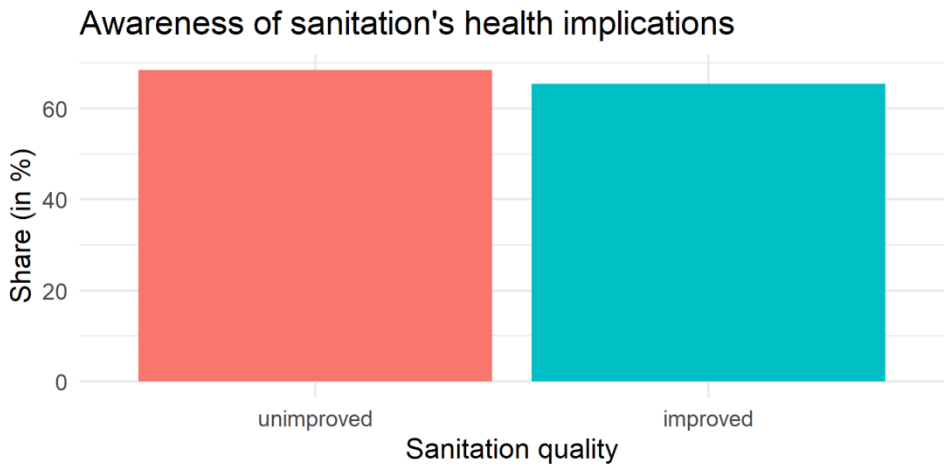
> I think the biggest impact is on health. When we're having good sanitation systems […] we are generally protecting ourselves from diseases. (CHV3 2023)

Interview partners confirmed that this connection between sanitation and health is widely recognised (PWP1 2023). Respondents emphasised that inadequate sanitation facilities contribute to communicable diseases such as cholera, typhoid and diarrheal illnesses (CHV1 2023; CHV3 2023; CPH2 2023). One interviewee noted the broader public health implications of poor sanitation, stating:

> Because they have also come to realise that whenever there is a disease outbreak, it doesn't only affect me with a poor toilet, but it may also get to you. (WSP3 2023)

Furthermore, one respondent highlighted that the negative health effects of poor sanitation extend beyond households, affecting truck operators and pit emptiers as well (PEX1O 2023).

Figure 13: Awareness of sanitation's health implications differentiated according to sanitation quality

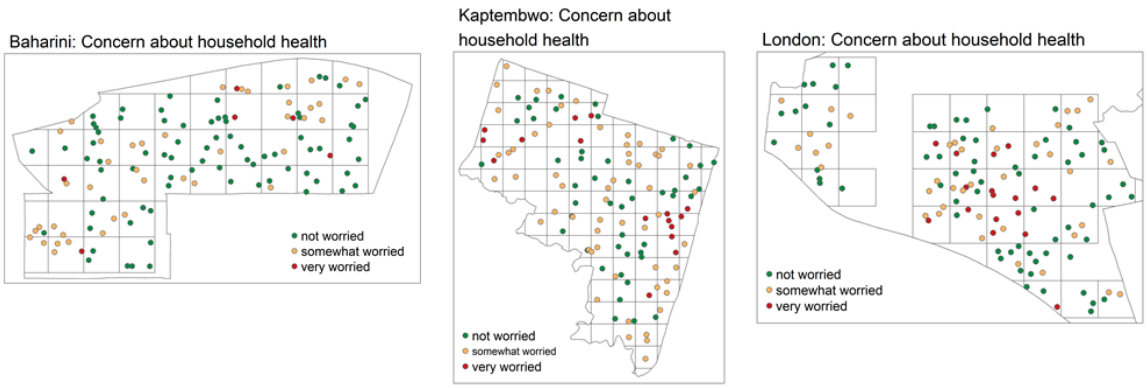


Source: Authors

To analyse health impacts more closely, additional survey data were considered. Roughly half of respondents reported a fever within the past month, and 19 per cent had malaria. However, few households reported other diagnosed diseases. For treatment, 71 per cent of households rely on public hospitals or clinics, while 46 per cent also consult private doctors. Nonetheless, one-third of households could not afford medical care if a family member sustained a broken arm. The majority of households are insured through the National Hospital Insurance Fund.

When asked about their concerns regarding household health, nearly half of respondents reported being worried. Mapping these data reveals that health concerns are unevenly distributed across sub-locations (see Figure 14). Whereas few households in Baharini expressed strong concern, clusters of high concern were found in Kaptembwo and London. In London, only households located east of the Giotho dumpsite reported being very worried about their health.

Figure 14: Concern about household health in the three sub-locations



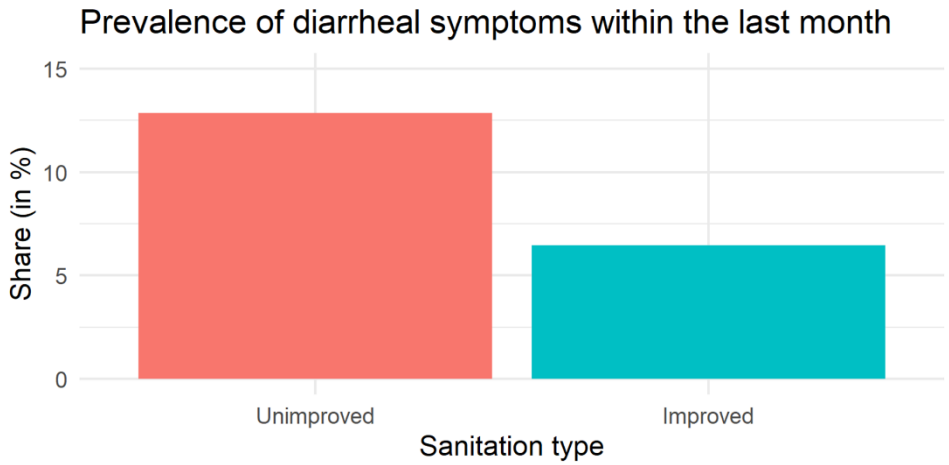
Source: Authors

When combining data on health status with the quality of sanitation facilities, households with unimproved sanitation facilities were found to be twice as likely to report diarrheal symptoms in the past month as those with improved facilities (see Figure 15). More generally, these households also expressed greater concern about their health, even after controlling for their ability to afford health care. The fact that households with unimproved sanitation are both more

likely to experience negative health outcomes and more concerned about their health – while being equally aware of the sanitation–health link – suggests two possible interpretations.

First, further sensitisation may be needed to strengthen awareness among households with unimproved facilities about the adverse health impacts of poor sanitation. Ongoing efforts by community health volunteers in Nakuru City already aim to address this by promoting safe sanitation practices. Second, the relatively high level of awareness (67 per cent) among households with unimproved sanitation suggests that awareness alone does not necessarily translate into action or improved conditions. This may indicate that the improvement of sanitation facilities lies beyond the control of individual households. Supporting this assumption, survey data show that only 38 per cent of tenants have access to improved sanitation, compared with 81 per cent of homeowners. Hence, landlords play a crucial role in providing access to adequate sanitation.

Figure 15: Prevalence of diarrheal symptoms within the last month differentiated according to sanitation quality



Source: Authors

In qualitative interviews, respondents identified a lack of cleanliness in shared facilities, limited access to clean water and infrequent handwashing as major causes of sanitation-related health risks (CHV1 2023; WSP3 2023):

> […] [U]sually these shared toilets are not very well. […] [W]hen it is shared, no one really takes much responsibility for cleanliness, how it should be cleaned, what happens when it is full. (WSP3 2023)

Respondents also highlighted the pollution of groundwater and surface water due to blockages, overflows and leakages, all of which pose risks to human health (CHV1 2023; PPF4 2023). However, several interviewees noted a decline in waterborne diseases in recent years, attributing this to improvements in sanitation facilities and greater awareness of hygiene practices (CHV1 2023; CHV3 2023; FGD1 2023):

> […] [B]efore that the diseases were very high. However, for now, they have really reduced. We rarely get cases of diarrhoea. We rarely get cases of cholera unless maybe just because of ignorance and all that, but we rarely get them. (CHV1 2023)

Beyond direct health impacts, respondents also mentioned economic and psychological effects arising from illness, such as loss of income and increased medical expenditures (CHV1 2023; CHV3 2023; CPH2 2023; PWP1 2023; WSP3 2023):

> The impact on the economy is just stress. I think one of the problems will be stress. Sanitation is poor. You don't have money. So who are you now? […] The poverty line will increase because I think that is the biggest impact. (CHV1 2023)

5.5.2 Effects on the environment

The survey revealed several environmental problems perceived across the sub-locations. One-third of households reported experiencing unpleasant smells, even when connected to the sewer system. Facility type influences satisfaction with environmental cleanliness: Nearly 70 per cent of households with pit latrines complained about a lack of cleanliness, compared to only 40 per cent among those with septic tanks or sewer connections. About 21 per cent of households lack solid waste collection services and mostly dispose of waste by leaving it at dumpsites or burning it. The most commonly encountered pests were mosquitoes (70 per cent), cockroaches (55 per cent) and rats (28 per cent).

Roughly one-quarter of households experience water stagnation, primarily due to heavy rainfall and inadequate drainage. Overflow of latrines and wastewater channels was reported less frequently. However, during heavy rainfall, 32 per cent of households reported contamination of drinking water. The majority of respondents were aware of environmental changes in and around Lake Nakuru and had visited the national park.

Interview respondents perceived that inadequate sanitation in Nakuru City contributes to environmental pollution, especially through drainage overflows during the rainy season (CHV3 2023; WSP2 2023). They emphasised that proper disposal of faecal sludge, improved toilet facilities and expanded sewer and drainage infrastructure could positively affect the environment:

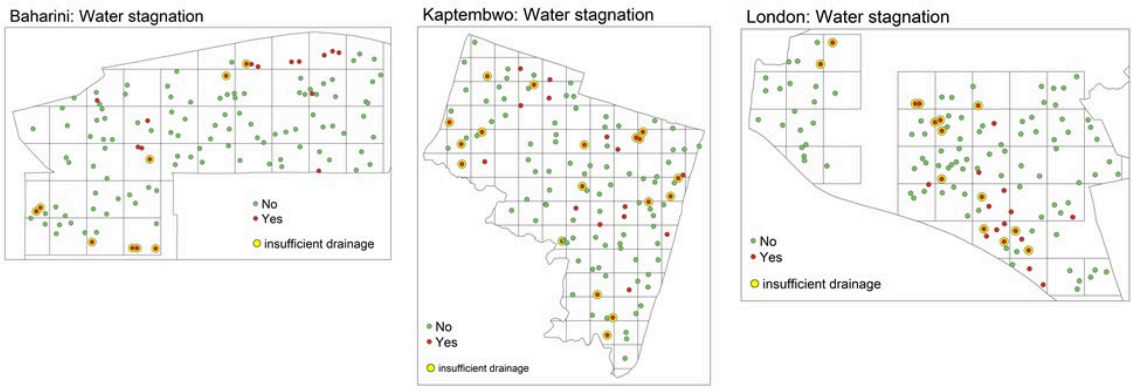
> Proper disposal allows the community to enjoy better environments. The intervention of Nakuru County in employing waste pickers and waste managers has helped Nakuru be better in terms of the environment. […] [D]rainages also improve the conditions of our environment. (CHV3 2023)

Survey data confirm these perceptions, showing clusters of water stagnation in Baharini and London (see Figure 16). In Kaptembwo, cases were more dispersed, and respondents attributed them mainly to insufficient drainage. Semi-structured interviews further revealed that some on-site sludge continues to be disposed of in the environment:

> There are those who do manually […]. I can say they do the dig and bury, because they don't have the trucks, they're not licensed to go and transport it to the sewer [WWTP]. (PPE3 2023)

This highlights the need to strengthen cooperation between manual emptiers and NAWASSCO to ensure proper sludge disposal at WWTPs. Other environmental problems mentioned included air pollution during sludge removal, groundwater contamination and reduced capacity for crop cultivation (CHV1 2023; PEX1O 2023). One interviewee also suggested raising community awareness about rainwater harvesting and storage to reduce water costs (CSO5 2023).

Figure 16: Households that report repeated water stagnation near their residences in the three sub-locations



Source: Authors

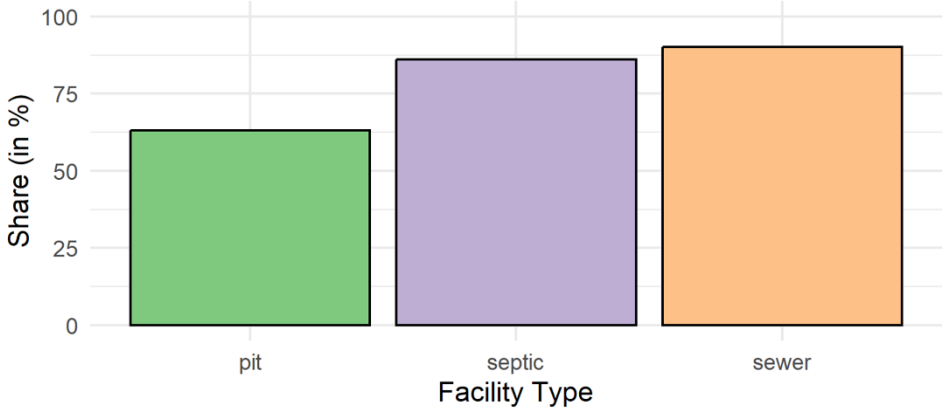
Solid waste governance emerged as another critical issue closely linked to sanitation. Several respondents highlighted that improper disposal of non-biodegradable diapers causes blockages in drainage systems. The additional disposal fee of 200 Ksh per month – on top of the regular waste fee of 150 Ksh – can burden low-income households, leading some to dispose of diapers improperly, such as in garbage bins or toilets. This practice can result in blocked drains, sewage overflows and environmental pollution (FGD1 2023; CSO5 2023):

> They use diapers, Pampers. So, disposing of these Pampers becomes a problem. If you put them in the sewer line, it blocks. If you throw them in the open, another problem. (FGD1 2023)

According to the survey, solid waste collection is more common among households with improved sanitation facilities than among those with unimproved facilities (Figure 17). The lack of solid waste services encourages people to dispose of waste in pit latrines or the open environment, creating further blockages and challenges for sanitation service providers (FGD1 2023; PEX1O 2023; PPE4 2023). Regarding Lake Nakuru, respondents emphasised that all forms of waste – solid and liquid – eventually flow into the lake due to its location at the lowest elevation of the basin:

> [...] Lake Nakuru National Park is very interesting because it is at the bottom of the basin, and most of the, in fact, all of the waste is washed into the lake [...] (NEN2 2023)

Figure 17: The existence of solid waste collection differentiated according to sanitation quality



Source: Authors

Lake Nakuru, a Kenyan National Park and RAMSAR site, is also a crucial source of livelihood for many (NEN2 2023). Nearly 79 per cent of survey respondents believe that wastewater affects the lake, and 49 per cent are aware of its rising water levels. As mentioned earlier, effluent from the Old Town WWTP fails to meet NEMA standards (NEN2 2023). Its high nutrient content promotes algal blooms and may encourage invasive species. However, industrial and agricultural discharges also contribute to pollution, making it difficult to attribute responsibility to a single source. A cooperative approach involving multiple stakeholders is therefore required. One interviewee stressed the need for stronger regulation and corporate responsibility:

> […] The private sector […] benefits a lot from all the profits they make. […] So they have a role to play. Their profits should not just go into their pockets. You have to set aside some for CSR, so that we all come together to protect our environment – the private sector, civil society, citizens and the government. It is not a one-man affair. (CSA1 2023)

5.5.3 Interactions between health and environment effects

There are direct interactions between the health and environmental effects of sanitation practices in Nakuru City. Water stagnation and overflows caused by blocked or inadequate drainage systems contribute to the spread of waterborne diseases and provide breeding grounds for mosquitoes (CHV1 2023). During the rainy season, improperly disposed of diapers pose an additional health risk:

> […] Pampers, […] they have faeces inside. They put them at the garbage collection point. […] [W]hen it rains like this, you see the waterborne diseases will spread because the Pampers will be rained on. (PPE4 2023)

Pollution of Lake Nakuru by untreated or partially treated sewage also affects the health of nearby communities, particularly those engaged in fishing (NEN2 2023). Rising lake levels in recent years have submerged pit latrines and inundated parts of Old Town WWTP, leading to faecal contamination and displacement of families:

> I think, two years ago the lake overflowed. There was a lot of water and it displaced very many families. (CSO5 2023)

Respondents also highlighted the economic impact of pollution and rising water levels. The National Park has had to spend considerable resources removing solid waste:

> […] Our guests come and say we have not paid $60 or $80 to see a lot of rubbish. […] We are spending a lot more money trying to clean up and engaging the county government to do their part and NAWASSCO to unblock sewage lines. (NEN2 2023)

Pollution and the declining number of flamingos also threaten the park's tourism value.

Finally, climate change – particularly shifts in precipitation – will further affect sanitation in Nakuru City. One respondent observed that inadequate sanitation, combined with changing climatic conditions such as rising water levels, could lead to groundwater contamination and waterborne disease outbreaks:

> […] [W]ith the current changes in climatic and environmental conditions, like the rising water level and all those things, you're not sure about the underground situation. […] There is an urgent need to improve the types of toilets we have to prevent pollution, because it is linked to disease. (CSO1 2023)

Several infrastructure adaptation projects, such as the KfW Lake Nakuru Biodiversity Project and the Itare Dam, are already underway. However, the full extent and timing of climate change

impacts remain uncertain and should be taken into account in the planning and implementation of sanitation infrastructure.

5.6 Determinants of sanitation practices

5.6.1 Policies

Finally, we turn to the determinants shaping the lived sanitation practices discussed above. As demonstrated, policy and legal frameworks are a key influence on sanitation practices in Nakuru City. Yet, these official documents themselves have deep historical roots. The legal and institutional foundations of Kenya's water and sanitation sector date back to the colonial period in the late 19th century. During the British East Africa Protectorate, "the first piped water supplies were developed and managed by the Uganda Railways to serve major towns". At the same time, pre-existing "institutions were systematically eroded" (Nyanchaga, 2016, p. 35).

By the late 1920s, the colonial administration had enacted its first water legislation. A Water Resources Authority was established in 1951, followed by the first National Water Act in 1952. Up until "the early 1960s, the 'variegated' nature of the water administration in Kenya continued just like in the decades before" (Nyanchaga, 2016, p. 39), with overlapping mandates and unclear responsibilities that led to inefficiencies in service delivery. International organisations such as United Nations International Children's Emergency Fund (UNICEF) and WHO also began to engage in the sector, and many of the problems they identified during the late colonial era continue to resonate today (Nyanchaga, 2016, p. 41).

After independence in 1963, international investment in water resources increased. Initially, the Ministry of Natural Resources assumed responsibility for the sector, which was later transferred to the Ministry of Agriculture and eventually to the newly established Ministry of Water, Sanitation and Irrigation (Nyanchaga, 2016, pp. 42, 51). The post-independence period was marked by the policy of free provision of basic services, including water and sanitation (Nyanchaga, 2016, p. 42). This changed fundamentally in the early 1980s, when the International Monetary Fund and the World Bank introduced Structural Adjustment Programs (SAPs). Water and sanitation services were commercialised and became available only against payment (Nyanchaga, 2016, p. 51). As our research shows, the underlying tension between "a market-based approach and a rights-based approach" (Nyanchaga, 2016, p. 601) persists in official policy documents today and is mirrored in sanitation practices across Nakuru City. However, sanitation practices cannot be explained with formal documents alone.

5.6.2 Sanitation infrastructure

As previously discussed, sanitation infrastructure – including containment facilities, sewer lines and treatment plants – forms the foundation of all sanitation practices. It determines the safety of containment and treatment, as well as the structure of the sanitation service chain. In Nakuru, this infrastructure is unevenly distributed, prompting questions about what factors shape access.

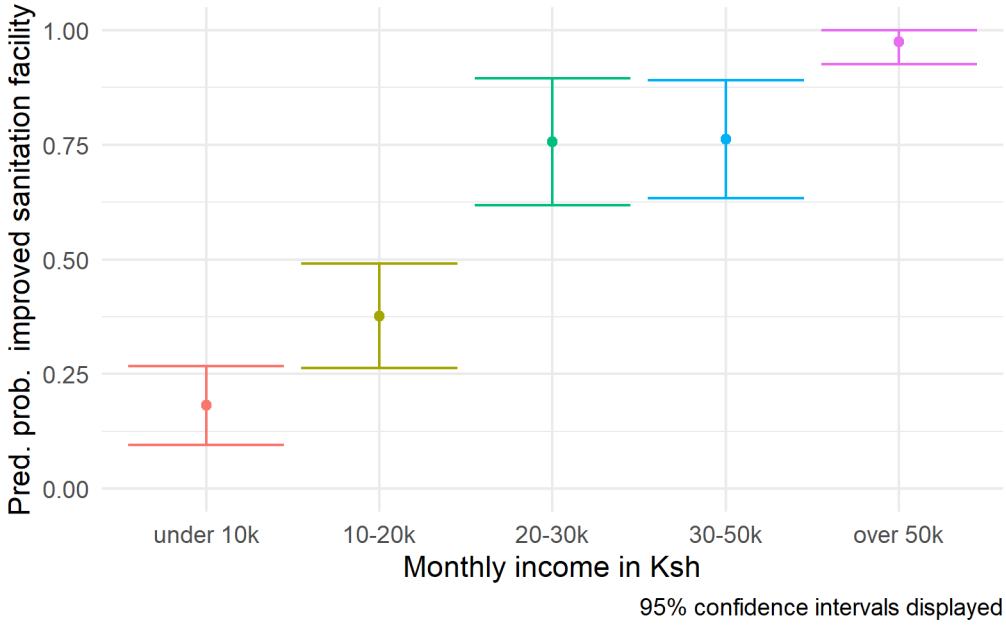
Public sanitation infrastructure in Nakuru City dates back to the British colonial era. Founded in 1904 along the Mombasa–Kisumu railway line, Nakuru saw rapid urban growth over subsequent decades. Water and sanitation works were constructed to serve the population, especially the colonial elite. The first sewer lines and the Old Town treatment plant were built in the 1950s.

Following independence, shifting government priorities, chronic underfunding and rapid population growth led to the city outgrowing its initial infrastructure. Consequently, some central neighbourhoods (such as Baharini) remain well-connected to the aging piped network, whereas suburban, peri-urban and informal settlements (such as Kaptembwo and London) – which developed after independence – are largely excluded from public services. These spatial

disparities coincide with socio-economic differences: Wealthier households can afford to live in better-serviced areas.

Figure 18 illustrates how public infrastructure shapes sanitation conditions in the city. In Baharini, a relatively affluent sub-location, the western parts near the city centre have a dense sewer network, and most surveyed households – represented by coloured dots – use sewered toilets. Moving eastward, as sewer lines become sparse, on-site facilities such as septic tanks become dominant. Notably, many pit latrines exist even near sewer lines, particularly in Bondeni, a low-income section of Baharini. Despite the technical and legal possibilities of connecting to the sewer, many households do not, likely due to the prohibitive costs of installation.

Figure 18: Predicted probabilities of improved sanitation facilities based on Model 7



Source: Authors

Table 2 further explores the relationship between household income, distance to sewer lines and access to sewered toilets using logistic regression models. Income and distance jointly determine whether a household's facility is connected to the sewer: Higher income increases the likelihood, while each additional metre of distance reduces it. These effects are statistically significant and intuitively plausible – wealthier households closer to the main sewer are more likely to be connected.

Model 6 adds nuance by including an interaction term between income and distance. Here, the distance variable alone becomes insignificant, and only its interaction with middle- and high-income groups remains significant. This indicates that proximity to sewer lines benefits only those who can afford to connect – households with monthly incomes above 20,000 Ksh. In short, sewer expansion primarily benefits the better-off, excluding poorer residents, as seen in Bondeni.

Models 7 and 8 replace the dependent variable with access to an improved sanitation facility (per WHO classification) to assess whether sewer infrastructure enhances overall sanitation conditions. Surprisingly, sewer proximity is neither a strong nor significant predictor. Instead, household income remains the main determinant of improved sanitation quality. Figure 18 visualises the predicted probabilities derived from Model 7.

Table 2: Logistic regressions of sewer connection and improved sanitation facilities

	Dependent variable			
	Sewered toilet		Improved facility	
	(5)	(6)	(7)	(8)
Income: 10-20k	1.742***	2.141***	1.001***	0.944*
	(0.526)	(0.707)	(0.386)	(0.548)
Income: 20-30k	1.634***	3.343***	2.639***	2.940***
	(0.576)	(0.910)	(0.484)	(0.701)
Income: 30-50k	2.498***	3.882***	2.667***	2.938***
	(0.579)	(0.836)	(0.467)	(0.626)
Income: over 50k	2.541***	7.910***	5.168***	4.769***
	(0.587)	(2.240)	(1.055)	(1.209)
Distance to main sewer (m)	-0.006***	-0.001		-0.00003
	(0.001)	(0.002)		(0.001)
Income: 10-20k * distance		-0.002		0.0004
		(0.002)		(0.001)
Income: 20-30k * distance		-0.018**		-0.0004
		(0.009)		(0.002)
Income: 30-50k * distance		-0.016**		-0.001
		(0.008)		(0.001)
Income: over 50k * distance		-0.083**		0.003
		(0.034)		(0.009)
Constant	-1.422***	-2.148***	-1.504***	-1.478***
	(0.466)	(0.596)	(0.295)	(0.430)
Observations	258	258	265	256
Log likelihood	-114.201	-97.753	-130.476	-123.094
Akaike Inf. Crit.	240.402	215.507	270.952	266.188

Note: *p<0.1; **p<0.05; ***p<0.01

The baseline category for income is “under 10k”. Average monthly household income is in Ksh.

Source: Authors

Access to improved sanitation is highly income-dependent. For households earning under 10,000 Ksh per month, the probability is only 18 per cent; it rises to 38 per cent for those earning between 10,000 and 20,000 Ksh, and plateaus around 75 per cent for middle-income households. Only the most affluent (over 50,000 Ksh monthly) approach near-universal access (98 per cent). In Nakuru, therefore, income inequality translates directly into sanitation inequality. As one NAWASSCO representative put it,

> I cannot invest in good toilets when I don’t have food or school fees for my kids. Poverty is also another issue. (WSP3 2023)

Another civil society actor echoed this sentiment:

> Without eradicating poverty, sanitation will remain a big problem. You must first feed your family before you can think about clean water and toilets. (CSA1 2023)

Housing tenure further compounds inequality. Homeowners, who are typically wealthier and responsible for their own facilities, enjoy much better sanitation: 83 per cent of surveyed homeowners have improved toilets. Tenants, by contrast, often lack both the resources and legal authority to improve their sanitation; only 38 per cent report access to improved facilities. This underscores the crucial role of landlords in improving sanitation at the containment stage.

Yet, as interviews reveal, landlords often lack incentives:

> Most landlords do not live there. They would rather build an extra rental room than invest 100,000 Ksh in a toilet. (WSP3 2023)

To counter this, NAWASSCO, with support from VEI and WSUP, previously offered subsidies of 10,000-20,000 Ksh per toilet constructed. Although this encouraged investment, the programme faced misuse – some landlords converted toilets into storage or additional rental units (WSP1 2023).

With nearly half the surveyed population still lacking improved sanitation, there remains a pressing need for policies that incentivise better facilities for low-income households while safe-guarding against misuse. This may require clearer standards for sanitation infrastructure, stricter disbursement conditions and robust monitoring mechanisms.

5.6.3 Momentum in the sanitation sector

Nakuru County and NAWASSCO have often been hailed for their commitment to improving sanitation in recent years, earning Nakuru the reputation of being a role model for other cities in Kenya and beyond. As discussed above, this reputation is not without merit. The numerous bills and policies on sanitation enacted since the onset of devolution in 2010 demonstrate the high priority successive county governments and administrations have placed on the sector. Likewise, the various programmes initiated or supported by NAWASSCO – many of which predated its formal legal mandate – underscore the organisation's proactive stance in enhancing containment facilities and ensuring safety across the sanitation service chain.

Although several of these legislative and practical initiatives fell short of their intended goals, and sanitation conditions in the city still leave considerable room for improvement, the visible commitment across different levels of governance is undeniable. This raises a crucial question: What explains this strong local momentum? Understanding the drivers behind Nakuru's progress is particularly relevant, as any effort to replicate or build upon its sanitation experience depends on similar commitment from key actors elsewhere. Ideally, addressing this question would call for a comparative approach, which remains a promising avenue for future research. However, the temporal and resource constraints of this project limited such an analysis. Nevertheless, it is possible to offer tentative insights into the factors that spurred Nakuru's sanitation drive.

Findings from the semi-structured interviews indicate that several interrelated factors were at play. A key enabling condition was the process of devolution, which transferred responsibility and resources for water and sanitation from the national to the county level. As one respondent noted:

> You know, we never had devolved governments and everything was centralised. Everything was being run by the national government. Therefore, resources were not being shared so equally. […] Now we have certain budgets going to the devolved governments; that means counties are now able to do much more. (CSA1 2023)

Devolution, therefore, created the institutional and financial space for local action. Yet, the comparatively more limited progress in other counties shows that devolution alone cannot explain Nakuru's success. Beyond structural change, what made a decisive difference was political will. As one respondent put it:

> There was a lot of open defecation in this town. So the county government came with a strategy. (WSP1 2023)

At the county level, this commitment translated into progressive policy instruments such as the Nakuru Countywide Inclusive Sanitation Strategy (DoHS & DoWEENR, 2019). It also fostered an enabling environment for local actors – particularly NAWASSCO – to broaden their operations.

> I can say for Nakuru, it is because we got goodwill from the partners and the county. There has been not much interference and all that. And also because, as a water company, we took it positively. Most utilities in other counties were like, what is the value addition for this? […] They said it's not a viable business. But when we began, we got a lot of support from partners, from the county and from the national government. (WSP3 2023)

Thus, the recognition of sanitation as a key issue – and the political will to act upon it – lay at the foundation of Nakuru's progress. However, "political will" remains an unsatisfying explanation, as it risks tautology: Sanitation was prioritised because there was a will to prioritise it. The interviews offer only limited evidence on why sanitation, specifically, gained such attention. One plausible factor is public pressure, particularly from civil society and activists. As one activist observed:

> When we make noise, people are listening – especially on social media, Twitter, Facebook and Instagram. Our government is there because government is people. Those ministers are there. They are listening. If we target them on Twitter, they will listen. And we should make more noise. It's picked up by journalists, in newspapers, on radio. […] I can tell you for sure that noise does help. I have seen so many things being acted upon from the noise that we make. (CSA1 2023)

Once this initial impetus was set in motion at the county level, much of the subsequent momentum emanated from NAWASSCO itself.

> For the water companies, their focus was not much in the low-income areas. But the establishment of the pro-poor unit in NAWASSCO really contributed much. Initially, we were focusing on water, but we noted that water and sanitation go hand in hand. (WSP3 2023)

This institutional reorientation led NAWASSCO to focus more explicitly on sanitation and on low-income communities. The pro-poor unit began piloting new approaches and quickly attracted external support. With encouragement from development partners and the national government, these early initiatives expanded organically into a broader sanitation agenda:

> Now that NAWASSCO is a water and sanitation company, we asked: What is our role in sanitation? […] The national government, through the Water Sector Trust Fund and the Bill and Melinda Gates Foundation, provided grants to pilot projects. We began engaging communities to help them realise the importance of investing in improved sanitation. We started with containment, then partners came in – the EU, WSUP and others – each adding to our efforts. […] That's how we got to where we are. (WSP3 2023)

NAWASSCO's willingness and ability to innovate made it a focal point for collaboration among domestic and international partners, who brought in new ideas, funding and interventions. Although this dynamism greatly advanced the sector, it also introduced occasional overlaps and inconsistencies.

Despite these achievements, significant challenges persist. Many households still rely on unimproved containment facilities, and ensuring safe management along the sanitation service chain remains difficult. These issues reveal deep tensions between NAWASSCO's dual roles: as a provider of essential public goods – right to safe water and sanitation – and as a commercially oriented profit-making enterprise. Public health and environmental protection are collective goods, yet NAWASSCO must operate within the logic of financial sustainability. This contradiction is especially evident in its engagement with pit emptiers.

Pit emptiers affiliated with NAWASSCO receive protective gear, vaccinations and organised access to treatment plants, but must surrender 60 per cent of their earnings to the utility. Many therefore prefer informal and unsafe disposal practices. According to NAWASSCO representatives, however, the fee structure merely allows the programme to remain self-sustaining:

> If NAWASSCO is providing the equipment, vaccinations and protective gear, it does not make money at all. […] But if we let them do it on their own, they will not follow the right procedures. […] The vaccines are also not cheap. […] For the pit emptiers, they only look at how much money they bring in. But when you go into details, you realise the utility is making nothing out of it. (WSP3 2023)

This highlights a fundamental conflict between NAWASSCO's commercial structure and the public goal of universal, safe sanitation. Whether these competing interests can be reconciled under conditions of widespread poverty and inequality remains uncertain. Given the critical public health implications, one potential solution would be to restructure NAWASSCO's pro-poor unit – separating it from profit-oriented operations – and support its activities through county budget allocations. Such an approach could help safeguard vital public goods while maintaining institutional sustainability.

6 Limitations

After presenting our results in detail, it is important to acknowledge several limitations of this research project. Some of them affected the study as a whole, while others were specific to either the qualitative or quantitative components of data collection and analysis.

General limitations

A key limitation concerns the positionality of the research team. As external researchers unfamiliar with both Kenya generally and Nakuru City specifically, our position carried significant implications – both advantageous and disadvantageous (Holmes, 2020). On one hand, our outsider status likely influenced local perceptions, particularly during data collection. Respondents may have answered differently to white foreign researchers than they would have to local enumerators, especially on sensitive sanitation-related issues. In some cases, people may have declined to participate altogether due to this positionality. On the other hand, our limited familiarity with local norms and cultural references may have led to misinterpretations of certain statements or behaviours. Together, these factors posed challenges in fully understanding and contextualising local practices.

Throughout the research, we tried to remain self-aware of these dynamics and critically reflect on our own positionality. At the same time, being outsiders may also have offered certain advantages – allowing us to discern overarching patterns and relationships that might not be visible to community members themselves. However, realising this potential benefit required continuous self-reflection to avoid the misinterpretation of evidence.

A second limitation relates to social desirability bias and power asymmetries during interviews and surveys. Differences in education level, language proficiency or perceived authority may have made some respondents feel intimidated or cautious, leading them to provide socially desirable rather than candid responses. This risk was particularly pronounced when discussing sensitive topics such as income, well-being and sanitation practices. Similarly, power relations could have influenced responses during qualitative interviews: Public officials might have avoided criticism of government policies, while pit emptiers and truck operators affiliated with NAWASSCO may have hesitated to express dissatisfaction for fear of repercussions. To minimise such effects, we emphasised voluntary participation and allowed respondents to skip questions they did not wish to answer. Nonetheless, certain power dynamics – such as hidden political pressure or informal alliances – may still have shaped the data in ways we could not fully control or detect.

A third limitation was the scarcity of reliable secondary data, particularly concerning environmental and health impacts. Although the 2019 Kenyan census contained some relevant information, the level of aggregation was too coarse for our analytical needs. Additional complications arose from inconsistent administrative classifications across datasets – some organised by wards, others by sub-locations – making comparison and integration difficult.

Finally, the language barrier posed greater challenges than anticipated. We underestimated the centrality of Kiswahili as a lingua franca in Kenya. Conducting the household survey solely in English would not have been feasible, particularly in low-income neighbourhoods. Therefore, surveys were administered in Kiswahili by local research assistants. Although qualitative interviews were conducted in English, we used a translator for one session; however, translation proved inefficient and reduced flexibility, so we decided against using it systematically. This decision, while practical, inevitably excluded non-English-speaking stakeholders and may have led to missed insights.

Survey-related limitations

In the household survey, several constraints emerged from our reliance on local research assistants. The survey was conducted over three weeks, primarily in the mornings, to avoid overburdening the assistants with full-day or weekend work. However, this schedule led to an imbalance in respondent demographics – particularly between men and women – and created a bias towards households with members available in the mornings (e.g. caregivers, retirees, unemployed individuals or those with health conditions). Although our random sampling design provided some flexibility, the effect on representativeness cannot be ruled out.

Furthermore, the research assistants conducted interviews in Kiswahili, which meant they sometimes deviated from the original questionnaire wording or order and used varying colloquial expressions. These differences could have introduced inconsistencies or misunderstandings.

Another limitation stems from the association of the enumerators with NAWASSCO, as they presented themselves as such during the survey. This affiliation likely shaped respondents' attitudes – potentially creating positive bias among those with good prior experiences or distrust among those with negative ones. However, NAWASSCO's recognition in the community also facilitated access to respondents, especially since IDOS was largely unknown locally.

Access constraints were particularly pronounced in high-income areas. Security guards and caretakers often acted as gatekeepers and, in some cases, answered questions themselves. Despite our attempts to adapt, these circumstances may have introduced bias. The presence of white researchers during some surveys had mixed effects: It sometimes helped build trust with wealthier households but could also create expectations or divert attention from the research purpose.

Safety concerns presented another challenge. In one sub-location, researchers felt unsafe and had to skip several grid cells. Following this incident, we collaborated closely with village elders, who identified secure areas and occasionally accompanied the team. Their involvement enhanced safety and facilitated access, as they were respected community figures. However, their authority may also have influenced respondents' willingness or manner of participation.

Interview-related limitations

For the qualitative interviews, the research team's lack of prior engagement with sanitation in Nakuru City initially made it difficult to identify and reach key informants. We relied on gatekeepers from our partner organisations – NAWASSCO, Egerton University, the Nakuru County Government and UN-Habitat – as well as community elders and government officials who referred us to further contacts through snowball sampling. This reliance inevitably shaped our interviewee pool, as access was mediated by existing power relations, personal networks and institutional interests**.**

Moreover, the number of interviews we could conduct was constrained by time limitations, despite surpassing our initial targets. The in-depth analysis of qualitative data is inherently time-intensive, and the short duration of the project restricted our capacity to expand the sample. Consequently, certain stakeholder perspectives remain underrepresented – most notably those of landlords and public health officials.

In sum, this research project faced several interrelated limitations stemming from positionality, power relations, data availability, language barriers, access constraints and time restrictions. Although we took deliberate measures to mitigate these challenges, their influence on the findings cannot be entirely discounted. Recognising these limitations is crucial for interpreting our results and for guiding future research seeking to build on this study.

7 Conclusion

Our research sought to shed light on the interplay between official rhetoric about sanitation and lived practices, examining how these dynamics influence environmental health. The study focused on Nakuru City, a rapidly growing secondary city often described as a role model in Kenya where sanitation responsibilities have recently been devolved to the subnational level. Adopting an interdisciplinary approach, we combined quantitative and qualitative methods: A georeferenced household survey was complemented by semi-structured interviews with actors operating at different institutional and community levels. The findings of this research reveal significant variations in the extent to which different actors and institutions address sanitation for all and its positive implications for society, human health, and the environment.

Sanitation practices in Nakuru City are deeply shaped by Kenya's evolving policy and institutional frameworks, whose roots extend back to the colonial period. The earliest water and sanitation systems were established under British rule in the early 20th century, primarily to serve colonial settlements and the Uganda Railways. Indigenous systems of water and waste management were gradually displaced.

Formal sector governance began with the 1951 establishment of the Water Resources Authority and the National Water Act of 1952, but overlapping mandates and weak coordination characterised the system – a problem that continues to affect the sector. International agencies such as UNICEF and WHO were already active in this space before independence, and they have identified governance and inequality challenges that remain relevant today.

After independence in 1963, the state initially pursued universal access to basic services. However, the economic reforms of the 1980s under SAPs marked a major shift towards commercialisation and cost recovery. Since then, Kenyan water and sanitation policy has oscillated between a market-based model and a rights-based approach, a tension that still shapes implementation in Nakuru. Although official documents promote universal access, practical realities – especially affordability – limit the effectiveness of these commitments.

7.1 Bringing sanitation into the political spotlight

Despite sanitation being high on the agenda of government agencies, it is still on the periphery for the ministries, local government and in legislations. The Council of Governors offers a strategic platform to raise awareness among national legislators about the constitutional right to sanitation for all and its cross-cutting nature. Collaborating with other counties could help increase funding, establish a National Environmental Sanitation Coordination and Regulatory Authority, and create a dedicated sanitation fund.

Kenya's 2010 devolution reforms transferred responsibility and budgets for water and sanitation from the national to the county level. This shift gave counties such as Nakuru greater autonomy to prioritise sanitation in their planning. As one civil society actor noted, "Now counties can do much more." However, differing outcomes across counties show that devolution alone is insufficient; leadership and initiative are critical.

County leaders recognised the severe consequences of open defecation and poor sanitation, developing strategies such as the Nakuru Countywide Inclusive Sanitation Strategy (DoHS & DoWEENR, 2019). Their commitment provided an enabling environment for NAWASSCO – the city's utility – to take a proactive stance. Political backing ensured continuity of programmes and legitimacy for partnerships with international donors.

Nakuru stands out nationally for its visible progress and active engagement in sanitation. The city's recent trajectory illustrates how political will, institutional innovation and partnership can generate local momentum even under resource constraints. However, such initiatives need to be supported with national- and county-level funding. At the county level, it is essential to raise awareness of how environmental factors affect sanitation infrastructure. Climate change – particularly changes in rainfall and drought patterns – has direct implications for system performance and must be integrated into planning processes, for example in considering the additional wastewater from the Itare Dam.

7.2 Strengthening integrated and long-term approaches to sanitation

In Nakuru City, there is a mismatch between the access to water supply and sanitation provision. As can be seen from the household survey, 64 per cent of the households that have access to tap water in their communal yard or within the dwelling report receiving water only a few days a week. Around 60 per cent of the households rely upon on-site facilities. An unreliable water supply system not only poses challenges concerning quality and hygiene issues, but also the degree of access to safe sanitation. The integrated management of water and sanitation is

therefore essential. A reliable water supply system enables households to maintain cleanliness and prevent disease transmission, while well-designed sanitation systems protect water sources from contamination. This interdependence is recognised in SDG 6, which jointly calls for universal access to safe drinking water and adequate sanitation. In practice, the policies and infrastructure for both must be planned together – ensuring that wastewater is safely managed and that water sources remain uncontaminated. Ultimately, access to clean water and proper sanitation is not just a technical issue but a foundation for human dignity, health and economic productivity.

Intersectoral coordination is crucial for addressing sanitation issues comprehensively. There is a need to clarify the responsibilities of DoWEENR for on-site sanitation, in coordination with the County Health Department. As NAWASSCO reports to the DoWEENR, on-site sanitation should more clearly fall within its official mandate. This would also improve communication within NAWASSCO, where on-site sanitation currently receives less attention than sewered systems. Given that sanitation intersects with multiple sectors and stakeholders, NACOSTEC, which was created to facilitate such coordination, needs to be strengthened and adequately funded to realise its potential. Enhanced collaboration can help align interests, develop a coherent legal framework and promote a holistic approach to improving sanitation.

Monitoring and implementation in existing sanitation systems remain weak. Key areas of concern include:

- Water supply: Many respondents reported that tap water becomes contaminated with solids during heavy rainfall. NAWASSCO should identify and eliminate the causes of this contamination.

- Housing policy: New buildings must comply with environmental and health standards, yet licensing often proceeds without adequate monitoring. The government must also find ways to improve sanitation facilities in existing residences, ensuring that enforcement responsibilities do not fall unfairly on tenants.

- Environmental monitoring: Discharge of untreated or insufficiently treated wastewater into Lake Nakuru poses environmental and economic risks. The strict regulation of effluent quality from the WWTP and surrounding industries – accompanied by consistent follow-up – is essential for lake protection.

Public participation in setting priorities is vital, as residents are most affected by weak implementation.

Sustainable sanitation is also closely linked to interventions in related sectors:

- Solid waste management: Collection remains inadequate, and improper disposal (e.g. diapers and solid waste in sanitation facilities or open drains) causes sewer blockages and complicates pit emptying. Providing more collection bins, financial support and incentives for proper disposal could reduce environmental waste and enhance recycling potential.

- Water access: Low-income areas are particularly underserved. Enforcing standardised water prices at kiosks would improve affordability, as current prices vary widely. High costs for water metres also limit access to tap water; subsidies or price reductions could help expand coverage.

- Drainage systems: Functional stormwater drainage is essential to prevent water stagnation, the contamination of drinking water and disease outbreaks. The construction and maintenance of stormwater drains should be the responsibility of public works departments, not communities.

7.3 Structural contradictions threatening long-term sustainability

NAWASSCO must operate as a profitable enterprise while providing what is fundamentally a public health service – the right to sanitation. This is challenging, as NAWASSCO was established as a profit enterprise catering largely to higher-income households. Only recently has it started to address on-site sanitation in low-income areas. Second, its engagement with pit emptiers illustrates this dilemma. Formally affiliated emptiers receive protective gear, vaccinations and access to treatment plants, but they must remit 60 per cent of their earnings to NAWASSCO to ensure that the programme remains financially solvent. Many respond by reverting to informal and unsafe dumping. The utility argues that costs for safety equipment and vaccinations justify the deductions, but the arrangement exposes the limits of commercial logic when applied to essential services.

Second, the county government focuses on the formal sector, excluding the informal sanitation sector. The pit emptiers and other informal service providers fill crucial gaps in areas with a lack of sewers, yet county policies neither recognise nor support them adequately. Without formal inclusion – through licensing, training and affordable disposal options – efforts to achieve safe citywide sanitation will remain incomplete. On-site sanitation will remain essential in Nakuru for the foreseeable future, as complete sewer coverage is not achievable in the medium term. Nevertheless, current policies prioritise sewer expansion. A rebalancing of attention – supported by adequate funding and personnel – is needed.

Collaboration with emptying and transport service providers also requires improvement. Revising the pricing structure for truck operators and pit emptiers could enhance cooperation and service quality. This could include differentiating disposal fees by truck size, standardising pit emptier fees and adopting a more equitable profit-sharing arrangement between NAWASSCO and service providers. Truck operators and pit emptiers should be better represented in official documents and operational decision-making within NAWASSCO. Policy changes and new licensing requirements must be communicated clearly to all stakeholder groups. Identifying and engaging independent emptiers will be crucial for improving both health and environmental outcomes.

Third, the county government has been largely engaging sanitation issues with a focus on sewer-based sanitation, thereby ignoring on-site sanitation. The expertise of pit emptiers should be utilised to identify informal or independent operators. Engaging with them is essential to disseminate safety information, clarify regulations and strengthen the on-site sanitation service chain. NAWASSCO should also recognise the benefits of close collaboration with all pit emptiers. Furthermore, they should leverage the extensive local knowledge of community health volunteers and community-based organisations, whose insights into health and environmental conditions are often absent from citywide decision-making bodies. Similarly, regular payment of promised allowances for voluntary workers – such as community health volunteers and community-based organisations – would be fair compensation for their contributions, for instance in cleaning stormwater drains – a task that effectively compensates for the lack of government service delivery. In general, public works should not rely solely on community volunteers. Community health volunteers also expressed a need for additional training and capacity-building to enhance their ability to inform communities about the health impacts of sanitation. The County Health Department could play a key role in identifying their needs and strengthening their role and recognition of their work.

7.4 Sanitation infrastructure and inequality

Sanitation outcomes in Nakuru City are fundamentally determined by the distribution of and accessibility to physical infrastructure – containment systems, sewer networks and treatment facilities. Public sanitation infrastructure in Nakuru dates back to the colonial era. Sewer lines and treatment works constructed in the 1950s served the city's wealthier central zones. However, rapid post-independence urban expansion, underfunding, and limited maintenance left newer and poorer neighbourhoods without equivalent services. Aging sewer systems, limited treatment capacity and underinvestment constrain service expansion. Infrastructure upgrading must accompany behavioural and institutional reforms; otherwise, inequities will persist.

A turning point came with the creation of NAWASSCO's pro-poor unit**,** which reoriented the utility's narrow focus on water supply towards an integrated approach that included sanitation. Beginning with small pilot projects supported by the Water Sector Trust Fund and the Bill & Melinda Gates Foundation, NAWASSCO tested community-based models that gradually evolved into a comprehensive citywide sanitation agenda. These initiatives attracted broad donor engagement – from WSUP, VEI and the European Union, among others – making NAWASSCO a hub of innovation. The utility's openness to experimentation, combined with supportive county leadership, generated a self-reinforcing cycle of progress.

Despite this progress, the spatial and socio-economic divide is stark**.** Central neighbourhoods such as Baharini remain connected to aging sewer systems, while peri-urban and informal settlements such as Kaptembwo and London rely largely on unimproved pit latrines. Statistical analysis shows that household income and proximity to sewer lines jointly determine sewer access: Wealthier households located near existing networks are far more likely to be connected. Each additional metre of distance reduces the likelihood of connection, but only among those who can afford the high installation costs. In effect, sewer expansion reinforces inequality. Even where infrastructure exists, many low-income households remain unconnected because connection fees are prohibitive. Reducing the amount of shared sanitation facilities offers substantial health benefits. Survey results show that some toilets are shared by more than 10 households, increasing the risk of communicable diseases. Reducing the number of users per facility could improve both hygiene and health outcomes.

Access to improved sanitation facilities, as classified by WHO, follows the same pattern:

- Households earning below 10,000 Ksh per month have only an 18 per cent likelihood of using improved facilities.
- Middle-income households (20,000-50,000 Ksh) reach roughly a 75 per cent likelihood.
- Only the wealthiest households achieve near-universal access.

As one respondent summarised, "You cannot invest in toilets when you have no food or school fees." Poverty thus remains the single strongest constraint on improvement in sanitation.

Housing tenure amplifies this divide. Homeowners – typically better-off – are responsible for their own facilities and thus achieve 83 per cent coverage with improved toilets. Tenants, who lack both the control and incentive to invest, reach only 38 per cent coverage. Landlords often prefer to add rental units rather than spend on sanitation, as noted by utility staff: "They would rather build another room than invest 100,000 Ksh in a toilet." Landlords play a pivotal role in determining sanitation quality, as construction, maintenance and sewer connections fall under their responsibility. Tenants, by contrast, often lack the means to make improvements. Financial incentives and legal instruments could encourage landlords to invest in better facilities. However, such initiatives must be accompanied by robust regulation and monitoring to prevent the misuse of funds.

Economic hardship and weak incentives for landlords continue to block access to improved sanitation. Addressing these issues requires targeted subsidies, innovative financing (e.g. revolving sanitation funds) and stronger enforcement of building standards.

7.5 Policy implications and the way foward

1. Integrate drinking water and sanitation rather treating them as separate entities:

Drinking water and sanitation facilities are fundamentally interconnected components of public health and sustainable development. Safe drinking water cannot be achieved without effective sanitation, and poor sanitation undermines the quality of water resources. When human waste is improperly managed – through open defecation, leaking pit latrines or unsafe sludge disposal – it contaminates the surface and groundwater, spreading waterborne diseases such as cholera, typhoid and diarrhoea. Conversely, the availability of clean water supports hygienic sanitation practices such as toilet flushing, handwashing and the cleaning of facilities.

2. Pro-poor sanitation funds in county budgets:

Reconstitute NAWASSCO's pro-poor unit as a publicly funded entity distinct from commercial operations. This would safeguard its social mandate and ensure continuity beyond donor projects.

3. Formalise and support informal service providers:

Recognise pit emptiers through certification, capacity-building and regulated access to treatment sites. Reducing disposal fees and ensuring occupational safety would minimise illegal dumping and improve environmental outcomes.

4. Target infrastructure investment strategically:

Prioritise sewer extensions and decentralised treatment solutions in underserved, high-density settlements. Combine public investment with household-level subsidies to lower connection barriers.

5. Increase landlord accountability:

Enforce minimum sanitation standards in rental housing through inspections and penalty mechanisms while offering incentives for compliance.

6. Enhance coordination and monitoring:

Establish a county-level sanitation coordination platform that brings together government agencies, NAWASSCO, civil society and development partners to harmonise programmes and avoid duplication.

7. Sustain political and civic engagement:

Build on Nakuru's experience by institutionalising participatory planning, supporting community awareness campaigns and maintaining transparency in resource allocation.

Nakuru's sanitation experience demonstrates that progress depends not only on infrastructure or financing, but also on governance alignment, inclusive institutions and persistent political commitment**.** Devolution has provided a window of opportunity, but leadership at both the county and utility levels converted it into tangible results. Still, disintegrated water and sanitation, persistent inequality, affordability barriers and the commercial constraints of a public utility threaten to stall further gains. Ensuring safe, equitable and sustainable sanitation for all will

require bridging the divide between market logic and public health imperatives – through institutional reforms, targeted support for the poor and continued civic engagement. If Nakuru succeeds in balancing these goals, it can continue to serve as a model for Kenya's – and Africa's – urban sanitation transformation.

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Annexes

Annex 1: Inception workshop

Title:	**Sanitation Governance and Its Implications on Environmental Health**
Program:	**Inception Workshop**
Date:	23/02/2023
Duration:	09.00 – 16.30h
Venue:	The Ole-Ken Hotel, West Road, Nakuru
Moderators:	Grace Kabubu and Johannes Vogel

09.00	Arrivals and registration
	Prayers and introduction
	Opening remarks
	Introduction of IDOS
10.00	Introduction of Research Team
	Presentation of Inception Report
	Presentation of IDOS-led research
11.00	Coffee break
	Feedback from audience
12.00	Refresher
	Introduction to group work
	Breakout group
13.00	Lunch break
14.00	Breakout group continued
15.00	Presentation of group work
	Coffee break
16.00	Presentation of group work continued
	Outlook
	Closing remarks

Annex 2: Dissemination workshop

Title:	**Sanitation Governance and Its Implications on Environmental Health**
Program:	**Dissemination Workshop**
Date:	25/04/2023
Duration:	09.00 – 16.30h
Venue:	The Ole-Ken Hotel, West Road, Nakuru
Moderation:	Grace Kabubu, Johannes Vogel

09.00	Arrivals and registration
	Prayers and introduction
	Opening remarks
10.00	Presentation of research and findings
11.00	Tea break
	Discussion of open questions
12.00	Feedback from participants
	Geospatial mapping of water-related risks
	Behavioral patterns of the community
13.00	Lunch
14.00	Findings from IDOS-led research
	Open discussion
15.00	Outlook
	Closing remarks
	Tea and departure

Annex 3: Structured interview of the household

(Sanitation practices, human health, and the environment)

1) Identification and metadata

NO.	QUESTION	CODING CATEGORIES
101	Enter the name of the interviewer/investigator.	[NAME]
102	Record the date and time of the interview.	DD/MM/YYYY
103	Record the sub-location where the interview is conducted.	01 – Baharini 02 – Kaptembwo 03 – London
104	Record the grid cell where the interview is conducted.	[Enter cell ID]
105	Record the location of the interview.	[GPS]
106	Is a household representative present?	01 – Yes 02 – No
Introduce yourself: **Good day, my name is ____. I am working with the German Institute of Development and Sustainability in cooperation with Egerton University. We are conducting a survey about sanitation, health and the environment in the NAWASSCO area of Nakuru. We would like to collect this information because we want to learn more about sanitation quality in the city. Your answers will be treated confidentially so that no one can link you with your responses. You do not have to be in the survey, but we hope you will agree to answer the questions since your views are important. There are no wrong answers to our questions; we are interested in your personal opinion.**		
107	What is your relationship to the household head? (Select respondent position in the household.)	01 – Household head 02 – Partner of household head 03 – Elderly household member 04 – Other (specify): _____ 05 – None of the above
108	Do you agree to be interviewed?	01 – Yes 02 – No

2) Socio-economic characteristics

First, we would like to ask some general questions about your household.

NO.	QUESTION	CODING CATEGORIES
HOUSEHOLD OBSERVATIONS		
201	Observe main materials of the dwelling. Record observation. (SC for each segment)	**A – Main Walls** 01 – Natural (Cane, Palm, Trunks, Dirt) 02 – Rudimentary (Bamboo / Stone with mud, uncovered adobe, cardboard, reused wood) 03 – Finished (Cement, Stone with cement, Bricks, Cement, Covered Adobe, Wood Planks) **B – Roof** 01 – Natural (Thatch, Palm Leaf, Sod) 02 – Rudimentary (Rustic mat, Bamboo, Wood planks, Cardboard) 03 – Finished (Metal, Ceramic tiles, Cement, Roofing shingles)
BASIC PERSONAL INFORMATION		
202	Observe the gender of the respondent.	01 – Male 02 – Female 03 – Other
203	How old are you in years?	[NUMBER]
204	What is your current marital status?	01 – Married & living together 02 – Married & living separated 03 – Divorced 04 – Widowed 05 – Never married and never lived together (single)
HOUSEHOLD MEMBERS		
205	How many people live in your household, you included?	[NUMBER]
206	How many household members are infants younger than 1 year old?	[NUMBER]
207	How many household members are children from 1 to 4 years old?	[NUMBER]
208	How many household members are children from 5 to 16 years old?	[NUMBER]

NO.	QUESTION	CODING CATEGORIES
EDUCATION		
209	Can you read and write?	01 – Yes 02 – Somewhat 03 – No
210	What is the highest level of education you have achieved?	01 – None 02 – Primary school 03 – Secondary school 04 – Vocational 05 – University degree
INCOME		
211	What are currently the main sources of household income? (MC)	01 – Salary / Regular wages 02 – Daily wages 03 – Vending (market / road side) 04 – Own business / self-employment 05 – Pensions 06 – Rents 07 – Credit 08 – Support from family / friends 09 – Other (specify): _____
212	What is the average household income per month?	01 – 10,000 Ksh or less 02 – 10,001 to 20,000 Ksh 03 – 20,001 to 30,000 Ksh 04 – 30,001 to 40,000 Ksh 05 – 40,001 to 50,000 Ksh 06 – 50,001 to 100,000 Ksh 07 – Over 100.000 Ksh -99 – Don't know / Don't want to tell
ORIGIN AND LANGUAGE		
213	For how long have you lived in Nakuru City?	01 – Always lived here 02 – For over 10 years 03 – For 6-10 years 04 – For 2-5 years 05 – For 1 year or less
214	From where did you move to Nakuru City?	01 – Village / rural area 02 – Another city

NO.	QUESTION	CODING CATEGORIES
215	What languages do household members speak among each other? (MC)	01 – Kiswahili 02 – Kikuyu 03 – Kalenjin 04 – Luo 05 – Luhya 06 – Kamba 07 – Somali 08 – Kisii 09 – Mijikenda 10 – An Indian language (Hindi, Gujarati, Bengali …) 11 – English 12 – Other (specify): _____ 13 – Response declined
216	What religion(s) do household members practice?	01 – Christianity 02 – Islam 03 – Hinduism 04 – None 05 – Other (specify): _____
HOUSEHOLD ASSETS		
217	Does the household head own, rent, or lease the property?	01 – Owned → 220 02 – Rented 03 – Leased 04 – Occupied / informal 05 – Entrusted for free
218	If rented/leased: Who is the landlord?	01 – A private individual 02 – A private company 03 – A public organization 99 – Don’t know
219	If rented: How much rent do you pay per month?	01 – 2,000 Ksh or less 02 – 2,001 to 3,000 Ksh 03 – 3,001 to 5,000 Ksh 04 – More than 5,000 Ksh -99 – Don’t know / Don’t want to tell
220	If leased: How much lease do you pay per year?	01 – 10,000 Ksh or less 02 – 10,001 to 20,000 Ksh 03 – 20,001 to 30,000 Ksh 04 – Over 30,000 Ksh -99 – Don’t know / Don’t want to tell

NO.	QUESTION	CODING CATEGORIES
221	How many rooms does the house / apartment have, including the kitchen?	[NUMBER]
222	How many rooms in the house / apartment are used for sleeping?	[NUMBER]
223	Does your household have any of the following assets? (MC)	01 – Access to electricity 02 – Radio / speaker 03 – Television 04 – Refrigerator 05 – None
224	Do any household members own any of the following items? (MC)	01 – Mobile phone 02 – Bicycle 03 – Motorcycle / motor scooter 04 – Car / truck 05 – None

3) Water and sanitation

Now, we would like to ask some questions about your water and sanitation facilities.

NO.	QUESTION	CODING CATEGORIES
DRINKING WATER		
301	Where does the drinking water drinking for the household mainly come from? If unclear, observe.	**Piped water** 01 – Piped into house 02 – Piped into yard 03 – Public taps / standpipe **Dug well** 04 – Protected well 05 – Unprotected well **Others** 06 – Spring water 07 – Rain water 08 – Tanker truck 09 – Cart delivery 10 – Bought in bottles 11 – Water kiosk 12 – Other (specify):_____
302	How many minutes does it take to get to this water source from the house?	[NUMBER]
303	How many days per week do you receive water from this source?	[NUMBER]

NO.	QUESTION	CODING CATEGORIES
304	How do you store water from this source? (MC)	01 – Closed plastic containers 02 – Open plastic containers 03 – Closed skyplast containers 04 – Open skyplast containers 05 – Other (specify): _____ 06 – Don't store
305	Do you think the quality of this water good enough for drinking **without treatment**?	01 – Yes 02 – No 99 – Don't know
306	Does the drinking water have any of the following features? (MC)	01 – Salty 02 – Highly chlorinated 03 – Polluted with sand / dust 04 – Bad odor 05 – Other (specify): _____ 06 – None
307	What methods do you use to improve the quality of drinking water, if any? (MC)	01 – Bleach / chlorine 02 – Strain through cloth 03 – Water filter 04 – Boil 05 – Other (specify): _____ 06 – None
308	Do you use a different source of water for cooking or handwashing?	01 – Yes 02 – No → 310
WATER FOR COOKING / HANDWASHING		
309	Where does the water for cooking or handwashing for the household mainly come from? If unclear, observe	**Piped water** 01 – Piped into dwelling 02 – Piped into yard 03 – Public taps / standpipe **Dug well** 04 – Protected well 05 – Unprotected well **Others** 06 – Spring water 07 – Rain water 08 – Tanker truck 09 – Cart delivery 10 – Bought in bottles 11 – Water kiosk 12 – Other (specify): _____

NO.	QUESTION	CODING CATEGORIES
310	Does the water for cooking/handwashing have any of the following features? (MC)	01 – Salty 02 – Highly chlorinated 03 – Polluted with sand / dust 04 – Bad odor 05 – Other (specify): _____ -99 – Does not apply
311	Is the cost of water a financial burden for the household?	01 – Strongly agree 02 – Somewhat agree 03 – Somewhat disagree 04 – Strongly disagree 99 – Don't know the cost of water / Included in rent
312	Overall, how content are you with the access to water available to your household?	01 – Very content 02 – Somewhat content 03 – Somewhat discontent 04 – Very discontent
HANDWASHING		
313	We would like to learn about the places that households use to wash their hands. Where do household members most often wash their hands? [If possible, observe]	01 – Tap (with running water) 02 – Bucket / container 03 – No place for handwashing nearby
314	Is there always soap or detergent at the place for handwashing? [If possible, observe]	01 – Soap / detergent present 02 – No soap / detergent
SANITATION FACILITIES		
315	What kind of toilet facility do members of your household usually use? [If unknown, ask for permission to observe facility.]	**Flush toilet / pour flush** 01 – … to piped sewer system 02 – … to septic tank 03 – … to pit latrine 04 – … to somewhere else 05 – … to unknown **Pit latrine** 06 – ventilated improved 07 – with slab 08 – without slab / open pit **Other** **09 – Compost toilet** **10 – Bucket toilet** **11 – No facility / bush / field** **12 – Other (specify): _____**

NO.	QUESTION	CODING CATEGORIES
316	If pit latrine: Is it lined, does it have solid sidewalls? [If unknown, ask for permission to observe facility.]	01 – Yes (lined pit) 02 – No (traditional pit) 99 – Don't know -99 – No pit latrine
317	Where is this toilet facility located?	01 – In own dwelling → 319 02 – In own yard / plot 03 – In the neighborhood 04 – Other (specify): _____
318	How long do you have to walk to this this toilet from your residence (one-way)?	[NUMBER]
319	If toilet not in dwelling: Do you ever feel insecure / anxious about going to the toilet/latrine at night?	01 – Yes 02 – Somewhat/Sometimes 03 – No
320	Do you share this toilet facility with other households, and if so, with how many, including your own?	01 – Don't share toilet→ 324 02 – 2 to 5 03 – 6 to 10 04 – More than 10 99 – Don't know
321	If shared: Who owns this toilet facility?	01 – The property owner 02 – The neighborhood community 03 – The government 05 – Other (specify): _____ 99 – Don't know
322	If shared: How is the toilet use paid for?	01 – Each use has to be paid [NUMBER] Ksh 02 – Use is free of charge 03 – Included in rent / lease
323	If shared: Do any of the following issues apply to this toilet facility? (MC)	01 – Crowded at peak hours (morning / evening) 02 – Dirty 03 – Smelly 04 – Not maintained properly 05 – Other (specify): _____
324	If shared: What kind of materials beyond excreta do people dispose in the toilet? (MC)	01 – Household trash 02 – Grey water (e.g. from cooking) 03 – Animal excreta 04 – Other (specify): _____ 05 – None
325	Who is responsible for cleaning of the toilet facility?	01 – The household 02 – The property owner 03 – The neighborhood community 04 – Other (specify): _____ 99 – Don't know

NO.	QUESTION	CODING CATEGORIES
326	Whom do you contact if an issue with the toilet facility arises? (It could be clogged, full, etc.)	01 – The property owner 02 – A technician / expert 03 – The chief 04 – No one (would handle it myself) 05 – Other (specify): _____ 99 – Don't know
327	If onsite facility: What do you do when the toilet is full or flooding over?	01 – Have it emptied 02 – Use a different one → 330 03 – Dig a new one → 330 04 – Other (specify): _____ 99 – Don't know → 330 -99 – Does not apply → 330
328	If emptied: Who emptied the onsite facility last time?	01 – Truck operators 02 – Manual pit workers 03 – Local inhabitants 99 – Don't know -99 – Does not apply
329	If emptied: Who pays for the emptying?	01 – Household pays 02 – Landlord pays / included in rent / lease 03 – Don't know
330	If emptied: How much does one emptying cost?	[NUMBER] Ksh -99 – Don't know
331	If emptied: How often is the onsite facility emptied?	01 – Several times per month 02 – Several times per year 03 – Once per year 04 – Every few years 05 – Has never been emptied 99 – Don't know
332	How content are you with the toilet access available to your household?	01 – Very content 02 – Somewhat content 03 – Somewhat discontent 04 – Very discontent
333	Do you think waste water/sewage has an effect on the health of household members?	01 – Yes 02 – No 99 – Don't know

NO.	QUESTION	CODING CATEGORIES
334	What aspect of your toilet facility, if any, is a challenge for you or the household members? (MC)	01 – Costs 02 – Distance 03 – Lack of cleanliness 04 – Inconvenience of use 05 – Lack of privacy 06 – Insecurity of use / technical security 07 – Insecurity (e.g. at night) 08 – Other (specify): _____ 09 – None

4) Health

Now, we would like to ask some questions about health in your household.

NO.	QUESTION	CODING CATEGORIES
FOOD INTAKE		
401	During the last month, was there any day you worried the household would not have enough food to eat?	01 – Yes 02 – No
402	If children part of household: Are any of the children under 5 in the household underweight or overweight? (MC)	01 – Yes, underweight 02 – Yes, overweight 03 – No
403	Over the last week, where did the household mainly get its meals from? (MC)	01 – Cooked in the house 02 – From roadside vendors 03 – Restaurants
GENERAL HEALTH		
404	How worried are you currently about the health of the household members, you included?	01 – Not worried at all 02 – Somewhat worried 03 – Very worried
405	Are there household members who have any kind of disability? (MC)	01 – Yes, physical disability 02 – Yes, mental disability 03 – None
DISEASE INCIDENCE		
406	Did you or any members of the household experience any of the following symptoms within the last month? (MC)	01 – Abdominal pain or cramps 02 – Fever 03 – Lightheadedness or dizziness 04 – Frequent loose, watery stools (*kuharisha*) 05 – None

NO.	QUESTION	CODING CATEGORIES
407	If children are part of the household: Did any of the children under 5 in the household experience any of the following symptoms within the last month? (MC)	01 – Abdominal pain or cramps 02 – Fever 03 – Lightheadedness or dizziness 04 – Frequent loose, watery stools (*kuharisha*) 05 – None -99 – No children
408	Did a medical professional diagnose you or any members of your household with any infectious disease over the last 6 months? (MC)	01 – Malaria 02 – Dengue 03 – Cholera 04 – Dysentery 05 – Typhoid 06 – Gastroenteritis 07 – Tuberculosis 08 – Covid-19 09 – Hepatitis 10 – Schistosomiasis 11 – Eye infection 12 – Skin infection 13 – Other (specify): _____ 14 – None
409	Did a medical professional diagnose you or any members of your household with any chronic disease? (MC)	01 – Cardiovascular (Hypertension, Cardiomyopathy, etc.) 02 – Asthma 03 – Diabetes 04 – Skeletal fluorosis 05 – Tuberculosis 06 – Cancer 07 – Other (specify): _____ 08 – None
HEALTH FINANCING & INSURANCE		
410	What kind of medical experts would you go see if you or somebody else in your household got sick? (MC)	01 – Public primary healthcare center 02 – Private doctor / clinic 03 – Traditional medicine practitioner 04 – Free health camp 05 – Other (specify): _____ 06 – None
411	Imagine a household member broke an arm: Could you afford professional medical treatment?	01 – Yes 02 – No

NO.	QUESTION	CODING CATEGORIES
412	How do you finance health expenditures? (MC)	01 – Out of pocket 02 – Personal savings 03 – Public Health Insurance (NHIF) 04 – Private Health Insurance 05 – Borrow from friends/family 06 – Borrow from bank/credit institute/money lender 07 – Gift from friends/family 08 – Other (specify): _____

5) Environment

We would like to ask some questions about the environment of your household and the city now.

NO.	QUESTION	CODING CATEGORIES
501	How content are you with the cleanliness of your household surroundings?	01 – Very content 02 – Somewhat content 03 – Somewhat discontent 04 – Very discontent
502	Do you regularly notice unpleasant smells in the proximity of the house?	01 – Yes 02 – No
503	Is solid waste collected from your home?	01 – Yes → 505 02 – No
504	If it is not collected, where do you usually dispose your solid household waste? (MC)	01 – Garbage dump 02 – In the environment 03 – Burn 04 – Bury 05 – Into a pit latrine / toilet 06 – Other (specify): _____ -99 – Does not apply
505	What types of domesticated animals are often present around the house? (MC) [Also observe]	01 – Cows / bulls / cattle 02 – Horses / donkeys / mules 03 – Goats / sheep 04 – Pigs 05 – Cats / dogs 06 – Chickens / poultry 07 – None

NO.	QUESTION	CODING CATEGORIES
506	What types of other animals (e.g.: rodents, insects) are often present in and around the house or toilet facility? (MC)	01 – Mosquitoes 02 – Cockroaches 03 – Bed bugs 04 – Snails 05 – Rats / rodents 06 – Other (specify): _____ 07 – None
507	Does water repeatedly stagnate in the proximity of the house?	01 – Yes 02 – No → 509
508	What are possible reasons for the stagnation of water? (MC)	01 – Heavy rain / flooding 02 – Insufficient drainage 03 – Sewerage discharge 04 – Terrain (low elevation) 99 – Don’t know -99 – Does not apply
509	Do you experience an overflow of latrines/waste water channels during heavy rainfall / flash floods?	01 – Yes 02 – No → 512
510	In case of heavy rain /flash floods: does the water ever enter your house?	01 – Yes 02 – No
511	In case of heavy rain /flash floods: do you notice a contamination of your drinking water?	01 – Yes 02 – No
512	Over the last 5 years, have you noticed or heard of any changes in Lake Nakuru?	01 – Yes 02 – No → 514
513	If you noticed changes, which exactly? (MC)	01 – Rising surface level 02 – Falling surface level 03 – Increased pollution 04 – Decreased pollution 05 – Increased wildlife 06 – Decreased wildlife 07 – Other (specify): _____ -99 – Does not apply
514	Do you think waste water/sewage has an effect on Lake Nakuru?	01 – Yes 02 – No 99 – Don’t know
515	Have you ever visited Lake Nakuru National Park?	01 – Yes 02 – No

6) Governance

Lastly, we would like to ask some questions about your knowledge and opinion about service delivery.

NO.	QUESTION	CODING CATEGORIES
TOPIC		
601	Are you aware of any formal rights you have regarding access to safe water and sanitation?	01 – Yes 02 – No → 603
602	If yes to 601: Can you name any rights? (MC)	01 – Right to water 02 – Right to safe sanitation 03 – Other (specify): _____ 04 – No
603	Who do you think should be responsible for providing safe sanitation? (MC)	01 – Public authorities (city, county, national levels) 02 – Private companies 03 – Individual households 04 – Property owners 05 – Other (specify): _____ 06 – Don't know
604	In general, how satisfied are you with the overall work of the county government of Nakuru?	01 – Very satisfied 02 – Somewhat satisfied 03 – Somewhat unsatisfied 04 – Very unsatisfied 99 – Response declined
605	In general, how satisfied are you with the overall work of the national government of Kenya?	01 – Very satisfied 02 – Somewhat satisfied 03 – Somewhat unsatisfied 04 – Very unsatisfied 99 – Response declined
606	Did you vote in the 2022 Kenyan general election?	01 – Yes 02 – No 98 – No right to vote 99 – Response declined

7) Conclusion

NO.	QUESTION	CODING CATEGORIES
TOPIC		
701	We would like to select households for in-depth interviews or group discussions about sanitation practices and perceptions. These will take longer than this survey. Would you be interested in participating?	01 – Yes 02 – No
702	Do you have any further comments or suggestions?	01 – Yes, specify: _____ 02 – No
703	Own notes of the interviewer.	Specify: _____

Thank you for you cooperation and have a good day!

[End interview.]

Annex 4: Guideline of semi-structured interviews

Thank you for taking part in our research. We are X and Y, research fellows at the German Institute of Development and Sustainability. X will mainly guide you through the interview, while Y will be taking notes, so that we can remember what you have told us. However, Y might ask some questions, too, if necessary.

Together with NAWASSCO and Egerton University, we are conducting a three-month research project on the challenges of providing safe sanitation in Nakuru City. (Sanitation refers to the systems and practices used to keep places clean and hygienic, particularly in relation to the disposal of human waste water.)

The project looks at how sanitation is officially regulated and how it is actually being practiced/ done. It studies the impact of urban sanitation on people's health and the environment. The aim of the research is to find opportunities for improvement in the sanitation sector of Nakuru City. In our research, we use a combination of different methods like talking to people and studying data, for example on where sanitation works well and where it should be strengthened.

Our interview will last about 30 to 60 minutes. The questions we prepared – on your work, sanitation, its development, present status, and future – only provide a loose structure. So please feel free to intervene at any time. There are no right or wrong answers. You are the expert, and we are interested in your opinion.

Do you have any further questions? No? Then I will now start the audio recording.

Your work	**1.**	**Could you please introduce yourself briefly?** **Can you tell us more about your work and what role sanitation plays in it.**	**RQ 2**
	1a.	**What activities/projects, etc. are you currently working on that are related to sanitation/WASH?**	**RQ 1 & 2**
	2.	**When you talk about sanitation, what do you mean by it?** – **How would you define safe sanitation?**	/
	3.	**Who do you cooperate with regarding sanitation? Can you describe the cooperation in detail?** – If not mentioned, ask for: Do you also cooperate with any **community-based organizations**? – How do you see your relationship to NAWASSCO? – How do you see your relationship to the County Department of Health & Sanitation?	**RQ 2**
Sanitation in General	**4.**	**How would you describe the current sanitation situation in your sublocation?** *(Where you work as a XXX)* – How do you perceive the sanitation facilities as well as the removal and transportation of feces in your sublocation?	**RQ 2**

Evolution of Sanitation	**5.**	**According to your experience, how has the sanitation situation changed over the past years in your sublocation? What has improved? What has gotten worse?** – Sanitation situation concerns among others: sanitation facilities as well as the removal and transportation of feces in your sublocation – **How would you explain these developments?** – **What other factors influenced these developments?**	**RQ 2**
Distribution of Respons-ibilities	**6.**	**How do you perceive the distribution of responsibilities regarding sanitation in Nakuru City at the moment?** **How do you perceive the role of … regarding sanitation in Nakuru City?** - **state (local administration, county government, national government)** - **institutions (education, religious, ...)** - **private sector (water providers, truck operators, …)** - **civil society (NGOs)** - **communities**	**RQ 2, 4**
	7.	**Who do you think should be responsible for providing safe sanitation?** - **Public authorities, private companies, individual households, property owners, or others?**	**RQ 4**
Impact of Sanitation	**8.**	**<u>What</u> do you think are the most important effects of the current sanitation situation in your sublocation?** - **… on the economy?** - **… on the society?** - **… on human health?** - **… on the environment?** **<u>And in Nakuru City</u>?**	**RQ 3**
	9.	**How are these effects distributed within the city [sublocation]? Are some communities more affected than others? Which? Why?** *[In case question about city level cannot be answered, ask for sublocation.]*	**RQ 4**
Future of Sanitation	**10.**	**What are the most important challenges for providing safe sanitation in the future? How could they be addressed?**	**RQ 4**
	11.	**From your perspective, what are promising opportunities to improve sanitation situation?** - **Quality: Onsite / offsite?**	**RQ 4**
	12.	**From our side, we have now reached the end of the interview. Would you like to add anything from your side, or do you have any further questions?**	**/**

Annex 5: Informed consent form

Informed Consent Form: Qualitative Interview for 'Sanitation Governance and Its Implications on Environmental Health in Nakuru City, Kenya'

(Duration: March to April 2023)

Informed Consent Form for _____
Name the individual(s) for whom this consent is written.

Name of Investigator: _____

Name of Organization: _____

This Informed Consent Form has two parts:

Information Sheet (to share information about the interview with you)
Certificate of Consent (for signatures if you choose to participate)

Part I: Information Sheet

Abstract

We are conducting research on sanitation, health, and the environment in Nakuru City. We want to ask about your expertise, experiences and perspectives on sanitation, which will take about one hour. We will interview other stakeholders to get a comprehensive understanding of the sanitation situation in the city. There are no major risks or short-term benefits you can expect from participating. But we hope to contribute to future improvements of sanitation in Nakuru which may also benefit you and your department. Unfortunately, we cannot financially compensate you. The participation in our interview, which is conducted for scientific purposes only, is voluntary. You can always contact us for more information. Our contact details are provided below. ***We ask for your consent to conduct the interview with you and record it on audio equipment*** *(see Part II, Certificate of Consent)*.

Introduction

I, _____, and _____, Postgraduate Researchers at the German Institute of Development and Sustainability (IDOS), Tulpenfeld 6, 53113 Bonn, Germany, will be conducting the qualitative interview under the guidance of Dr Saravanan V Subramanian (saravanan.subramanian@idos-research.de). We invite you to take part in our research study "Sanitation Governance and Its Implications on Environmental Health in Nakuru City, Kenya". The study seeks to identify processes and structures of sanitation governance at different levels, their implications on environmental health, and their determinants.

This document aims to inform you about the research and the measures taken to safeguard your privacy rights so that you can make a well-informed decision regarding your participation. All statements and information in this form are compliant with the "General Data Protection

Regulation (GDPR)" of the European Union and the German "Federal Data Protection Act (BDSG)". We are strictly bound to these laws, which were designed to protect you against any misuse of the information you give us.

Purpose of the research

You are being asked to take part in this research study because your expertise on sanitation governance in the city of Nakuru is of special interest.

The purpose of this research study is to obtain information on (a) how policies and legislations affect sanitation, (b) how sanitation is practiced at the city, ward, and household level, (c) the implications of these practices on health and the environment, and (d) what determines these practices. Next to in-depth interviews, which our research team will conduct in the months of March and April 2023, approximately 300 people will participate in a household survey in three wards of Nakuru City.

Procedures

We would like to ask several questions concerning sanitation governance and its consequences. There are no right or wrong answers; we want to learn more about your perspective. The interview will be conducted by 1-2 members of the IDOS research team and will be recorded in order to be able to transcribe it afterwards and analyze it anonymously. The data is stored safely on a secure cloud in compliance with data protection requirements. Your involvement will last approximately an hour. Apart from you, we will also these questions to other stakeholders in the sanitation sector of Nakuru County and City.

Statement of confidentiality

The information you provide will be kept strictly confidential. We will share the information only within the research team. Your name will not be used so we can describe what you think without anyone knowing that it is you.

The information collected through this interview will be stored on a computer and used to prepare a transcript. The anonymized information will be shared with our partners at Egerton University. Your anonymized research records are reviewed, stored, and analyzed in a secured cloud storage.

In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

Compensation for participation

You will not receive any compensation for taking part in the interview.

Voluntary participation

Taking part in this interview is voluntary. If you choose to take part, you can choose not to answer any question. You have the right to reject your participation or stop participating in this study at any time. If you decide not to participate or choose to stop participating in the research at a later date, there will be no negative consequences, penalties, or loss of benefits.

Contact information for questions or concerns

You have the right to ask any questions about this research. If you have questions, complaints, or concerns, please feel free to contact the principal investigator, Dr Saravanan V Subramanian (Saravanan.Subramanian@idos-research.de).

Part II: Certificate of Consent

Before deciding on taking part in this interview, you should have:

- *been able to discuss this study with an investigator*
- *reviewed the information in this form*
- *had the opportunity to ask any questions you may have*

Your signature below means that you have received this information, have asked the questions you currently have about the research, and have received answers to those questions.
Do you have any questions at this point? You can ask us anything that you did not understand or want to know.

I, _____, after being informed about the project described in this format, and having all my questions and concerns about this project answered, voluntarily accept to participate in this project. I have had the opportunity to ask any questions related to the project. I understand the procedures of the project and how the information will be treated confidentially, without revealing the identity of any person participating in the project in any result reported or published. I give my authorization to give access to this information to all members of the research team, knowing that this information will be used confidentially. I understand that my consent does not take away any legal rights in the case of negligence or other legal fault of anyone who is involved in this study. I further understand that nothing in this consent form is intended to replace any applicable laws.

Participant: By signing this consent form, you indicate that you are voluntarily choosing to take part in this research.

_____	_____	_____
Signature of participant	Name	Date
or thumb impression		

Person interviewing / explaining the research: Your signature below means that you have explained the research to the participant or participant representative and have answered any questions about the research.

_____	_____	_____
Signature of interviewer	Name	Date
or thumb impression		

Annex 6: Transcription rules (for manual transcription editing)

(Adapted from Dresing, Thorsten/Pehl, Thorsten (2015): Manual (on) Transcription – Transcription Conventions, Software Guides and Practical Hints for Qualitative Researchers, 3rd Edition).

- Fully transcribe, do not summarize. If a (partial) sentence is unclear in its wording, it should be preserved exactly as spoken, but a comment in square brackets can be inserted within the transcription text to provide clarification for better understanding during coding.
- In general, the entire interview should be transcribed. Mark passages of the interview that are not relevant to our research and thus not relevant to coding and analysis of the transcript in light gray (within these italicized passages, manual editing is less relevant as they will likely be skimmed during analysis), plus optional comments in square brackets, e.g., [interruption due to phone call], [recommendation of good restaurants in Nakuru, not transcribed]. Highlight key messages of the interview that may be considered as quotes for the report in bold and italic.
- Difficult-to-understand words with ambiguous meaning should be marked in red.
- If words or parts of sentences are completely unintelligible, use ...?... (one word unintelligible) and ...???... (multiple words unintelligible).
- Names and companies should be replaced with (person), (organization), etc., for anonymization purposes, unless they are public figures (e.g., NAWASSCO, NEMA) or information that does not reveal the identity of the interviewee.
- Sentence breaks or unfinished sentences should be marked with / to facilitate recognition of meaningful units during later analysis.
- Word interruptions and stuttering should be omitted (if transcribed automatically by F4x, they should be deleted). Word duplications should only be transcribed if used for emphasis/reinforcement (e.g., “This is very very important to me.”).
- Affirmative utterances by the interviewer, such as “uh-huh, yes, right”, etc., should not be transcribed (if transcribed automatically by F4x, they should be deleted) (for details, see point k).
- Monosyllabic answers should be transcribed and accompanied by an interpretation, e.g., “Mhm (affirmative)” or “Mhm (negative)” or “Mh (thoughtful)”.
- Filler words (if not falling under point h) should be removed whenever possible for better readability, unless they indicate clear hesitation by the interviewee
- Interjections, interrupted follow-up questions, started sentences, etc., by the non-speaking person should be transcribed in the paragraph of the speaking person, enclosed in parentheses, and marked in bold (e.g., “So yesterday I went (oh that means) to the WWTP”).
- Emotional nonverbal expressions of all participants that support or clarify statements should be transcribed in parentheses, e.g., (laughter), (sighs) — if a nonverbal expression is from the non-speaking person within the paragraph of the speaking person, refer to point k, i.e., also enclose it in parentheses and mark it in bold (e.g., “You can imagine that was really remarkable (laughter) (laughter) and I had to...”).
- Look up and correctly enter abbreviations used by the interviewee, if necessary.

- Units of measurement such as “liter” and “meter” should always be spelled out for consistency. Percentages should be written with the “per cent” sign (e.g., 70 per cent of the people...).
- “zero” to “twelve” should be spelled out, while numbers from 12 onwards should be written as numerals. Thousands should be separated by commas (e.g., prices at the WWTP = 15,000).
- If direct speech is quoted in a recording, the quote should be enclosed in quotation marks (e.g., and then I said, “Well, let’s see about that.”).