5

Small Towns in Arid Lands

Unreliable Piped Water Services and Flash Floods in Lodwar

5.1 Introduction

About 600 km northwest of the Kenyan capital, Nairobi, lies the country's largest, driest and poorest county – Turkana. With daytime temperatures hovering around 35°C and virtually no rainfall for most of the year, the stark aridness of the landscape is characterised by a few hardy trees and red dusty expanses where seasonal gullies and channels are the only fingerprints of rare but intense rainfall events. Lodwar, the largest town and headquarters of Turkana County, is nestled between two rivers and overlooked by black volcanic hills. One of the two rivers is the Turkwel, the only perennial river in the county that originates from southern Uganda, flowing north from Mount Elgon and draining into Lake Turkana – the world's largest desert lake. Boreholes dug along the Turkwel serve the town's 83,000 people through a piped water network, though supply is highly unreliable and unequal across the town's neighbourhoods (Tanui et al., 2020). The other river is the Kawalase, a seasonal river or 'laaga' as they are called, which has earned the nickname of the 'river of death' for its dangerous flash floods that engulf cattle, vehicles, and anyone unlucky enough to be caught in their violent and sudden path.

While Turkana also has a bimodal rainfall pattern like Kitui, rainfall in the Turkwel basin exhibits high spatial variation, ranging from 900 to 1,700 mm per year in the upstream areas to only 200 mm in the downstream section where Lodwar is located (Hirpa et al., 2018) (Figure 5.1). Droughts are common in these arid and semi-arid landscapes in the Horn of Africa and occur due to a complex interaction of hydroclimatic factors resulting in consecutive failed rains during the October–December 'short rains' season. Two of the most severe droughts of the twenty-first century occurred in 2017 – the year we started our fieldwork in Lodwar, and in 2022 – the year we are writing this chapter. And in between these years, Kenya recorded some of the wettest years in recent history, raising alarms

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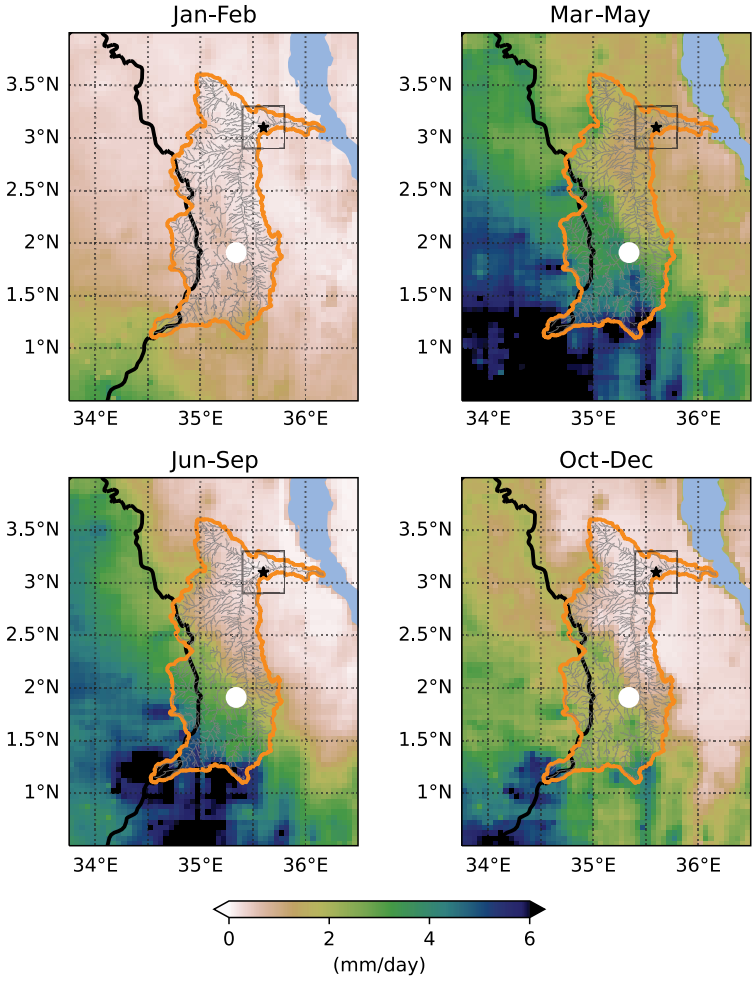


Figure 5.1 Charts showing spatial variations in rainfall in the Turkwel River basin (orange boundary) across different months. (Star shows location of Lodwar town, and white dot shows Turkwel Gorge dam). Map drawn by Ellen Dyer using rainfall data from 2016 to 2022 available from the Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS).

of widespread flooding in late 2020 as the Turkwel dam was at risk of overflowing for the first time since its construction in the late 1980s (Macharia, 2020).

Turkana has always been a land of extremes, not only in terms of climate but also in its geopolitical importance. Inhabited by nomadic pastoralists who periodically fight over scarce grazing grounds, Turkana has long been treated as an area of low economic value and unworthy of development investments, both by the colonial and post-independence regimes. The result is that today the county has the highest poverty rate in Kenya, with four out of five people living in absolute poverty, unable to meet the very basic needs for food and drinking water. Adult

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literacy is 20 per cent and less than half of school-aged children are enrolled in primary school. Following a century of social exclusion, it is not surprising that the locals have a sense of separation, and they often joke that they are travelling to Nairobi to visit Kenya.

However, in the past decade, Turkana, and Lodwar in particular, came to the limelight with the discovery of oil in 2012 and two major aquifers in 2013. At the same time, the ongoing construction of the LAPSSET (Lamu Port – South Sudan – Ethiopia Transport) corridor – an ambitious infrastructure development project for connecting 160 million people across four East African countries – has elevated the strategic importance of Lodwar as it links Kenya with neighbouring South Sudan and Uganda (Schilling et al., 2016). To what extent the benefits of these developments will be passed on to the Turkana people is unknown, but for now the hopes of better economic opportunities and living standards have made Lodwar a desired destination for many rural migrants. International aid organisations, construction companies, and businesses are increasingly making a base in Lodwar. Thus, what was once a 'closed district' under British colonial administration is now well connected to the world, with multiple direct flights between Lodwar and Nairobi every day.

But life in Lodwar is not easy and one of the many challenges is water. Despite being cradled by two rivers and close to a reportedly large groundwater reserve, Lodwar remains a thirsty town due to significant institutional and operational risks associated with the town's piped water supply. The town's growing population, having almost doubled between the 2009 and 2019 census, and the planned irrigation schemes upstream along the Turkwel River are driving up demand for groundwater resources. At the same time, frequent occurrence of severe droughts is constraining water availability in the basin by reducing run off and groundwater recharge. The problem of too little water also coexists with that of too much water, as a section of the town's residents live in fear of being swept away by flash floods often occurring in May or October. The decision to relocate to safer grounds has opportunity costs. Life outside the town boundary is challenging with limited income sources and no water, education, or healthcare facilities. For those who decide to move away, the 'river of death' ultimately becomes their lifeline. The scoop holes and shallow wells on the riverbed may not provide safe water, but it becomes the only reliable and affordable source.

Lodwar offers a unique opportunity to understand how people negotiate between two different water risks – exposure to flash floods and drinking water services – while trying to make a living within an urban space. While risks emerge from the interplay of environmental, institutional, and economic factors, who is at risk and how they navigate them depends on their intersectional identities – their gender and age, where they are from, their family and relationships, their education, and

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socioeconomic status. In this chapter, we delve into the life histories and water diaries of the people of Lodwar to explore how experiences of risks are differentiated across social and spatial axes. We embed these stories within the broader landscape of development activities and climate change in the region to discuss how risks are likely to play out in future.

5.2 Drought, Destitution, and Development

In 2022–2023, as the world continued to recover from the COVID-19 pandemic and the economic repercussions of Russia's invasion of Ukraine, countries in the Horn of Africa endured the worst drought in four decades. Major rainfall deficits for five consecutive rainy seasons since late 2020 led to drying up of soil moisture and waterways, causing crop failure, widespread death of livestock and severe hunger, with 25 million people in Kenya, Ethiopia, and Somalia facing extreme water insecurity (OCHA, 2023). The drought was the result of a prolonged multi-year La Niña event and a concurrent negative phase of the Indian Ocean Dipole, both of which caused dry weather and high temperatures in East Africa by pulling away moisture towards Southeast Asia. While the El Niño-La Niña cycles and the Indian Ocean Dipole – periodic fluctuations in ocean temperatures – are natural phenomena driving global climate and precipitation patterns, overall rise in sea surface temperatures caused by climate change is thought to amplify the intensity of these events in recent years.

Droughts are a defining characteristic of these arid and semi-arid regions, and have been instrumental in shaping the livelihood strategies, population dynamics and development trajectory of Turkana, with implications for present-day water insecurities in Lodwar. For centuries, the nomadic pastoralists of Turkana have used their knowledge of the environment and social networks to strategically navigate these fragile landscapes in search of water and pasture for their livestock. To cope with prolonged dry spells, pastoralists adopted flexible herd management practices, including herd diversification, herd-splitting and clear sex- and age-set-based division of labour (McCabe, 1990). Persistent droughts exacerbated livestock raids and ethnic conflicts over access to dry-season pasturelands, notably with the Merille tribe in bordering southern Ethiopia and the Pokot tribe in West Pokot and Baringo Counties in Kenya and the Pokot District in bordering eastern Uganda.

Throughout the twentieth century, however, the resilience of Turkana herders has been eroded through a combination of geopolitical and environmental pressures, many of which can be traced back to the exploitative policies of the British colonial administration (Abdullahi, 1997). The Turkana people, who actively resisted British domination of their homelands, were considered a nuisance to

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the European farmers in neighbouring Trans Nzoia County (Nicholas, 2018). At the same time, the pastoralists' primitive mode of production was of little economic value to the colonial regime. Thus, to 'contain' the Turkana pastoralists, the British launched a major punitive expedition, confiscating and slaughtering over a quarter million livestock, and deliberately segregating the Turkana people by declaring it a closed district in 1920 (Nicholas, 2018). The free movement of people, which was further restricted by demarcating national boundaries and reserving fertile land for commercial farming by white settlers, prevented the pastoralists' ability to balance seasonal variations in water and fodder availability across grazing areas.

The systemic decline in coping capacities increased pastoralists' vulnerability to droughts overtime, causing many herd owners to move into famine relief camps, food distribution sites, irrigation schemes, as well as small towns and trading centres, one of which is Lodwar (McCabe, 1990). A series of devastating droughts and famines in 1960–1961, 1974–1975, and 1980–1981 spurred the influx of relief and development efforts by the international donor community, with half of Turkana's residents being on relief rolls in the early 1980s (Akall, 2021). To enhance drought resilience and reduce relief dependency, the post-Independence Kenyan government and the donor community promoted shifts from pastoralism to irrigated agriculture and fishing in Lake Turkana (Derbyshire, 2020). Settled farming would also allow provision of basic services, such as clean water, healthcare, and education, that the Turkana people has historically been deprived of. Despite large capital investments, these projects mostly failed to achieve their objectives in the long term, as settled agriculture was a markedly different way of life that the pastoralists found difficult to adopt (Hogg, 1982).

The influx of donor investments in the mid 1980s, however, facilitated the transformation of Lodwar from a remote, dusty, and relatively inconsequential town into a growing economic centre with an array of shops and services. While the poorer cattleless Turkana migrated to Lodwar to seek humanitarian aid facilitated opportunities, herders and fishermen from surrounding villages gathered for trade and created demands for consumer goods. However, as aid money dried up in the 1990s, the drought-stricken pastoralists found themselves in a one-way poverty trap. Having spent more than a decade on the donor sponsored programmes, such as the food-for-work schemes under the Turkana Rehabilitation Project, the pastoralists lost the social networks to (re)establish themselves in the pastoral economy, without being able to establish a firm foothold in the new economic environment either (Broch-Due and Sanders, 1999). Today, Lodwar is home to many of these destitute people who struggle to survive in a cash economy, through meagre earnings from charcoal and firewood sale, basket weaving, beer brewing and casual labour, in the driest part of the entire county.

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5.3 An Obituary of a Water Utility

Across Turkana county, surface water sources, including seasonal rivers and shallow wells on dry riverbeds, and boreholes are predominantly used for drinking and domestic purposes. There are about 1,500 boreholes in the county, installed by various organisations over the past four decades – the most prominent of these being the Catholic Diocese of Lodwar. The diocese, which started its journey in the 1960s with the arrival of Irish missionaries, plays a pivotal role in provision of water, education, and healthcare services across the county. Only a handful of towns in Turkana have piped water network, but none as extensive as Lodwar. The responsibility of Lodwar's piped water supply lies with the Lodwar Water and Sanitation Company (LOWASCO) – a private utility operating since 2007 through a Service Provider Agreement with the Rift Valley Water Services Board. However, following the Turkana Water Act 2019, water service delivery in high-density areas will be contracted to one or more urban and rural water companies that will be regulated by the newly established Turkana County Water Department (Turkana County Water Act, 2019) (Figure 5.2).

The piped network is entirely dependent on groundwater from the shallow alluvial and intermediate aquifers recharged by the Turkwel River. Most of LOWASCO's production boreholes operate on hybrid pumping systems of solar and grid electricity, with average daily total abstractions ranging from 4,000 m^3 in the dry season to 5,200 m^3 in the wet season. While the boreholes yield enough



Figure 5.2 Typical dome-shaped huts in Lodwar with a metered LOWASCO water tap protruding from the ground (Photo credit: Sonia Hoque, February 2019).

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water to serve the municipality, as of 2019, the network covered only 58 per cent of the population in the service area with 8,000 connections (Olago and Tanui, 2023). Apart from individual household connections, water is supplied through communal points within a compound, kiosks, and a network of both utility and privately owned tanker trucks. The spatial heterogeneity in services is evident from the household survey we conducted in 2017, where 31 per cent of households within LOWASCO's service area reported using kiosks as their main water source, followed by 24 per cent who borrowed or bought from neighbours, 20 per cent who resorted to scoop holes or wells by the river, and only 19 per cent who used piped water within their dwelling or compound (Figure 5.3).

Jessica Ekodos, a 31-year-old mother of three, lives in Namakat village along the Turkwel. 'Life was good' when she moved here with her husband 16 years ago. Her husband worked as a security guard, while she walked door to door, selling Mandazi (Swahili fried bun) and vegetables. They were happy to find a place that is close to the town as well as the river which they used for drinking, washing, and bathing. Although there was no electricity or piped water, people had food to eat. She even took her children to ride the merry-go-round, as she fondly remembers.

A few years later, the village elders wrote an application to urge LOWASCO to connect this area to the piped network. Jessica's house was connected in 2014. But in 2016, they were disconnected due to outstanding bills. While LOWASCO said they had KES 7000 (USD 700)[1] due, Jessica believes it was not more than KES 500 (USD 5). Now they fetch water from their neighbour and contribute KES 100 (USD 1) to their bills.

For Lodwar's residents like Jessica, there are three main complaints about LOWASCO's water service: first, high connection charges which vary based on the household's location in relation to the main distribution pipe; second, faulty meters and discrepancies in billing often resulting in unusually high bills and disconnection due to outstanding payments; and third, an unreliable service meaning the taps can be dry for days or weeks at a time. Whether one is connected or not, water expenditures are usually quite high and unlike Kitui, there are no seasonal pulses in water sources and costs (Figure 5.4). Those fetching most of their water from own piped connections reported an average monthly bill of KES 500 (USD 5), while those getting from neighbours, handpumps or kiosks paid an average of KES 1,600 per month (USD 16) (Figure 5.5). Yet, regardless of source, the total volume of water used was only about 4 m^3 per month per household, equating to approximately 20 litre per capita per day.

Despite households bearing such a significant cost burden for water, more than 40 per cent of LOWASCO's water supplied is unaccounted for, posing a major threat to the sustainable service delivery. A network mapping study in 2018 confirmed that a

[1] Currency conversions are based on exchange rates at the time of data collection, averaging at USD 1 = KES 100 during 2018–2019.

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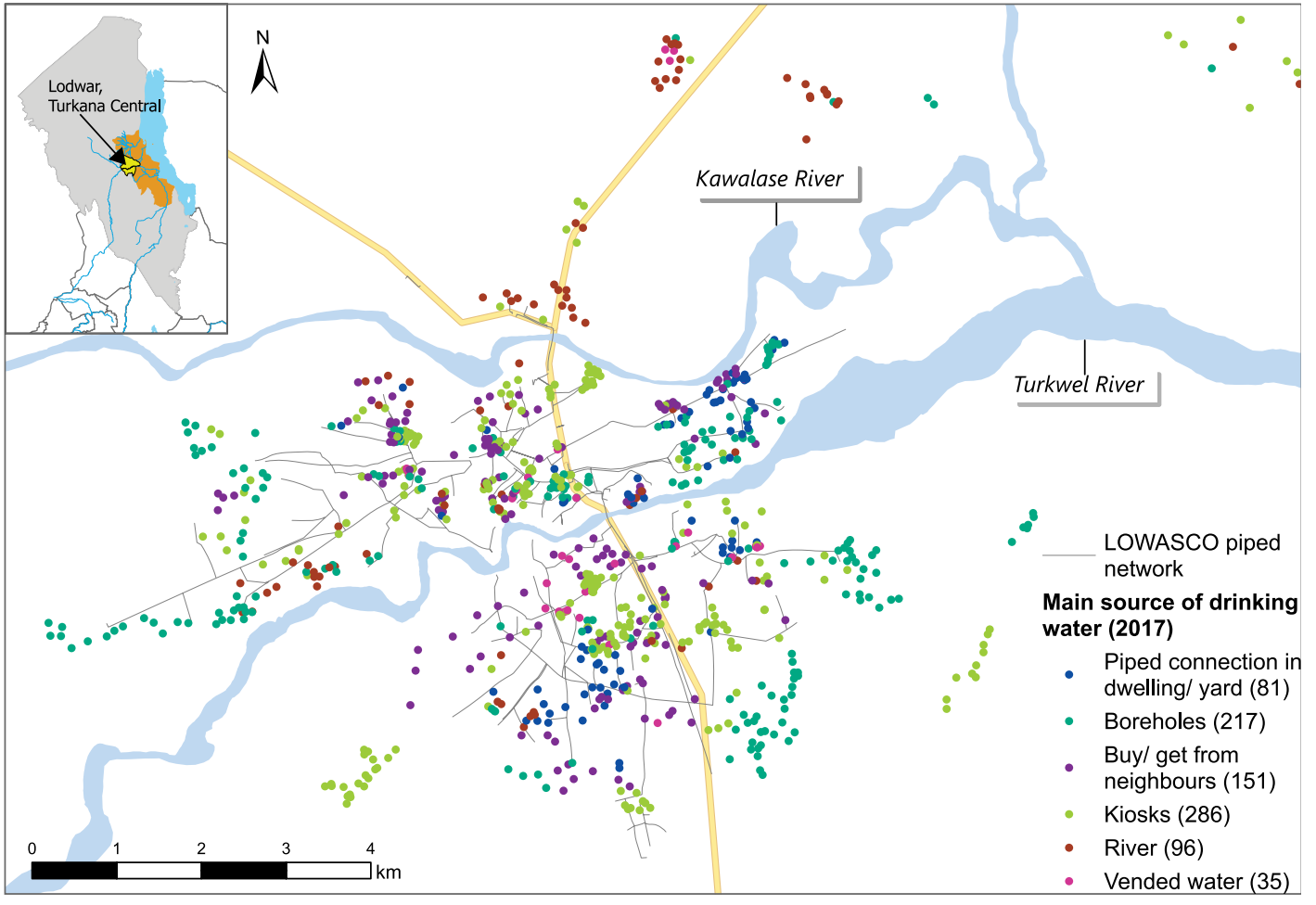


Figure 5.3 Main sources of drinking water reported by households in Lodwar town in 2017.

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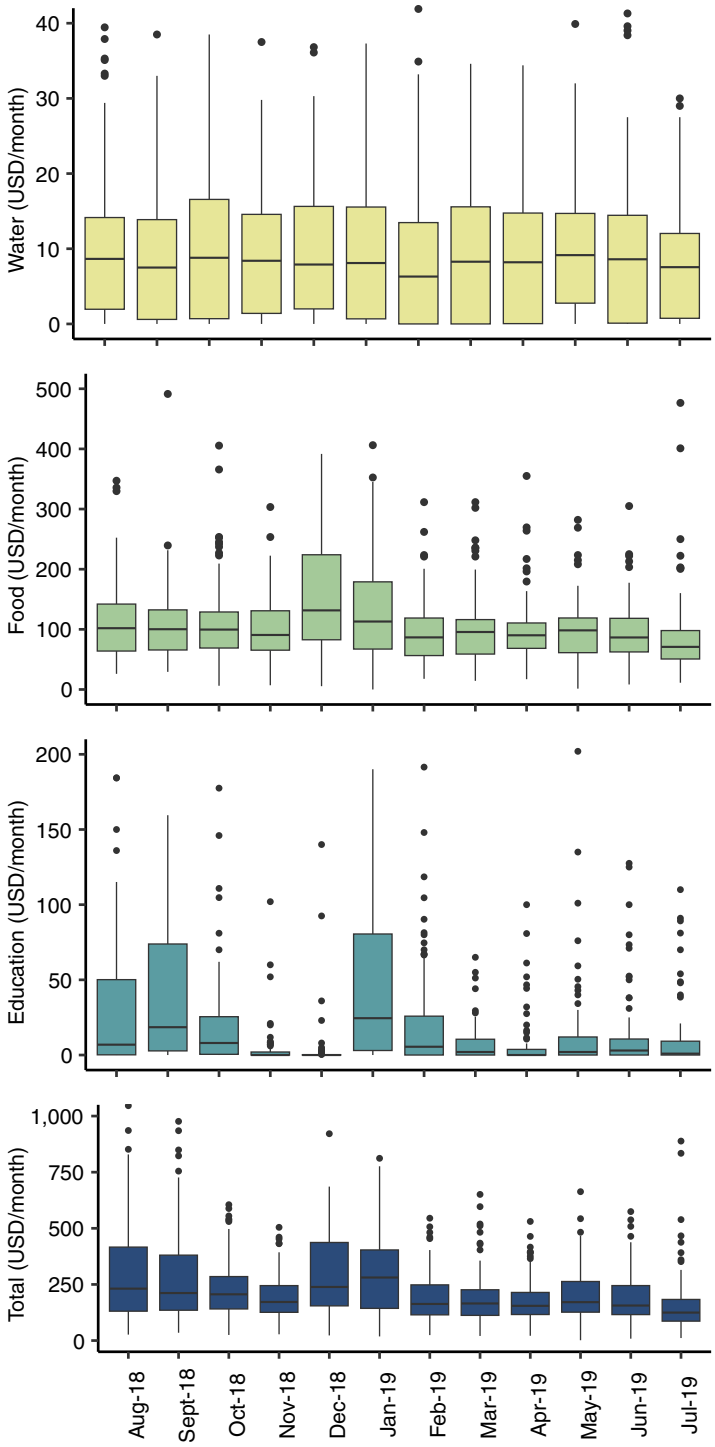


Figure 5.4 Monthly variations in water, food, education, and total expenditures reported by 98 water diary households during 2018–2019. Water expenditures remain relatively stable throughout the year, with food expenditures peaking during Christmas (December 2018) and educational expenditures peaking in beginning of term (September 2018 and January 2019).

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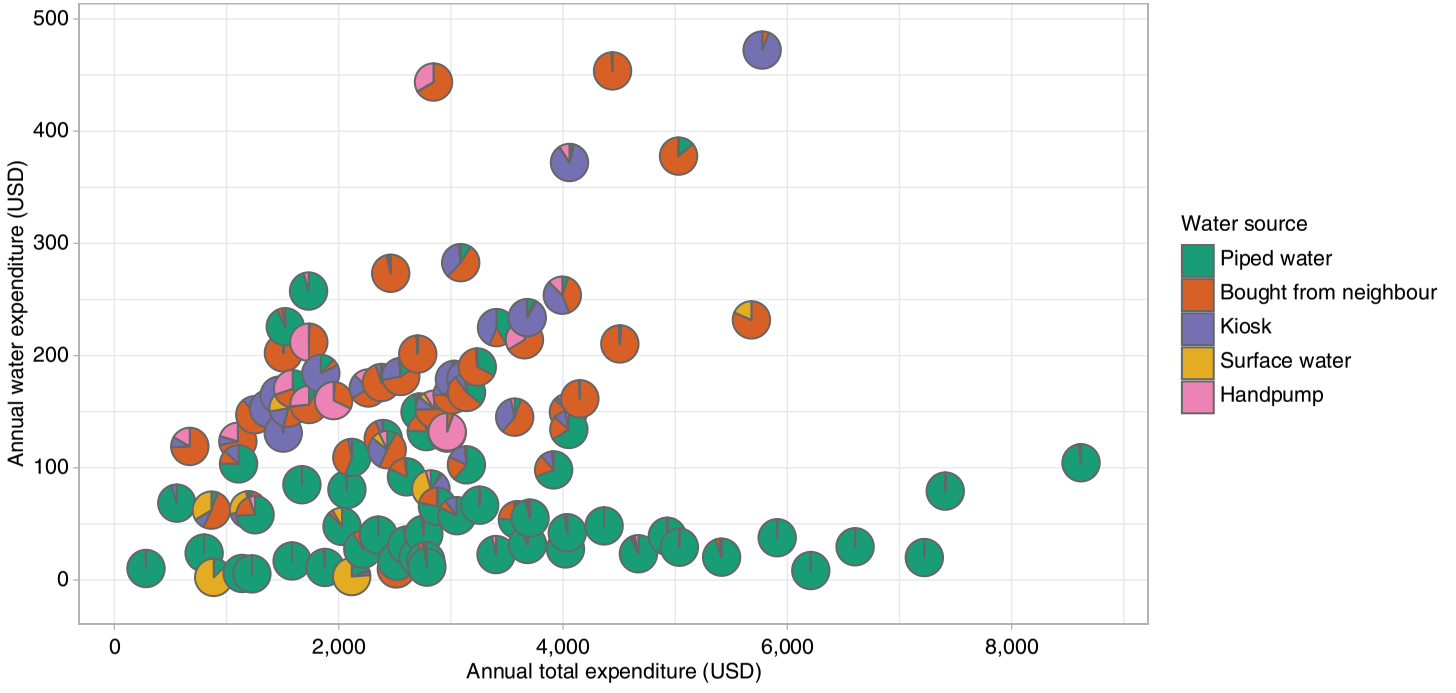


Figure 5.5 Annual water expenditure incurred by 98 water diary households in 2018–2019 in relation to their total household expenditures and the proportion of water fetched from different sources.

considerable amount of water is lost due to overflows of storage tanks with limited capacities, and leakage along the main pipelines (Maxwell et al., 2020). In 2019, the Office of the Auditor-General released a scathing report of the utility criticising the lack of a proper Board of Directors or Corporate Secretary, and revealing stark anomalies across the scale of LOWASCO's operations (OAG, 2019). Improper representation, financial inaccuracies, discrepancies in provided cash flow statements, lack of transparency over assets from the Rift Valley Services Board, and opaqueness over company expenses were documented. The lack of evidence was so great that the Auditor-General struggled in concluding the lawfulness or lack thereof of utilisation of public resources by LOWASCO. And then, in 2021, LOWASCO made headlines when the Kenya Power Company disconnected energy supply for LOWASCO's operations, as it owed electricity bills worth KES 11 million (Etyang, 2021). The residents went weeks without any supply of drinking water, until the county government mediated the situation between the two companies

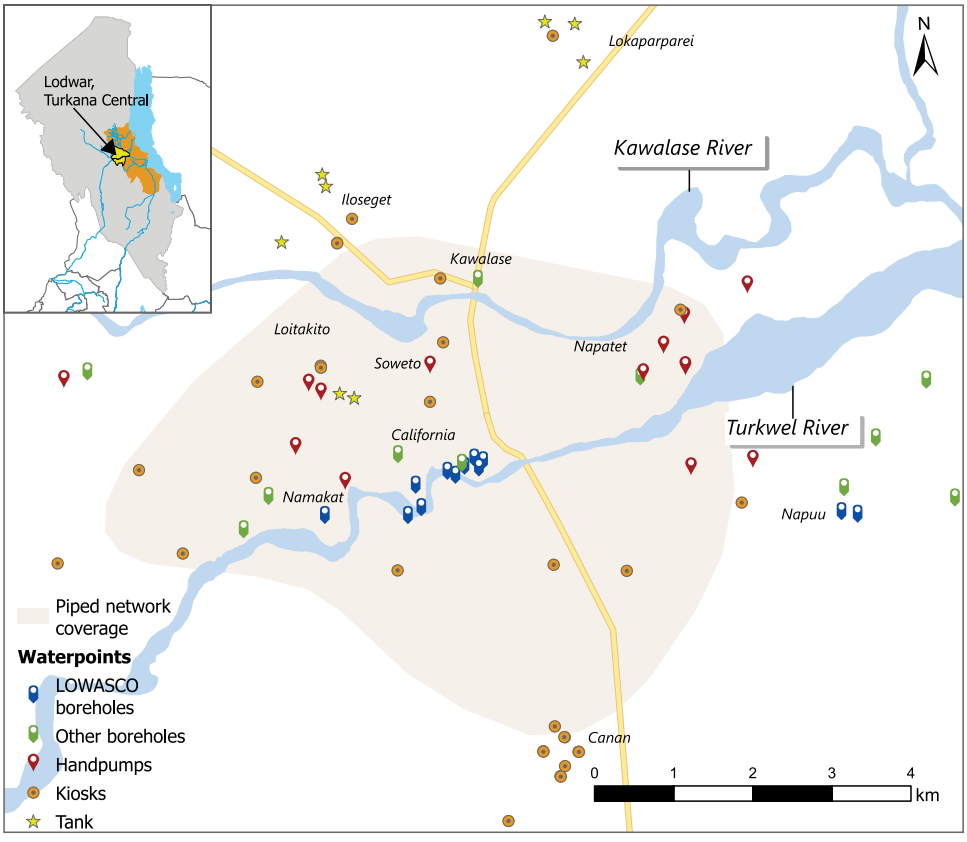


Figure 5.6 Map of Lodwar town showing location of waterpoints (functional at the time of data collection). Data combined from multiple rounds of water supply infrastructure mapping in June 2021, February 2022, and May 2023.

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Over the years, a number of NGOs and international organisations have collaborated with LOWASCO to support their operations through diverse initiatives including the installation of solar-powered boreholes and automated water kiosks (Figure 5.6). Since the ATM-operated kiosks are designed to be self-serviced, they do not have any paid operator and engage community volunteers to report faults and prevent vandalism. Unlike other LOWASCO built kiosks, where private operators get to keep part of the revenue, the caretakers of the ATM-operated kiosks were frustrated as they are burdened with the unsatisfactory job of mediating user complaints and delayed actions by the utility. Interestingly, or rather unfortunately, the automated technologies have led to a small-scale black market of water resale, as those with cards can purchase enough water to deplete the storage, creating an artificial scarcity. In fact, two of the ATM kiosk managers reflected that the idea of reselling the water at a higher price was a means of compensating for their time commitments that are otherwise unappreciated.

5.4 Floating Elephants and Sinking Livelihoods

But water supply is just part of the many challenges of life in Lodwar. For people like Jessica, who live in low-lying areas such as Namakat along the Turkwel River and Napatet, Soweto and Loitakito along the Kawalase River, there is constant fear of being washed away by flash floods. These areas are often occupied by the poorest who risk living in flood prone places to benefit from proximity to central business areas where government and NGO offices, and commercial establishments are located.

For Jessica, life became harder when her husband lost his job in 2017. Soon after that there were two successive floods, and the one in October 2019 was the 'mother of all'. It was even more destructive than the flood of Etom (elephant) in 2006 – one that carried away an elephant calf. Since Jessica had three separate houses within the compound, she still managed to save her stove, mattress, and some documents by moving them to the raised house, while the other two were washed away. One good thing was that the waters came in the afternoon. 'My children are safe, but I lost my five goats', she said, while pointing at the Mathenge trees where her goats' shelter used to be.

Jessica, like many others in her village, wants to relocate to a safer place. She has a plot of land north of Kawalase, but any 'rational person with children' will hesitate to move there as the place has no schools or water. The route to the nearest school in Nakwamekwi is unsafe. If they had a motorbike, they could have used it for transportation as well as carrying water.

As Jessica was sat breastfeeding her youngest son, she mentioned that she is now 'living her worst life'. Her husband now does construction work which becomes available once in a while. 'Life is good when you have food. Here you can stay a whole day without eating anything', she added. Given her childcare responsibilities, she is unable to go and look for work. If only she could get some work, they would be able to save money to buy land and relocate to a safer area.

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Jessica's story epitomises the struggles and concerns of the poorest people of Lodwar – getting food to eat, education for children, water for the family, and a safe place to live. Lodwar has a relatively high simple daily intensity index, which means the infrequent days that it does rain, it rains a lot. Infrequent rain and high temperatures followed by intense rainfall can trigger flash flooding, a characteristic of the Kawalase, and river flooding which can occur when the Turkwel River exceeds its banks and recedes. The 2019 flood, which Jessica recalled, intensified the town's water crisis, as all the LOWASCO boreholes along the Turkwel River were flooded and remained non-operational for more than a month, as the authorities struggled to source damaged parts that needed replacement (Etyang, 2019).

Relocation to peripheral villages such as Lokaparparei and Iloseget, on the other side of Kawalase River, is a common coping mechanism, though there are multiple factors to consider. Living close to the town centre provides income opportunities through small businesses, like selling vegetables, or casual jobs, like doing laundry or construction. Ajikon Akwar, a 38-year-old mother who moved from Napatet to Lokaparparei, mentioned, 'It is so easy to go without food here. The main income generating activity is fetching woods and palm leaves for weaving baskets. When I am not feeling well or I have chest pain, I stay at home and start weaving baskets. When I am done, I can sell them for KES 20 (USD 0.20) each. I use it to buy maize flour and make porridge for my children, without sugar or salt.' By moving to new areas, people also lose the customer base that they developed over the years. Moreover, when most people in the community are poor, there is little demand for goods and services. Gender often intersects with spatiality to restrict access to employment or social support. Regina Ewoi, a 22-year-old resident of Soweto, whose father left her mother after remarrying another woman, believes that having 'no boys in the family' is a major cause for their distress. 'Boys are outgoing. They mix with different people and get information about job opportunities, bursaries, and aid.'

To be able to relocate, one also needs access to land and money to build a house. In Turkana, most of the land is community owned and bestowed upon the County Council under the Trust Land Act. Individuals do not hold titles to the land they occupy, except in urban areas like Lodwar, where they are given allotment letters as proof that they are occupying the land legitimately. In Lodwar, owing to the high in-migration of outsiders, about 65 per cent of the land occupiers are non-ancestral settlers (World Bank, 2015). While early migrants could claim any unoccupied land, land has become increasingly scarce and those with allotment papers are selling land to property developers. Several factors have contributed to this increased land demand. Since the devolution in 2013, there has been increased demand for housing to accommodate county government staff and officials of non-governmental organisations. At the same time, the upgrading of the 960 km Eldoret–Juba road linking Kenya and South Sudan attracted investments in satellite

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colleges, petrol stations, bars, retail shops and modern residential housing in small towns like Lodwar (Business Daily, 2016). Thus, while one may temporarily settle on uninhabited land borrowed from a friend or neighbour; there is risk of being evicted if the owner finds a suitable buyer.

Even when one gets access to land, lack of finance to build a house can be a deterrent to relocation. Development organisations like Red Cross have occasionally supported people in getting land and building houses, only to find those houses being abandoned after some time. As Jessica narrated, lack of income, absence of schools and healthcare facilities, and lack of drinking water were reported as the major constraints of life in these villages. Since these are outside the piped water network, residents depend on either water tanks or the Kawalase River. Of the five water tanks we mapped in Iloseget and Lokaparparei, one was provided by the county government and four were privately owned by residents who saw a business opportunity in selling water (Figure 5.7). In all cases, the tanks were filled by



Figure 5.7 Private water vendor selling water for KES 30 per 20-litre jerrycan (USD 1.5 per m^3) in Lokaparparei, 4 km north of Lodwar town (Photo: Waterpoint Survey, July 2021).

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tanker trucks carrying water from LOWASCO boreholes. While people are content with the quality of the tank water, supply can be very unreliable.

Esther Lotieng owns and operates a water tank in Lokaparparei, a village 4 km north of Kawalase River. When she came to this area, she realised that people do not have water to drink. She asked her husband to save some money and buy her a tank so that she can earn some money and also have water for her family. She pays KES 5000 for the water bowser (tanker) to bring 5000 litres of water from Moi gardens borehole and sells this water for KES 30 per 20-litre jerrycan (USD 15 per m^3). People in Lokaparparei are poor and cannot afford to buy water. But when it rains, Esther's sale increases as people are scared to go to the river during high flow. Before the Kawalase bridge was constructed, the water supply was unreliable. One would receive a call from the truck driver saying that they would not come due to risk of floods.

Bulk sale of water to tanker trucks, whether owned by private vendors or by LOWASCO, is a major source of revenue for LOWASCO. Tanker trucks fetch water from LOWASCO boreholes and sell to construction sites, schools, or community storage tanks outside the service area. Individual households in these areas can purchase water from the tank owners or hire *boda bodas* to fetch water from kiosks or boreholes in the town. While the kiosks sell water for KES 5 per 20-litre jerrycan (USD 2.5 per m^3), households end up paying KES 120 for four jerrycans (USD 15 per m^3), with the KES 100 being charged for transport.

But for the vast majority, vended water is unaffordable, and river is the only source within their means. The dry riverbed of Kawalase becomes a busy area



Figure 5.8 Children scooping water from the dry riverbed of Kawalase River in Lodwar (Photo credit: Sonia Hoque, February 2019).

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early in the morning and in late afternoon when the sun is a bit more forgiving. Women and children, and few men, can be seen digging scoop holes to fill up their jerrycans pint by pint (Figure 5.8). Since children cannot be left at home on their own, mothers have to carry young children on their journey to fetch water while older children end up walking long distances alongside. Open defecation along the river amplifies water collection challenges, as new wells need to be dug every day to avoid contamination by human faeces. Water is usually never treated before consumption as such additional tasks seem impossible due to physical exhaustion, coupled with lack of time and resources. As one respondent mentioned, 'By the time we reach home, our children are thirsty. They will be crying "Mama, Mama," so you feel sorry and decide to give the water the way it is. Boiling and cooling the water takes like forever.'

5.5 Governing Groundwater for Growth

While the daily water challenges of Lodwar's residents have changed very little over decades, there have been several significant institutional and infrastructure developments in the past decade which have rejuvenated hopes of a better future. In 2010, Kenya enacted a new constitution, establishing a devolved government with large-scale political, fiscal, and administrative decentralisation to 47 newly formed counties. The devolution, which came into effect after the 2013 general elections, enabled Turkana to take greater accountability and responsibility for its development. From a neglected district largely under the pastoral care of the Catholic diocese, Turkana elected its own governor and county assembly, with access to an equitable share of the national revenue. In 2012, the county's fortunes also appeared to have prospered when the UK listed company Tullow Oil announced the discovery of 750 million barrels of commercially viable oil in Lokichar, about 90 km from Lodwar (Mkutu Agade, 2014). The following year, Turkana seemed to have won the water lottery. Using satellite exploration technologies, deployed by Radar Technologies International, identified the presence of two large aquifers under the county's dry thorny landscape. The Lotikipi Basin Aquifer and the Lodwar Basin Aquifer were estimated to hold about 250 billion m^3 of water, enough to supply the whole country for the next 70 years (Gramling, 2013).

The lure of two precious natural resources, coupled with the newfound institutional and fiscal autonomy, reawakened the sleepy transit town of Lodwar. With the influx of shops, guesthouses, leisure centres and hotels, the demand for water services have continued to rise and new connections have been added to the network without proportionate increases in supply. Despite the hype surrounding the discovery of aquifers, there has been no progress in actually bringing the water from over 1 km below ground to taps in people's homes. A small-scale drilling

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project by the government in 2015 identified that the water in Lotikipi aquifer is highly saline, and unfit for human consumption, irrigation or livestock. This subdued the hopes of a miraculous solution, and led to conversations with investors about desalination, though the project did not take off as energy costs were deemed higher in lifting and treating the water than any feasible economic usage. Ideas to irrigate food crops or grow cotton are politically popular but financially redundant.

While groundwater is widely recognised as a strategic resource for economic development in these rain-deprived drylands of Sub-Saharan Africa, there is insufficient understanding of aquifer characteristics, including their recharge mechanisms and potential impacts of geogenic and anthropogenic activities. In Lodwar, potable groundwater can be obtained only from recent alluvial and Holocene age sediments of the Lodwar Alluvial Aquifer system (less than 100 m below ground level), as older sediments mostly yield saline water (Tanui et al., 2020). Further analysis of isotopic composition confirms that the aquifer is mainly recharged by surface flows from the perennial Turkwel River and by infiltration of local precipitation during the wet season. This makes the aquifer susceptible to upstream flow regulation by the Turkwel Gorge dam and prolonged droughts, as well as faecal contamination resulting from a lack of sewerage network and municipal waste disposal system (Tanui et al., 2023).

5.6 Conclusion

It is hard to reconcile the image of a young elephant carried by a seasonal river in flood in 2006 with four years of devastating drought a decade later. Yet, life in Turkana has always been a brutal challenge with no easy solutions for improving water security despite the illusion of oil wealth or unlimited groundwater briefly emerging. Lodwar reflects the wider African condition in terms of where demographic growth is likely to increase decisively in the decades to 2050 when the continent will double in size to 2.5 billion people (Department of Economic and Social Affairs, 2022). Increasing water security in small towns is central to the prospects of Africa's development aspirations. The diaries provide insights and lessons into the daily decisions and dilemmas of extremely vulnerable households in this context. We consider three themes from the findings in Lodwar which may chart more sustainable and equitable futures if policy and practice are effectively designed and delivered. One key motif underlines any pathway to a water secure future – an inclusive and safely managed drinking water piped network run by an accountable and efficient utility.

First, the depth and breadth of vulnerability and deprivation in Lodwar is acute and visceral. Beyond the numbers and stories, the lived reality in the town is harsh and unrelenting. Unlike Kitui or Bangladesh, where alternative water resources

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are available for parts of the year, Lodwar has almost no alternative water sources to the built infrastructure supplied by government and donors. Without a working piped connection to the home, a family's choices decrease as their costs increase. The diaries chart a common story of people using similar volumes of water at around 20 litres per person per day, but very different choices and costs in where and how they access drinking water.

The physical, economic, psychological, and emotional stress of securing basic drinking water from kiosks, rivers, handpumps or neighbours is considerable. Living north of the Kawalase River incurs economic, physical, and water security risks but is a choice some families must take given a lack of alternatives. While families will commonly go a day without eating, few can choose not to collect water given the extreme heat. Without an affordable drinking water supply, this means scooping water from riverbeds in the dry season and taking extreme risks in the unpredictable wet season. Even those living in the main town have to contend with kiosk attendants independently increasing prices to cover their salaries. In cases where ATM kiosks exist, creating a monopoly on the tokens to access the water allows an artificial and inflated market to emerge. This is all predictable in a town where water is extremely scarce, deprivation is high, unemployment is rife, and governance is weak.

Second, decentralisation does offer the prospect for positive change. The county government has undoubtedly inherited a difficult and dysfunctional legacy dating back to the colonial period. LOWASCO is a caricature of a badly managed utility with some of the worst performance metrics across all of Kenya's urban water utilities with an 'expired' tariff and operating licence, and an estimated provision of 24 litres per person per day to less than half of the town's population (WASREB, 2022). A kaleidoscope of individual and uncoordinated donor projects has done little to address the fundamental lack capacity or leadership in the utility despite significant financial investments. Recent legal and policy initiatives scratch the surface of systematically delivering accountability and responsibility into a functioning utility for the town. Development actors share this burden with local offices and highly qualified staff working in partnership with the county government. The results, to date, are inconsequential for the lives of the most vulnerable. Narratives of how ATMs are improving livelihoods ring hollow when the daily practices and behaviour of people are assessed. A new borehole which loses two-fifths of its supply is a poor return.

Dysfunctional systems for a critical resource create market opportunities. While piped systems and kiosks may often run dry, a vending market flourishes with tankers (bowsers) ensuring key facilities (e.g. hotels, government offices, companies) are supplied with water from government boreholes at increased costs. A secondary market in water supply emerges with some households in more

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distant locations able to invest in storage to benefit from their neighbour's distress. Vending is supplied through county boreholes providing a regular source of income for the government. There is pragmatism in bulk water supply compared to chasing individual connections with complaints from dissatisfied customers. Unfortunately, the spiral of performance heads in the wrong direction. Vended water is by no means an inappropriate or inequitable allocation of public water, but it needs an accountable regulatory framework within a wider strategic planning and financial model. Such a model has been developed with the county government, but it has not been executed (Masinde et al., 2021), though other agencies have endorsed and republished the approach.

Third, Lodwar is at the mercy of the climate and upstream water users. The climate story is well-rehearsed with the critical need to monitor and manage the Lodwar Alluvial Aquifer System. Led by the University of Nairobi, significant progress with county and national government has provided a sound framework for implementation (Olago and Tanui, 2023). If implemented, the town's future looks more sustainable; time will tell on the commitment to these decisions which will limit or stop land sales in key recharge areas where prices have escalated. Of equal concern is plans to increase irrigated agriculture upstream near the Turkwel Gorge dam.

Modelling analysis of scenarios to increase irrigation near the dam reveal this may be the existential threat to Lodwar's water security. If proposed irrigation occurs it will dramatically reduce streamflow reaching the town and recharging the aquifer (Hirpa et al., 2018). County and national government are aware of this threat with the Kerio Valley Development Authority the boundary organisation charged with managing the allocation and development of water resources in the Turkwel river system. As Turkana has witnessed the reduction in flows from the Omo River into Lake Turkana as Ethiopia shifted from using their upstream dams only for hydroelectric to also expanding sugarcane and other crops, the same fate may come to pass if irrigation expands upstream with serious implications for Lodwar's future water security.

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