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Platforms for the urban poor: Platform frugality in Mathare informal settlement

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ABSTRACT

Limited attention has been paid to platforms in informal settlements, where residents face multiple, simultaneous resource constraints. We address this challenge by elucidating how informal settlement residents use platforms to address resource constraints and by identifying limitations to platform deployment. Conceptually, we combine literature on platforms and informal settlements with that on frugal innovation to distinguish various platform domains and introduce the concept of platform frugality to explain platform deployment. Based on an empirical case study of Mathare informal settlement, we reveal that platform frugality varies across domains. Social media and certain fintech platforms are more frugal than other platforms and are more widely deployed in informal settlements, addressing more resource constraints. More advanced fintech, gig, health, and utility platforms are rarely used in informal settlements. Generic limitations to platform deployment include costs and residents' lack of formal IDs.

1. Introduction

Platform deployment exhibits different development dynamics in the Global South than in the Global North (Ciriola et al., 2023). Many citizens in the Global South face informality and poverty. The World Poverty Clock (2025) estimates the number of urbanites in extreme poverty at about 67 million. Limited resources—whether financial, human, social, natural, or physical—combined with exclusionary urban systems make it hard for over 1 billion urbanites to survive (Solesbury, 2003). Approximately 1.2 billion people live in informal settlements (Mahendra et al., 2021), characterised by sub-standard houses, infrastructure, services, and unemployment (Satterthwaite et al., 2020). Such settlements face interacting resource constraints related to income, essential services, housing, education, and other (Satterthwaite et al., 2020).

Platforms offer new opportunities and challenges for citizens in the Global South (Bonina et al., 2021). Yet, limited attention has been paid to platform deployment by informal settlement residents who are simultaneously confronted with interrelated resource constraints

(Seeliger & Turok, 2014). Existing literature does not specify how platforms affect urban poverty, as studies are conceptual (Bonina et al., 2021) or focus on one specific theme (e.g., digital entrepreneurship, Friederici et al., 2020) or a single platform domain, including ride-hailing (Heeks et al., 2021); social media (Nicholson et al., 2016); fintech (Bhagat & Roderick, 2020); electricity, gas, and water utilities (Amankwaa et al., 2022); and online gig (Wood et al., 2019). This article shows that practices by informal settlement residents to address resource constraints differ both between and within platform domains, depending on levels of platform frugality. We focus on platform deployment in informal settlements within the broader context of the digital divide (e.g., Heeks, 2022; Wamuyu, 2017). However, rather than describing the divide itself, we elucidate how informal settlement residents use platforms. We raise the following research questions: i) What is the level of frugality of different platform domains; ii) how do informal settlement residents use different platform domains to address their resource constraints; iii) what are the limitations to platform deployment in informal settlements?

To address these questions, we link literature on informal

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settlements, resource constraints, and platforms with the concept of frugal innovation, and conduct an empirical study in Mathare, one of Nairobi's (Kenya) largest informal settlements. Frugal innovation (or 'frugality') is "an approach to creatively solving local problems through complexity reduction" (Busch, 2021: 14) in a resource-constrained context (Agarwal et al., 2017). Frugal innovation is thus a key concept to elucidate how informal settlement residents address resource constraints (Fransen et al., 2023). Platforms are assumed to be frugal as this technology can be easily deployed to provide affordable services to underserved population groups (Van Tuijl et al., 2024), and thus, help vulnerable citizens to gain access to essential services (Guma, 2023). Examples include, M-Pesa, an SMS-based digital banking infrastructure for resource-constrained citizens, and M-Kopa, an affordable digital off-grid energy solution (Fransen et al., 2023).

Based on empirical data and inductive reasoning we elucidate how Mathare residents deploy different platform domains (fintech, gig, health, social media, utility) (Langley & Leyshon, 2017) to address their resource constraints. We argue that the degree of frugality differs between platform domains. This helps us explain platform deployment in informal settlements and unveil differences across domains. To support our argument, we first identify how Mathare residents deploy platforms to address their resource constraints. We subsequently analyse and compare how platform frugality explains platform deployment across domains, considering limitations to platform deployment.

The remainder of this paper is as follows. Section 2 discusses literature to introduce the concept of platform frugality and differentiates the platform domains that we use to structure our debate. Section 3 details our method, section 4 our results, and section 5 the debate where we answer the research questions. The last section provides conclusions and recommendations.

2. Theory

2.1. Informal settlement and resource constraints

Informal settlements are defined by poor-quality houses and infrastructure built outside formal regulations (Satterthwaite et al., 2020). However, there are major differences in the level of informality, with many informal settlements offering partially formal and informal housing, services and infrastructure (Banks et al., 2020). What is (in) formal also depends on planning policies, as informal settlements operate outside of these regulations (Roy, 2005). What is informal in one context may therefore be formal in another.

Within informal settlements, we identify a variety of resource constraints, which we group into four categories. First, residents are likely to face physical resource constraints, such as low-quality housing and public spaces (Huchzermeyer & Karam, 2006). Second, they may face limited access to sustainable livelihoods, as many residents have irregular, uncertain and lowly paid employment and income. Access to credit is limited, because many residents lack formal banking systems (Kimani et al., 2021). Third, residents may face limited access to and low quality of utilities including drinking water, electricity and gas (Van Welie et al., 2019). Fourth, they often have poor access to other public services such as health, safety and education (Satterthwaite et al., 2020). Empirical studies highlight poor health conditions and unsafety as key concerns in informal settlements (Fransen et al., 2024).

The categories are interrelated. For instance, health concerns in urban informal settlements stem from issues like unemployment, low-quality housing and utility services, and violence (Corburn & Sverdluk, 2019). Likewise, a lack of income hinders residents in obtaining better health and utility services or improving the quality of their homes (Keskinen et al., 2022). Accordingly, residents face multiple resource constraints simultaneously (Satterthwaite et al., 2020).

2.2. Frugal innovation and platform frugality

Frugal innovation encompasses solutions to address resource constraints based on the principle of 'doing more with less' (Radjou et al., 2012) 'for many people' (Bhatti et al., 2018). This latter aspect differentiates frugal innovation from efficiency. The concept has been intensively discussed in theoretical reviews (Pisoni et al., 2018) and related to other types of resource-constrained innovation, including low-cost innovation (Zeschky et al., 2014). We follow and slightly adapt Leliveld and Knorringa's (2018):1–2 definition, describing frugal innovation as an approach of "(re)designing products, services, systems, and business models to reduce complexity and total lifecycle costs, and enhance functionality, while providing high user value and affordable solutions" in resource-constrained environments (Agarwal et al., 2017). Despite its focus on resource saving, and origin in the context of informal grassroots innovations (Bhatti et al., 2018), few studies explicitly link frugal innovation with informality (Fransen et al., 2023; Meagher, 2018). These studies are critical on frugal innovation as frugal practices in informal settlements are mainly survival-oriented without bringing structural change (Fransen et al., 2023) while increasing inequality (Meagher, 2018). Frugal innovation has potential to generate social good, but its contribution to social well-being and inclusion is questionable due to the multidimensional challenges of resource-constrained settings (Pineda-Escobar, 2025).

An emerging research field analyses how digitalisation and frugal innovation address resource constraints (Van Tuijl et al., 2024). This field assumes platforms to be frugal based on the idea that platforms, such as WhatsApp, can be accessed by many people at low or no costs (Prabhu, 2017), on the condition of having digital access. This perspective assumes that platforms help precarious citizens to gain affordable access to critical services (Guma, 2023). For instance, fintech and social media platforms are perceived as affordable channels for frugal innovators in resource-constrained contexts to reach global investors and buyers respectively (Van Tuijl & Knorringa, 2023). Likewise, platforms support frugal innovators to develop affordable agricultural services for smallholders, such as land-mapping (Agarwal et al., 2020).

We contribute to this field by introducing the concept of platform frugality, based on the core dimensions of frugal innovation (Bhatti et al., 2018; Van Tuijl et al., 2024; Weyrauch & Herstatt, 2017): accessibility (FI can be deployed by a large number of resource-constrained users); affordability (i.e., low user-costs); and simplicity (low user-complexity). Thereby, platforms with a high level of frugality are easy to access, simple to use, and available at low costs, whereas platforms with low frugality are hard to deploy due to costs, complexity or other access restrictions.

While literature assumes all platforms to be frugal (Van Tuijl et al., 2024), empirical examples indicate differences in platform frugality. For example, banning social media platforms reduces *accessibility*, thus lowering platform frugality and explaining a decline in platform usage. Similarly, a fee on food delivery platforms reduces *affordability*, also lowering platform frugality and deployment (Van Tuijl et al., 2023; Haidar, 2024). For firms, social media platforms are less *affordable* than for consumers as firms need to pay marketing costs whereas the latter can join for free (Hossain, 2021). An example of *simplicity* is Instagram, which increased frugality by focussing on photo sharing instead of providing more functions to attract more users (Garber, 2014). Taken together, these differences in platform frugality might explain platform deployment, but this is not yet studied. We therefore explore how platform frugality explains platform deployment, without aiming to rank platform frugality.

2.3. Linking platform domains, frugal innovation and resource constraints

Literature suggests ample opportunities of platforms for development, if policies overcome their negative side-effects (Sturgeon, 2021). A literature review indeed shows positive effects of platforms in relation

to sustainable development (Bonina et al., 2021). However, this review and other studies also show negative effects, including dependency on Western platform operators (Couldry & Mejias, 2019). Platform frugality may magnify these positive and negative effects.

The influence of platforms on development differs across (sub)domains. Langley and Leyshon (2017) define platform domains in Western contexts. For informal settlements, we add health and utility platforms – as access to health and utilities is widely constrained (Van Welie et al., 2019) and exclude online exchange markets and sharing platforms as these domains are less likely to be relevant.

Fintech encompasses digital banking platforms, such as M-Pesa. This domain provides opportunities for financial inclusion, offering affordable banking services for those without bank accounts (Meagher, 2018). As this platform works through SMS technology, it can be accessed without smartphones, which increases accessibility. Accordingly, this domain is regarded as frugal (Knorrington et al., 2016). Fintech also offers new options for small loans (Langley & Leyshon, 2022), crowdfunding for (informal) entrepreneurs, and fundraising (Van Tuijl & Knorrington, 2023). Overall, fintech platforms offer options to address livelihood constraints by providing banking infrastructures and access to financial products for previously underserved citizens.

Gig platforms offer (self)employment opportunities for previously excluded citizens (Wood et al., 2019) and support livelihood improvement by online work (Keskinen et al., 2022). They are divided into digital remote (e.g., coding) and local on-site (ride-hailing) tasks through platforms, such as Upwork or Uber. Frugal innovation literature discusses the potential of gig platforms to improve livelihoods (Ahuja, 2021). Beyond direct income generation, gig platforms support vulnerable citizens indirectly, such as creating an institutional infrastructure in countries where such infrastructures are absent (Heeks et al., 2021).

Health platforms may improve health services in various ways (Bonina et al., 2021). For instance, the DHIS2 platform supports health management for healthcare providers (Nicholson et al., 2022) and M-Jali supports community health workers (CHWs) in low-resource settings (Van Herpen et al., 2023). Within frugal innovation literature, health platforms provide resource-constrained citizens affordable access to medical services (Sarkar, 2021).

Social media platforms may contribute to poverty alleviation by broadening access to resources (e.g., expertise) and (job) information (Bonina et al., 2021). Moreover, social media usage in informal settlements may improve safety and health by reducing drug abuse (Mutai et al., 2020). Additionally, social media facilitates collective action (Nicholson et al., 2016), also among workers on gig platforms (Anwar & Graham, 2020). This domain thus complements other domains, as evidenced by WhatsApp usage in informal settlements to connect with formal gig platforms (Cirolia et al., 2023). Social media platforms are regarded as frugal due to their free and widely accessible character (Prabhu, 2017). For instance, semi-illiterate refugees in camps use WhatsApp for learning and entrepreneurship (Ritchie, 2022). Likewise, entrepreneurs in informal economies use social media to access global markets (Sheikh et al., 2023). Thus, social media platforms are important to access several resources and can indirectly contribute to address a variety of resource constraints.

Utility platforms are deployed by utility providers to supply ‘pro-poor’ services, enabling informal settlement residents to access basic utilities (Guma, 2019). These platforms allow for more heterogeneous utility infrastructures and rebalance power relationships between utility providers and residents (Chambers, 2019). In frugal innovation literature, platforms are assumed to be frugal alternatives to large universal utility infrastructures. Platforms enable off-grid solar energy and water services to resource-constrained citizens in remote areas through pay-as-you-go models. Such models are more affordable and accessible, as users pay small, consumption-based amounts instead of paying large upfront costs for water pumps or electricity connections (Howell, 2021).

2.4. Limitations to platform frugality and -deployment

Literature discusses challenges related to digital exclusion and other dark sides of platforms. *Gig platforms* pose challenges for workers, such as low payments (Wood et al., 2019). *Fintech platforms* exclude citizens without digital access (Leliveld & Knorrington, 2018) or entrepreneurial skills needed to repay loans, and have been criticized for extracting rents from vulnerable users (Bhagat & Roderick, 2020; Langley & Leyshon, 2022). *Utility platforms* may directly exclude users who fail to pay or limit their agency by removing options such as low-cost self-repair in utility infrastructures (Chambers, 2019). Likewise, too many sophisticated functions on free *health platforms* reduce their suitability for healthcare workers providing relatively simple services (Nicholson et al., 2022). These drawbacks indicate limitations to platform frugality (e.g., increased costs and complexity, or lower accessibility), and accordingly, limit the degree to which platforms are deployed to address resource constraints.

To conclude, literature tends to regard all platform domains as frugal –without differentiating between levels of frugality– and as complementary when addressing different resource constraints. However, this paper argues that platform frugality differs both across and within platform domains. This reveals limitations to the degree to which informal settlement residents deploy platforms to address resource constraints.

3. Method

3.1. Research design

We adopted a case study design (Yin, 2003) as it enables the understanding of the effects of platform deployment on poverty in real-life contexts that are too complex for surveys or experimental studies (Jensen & Rodgers, 2001). Thus, this design is appropriate for elucidating how informal settlement residents use platforms to address resource constraints and limitations in platform deployment. This method is particularly suited when in-depth analysis of a phenomenon (i.e., platform deployment) is more important than the generalisation of the results (Flyvbjerg, 2006). As a result, research findings are explorative and context-specific.

We selected Mathare informal settlement as case study for three reasons. Firstly, it is one of Nairobi's largest informal settlements, where its inhabitants are confronted with multiple resource constraints (Fransen et al., 2023) and a digital divide (Wamuyu, 2017). Secondly, Mathare has a relatively long history in platform deployment. It was one of the pilot areas for M-Pesa, and utilities attempt to platformise utility infrastructures there (Chambers, 2019; Guma, 2022). Moreover, its location in Nairobi, a leading ICT hub and test-bed in Africa (Cirolia et al., 2024; Friederici et al., 2020; Pollio, 2024), indicates potential for Mathare residents to address resource constraints through gig work. Thirdly, one of the authors is a community researcher within Mathare, trusted by fellow residents. This trust, alongside his understanding of the local culture, helped to gather data.

The study is part of a larger community-based participatory research (CBPR) initiative. CBPR aims to create reciprocal relationships between researchers and communities. It co-produces knowledge (i.e., on platform deployment), equally valuing community and academic knowledge while being aware of power imbalances (Mitlin et al., 2020). Principles include validation workshops and empowering local community organisations through knowledge. More concretely, this case study aimed to co-create knowledge for piloting a ‘village digital hub’ to enable all Mathare residents to deploy platforms.

3.2. Data collection and analysis.

The data collection consisted of different stages (see Table 1). It started with a co-creation workshop with community members and

Table 1
Data collection stages.

Stage	Actors	Output	Timing
Co-Creation workshop on research theme, –questions, selection criteria	All researchers Workshop participants: community leaders and CHWs (16)	Interview protocol Transcripts	May–June 2022
11 Pilot interviews	Interviews: Residents		
37 semi-structured, in-depth interviews	Community researchers; other Nairobi researchers; Interviews: residents	Transcripts	Summer 2022
Interview and field visit digital training centre	All researchers Leader digital training centre	Field notes	November 2022
Validation workshop	All researchers Workshop participants: Residents (38); community leaders (6); local administrators (4)	Transcript	November 2022
Mapping digital infrastructure and facilities	Community researchers other Nairobi researchers	GIS maps Field notes	Winter 2022/2023

eleven pilot interviews. We asked workshop participants about their largest constraints and platforms used, aiming to co-develop a reliable interview protocol and sharpen our research focus. For instance, we excluded housing as this was not regarded as a direct resource constraint. Further data were collected from thirty-seven household interviews, each lasting approximately one hour. We selected households based on maximum variety in location, gender, household composition, and age (see [appendix A](#)). Of the household sample, 56 % are female, the age ranges from 18 to 72 while 37 % live in tenements and the remaining 63 % in tin shacks. Household composition varies widely, with slightly more male- than female headed households (54 %) and many broken families, with (grand)mothers looking after (grand) children, children looking after their parents, and friends living together. This variety enabled us to identify different platform practices for addressing resource constraints. Each interview took place inside the house, enabling observation. Respondents were asked about their challenges in daily life; practices to address constraints; access to and usage of digital devices; platform used; and challenges regarding platform deployment. We also interviewed the Programmes Directorate of the ICT Authority and visited a digital community training centre in nearby Kamukunji constituency. This visit and in-depth interview with the centre manager aimed to provide deeper insights into the potential of platforms to address residents' resource constraints and deployment challenges. We ended with a GIS mapping of available digital infrastructure (e.g., water ATMs).

We followed four strategies to reduce bias and increase validity and reliability. First, the research team included community researchers with deep knowledge of Mathare, other Nairobi researchers knowledgeable about the Kenyan context and literature, and non-Kenyan researchers specialised in platforms and informal settlements. Interactions within the team at each research stage helped us to overcome misunderstandings and contextualise our findings. Second, most interviews were conducted in pairs of community and other Nairobi researchers, with the pilots also including non-Kenyan researchers. Third, we interviewed diverse actors within households (parents, singles, teenagers) to mitigate bias ([Eisenhardt & Graebner, 2007](#)) and explore different platform practices and limitations. Finally, primary data were triangulated with secondary data sources, including existing studies.

We captured information through audio recordings of the interviews and workshops and took observation notes. The interviews were done in Swahili and transcribed and translated by the community researchers. The workshops were done in Swahili and simultaneously translated into English. We anonymised interviewees with IDs. Deductive and inductive coding was based on the core dimensions of our study: resource

constraints, platform domains, and limitations in platform deployment. We used these codes to analyse the transcripts in 'Atlas.ti' to identify associations between platforms and resource constraints. This analysis process was done iteratively, with constant discussions between all researchers and a validation workshop with different actors. We asked workshop participants whether they recognised these patterns and explanations for why certain platforms domains are more used than others.

4. Results: Resource constraints and platforms

This section describes our results on platform practices, structured along the resource constraints in Mathare.

4.1. Livelihood

Most respondents mention livelihood restrictions – characterised by low and uncertain income and employment– as key constraints. Households widely use platforms to address these constraints. All respondents use M-Pesa for receiving and transferring money. Even residents without mobile phones borrow devices from neighbours or relatives to use this platform. Residents widely use other fintech platforms, such as Fuliza, to borrow money. Often, they borrow small amounts (e.g., KSh 500, about €3,20) for buying daily needs, such as food. Occasionally, residents borrow larger amounts for purchases like household goods after a fire outbreak or to start a business.

Fintech platforms are popular due to the possibility to borrow small amounts. For instance, MT37 indicated that fintech platforms ease access to new loans upon timely debt repayment. In case residents cannot repay their debt on a particular platform, they can simply get a new loan on a competing platform, or on the same platform accessed with a new SIM card. However, online borrowing risks escalating debts (MT34; K17). B1 even stopped using fintech platforms as she feared a debt trap.

Fintech platforms are also used to collect money, while social media platforms, such as WhatsApp, are used in informal saving groups ('chamas') (ET6;MK15;MT11). They use chamas to raise money and support members to pay school fees, purchase essential commodities, or undertake investments to establish small-scale enterprises.

Other, but rarely used, practices on fintech platforms encompass accessing venture capital (e.g., MK24 established a crisp-selling business with venture capital) and investments in digital currencies (MT46).

Residents also use platforms for job searches, mainly on social media platforms. For instance, MT46 obtained a 'Kazi Mtaani' job – a project aimed at creating public goods in informal settlements – through a WhatsApp group. And MT14 stated: "*I enquire about online jobs through WhatsApp since I have many entrepreneurs' contacts. ... I can post that I am looking for a job or text them. It has helped me because there was a time I worked online where I was earning when people view my status, 1 view was KSh 30*". The latter remark unveils that social media is used to generate income by online work, in this case online marketing.

Gig platforms, in contrast, are less frequently used. Only three respondents conduct jobs through online advertising, marketing, writing, and data mapping. None of the respondents participated in gig platforms for location-dependent work.

By contrast, social media is widely used to support business activities. Residents use social media for marketing their products/services. For instance, MB36 promotes her laundry services through WhatsApp. Social media is also used to receive customer information, such as a tailor who receives pictures through WhatsApp with styles her customers want. Furthermore, residents use social media for online sales.

Finally, respondents use social media for self-learning for business. For instance, a hairdresser and a digital entrepreneur watch YouTube videos to learn new dreadlock styles and how to invest in cryptocurrencies respectively. Residents also use social media for self-learning beyond business purposes. For instance, MT19 consults YouTube so he can self-repair his TV. Others use social media for learning health and safety issues, or during their study.

4.2. Safety

Safety concerns are the second constraint mentioned by our interviewees. This aligns with earlier studies on Mathare stressing safety concerns, due to youth gangs, drug abuse and police killings (Fransen et al., 2024). Safety concerns range from theft and murder to fires and fights. Most residents apply non-digital practices to tackle safety concerns. Examples of crime avoiding measures include reinforcing doors with metal bars or safety management education. A mentioned example of a response to fire is collectively drawing water from the river to extinguish fires.

Platform deployment to address unsafety issues turns out to be limited. For instance, a local administrator referred to the existence of the SMS code 988 or Mulika platform that residents can use to report crime, but none of the residents use this platform. Likewise, only one CHW uses a platform of a Non-Governmental Organisation (NGO) to report unsafe situations, such as open electricity cables. Additionally, very few residents use social media to report crime or for self-learning to increase safety. For instance, MT45 uses the Facebook page 'Jukwaa' to learn how to handle electric products (e.g., electric kettles) to avoid fire.

Social media is used to raise attention concerning unsafe situations among policy actors. Practices on platforms such as X contribute to awareness creation regarding crime incidences. For instance, MT19 engages in online awareness about fire occurrences in Mathare: *"post them <messages on fire> tagging even the political leaders of our area, letting them know their people's houses were burnt and would want their help"*. Likewise, MB36 participates in the 'Women Are Wonderful' WhatsApp group that focus on women empowerment, and MT10 stresses the importance of social media to strengthen the effect of physical demonstrations to improve the living conditions in slums. Social media is thus deployed for activism.

4.3. Health

Respondents use platforms in four ways to deal with health constraints. Firstly, residents use health platforms to trace their health status. MT10 tracks his footsteps and two women follow their menstruation cycle in health platforms.

Secondly, respondents consult social media for health advice, self-diagnosis and self-medication. For instance, ET6 consults YouTube to obtain advice on her pregnancy. Likewise, Facebook is a good source for residents to get health advice: *"I got help through Facebook in Kilimani mums <group> because I had a skin disease. From there, I saw someone post a screenshot of a product saying that it helps with skin diseases. I went directly to the chemist and asked for the medication"* (MT45).

Thirdly, CHWs deploy social media platforms. All CHWs in our sample use WhatsApp groups to report and share health information. They used WhatsApp during the COVID-19 period to report new cases of infections, thereby tracking the spread of the virus. They also share pictures within WhatsApp groups, and use these to learn from each other on how to treat patients. Likewise, CHWs watch YouTube videos: *"It was a movie that we were told to watch and teach the kids. Our program is HIV prevention. It is called Sugar. We were told to follow from YouTube. Then the next day, we came and discussed it"* (MT45).

Finally, respondents use the National Health Insurance Fund (NHIF) platform, provided by the government, to cover healthcare service costs. However, only seven respondents subscribed to this platform with only two actually using it.

4.4. Utilities

Another resource constraint mentioned by interviewees includes access to utility services (cf. Van Welie et al., 2019). Most respondents do not use platforms to access utility services but rely on 'traditional' supply through on-site vendors for gas and water, and illegal electricity connections. Furthermore, they deploy other non-digital practices to

address constraints to essential services, such as water purifier tablets to clean drinking water.

Nevertheless, some respondents use specific platforms to access basic utilities but with differences between the utility types. Five interviewees use the platform from Kenya Power, the formal electricity provider. Four others use this platform indirectly through their landlord. All other interviewees make use of illegal electricity connections, with MK15 being an exception. She shifted from an illegal connection to solar energy through the M-Kopa platform after her house burnt down.

Platform deployment to access other utilities is even lower. Only three people use the M-Gas platform. MB36 indicated using this platform to reduce the risk of a fire outbreak: *"When I am away, I usually walk with the card, because of this my child cannot play with fire ... It <the card> acts as a matchstick. Without it <a cooking stove> cannot be switched on."* With the exception of shopkeeper MT39 who sells water from a water ATM, none of our interview respondents had direct access to such ATMs. Two people indirectly obtain their water through platforms, by using a smart water card from other people.

Table 2 summarises the identified practices.

Table 2

Results on how residents use platforms to address resource constraints.

Constraint	Practices on platforms (responded IDs)
Livelihood	<p><i>Access to funding</i></p> <ul style="list-style-type: none"> Fintech platform (M-Pesa) for money transfer (all interviewees) Fintech platforms to borrow money (MK15;T31;MB36; MT45;K17;MK24;MB23;MT34;MT7;MB20;B33;MK25; MT22;B1;MK43;MT28;MB16;MT21). Social media platforms for collective saving (MK15;ET6; MK43) Fintech platforms to obtain venture capital (MK24) Fintech platforms to invest in digital currencies (MT4) <p><i>Find jobs</i></p> <ul style="list-style-type: none"> Social media platforms to find jobs (MT14;MT40;MT45; MT46;MK24;K17;MK10) <p><i>Do and support jobs and entrepreneurship</i></p> <ul style="list-style-type: none"> Gig (MT11;MT13;K17) and social media platforms (MT14; MT11) to do online work Social media platforms to promote products (MT10;T41; MT28;MB36;MB23;MT7;MT19;MT39;MB36) Social media platforms to receive client information (MT40; MT22) Sell goods on social media platforms (MT11;MT45;friends of MB23) Social media platforms for self-learning for business (MT40; MT13;MK15;MT22;MB20) and non-business purposes (MT19;MK24;MT46)
Safety	<ul style="list-style-type: none"> NGO platform to report unsafety (MT3) Social media platforms for reporting and self-learning (MT19;MT45) Social media platforms for activism (MT19;MT45;MT47; MT29;MB36;MB8;MB36)
Health	<ul style="list-style-type: none"> Health platforms to trace health status (B1;MT46;MT10; MT20) Social media platforms for health advice, (self)diagnosis and medication (MK15;ET6;K17;MT45;MT46) Social media platforms as CHW tool (ET6;MT45;MT11;MT3) National Health Insurance Fund (NHIF) platform (MT10; MT22;B1;MT21;MT38;MT45;MK2)
Access to basic utilities	<ul style="list-style-type: none"> Electricity paid in tokens to Kenya Power directly (T31; MT10;MT21;T41;MT13) or indirectly (MT38;MB36;MT22; MK26) Solar energy through platforms (MK15) Water through ATMs, but only indirectly (MT18;MT9) Gas through M-Gas (MB36;MK26;MT46)

5. Debate

This section describes platform frugality to explain the deployment of each domain to address resource constraints and ends with an analysis of limitations to platform deployment.

5.1. Fintech

All fintech platforms are important to address livelihood constraints, but platform usage varies depending on platform frugality. M-Pesa is a normalised banking infrastructure that is (in)directly deployed by all respondents for payments, receiving gifts, or informal borrowing from friends and families. We confirm that M-Pesa is highly affordable, accessible and simple to use, also due to SMS technology enabling wider and easier access for residents who do not have skills or budget to work with smartphones (Knorringa et al., 2016). This explains the wide deployment of M-Pesa.

Lending platforms are key in livelihood practices, enabling relatively easy access to small loans that are also used to address other constraints. However, these platforms are less frugal than M-Pesa, as citizens can be excluded from accessing these platforms if they cannot repay their debt. Respondents (MB20;MT21;MT34;MB36) mentioned being excluded as their risk profile was perceived as too high. New measures from authorities and platform operators aim to further avoid residents obtaining new loans. For instance, authorities have set up a blacklist of persons who do not repay their debt. Such measures exclude residents and may increase inequality (Bhagat & Roderick, 2020), but also avoid fintech platforms exploiting informal settlers through high-cost and short-term credit products (Langley & Leyshon, 2022).

Other fintech platforms for livelihood practices are linked to more complex functions such as obtaining venture capital. These platforms thus have a lower level of frugality, contrasting existing literature (Van Tuijl & Knorringa, 2023). Key causes explaining the limited deployment of such platforms are associated with a low level of frugality: costs and digital skills that suggest a relatively high user-complexity. For instance, MT13 wanted to try Bitcoin, but it was too expensive.

5.2. Gig

We contrast frugal innovation literature (Ahuja, 2021) and classify gig platforms within the low frugality category, with platforms for on-site gig work being even less frugal than those for online jobs. A key cause for low frugality, and hence, limited deployment of online gig platforms is the access requirement to upload formal IDs (that informal settlement residents lack), as explained by a tech mediator and aligning with Hackl and Najdi (2024). For on-site local gigs, access barriers turn out to be even higher, explaining that none of our respondents participate in such platforms. They are not only excluded by legal barriers, but are also confronted with user costs (cf. Guma, 2023), including transaction costs (Hossain, 2021) and investments in fixed assets (e.g., motorcycles for ride-hailing) hindering them from participating in on-site gigs. Overall, these platform access and costs barriers explain that gig platforms are mainly used in livelihood practices for online work, but only in rare cases. The potential of gig platforms for livelihood improvement in informal settlements (Keskinen et al., 2022) is thus not realised in Mathare.

5.3. Health

We contrast frugal innovation literature (Sarkar, 2021) which perceives health platforms as frugal. Causes of low frugality are that health platforms require formal IDs and that the NHIF platform and scheme are hard to understand (i.e., too complex to use). The low level of frugality is associated with low deployment. Only a few residents in Mathare use health platforms mainly for tracing their health status or paying healthcare costs.

5.4. Social media

We confirm that social media platforms are frugal (Sheikh et al., 2023), as they are simple to use, ‘freely’ accessible and require little skills. We add to theory that social media platforms function as frugal alternatives for other domains. For instance, online marketing on social media platforms offers residents a simple and affordable alternative for online gig platforms. Likewise, ‘free’ social media platforms are consulted for health advice and self-medication as frugal alternatives for health platforms. Similarly, collective saving schemes on social media function as simple alternatives for fintech platforms. This aligns with informal ride-hailing service providers who use social media platforms to bypass formal access to gig platforms and to overcome the absence of formal institutions (Cirolia et al., 2023; Paredes & Vigiola, 2024). We thus find that the high level of frugality of social media platforms associates with its wide deployment to address all resource constraints with the exception of access to basic utilities.

However, we find differences between the social media sub-domains. WhatsApp is more frugal than YouTube as watching videos requires higher user costs due to more advanced smartphones and more internet data. Other types (e.g., Instagram) are positioned somewhere in between these extremes. Thus, this explains why WhatsApp is more widely deployed than other social media platforms.

5.5. Utility

Utility platforms have a low level of frugality, contrasting Howell (2021), who argues that platforms increase access to basic utilities. All utility types have a low degree of frugality, but the rationale of low platform deployment differs between utility types. Many residents are excluded from accessing the electricity platform by Kenya Power due to their informal status. Another rationale for not using this platform is the existence of more affordable illegal electricity connections. The existence of more affordable alternatives is also a rationale for the limited deployment of solar-energy and M-gas platforms. We propose that the existence of affordable alternatives in urban informal settlements explains the difference with the frugal innovation literature on rural areas (Van Tuijl et al., 2024) where there are no affordable alternatives.

Dependency on a single supplier is another deployment barrier of M-gas platforms: *“It is also stressful when the gas is depleted, you have to call them and you are not sure if they will come, sometimes they just hang-up”* (MK25). Such a dependency increases user-complexity and aligns with frugal innovation literature showing reduced options for low-cost self-repair of smart water pumps (Van Tuijl et al., 2024).

For water utility platforms, the power of gangs is a major barrier hindering affordable access to clean water. We mapped twenty-five water ATMs of the municipal water utility —Nairobi Water— aiming to supply water with a low price of 0.5 KSh for a 20-l jerrycan. However, only three ATMs still run through the formal platform, thirteen supply water illegally without smart cards and nine are out of order: *“They <Nairobi Water> built the water ATMs here but later claimed it had no water. We do not know who destroyed it at night; there must be a group <a gang that sells water that broke it down>”* (MT40). Accordingly, many of our respondents rely on water suppliers controlled by gangs and pay a high price of 5.00 KSh per jerrycan.

To conclude, the low frugality of utility platforms explains why only a few residents use this domain that they only use to access basic utilities. Moreover, our analysis of platform frugality explains differences within this domain. Whereas electricity and gas utility platforms are not popular among residents due to existence of more affordable alternatives, the potential of affordable water access provided through smart water systems is not reached due to gangs who makes these less accessible and affordable (Guma, 2019).

5.6. Comparing platform frugality

Fig. 1 conceptualises the level of frugality of each domain (research question 1), showing that social media platforms, the fintech platforms M-Pesa and lending platforms are more frugal than more advanced fintech, utility and health platforms. This conceptualisation does not aim to rank platforms domains, but rather to explain differences in how informal settlement residents use the different domains to address their resource constraints (research question 2). Table 3 shows that residents widely deploy social media to address multiple resource constraints. Likewise, M-Pesa and lending platforms are widely used to address livelihood and other resource constraints. As these are owned by Safari, it gives this telecom firm a strong influence on informal settlers' life. Moreover, most other platforms run on the M-Pesa infrastructure. Further research should explore M-Pesa's role as an African "platform of platforms" (Van Dijck et al., 2018) and its impact on informal settlements. Utility, health and more complex fintech platforms are less frugal and hardly used by informal settlement residents to address resource constraints. The difference in usage is explained by differences in access, affordability and complexity. These frugality dimensions are interrelated, for instance, higher user costs can be perceived as an access barrier. Exploring these interrelations is suggested for further research.

5.7. Limitations to platform deployment

Analysis of platform frugality has unveiled specific limitations to platform deployment in informal settlements (research question 3). Table 4 shows specific limitations per domain. For instance, deployment of social media is mainly hindered by internet costs, whereas gig platforms usage is also limited due to investment costs in physical assets required to perform on-site gigs.

Two generic limitations hinder the deployment of platforms across all domains. Firstly, high internet costs challenge all respondents to use platforms more frequently (cf. Wamuyu, 2017) and to access more complex platforms. This reduces the potential of less frugal platforms, including gig work for livelihood improvement in informal settlers (Keskinen et al., 2022), and may reduce informal settlers' livelihood options. The latter is illustrated by MT17 who sometimes skips meals to save money to buy internet bundles. Secondly, various platform domains restrict access by a required formal ID to participate.

Frugal platforms are not a panacea to address resource constraints. They have dark sides, such as fake news on social media and increasing debts through credits traps (Langley & Leyshon, 2022). Finally, the deployment of platform practices to address livelihood constraints may be short-term. For instance, MB20 learned soap-making through social media and sold these in Mathare but stopped as others also started selling soap. Hence, digital entrepreneurship does not only increase global (Friederici et al., 2020), but also local competition. It suggests that frugal innovation (in this case using social media) is mainly a survival-oriented strategy in informal settlements (Fransen et al., 2023). This also unveils limitations of our study. Platform frugality is suitable to explain platform deployment (the aim of this paper), but not yet its effects on long-term effects on development. Moreover, we have focussed on social and economic values (the largest constraints of Mathare residents), but not on environmental values. Therefore, further research on platform frugality and trade-offs between different values and short-versus long-term development is imperative, also given the (highly debated) promises of frugal innovation for sustainable development (e.g., Albert, 2019).

6. Conclusion

Platform literature in the Global South (Bonina et al., 2021) is primarily conceptual or focuses on a single platform domain without paying adequate attention to the multiplicity of resource constraints in informal settlements (Seeliger & Turok, 2014). This paper aims to explain differences in platform deployment across domains and reveal limitations. Thereto, we have introduced the concept of platform frugality, indicated by platforms' accessibility, affordability, and simplicity.

Based on a case study of Mathare, we conclude that platform frugality differs both between and within platform domains. This explains differences in platform deployment by residents in Mathare and contradicts frugal innovation literature that perceives platforms as homogenous and frugal (Van Tuijl et al., 2024). Our findings show that residents of Mathare widely deploy frugal social media and fintech platforms (M-Pesa and lending) to address different resource constraints. As such, social media and these fintech platforms serve as frugal substitutes for other domains (health, gig, utility, more advanced fintech).

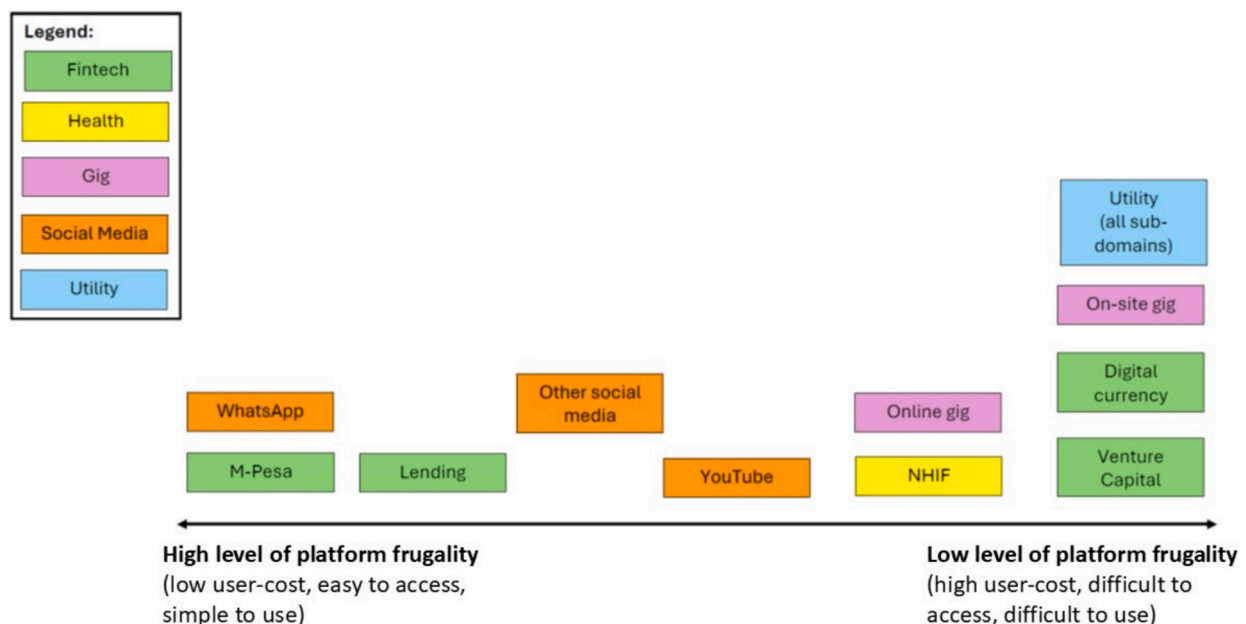


Fig. 1. Frugality of platform domains.

Table 3
Platform domains, resource constraints and practices.

Resource constraint Platform domain	Safety	Livelihood	Health	Access to basic utilities
<i>Fintech</i>	<ul style="list-style-type: none"> Indirectly, M-Pesa and lending platforms to pay for safety measures 	<ul style="list-style-type: none"> M-Pesa for money transfer Borrow money Obtain venture capital Invest in digital currencies 	<ul style="list-style-type: none"> Indirectly, M-Pesa and lending platforms to pay for health treatment 	<ul style="list-style-type: none"> Indirectly, M-Pesa and lending platforms to pay for basic utility services
<i>Health</i>			<ul style="list-style-type: none"> Trace health status NHIF platform to cover healthcare costs 	
<i>Gig</i>		<ul style="list-style-type: none"> Do online work 		
<i>Social media</i>	<ul style="list-style-type: none"> Reporting and self-learning 	<ul style="list-style-type: none"> Collective saving schemes Find jobs Do online work Promote products Receive client information Sell goods 	<ul style="list-style-type: none"> Health advice, (self) diagnosis and medication CHW tool 	
<i>Utility</i>				<ul style="list-style-type: none"> Electricity paid in tokens Solar energy through platforms Water through ATMs (only indirectly) Gas through M-Gas

Table 4
Limitations to platform deployment.

Platform domain	Limitation < frugality dimension>
<i>Fintech</i>	<ul style="list-style-type: none"> Increasing inequality due to exclusion from lending platforms <access> Internet costs and skills for more advanced platforms <affordability, complexity>
<i>Health</i>	<ul style="list-style-type: none"> Need formal IDs <access> Internet cost <affordability>
<i>Gig</i>	<ul style="list-style-type: none"> Exclusion due to need of formal IDs (both types) <access> Transaction- and assets costs (on-site local gig) <affordability>
<i>Social media</i>	<ul style="list-style-type: none"> Internet and smartphone costs, particularly for more advanced platforms <affordability> Risk misinformation <complexity>
<i>Utility</i>	<ul style="list-style-type: none"> High costs compared to (illegal) alternatives <affordability> Dependency on suppliers <complexity> Power of gangs <access>

Secondly, we conclude that platform frugality reveals limitations to

platform deployment. Generic limitations to platform deployment include costs and residents' lack of formal IDs. Residents' informal status hinders access to gig (Guma, 2023; Hackl & Najdi, 2024) and health platforms. Moreover, online and on-site gig platforms differ in platform frugality with the latter having even larger access barriers, and accordingly, less options to benefit from potential advantages in the gig economy. Furthermore, regarding smart urban infrastructures (Guma, 2019), we show that informal settlement residents hardly benefit from utility platforms, as these are less affordable, more complex to use and/or less accessible.

The key contribution of this paper is the introduction of platform frugality as a tool to reveal differences in platform deployment across and within the domains. Platform frugality also offers useful insights for urban practitioners. We recommend development practitioners promote social media platforms as frugal alternatives for other domains, while running information campaigns on platforms' dark sides. Furthermore, we propose platform operators and governments supply free internet to enable residents to use platforms when addressing resource constraints. This may reduce the digital divide within informal settlements between those who mainly access frugal platforms, and those who deploy more advanced platforms. Finally, we recommend platform frugality as a tool for development in conjunction with non-digital practices and specificities of informal settlements.

This explorative study is based on a single case study and its results cannot be generalised. Therefore, we suggest a quantitative analysis on platform deployment in different informal settlements. We recommend comparative case studies to refine the concept of platform frugality. Another avenue for future research is exploring the long-term impacts of platforms in informal settlements. Preliminary evidence suggests that platform deployment is mainly survival-oriented and does not lead to structural improvements. A longitudinal study could strengthen our conceptualisation by comparing impacts across domains.

CRedit authorship contribution statement

Erwin van Tuijl: Writing – review & editing, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jan Fransen:** Writing – original draft, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Samuel Kiriho:** Funding acquisition, Data curation. **Harrison Kioko:** Formal analysis, Data curation. **Alice Menya:** Writing – original draft.

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Declaration of competing interest

We declare that we have written the submitted manuscript and have no competing interests.

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Appendix A. Characteristics respondents

ID	Location	Profession/Occupation	Age	Household size	Marital status
B1	Bondeni	Social Artist	Not specified	4	Married
B33	Bondeni	Trained by KYEOP	24	Not specified	Married
B5	Bondeni	Washing Clothes	20	4	Married
ET6	Mathare	Informal: baby sitting; laundry; CHW	38	Not specified	Not specified
K17	Kosovo	A father of four	43	5	Married
MB16	Mabatini	Construction worker, hotel worker	54	Not specified	Married
MB20	Mabatini	CHW, casual labourer	Not specified	6	Married
MB23	Mabatini	Laundry	33	4	Married
MB36	Mabatini	Washing cloths	50	Not specified	Separated
MB42	Mabatini	Student, KU (Biochemistry)	19	6	Single
MB8	Mabatini	Not specified	Not specified	Not specified	Not Specified
MK15	Mlango Kubwa	Certificate in ICT	32	4	Single
MK2	Mlango Kubwa	Mother	42	6	Single
MK24	Mlango Kubwa	Student (diploma)	21	4	Single
MK25	Mlango Kubwa	Washing Clothes	37	4	Married
MK26	Mlango Kubwa	Student (food and beverage)	22	3	Single
MK43	Mlango Kubwa	Employed for half a day	Not specified	Not specified	Not Specified
MK44	Mlango Kubwa	Selling charcoal and meat	72	4	Widower
MK47	Mlango Kubwa	Laundry services	Not specified	Not specified	Not specified
MT10	Mlango Kubwa	Photographer/undergraduate	24	2	Single, lives with his brother
MT11	Mathare	Online business (selling rice & cloths); CHW	32	5	Married
MT12	Mathare	Selling water	30	6	Not specified
MT13	Mathare 3C	Diploma in IT; unemployed	28	4	Married
MT14	Mathare 3A	Completed high school	22	3	Not specified
MT18	Mathare 3C	Not specified	Not specified	Not specified	Married
MT19	Mathare	Painter	22	2	Not specified
MT21	Mathare	Trained at Maji Mazuri Hub	Not specified	3	Married
MT22	Mathare 3A	Tailor	55	4	Widow
MT27	Mathare	Studied IT	24	3	Not specified
MT28	Mathare	Food Vendor	42	6	Single
MT29	Mathare	Social Justice Activist	Not specified	1	Not specified
MT3	Mathare	CHW	41	3	Divorced
MT30	Mathare	Dropped out of school (Electrical Installations)	26	2	Married
MT34	Mathare	House burnt down	33	5	Not specified
MT35	Mathare	Dropped school in form 2	20	Not specified	Single
MT37	Mathare	Not specified	27	1	Not specified
MT38	Mathare 3A	Lives in a concrete house	42	2	Single
MT39	Mathare	Own a kiosk (businessman)	31	4	Married
MT4	Mathare	Sick; unemployed	Not specified	3	Not specified; Lives with 2 grand children
MT40	Mathare	Hairdresser	38	7	Separated
MT45	Mathare 3C	Mentor ; CHW	25	4	Single
MT46	Mathare	Did Computer studies; unemployed	Not specified	Not specified	Not specified
MT6	Mathare	Unemployed	28	3	Widow
MT7	Mathare	Food Vendor	36	5	Married
MT9	Mathare	Food Vendor (Hotel)	36	7	Not specified
T31	Thayu	Nurse aid	30	4	Married
T32	Thayu	BodaBoda rider	Not specified	Not specified	Not specified
T41	Thayu	Interior designer	34	4	Married

The ID is based on the name of the neighbourhood/location of the respondents, followed by the number of the interview. Note that 'Mathare' is both the name of a neighbourhood as well of the entire settlement.

Data availability

The data that has been used is confidential.

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