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ORIGINAL ARTICLE

Resilience Pathways of Informal Settlements in Nairobi: Stasis, Decline, Adaptation, and Transformation

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Abstract

This study investigates resilience pathways of informal settlements, and their diverse impacts through community-based participatory research in Mathare and Korogocho, Nairobi. Results reveal that resilience pathways were relatively stable in the 1970s and 1980s, declined in the 1990s, and changed towards more adaptive approaches in the 2000s. Each period accommodates a dynamic mix of maladaptive, adaptive, and transformative resilience initiatives. Adaptive resilience initiatives are sustainable and adopt frugal practice to cope with resource constraints, without harming others. Transformative resilience initiatives are rare, as they require a significant shift in societal norms and institutions. The study emphasizes the need to recognize the dynamics and variety of resilience initiatives in informal settlements. The study therefore recommends (1) recognizing and supporting adaptive and transformative resilience initiatives; (2) recognizing the dynamics and variety of resilience initiatives of informal settlements; and (3) addressing inhibiting institutional settings of informal settlements.

Keywords Resilience · Vulnerability · Frugality · Mathare · Korogocho · Kenya

Résumé

Cette étude examine les moyens de résilience à long terme des établissements informels, et leurs divers impacts, à travers une recherche participative chez les communautés à Mathare et Korogocho, Nairobi. Les résultats révèlent que les moyens de résilience étaient relativement stables dans les années 1970 et 1980, qu'ils ont diminué dans les années 1990, et qu'ils ont changé vers des approches plus adaptatives dans les années 2000. Chaque période accueille un mélange dynamique d'initiatives de résilience inadaptés, adaptés, et transformatives. Les initiatives de résilience adaptés sont durables et adoptent une pratique frugale pour faire face aux contraintes de ressources, sans nuire à autrui. Les initiatives de résilience transformatives sont rares, car elles nécessitent un changement significatif des normes et institutions sociétales. L'étude souligne la nécessité de reconnaître les dynamiques et la variété des initia-

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tives de résilience dans les établissements informels. L'étude recommande donc (1) de reconnaître et de soutenir les initiatives de résilience adaptative et transformatives; (2) de reconnaître les dynamiques et la variété des initiatives de résilience des établissements informels; et (3) d'aborder les cadres institutionnels inhibiteurs qui sous-tendent les vulnérabilités dans les établissements informels.

Resumen

Este estudio investiga los caminos de resiliencia a largo plazo de los asentamientos informales, y sus diversos impactos, a través de la investigación participativa basada en las comunidades de Mathare y Korogocho, Nairobi. Los resultados revelan que los caminos de resiliencia eran relativamente estables en las décadas de 1970 y 1980, disminuyeron en la década de 1990, y cambiaron hacia enfoques más adaptativos en la década de 2000. Cada período acomoda una mezcla dinámica de iniciativas de resiliencia inadaptadas, adaptadas y transformadoras. Las iniciativas de resiliencia adaptadas son sostenibles y adoptan prácticas frugales para hacer frente a las limitaciones de recursos, sin perjudicar a otros. Las iniciativas de resiliencia transformadora son raras, ya que requieren un cambio significativo en las normas e instituciones sociales. El estudio enfatiza la necesidad de reconocer la dinámica y variedad de iniciativas de resiliencia en los asentamientos informales. Por lo tanto, el estudio recomienda (1) reconocer y apoyar las iniciativas de resiliencia adaptada y transformadora; (2) reconocer la dinámica y variedad de iniciativas de resiliencia de los asentamientos informales; y (3) abordar los entornos institucionales inhibidores que subyacen a las vulnerabilidades en los asentamientos informales.

Introduction

The resilience of marginalized communities is high on the scholarly, social, and political agenda following the accentuated vulnerability of approximately 1.2 billion urban poor residents housed in informal settlements (Mahendra et al. 2021). The co-occurrence of the global pandemic Covid-19 with a wide range of shocks, including the Ukraine war, persistent droughts, economic crises, and sociopolitical instability, intricately interwoven with ongoing deprivations, engenders informal settlements as 'global hotspots of vulnerability' (UN-Habitat 2020, p. 2). The capacities to cope in informal settlements are limited, yet (state) support is insufficient (Rivero-Villar and Medrano 2021). Urban poor communities strive to survive under constraints, but hybrid shocks have pushed millions of informal settlers below the poverty line, especially in Sub-Saharan Africa, threatening the progress made in poverty alleviation over decades (Yonzan et al. 2022). Resilience in this context draws attention. In 2014, the IPCC already warned that major disasters are likely to strike in informal settlements (Revi et al. 2014), as these settlements are vulnerable due to substandard and often illegal housing, infrastructure, services, and employment combined with limited governance capacity to reduce vulnerabilities (Seeliger and Turok 2014; Satterthwaite et al. 2020).



Urban resilience is a widely applied concept, yet it remains eminently fuzzy and contested in current policy and academic debates (De Carli 2016, p. 775). A popular application of the concept defines resilience as the 'capacity of a city (individuals, communities, institutions, businesses, and systems) to survive, adapt, and thrive no matter what kinds of chronic stresses or acute shocks they experience' (Rockefeller Foundation and ARUP 2019). In a neo-liberal frame, informal settlers are portrayed as incrementally building resilience as they confront precarity in their daily struggle for survival. Resilience evolves as communities gradually learn and practice to survive, while concomitantly hazards are being eliminated so that they will not be required to deal with recurring risks (Kaika 2017). However, such a perspective may over-glorify agency and aestheticize vulnerability, poverty, and suffering of the urban poor without necessarily exploring risks and government responsibility (Banks et al. 2020). The question is not only how vulnerable communities cope but also why they should cope with chronic stresses and acute shocks in the first place: what institutional systems cause these vulnerabilities? A political-economic framing brings to light that many vulnerabilities originate outside vulnerable communities and require a systemic multilevel perspective with an eye for power imbalances (Kaika 2017).

A second contestation inherent in the resilience definition is the interpretation and measurement of 'transformation'. The concept of transformation is integral to resilience, emphasizing the ability of communities to recover, adapt, and progress towards a structurally improved state (Satterthwaite and Dodman 2013). However, the coping mechanisms of urban vulnerable communities are often insufficient to trigger transformation. They relieve acute suffering in the short term within limited time and space and may even "physically divert risk… to other members of the community or, at best, function as temporal solutions that will have to be repeated in the future" (Rivero-Villar and Medrano 2021, p. 5). The application of a neo-liberal approach of resilience to these complex social systems without understanding their variety and power imbalances may hinder positive transformation (Pelling et al. 2012; Meerow & Newell 2019). Shocks and persistent deprivations point towards the need to transform informal settlements, but the transformation mechanisms within the context of informality and resource constraints remain unclear.

Thirdly, a challenge also lies in defining 'chronic stresses and acute shocks'. Resilience literature is concerned with disasters such as flooding, and drought linked to long-term stressors such as climate change. While these disasters do indeed cause havoc and occur more regularly and with increased intensity, our respondents offer a more socialized perspective. They define resilience as an everyday hustle to survive in an uncertain environment. Their main chronic stresses are income loss and precarious livelihoods, unsafety, and illness. These everyday stressors are likely to increase in number and intensity due to the increased occurrence and intensity of disasters. By combining these notions, we contextualize the definition of resilience to informal settlements as an everyday hustle to survive in a deeply uncertain environment, embedded in contextual (historical) practices and broader institutional frameworks.

This paper explores the long-term processes that emerge out of the systemic interaction between institutional frameworks, vulnerabilities, and the everyday hustle



within informal settlements. Our analytical approach to resilience focuses on how the continual struggle for survival against multifaceted livelihood, health, and safety challenges is earned over time and space, also in the broader context of disruptive shocks such as gang entry and ousting or Covid-19. Resilience of informal settlements is not static: it changes for the good or worse in complex, systemic processes. This paper explains and compares resilience pathways of informal settlements over the last 50 years, defined as space- and time-specific processes within which institutional contexts, vulnerabilities, and daily resilience initiatives of multiple actors co-evolve. This leads to our main research question: How do institutional contexts, vulnerabilities, and resilience initiatives interact to shape the resilience pathways of informal settlements in Nairobi, Kenya?

We trace the resilience pathways of two large informal settlements in Nairobi: Korogocho and Mathare. In both settlements, we find that resilience pathways were relatively static in the 1970s and 1980s, declined in the 1990s and early 2000s, and transformed from 2006 onwards, leading to adaptive resilience pathways. We critically explore these pathways and their relationship to the heterogeneous variety of often contradicting resilience initiatives within. Following Elmqvist et al. (2019) and Folke (2006), we do so by assessing if the initiatives are adaptive, maladaptive, or transformative. To appreciate resilience initiatives in a resource-scarce environment, we turn to the concept of frugality, defined as a creative and robust fix using limited resources (Radjou et al. 2012).

The paper is structured as follows. "Theory" section brings together literature on resilience, informal settlements, and frugality. It discusses resilience pathways of an informal settlement, followed by a conceptual framework. "Methods" section subsequently offers the research methods, and "Findings" section mentions the findings followed by debate, conclusions, and recommendations.

Theory

Resilience Pathways of and in Informal Settlements

Resilience pathways occur at multiple levels, which interact with each other over different spatial and temporal scales (DeWeijer, 2013 in Seeliger and Turok 2014). They follow path-dependent processes, whereby the past steers the direction of development (Folke 2006). In informal settlements, substandard built environments and institutional contexts are likely to condition resilience pathways. Understanding the resilience of informal settlements thus requires a historical, spatial, and multilevel perspective.

Exploring the resilience pathways of informal settlements is challenging, as it aims to zoom in on a meso-level phenomenon influenced by macro-level institutional frameworks and encompassing heterogeneous subcommunities, households, residents, and firms. We apply the concept of "general resilience", defined as the ability of a system and its subsystems to cope with shocks and stresses (Folke et al. 2010; Nykvist and Heland 2014). We treat general resilience as the resilience of informal settlements, acknowledging that they are open systems in which vulnerabilities and



resilience initiatives are conditioned by institutional contexts. We thereby perceive the general resilience of informal settlements as the meso-level meeting point of institutional contexts, vulnerabilities, and resilience initiatives. General resilience is subsequently operationalized for the core resilience challenges that our respondents have highlighted: livelihoods, with a focus on income and finance, health, and safety.

Whereas general resilience offers a modal picture at the level of informal settlements, "specified resilience" describes how any part of the system or any actor in the informal settlement is impacted by and responds to shocks (Folke et al. 2010; Nykvist and Heland 2014). As informal settlements are heterogeneous, general resilience affects subcommunities, households, and individual residents in different ways. In this paper, we describe how the general resilience of informal settlements changes over time and indicate how these changes impact the specified resilience of subcommunities and households in informal settlements.

Unpacking Resilience Pathways

To better understand the resilience pathways of informal settlements, we explore their institutional context, vulnerabilities, and resilience initiatives.

Informal settlements are often perceived as existing outside the formal planning and governance structures of cities, while they are deeply embedded in the urban fabric and socioeconomic systems. Informal settlements are both officially recognized and regulated by city authorities, while also being neglected and stigmatized. For example, Nairobi County recognizes Mathare and Korogocho through specific funds allocated for local development projects and engages with police, chiefs, village elders, and resident groups in matters of security. This recognition, although partial and contingent, demonstrates that informal settlements are not disconnected from the city, contrary to what terms like "non-city" may imply (Rojas Symmes et al. 2023). Instead, informal settlements are intertwined with, and in many ways, constitutive of not only the physical but also the social, economic, and political infrastructure of the city (Suhartini & Jones 2019). In fact, residents of informal settlements often navigate complex legal and administrative processes to access basic services and rights. In most cases, residents self-organize to engage with formal urban institutions to secure essential services and rights. As a result, many residents have developed innovative solutions to access basic services (Blomkvist et al. 2020). This leads to the emergence of complex governance arrangements centred around basic provisions, where actors within informal settlements become part of broader urban governance institutions, functioning as social, economic, and political nodes within the city.

Vulnerabilities in informal settlements are related to their demographic characteristics, spatial dynamics, and resource constraints. In neo-liberal urban landscapes, informal settlements are often located in high-risk zones or far away from employment opportunities and services. Demographically, they are likely to house vulnerable and discriminated groups. Resource constraints, manifested in substandard infrastructure, precarious housing, and low incomes, make informal settlers more susceptible to shocks (Seeliger and Turok 2014; Satterthwaite et al. 2020).



Within the institutional and vulnerability context, informal settlers engage in make-do resilience initiatives, which involve everyday adaptations in immediate response to shocks and stresses (Jabeen 2019). These resilience initiatives are often precarious, temporary, frugal, and conflicting. As they build on each other, informal settlements resemble dynamic makeshift environments (Pieterse 2008; Vasudevan 2015).

Informal settlers' collective actions venture into developing shock-proof "hard" infrastructure or "soft" infrastructure, strengthening the capacity of people and their fragmented networks (Simone 2008). These actions may reduce vulnerabilities, such as through solid waste collection. However, collective action rarely challenges the broader institutional setting (Adger et al. 2009). Other actors, including governments, donors, and firms, may also offer shock-reducing infrastructure, services, and support (Fransen et al. 2022). The governance arrangements that emerge when external actors partner with collective actions can lead to adaptive or transformative resilience pathways but can also result in participation fatigue, mistrust, elite capture, or bureaucracy (Brandsen 2016; Fransen et al. 2022).

The multitude of resilience initiatives affect resilience pathways in different ways. Following Folke (2006) and Elmqvist et al. (2019), we question whether these initiatives are (mal)adaptive and/or transformative. Transformation requires changes in institutional contexts, which often involve more powerful actors such as governments. Maladaptive initiatives increase vulnerabilities for others or in the long term. For example, if a government widens a road, it may improve the resilience of some urbanites but harm others if it leads to their displacement. Elmqvist et al. (2019) argue that self-organized initiatives may enhance specified resilience in the short run but overlook the resilience of the wider community or the longer term. A vulnerable household, for instance, may adapt to power cuts by illegally connecting to electricity, which increases the risk of fires in the neighbourhood.

To identify whether resilience initiatives in a resource-scarce context are (mal) adaptive or transformative, we turn to the concept of frugality, which involves the innovative and minimal use of resources and intuitive processes to identify low-cost options by removing non-essential functions (Tiwari et al. 2014). The slogan "fail cheap, fail fast, fail often" (Radjou et al. 2012) represents the temporal, experimental, and makeshift nature of frugal resilience initiatives. Frugal resilience initiatives offer affordable, basic functionality with reduced total cost and easy access (Tiwari et al. 2014). Frugality may indicate adaptive or transformative capacity if it provides an affordable and robust quick fix to shocks and disturbances (Bahadur and Doczi 2016). Therefore, the adaptability of resilience initiatives is determined by who it benefits or impairs, its likely long-term effects, and its frugality (affordability and quality).

Conceptual Framework

In line with theory, we conceptualize that resilience pathways of informal settlements are likely to be influenced by their institutional context, vulnerabilities, and resilience initiatives (Fig. 1). The combination of (mal)adaptive and transformative



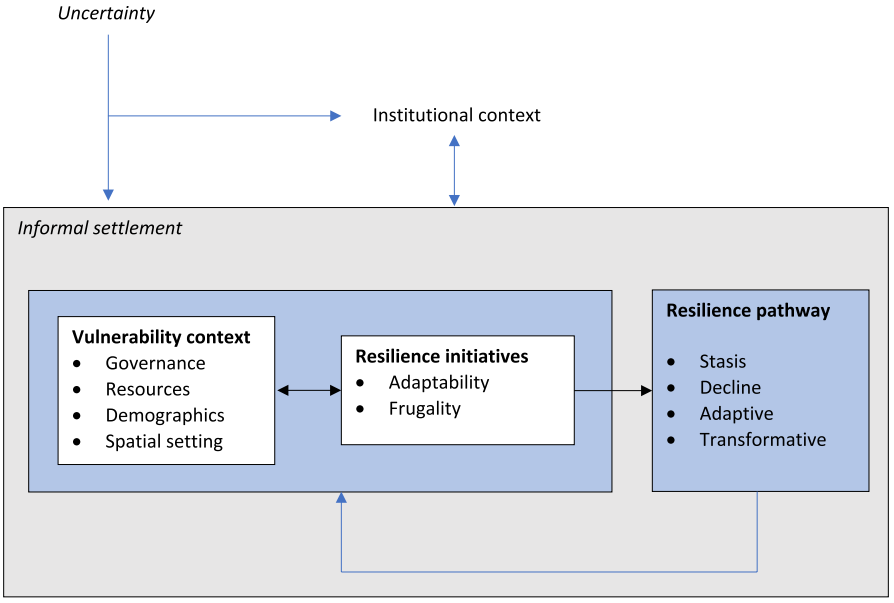


Fig. 1 Resilience pathways of informal settlements. *Source* Authors

resilience initiatives are formed by and form the institutional context and vulnerabilities of informal settlement. These interactions are expected to result in constant dynamics and may push resilience pathways in different directions. Resilience pathways depict trends in the general resilience of informal settlements, which, in turn, impact the specified resilience of actors within informal settlements in various ways.

Methods

We conduct an exploratory qualitative, community-based participatory inquiry within the framework of a multiple case study design (Yin 2009). The study focuses on two large informal settlements, Mathare and Korogocho, which have a history of over five decades and are located in close proximity to each other (Fig. 2). Mathare, established in the 1920s, has not benefited from formal redevelopment and only experienced a failed upgrading attempt in 2011–2012 under the phase 1 of the Kenya Informal Settlement Improvement Programme. On the other hand, Korogocho, established in the 1960s, has been a beneficiary of a rudimentary formal upgrading program. Recognizing the heterogeneity within the settlements, we select two neighbourhoods (Mitaa) from each settlement, anticipating that their diversity would be representative of the overall population variation in a minimal sense (Seawright and Gerring 2008, p. 297). In Mathare, we focus on Village 2 and Mathare 3C, which represent different socio-economic statuses and housing typologies (shacks and concrete high rises) among the 13 villages in Mathare. In Korogocho, we examine two villages: Grogon, which has partially been upgraded, and K1

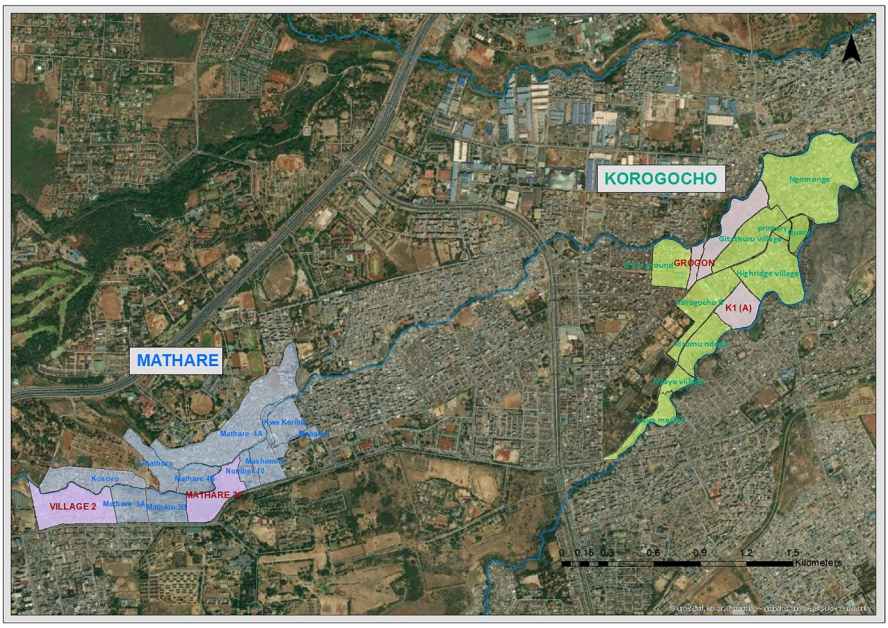


Fig. 2 Map on Mathare and Kporogocho. *Source* Authors. Percentages are based on perceptions of a small sample and are therefore indicative. Sample size in Korogocho:12 in 1970s/1980s; 36 in 1990s/2000s. Sample size in Mathare: 17 in 1970s/1980s; 48 in 1990s/2000s

(Korogocho A), which has not been upgraded. While upgrading efforts are spatially bound, the changes affect residents across all eight villages, although in different ways. Data from the selected Mitaa are aggregated and discussed at the settlement level, while leveraging the variety to add nuance to the resilience pathways.

Empirically, we employed a constructivist approach to examine the coevolution of institutional and vulnerability contexts and resilience initiatives. These constructs are operationalized in Table 1. Analytically, we applied the rounds model (Teisman 2000) to identify three distinct rounds with different configurations of institutional and vulnerability contexts, resilience initiatives, and resilience outcomes: (1) stasis in the 1970s and 1980s, (2) declining resilience in the 1990s and early 2000s, and (3) adaptive pathways from around 2008 to 2020. These rounds are demarcated by decisive events, such as the rise and fall of powerful gangs as influential actors. We are aware that a "one round, one pathway" approach is overly simplistic for complex and heterogeneous informal settlements. It represents general resilience, calculated as the modal score reflecting perceived improvements or declines in health, safety, and livelihood conditions within each round. While each round represents a distinct resilience pathway, we acknowledge that resilience outcomes vary and encapsulate different manifestations. This variety is partially described. Moreover, the boundaries between rounds are not rigid, as changes in pathways occur over several years.

In the study, we conduct individual storytelling sessions with 17 elderly inhabitants aged 66–80 years, with the youngest participant being 16 years old at the beginning of the first round (1970s). These sessions comprehensively



Table 1 Operationalization

Variable	Sub-variable	Indicators
Institutional context	Governance	Perceived role of/ coordination among actors
Vulnerability context	Resources	Perceived resources
	Demographics	Density of settlement
	Spatial setting	Locational risks
		Distance to work and services
Adaptability of resilience initiatives	Actor	Actor
	Frugality	Quality
		Affordability
	Adaptability	Sustainable use of resources
		Effect on general resilience (harming others)
Resilience outcomes	General resilience	Perceived change in resilience (overall, health, safety, livelihoods)

Source Authors

describe and compare resilience, institutional context, and vulnerability from the 1970s to 2020. Semi-structured household interviews are conducted with 41 respondents aged 23–51 years, providing data primarily on the second round and partially on the third round. Additionally, we interview 29 key informants (such as village elders, community health volunteers, CBO representatives, chiefs, a businessman, and a religious leader) to enrich the historical narratives and household interviews and triangulate data. In total, 87 respondents are selected in a stratified sample which aims for diversity in age, gender, education, and marital status (Table 2).

The data are analysed with the participation of community researchers in five steps. First, we transcribe the data and developed coding schemes. Second, we apply a code book to group data for each settlement and round, incorporating the tacit knowledge of the community researchers. Third, we assess the perceived changes in health, safety, and livelihood for each respondent in each round and assign values, resulting in perceived general resilience outcomes for each settlement as modal scores. The factors across the three rounds are then configured, leading to the grouping of pathways. Fourth, the participatory analysis is cross-checked by re-coding and regrouping the data using Atlas.ti software, and triangulating data with over 100 secondary reports, 23 of which are referenced in this article. By triangulating data we aim to overcome the recall bias. Finally, the refined findings are presented to residents of Mathare and Korogocho in data validation workshops conducted at the settlement level. This iterative process and triangulation increased internal validity, enhance the capacity of community researchers, and facilitate knowledge transfer to the communities. However, the external validity of the findings is limited due to the context-specific nature of the two settlements. Additionally, due to the small sample size within selected neighbourhoods, the study may not capture the full range of specified resilience and should therefore be considered exploratory.



Table 2 Sample

	Age of all respondents				Gender		Education				Marital status of household interviews (41)			
	18–34	35–54	55–64	>65	Female	Male	Primary	Secondary	Tertiary	NA	Married	Single	Widowed	Separated
Total	30	33	7	17	39	48	9	21	14	43	21	16	2	2
	34%	38%	8%	20%	45%	55%	10%	24%	16%	49%	51%	39%	5%	5%
Korogocho	18	12	2	8	17	23	4	14	3	19	10	7	2	1
	45%	30%	5%	20%	42%	58%	10%	35%	8%	48%	50%	35%	10%	5%
Mathare	12	21	5	9	22	25	5	7	11	24	11	9	0	1
	25%	45%	11%	19%	47%	53%	11%	15%	23%	51%	52%	43%	0%	5%

Source Authors

At least one differently abled person was interviewed in each settlement

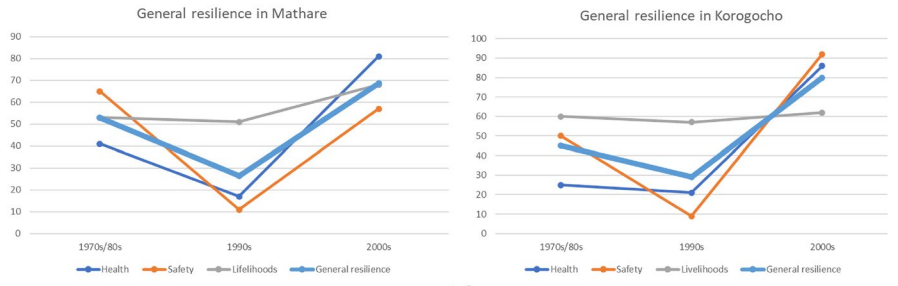


Fig. 3 Trends in general resilience of Mathare and Korogocho. *Source* Authors

Findings

This section chronologically describes the resilience pathways of both settlements. In summary, respondents perceive that resilience pathways were relatively in stasis in the 1970s/1980s (which was a few years after the country's independence in 1963), after which they declined in the 1990s which is labelled by other scholars 'the lost decade' (Rono 2002), and then increased again (Fig. 3). This trend appears to be most pronounced for perceived safety and least for perceived livelihood. Health resilience hardly reduced in Korogocho in the 1990s but increased sharply in the new millennium.

Mathare

Statis (Up To 1980s)

Mathare emerged in the 1920s (Chiuri 1978) and experienced growth in the 1960s as a bushy and sparsely populated village (M8, M14, M18). During the 1970s and 1980s, the settlement became denser as more people migrated to cities post-independence. Reflecting on those times, a 57-year-old resident (M62) narrated, "In those times, people were suffering a lot, but life was simpler". People had limited resources, facing poverty, illiteracy, and weak employment skills (M14). However, the area had abundant land, although not fertile (M12), and the river provided clean water, while trees offered fruits. The Mathare Quarry also offered employment opportunities, particularly for the construction of the nearby Kenya Air force Moi Base (M8; Médard 2010; Andvig and Barasa 2014). Most houses were constructed using wood, mud, iron sheets, nylon papers, and/or cardboard boxes. Two elderly women referred to their makeshift houses in the 1970s/1980s as "homes", but in subsequent rounds, they used the term "slums" (M64, M66).

Local vendors provided basic services, while many households resorted to relieving themselves in the bush and sourcing water from the stream (M66). Some residents established schools, and others advocated for services from the Nairobi City Council, forming the basis for community organizing connected to governance structures in the city through various arrangements. The government provided basic

infrastructure and services, which were perceived to be efficient but geographically distant (M10). Waste was collected weekly from designated solid waste collection points (M8), politicians facilitated access to housing, employment, and infrastructure, and local chiefs facilitated community dialogues. Public toilets were numbered and used as landmarks for businesses and crime (M19).

During this period, most respondents perceived the level of resilience as average, serving as a benchmark (Fig. 3). The relative safety of Mathare was often associated by village elders (M71, M70) with the prevalence of non-tribal politics.

> Peace was also very good, there was no tribal divisions, people lived together as one family. Division politics come later in the late 1990s when the multiple political parties was introduced. (M71).

Respondents in Mathare 3C, however, cite widespread petty crimes. An elderly resident stated that "one couldn't even hold anything that could be seen sellable (1980s). One would be safe if he/she is known" (M68). This notion perpetuates to-date, "Mathare's safety depends on you being a residence or a visitor" (M102). Drug abuse and alcoholism were also rampant (M14). Youth groups such as KANU youth wingers provided security in collaboration with area chiefs and were deployed to quell resistance to local administration. Other youth groups such as Bondeni and Kiamutisya had a more tense relationship with the local administration and police (M9; Van Stapele 2020).

Most respondents agree that health risks posed the largest challenge, as health services were hard to access. When people were ill, they "made use of herbalists, the well-known lady was Nyauyoma who assisted most people" (M9). Occasionally, local government would collaborate with local faith-based groups to provide health services, while the church brought in foreign doctors (M8). During a widespread cholera outbreak in 1987, the government responded fast: the area was immediately fumigated to avoid further spreading (M8).

The ability to cope with income loss was considered average (Fig. 3). Many households survived harsh periods by combining urban farming (Van Stapele 2014), sex work, re-using materials and brewing Chang'aa—illicit beer (M12; M14; M68):

> Sex work is the oldest profession in Mathare. Most sex workers were single women, transferring the same to their daughters. (…) Young men indulged in criminal activities. (…) Chang'aa is the cash crop for Mathare residents, young men were the ones in charge of brewing while women sold the brew. (M68)

These livelihood activities enabled most residents to survive, but not to thrive. M72 noted that most households could afford three meals a day. Community leaders offered financial support to some youth to alleviate poverty and counter crime (M70), while collective action (M8), including microcredit and merry-go-rounds (M9, M11) enabled some to smoothen income loss. However, other families were destitute. Some mothers picked potatoes and bananas that had been thrown away in neighbouring areas (M13). At the same time, households close to politics or with an entrepreneurial spirit flourished:



> I came here with my husband when the lands were almost bare and it used to be a quarry, existing houses were countable. We are the ones who sold timber to people who were building at that time... I was the third person to set up water tap... then started selling water to the members of the community. (M66)

Decline (1990s and Early 2000s)

On average, respondents argue that resilience declined for most households in the 1990s and early 2000s (Fig. 3). Many households became more vulnerable for two reasons. First, as the settlement became denser, opportunities for urban agriculture diminished, while competition for scarce resources intensified. Second, the role of the government underwent a change, becoming more political, while gangs gained greater control over services and public spaces (M7). This shift in the roles of government and gangs is believed to have started when a structural adjustment programme was announced in 1986 and intensified during politically instigated violence in the advent of multiparty democracy in 1992, which created more opportunities for gangs backed by local politicians. Starting from 1998, Mungiki groups gradually took control of public transport routes, illegal electricity distribution, public toilets, and the housing markets across most of Mathare, leaving only a few strongholds for other groups. Residents began referring to them as "the local government" (Rasmussen 2010).

Respondents generally perceive a sharp decline in safety (Fig. 3). Most agree that safety services became politicized and fragmented. While some police officers supported community safety initiatives, others colluded with gangs and corrupted local leaders (M84, M106). Respondents' perceptions on police killings of suspected criminals are strongly divided, ranging from support to condemning the police officers as "killer cops" (M7, M8, M21, M84).

Due to political instigation and ensuing turf wars, Mungiki increasingly employed fear tactics and started demanding higher fees for local services, including security and electricity (M7, M69). Unsafety in Mathare was also associated with a prolonged upgrading conflict in Mathare 4A, which had repercussions across households in Mathare. The dispute between residents and upgrading partners revolved around the allocation of new houses and plots, as well as rent payments (Kigochie 2001). This conflict remains unresolved to this day.

Most respondents perceive that health resilience declined slightly as well (Fig. 3). The environment became less healthy as garbage collection by the city council ceased in 1992, public toilets were neglected, and violence increased. The occurrence of diseases such as cholera, HIV, and tuberculosis rose, while major hospitals were located outside the settlement. Although health services were fairly cheap, they remained unaffordable for many residents. Health risks escalated due to maladaptive resilience initiatives, including the brewing of chang'aa (illicit alcohol) with formaldehyde (M73), unsafe electricity connections known as "sambaza" that caused fires (M18, M19), makeshift water connections called "spaghetti" that exposed water to contaminants (Fransen et al. 2023), and the greasing of stagnant water to prevent mosquito breeding, which resulted in car oil seeping into drinking water.

Livelihoods were perceived to remain relatively stable over time, with continued access to jobs in the nearby city centre and higher-income areas. Respondents noted gendered livelihood roles, with women more likely to work as house helps in Indian estates, engage in sex work, sell chang'aa or vegetables, run food kiosks, or operate other small businesses (M67, M64). Some women were able to accumulate assets and purchase property (M62). On the other hand, men were more likely to engage in activities such as distilling chang'aa, working as casual labourers or security guards, or participating in criminal activities, including gangs (M62, M68; Van Stapele 2015). In certain households, particularly in Mathare 3C, connections with gangs resulted in increased wealth, while others struggled to afford even one meal a day (M16, M72). Many resilience initiatives were perceived as maladaptive, including theft and the use of formaldehyde powder from mortuaries to accelerate and scale up the production of chang'aa (M17).

As the government withdrew from some basic services, more community-based organizations (CBOs) and non-governmental organizations (NGOs) began operating in the area from the mid-1990s onwards, including the Mathare Youth Sports Association, Red Cross, and Médecins Sans Frontières. Some of these organizations collaborated with local leaders (M9, M10). Additionally, private security companies emerged, primarily protecting businesses in the nearby settlement of Eastleigh. However, they also provided employment opportunities as security guards (M10). Therefore, while general resilience declined, there were also some positive adaptations observed. By 2006, the institutional context had become intricate, with Mungiki exerting power, an increasing presence of CBOs and NGOs, and shifting roles of the government.

Self-organization (2006 Onwards)

From November 2006 to February 2008, the police engaged in a battle with the Mungiki to regain control over informal settlements (Van Stapele 2015). During this violent period, the police recorded 108 extrajudicial killings in Mathare (Ombuor and Bearak 2020). Many residents no longer accepted the authority of the Mungiki, and some joined the fight, prompted by rising living costs after a tax hike on the local alcohol industry in November 2006 (Van Stapele 2015). Gangs also joined the conflict, attempting to seize profitable ventures and/or supporting politicians. The violence reached its peak during the post-election violence of 2007/2008, which effectively ended the reign of the Mungiki groups in most villages (Bennett et al., 2015). In 2007, the government initiated "the peace project" to engage the youth in rebuilding peace, leading some individuals to reform from criminal activities and violence (M130). In 2013, the entrance of CBOs was further facilitated by the regularization of group registration under the Public Benefit Organizations Act of 2013.

Residents became suspicious of groups attempting to seize control, fuelled by fear of further violence (KNCHR 2008b), thereby creating opportunities for governmental agencies, smaller gangs, CBOs, NGOs, and private firms to fill the void. These various actors assumed the responsibilities previously held by the Mungiki groups, including garbage collection, security provision, rental housing, and dispute resolution. The government also increased its investments in local development



projects, although often driven by political motives. For instance, according to M7 and M14, political leaders were credited for the construction of infrastructure such as Mau Mau Road and public toilets. However, coordination among these multiple initiatives remained weak.

Most respondents perceived a gradual increase in resilience for the majority of households. Perceived safety improved but remained problematic (Fig. 3). Female respondents in Mathare 3C shared accounts of harassment and threats by gang members, particularly targeting single and divorced women (M75). Some families engaged with gang members socially in an attempt to ensure the safety of women (M90). The police provided security during the day but expressed fear of conducting night patrols due to the presence of gangs (M93, M75, M72). Mathare also witnessed an increase in police killings of suspected gang members (M13; KNCHR 2008a; Van Stapele 2020). On one hand, gangs intimidated residents and dominated lucrative illegal businesses, including drug dealing. On the other hand, they offered protection to informal settlers against police brutality and external criminals (Mutahi 2011). Meanwhile, the police became increasingly intertwined with criminal gangs (M10), while the local government facilitated community policing through the Nyumba Kumi initiative. Security providers, suspects, and the police were at odds with each other but were also suspected of collusion, creating a fluctuating, complex, and tense mix of interests. As M10 explained, "In some instances, you'll see police patrol in your area, and after they have passed, the thieves take over… It makes you wonder if they are working together".

Many respondents perceived an improvement in health resilience. They experienced fewer diseases than before; for example, malaria stopped spreading during the COVID-19 pandemic, and tuberculosis became rare and curable. Better hygiene practices, increased awareness, and social measures not only fought against COVID-19 but also had a positive impact on other diseases (M17). Various adaptive resilience initiatives were noted during the pandemic, such as government distribution of masks, cash transfers, installation of boreholes, and distribution of water and food. Community health volunteers provided support to local communities, and water kiosks introduced digital payment systems under the auspices of the Nairobi City Water and Sewerage Company (M18). Furthermore, the government, CBOs, and NGOs constructed public toilets (M7, M14), private hospitals and clinics were opened in proximity with better equipment than before (M8), and the National Health Insurance Fund became available.

However, not all households experienced equal improvements in health, as the costs of water, toilets, and health insurance were perceived to be high (M7, M8, M18). For those who could not afford these services, the government, NGOs, and CBOs offered them at subsidized rates or even for free (M21). However, these services were often geographically distant (M8, M17, M18, M27). Solid waste management was considered inadequate, as garbage collectors often disposed of waste in the river and did not educate households on proper waste management (M8).

Livelihood resilience is perceived to have slightly improved, although there are significant differences between households. By 2019, the population of Mathare had increased to over 200,000 residents (KNBS 2019) and in its wake competition for jobs, services, and infrastructure intensified (M11). However, new



income-generating initiatives emerged, such as subletting rooms, mask making, digital work, or cleaning public space for money (M12, M22). Some households experienced improved employment opportunities and gained access to better services (M8, M11). They also utilized digital information and e-banking services (M40), enjoyed better nutrition (M64), found stable tenancy closer to main roads (M7), and were able to save money (M74).

On the other hand, many people still resorted to working in Chang'aa dens (illegal alcohol brewing), drug-related activities, or engaging in sex work (M17). Most households remained poor (Give Directly 2021; M50, M64, M67). The poverty situation was perceived to have worsened during the COVID-19 lockdown (M7). In response, households reduced their expenditure, engaged in "side hustles", reused materials, sought income through government initiatives like "Kazi kwa Vijana" (Work for Youth), received financial support from organizations like Give Directly, and/or accessed microcredit (M18). As the population continues to grow, reaching close to 250,000 people in 2022 (SDI-K, 2022), further changes in livelihoods are expected.

Korogocho

Stasis (1980s)

Korogocho, which means "scattered" or "broken", is an informal settlement located at the foot of Nairobi's landfill, approximately 11 km from Nairobi City Centre. In the early 1980s, the settlement consisted of scattered houses, with available land for urban agriculture and two clean rivers used for drinking and irrigation (K1, K3, K12). Most households relied on the landfill and urban agriculture for their livelihoods, as other job opportunities and services were relatively far away. The government had limited involvement in the settlement, with key facilities such as the chief's office, public office, police station, and public health centre located outside of Korogocho (K1, K10). Additionally, electricity was lacking in the settlement (K7, K9). The city council provided water taps along main roads, but limited water pressure led to water shortages and high prices (K2, K12). As a result, residents had to walk long distances in search of clean water. Over time, the settlement became more densely populated, particularly with garbage collectors working at the landfill. Within a decade, it grew to become the fourth largest informal settlement in Nairobi, with a population estimated between 120,000 and 150,000 people.

Respondents perceive the level of resilience during this period as somewhat lower compared to the present (Fig. 3). Particularly, health resilience was considered low, partly due to the distance to health services and a lack of awareness about illnesses (K12). Residents were vulnerable to various diseases, including malaria and tuberculosis, and there were cases of sexually transmitted infections attributed to the increasing incidents of rape against older women by young men (K10).

The perception of safety resilience varied widely (Fig. 3). Some respondents reported that crime was prevalent in Korogocho, with frequent reports of murdered individuals and bodies being dumped in nearby quarries (K12). However, K10



recalls that in the 1980s, the crime rate was relatively low. Youth groups such as the KANU Youth wingers provided security services (K13).

Most respondents perceived livelihood resilience during that period as more straightforward compared to the present, with fewer opportunities but also fewer risks and competition. According to K12, "We took three meals a day, but nowadays you skip meals or have tea without milk because you don't have money". K15 notes that residents were able to survive by supplementing their income from waste collection with urban agriculture and informal trade along the main road.

Decline (1990s)

In the 1990s, density increased, and local politicians began to establish their influence through gangs after the realization of multiparty democracy (see also the section on Mathare). Since the government did not have a police station or official government representation, there was no formal oversight on the role of gangs. For security, residents relied on neighbouring settlements' offices, such as the Ruaraka police station and the Mathare Administrative Police camp (K9). At the same time, the landfill provided a constant flow of work, although it was unhealthy, unsafe, and casual.

Changes in the institutional and vulnerability context were associated with a perceived decline in resilience by most respondents, particularly in terms of safety (Fig. 3). Korogocho was considered the most unsafe settlement in Nairobi during the 1990s (K6), which had ripple effects on the city. According to K9, "youths from age 15 and above had started going to the city centre and other estates to rob people. Some had already bought weapons". Local gangs with ties to local politicians acted as the de facto local government. The police or fellow residents killed suspected criminals for engaging in crime, resulting in frequent burials (K9). In the early 1990s, the KANU Youth Wingers continued to provide security:

> Security was provided by 'KANU youths' in collaboration with the area chief. They did not charge for security but charged anyone building houses or business kiosks. The main challenge was that their children were also involved in crime, thus making it very difficult to be effective (K9).

When Mungiki groups entered Korogocho at the turn of the millennium (Anderson 2002), the settlement already had high levels of crime. Therefore, some respondents considered the Mungiki as an asset, despite their violent nature:

> They did not charge the community but charged public vehicles operating on routes. (…) The community sought their intervention in dispute resolution where they had set up an office. According to me, they were a good alternative security (K12).

Many respondents perceived that health resilience remained troublesome (Fig. 3), primarily due to an unhealthy living and working environment, as well as distant health services. Tuberculosis and HIV/AIDS were the main illnesses they were grappling with. "Some people believed that diseases like HIV/AIDS came with the



whites" (K14) or were a result of witchcraft (K15). Increased unsafety caused by gangs was somewhat counterbalanced by a more active role of NGOs, CBOs, and the local Catholic Church, which started youth empowerment programmes (Achola and Ndung'u 2006). Livelihood resilience also remained troublesome according to most respondents (Fig. 3). Many households survived by working on the landfill, engaging in drug dealing, and sex work. Over time, Mungiki and other politically aligned groups became more violent and criminal. K1 expresses the dual role of gangs:

> They (Mungiki) offered income-generating activities for the youths but also promoted crime (...). This has led to many youths being killed by the police.

Upgrading (2000s)

In the new millennium, Korogocho experienced a significant increase in population, becoming a sprawling settlement hosting over 150,000 residents (Pamoja Trust 2001). It emerged as the fourth largest informal settlement in Nairobi. From 2003 to 2006, Mungiki groups gradually lost power in tense and violent conflicts involving the police, other gangs, and residents, although some groups remained active at the landfill even after the post-election violence of 2007/2008 (Bennett et al. 2015). During this period, Father Alex, an Italian priest from the Catholic church in Korogocho, negotiated an upgrading programme with the Italian Government under the Jubilee global campaign on debt cancellation (UN Habitat 2010). As part of the agreement, the Italian government cancelled a portion of Kenya's debt in exchange for the reallocation of funds to the upgrading program. The Korogocho Slum Upgrading Programme (KSUP), with a budget of Ksh210 million (approximately 1.6 million euros), commenced in 2008 by conducting a renumeration of the settlement. The programme was governed by a Residents Committee (RC), comprising 6 elected representatives from each of the eight villages in Korogocho, the area councillor and the area chief. It was further organized into sub-committees that incorporated different interest groups, such as women, youth, and elders. The RC was responsible for community dialogues and communication, while the Catholic church acted as the trustee (K1). The physical infrastructure development included sanitation facilities, a road bridge, streets, street lighting, water supply, housing, and a police station (King'ori, 2014).

However, conflicts arose during the implementation of KSUP, particularly between landlords (often also village elders) and tenants. Many landowners opposed the programme out of fear of losing their income. KSUP proposed sharing plot ownership among four houses with tarmacked throughways, which would reduce tenancy and facilitate police surveillance of illegal industries (UN Habitat 2012). Tensions escalated during the construction of the ring road, resulting in the displacement of residents who were on the list for a house (Burugu 2015). The housing construction itself was also marred by conflicts. KSUP faced an impasse between older residents (who were renumerated in 2008) and residents who moved in after 2008 but also claimed a plot and housing. Consequently, implementation remains incomplete due to conflicting interests (Burugu 2015; King'ori, 2014). The upgrading programme



affected all residents, even those not directly involved, providing opportunities for some while causing resistance from others. The upgrading scheme became a political tool through which some local groups connected with urban institutions, including the county government and political parties, while others remained isolated.

Despite these challenges, most respondents perceived a significant improvement in resilience (Fig. 3; UN Habitat 2012). Safety risks were reduced due to the presence of a new police station within the area (K2). Additionally, the advent of mobile phones in the 2000s contributed to a drop in crime rates as it became easier to report incidents and contact security agents (K9). Government programmes such as community policing and youth employment initiatives also enhanced security (K10; K19). However, while safety improved for many, crime and unsafety remained major concerns for some households. Vertigans et al. (2021) also observed an increase in crime rates during Covid-19 restrictions.

Perceived health resilience improved according to most respondents, attributed to the establishment of new health centres and mobile clinics (K17), sanitation facilities (K15), and the activation of community health volunteers (K2). "Nowadays, there are many organizations like Umande Trust, Pamoja Trust, and Action Aid that have established public toilets and sanitation blocks", narrated K1. Awareness of diseases was also perceived to have improved. Especially during Covid-19, residents made efforts to keep their environment clean through community garbage collection (K1, K15), hand washing, mask-wearing, and maintaining social distance. These measures were also believed to have reduced the number of water-borne diseases like cholera. However, health risks and overall development varied between households and neighbourhoods. In recent years, some schools and health clinics have been established in Korogocho A. Additionally, there has been investment in infrastructure, such as roads and water pipes, leading to a more development compared to Korogocho B, largely driven by collective efforts from residents. However, respondents noted that development in Korogocho A was still slow, and the settlement remains largely informal (K15, 16, 17, 19). Moreover, access to water improved on average, and Grogon is perceived to have a better water supply than any of the other villages (K40).

KSUP supported adaptive resilience initiatives by CBOs, which improved health and livelihood resilience. For example, a youth group initiated a plastic light bulb project in 2010, using bleach and soda bottles to provide light to houses without electricity, thus reducing costs (Kiti 2012). Several CBOs collaborated with an NGO to construct six biogas toilets and community kitchens between 2008 and 2010, offering sanitation and affordable gas to surrounding households. However, maladaptive initiatives such as illegal electricity connections continued to persist. "Nowadays, a lot of people have acquired electricity through illegal means, and less than 30 people have it through legal means" (K2). While illegal connections provide local jobs and are more cost-effective (K22), they also increase the risk of fire.

According to the perception of most respondents, livelihoods on average remained at a similar level, despite temporary labour-intensive and community-based construction projects (King'ori, 2014), microcredit schemes, the reuse of materials, and the emergence of CBOs from Mathare, such as the social justice movement, as well as national programmes like the youth fund and youth employment programmes.



However, corruption was reported to hinder the effectiveness of government programmes. Most available jobs were casual, and with Covid-19 restrictions, many struggled to find employment.

> A lot of people in the area are casual laborers who depend on jobs such as laundry, home management, among others in areas such as Eastleigh, and with the pandemic, people are not allowing others into their homes due to fear of spreading the virus (K4).

K20 and K22 noted that poverty remained prevalent, reinforced by uncertain, unsafe, and unhealthy employment at the landfill, limited job opportunities, extrajudicial killings, and drug abuse.

Debate

The previous sections have applied the concept of resilience pathways to informal settlements, highlighting long-term trends of general resilience. We find that resilience pathways of informal settlements influence and shape resilience dynamics within these communities, with varying impacts across different spatial and temporal contexts. While resilience pathways describe resilience at the meso-level, they do not negate the potential for individual improvements within a declining pathway or suggest universal adaptation within an adaptive pathway. The generic trends observed at the meso-level cannot fully capture the internal diversity and institutional complexities within informal settlements. Rather, these trends serve to visualize long-term meso-level patterns that are dynamically linked to higher and lower levels. It is important for meso-level interventions, such as upgrading programmes, to recognize and consider the time- and space-specific resilience pathways of informal settlements. This understanding can inform more effective and contextually relevant interventions.

Figure 4 illustrates the perceived resilience pathways of the two settlements. In the 1970s and 1980s, a state of stasis is observed, where resilience gradually changes and varies among the two settlements and local actors while remaining at a relatively similar overall level. Resilience is perceived to have declined in the 1990s, characterized by

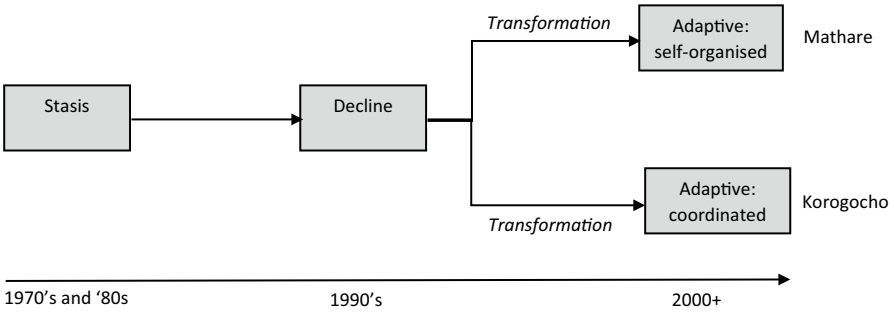


Fig. 4 Resilience pathways in two informal settlements in Nairobi. *Source* Authors

the withdrawal of government support and the gradual takeover by gangs. Additionally, higher population densities reduced opportunities for urban agriculture. This decline in resilience aligns with nationwide economic recessions that followed the "lost decade" of 1980–1990 (Rono 2002, p. 82). Similar declining pathways have been reported in the literature, attributed to factors such as violence (Bennett et al. 2015), natural disasters (Haokip 2018), and misguided policies (Folke 2006).

Both settlements entered a distinct period of transformation from around 2005 to 2008, triggered by violent conflicts between gangs, residents, corrupt police guards, and other actors, as the government sought to regain control. These findings support the notion that resilience pathways undergo changes at specific moments when the existing configuration is no longer sustainable and the institutional context shifts (Folke 2006; Seeliger and Turok 2014).

Following the transformation, both settlements appear to have entered a period of adaptive resilience. These findings confirm that adaptive resilience pathways emerge when actors learn from uncertainty and gradually adjust and improve resilience initiatives. However, inhibiting institutional contexts are unlikely to be effectively addressed (Adger et al. 2009; Folke 2006). In both settlements, changes in governance assemblages are observed, with new actors emerging and interacting with broader governance structures in various ways. This results in a wide variety of governance assemblages, often lacking effective coordination.

The theory section introduced the concept of frugality, suggesting that adaptable resilience initiatives in informal settlements tend to be frugal. The findings indicate that adaptability and frugality of resilience initiatives are often associated. Most resilience initiatives are characterized by their low-cost and basic functionality. When external actors initiate initiatives that are not frugal, such as road tarmacking and widening, they may conflict with local resilience initiatives and interests. We confirm that maladaptive resilience initiatives lack sustainability (Elmqvist et al. 2019) and the robustness associated with frugality (Tiwari et al. 2014), such as for illegal electricity connections and improper waste disposal.

On the other hand, we find that adaptive resilience initiatives offer sustainable, low-cost, and robust quick fixes. Examples include plastic bulb lights, community health volunteers providing basic health services, microcredit programmes, merry-go-arounds, and community service delivery. The fumigation campaign during the cholera outbreak serves as an example of an adaptive resilience initiative that may not necessarily be frugal. The upgrading programme in Korogocho potentially represents a transformative resilience initiative, although its potential has not been fully realized (Burugu 2015; King'ori 2014). Therefore, the findings confirm that resilience activities alone are unlikely to transform institutional and vulnerability contexts, but they can enable informal settlers to cope with uncertainty (Bahadur and Doczi 2016).

Conclusions and Recommendations

The application of resilience literature to the context of informal settlements is complex and multifaceted. In our study, we define resilience as the everyday struggle to survive in an uncertain environment, shaped by settlement practices and broader

institutional frameworks. Resilient communities actively confront multiple challenges and continuously learn to cope with disruptive shocks and disasters. Our findings highlight distinct variations in perceived resilience over time and space, both within and between informal settlements. Specifically, we identify periods of stasis, decline, transformation, and adaptation, each characterized by different dynamics between the institutional contexts, vulnerabilities, and resilience initiatives. The shifting responsibilities and roles of government and gangs strongly influence resilience pathways in Mathare and Korogocho.

We also observe that actors adopt both maladaptive and adaptive resilience initiatives. Hereby adaptability is often associated with frugality, encompassing low-cost and robust quick fixes. Maladaptive resilience initiatives, although providing short-term survival, tend to be fragile, unsustainable, and may perpetuate poverty traps (Fransen et al. 2023). In contrast, adaptive resilience initiatives are frugal, sustainable, and do not impose additional risks on others. Transformative resilience initiatives are relatively rare, and the upgrading programme in Korogocho, while aiming for transformation, remains contested. Our study confirms that resilience initiatives, including frugal ones, are unlikely to fundamentally alter inhibiting broader institutional frameworks (Adger et al., 209; Bahadur and Doczi 2016).

Based on our conclusions, we provide several policy recommendations. We acknowledge and support community initiatives such as the Mathare Spatial Planning Area Research Collaborative (MSPARC), which advocates for settlement upgrading and partnerships with local government, universities, and other actors. Recognizing that contemporary resilience pathways often fall short in addressing institutional contexts and vulnerabilities, we encourage a focus on "soft" infrastructures, including employment services, policing, microcredit, education, and health services. These areas have the potential to significantly impact resilience with lower initial investments. Furthermore, we recommend stronger coordination among local government, CBOs, NGOs, and other local actors to support adaptive and transformative resilience initiatives while preventing maladaptive ones. Visualizing and supporting local resilience initiatives that are frugal, sustainable, and do not harm others is crucial.

The main contribution of our study lies in the conceptualization of resilience pathways in informal settlements. We suggest future research delving deeper and broader into this topic. Case study research can map the variety of specified resilience, analyse the interplay between different levels of resilience pathways, and explore the triggers of transformative resilience pathways. Comparative research across informal settlements can further investigate resilience pathways and generalize our findings. Lastly, we advocate for community-based research as it provides in-depth insights into the local context, empowers community researchers, and ensures data remain with the community.

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Data availability Data is available upon request.



Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

References

Achola, H.O., and J.M. Ndung'u. 2006. *Koch life: Community sports in the slum*. Nairobi: Paulines Publications Africa.

Adger, W., S. Dessai, M. Goulden, M. Hulme, I. Lorenzoni, D. Nelson, L. Naess, J. Wolf, and A. Wreford. 2009. Are there social limits to adaptation to climate change? *Climatic Change* 93: 335–354.

Anderson, D. 2002. Vigilantes, violence and the politics of public order in Kenya. *African Affairs* 101 (405): 531–555.

Andvig, J.C., and T. Barasa. 2014. A political economy of slum spaces: Mathare Valley. NUPI Working Paper 838. Oslo: Norwegian Institute of International Affairs.

Bahadur, A., and J. Doczi. 2016. *Unlocking resilience through autonomous innovation*. London: Overseas Development Institute.

Bennett, R., G. Chepngeno-Langat, M. Evandrou, and J. Falkingham. 2015. Resilience in the face of post-election violence in Kenya: The mediating role of social networks on wellbeing among older people in the Korogocho informal settlement, Nairobi. *Social Science & Medicine* 128: 159–167.

Blomkvist, P., D. Nilsson, B. Juma, and L. Sitoki. 2020. Bridging the critical interface: Ambidextrous innovation for water provision in Nairobi's informal settlements. *Technology in Society* 60: 10122.

Brandsen, T. 2016. Governments and self-organization: A Hedgehog's dilemma. In *Critical reflections on interactive governance. Self-organization and participation in public governance*, ed. J. Edelenbos and I. van Meerkerk, 337–351. Cheltenham: Edward Elgar Publishers.

Burugu, D. 2015. Conflict in slum upgrading programme. A case study of Korogocho slum in Nairobi. *The East African Review* 151 (1): 10–17.

Chiuri, W. 1978. *Mathare valley: A squatter settlement in Nairobi: A case study*. Nairobi: Unicef.

Elmqvist, T., E. Andersson, N. Frantzeskaki, T. McPhearson, P. Olsson, O. Gafney, and C. Folke. 2019. Sustainability and resilience for transformation in the urban century. *Nature Sustainability* 2 (4): 267–273.

Folke, C. 2006. Resilience: The emergence of a perspective for social–ecological systems analyses. *Global Environmental Change* 16: 253–267.

Folke, C., S.R. Carpenter, B. Walker, M. Scheffer, T. Chapin, and J. Rockström. 2010. Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society* 15 (4): 20.

Fransen, J., B. Hati, R. Nyumba, and E. van Tuijl. 2023. Community vitality and frugal practices in informal settlements in Nairobi: Towards a typology. *Cities* 134 (January): 104179.

Fransen, J., D.O. Peralta, F. Vanelli, J. Edelenbos, and B.C. Olvera. 2022. The emergence of urban community resilience initiatives during the COVID-19 pandemic: An international exploratory study. *The European Journal of Development Research* 34 (1): 432–454.

Give Directly. 2021. GD Live Newsfeed. https://live.givedirectly.org/. Accessed 30 Nov 2021.

Haokip, T. 2018. Role of CBOs in resilience building: Good practices and challenges. In *Development and disaster management*, ed. A. Singh, M. Punia, N. Haran, and T. Singh, 281–299. Singapore: Palgrave Macmillan.

Jabeen, H. 2019. Gendered space and climate resilience in informal settlements in Khulna City. *Bangladesh. Environment and Urbanization* 31 (1): 115–138.

Kaika, M. 2017. "Don't call me resilient again!": The New Urban Agenda as immunology… or… what happens when communities refuse to be vaccinated with 'smart cities' and indicators. *Environment and Urbanization* 29 (1): 89–102.

Kigochie, P. W. (2001) Squatter rehabilitation projects that support home-based enterprises create jobs and housing. The Case of Mathare 4A, Nairobi. Cities, Vol. 18, No. 4: 223–233.

King'ori, A.N. 2014. Influence of community participation in completion of development projects: a case of Korogocho slums, Nairobi County. Doctoral dissertation, Kenya.

Kiti. 2012. Water Light Project—Korogocho slums. https://www.youtube.com/watch?v=OfaO9d_O7Mg. Accessed 16 Dec 2022.

KNBS. 2019. *Kenya National Bureau of Statistics. 2019 Kenya Population and Housing Census*, vol. II. Nairobi: KNBS.

KNCHR. 2008a. *'The Cry of Blood' Report on extra-judicial killings and disappearances*. Nairobi: KNCHR.

KNCHR. 2008b. *On the brink of the precipice: A human rights account of Kenya's Post 2007 elections violence*. Nairobi: KNCHR.

Mahendra, A., R. King, J. Du, A. Dasgupta, V.A. Beard, A. Kallergis, and K. Schalch. 2021. *Seven transformations for more equitable and sustainable cities*. Washington DC: World Resource Institute. https://doi.org/10.46830/wrirpt.19.00124.

Médard, C. 2010. City planning in Nairobi: The stakes, the people, the sidetracking. In *Nairobi today: The paradox of a fragmented city*, ed. Hélène. Charton-Bigot and Deyssi Rodriguez-Torres, 25–60. Nairobi: IFRA.

Meerow, S., and J.P. Newell. 2019. Urban resilience for whom, what, when, where, and why? *Urban Geography* 40 (3): 309–329.

Mutahi, P. 2011. Between Illegality and Legality. (In)security, crime and gangs in Nairobi informal settlements. *SA Crime Quarterly* 37: 11–18.

Nykvist, B., and J. Von Heland. 2014. Social-ecological memory as a source of general and specified resilience. *Ecology and Society* 19 (2): 47.

Pamoja Trust. 2001. Korogocho informal settlements enumeration report, July, 2001. Nairobi: Pamoja Trust. https://www.globalhungerindex.org/case-studies/2009-kenya.html#fn-03-ref.

Pelling, M., D. Manuel-Navarrete, and M. Redclift. 2012. *Climate change and the crisis of capitalism: A chance to reclaim, self, society and nature*. Hoboken: Taylor and Francis. https://doi.org/10.4324/9780203146118.

Pieterse, E. 2008. *City futures: Confronting the crisis of urban development*. London: SAGE.

Radjou, N., J. Prabhu, and S. Ahuja. 2012. *Jugaad innovation: Think frugal, be flexible, generate breakthrough growth*. London: Wiley.

Rasmussen, J. 2010. Mungiki as youth movement: Revolution, gender and generational politics in Nairobi, Kenya. *Young* 18 (3): 301–319.

Revi, A., D.E. Satterthwaite, F. Aragón-Durand, J. Corfee-Morlot, R.B.R. Kiunsi, M. Pelling, D.C. Roberts, and W. Solecki. 2014. Urban areas. In *Climate change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. Contribution of working group II to the fifth assessment report of the Intergovernmental Panel on Climate Change*, ed. C.B. Field, V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White, 535–612. Cambridge: Cambridge University Press.

Rockefeller Foundation and ARUP. 2019. City resilience index. Understanding and measuring city resilience. https://www.arup.com/perspectives/publications/research/section/city-resilience-index. Accessed 8 Apr 2020.

Rojas Symmes, L., A. Cortés Salinas, and D. Moreno. 2023. Santiago, the non-city? Destruction, creation, and precariousness of verticalized space. In *Urbicide: The death of the city*, 865–890. Cham: Springer.

Rono, J.K. 2002. The impact of the structural adjustment programmes on Kenyan society. *Journal of Social Development in Africa* 17 (1): 81–98.

Satterthwaite, D., D. Archer, S. Colenbrander, D. Dodman, J. Hardoy, D. Mitlin, and S. Patel. 2020. Building resilience to climate change in informal settlements. *One Earth* 2 (2): 143–156.

Satterthwaite, D., and D. Dodman. 2013. Towards resilience and transformation for cities within a finite planet. *Environment and Urbanization* 25 (2): 291–298.

SDI-K. 2022. Mathare Settlements: Profiling Data Findings: 'Making the invisible visible'. https://static1.squarespace.com/static/58d4504db8a79b27eb388c91/t/63849962a69e574c786e9a9c/1669634487063/Mathare+Profiling+Report_2022+Final.pdf.

Seawright, J., and J. Gerring. 2008. Case selection techniques in case study research. *Political Research Quarterly* 61 (2): 294–308. https://doi.org/10.1177/1065912907313077.

Seeliger, L., and I. Turok. 2014. Averting a downward spiral: Building resilience in informal urban settlements through adaptive governance. *Environment and Urbanization* 26 (1): 184–199.

Simone, A. 2008. People as infrastructure. In *Johannesburg: The elusive metropolis*, ed. S. Nuttall and A. Mbembe, 68–90. New York: Duke University Press.

Suhartini, N., and P. Jones. 2019. *Urban governance and informal settlements*. Cham: Springer.



Teisman, G.R. 2000. Models for research into decision-making processes phases, streams and decision-making rounds. *Public Administration* 78 (4): 937–956.
Tiwari, R., K. Kalogerakis, and C. Herstatt. 2014. Frugal innovation and analogies: some propositions for product development in emerging economies. Working paper. Technologie und Innovationsmanagement, Technische Universität Hamburg, Hamburg.
UN Habitat. 2010. *Korogocho situation analysis. A snapshot*. Nairobi: UN Habitat. https://habnet.unhabitat.org/sites/default/files/documents/Final%20Report%20Korogocho%20S%20A%20a%20snapshot.pdf. Accessed 16 Dec 2022.
UN Habitat. 2012. *Korogocho streetscapes: Documenting the role and potentials of streets in citywide slum upgrading*. Nairobi: UN Habitat.
UN Habitat. 2020. *RISE-UP: Resilient settlements for the urban poor*, 1–4. Nairobi: UN Habitat. https://unhabitat.org/programme/rise-up-resilient-settlements-for-the-urban-poor.
Van Stapele, N. 2014. Intersubjectivity, self-reflexivity and agency: Narrating about 'self' and 'other' in feminist research. *Women's Studies International Forum* 43: 13–21.
Van Stapele, N. 2015. Respectable 'illegality': Gangs, masculinities and belonging in a Nairobi ghetto. Doctoral dissertation, Universiteit van Amsterdam [Host].
Van Stapele, N. 2020. Police killings and the vicissitudes of borders and bounding orders in Mathare, Nairobi. *Environment and Planning d: Society and Space* 38 (3): 417–435.
Vasudevan, A. 2015. The makeshift city: Towards a global geography of squatting. *Progress in Human Geography* 39 (3): 338–359.
Vertigans, S., N. Mueller-Hirth, and F. Okinda. 2021. Resilience in a Kenyan informal settlement during the COVID-19 pandemic. *Acta Academica* 53 (2): 122–142.
Yin, R.K. 2009. *Case study research: Design and methods*, vol. 5. London: SAGE.
Yonzan, N., A. Cojocaru, C. Lakner, D.G. Mahler, and A. Narayan. 2022. *The impact of COVID-19 on poverty and inequality: Evidence from phone surveys*. Washington: The World Bank Blogs.

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