Challenges of Improving Livelihoods by Slum Upgrading
A Sociotechnical Transitions Perspective

George Kiambuthi Wainaina

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Uitdagingen voor de verbetering van de levensomstandigheden door sanering van sloppenwijken
Een sociotechnisch transitie perspectief

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Summary

Infrastructure development will continue to be essential for supporting livelihoods in cities globally. It however lags behind in the global south cities because they are urbanizing more rapidly than their global north counterparts are. The urbanization is at a rate that outpaces infrastructure capacity to support livelihood activities. This combined with ineffective urban policies and plans have led to urban sprawl. Consequently, spatial areas with deteriorated or inexistent basic infrastructures —slums— to support basic services such as water, sanitation, storm water and security among others, are commonplace. Since the 1970s, governments, residents and non-state actors have established multiple interventions to introduce basic infrastructures with the intent to improve the residents' livelihoods. These past interventions, which have been key components of slum upgrading, have yielded limited benefits and in some cases worsened livelihood opportunities for the residents. Despite limited success, current research still places basic infrastructure interventions as the most promising way of improving residents' livelihoods.

This thesis aims to investigate why infrastructure interventions through slum upgrading succeed or fail to improve resident's livelihoods in global south cities. To achieve this aim, the thesis identifies and investigates four outstanding challenges facing slum upgrading from current academic and practice literature. They occur at the slum scale while planning and implementing slum upgrading projects and at the city and national scale while implementing slum-upgrading programs. Programs comprise multiple projects and are avenues for recursively informing policy and practice. The first challenge is the limited understanding of how slums are structured and how upgrading influences such structures to affect livelihoods. Most literature perceives and defines slums as deprived places and nothing more. To understand this, this thesis uses sociotechnical transitions literature to conceptualize the *infrastructure-livelihoods nexus* (hereafter referred to as *nexus*) that structures places and determines their development trajectory. The second challenge is the limited understanding of the mechanisms by which improvement of livelihoods occurs after delivery of infrastructures. This thesis conceptualizes these mechanisms and refers to them as the *appropriation process.* Many examples of functional infrastructures that fail to improve livelihoods of residents in slums exist. Therefore, it is productive to provide ideas on how appropriation takes place.

To understand the slum infrastructure-livelihoods nexus and appropriation, planning professionals have actively started prioritizing participation—involvement and engagement of end users by planning professionals. Participation still suffers from multiplicity of planning implementers in their different capacities and their interactions with residents while conducting upgrading. Therefore, the third challenge is limited knowledge of how different implementers interact with residents to influence infrastructure outcomes. There also lacks meaningful ways of aggregating the multiple implementers who have different interests, constraints and worldviews—*institutional logics*—including residents. While understanding all of the above is essential for improving livelihoods through one slum upgrading project, it is not sufficient for achieving this in citywide or national scales. Cross-project *learning*—capturing, resolving and referencing insights and challenges—is lacking and is the fourth challenge. How to structure this in programs to achieve livelihood improvements at city and nationwide scales is still an outstanding problem.

The focus of the empirical investigation is a 165 million dollar slum-upgrading program in Kenya funded by the World Bank. The program had over 80 projects in its first phase that implemented a mix of basic service infrastructures. It was evaluated as a whole and in part using a subset of 15 slum-upgrading projects and two among the 15 as in-depth case studies. This was through a qualitative approach using field stays and

observations, interviews and document reviews. The qualitative approach facilitated in-depth analysis of phenomena, comparative configurational analysis, and case studies. The paragraphs that follow summarize the four papers that comprise the thesis and elaborate conceptual outcomes and the empirical findings of the thesis.

This thesis builds on sociotechnical transitions literature to develop the infrastructure-livelihoods nexus and the appropriation concepts. It conceptualizes the infrastructure livelihoods-nexus as the interlinked rulesets—*regimes*—that guide the use of basic infrastructures (infrastructure regime) and achievement of livelihoods (production and reproduction regimes). From a practice perspective, regimes manifest in the temporal (when), spatial (where), organizational mode (roles) and transaction costs dimensions of achieving livelihoods. These dimensions coincide to present opportunities for residents to use infrastructures in benign or destructive ways to catalyze securing livelihoods. As demonstrated by Kasarani informal settlement, most opportunities favor securing livelihoods at the cost of infrastructure lifespans. This perpetuates infrastructure deterioration and precarious livelihoods. Most studies base the definitions of a slum on this outcome and not the underlying regimes. New or upgraded infrastructure during slum upgrading thus matches or mismatches with the existing infrastructure-livelihoods nexus. This is observable in the disruption or extension of one or more of the four dimensions in practice. Regime misalignments imply unsuccessful reconfiguration of the nexus thus no improvement in livelihoods, partial alignments imply a partial reconfiguration and short-lived livelihood gains, and alignment implies a successful reconfiguration. The case study of Kasarani demonstrates all these alignments for individual infrastructures and an overall partial reconfiguration of the nexus for all. This implies that Kasarani remains in a deteriorating trajectory

While complementing the infrastructure-livelihoods nexus, the thesis conceptualizes the appropriation process. Appropriation occurs from when residents take over new infrastructures and denotes how they use them over time resulting in improvement of their livelihoods or not. The response strategies to new infrastructures that residents use include the following. No response—the infrastructure fits in their nexus—, navigating—access alternative infrastructure for the same service—, negotiating—leverage on social relations to access the infrastructure for a service—, contravening—access the infrastructure by force and lastly coping—achieve the service by any other means necessary due to lack of access to infrastructure. In sum, appropriation results to deterioration/sustenance of infrastructure and subsequent limited/improved livelihoods. Findings from Munyaka informal settlement confirmed that mechanisms for appropriation that deliver improved livelihoods commence with either no response or navigation followed by adoption and cosustenance. Those that do not, commence with coping and/or contravening, followed by redefining the infrastructure use and limited cosustenance. Residents choose any strategy based on the net value of the infrastructure in their nexus.

Participation is key for evaluating the nexus and anticipate appropriation. This thesis resolved the challenge of multiplicity of actors involved in slum upgrading by aggregating them based on their institutional logics. These meaningfully grouped actors based on their interests, constraints and worldviews into five groups. Through these groups, more actors that come up in upgrading process can be included. This allowed for empirical analysis that accounts for the complexity of many individual actors and at the same time gaining more qualitative insights about them. The groups comprise of actors following the rationale of the *community* e.g. residents and community representatives, the *market* e.g. contractors, service utilities, the *state* e.g. politicians at different levels*, the hierarchy* e.g. enforcement officers in government, and the *profession* e.g. engineers, planners. In addition, the thesis establishes a

typology for assessing integrated infrastructure outcomes based on whether implementers deliver infrastructures in a functional state and whether residents use them as per expectations of implementers. These allowed for a configurational analysis using qualitative comparative analysis (QCA) of 15 settlements to identify how the different actor groups relate with the community group during upgrading to influence upgrading outcomes. The cases demonstrate that participation characterized by the configuration of collaborative market, professional, and community-oriented actors is sufficient to deliver infrastructures that are sound structurally and that residents use as per expectations of implementers. In addition, it demonstrates that configurations with collaborative market or professional actors can overcompensate for other non-collaborative relationships to deliver successful infrastructures.

To facilitate scale, the thesis provides structures for cross-project learning by conceptualizing and evaluating three types of process-groups that occur in programs. These include r*ecursive, sequential* and *learning* processes. Learning processes are responsible for problem identification at both the program and project levels and their resolution as well as providing insights for policy reflection. They include knowledge acquisition, transfer, synthesis, and integration. Sequential processes focus on ensuring the delivery of project goals for instance infrastructures in slum upgrading programs. Planning professionals can concretely anticipate, monitor, and evaluate these during project planning. They include processes like program design, procurement, infrastructure construction, periodic monitoring and supervision, and handover. Lastly, recursive processes, include participation, communication, planning, and collaboration. Recursive processes are difficult to anticipate. They bridge both learning and the sequential processes at the projects and the program level. Therefore improving the efficiency and effectiveness of the recursive and learning processes are essential to delivering improved livelihoods for both projects and programs, and relevant policy insights at nationwide scales.

In summary, the thesis offers insights on alternative conceptualization of slums and appropriation process that is relevant for planning professionals to support achieving improved livelihoods for the urban poor in the global south cities. It extends sociotechnical transitions beyond one sector and introduces a livelihood and place dimensions to the literature. Appropriation extends planning literature that has focused on plan-making and plan-implementation. Practically, it provides means and methods of evaluation of configurations for participation, infrastructure performance, and assessment of infrastructure livelihoods nexus. These are necessary to achieve livelihoods improvement for contexts beyond global south cities. It is clear that the deterioration of livelihoods in global south cities due to urban sprawl will require appreciation that urbanization that follows the settlement and then formalization pattern in contrast with the global north. Therefore, planning concepts and practice at all levels there has to embrace paradigms that ameliorate this as presented in the thesis.

Chapter 1: Introduction

"The *needs and concerns* of these people (slum dwellers) are rarely taken into account in conventional urban planning, financing and policymaking, leaving an enormous segment of the global population behind. … Without *concerted action* on the part of Governments at all levels, in collaboration with civil society and development partners, the number of slum dwellers will continue to rise in most developing countries," U.N. (2021, p. 48)

"Leaving no one behind will require an *intensified focus* on 1 billion slum dwellers" U.N. (2022).

The biggest proportion of the concerted action and intensified focus on slum upgrading is the introduction of basic service infrastructures in slums. The intent is to improve the living conditions of the residents and catalyze livelihoods. The outcomes of previous infrastructure interventions relative to livelihood improvement have been uneven. This is the case in global south countries currently conducting nationwide slum upgrading. Many infrastructures upgraded remain unused and cumulative gains at nationwide scales are yet to be achieved. *This thesis aims to investigate why and how newly introduced infrastructures succeed or fail to transform the livelihoods of the urban poor at the slum and national scales in global south cities.* This is important to understand why current interventions fail and how to improve their likelihood of success.

In consensus with the sentiments above, the current financing, policymaking, and conventional urban planning practices fail to address the livelihood needs of residents. This thesis focuses on the deficits in urban planning practices that slum upgrading follows at the slum, citywide, and national scales. Current urban planning practice involves the operationalization of urban policies through programs that comprise projects spread at city and/or national scales (UN Habitat, 2015). Programs act as intermediary organizations that govern the projects as well as inform policy. This thesis zooms in to the deficits of slum upgrading at the project and program level that bar improvement of dweller livelihoods.

The thesis identifies four outstanding gaps that practitioners face from academic and practitioner literature, and engages scientific literature to propose conceptual and practice means to resolve them. At the project level, these gaps include: (i) the persistent view of slums only as areas of deprivation that guides current interventions. This is a prevailing characteristic of many definitions in use. (ii) The gap in understanding the social processes that occur while and after planning professionals deliver infrastructures and when an influence on livelihoods manifests. (iii) How the multiple actors carrying out the planning and implementation activities relate with residents to influence the functionality and utility of infrastructures delivered. This relates to the greater challenge of social inclusion. At the program level, (iv) How cross-project learning in slum upgrading programs can be structured and operationalized.

This thesis draws on and contributes to infrastructure planning, a subset of urban planning and sociotechnical transitions literatures to conceptualize these challenges and solutions in alignment with current planning practice. Planning literature explains how decisions to implement different infrastructures are reached and how actual implementation occurs (Carroli, 2018; McConville, 2010). This literature forms the overall backdrop of this thesis as it envisions future transformation due to intended interventions. Sociotechnical transitions literature complements planning by extending it by explaining how systemic changes occur with a focus on infrastructures and technologies after planning delivers them (Fuenfschilling & Truffer, 2014; Ramos-Mejía et al., 2018). This was used to conceptualize slum contexts

and as a result, the *infrastructure-livelihoods nexus* and the *appropriation* concepts are developed. Sections 1.2.1 and 1.2.2 explicate these concepts respectively.

The concepts and literature insights were operationalized empirically on a 165-million-dollar slum upgrading program in Kenya. The objective of the program was to improve the living conditions of slum dwellers in selected cities in Kenya (WorldBank, 2011). Kenya represented global south countries[1] with its comparable urbanization rates and programmatic interventions for slum upgrading. The program's projects resulted in varied outcomes that made it a rich case study. Two of the program's projects were investigated qualitatively as in-depth case studies, fifteen comparatively, and lastly, the overall program was investigated to understand cross-project learning. The program had a total of 80 slum upgrading projects that were implemented between 2011 and 2020. Further details of the program are presented in Section 1.4 and are the focus of Chapters 2 to 5.

The rest of this chapter comprises six sections. Section 1.1 elaborates on the outstanding gaps for improving the livelihoods of the urban poor in global south cities. This is followed by Section 1.2, which explains the conceptual underpinnings of this thesis. Section 1.3 presents the research questions and Section 1.4, the basis by which I selected Kenya and the slum upgrading program for investigation. Section 1.5 highlights the suite of methodologies that this thesis embraces and Section 1.6 provide an outline of the chapters that follow.

1.1 The challenge of lifting the urban poor out of poverty

The world urbanizing rapidly. Currently, 56% of the people live in urban settings globally and projections indicate that this will rise to 70% with the prevailing trend by 2050. This has in turn resulted in unprecedented and unsustainable urban development as the land use patterns (Randolph & Storper, 2023; World Bank, 2022). The development has been characterized by challenges such as lacking, congested, or obsolete basic service infrastructures and limited housing for residents in the global south (Nechyba & Walsh, 2004). A large proportion of the new urban population ends up in settlements that have no formal status, hence informal settlements. Planning professionals have attempted to counter this through interventions targeting the improvement of basic service infrastructures under the label of slum upgrading. These interventions have been characterized by policies operationalized by programs aimed at improving basic service infrastructures in the slums (Turley et al., 2013). Their target has been and is to transform regions, cities, and neighborhoods towards more sustainable and livable spaces socioeconomically and ecologically (Artmann et al., 2019; Polidoro et al., 2012). However, this transformation has not always been successful. This is partly because such interventions are often based on the global north's practices of urban planning, which commences with formalization (definition of property claims) followed by residents settling following laid out rules of infrastructure use. Urban planning in the global south follows the contrary sequence (Randolph & Storper, 2023). Residents settle and form their own social and material "infrastructures" before planning interventions to develop most of these locations occur. Due to this, current urban planning in the global south result in unequal spaces exacerbating socio-spatial segregation and the emergence of neighborhoods characterized by slums (Boanada-Fuchs & Rohner, 2021; Davis, 2006; Polidoro et al., 2012; U.N., 2022; UN-Habitat, 2003; UN

[1] Refers to three regions where 85 per cent of slum dwellers live in three regions – Central and Southern Asia (359 million), Eastern and South-Eastern Asia (306 million), and sub-Saharan Africa (230 million) (U.N., 2022).

Habitat, 2015). These slums are defined based on what they lack i.e. at least poor structural quality of housing, overcrowding, inadequate access to safe water, inadequate access to sanitation and other infrastructure, or insecure residential status (UN Habitat, 2015).

Planning professionals are currently grappling with the glaring challenge of improving the living conditions of the over one billion residents currently living in slums (U.N., 2022). This challenge has been longstanding and has prompted multiple policies at global and local scales. Notable (but not exhaustive) policy interventions globally have included the 1988 "Global strategy for shelter to the year 2000", which set the pace for the need for global and national strategies for the poor. The 1992 Istanbul Habitat II conference, and the MDGs established by the UN Millennium Declaration in the year 2000 advocated for slum upgrading as a means for achieving development targets (Tsenkova et al., 2008). More recently, the SDGs and "The New Urban Agenda" have been instrumental in advocating for policies and commitments that focus on social inclusion, equity, and improvement of the livelihoods of people living in slums (U.N., 2022; UN, 2017). This global evolution has recursively influenced national and subnational policies and plans for infrastructural interventions to improve livelihoods in slums.

At national level in the global south, operationalization of policies and plans have shifted from the eradication of slums (slum clearance) and offering of public housing in the 1970s and 80s, to self-help where residents develop the settlements themselves. These were individual stand-alone projects. At the turn of the century, operationalizing these policies has shifted in favor of national programs that incorporate multiple projects for slums and emphasize the participation of residents in decision-making (World Bank, 2021). While such programs may comprise other elements, a large proportion of their budget goes to the design and implementation of coordinated combinations of infrastructures in multiple slums for different cities at once (Acioly, 2021; Andavarapu & Edelman, 2013; Turley et al., 2013). The infrastructures target basic services such as water, sanitation, mobility, solid waste, and security services (Acioly, 2021). The interest in combinations of infrastructures, as opposed to single-sector infrastructures, has been fueled by the realization of how different infrastructures integrate and synergize in urban contexts to result in overall improvement of living conditions (Narayan et al., 2021; Randolph & Storper, 2023).

The premise and promise of slum upgrading are that infrastructure investments in slums result in improved basic service provision (WorldBank, 2011) that consequently promotes the livelihoods of the urban poor in cities. However, this is not always the case. Evidently, despite four decades of upgrading efforts, the one billion challenge still stands. It is even projected that the number will rise to three billion by 2030 primarily due to urbanization factors associated with dynamics in demographics, migration, infrastructure, and socioeconomic activities (Randolph & Storper, 2023; UN-Habitat, 2018). The following among many exemplify how failure manifests. Cherunya, Truffer, et al. (2020) outlines the case of an upgrading project in Kenya, which resulted in the deterioration of livelihoods and relegated residents to deeper poverty as a consequence. In another case in Brazil, Libertun de Duren and Osorio Rivas (2020) report that infrastructures improved livelihoods only shortly after they were delivered. The infrastructure rapidly deteriorated afterward to a point that ten years later, the settlements that never received any upgrading were doing better. In another case in Brazil, residents even sabotaged roads by digging potholes to maintain the status quo of their livelihoods (Yeboah et al., 2021). In South Africa, Massey (2014) reports that residents set up illegal electricity and water connections, and established informal home-based

businesses after a slum upgrading exercise. These and other examples demonstrate that despite progress in investments for slum upgrading and experiences, there are still gaps as to why the improvement of livelihood is not very common. Based on these and other cases, failure from an infrastructure and livelihoods perspective manifests to different extents. These include nonfunctional infrastructures as delivered, functional infrastructures that lack utility for the residents, and infrastructures that disrupt existing residents' means of securing livelihoods.

I, therefore, ask why slum upgrading fails to contribute towards reducing the 1 billion number through the improvement of their livelihoods. To answer this, *this thesis aims to investigate why and how newly introduced infrastructures succeed or fail to transform the livelihoods of slum residents at the slum and national scales in global south cities.* This is significant for two reasons. First, it provides empirical recommendations for planning and implementing infrastructures that have known potential to improve the livelihoods of slum residents at scale. Secondly, it provides crucial conceptual insights into the question of the contribution of infrastructure development to sustainable urbanization.

This thesis proposes four challenges that lead to the failure of the slum upgrading process based on the current literature gaps. There are other challenges such as financing, land tenure, and politics among others, which fall beyond the scope of this thesis since they have received relatively more attention in the literature. The first challenge is the consequence of a limited understanding of the slum context. The prevailing view of slums as deprived places is too simplistic. It focuses on what basic services or resources residents lack and not how they use what is available to achieve their basic needs (UN Habitat, 2015). It assumes that infrastructures and associated services are nonexistent yet residents have established means to achieve the said services on their own long before any intervention. Consequently, it misses the proactiveness of residents in using the infrastructures that already exist, however dilapidated, in achieving basic services and securing their livelihoods. It also misses the fact that infrastructures are attached to use practices that are shaped by wider socioeconomic conditions in a given place. Consequently, planning professionals run the risk of implementing new infrastructures that do not match the spatiotemporal and socioeconomic constraints that residents face in a slum leading to failed infrastructures (Mukeku, 2018). To avoid this risk, there is a need to understand the nexus of livelihood practices and infrastructure use practices—*the infrastructure-livelihood nexus*—that typically results in development characteristics observed in informal settlements. Understanding this nexus is essential to propose solutions that offer utility to the residents. Sub-section 1.2.1 elaborates the conceptual basis of this nexus further.

Secondly, academic evaluations of slum upgrading interventions report limited improved livelihoods after a few years of having delivered functional infrastructures (Cherunya, Truffer, et al., 2020; Libertun de Duren & Osorio Rivas, 2020; Turley et al., 2013; Yeboah et al., 2021). On the other hand, practitioner reports limit their commitment to improving the living conditions of residents through infrastructure investments but not their livelihoods (UN-Habitat, 2020; WorldBank, 2011). They report success based on infrastructure output metrics such as the number of kilometers built or the number of residents connected with piped water. Such evaluations by default report the successful delivery of infrastructures (See World Bank (2020); World Bank Group (2020) as examples). However, they avoid engaging in the impact of the infrastructure on the livelihoods of residents. Indeed, this would not be an easy promise for them to fulfill. It is at the livelihoods level after residents engage with the new infrastructures for some time that researchers report failures (Turley et al., 2013; Yeboah et al., 2021). The link between improving living

conditions using infrastructures and achieving improved livelihoods is very blurred. This is the second challenge and exemplifies a missing conceptual link in what happens when infrastructures are delivered whether functional or not, and when improvement of livelihoods manifests. To contribute to this, this thesis develops the concept of *appropriation* to explain this link in a systematic way. It explicates appropriation in Sub section 1.2.2 and further in Chapter 3.

The third challenge is related to the multitude of planning professionals engaging slum residents during upgrading processes. Over the years, planning professionals have acknowledged the social dimension of slum upgrading. They believe that it is sufficient to address this through participation. Participation denotes the process of involving and engaging residents in decision-making to include their views in shaping planning interventions (Enserink et al., 2007). While participation is deemed essential, only a few slum upgrading studies report its actual effect on improved livelihoods (Kiefer & Ranganathan, 2018b; Patel, 2013). In contrast, most existing studies correlate insufficient participation as deterrence for infrastructure investments from reaching their ultimate goal of improving livelihoods (Cherunya, Ahlborg, et al., 2020; Massey, 2014). Rare examples claim that it is not always beneficial and can perpetuate the living conditions in the slum (Lizarralde & Massyn, 2008). This thesis takes the popular stance that participation cannot be ignored and it has to stretch into implementation. The conceptualization is elaborated in Sub section 1.2.3 and the method in Subsection 2.3.

Clarifying the slum context, appropriation, and participation are essential for delivering individual functional slum-upgrading projects. It is however not sufficient for scaling the improvement of livelihoods at a pace that outdoes the current increase in residents in slums as targeted by programs. Typically projects are single-sector, task-oriented with fixed objectives and scopes (Lycett et al., 2004; Pollack & Anichenko, 2021). This was beneficial for project planning purposes but failed in effectively delivering infrastructures that offered residents utility. It often resulted in isolated technocratic interventions that had limited livelihood benefits to slum residents (Ahern et al., 2014; Boanada-Fuchs & Rohner, 2021; Cherunya, Truffer, et al., 2020). It also did not have cumulative benefits and overlooked appropriation.

Programs are currently remedying this since ideally, they aim to achieve national policy goals of urban livelihood improvement through coordinated projects that are cross-sectoral and within extendable timelines. Such programs have the potential to achieve scale in two ways: by bridging wider urban policies to improve the effectiveness of current and future program phases, and by improving projects' processes at the slum level through learning (Pollack & Anichenko, 2021; UN Habitat, 2015). Achieving this heavily relies on cross-project learning, which is an outstanding challenge for scaling slum upgrading (Boanada-Fuchs & Rohner, 2021). Learning implies the acquisition, synthesis, integration, and transfer of insights from experiences to improve future outcomes for an organization (Argote et al., 2021). It is therefore important to understand how cross-project learning in slum upgrading programs can occur and is structured to improve the livelihoods of residents at the national scale.

In summary, this thesis argues that effective participation during planning is essential for delivering functional infrastructures that are of utility to residents and that improve livelihoods. Such participation has to account for the infrastructure-livelihoods nexus in a slum and anticipates future appropriation of planned infrastructures. It is therefore salient to understand the infrastructure-livelihoods nexus and appropriation conceptually, to guide the practice of participation at the individual slum level. At the

national level, planners have to appreciate the urbanization sequence of first settling, building infrastructures, and eventual formalization entrenched in the global south (Randolph & Storper, 2023). Due to this, they have to design programs that focus on learning to accelerate the achievement of nationwide livelihood transformation. In sum, these contribute to the main aim of this thesis in explaining how best the future slum upgrading can improve not only the living conditions but also the livelihoods of residents in global south cities. Consequently, this contributes to more sustainable urban transformation.

1.2 Theoretical and conceptual foundation

This thesis is theoretically anchored and contributes to planning and sociotechnical transitions literature in a complementary manner (Fuenfschilling & Truffer, 2014; Healey, 1997). Planning literature engages with attempts to organize infrastructure, social and economic relations in space through different scales of governance (Huxley, 2009; Randolph & Storper, 2023). Sociotechnical transitions literature focuses on the long-term transformation of configurations of actors, rules, infrastructure, and technologies that fulfill a societal need—sociotechnical systems (Fuenfschilling & Truffer, 2016). The thesis explains how planning outputs (in this case, infrastructures) transform existing sociotechnical configurations. The link between these two literatures has previously provided useful insights for conceptualizing urban phenomena (Carroli, 2018; Hodson & Marvin, 2010).

Planning by definition is a process where needs are assessed, interventions are proposed and prioritized, and implemented by planners to improve the livelihoods of residents (McConville, 2010; UN Habitat, 2015). Following Rydin and Pennington (2000) and Hersperger et al. (2019)'s perspective, planning comprises plan-making and plan-implementing phases. For this thesis, planning, therefore, encompasses both phases and is conceptually distinct at the scale of programs and projects. The specific focus of the thesis is a subset of urban planning namely infrastructure planning (Neuman, 2009). At the program level in most global south governments, planning takes the perspective of strategic implementation of long-term and coherently set policy objectives for a wide geographic region such as a country over time (Hersperger et al., 2019). In other words, slum upgrading programs act as avenues to transform the policy to practice in phases at scale using multiple projects (Ochieng et al., 2017). Projects are organizational forms whose main intent is to deliver products/infrastructures within a set time, budget, and specified scope (Pollack & Anichenko, 2021; Pollack et al., 2018). On the other hand, planning takes the perspective of project planning at the slum level (Dvir et al., 2003; UN Habitat, 2015).

Slum upgrading, specifically infrastructure investments, has been anchored on procedural planning theories conceptually. Such theories explain how planning is done (Faludi, 1973; Thomas, 1979). The most prominent ones concerning slum upgrading have been the rational-comprehensive theory and incremental theory. The former manifested in top-down projects that adopted technocratic approaches led by experts. The planners envisioned converting slums into modern estates similar to those in cities of the global north using current global north-oriented urban planning practices (Randolph & Storper, 2023). Such projects received criticism due to the limited participation and little contribution to the livelihoods of residents (Cherunya, Truffer, et al., 2020). The latter manifested in bottom-up slum upgrading projects that focused on solving immediate challenges where participation was by stakeholders who could best articulate themselves (Rigon, 2014). Projects anchored on this theory proved difficult to finance, replicate

and scale, and were the short-term "patch work" (Allmendinger, 2017; McConville et al., 2011; McConville, 2010).

To counter the deficits of the two theoretical approaches discussed, slum-upgrading projects embraced collaborative planning theory at the turn of the century. For planners, this was a favorable middle ground for gaining the benefits of bottom-up and top-down projects. In collaborative planning, the planner focuses on building consensus among stakeholders through open dialogue and decentralized participation (Brand & Gaffikin, 2007; Goodspeed, 2016; Healey, 1992, 1997, 2003). The planner plays the role of a facilitator or an intermediary (Healey, 1997) and creates platforms for seeking consensus and conflict resolution in a participatory manner that is inclusive of all stakeholders (Innes & Booher, 1999; McConville, 2010; Neuman, 2009; Raynor et al., 2017). This is advocated for in slum upgrading, where participation is at the core of practice under the label of participatory slum upgrading (UN-Habitat, 2020; World Bank, 2011, 2021). The theory provides a framework to address challenges that occur in the planning process by involving residents through participation (Brand & Gaffikin, 2007; McConville, 2010). These include coordination, communication, power imbalances, building trust, and conflict resolution (Zanudin et al., 2022).

While planning literature is useful conceptually, it falls short in the following ways. First, the adopted perception of slums still dwells on deprivation as opposed to how they are structured. This leads to proposed infrastructures that are often a mismatch to the slum contexts—infrastructure-livelihood nexus. Secondly, it does not explain how the infrastructures delivered improve livelihood—appropriation. This is exemplified in current projects that focus on improving the living conditions of residents which is not always analogous to improving livelihoods (UN-Habitat, 2020; World Bank, 2020). Thirdly, it does not solve the challenge of a multiplicity of actors that participate in upgrading. The sections that follow conceptualize the infrastructure-livelihoods nexus, appropriation using sociotechnical transitions literature, and provide conceptual inroads for aggregating a multitude of actors that participate and involve residents during slum upgrading.

1.2.1 Slum contexts and the infrastructure-livelihoods nexus

Historically, theory and practice define and describe slums based on the deprivation of basic service infrastructures, and poverty. For instance, D'souza (1979) described them as "congested localities with substandard housing and insanitary surroundings accommodating poor people who follow low-paid occupations or are underemployed or unemployed, and who lead a life of crime and are morally depraved." More recently the agreed upon definition avoids victimizing the residents there. UN Habitat (2015) defines them as areas characterized by one or more of the following "poor structural quality of housing, overcrowding, inadequate quality to safe water, inadequate access to sanitation and other infrastructure, or insecure residential status." This understanding is what has informed policy and planning. Despite these definitions, slum residents are still referred to as beneficiaries, even in cases where upgrading deteriorates their livelihoods. The definitions and descriptions are based on livelihoods literature that has been instrumental in the study of slums (See Hossain and Naimul Wadood (2020), Owusu et al. (2008), Rakodi and Lloyd-Jones (2002), Gulyani and Bassett (2010) among others). According to this literature, a livelihood comprises capabilities, assets including both material and social resources, and activities essential for living (Chambers & Conway, 1992). The literature establishes assets that include

human e.g. skills and knowledge, social e.g. informal networks and group memberships, natural e.g. soil, water, and forests, physical e.g. basic infrastructure, and financial capitals e.g. savings and credit. Residents draw upon these to make a livelihood in the context of socioeconomic, political and environmental dimensions.

The literature further establishes the concept of livelihood strategies, which refers to different activities that households engage in to access and use the livelihood assets to make a living (Manlosa et al., 2019; Rakodi & Lloyd-Jones, 2002). Examples of livelihood strategies in this literature include engaging in production activities such as agriculture, employment, trading, and remittances among others. This literature is useful for assessing capitals and specifically infrastructures in informal settlements. However, in baseline studies of slums, it has mainly been used to assess and take stock of infrastructures that lack quantitatively due to distance, costs, or access (see MLHUD (2013b, 2013c, 2013d, 2014a, 2014b). Even if it was used on the contrary, this literature has a limited understanding of the qualitative processes and mechanisms through which households and communities transform and maintain their livelihoods over time (Clay, 2018; Scoones, 2009). This is because it favors quantitative over qualitative insights (Clay, 2018). In addition, livelihoods literature views new infrastructures as an addition to physical assets but does not consider its potential shock characteristic on the residents' livelihood strategies. Therefore, livelihoods literature has not provided a sufficient means to conceptualize what a slum is and what happens when upgrading takes place.

Motivated by criticism of current negative connotations of slums and the limits of livelihoods literature, a shift from defining slums as something negative towards what exists is emerging in the planning literature. To illustrate, Mukeku (2018) after a study of the Kibera slum in Kenya concludes that slums must not only be viewed based on lacking basic infrastructures but also based on the interactions of the infrastructures present with socioeconomic activities in space and time. The author concludes that analogies between slum infrastructure and practices in time best explain what slums are. In another example, Alaazi and Aganah (2019) emphasize that policy dialogue ought to shift from a static perception of slums as health risks toward health promotion agenda in the slums. Mukeku (2018)'s views are particularly important since they propose the incorporation of securing livelihoods in a context of interlinked spatiotemporal and socioeconomic constraints. This is a structural angle to defining slums beyond deprivations and is also supported by current practice (Cities Alliance, 2021). I concur with these views that a shift from perceiving slums as places of delinquent people and crime, or a place that lacks services is timely. They are complex places but not chaotic a fact that definitions and descriptions ought to appreciate.

The interlinkage between the socioeconomic and spatiotemporal conditions in slums is structural in nature. It has received fruitful attention from researchers in the field of sociotechnical transitions (Cherunya, Ahlborg, et al., 2020; van Welie et al., 2018; M. J. van Welie et al., 2019). Murphy and Carmody (2019) conceptualize cities as sociotechnical systems organized by overlapping production, reproduction, and infrastructure regimes. Regimes are bundled rules-sets that manifest or are observable in the practices of residents and that govern and guide infrastructure use, production, or consumption at a given time in a place (Fuenfschilling & Truffer, 2014; Murphy & Carmody, 2019; Rip & Kemp, 1998). According to Murphy and Carmody (2019), production regimes guide practices for value generation such as making an income, consumption regime guides activities for social reproduction, and infrastructure regimes regulate practices for basic infrastructure use. The authors argue that the priorities of planners in shaping the

infrastructure regimes determine resultant development outcomes leading to parasitic/generative development for a given urban setting (Murphy & Carmody, 2019). Inspired by these concepts, van Welie et al. (2018) explain the splintered nature of a subset of an infrastructure regime for the sanitation sector in informal settlements. It comprises shared toilets, sewers, and buckets among others as well as their respective use practices and actor arrangements for use in time and space. The authors recommend the extension of such studies to incorporate more infrastructures beyond sanitation infrastructure and technologies.

I build on the regime concept following the ideas of Murphy and Carmody (2019) to conceptualize the infrastructure-livelihoods nexus. I argue that slums are subsystems of the city sociotechnical system, characterized by overlapping production, reproduction (emanating from the consumption regime), and infrastructure regimes. Production and reproduction regimes are socioeconomic in nature and manifest in the rules that govern the practices of making a living, providing for oneself and a household, and being part of a community. These two encompass the livelihood aspect of the nexus. The infrastructure regime pertains to rules that manifest in practices observed in basic service infrastructure use and comprise the infrastructure aspect of the nexus. Therefore, slums entail the patterned constellation of socioeconomic and infrastructure (sociotechnical) activities that are governed by rules that are observable in interconnected production, reproduction, and infrastructure regimes. The infrastructure-livelihood nexus for a slum then manifests as aligned production and reproduction regimes that misalign with the infrastructure regime leading to the deterioration of existing and new infrastructures introduced.

This conceptualization has both practice and conceptual significance. In practice, it exposes the existing capability of current participation (discussed in Section 1.2.3) exercises to identify the dynamic and systemic interconnections in the nexus at the regime level. Conceptually, it extends the sociotechnical regime concepts beyond single infrastructure systems to the nexus of livelihoods, places, and multiple infrastructure systems.

1.2.2 Infrastructure appropriation

Appropriation comprises residents' strategies to utilize new infrastructures in the context of the constraints/freedoms of their infrastructure-livelihoods nexus. The outcome of this manifests as squatting, trespassing, vandalism and sabotage, modification, and in minimal instances, active support and maintenance of infrastructures (Cherunya, Ahlborg, et al., 2020; Libertun de Duren & Osorio Rivas, 2020; Massey, 2014; Patel, 2013). Planning studies mostly focus on why residents resort to these appropriation outcomes (see Libertun de Duren and Osorio Rivas (2020) for instance). Little attention is paid to the mechanisms of how the appropriation processes occur. The sociotechnical transitions literature however highlights the appropriation process albeit implicitly from the perspective of technological embeddedness. This refers to the process where technologies are integrated into broader technical, socioeconomic systems and actor networks (Moors & Dijkema, 2006). Indeed, this is largely a technological and structural perspective and not a user-centered one. It is only recently that this literature has extended embeddedness to basic service infrastructures and technologies in slums.

In line with this extension, Cherunya, Ahlborg, et al. (2020) provide four heuristic strategies that residents undertake to respond to new sanitation technologies and that determine whether it embeds in the

livelihoods of the residents. These include coping or contravening, and negotiation or navigation. All these strategies either go against or follow socially endorsed rules and enable daily practices and activities that are repeated over time and take shape within slum spaces (Cherunya, Ahlborg, et al., 2020). The four strategies are spawned by two dimensions: i) mobilizing individual resources vs. social ones (i.e. through social networks), and ii) being in alignment with social expectations and rules or in opposition.

I build on these four strategies to explain mechanisms of appropriation and associated outcomes on residents' livelihoods. Appropriation and embeddedness however differ. Appropriation is a process that focuses on residents adopting an offering for a specific purpose in the constraints of their infrastructure-livelihoods nexus while embeddedness is an outcome state of this. Besides Cherunya's study that focuses on sanitation technology, no other studies explain nor conceptualize appropriation mechanisms for basic service infrastructures in slums. Doing so using this thesis contributes to further understanding of the appropriation of different infrastructure systems. Planning and sociotechnical transitions researchers recommend participation as a tool to anticipate processes such as appropriation (Cherunya, Ahlborg, et al., 2020; Cherunya, Truffer, et al., 2020; Groves et al., 2013; Patel, 2013). Therefore, conceptualizing appropriation also provides empirical indicators for practitioners and researchers to establish insights about anticipating it during participation.

1.2.3 Participation

Participation denotes the involvement and engagement of stakeholders that are affected by or are interested in a proposed intervention by implementers (Brownill & Parker, 2010a; Enserink et al., 2007). Conceptually, participation in planning literature can be traced from Arnstein (1969)'s ladder of participation, which was later modified to fit into global south contexts (Choguill, 1996) and applied in slums by Johar (2017) among others. The ladder demonstrates the extent residents get involved in interventions ranging from citizen control, delegated power, partnership, consultation, informing, placation, and therapy, to manipulation in declining order (Arnstein, 1969). Its role in slum upgrading is significant. It is an instrument for the empowerment of residents for them to initiate dialogue and shape outcomes of upgrading. The shaping has the potential to improve the effectiveness of slum upgrading as demonstrated by Patel (2013). In addition, it provides a platform for building the capacity of residents. Planning professionals further use it as a means for gaining entry into slums where trust building is essential to understand the slum's socio-spatial context through the residents (Johar, 2017; Nwachi, 2021; Patel, 2013).

Despite the benefits, operationalizing participation suffers due to power imbalances among stakeholders, the multiplicity and diversity of participants, and limits in understanding cultural protocols and social-spatial relationships or the context of planning (Brand & Gaffikin, 2007; de Vries, 2016; Rigon, 2014). Healey (2003) extensively discusses the issue of power and underscores that collaborative planning does not seek to neutralize power and hence the role of the planner as an intermediary and mediator (Healey, 1997). Innes (2004) on the other hand states that power differential is beneficial and may lead to even new partnerships where stakeholders agree to disagree on certain issues. In practice, participation broadly manifests in distinct processes of project planning such as those illustrated by the Equator principles. These take into account factors such as stakeholder engagement, grievance mechanisms, transparency,

independent reviews, environment and social safeguards, and independent monitoring and reporting of projects (Equator Principles Association, 2013; World Bank, 2021)[2].

The multiplicity and diversity of actors and limited understanding of the slum context remain outstanding challenges for participation as a tool for planners. I offer conceptual inroads for the latter in Sub sections 1.2.1 and 1.2.2. For the former, planners have to mediate and contend with multiple actors with different rationalities, interests, and motivations—logics (Rigon, 2014; Rydin & Pennington, 2000). In slum upgrading, all actors outside the slum be it, builders, government officials, or consultants, involved in the upgrading process have to involve and engage with the residents at some point in the planning process. This implies that participation is not a one-off event but continuous interactions and relationships between residents and other actors at different times of planning. Studies only perceive this relationship in sum (Massey, 2014) and none seeks to understand how the different configurations of such relationships can be conceptualized or would influence upgrading outcomes. To inform planning practice and how these can be conceptualized, I borrow the ideas from the literature on institutional logic (Thornton & Ocasio, 2008; Thornton et al., 2012). Institutional logics are value systems that condition actors' choices to influence material outcomes. There are limited ideal type logics which include market logic, state logic, professional logic, hierarchal/corporation logic, religion logic, community logic, or family logic (Thornton & Ocasio, 2008). I argue that actors can be aggregated based on these logics without losing the value that diversity provides while at the same time reducing the complexity that is associated with diversity. As outlined in Subsection 1.5 and demonstrated in Chapter 4, this provides an avenue for studying complex phenomena using emerging methods that offer new insights into the field and practice of learning.

To summarize Section 1.2, there are outstanding and interlinked conceptual challenges that stand in the way of achieving improved livelihoods at scale using infrastructure interventions. At the slum level, the infrastructure livelihood nexus and the appropriation process have not been sufficiently conceptualized. In addition, participation as currently conceptualized is not equipped to anticipate appropriation nor handle the multiplicity and diversity of implementing actors. Its challenge of the multiplicity and diversity of actors and influence on upgrading outcomes still stands. These complicate planning. Attending to these conceptual gaps as well as the gaps discussed in Subsection 1.1 will equip planners with the necessary insights to accrue Slum upgrading programs' full potential of scaling improved livelihoods nationally.

1.3 Research questions

The overarching question that this thesis sets out to investigate is why infrastructure investments fail or succeed in improving the livelihoods of slum residents in the slums across cities of the global south. The literature presented current conceptual and empirical advances. It also presented gaps that need to be filled to guide and extend planning's promise of achieving improved livelihoods at scale. To answer the main question, this thesis breaks it down into its conceptual and empirical aspects. Specifically, the conceptual aspects investigate the following questions:

i. How can the infrastructure-livelihoods nexus in slums be conceptualized and how is it transformed by slum upgrading interventions?

[2] https://equator-principles.com/

Understanding this is essential due to the conceptual move towards redefining slums beyond the perspective of lack. Besides this, it is also essential to understand the strategies that residents embrace to maneuver infrastructures while securing livelihoods within the slum's context. To this end, we ask the following:

ii. How does the appropriation of new infrastructure by residents occur and how does this influence their livelihoods?

Since infrastructure interventions have an impact on the way residents organize their livelihoods by creating new mismatches between productive and reproductive regime structures and leading to a variety of appropriation strategies, we ask how planners can reliably anticipate these processes empirically to better align outcomes from infrastructure interventions with residents' livelihoods. Since their recommended tool to achieve this is participation, we ask the following question:

iii. How can participation be configured to deliver infrastructures that improve livelihoods?

So far, these questions probe the limits of planning in understanding the slum context and anticipating appropriation conceptually and empirically. However, they are limited to individual projects. To achieve livelihood improvement across global south cities as envisioned by urban planning, we investigate how to structure and leverage cross-project learning and ask the following:

iv. How can planners leverage synergies from multiple projects through learning to accelerate scaling improved livelihoods at a national scale?

By answering these questions, this thesis seeks to extend the conceptual understanding of slums and the strategies of their residents. In addition, it seeks to equip planners with knowledge and tools relevant to achieving nationwide livelihood improvements for slum residents.

1.4 Case selection

Improving the livelihoods of residents is a strategic objective for developing and emerging countries globally. Governments in the global south are paying keen attention to the increasing number of residents living in urban poverty as urbanization rates increase. To address this, they are establishing participatory initiatives in slums in the form of slum upgrading programs aiming to catalyze the livelihoods of residents. They are primarily doing this through the implementation of complementing basic service infrastructures that connect the slums to trunk city infrastructure. The end goal is to improve livelihoods at scale and productive urban transformation. Over time, the focus has been on capital cities until recently where such programs are now being expanded to other cities in these countries (see Cities Alliance (2022); (UN-Habitat, 2020) for example in Tunisia, Bangladesh, Uganda, and Burkina Faso among other countries). It is in this context that a scoping exercise of such existing initiatives in African countries led to the selection of the Kenya Informal Settlement Improvement program (KISIP) as a case study for this thesis (WorldBank, 2011).

Kenya reflects many middle and low-income countries, whose over 56 percent of the urban population lives in slums (Otiso, 2005; Wamukoya et al., 2020). The country's rate of urbanization supersedes the capability of basic service infrastructure investments (World Bank, 2016). The country has a long history of slum upgrading with mixed interventions. The interventions were characterized by a mix of evictions and sites and services schemes in the mid-1970s as were top-down, project-based, and common practice

at the time (Danso-Wiredu & Midheme, 2017; Lines & Makau, 2018). At the turn of the century, the government embraced the participatory slum upgrading program—Kenya slum-upgrading program (KENSUP)—with a focus on housing from 2005 to 2020. (Muraguri, 2011). KENSUP has received substantial attention in many previous studies and predominantly focused on major slums in Nairobi such as Kibera (Anderson & Mwelu, 2013; Cherunya, Ahlborg, et al., 2020; Cherunya, Truffer, et al., 2020; Kimeto & Somba, 2017). KISIP was based on post-implementation learnings from KENSUP and focused on basic services as is the current best practice of slum upgrading (Acioly, 2021; WorldBank, 2011). KISIP is the largest upgrading program undertaken by the Kenyan government in terms of geographical and financial scope (World Bank Group, 2020). It extended its focus to other cities besides Nairobi in its first completed and second ongoing phase. Both phases have received little attention from any studies besides internal evaluations. This study thus provides insights with the potential to shape the second phase as well as other upgrading programs beyond Kenya.

The infrastructure planning and implementation of the first phase of KISIP commenced in 2011 and ended in 2020. It was funded with $ 165 million by the World Bank and covered 80 informal settlements in different cities in Kenya. The program aimed to improve the living conditions for residents by linking them to the city, providing secure tenure, and providing water, sanitation, mobility, drainage, solid waste management, and security lighting infrastructure (World Bank, 2011). Each settlement received at least a combination of four infrastructure sets from this list. The program was appraised following the Equator Principles[3], which are globally renowned standards for investing in infrastructural projects.

KISIP provided a useful empirical case because of the following reasons. First, it provided a natural experiment where 80 slums were upgraded at a traceable period, with the same planning, implementation, and post-implementation processes with actors structured similarly but with different outcomes. This study focused on the overall KISIP program and its subset of 15 slums (projects) as a representative of the 80 in Nakuru (3), Mombasa (4), Eldoret (2), Naivasha (4), and Machakos (2). These were chosen after a pilot visit and discussions with the program management team to identify the slums where upgrading was already complete before 2019 and was diverse in terms of the perceived outcomes, religion, tribal affiliations, and infrastructure interventions. Secondly, different aspects of KISIP including implementation processes, scope, outcomes, and organization could be studied due to its recent implementation. Third, KISIP provided integrated multiple infrastructures that increased the program's complexity making it worthwhile for developing insights for understanding and analyzing complexity to improve future programs. Fourth, KISIP was meant to be a platform to test principles for a scalable program (World Bank, 2011). Therefore, insights from it are deemed useful for other upcoming programs and are a trailblazer for an overarching urban development strategy in Kenya and beyond. It had the potential to provide generalizable insights both at settlement level and program level scales for other countries that are establishing such initiatives (Cities Alliance, 2022; UN Habitat, 2015).

Through functional infrastructural projects at the settlement level, KISIP also targeted to contribute to strategic objectives at the country and global levels. These included synergizing with other national initiatives such as the Kenya Municipal Program which focused on strengthening the essential institutions of urban management, KENSUP, and the Nairobi Metropolitan Services Project, which would support infrastructure development (World Bank, 2011). The three were to contribute to and aligned with the national Ministry of Land and the Ministry of Housing. In addition, they are in line with the country's *Vision 2030* which targets "a well-housed population living in an environmentally secure environment", the vision

[3] https://equator-principles.com/

mid-term plans for 2008-2013 (World Bank, 2011; World Bank Group, 2020). The program was linked to national policies thus providing insights into the role of programs in urban planning.

1.5 Methodology

A suite of qualitative approaches was employed in this thesis because of their capability in facilitating in-depth analysis of phenomena, comparative configurational analysis, and case studies where the sample size is small (Goertz & Mahoney, 2012; Rahman, 2020; Rihoux, 2006). Each research question corresponds to a paper and a chapter in this thesis.

For the first research question, an abductive approach was used to conceptualize and analyze the slum context and how upgrading influences it. This approach allows for informing and updating theories and thus has the potential to improve understanding of livelihoods improvement (Dubois & Gadde, 2002). The second question necessitated tracing mechanisms available for residents in engaging with infrastructures and the effects on their livelihood (Beach & Pedersen, 2013). This was done for one slum. It was essential for explaining mechanisms that lead to specific infrastructure-use patterns for newly introduced infrastructures by residents. This allowed for within-case causal inference alluded to by process tracing methodology (Beach & Pedersen, 2013). This had the potential to provide generalizable mechanisms for different use characteristics of different infrastructures by residents. For the third research question, participative interactions between residents and different actor groups were analyzed through a qualitative comparative analysis (QCA) approach of the upgrading process and its outcomes for fifteen informal settlements in the KISIP program, which presented a natural experiment (Furnari et al., 2021; Rihoux & Ragin, 2009; Schneider & Wagemann, 2012). The configurational rationale and method provided insights that establish the configurations of participative actions that led to successful or failed upgrading projects. Such configurations had not been studied before in literature. Lastly, how program management teams learn during the implementation of upgrading programs to improve overall program outcomes was studied through an abductive approach. Apart from the third research question which required additional FSQCA software (Ragin, 2009), the rest of the analysis was conducted using Nvivo software (Edhlund & McDougall, 2019). This involved developing a coding scheme informed by theory for each specific question, assigning the data to the coding scheme, and organizing, reviewing, and updating the coding scheme based on emerging codes from the data. The analysis involved establishing connections, patterns, and themes among the coded data.

The empirical campaign for this thesis was conducted in two phases from late 2019 to early 2022. The first phase commenced from October 2019 to February 2020 in fifteen informal settlements where observational data on how residents were using the recently constructed infrastructures as well as whether the infrastructures were delivered by implementers in a usable state was collected. In addition, 69 key informant interviews were conducted. To complement the interviews and observations, publications and reports relevant to the overall KISIP program and specific to the fifteen settlements were reviewed. Thirty-nine of these were included as part of the data sources. The second phase took place between August 2021 and January 2022. Sixty-five interviews were conducted and 33 reports specific to KISIP, which included annual implementation status reports, annual audit reports, completion reports, and design phase reports were reviewed and included as part of the dataset. In addition, the author observed and had multiple informal field conversations with residents to gather insights that often go unreported due to cognitive biases.

A snowball sampling approach commencing with targeted key informants was used to build trust with interviewees especially in the slum settings and on the initial days of the empirical campaign where there is a high prevalence of mistrust and research fatigue (Parker et al., 2019). In addition, an extended exposure approach was through long stays in the slums to conduct field observations and casual observations were adopted. The key informants included slum residents that were involved in the process of planning and implementing the projects, other residents, government officials at the regional and national level, World Bank affiliated officials, UN habitat officials, consultants, and contractors. Relevant permission and consent were sought from government authorities and interviewees respectively. A list of anonymized interviewees and data sources is presented in the Appendices for each chapter.

1.6 Thesis outline

Chapter 1 introduces this thesis. The rest of the thesis Chapters 2 to 5 comprise the four research papers and Chapter 6 provides a synthesized conclusion of this thesis.

In a novel way, Chapter 2 conceptualizes the infrastructure livelihood nexus as comprised of production, reproduction, and infrastructure regimes that are interlinked at temporal, spatial, organizational, and transactional dimensions. Any disruption in one dimension has to be compensated for by any or a combination of the other three to reconfigure the three regimes. In slums, the dimensions interlink to favor seeking livelihoods at the expense of sustaining infrastructures. The concept demonstrates that mis/alignments of new infrastructures with the existing regimes determine whether improvement of livelihoods and a development trajectory is achieved. The study employed a qualitative approach with a dataset comprising nine in-depth interviews, six project reports, and a master's thesis. Chapter 3 builds on Chapter 2 and conceptualizes infrastructure appropriation. It demonstrates how appropriation influences the prospects of sustaining the infrastructures' functionality and utility to influence the livelihoods of residents. The chapter takes a qualitative approach with the intent to draw causal inferences from the data in an abductive manner. The dataset for the chapter comprised field observations during a three-week stay in one representative slum and 28 in-depth interviews. The chapter demonstrates the strategies that residents employ and the varied impacts that the strategies have on infrastructures over time. These may either favor or bar the maintenance of functionality and the sustenance of the utility of the infrastructure in the slum. In addition, the chapter establishes an additional role for the participation of anticipating appropriation during planning.

Chapter 4 investigates the relationships between planners and residents in terms of actor interactions, configuration, and influence during slum upgrading. Participation is a key tool that planners employ to understand the infrastructure livelihood nexus from the residents' perspective during slum upgrading projects. It aids in effecting planning and implementation or redesign of infrastructures to least disrupt the extant livelihoods of residents. The Chapter takes a cross-case and configurational perspective to demonstrate sufficient configurations of actor interactions with residents that result in infrastructures that are delivered in a functional state and have utility among the residents. The participation configuration was based on a novel conceptualization for grouping multiple actors involved in upgrading based on their guiding logic defined by their interests and constraints in action. Qualitative data was gathered from sixty key informant interviews, observations from field visits to 15 slums, at least two project reports for each slum, and grey literature. A qualitative comparative analysis (QCA) was conducted for the fifteen slums where upgrading took place as a sort of natural experiment. The Chapter establishes three sufficient pathways that all emphasize that the presence of collaborative professional, market and community-

oriented actor groups is sufficient to deliver successful infrastructures and can over-compensate for politically motivated actor groups and or those whose actions are constrained by hierarchies.

To facilitate the scaling of livelihood improvements at the national level through programs, Chapter 5 addresses the learning challenge. The chapter explains how slum upgrading can be barred by limited learning within programs due to inefficient and ineffective program processes, structure, team members, and tools. The chapter establishes processes that are essential for learning as well as for delivering successful upgrading outcomes. The datasets for the chapter included 37 interviews with funders, the KISIP national team, county team members, community representatives, and consultants. In addition to the interviews, 33 reports were specific to KISIP and field observations in 16 slums. The chapter concludes that learning can improve program outcomes and well-conceptualized recursive processes that include participation, coordination, communication, and synthesizing information are essential though insufficient for it. To make learning effective, these processes have to be supported by committed teams, equitable incentives to engage and collaborate, and allowance for flexibility in structures.

Chapter 6 concludes by answering the research questions and synthesizing the overall insights from the individual chapters in a broader sense to inform social inclusion and urban transformation. In addition, it provides implications of this thesis on planning practice, planning, and sociotechnical transitions literature and methodologies for studying urban systems.

Chapter 2: The infrastructure-livelihoods nexus: Structuring slum contexts using sociotechnical transitions concepts[4]

Abstract

The unfettered growth of slums is a daunting transition challenge and many upgrading programs fail to sustainably improve the livelihoods of slum residents. This paper proposes a transitions framework to investigate the mechanisms for the success or failure of slum upgrading programs. We conceptualize slums as urban subsystems, governed by sociotechnical (infrastructure) and socioeconomic livelihood regimes (related to production and social reproduction). The framework permits the examination of mis/alignments between rules associated with new infrastructures, and those that regulate existing production and social reproduction activities of slum residents. This approach extends transition studies by accounting for the multi-system interactions between different infrastructure regimes (e.g., transportation, sanitation) within a local sociotechnical system. It also explicitly accounts for livelihood outcomes, in terms of production and reproduction rules. We apply this framework to an in-depth analysis of a slum upgrading project in Naivasha, Kenya, which was part of a broader program covering another 38 slums.

[4] Wainaina, G.K., Truffer, B., & Murphy, J. (accepted subject to revision). Infrastructure, livelihoods, and sustainability transitions: Structures that influence sustenance of outcomes informal settlements upgrading interventions. *Environmental Innovation and Societal Transitions*.

2.1 Introduction

Governments and development agencies have drawn attention to the over 1 billion urban residents living in informal settlements, mostly in the Global South (UN, 2020). The poverty and deprivation associated with such settlements have prompted municipalities and development agencies to implement upgrading programs to improve dwellers' livelihoods and prevent evictions. Such interventions have largely sought to improve infrastructures (e.g. housing, roads, water, sanitation) with the expectation that upgraded basic services will rapidly improve residents' livelihoods (e.g., Koster and Nuijten (2012); WorldBank (2011)). However, the evidence shows that such investments can have mixed results as infrastructure improvements may disrupt residents' livelihood strategies, which in turn may induce quick deterioration of the new infrastructures (Cherunya, Truffer, et al., 2020). Gains from upgraded infrastructure may be further constrained if the underlying forces (e.g., unemployment, labor precarity, high rural-to-urban migration pressures) that perpetuate poverty cycles, and unsustainable user practices are neglected or persist after implementation (Brown-Luthango et al., 2017; Massey, 2014). Needed is an integrated approach that can account for the infrastructure-livelihoods nexus such that we can better understand the mechanisms through which upgrading (socio-technical) initiatives lead to (or not) livelihood improvements(Calderón & Servén, 2014).

In contexts like slums where access to multiple basic services such as water, sanitation, energy, and transportation is severely lacking, residents have to develop alternative coping strategies (Cherunya, Ahlborg, et al., 2020; Gough, 2019). Despite its significance for development, relatively little is known about how, precisely, new infrastructure investments impact livelihood activities. This gap in our knowledge is significant both practically and conceptually. Practically, many attempts at upgrading informal settlement or slum infrastructures fail to transform communities in large part because designers and implementers understand relatively little about the actual livelihoods of residents (e.g., how, where, and when residents commute to work, what household budgets and spending priorities are). The success of upgrading projects depends crucially on the ability of residents to accommodate the requirements of new infrastructures, aligning these with their every day livelihood strategies. Such strategies are essential to understand given they are unlikely to change quickly even after an upgrading project given they are often deeply embedded in place-specific contexts.

Conceptually, there is a need to develop frameworks that capture the place-specific rules, routines, and practices that make infrastructures more or less able to improve livelihoods; i.e. to unpack and explicate the livelihoods-infrastructure nexus. Transition scholars further need to consider the wider sustainability implications of infrastructural innovations and include issues of social justice and improved socio-economic development (e.g., see Grant et al. (2020), Smit and Musango (2015), Swilling (2014), Swilling et al. (2016)). Tackling these conceptual challenges requires a place-based lens, a turn that has been advocated for recently e.g., Carroli (2018); (Hodson et al., 2017).

This paper advances and applies a sociotechnical transitions perspective to the study of the infrastructure-livelihoods nexus. Transition thinking has proven to be effective in highlighting the multiple ways that new technologies align with and shape institutional conditions and practices to generate "socio-technical configurations that work" (Rip & Kemp, 1998). It therefore can enable researchers to conceptualize infrastructure upgrading projects as interventions designed to induce sociotechnical transitions in particular places (Hodson & Marvin, 2010). However, the currently dominant approach in transition studies focuses on the development conditions of single technologies (e.g., renewable energy, bus-rapid transit), which need to mature and institutionalize to better contribute to (mostly environment related)

sustainability outcomes. In order to tackle the urban upgrading problem in the Global South, we argue that there is a need to capture the interactions between infrastructures, the associated services of providers, and the everyday practices of users (i.e., residents) (see also (Rosenbloom, 2020)). In doing so, it will be possible to determine if alignments exist between these actors, infrastructures, services, and practices, and whether the sociotechnical configurations associated with them can improve (or not) both environmental performance and the living conditions of urban residents.

We conceptualize informal settlements or slums as subsystems of larger-order urban sociotechnical systems that are governed through configurations of rules associated with sociotechnical(infrastructure) and socioeconomic regimes (Murphy & Carmody, 2019). Sociotechnical regimes govern the use, operation, and maintenance of newly introduced (or formerly existing) infrastructures e.g., roads, and sanitation - see Fuenfschilling and Truffer (2014); van Welie et al. (2018). Socioeconomic regimes govern the production (e.g., employment, manufacturing, services) and reproduction activities (e.g., householding, provisioning, socializing) of settlement residents. Taken together, production and social reproduction activities constitute the livelihood strategies that shape and are shaped by the infrastructure regimes. Both types of regimes consist of formal and informal rules, which are often highly institutionalized and shape regularized practices of actors (Cherunya, Ahlborg, et al., 2020). Moreover, sociotechnical and socioeconomic regimes are aligned with or interdependent on one another in ways that shape the evolution and development of urban (sub) systems (i.e., slums). All told, regime-specific rules, and inter-regime alignments, embed communities in governance structures and create a place and time-specific variegations in the functioning and operation of settlement subsystems.

In operationalizing this approach, we view slum upgrading programs as explicit attempts to induce sustainability transitions in communities through investments in new infrastructures. We take a practice lens to derive and explore regime-specific rules that guide how, when, and where infrastructures are appropriated. Specific infrastructure interventions are packaged with particular rules whose adoption is necessary for successful implementation. We argue that the success of these programs is not solely determined by the quality and utility of the infrastructure itself but by the degree to which there are alignments between it and the rules governing socioeconomic (livelihood) regimes.

To qualitatively understand these alignments, and the livelihood-infrastructure nexus more broadly, we develop a systematic approach to identify intersections between infrastructure (sociotechnical), production (socioeconomic), and reproduction (socioeconomic) regimes that will be shaped by or recursively shape settlement upgrading interventions. Our focus is on the rules governing regimes and how these are effected by, or influential on, the development outcomes that accompany an upgrading intervention; namely whether it can foster a sustainability transition. In doing so, we extend transition frameworks beyond the sociotechnical (infrastructure) realm to embrace broader questions related to livelihoods and community wellbeing in the Global South.

The framework is applied and illustrated through an analysis of recent slum upgrading initiatives in Kenya. Our focus is on the Kasarani informal settlement on the outskirts of Naivasha town in Kenya's rift valley, northwest of Nairobi. Kasarani's roads, water, solid waste, footpaths, drainage, and lighting were upgraded between 2012 and 2018 as part of a nationwide upgrading program that targeted informal settlements in and around secondary towns in Kenya. Drawing on field research, we assess the impacts of these investments on livelihood strategies in the settlement, focusing on the alignments between the rules associated with the production, reproduction, and infrastructure regimes observed in Kasarani. The analysis shows how alignments led to livelihood improvements and how partial - or misalignments meant

that some infrastructure interventions failed to provide or sustain envisioned benefits for dwellers. We focus on roads and footpaths to further elaborate findings since they largely impact both production and reproduction activities in informal settlements as well as provide an avenue for physical and spatial integration to the city (Acioly, 2021; Banashree et al., 2012). They also provide a foundation for other basic urban services.

The section that follows explores the nexus between infrastructures and livelihoods by explicating insights from livelihoods and transitions literature. The third and fourth sections elaborate on the qualitative and abductive approach employed in the present paper and the appropriateness of the Kasarani informal settlement for analysis. Sections five and six present and discuss the main findings; namely that the sustainability of upgrading initiatives depends on whether there are alignments between the rules associated with new infrastructures, and those associated with the extant socioeconomic regime. More broadly, we argue that our conceptual approach is not limited to informal settlement upgrading but can instead be applied to a wide range of transition processes that link urban infrastructures to livelihoods.

2.2 The infrastructure-livelihoods nexus

Livelihoods research, a long-established area in development studies, has led to the development of frameworks that account for the intersections between the productive and reproductive activities of individuals, households, and communities in the Global South, and the political-economic and vulnerability contexts they are situated in (Bebbington, 1999; Chambers & Conway, 1992; Rakodi & Lloyd-Jones, 2002; Scoones, 1998). Livelihoods analyses are place-based, grounded, and often applied works that seek to "put the last, first" through research that explicates how marginalized or poor communities mobilize multiple assets – i.e., human, physical, financial, political, social, and natural capital –to survive, accumulate, and improve their well-being (Chambers, 1997; Rakodi & Lloyd-Jones, 2002). While early livelihoods research focused principally on rural areas, it has been increasingly deployed to examine the strategies of urbanites in Southern cities, particularly those who live in informal settlements and slums (Rakodi & Lloyd-Jones, 2002; Saharan et al., 2019). Some of these works have focused explicitly on infrastructure and its contribution to livelihoods through the provisioning of essential resources and services such as water, energy, and housing (Crawford & Bell, 2012; Mangíra et al., 2019; Rouse, 2006).

While livelihoods research offers a substantive means through which to assess the conditions, needs, and opportunities of communities throughout the Global South, it remains more of a tool to take stock of assets and constraints rather than providing a conceptual approach to understanding development pathways. It can help to highlight critical areas of intervention about particular assets (e.g., social, financial), vulnerabilities, and structures, but it tells us little regarding how development (e.g., infrastructure) projects and trajectories shape or are shaped by established livelihood practices, strategies, and path-dependencies. This limitation is one that we believe can be addressed through an engagement with transitions perspectives that take a sociotechnical, systemic view of place-based development.

2.2.1 Informal settlements as sociotechnical subsystems

Following Murphy and Carmody (2019) and (Murphy, 2022) work on urbanization pathways in Africa, we conceptualize informal settlements as subsystems of urban sociotechnical and socioeconomic systems. Urban and settlement (sub)systems are realms of technological, material, social, and economic life whose development trajectories are shaped by infrastructures, economic forces, technologies, and livelihood strategies governed by infrastructure, and socioeconomic regimes (Geels, 2004; Markard et al., 2012; Schot et al., 2016; Shove et al., 2015). Regimes are constituted by institutionalized formal and informal

beliefs, values, norms, routines, regulations, practices, and capabilities that mutually construct and are constructed by actors in a system (Fuenfschilling & Truffer, 2014).

Infrastructure regimes are *sociotechnical* in nature, and very much aligned with conventional views of regimes from transitions scholarship (e.g., see Canitez (2019); van Welie et al. (2018)). They manifest as the rules that guide the use of and provision of basic service infrastructure and technologies, such as sanitation, transport, energy, water, and other collective goods that are vital for the survival and well-being of urban residents. Infrastructure regimes regulate, sanction against, or inform the negative externalities that are associated with basic services such as congestion, safety concerns, public hygiene, and pollution, among others, issues that can have significant impacts on productivity, health, and the quality of livelihoods. Importantly, however, infrastructure regimes in informal settlements are often governed in ways that are specific to the community, functioning outside the (rational, modernist, statist) expectations, practices, and rules that nonlocals or technocratic authorities expect (Jones, 2019). In contrast, informal settlement infrastructure regimes are commonly governed by private (market), informal, and/or communal interests that may be illegible or irrational to authorities but which play a central role in the distribution, access, cost, and use of basic services (Achwoka, 2016). This follows the conceptual views of van Welie et al. (2018) on service regimes that govern the provisioning of specific services such as sewered sanitation, and sectoral regimes that govern the sector at large (e.g., sanitation). Infrastructure regimes build on this to incorporate both service and sectoral regimes of different services. The combined change in several infrastructures during an upgrading intervention is a useful departure for transition studies since it allows study of interacting sets of technologies as opposed to single technologies and sectors that have been characteristic of previous transition studies (Rosenbloom, 2020).

In contrast to infrastructure, production, and reproduction regimes are principally *socioeconomic* in nature and capture the livelihoods dimension of the livelihoods-infrastructure nexus. Production and reproduction regimes manifest in the rules that govern the practices of making a living, providing for oneself and a household, and being part of a community. Production regimes are rules that relate principally to the income-generating production activities that informal settlement residents use to earn income and meet their material needs (e.g., work in nearby industries, microenterprises, and hawking). Core production rules are those that relate to formal and informal employment, entrepreneurship, microenterprise, and economic upgrading (e.g. skills, and wage increases). They dictate who does which production activities, and when, how, and where such activities are conducted. Reproduction regimes entail the rules associated with everyday life in households (e.g., cooking, childcare, provisioning, socializing, and leisure). Reproduction regimes dictate how and where individuals go about meeting basic needs and being part of a community (Cherunya, Ahlborg, et al., 2020; Geels et al., 2015; McMeekin & Southerton, 2012; Warde, 2005). In informal settlements, reproduction regimes are commonly characterized by resilience and survivalist rules given the myriad challenges that force residents to develop innovative, affordable means to access basic goods and services (Jones, 2019; Van Horen, 2000). These rules are anchored in social relations and they play a key role both in sustaining livelihoods and providing opportunities for social upgrading.

All told, informal settlements entail the patterned constellation of socioeconomic and infrastructure (sociotechnical) activities that are governed by rules that are observable in interconnected production, reproduction, and infrastructure regimes. To explicate the livelihoods-infrastructure nexus, it is necessary to conceptualize and analyze the particular ways in which regimes interact with one another in a

settlement. To do so, we focus on the rules associated with infrastructure regimes (established or emerging), and their alignments with the rules embedded in production and reproduction regimes.

2.2.2 Alignments, partial alignments, and misalignments of regime's rules

Investments in new infrastructures as conceived by actors from outside a settlement will typically be accompanied by anticipated changes in the rules of appropriation, use, and maintenance. Indirectly, they often require changes in rules guiding livelihood strategies. These rules are typically defined by upgrading program implementers and are often associated with technocratic logic regarding how infrastructure should be governed and used. If aligned, rules in the (re)production regime can be adapted to the requirements of the new infrastructure regime. Such adaptations could include extended working durations, new (re)production activities, increased (re)production capacities, and/or new spaces for (re)production practices, among others. In contrast, partial alignments may mean that there is a mix of positive and negative impacts on (re)production regime practices while misalignments might result in negative consequences such as the displacement of existing livelihood practices, or even residents; circumstances that might result in acts of sabotage or misappropriation of new infrastructures by community members.

Recursively, changes to the socioeconomic regimes that accompany new infrastructures will, in turn, shape/determine the functioning of infrastructures. Settlement residents appropriate, consume, maintain, ignore, sabotage, and/or transform new infrastructures in line with their material realities and the pre-existing/embedded rules and practices that are part-and-parcel of their livelihood strategies. The more these livelihood rules align with the rules in the emergent infrastructure regime the better the distribution and quality of collective goods and services will work. If misalignments occur, negative impacts on the functioning of infrastructure regimes will occur such as disrepair and uneven distributions of basic services. Misalignments mean that the rules governing infrastructure regimes will not be respected and might lead to malfunctioning or even breakdown in the service provision.

Few studies implicitly signaling different inter-regime alignments exist in the broader literature of slum upgrading. Patel (2013) for instance elaborates on the successful upgrading of Zwelisha, an informal settlement in Durban, and attributes its success to the implementers' focus on the well-being of the residents, community participation as well as informal continuity of local leadership. In contrast, other upgrading exercises result in infrastructure sabotage, displacements through gentrification, or abandoned and unused infrastructures even if structurally well-built. Such examples are widely reported in diverse informal settlements in Kenya and Brazil among others (Libertun de Duren & Osorio Rivas, 2020; Yeboah et al., 2021). Lastly, instances of borderline successful upgrading also occur and lead to the hybridization of (new) infrastructure regimes. Examples of such cases include where residents redefine infrastructures for additional and multiple uses or when they have to accommodate it into their livelihood strategies despite its associated challenges. For instance, Massey (2014) explores instances of hybridization in two informal settlements in Cape Town where women extended their newly provided houses making space for road-facing shops and using roads as meeting spaces. The author argues that hybridization, which she refers to as counter-conduct, stems from previous practices and is traditional and socially based. Though all these studies independently show the inter regime alignments albeit very implicitly, the explanatory mechanisms for the observed outcomes of upgrading has not been explored systematically. This paper aims to fill this gap.

To summarize, inter-regime alignments can either entrench existing regimes or, ideally, drive transitions toward new, more sustainable rules and development outcomes such as improved basic service distributions and more resilient livelihood strategies. In contrast, partial alignments due to newly introduced infrastructures often lead to new hybridized infrastructure regimes that are characterized by a blend of both old and new rules that favor extant production and reproduction rules. Such changes could be for the better or worse, but they will not reflect the imagined/idealized goals envisaged by upgrading implementers. Lastly, misalignments are circumstances where there is often no net benefit from the infrastructure upgrading on livelihoods.

2.2.3 A practice lens to rules

Rules are often implicit and only observable in everyday practices (Jones & Murphy, 2011; Reckwitz, 2002; Shove et al., 2012; Shove et al., 2015). Practices are stable and recurring patterns of behavior that reflect the explicit and implicit rules governing sociotechnical and socioeconomic regimes (Shove et al., 2012). As such, they offer an epistemological object that can reveal rules and their potential alignments or mis/non-alignments as they relate to new infrastructures.

Insights from practice-oriented approaches have been absorbed in earlier transition studies focusing on informal settlements. Specifically, van Welie et al. (2018) conceptualized regime structures in informal settlements as manifest in the following practice-related dimensions: ways of dealing with artifacts and infrastructures, organizational modes, structuring of time and space, mobilized rationales, and social interaction. Artifacts and infrastructures represent physical components of technologies such as pipes, taps, and roads among others, organizational modes represent actor arrangements to access and provide a given service while time and space represent when and where services are conveniently offered or consumed. In addition, the rationale represents why actors choose to provide or use services. Often in informal settlements, this is based on transaction modes and social relations. These "practical" dimensions of regimes provide avenues for concrete observation and analysis of the rules governing them, which are often implicit. Therefore, the nature of alignments of socioeconomic and Infrastructure regimes/rules can be analyzed by observing practices along these regime dimensions. Such rules include how the provision or use of the service is organized—organizational mode rules—, where the use occurs—spatial rules—, when the use occurs —temporal rules—, and what rules are expected with new infrastructure investments.

All told, alignments of (inter)regime-specific rules, or lack of them, can offer a means to examine and evaluate the (social) livelihoods-infrastructure nexus effectively. Specifically, the success or failure of upgrading outcomes can be attributed to alignments, nonalignments, or misalignments between the rules (revealed through practices) of new infrastructures with extant production and reproduction regimes. The degree to which their rules complement, conflict, and/or are irrelevant to the others determines the likelihood that an infrastructure upgrading project to have significant and wider effects on the livelihoods of slum dwellers. We now demonstrate/illustrate how this framework can elucidate the livelihood-infrastructure nexus, drawing on the case of a slum upgrading project in Naivasha, Kenya.

2.3 Methodology

The context of the study was in the Kasarani informal settlement on the outskirts of Naivasha town in Kenya (see Figure 1). The rapid urbanization currently experienced in the country, with an annual urban population growth of 4.3 percent, is synonymous with many countries in the global south (The World Bank, 2019). Consequently, the sprawl of informal settlements in all cities and towns in the country is

commonplace (UN Habitat, 2016). Kasarani was selected since its infrastructure had recently been upgraded under a countrywide informal settlement upgrading program (WorldBank, 2011). These investments comprised six infrastructure types i.e. water supply, roads, footpaths, stormwater drainage, solid waste management unit, and street lighting (floodlights). Concerning its production and reproduction regimes, Kasarani is compelling as a case study. It has diverse socioeconomic activities ranging from local, trans-local, and international scales that exploit the cheap labor of the residents and the infrastructures. It is also a vibrant, diverse community in terms of its ethnic and religious composition, as well as concerning household composition. While some dwellers claimed that the community is united, politically fueled ethnic conflicts often arise during election periods (Lang & Sakdapolrak, 2015). Kasarani was studied against a background knowledge of another sixteen informal settlements throughout Kenya that the first author had visited.

Qualitative data was collected in Kasarani between November 2019 and the end of January 2020 by the first author. The data included observations of how dwellers conducted production and reproduction activities as well as how they accessed, used, and managed infrastructure. In addition, secondary data specific to Kasarani were reviewed to empirically assess conditions in the settlement before the upgrading. Nine key informant interviews complemented these two data sets (Anthony Gitonga, 2015; Antony Gitonga, 2015; Kioko, 2011; Kuiper, 2017, 2019; Kuiper, 2020; MLHUD, 2014b, 2014c; WorldBank, 2011). Study participants included individuals actively involved in the upgrading project, 3 relevant government officials, and 6 individuals who had resided in the settlement for over ten years. The interviews offered better opportunities for probing questions that yielded in-depth information. They also offered an opportunity for capturing both verbal and nonverbal cues while the respondents answered the questions.

This study employed an abductive approach, which allowed for the theoretical framework, empirical fieldwork, and case analysis to evolve simultaneously, and is useful for theory development (Dubois & Gadde, 2002). Qualitative (coding) analysis was conducted using Nvivo© software. The data was coded to reconstruct how the settlement operated before and what changed after upgrading and then analyzed to identify points of interaction between production, reproduction, and infrastructure activities and the implicit underlying rules that regulated the three aspects. The coding focused on the mis/alignment of the rules associated with the infrastructure regimes and the rules associated with the socioeconomic regime and subsequent developmental outcomes. In addition, presumptions of implementers and actual practices of users were coded including how they varied from actual use by residents.

2.3.1 Slum upgrading in Kasarani: A history

Kasarani was initially owned by Tarabete cooperative society but later sold to a white settler, municipal council, and four others in the 1980s (MLHUD, 2014b). It was founded in the 1980s by the government when the Naivasha municipal council leased plots to residents who were mostly descendants of workers who squatted in neighboring international flower farms. The first house was built in 1988 (Kioko, 2011; Kuiper, 2019). Over time, the settlement grew and was characterized by an influx of migrant workers working in flower farms from diverse ethnic communities, mostly renting (Kuiper, 2020). A section of the land was still owned by the government until the tenure project was initiated to issue people with title deeds in 2012. The settlement's population density was 8,929 people per km^2 and it occupies an area of about 14 hectares. The monthly household income for more than half of the households was less than 274 USD (MLHUD, 2014a). Secondary data and interviews showed about 88% of the residents made less than

100 USD per person per month from precarious jobs (Kuiper, 2017) as compared to at least 20 USD rent charges required monthly.

Before the upgrade, the status of basic infrastructure was deplorable as depicted in Figure 2.1. Secondary data and interviews indicated that roads were available as open spaces, but were characterized by encroachments and unpaved surfaces that were impassable, especially during the rainy season (MLHUD, 2014b, 2014c). Some alleys were only passable on foot. These characteristics limited the number and type of public service modes that could access the settlement. Only motorcycles, donkey carts, and vehicles with significant ground clearance could use these roads. To the dwellers, roads were governed as spaces for multiple activities based on time and need and were communal. Their use was based on who settled in which space first, both daily and for longer periods, and involved negotiation, compromise, and accommodation based on dweller relations. This is depicted in Figure 2.1 where production activities such as free-range goat rearing and drying cereals along the road pavements are observed. Reproduction activities such as children playing on roads and road pavements being used as dumping grounds followed implicit coping rules for space appropriation and dumping respectively. From the implementers' perspective, the roads did not have any amenities or road signs to enable coordination of the few transport modes that came into the settlement, they targeted them for upgrading (MLHUD, 2014a). They were to be paved, including footpaths and road signs, to improve mobility within and outside the settlement as well as the link to the main road towards Naivasha town.

A functioning drainage system was nonexistent (the whole settlement status resembled Figure 2.2). As a result, the settlement was prone to flooding during the rainy seasons, which exacerbated the already poor living standards of the dwellers (MLHUD, 2014a, MLHUD, 2014b). To improve the situation, drainage channels were proposed for construction along the roads. Dwellers did not know what the drainages would look like nor how they would integrate them into their daily lives. Similarly, there was no street lighting at night and residents had to be home by nightfall. This prompted a proposal for the installation of security streetlights in the settlement to improve security conditions. Solid waste management infrastructure was also unavailable and dwellers had to cope without it—see Figure 2.1—(MLHUD, 2014a). To ameliorate this challenge, the implementers proposed to build a solid waste sorting and recycling unit that was to be operated by dweller-run community-based organizations. Access to piped, quality and sufficient quantity of drinking water was limited but existed within the settlement via a community project. Only a few dwellers were connected with piped water and paid monthly (MLHUD, 2014a, MLHUD, 2014b). Quality was poor due to fluoride contamination of groundwater and pollution of surface water at Lake Naivasha. Dwellers had to access water from the nearby kiosk during its opening hours, fetch at the lake or buy from vendors during the day (Kioko, 2011).

Figure 2.1 Unupgraded section of Kasarani Informal settlement

Figure 2.2: Upgraded section of Kasarani Informal settlement

Caption: The roads and footpaths are being used as spaces for drying beans and other cereals leaving one lane open for vehicles, spaces for children to play, makeshift stalls, and dumping spaces depending on the time of day

2.4 Findings

2.4.1 Infrastructure regime alignments with rules in the socioeconomic regime and subsequent development outcomes

Before the upgrading program, rules associated with the socioeconomic regime and infrastructure regime were observed and reported in Kasarani informal settlements. Production activities included employment in flower and vegetable farms that produced for international export, as well as fishing and subsistence farming. Additional activities included small licensed and unlicensed businesses such as renting one-room structures to dwellers to live in or conduct business, transport services using donkey carts, bicycles, or motorbikes, and other illegal businesses such as fish poaching, sale of illicit brew, robbery, and prostitution as reported by Kuiper (2017) and selected Interviewees. Production activities both within and outside the settlement heavily influenced the rhythms of the dwellers' daily lives.

Production activities were shaped by rules that were extant way before the upgrading happened. One rule defined who could set up small businesses in the settlement, a practice that made it difficult for non-residents to do so. The consumption rules of residents further constrained non-residents given the former preferred to buy from people they knew and trusted. Restrictions were also present on who could conduct fishing in the lake. Seasons determined when fishing could be done and landlords determined times when they collected rent. Illegal business activities were conducted mostly at night, and small businesses were largely opened (after work hours from flower farms) and closed (after nightfall). Spaces allowed for flexibility in use. For instance, footpaths and other mobility spaces could also be used as areas to set up small shops or to sell goods informally. Lastly, transactions for basic commodities and services for daily use were on basis of trust with extended credits or part payments over time. They were usually low amounting to about 274USD monthly per household.

Reproduction activities and their associated rules constituted the prevailing reproduction regime. Such activities included those conducted by families at the household level such as cooking, eating, seeking water, sheltering, defecating, provisioning, sharing, and borrowing, and those conducted in a congregated manner outside the household but within the settlement such as worshipping, leisure, schooling and even grooming. The activities were organized around membership in either family, community groups, or religion and were sanctioned by leaders of these groupings. All reproduction activities followed the time cycles of production activities and were always secondary to production activities. They were practiced either early in the morning or late in the evening within the houses or outside in open or shared spaces (Kuiper, 2019). They were conducted in shared spaces that were often linked to or simultaneously with production activities. Where residents spent their income and did transactions was determined by familiarity, payment modalities, and social relations.

The two socioeconomic regimes discussed above shared common practices that shaped the rules of infrastructure use. These included dumping and commuting. Dumping was organized around coping. As reported by interviewees, waste was dumped at night or at all times on owners' compounds during the day and in public spaces if in small quantities in open spaces took place (MLHUD, 2014a). As observed and reported by interviewees during fieldwork, these wastes included organics from households such as food by-products and feces (animal, human), and inorganics such as polyethylene packaging materials and plastics. There were no monetary costs or transactions associated with dumping and the effort required was negligible. Residents' objective was only to ensure that the waste was outside their premises. One

interviewee stated that the dumping all over was a "mindset that was difficult to do away with". Dumping was associated with negative impacts on health and clogging the drainage systems.

Commuting for reproductive and productive purposes also shaped infrastructure regime rules. This was generally organized around those who owned transportation means (often individuals from outside the settlement) and residents in need of transport. Transport alternatives included walking, using bicycles or motor vehicles on available spaces that were used as roads, and also for other purposes. Times for commuting were relatively long due to the poor roads as well as other productive activities that were conducted on the road. It took place in the same spaces as other production and reproduction activities and was a production activity to only a few in itself. Commuting was paid for in cash and was negotiated by users based on social relations. The use of roads for commuting and transport was characterized by negotiation in available spaces (roads) at times dictated by owners of the commuting modes.

2.4.2 The impacts of upgrading: rule alignments and development outcomes in Kasarani

The effectiveness of the infrastructures installed in the settlement varied. The variation was dependent on the nature and extent to which the new infrastructure's rules aligned with the rules of the extant socio-economic regime. This section explicates this for the different infrastructures implemented in Kasarani.

Misalignments: Solid waste unit and storm water drainage

A solid waste management unit was installed during the upgrading exercise. The rules associated with the unit as explained by interviewees required residents' input in collecting their waste, sorting, transporting, and managing the unit at the settlement level. Extant rules for solid waste had been coping-oriented in nature with minimal input. A very small proportion of residents who could afford to have a locally organized group collect their waste from their households twice a month. Coping rules for most of the residents were therefore functionally efficient since they were less demanding. This was a clear misalignment between the new rules and the extant rules. Misalignment with rules in the socioeconomic regime was observed in three ways. A new organizational mode was expected for the management of the unit and at the settlement level, which contrasted with the extant individual-oriented setup. It required more time and effort from the dwellers to organize in collecting and sorting, transporting the waste to the unit, and in addition, organizing around managing the unit as a community-based organization. The dwellers did not consider waste management activities as immediate as compared to other production and reproduction activities and thus were not willing to trade the time. The unit did not significantly disrupt space use rules since it occupied little space in the settlement and the residents just ignored it. The substantial dweller efforts in waste management activities were considered a cost in kind, which they were not immediately willing to engage in. The aspired rules of use for the solid waste unit by implementers largely misaligned with the extant rules for solid waste management in the settlement. This misalignment manifested in the residents' unwillingness to engage or utilize the solid waste unit even two years later after its construction.

The new drainage system constructed in the settlement was associated with conventional rules for its use. The key rule was that it was supposed to be clear of all blockages at all times, especially where it was open. Such infrastructure was not available in the settlement previously. Residents still considered the spaces where drainages were, as open spaces and continued using them as such. Some built kiosks or spread their sales wares on them similar to how they used these spaces earlier. This was a nonalignment similar to that experienced with the solid waste unit. The nonalignment resulted in misalignment with the socioeconomic

regime as follows: first, the new rules sought to reconfigure the actor the organizational mode by bringing in new actors to manage the drainage systems who were inefficient in doing it and demanded residents to obey rules external the settlement and against their space use rules. Secondly, the open drains reconfigured spaces as exclusively for drainage services contrary to the extant socioeconomic regime. This did not auger well with the residents implicitly since the space was previously flexibly used for both productive and reproductive activities thus these were disrupted. Due to this decoupling, the drainage system barely served its purpose and was always blocked in some instances leading to more flooding and exacerbating challenges for residents while seeking livelihoods.

Alignments: Floodlights and water connections

Floodlights were also installed to improve security and lighting hours in the settlement. Rules for their operation included remote turning on and off at predetermined times, payments for monthly electrical bills, and periodic maintenance in case of breakdown. All these rules were enforced remotely. At the settlement, extant rules to ensure personal security included predetermined times for getting home and closing some businesses, usually just before dark. There was alignment between the two rules since the new rules were easily accommodated by the residents as they did not demand any compromises from them. The new rules for the use and management of floodlights did not demand any new organizational requirements in the settlement since the residents were passive users. Personal security remained a personal initiative as it was initially. Increased lighting time led to increased socioeconomic activities for the dwellers even at night since security and safety improved and any changes favored the extant socioeconomic regime. The floodlights occupied a minimal footprint (space) in the settlement, which did not disrupt production and reproduction spaces for other activities. Lastly, residents were not expected to pay for anything as all expenses were to be catered for by the regional government thus no added incurred expenses. Floodlights thus provided for overall increased socioeconomic activities in line with the settlement. These activities in turn led to more unsustainable exploitation of other infrastructures such as roads and drainage systems.

The capacity of the existing community-managed water supply system was upgraded in the settlement to improve water services in terms of quantity and quality. The extant rules for water service provision for the residents were not changed. These included payments monthly once a bill was issued, prorated payments to those who could not afford to pay in lumpsum, maintained opening times for water kiosks for those who used them, and underground pipe networks. This was in alignment with the rules of the socioeconomic regime in the following ways. The rules reinforced the existing organizational mode for the management and use the water, no new actors were introduced, they increased the time that water was available for households, at the water kiosks, and for other businesses, they did not disrupt spaces for other socioeconomic activities as pipes were fitted underground and lastly, they did not change the water tariffs thus maintained affordability and payment mechanisms. This served to improve the livelihoods of the residents.

Partial alignment and hybridized rules: roads and footpaths

The roads and footpaths that were constructed presented a unique case among all the infrastructures. They demonstrated partial alignment with the rules associated with the socioeconomic regime. This resulted in hybridized rules for infrastructure use where dwellers adopted rules that only suited them but disregarded those that went against the rules of their socioeconomic regime.

Implementers envisioned that conventional traffic rules that guide the use of roads and footpaths would be strictly followed. The implementation of new road works commenced with the relocation of structures that were on way leaves. These included structures where residents did small businesses or lived— in other words, where the socioeconomic regime was already functional. Using contractors, they built the roads and footpaths to bitumen standards, similar to those in nearby towns on spaces that were previously used for mobility, productive and reproductive activities simultaneously. The key rules that were associated with the use of these roads from the implementers' perspective included: the use of the left-hand side for motorists. Obeying road signage, traffic lights, and road markings where available. Driving at recommended speed limits in residential areas. Keeping roads and footpaths free of obstruction. A prohibition from driving or parking on footpaths, and maintenance mandated to the government among others. These rules limited the use of roads for mobility purposes only contrary to its earlier multiple and simultaneous uses.

In contrast, residents continued to consider the roads and footpaths as public spaces and appropriated them as such. They acknowledged the role of roads in improving commuting and transport services but had to carve out rules for its appropriation based on their existing rules. After implementers finished the construction of the roads and footpaths, the residents reestablished their small business structures on the footpaths and used sections of the road to operate a small business, conduct household chores, and even as meeting points for different groupings, like the depicted use for bean drying in Figure 2.2. This was entirely based on space appropriation rules within the settlement. These included: the occupation of space on a first come-first serve basis, setting up smaller businesses on busy roads in the evening, disposing of waste from production and reproduction activities using the immediate cheapest way possible meaning most of it ended on the roads and footpaths. Space appropriation rules were shaped by a production regime that maximized profits without necessarily accounting for negative externalities while on the other hand, reproduction activities ensured the daily survival of the residents based on mutual relations. The appropriation rules were a stark contrast—misalignment—to intended use rules by implementers in the sense that the latter were shaped by the production and reproduction rules in the settlement, which had evolved organically, while the former relied on enforcement by outside authorities.

The result of the partial alignment was hybridized rules. Hybridization manifested as residents partially adopted traffic rules established by implementers while maintaining their space appropriation rules informed by the production and reproduction regime. They only partially adopted the use of the left side by motorists but at the same time obstructed roads and footpaths with their business practices or living structures. Motorists from outside the settlement who were the majority had to conform and negotiate the use of these roads since enforcement of traffic laws was minimal and sometimes impractical. One resident explained this hybridization implicitly as follows:

> "We know, what each one of us does for a living, so I know what they deal with. Even if someone dries his or her beans outside *(pointing to the road in Figure 2.2- a production activity),* I do not mind so much, as long as it does not inconvenience me so much. When one vehicle stops and goes along *(on a lane blocked by a dweller doing business or kids playing),* this has not inconvenienced anyone in any way, so you just continue with what you are doing. If your kiosk is on the road, I know who you are; I would not go there *(to the authorities)* to call for your removal. So that bond of friendship and knowing each other has led to a lot of things to go wrong, but we are very accommodative …" Resident, Kasarani

The hybridized rules manifested in the socioeconomic regime as a partial reconfiguration of the rules governing the organizational mode that managed the infrastructure and commuting as a service. For the former, the roads attracted transport operators from outside the settlement who supplemented transport services with new and multiple modes of transport. This impacted the few who conducted these activities negatively but increased options for mobility for the residents. For the latter, actors from the government could now engage in maintenance services. This was positive for all residents. Commuting times and planning for commuting became more predictable consequently freeing up time for other activities. Spaces were only partially reconfigured. Expectations by implementers that the road spaces would be used exclusively for commuting could not be realized. As demonstrated by the quote above and Figure 2.2, the roads were additionally used as markets, playing spaces, congregation spaces, and value addition spaces which were a combination of production and reproduction activities. Their use remained very flexible and fluid. Transaction modes did not change. Payment modalities for commuting did not change but the prices for commuting were reduced due to better roads and more mobility options. This was to the benefit of the residents. Overall, the hybridized road appropriation rules impacted the settlement by partially enhancing mobility as a result of prevailing production activities within the settlement. Table 2.1 illustrates and summarizes how each infrastructure impacted couplings with the socioeconomic regime in Kasarani.

Table 2.1 Outcomes of installed infrastructure regimes and their impacts on coupling and associated livelihood implications

Infrastructures	Rules associated with the infrastructure regime	Disruption of rues in the socioeconomic regime				Livelihoods
Upgraded infrastructure *Equivalent unupgraded*	***Rule sets***	***Organizational mode rules***	***Temporal rules***	***Spatial rules***	***Transactional rules***	***Livelihood implications***
Floodlights *None*	New rules; automated turn on and off. They did not prompt dwellers to accommodate them in any way	New but remote actors thus no disruptions of actor relations in the settlement	Extended light hours for production and reproduction activities	No space use disruption due to minimal footprint	Payments are handled remotely and not done by dwellers thus no disruptions	Largely improved production and reproduction activities in the settlement by increasing available time for these activities
Water connections *Water connections*	No new rules; followed existing community water project rules	Actor-network remained the same	Extended times of water access due to household connections	Minimal space occupied since pipe networks were underground	Community water projects could handle payment mechanisms	Contributed to production and reproduction activities while at the same time releasing time for other production activities
Stormwater drainage *Open spaces*	New conventional rules for drainage use conditions that were never adopted by dwellers	New external actors that failed in reconfiguring the previous actor-network that was settlement oriented	Reduction of time used to counter flooding shocks occasionally experienced in the settlement	Reconfigured spaces partially for specific exclusive use i.e. drainage	No payments in cash or kind were expected thus no disruption	Minimal positive outcomes that were hard to sustain due to dumping from production and reproduction activities
Solid waste unit *Open spaces*	New conventional rules for collection, sorting, conveyance, treatment and disposal are envisioned but not adopted by dwellers. Coping was more functionally efficient for them	No new actors were expected. However, new actor constellations in solid waste management were expected. Implementers planned to engage existing community-based organizations	New time allocation for solid waste management-related activities at households and businesses	The minimal spatial footprint of the unit was non-disruptive of space use rules	Dweller efforts were required for the additional work of collecting and sorting waste and transporting it to the unit	Minimal positive outcomes since the infrastructure were never embedded in the settlement
Roads, footpaths *Open spaces*	Hybridized rules: both space appropriation rules by residents and formal traffic rules were at play (Figure 3)	New external actors partially reconfigured the previous actor-network that was settlement oriented	reduced access times due to better roads	Reconfigured spaces partially for exclusive use i.e. commuting	Payment methods remained the same, and transport costs reduced	Hard to sustain positive outcomes due to persistent activities done on infrastructure linked to both production and reproduction

Key	
	Alignment
	Partial alignment/Hybridization
	Misalignment

2.5 Discussion

The five infrastructures installed in Kasarani provide key insights for most infrastructures and infrastructure combinations that can be installed while upgrading informal settlements. Upgrading is characterized by two integrated aspects. These include rules that accompany the use of newly installed infrastructures as envisioned by implementers and extant rules that characterize the socioeconomic regime that the new infrastructure has to contend with. The latter significantly shapes the infrastructure regime.

Because of upgrading, we observe three ways by which new infrastructure and services reconfigure existing socioeconomic regimes. First, their rules for use can align with the extant socioeconomic regime leading to infrastructure adoption by residents. This in turn leads to improved livelihoods. The security lighting and the water supply infrastructure exemplify such. Such an alignment in informal settlements manifests as non-disruptive (security lighting) or non-intrusive (water supply infrastructure) appropriation rules specifically defining who manages the infrastructures and how they do it, spaces they operate, times of operations, and costs. Secondly, new infrastructure rules may partially align with the extant socioeconomic regime resulting in hybridization. This in turn influences socioeconomic activities positively to some extent but barely influences the socioeconomic regime itself. Such is exemplified by roads and footpaths in Kasarani. Hybridization occurred when residents only co-opted those appropriation rules for the infrastructure that aligned with their existing socioeconomic regimes. Lastly, infrastructure regimes can fail to align (misalignment) resulting in non-adoption of the infrastructure by the residents. Such is exemplified by the solid waste unit and the drainage system in the Kasarani settlement. A key challenge to improving these infrastructures' performance was the inability of implementers and residents to align the new infrastructures' rules with the extant socioeconomic regime. Such infrastructure was bound to vandalism or decay due to lack of use or ineffective in the long run as the socioeconomic regime was still not reconfigured.

Alignment, misalignment, and partial alignment each led to characteristic subsequent development outcomes. In Kasarani, alignments were associated with consequent positive immediate, and tentatively sustained livelihood outcomes for the residents. Partial alignments on the other hand were characterized by hybridized rules and were associated with consequent immediate positive livelihood outcomes that were short-lived due to the influence of inherent practices in a predatory socioeconomic regime. Misalignment was associated with decoupling which was not associated with any development outcomes. Rather, it contributed to persisting and often unsustainable rules, which eventually deteriorated infrastructure and negatively affected dwellers' livelihoods.

Given the Kasarani settlement, we observe substantial mis and partial alignments, especially in the solid waste unit and the storm water drainage. However, two infrastructures, roads, and footpaths indicate that misalignment does not necessarily have to be observed on all regime dimensions. Even one decoupled dimension could lead to mis or partial alignments and subsequent minimal implication on the residents' livelihoods. The alignment of water supply out of the five interventions in this study is likely to sustain its positive outcomes. Whether security lighting outcomes would be sustained depends on the capability of the regional government to maintain it. It is also clear that reproduction activities were strongly complemented and were complemented by production activities within the settlement but not by those outside the settlement. Thus, Kasarani remains largely on an unsustainable trajectory as the underlying rules driving these were not significantly influenced by the upgrading yet they substantially influenced the infrastructure. Alignment of regimes in common regime dimensions is therefore sufficient for effective upgrading outcomes.

2.6 Conclusion

We sought to understand mechanisms through which livelihood improvements do, or do not, occur following infrastructure upgrading initiatives. We employed a sociotechnical approach to understanding the livelihoods-infrastructure nexus. Insights from the case of an infrastructure upgrade led to the following conclusions. Firstly, upgrading contributes to alignments (misalignments, partial alignments) of extant infrastructure regime as operationalized through rules associated with organizational modes, time, spaces, and transactions leading to sustained or unsustained livelihood outcomes. In addition, socioeconomic regimes play a role in conditioning the appropriation of infrastructures by end users. Partial alignment leads to hybridized rules where residents only accommodate the rules that are in line with their socioeconomic regimes while ignoring the rest. Alignment ensures sustained upgrading outcomes while misalignment results in unused infrastructure or even its rapid deterioration. Secondly, failure in upgrading the settlement system is likely to occur if the dominant regimes' configuration that dictates the unsustainable trajectory of the informal settlement is not reconfigured by or after the intervention. The case of Kasarani illustrates a persisting extractive relationship due to the outside settlement production activities that predominantly control the daily life rhythms of the dwellers while maintaining meager wages at the expense of the infrastructures.

There is a further implication for transitions researchers. The developed concept can extend frameworks and analytical foci beyond a particular sociotechnical sector (e.g., energy, water) and into the realm of the socioeconomic and spatial aspects of transitions. In doing so, studies can move beyond a focus on the adoption or use of new infrastructures and technologies as the key indicator of "transition", and into more general, cross-sectoral concerns regarding community development and well-being as manifest in livelihood changes.

The regime approach was useful in assessing how infrastructures and livelihoods interact to shape the overall development implications and trajectories of informal settlements. The use of the approach is not limited to informal settlements, it has a broader relevance beyond development contexts and can be used in other fields and geographical areas to anticipate and assess how different technologies and infrastructures shape people's livelihoods and their likely development implications. Future research could focus on qualitatively comparing how alignments of sets of infrastructures in different locations impact residents. More so in locations that have their resident's rhythms of life driven by any of the other regimes. For instance, tourist destinations or high-end estates where reproduction activities are more dominant and how interventions there reconfigure regime constellations. Conceptually, further research would be essential to understand how different spatial extents of the different regime structures could influence the transition trajectories of places. In addition, planners need to be aware of how interventions disrupt extant rules to influence livelihoods positively. For instance in the case of Kasarani, since roads were used as market spaces while the designated market space remains unused, it would be worthwhile to incorporate business stalls along the roads instead of allocating market space elsewhere.

Chapter 3: Conceptualizing the infrastructure appropriation in slums[5]

Abstract

Infrastructure investments, a core element of slum upgrading, are a key measure for improving the livelihoods of over 1 billion slum residents globally. However, these interventions mostly fail in the long run. Planning practice often successfully delivers functional infrastructure but evidence shows that their contribution to improved livelihoods is either absent or declines sharply after some time. To explain this limited effectiveness, this study identifies the missing link between infrastructure delivery and livelihood improvements as lying in the appropriation process, i.e. the uptake and embedding of infrastructures into the daily practices of residents. Recent insights from sociotechnical transitions studies help to conceptualize appropriation. The authors use Munyaka informal settlement in Eldoret town Kenya as a case to investigate, the mechanisms of new infrastructure uptake. Findings indicate that appropriation is a social process and proceeds in three steps: reception, domestication, and institutionalization. This process is driven by the need to maintain or adjust residents' livelihood practices relative to prevailing socioeconomic and spatiotemporal conditions. The study concludes that appropriation is a significant process that planners should try to anticipate. Prevalent approaches to participation have to be modified accordingly. This is essential for planning to improve livelihoods in slums.

Keywords: Appropriation, Slum upgrading, Infrastructure planning, Participation, Infrastructure utility and functionality, Livelihood improvement

[5] Wainaina, G. K., & Truffer, B. (Submitted). The missing link of infrastructure appropriation: Explaining the limited effectiveness of infrastructure planning for informal settlement upgrading. *Urban Studies*

3.1 Introduction

As rapid urbanization processes lead to the explosive growth of informal settlements, slum upgrading has become a priority in many Global South countries (Randolph & Storper, 2023; World Bank, 2022). Investments in infrastructure, a core component of slum upgrading, remain commonplace planning interventions for improving the livelihoods of the residents (Acioly, 2021). Slum upgrading aims to improve the quality of settlements, and reduce the time and costs to access basic services through "solid" infrastructures to finally improve slum residents' livelihoods (Devkar et al., 2017). Despite many efforts, slum upgrading has failed to achieve this ultimate goal in many if not the majority of cases and may even contribute to deteriorating livelihoods in some cases (Cherunya et al., 2021). This is primarily due to resultant infrastructures that have failed to appreciate the existing resources, interests, and goals of the residents.

Researchers and planners agree that to improve outcomes of slum upgrading, residents must be involved and participate actively during the planning process (Patel, 2013; UN Habitat, 2015). Participation aims at involving residents to provide knowledge about context conditions to improve the outcomes of planning in terms of acceptance and fit with the needs of actors (Arnstein, 1969; Chambers & Conway, 1992; Choguill, 1996; Wainaina et al., 2022). Much is known about participation, its nature (Arnstein, 1969), its benefits for planners (Healey, 1997), and its configurations that work (Wainaina et al., 2022). However, little is known about the content that planners seek to learn through participation beyond baseline figures that concern what lacks in these places. Indeed, through participation, as it is currently implemented, planners often learn little about how residents will likely use proposed infrastructures but a lot about what kind of basic services lacked before the intervention.

We argue that the current dominant way of organizing participation during infrastructure planning misses anticipating the dynamic *social processes of appropriation* that happen only after the infrastructure has been delivered. This results in limited improvements in livelihoods due to infrastructure upgrading. This study aims to conceptualize appropriation and to explain how appropriation leads to ultimate impacts on livelihoods. Subsequently, it offers crucial insights into how participation should be extended to anticipate appropriation processes more accurately.

We develop the concept of infrastructure *appropriation* based on recent insights from sociotechnical transitions literature (Fuenfschilling & Truffer, 2016), which explains how transformation through reconfiguration of practices, infrastructure, and technologies—so-called sociotechnical systems —occurs to lead to societal benefits (Murphy & Carmody, 2019). Based on this literature, we define appropriation as a suite of social processes that occur after infrastructure delivery, where residents proactively and consistently take actions that shape the impact of infrastructures on residents' livelihoods. We understand appropriation as the stepwise embedding of different features of the provided infrastructures into practices of production and reproduction that enable residents' livelihoods. Even though every resident will have to enact this embedding process for him or herself, we consider appropriation primarily as a social process, i.e. one that leads to similar patterns of practices across different segments of slum residents (Cherunya, Ahlborg, et al., 2020; Mukeku, 2018; Wainaina et al., Submitted). The focus on appropriation is a much-needed conceptual extension to the planning literature beyond its current limit of plan-making and plan implementation as illustrated by Hersperger et al. (2019) and Malekpour et al. (2017).

We investigate mechanisms of appropriation using a qualitative research approach, for the case of newly introduced infrastructures in an informal settlement of a secondary Kenyan town Eldoret, called Munyaka.

We also highlight how far participation executed during the planning process was able (or not) to anticipate appropriation. Munyaka was one of 80 informal settlements that were upgraded under the Kenya Informal Settlement Improvement Program (KISIP) between 2014 and 2017 (MLHUD, 2013c). As such, it is representative of many informal settlements in cities of the Global South. The first author conducted field observations and 28 key informant interviews in November and December 2021. Questions and observations focused on how and why residents used the infrastructure constructed since its delivery two years prior and the prospects for its future utility including benefits to their livelihoods. Furthermore, they focused on how residents assessed the quality of participation for the different infrastructures. The first author qualitatively analyzed the data set using Nvivo to inform the findings of the study.

3.2 Unbundling appropriation in the context of basic service infrastructures

To improve the outcomes and impact of their interventions, planners started to engage with concepts from the sustainable livelihoods literature and their variations early on (Talukdar et al., 2010). This literature focuses on capabilities, equities, and sustainability aspects for residents to gain a living (Chambers & Conway, 1992). In addition, it gives attention to assets and capitals that residents have access to. These include natural assets e.g. soil and water, physical assets e.g. infrastructure, economic assets e.g. savings and remittances, human capital assets e.g. knowledge and skills, and social capital assets e.g. trust and adherence to rules (Winarso, 2022).

Through participation and employing livelihood concepts, slum upgrading has resulted in infrastructures with a varying utility to residents and consequent varying impact on livelihoods. Few successful upgrading interventions have been recorded e.g. Patel (2013). In contrast, larger numbers of failed interventions in varying extents are common despite participation claims e.g. (Cherunya, Ahlborg, et al., 2020; Cherunya, Truffer, et al., 2020; Chidambaram, 2020; Libertun de Duren & Osorio Rivas, 2020; Massey, 2014; Yeboah et al., 2021). To understand this state of affairs, it is necessary to understand how infrastructure delivery leads to improved livelihoods. It is however difficult to explain this through the lens of planning literature alone because planning only accounts for infrastructure delivery and not beyond (Hersperger et al., 2019; McConville et al., 2011). The livelihoods literature is only of partial help as it is rather static in accounting for what assets lack or exist in slums and not how (i.e. through which processes) residents learn to use the new offerings. We argue that there is a high potential benefit to better understanding what we frame as the *appropriation* of new infrastructures. Indeed, improving livelihoods does not happen overnight and the utility of delivered infrastructures have to be actively "produced" and sustained by the receiving residents before improvement of livelihoods can occur.

One explanation for the lack of attention to appropriation processes lies in the fact that slum upgrading studies have defined slums primarily focusing on what they lack (UN Habitat, 2015). More recent studies have tried to conceptualize slums as urban settlements which are social contexts structured by interlinked rulesets — regimes. These regimes guide production, social reproduction, and infrastructure use activities and constitute the so-called *infrastructure-livelihood nexus* (Murphy & Carmody, 2019). Such regimes guide, and are observable through the daily practices of residents as they secure their livelihoods. They are characterized by *temporal*, *spatial, organizational mode*, and *transactional cost* dimensions (van Welie et al., 2018). Slum upgrading influences residents' practices in these four dimensions and thus the infrastructure-livelihoods nexus can be observed through them. The following two paragraphs explain these dimensions in further detail.

The *spatial dimension* relates to the "where" and "why there" questions concerning siting and use of infrastructures (Jones & Murphy, 2011). Space plays multiple functions in securing livelihoods in slums (Kamalipour, 2020). New infrastructures will compete for the same spaces often transforming them from multiple uses to single spaces use or vice versa. In addition, the services new infrastructures provide are only an addition to the portfolio of residents' means to achieve a service even when they appear superior(Cherunya, Ahlborg, et al., 2020). The *transaction dimension* goes beyond cash and characterizes costs incurred in accessing infrastructure and using its associated service (Allen, 1991). These can be in cash, in kind, can allow for haggling, or are flexible over time e.g. pay per use or monthly bills (M. van Welie et al., 2019). Incomes are low in informal settlements and spending priorities shift from one basic service to another (Kamath et al., 2008).

The *temporal dimension* relates to when livelihood activities are conducted in alignment with infrastructure use (van Welie et al., 2018). this is illustrated for instance when accessing a toilet while selling or buying wares in a market during the day, when/if it opens, or being able to use a road to go to work in the rainy season, going to a bar in the evening, or even committing a crime on the streets at night. New infrastructures may reconfigure the infrastructure-livelihood nexus by reducing/increasing times of access to services, reducing/increasing times for socioeconomic activities, allowing the conduction of multiple activities concurrently, or forcing the sequencing of activities. The time needed to access basic services provided by infrastructures is limited for the residents due to other livelihood activities that compete for the same time (Chikaraishi et al., 2017). Lastly, the *organizational mode* dimension denotes how actors organize to seek and provide a basic service including operating and maintaining associated infrastructures (van Welie et al., 2018). A variety of actors within and beyond the slums including the residents themselves may be responsible for providing and sustaining such basic services (Devkar et al., 2017; Joshi & Khan, 2010). Transformations of the organizational mode manifest in residents taking up or being relieved of roles and stakes in providing a service. To illustrate, a new piped-water supply system relieves residents who were providing the service before through handcarts. A successful transformation in organizational mode would need to reincorporate these previous service providers in the operations of the new piped-water supply system. Therefore, when slum upgrading does not consider these four dimensions as interlinked, it often results in extending some at the cost of others.

With this understanding of the structural aspects of the infrastructure-livelihoods nexus, we may conceptualize a three-stage process for infrastructure appropriation including *reception*, *domestication,* and *institutionalization*. These three stages describe the residents' stepwise recognition of the new infrastructures, the infrastructures' alignment with residents' prevailing livelihood practices, and the willingness to maintain them in case the alignment proves to generate benefits for the residents, or actively obstruct or even destroy the infrastructure in case it is perceived as an impediment. The reception stage denotes the immediate responses of the residents when the new infrastructure and its services are delivered and opened for use. This reaction will strongly be conditioned by how residents experienced their involvement during the participation process. As Wainaina et al. (2022) have shown, this relates not only to the early planning stage of the locus of most participation processes implemented in planning but even more important during implementation. Feelings of unjust treatment or lapse in trust will lead to a more critical reception compared to processes that were conducted in harmony and where the voices of all stakeholders were taken into account.

The second step, domestication concerns the active uptake of the material infrastructures, their associated rules of use, and their proactive alignment with prevalent livelihood practices (Serensen, 2006). Domestication of new artifacts has been analyzed in a long series of product innovations in Science and

Technology Studies and similar mechanisms are likely to happen with newly introduced infrastructures (Ingeborgrud & Ryghaug, 2019; Pantzar, 1997; Serensen, 2006). Recent studies from sociotechnical transitions literature have provided further insights on how to understand the domestication of infrastructures (Cherunya, Truffer, et al., 2020; Wainaina et al., Submitted). Specifically, Cherunya, Ahlborg, et al. (2020) outline four response strategies that residents adopt to align basic service alternatives in slums on a personal scale. They proposed a four-way typology that distinguishes between whether the residents mobilize their resources or whether they draw on resources of their social environment. The second dimension relates to whether they respect prevalent social norms, rules, and regulations or whether they decide to break them.

Drawing on personal resources, residents typically first try to *navigate* between the requests of the new infrastructure and their capabilities and resources to maintain their livelihoods. Navigation respects social rules and regulations and tries to resort to alternative options in case of impediments. An illustration of this is a resident using a toilet at their workplace or that of a neighbor in place in case a newly installed public toilet proves to be too expensive for regular use. In case, rule-following is not possible, for instance, if alternative toilet facilities are not available during the night, actors often have to resort to *coping* options. This would be to defecate in open fields or into plastic bags, a behavior that might go against feelings of personal dignity, be considered shameful, or even formally illegal. If individuals do not possess the necessary resources by themselves, they may resort to accessing them through their social networks and therefore *negotiate* their access. This strategy comes into play, for instance, when asking neighbors to use their toilet in exchange for other neighborly services. Finally, access to socially available resources by going against socially accepted rules and regulations can be termed as *contravening.* This strategy is characterized by rule-breaking actions that seek to force access or exploit opportunities and may result in legally prosecutable actions. An illustration of contravening is a resident connecting to a water or sewer pipe network to access a service for free.

While these response strategies represent individual ways to react to the newly delivered infrastructure, over time and through community interaction, they will develop into a shared perception of how the new infrastructure can and should be used and whether it provides any utility at the community scale. The domestication stage denotes when residents, as observed in their practices, find relatively persistent use and symbolic representation of the new infrastructure and its associated service and how they serve their infrastructure-livelihoods nexus. So far, this has only been studied to an extent for individual technologies and products (see Bar et al. (2016); Dourish (2003) Nadal et al. (2019) for example). Only Cherunya, Truffer, et al. (2020)have mobilized these ideas for explaining failures in slum upgrading contexts. We did not find studies that related to basic service infrastructures specifically.

The institutionalization stage denotes strategies that residents employ once reception and domestication have been concluded and socially validated. In the case that residents have come to align the new infrastructures with their livelihood practices, they may be motivated to invest in its maintenance and proper functioning. If the opposite happens, the infrastructure is likely to *deteriorate* due to neglect or even outright destruction. The positive case might need collaboration with actors outside the informal settlement such as service providers, construction companies, or government officers. However, it might also mobilize residents to self-organize and maintain the service. This step primarily involves residents offering or withholding their resources to cooperate and maintain infrastructures that are introduced in their settlements. Resources here denote the costs in their infrastructure-livelihood nexus that they are willing to incur as compared to the benefits that they accrue due to the infrastructure amidst alternatives. Therefore, the institutionalization stage will manifest depending on whether residents are willing to

offer/withhold their time, money, and spaces or even reorganize by who and how they achieve a given service or destroy the infrastructure if it is judged to provoke disruptions to their extant Infrastructure-livelihood nexus. Such a case was observed by Libertun de Duren and Osorio Rivas (2020), where gangs destroyed paved roads to slow down police cars entering the informal settlement. The probability of residents engaging in maintenance decreases with unsuccessful domestication and poor reception.

All told, we argue that instead of the currently dominant view on infrastructure uptake as an act of acceptance by predominantly passive individual recipients or "beneficiaries", we have to understand post-delivery as a complex, social process, in which slum residents act as co-producers of infrastructure services. This process conditions whether or not improvements in livelihoods can unfold. Interactions among the residents along this process will lead to the institutionalization of a new infrastructure-livelihood nexus in the form of taken-for-granted practices, norms, and material structures. Appropriation overall will therefore lead to what transition scholars refer to as the "embedding" of socio-technical systems into local contexts (Fraedrich et al., 2015).

3.3 Methods

We employed a qualitative approach following abductive reasoning partially inspired by causal process tracing ideas (Beach & Pedersen, 2013; Blatter & Haverland, 2012). Through the case of the Munyaka informal settlement, we outlined the mechanisms that explain livelihood improvement due to infrastructure investments. The method proves causality based on the level of uniqueness and certainty of different evidence pieces in line with conceptual claims.

Munyaka is one of the eight informal settlements located in Eldoret town, Kenya. The settlement is located 4.3 kilometers northeast of the town, comprising 18,107 households, and occupies an area of 88 hectares. Munyaka residents are mainly small business people who operate within and outside the settlement. The monthly income for over half of the households was less than 13,000 Kenyan shillings (approximately $130) (Mangíra et al., 2019; MLHUD, 2013c). The settlement suffers from typical deficiencies in basic service infrastructures and this is what necessitated KISIP to upgrade it and another 79 settlements spread all over the country (WorldBank, 2011). KISIP's first phase was a 165 million dollars funded upgrading program that targeted improving informal settlements by providing basic services and infrastructures to improve their living conditions. This was a welcome response for over 60 percent of Kenyan households that live in housing that falls under the definition of slums (The World Bank, 2019). KISIP had been largely successful in the delivery of infrastructures but evidence on impacts on livelihoods was uneven (Wainaina et al., 2022). These settlements targeted were in secondary towns of Kenya and are similar to those in secondary towns in many countries of the global south (Cities Alliance, 2022; U.N., 2022). In addition, it allows for a comparison of how multiple and different infrastructures are eventually used since they were implemented in the same timeline with similar end users and socioeconomic contexts.

The first author collected data through in-depth interviews with four community representatives, twenty-two residents, and two government officials and observation in the informal settlement during a stay in the informal settlement from November 2021 to December 2021. In addition, the author reviewed two project reports, and four publications closely associated with the settlement and its upgrading process. This comprised the dataset for this study and was transcribed and analyzed qualitatively using Nvivo following abductive coding similar to the procedure presented by Vila-Henninger et al. (2022). The analysis sought to retrace and reconstruct the upgrading and appropriation process to establish how residents received, domesticated, and institutionalized the infrastructures after they were constructed. In addition,

the analysis sought to identify the aspects of the settlement participation identified or not that would have influenced appropriation and subsequent livelihood improvement,

3.4 Findings

The planning and implementation process in Munyaka took place between 2011 and 2017. In 2011, the KISIP team selected Munyaka as one of the settlements that would be upgraded after consultations with the Municipal council of Eldoret (later, the county government took over in 2013 after the devolution of governance all over the country) (WorldBank, 2011). Earliest activities at the settlement commenced in 2012 when the KISIP team and government officials through local leaders engaged residents using public mass gatherings in the settlement and elected community representatives' team. This team comprised 18 residents who reflected property owners, tenants, women, youth, people with disability, and elders. Their role was to advocate for the needs of the overall residents and link actors external to the settlement to the residents. Later, consultants facilitated participatory baseline studies, prioritization, and designs of infrastructures that would be installed. Through this exercise, the residents prioritized roads, sewerage, solid waste management, stormwater drainage, and street lighting (floodlights), which the consultant seconded as of April 2013 (MLHUD, 2013c). However a later report that year indicated different infrastructures that included roads, drainage, infiltration pits, ablution blocks, and floodlights and it was not clear to the residents how this list came about (MLHUD, 2013a). From field visits, all infrastructures in the latter list were constructed except infiltration pits.

There was no evidence that the residents were involved in reviewing or validating actual designs that were developed by the consultants. Procurement of contractors was done at the national government level and the infrastructure construction was launched in 2014 (Uasingishu County News, 2014). This marked the beginning of the plan implementation phase. In late 2014, construction work began and ended in early 2017. We outline in detail how participation took place for the individual infrastructures in the subsections that follow with a focus on ablution blocks, floodlights, and roads as a subset of the infrastructures installed. This is based on a theoretical sampling point of view as the three cases represent three types of outcomes with corresponding impacts on livelihood as follows. The ablution block represents failed upgrading outcomes due to adversary forms of appropriation, the floodlights represent successful outcomes and the roads represent different dynamics and thus a rich case of demonstrating the complexity of appropriation. The findings in the sections that follow are organized per infrastructure, first detailing how participation took place and how it influenced reception, domestication, and institutionalization unfolded leading to improved livelihoods.

3.4.1 Ablution blocks

Participation exercises informed planners that 86% of the residents had pit latrines in their homes and the rest shared one in their compounds (MLHUD, 2013c). They were also informed that the residents prioritized and were in consensus for sewerage as an alternative. Despite these, the planners decided to construct ablution blocks (MLHUD, 2013c, p. 15 p.15). This did not augur well with most residents who felt shortchanged. As a result, this led to a lapse in trust and some community residents consequently absconded their roles claiming limited consideration of their views by planners.

During implementation, contractors ignored the residents' views of an alternative location for some of the toilets. Residents felt that the locations either were far away from busy activities or not well thought out. They also held back some of their views not to appear conflictive as planners had warned them that the financiers would withdraw the financial support for the infrastructures if there were conflicts in the construction sites. When some residents followed up later on why the planners did not implement sewers,

they were told that the finances available were not enough for sewers and thus the ablution block was the only option and this was not negotiable *(as reported by multiple interviewees)*.

> **"**We *(community representatives)* felt we were used, just like rubber stamps they *(implementers in general)* come and pretend they want to consult us then they go their way… Then there were issues of the communication barrier, and they *(contractors)* were very arrogant." Community representative 4

Ultimately, functional ablution blocks were delivered that required payment for use, and a new organizational mode to manage and run them, and that ended up in suboptimal locations.
While the infrastructure delivery process seemed successful from the planners' view, their reception by residents unanimously was critical. This is because participation ignored crucial insights provided by the residents, which could have informed about later appropriation-induced problems. First, planners did not fully understand how the provision of sanitation happened in the settlement and the associated bottlenecks. They just assumed that the residents would adopt the new ablution blocks for lack of alternatives. The residents on the other side relied on their pit latrines, which needed regular emptying, which proved to be expensive. Their preference for sewers was mostly related to this challenge. A second insight the planners missed was the residents' socio-spatial knowledge of the settlement, which would have been key for establishing locations of the ablution blocks that would have fit the residents' usual mobility patterns.

The domestication stage for ablution blocks was characterized by navigating and contravening actions. The residents refrained from using the ablution blocks after delivery, despite being functional. One of the blocks in the center of the settlement was given to a women's group to manage, but no one was willing to pay due to the presence of other alternatives and the women immediately stopped operating it (*cost and organizational mode*). Navigation manifested when residents opted not to pay for toilet use as they claimed that they either had one at home or could use their neighbors' toilet near where they operated small businesses (*transaction*). Navigation also occurred due to *spatial* reasons. The residents opted to use other means as they reported that a second ablution block was located in an inferior place with lower population density where everyone had a toilet. In terms of contravention, one of the residents occupied the vacant verandah of one of the ablution blocks for drying cereals that she would sell afterward. She informally claimed the space and no one was stopping her from doing that. In addition, some unscrupulous residents made it a hiding spot when they committed crimes at night and even vandalized it. Due to this pattern of domestication, the ablution blocks were dilapidating with time.

Institutionalization of the ablution block was characterized by ignorance of the infrastructure and persisting vandalism. This was because residents did not find their economic or social worth, but rather a waste of resources, which would better have been transferred to other infrastructures. It was clear that the ablution blocks would never be used for the provision of sanitation and were deteriorating rapidly over time

Based on insights from this case, participation was poor. It only captured the status of the settlement and not the processes and challenges of achieving sanitation. The consensus was reached at the prioritization stage of planning but ablution blocks were constructed in place of sewers. Consequently, the residents' appropriation resulted in critical reception due to a lapse in trust during implementation, diverse acts of domestication i.e. navigation and contravening, and negative institutionalization characterized by vandalism and dilapidation. As a consequence, no improvement in livelihoods occurred.

3.4.2 Floodlights

From participation, the planners were aware of the following: (i) the insecurity issues that were prevalent in Munyaka due to the lack of lighting in any of the streets. (ii) The minimal space requirement for the floodlights. (iii) The need to pay for monthly electric bills, a responsibility that the Eldoret Municipality would take up. Placing adverts on the floodlight was proposed as a way of generating income to pay monthly bills. (iv) The floodlights' role in extended hours for livelihood activities. These were listed as potential factors that would be essential for implementing and sustaining the floodlights (MLHUD, 2013a, p. 61; 2013c, p. 51). These insights portrayed the awareness of the challenge of insecurity complemented by a solution that had a foresight for appropriation. Consensus for floodlights was reached through three prioritization engagements that took place at the settlement facilitated by consultants.

There was one relevant event during the construction of the floodlights, the issue of where to site them spatially. Some community representatives lobbied for siting them near their households. One of the floodlights had to be relocated from a representative's gate to a mutually agreeable location after financiers received complaints from other residents during one of their few field visits (reported by residents and witnessed by the first author). The planning process resulted in functional floodlights in optimized locations, whose charges were catered for by the county government, functioned automatically thus not requiring residents to take up any role immediately, occupied limited space, and that increased time for other socioeconomic activities relevant to livelihoods.

From an appropriation perspective, residents expressed overall approval of the reception of the floodlights due to the relatively smooth implementation of the floodlights. They however quickly realized that the envisioned automatic functioning did not always work. Domestication was also effortless since nothing was required of them yet the floodlights benefited them. From the moment its construction was completed, the amount of time residents could open their business premises increased as people felt it was more secure, those who worked as hawkers in the town could work more and return home much later. In addition, those who went for social activities had more time. Furthermore, the residents did not have to pay for the lighting as the local government catered for this and it occupied very little space. The prospects for the floodlight to continue functioning and contribute to improving their livelihood were very high.

The floodlight was further institutionalized effortlessly due to the net benefits in their infrastructure-livelihoods nexus. Residents proactively organized around sustaining the functionality of floodlights over time, when they perceived problems of persistent functioning after some time.

> "The problem is that it *(floodlight)* regularly goes off, in fact, it is we that usually switch them on, and there is a young man that volunteered to do that…. They *(county government)* usually come here to repair but it never lights up continuously, when it breaks down, they take a long time to come to repair after reporting, we usually switch it manually because they gave us the key." Resident 16

The case of floodlights presents a scenario of successful appropriation. The appropriation of the floodlight was characterized by approved reception, effortless domestication, and proactive institutionalization by residents. This was because the floodlights maintained and extended the infrastructure-livelihood nexus, which enabled to the improvement of livelihoods.

3.4.3 Roads

During the plan-making process of the road infrastructure, planners identified the following insights from participation: (i) only 14% of the residents had access to an all-weather road near their household. (ii) Roads were the priority for the residents as compared to all other infrastructure types. (iii) Road spaces were existing in the settlement; however, residents had encroached in some areas by extending their houses, shops, and market stalls. Shopkeepers pleaded to be relocated near the upgraded road where they could have easy access to customers rather than to hidden markets (iv). The need for the county government to take over the road after construction. (v) Likelihood of the constructed road to increase flooding. (vi) The norm of residents in disposing of their waste along existing roads (MLHUD, 2013a). There was a consensus to upgrade the roads. However, it was not detailed enough to inform the lengths, widths, and extents of the settlements that would be tarmacked and the multiple uses of road spaces beyond commuting. This was contentious during construction.

Information gathered about traders operating on roads was very relevant during road construction work. It prompted the planners to address the relocation of residents from trading along the roads. As a result, 53 traders who occupied the road spaces during its construction were facilitated to move their stalls a few meters away from the road (MLHUD, 2013a). Contentions however arose due to the lack of clarity in the content of the consensus in the plan making-phase and communication deficits. Residents in different clusters of the settlement claimed that some roads were never tarmacked contrary to their expectations. In terms of communication, community representatives reported that the contractors secluded them. Communication was also constrained between the contractors and the residents, and even within the community representatives. All these contributed to a lapse in trust.

> "So there was a communication breakdown, even the community elders didn't communicate fully, they only did to individual persons. And even sometimes they didn't t know the details." Resident 14

The implementation resulted in functional roads whose reception was mildly critical due to the following reasons. The roads were meant for the conveyance of traffic only, ignoring other uses such as play spaces for children and market spaces that were beneficial to residents *(space and time)*. The roads also did not cover all areas that the residents deemed essential and their management was the responsibility of the county government as planned (*operational mode*). They were also free for residents to use *(cost)*. Immediately after the handover, the road was useful in terms of accelerating traffic. Those who owned motorbikes, handcarts, and vehicles ferried people and goods in the neighborhood and to and from Eldoret town more efficiently as the roads were better. Transport took less time and residents paid less to ferry goods (*time and transaction*).

Domestication was quite complex and manifested through contravening, navigating, and coping actions. Contravening actions immediately occurred when the residents who had been facilitated to relocate reestablished their market stalls on the road spaces (*spatial*). They explained that that was where their customers passed and thus their wares could get more visibility, especially in the late evening, and they did not have to pay rent (*time and transaction*). They used this justification to occupy the road spaces and other residents were okay with it. This resulted in pedestrians walking or shopping from the road spaces that were meant for motor vehicles. The residents did not complain since they were mutually benefiting from cheap wares and preferred not to cause quarrels with neighbors as observed during fieldwork.

> "It is because of capability *(financial)*… You know rent is costly and not many will afford it, so people opt to use the spaces to set up businesses, another thing is the lack of rentals in the preferred places where they would like, they end up setting up the businesses on the roadside where there are many potential customers," Resident 1

Residents also engaged in benign contravening actions. This was illustrated when residents realized that the drivers and riders were driving too fast. This was especially dangerous as children played on and along the roads. They took up the responsibility to make earthen bumps to regulate these speeds and avoid accidents making the road more usable. The municipality later built solid bumps after residents persistently complained.

> "…there were no road bumps. We *(residents)* also erected some because of speeding vehicles and motorcycles. And you see that the soil makes the road dirty, later on after complaints, they came and erected professional ones." Resident 7

Secondly, residents conducted actions that comprised navigation as demonstrated below.

> "This road is very busy in the evening; even if you are passing using a vehicle it is difficult, so many would opt to use the other backroads because there are many people in the evening." Resident 2

Thirdly, residents also engaged in coping actions. It was evident that the residents dumped waste on the roads. They did this at night when no one was seeing them. Households and small businesses that could not afford waste collection fees mostly did this. There were also no other alternative spaces to dump and dumping on any open space was the norm for solid waste management in the settlement as explained by residents:

> "They *(residents)* dump mostly at night, and when we come here in the morning, there is garbage, what will you do? There was a day I cleaned here in the evening, and the following morning I found a lot of garbage here." Resident 13

The actions presented in the domestication stage for roads were all socially validated and occurred concurrently. Institutionalization, therefore, was characterized by residents maintaining the status quo of domestication. They did not take up any further role to maintain the functionality of the roads since it would either cost them financially or disrupt their social relations. Consequently, the roads remained partially blocked with at least one lane available for mobility and dilapidated albeit gradually due to continued dumping. This reflected how the road space was appropriated before the upgrading; only now the space was tarmacked.

Based on these findings for the roads, the reception was mildly critical due to a mix of the lapse in trust during participation and the overall contribution to the infrastructure-livelihoods nexus that the roads offered. Domestication reshaped the new road back to the space it was before upgrading and institutionalization cemented the status quo. While the residents accrued benefits from the road, it was gradually dilapidating and the benefits would likely be short-lived.

3.5 Discussion

The three infrastructures illustrate the three-stage mechanism of appropriation that led to distinct livelihood and infrastructure outcomes. The mechanism comprises residents' reception of new infrastructure, its domestication, and institutionalization based on whether it disrupts maintains, or extends the residents' infrastructure-livelihoods nexus. Maintenance and extension lead to the improvement of livelihoods to varied extents while disruption leads to their deterioration.

The ablution blocks were critically received due to a lapse in trust as consensus decisions during participation went unfulfilled. They were difficult to domesticate since they required extra payments, time (*transaction*), and reorganization to manage in a context where residents already had an alternative and already institutionalized options. For this reason, their appropriation resulted in dilapidation and sabotage with residents opting to retain the status quo of their infrastructure-livelihood nexus. They did not improve the livelihoods of the residents in any way. Similar outcomes of ablution blocks have been recorded but their causal mechanism was not elaborated to this detail (Chidambaram, 2020). The floodlights were very received in a much more positive way. They presented insignificant *spatial* competition in the status quo since they occupied very little footprint. They also extended the infrastructure-livelihood nexus (*time*) by providing more opportunities for socioeconomic activities at little extra cost (*transaction*). Due to this, it was in the interest of the residents to reorganize socially to keep them running due to their contribution to their livelihoods (*organizational mode*). The roads presented a more complex scenario as they prompted considerable reconfiguration of *space* use. Residents initially benefited from more efficient mobility at reduced costs and time of travel (*time and transaction*) but could not effectively reorganize socially to ensure substantial maintenance of the road as it would cost them either their existing social relations or money (*organizational mode and transaction*). Due to this, they opted to repurpose the road to the benefit of securing livelihoods even at the expense of its material deterioration leading to only a partial improvement of their livelihoods. There are many cases of institutionalized infrastructure reported in the literature about the fact of repurposing but without giving details on this came about (e.g. Massey (2014))

Explicating the three stages of the mechanism, the cases demonstrate that *reception* is heavily reliant on whether participation is effective in maintaining trust between the residents and implementers and reshaping infrastructures to fit the needs of residents and its ability to inform the planners about the full realities of residents' needs. It is already known that interactions of different actors with residents during infrastructure construction result in different infrastructure outcomes (Massey, 2013; Wainaina et al., 2022). This study extends this knowledge by informing the impact that participation has on the reception of infrastructures specifically and associated outcomes to livelihoods. As illustrated, ablution blocks and roads were accorded critical and mildly critical reception due to ineffective participation respectively while the floodlight was accorded favorable reception immediately due to effective participation. Findings demonstrate that reception's nature determines the actions that shape the subsequent domestication.

The cases demonstrate that *domestication* is a very proactive social process that takes longer in comparison to reception. As demonstrated in the richer case of roads, it comprises multiple interactions of individuals and groups over time to shape the infrastructure. These interactions model relationships over time, which regulate the actual use of infrastructure, motivate its maintenance or ignore its deterioration. Where these processes result in the maintenance or extension of the infrastructure-livelihoods nexus, domestication is effortless as in the case of floodlights. On contrary, disruptions to the nexus lead to navigation, contravention, and coping actions as demonstrated in the roads and the ablution block cases. It is important to note two things that relate to domestication. First, not all cases of

contravention are negative; some are benign and even gain support from formal authorities. A good example is the earthen bumps made by residents that the authorities later improved. Secondly, navigating and/or coping actions during domestication are likely to lead to ignorance and eventual dilapidation of the infrastructure.

The cases further demonstrate that *institutionalization* is driven by the social endorsement and replication of specific forms of domestication within the settlement. The new infrastructure becomes part of the institutionalized socio-technical system in the form of a modified, improved, or deteriorated infrastructure-livelihood nexus. Or in other words, full-scale "embedding" has taken place. The ablution blocks were institutionalized as a failed intervention, which to some extent was even considered a token of pride because the residents had been able to defend themselves against unwanted interventions. In the case of floodlights, it was an essential addition to their improved infrastructure-livelihood nexus showing positive impacts on their livelihoods leading to the mobilization of resources by residents to maintain it. The roads were an addition that residents shaped to fit their needs at the cost of the road's lifespan.

3.6 Conclusion

This study aimed to investigate mechanisms of appropriation that moderate the influence of infrastructure upgrading on the livelihoods of residents in slums. We conceptualized appropriation as a social process proceeding in three steps, reception, domestication, and institutionalization. The appropriation process will ultimately lead to the "embedding" of the new options into the infrastructure-livelihood nexus of the informal settlement. This will either lead to the reorganization of the residents' time and activity portfolio to maintain the new infrastructure, or they will repurpose or even destroy them to safeguard their livelihood practices.

For participation to be effective in informing the planning of infrastructures, it needs to anticipate processes of appropriation to support effective upgrading interventions. The study further demonstrates that slum upgrading should not only care about access and costs of basic services but also how the multiple uses of spaces reach critical junctures where residents are willing to organize themselves to sustain the infrastructures. This is the only way the livelihoods of informal residents can be improved.

Conceptually, it informs transition studies by unbundling the social processes leading to the embedding of new socio-technical structures in local contexts. It furthermore provides an alternative view on the role of residents in these processes, portraying them as proactive co-producers of outcomes instead of passive beneficiaries. Finally, we have shown that appropriation is a deeply social process, which builds on but institutionalizes individual appropriation strategies by residents. Further research is required to convert the conceptual insights elaborated here into practice tools that can aid planners to anticipate appropriation.

Chapter 4: Participation configurations that determine the success of slum upgrading projects[6]

Abstract

The academic literature largely acknowledges participation as a key condition for the successful upgrading of informal settlements. However, how individual participative actions of different actor groups and reactions of dwellers combine to influence project outcomes of upgrading processes has not been studied. This article posits that different combinations of the presence or absence of collaborative interactions between dwellers and other actors will decisively predict the success and failure of projects. Specifically, we argue that interactions between different groups of implementers and dwellers are conditioned by distinctive value systems—institutional logic—, which provide specific challenges to establishing collaborative interactions with dwellers as the actors conduct their roles. We identify sufficient combinations of participative actions that may lead to successful upgrading using qualitative comparative analysis (QCA) on 15 informal settlements in Kenya's secondary towns that were recently upgraded. Our findings indicate that participation has to consider a multiplicity of actors, who are guided by different logics; it has to span over the whole implementation cycle. It also has to deal reflexively with the issue of representation of the community. This extends the understanding of participation to a perspective that emphasizes the capabilities of implementers to enact collaborative relationships by bridging their own and the community's institutional logic.

[6] Wainaina, G. K., Truffer, B., & Lüthi, C. (2022). The role of institutional logics during participation in urban processes and projects: Insights from a comparative analysis of upgrading fifteen informal settlements in Kenya. *Cities*, *128*, 103799. https://doi.org/https://doi.org/10.1016/j.cities.2022.103799

4.1 Introduction

More than half of the global population lives in urban settings and about a billion of these in informal settlements characterized by limited basic services, insecure tenure, and poor housing (UN-Habitat, 2015); UN-Habitat (2016). Currently, an influx of about 70 million residents per year is expected in urban centers in developing countries where already, more than half live in informal settlements (Baker, 2008). These settlements exist globally with a range of names such as slums, favelas, squatters, and shacks among others. Ignorance or eviction as a strategy to get rid of these settlements by authorities has been consistently criticized. Consequently, authorities have adopted upgrading strategies such as insitu upgrading or relocation of communities to green fields, to counter this challenge.

Informal settlement upgrading processes are complex due to underlying sociocultural and socioeconomic factors that include heterogeneous ethnicities, religion, high population densities, insecure tenure; low incomes, and inadequate capability of key implementing actors to engage the dwellers (Das, 2015; Koster & Nuijten, 2012; Massey, 2013; Morrison, 2017a; Nunbogu et al., 2018). They typically target formalizing land tenure, investing in infrastructure, and setting up basic services and can be either single sector (targeting one service and its related infrastructure such as sanitation) or multisector and often occur per-project basis over a defined period (Núñez Collado & Wang, 2020).

Over time, community participation has been cited as a key factor to achieve better upgrading outcomes (Botes & Van Rensburg, 2000; Cherunya, Ahlborg, et al., 2020; Lucci et al., 2015; Nop & Thornton, 2020; Patel, 2013). It represents the involvement of stakeholders that are affected by or are interested in a proposed intervention by implementers (Enserink et al., 2007). At its interface in upgrading processes, participation comprises the implementers and dwellers who ultimately appropriate the upgrading outcomes. From the dwellers' end, it calls for them to take up more of the activities previously appropriated by outsiders during projects (Chambers, 1994). Often, outside actors ignore the creative and analytical capabilities of residents and perceive participation as a toolkit rather than a process of trust and relationship development during day-to-day interactions among actors (Chambers, 1994; Reed, 2008). To understand disconnects and tensions in participation, we propose to differentiate different actors responsible for upgrading – whom we call providers. More specifically, we aim at specifying whether and how upgrading success depends on the nature of interactions that different providers entertain with the informal settlement dwellers during the upgrading process.

We maintain that despite the large acceptance of the call for participation in development projects, its contribution to upgrading success has been hampered by a simplistic understanding of how and where interactions between dwellers and providers have to be coordinated. We propose to extend this understanding in three important respects: i) participation has to be differentiated according to provider groups in line with the rationalities that they adhere to, the kind of potential conflicts and disconnects that are likely to emerge, and appropriate forms by which needs of dwellers and specific actor groups can be accommodated. ii) We maintain that participation has to be organized across the whole upgrading process and should not be limited to the planning stage, because many needs and opportunities will only emerge during implementation. And iii), we call for a more differentiated view of how the community of dwellers participates and how representation by selected community members is organized.

Different actors share different rationalities and world views while providing key roles during upgrading processes (MacPherson, 2013; Wandersman, 2009). To assess how they engage dwellers while fulfilling these roles, we aggregate them according to different “institutional logics.” Institutional logics represents ways of decision-making, goal orientation, and types of exchange relations among actors. They give

identity and meaning to the actors (Currie & Guah, 2007; Greenwood et al., 2010; Skelcher & Smith, 2015). Established "ideal type" logic includes the market, the state, the hierarchy, the profession, the community, and the family (Thornton & Ocasio, 2008). Therefore, different actors are aggregated based on the logics that guide the role that they provide during the upgrading process. The resulting aggregation is as follows; a) market providers: contractors, utilities. b) Professional providers: planners, engineers. c) Hierarchical providers: regional and state officials. d) State providers: politicians; and e) Community: dwellers. This aggregation of actors follows stages and heuristics of the configurational theorizing process outlined by Furnari et al. (2020).

Participation manifests differently for each provider and dwellers and will require different capabilities and forms of engagement to accommodate the different interests and resources of all the actors involved. This is useful as it opens up opportunities for the aggregation of many actors into coherent groups based on the logics that guides the roles they play in upgrading and other kinds of projects.

Success was defined as improvements in infrastructures and services, the capacity to maintain them, and the absence of involuntary displacement of the original residents. It was quantified from an assessment of whether combinations of infrastructures introduced during the upgrading process were delivered in functioning condition as reported by the dwellers and observed by the first author and whether the dwellers effectively used or misused the components in the course of their daily practices knowingly or unknowingly. This quantification is detailed in the method section.

This research contributes to gaps in the literature in two ways. First, it addresses why some actors find it difficult to engage citizens in urban contexts (Nunbogu et al., 2018) and provides a methodology for assessing participation dynamics and their causal relation to project outcomes. This link has been frequently recorded in anecdotal evidence, which has stressed the need for further complementary studies (Brownill & Parker, 2010b; Conrad et al., 2011; Lüthi, 2012). Secondly, it opens a pathway for comparative analysis of activities in informal settlements with particular attention to secondary towns where they are rapidly increasing and very few studies have been conducted (Gulyani et al., 2014; Saharan et al., 2019). A need for comparative approaches and studies in urban studies has been stressed by Ruhlandt et al. (2020).

By demonstrating frictions and discontent among actors emanate from mismatches in institutional logics, this study extends the literature on participation from the formulaic notion of consultation to further ends of actor-rationalities and their capabilities to engage with the community and vice versa. Beyond considering individual interactions, we aim to identify, which combinations of interactions are crucial to explaining success or failure. These insights are in particular relevant to planners as they are often responsible to anticipate and accommodate conflicts among actors and coordinate interactions.

This study qualitatively compares fifteen informal settlements that were upgraded as part of the Kenya informal settlement improvement project (KISIP). Kenya, with 56 percent of its population living in informal settlements, was selected as it represents many Global South countries that are establishing strategies to improve the living conditions of informal settlement dwellers (World Bank, 2014). KISIP program facilitated a rare and valuable naturally-set experiment from which comparable and generalizable insights could be derived. This was a nationwide program conceptualized between 2009 to 2010 and implemented up to 2019 (World Bank, 2011). This study targeted projects that concentrated on the infrastructural component and service delivery specifically in secondary towns. Participation by settlement dwellers was required by the program during the upgrading process. As a prerequisite for consideration

for upgrading, dwellers from each settlement had to mobilize and form committees, so-called settlement executive committees (SEC) who were democratically elected.

Findings indicate that different combinations of collaborating actors can result in successful outcomes in upgrading. Some actors can also overcompensate for conflicts caused by others during implementation leading to either failure or success. The study offers a comparative methodology useful for analyzing different urban processes that require participation globally.

This paper is organized as follows; section 2 presents a theoretical discussion linking participation to institutional logics. This is followed by an explanation of the study approach and description of data sources and afterward a presentation of results from fuzzy-set QCA. How combinations of interactions lead to success and failure in settlement upgrading is then discussed. In the concluding section, we elaborate on the broader lessons derived from our approach for upgrading in particular, and for other development projects.

4.2 Linking institutional logics and participation to informal settlement upgrading

In the global south, informal settlements are key areas that urban planners and policy practitioners prioritize. Most cities cannot sustain themselves without them (Dovey & King, 2011). Upgrading them has however been barred by challenges ranging from policies, finances, implementation models, differences in perspectives of actors towards informal settlements as well as poor understanding of informal settlement context (Boonyabancha, 2009; McGranahan, 2015; Morrison, 2017a; Sibyan, 2020). Over the last decades, plans and policies have moved away from the eviction of slums towards insitu or place-based upgrading including different financing models. This has been advocated for in a bid to maintain long-term improvements with minimal livelihood disruptions (Henson et al., 2020). Collaborative planning that invokes the necessity to include all stakeholders—participation—in decision-making (Gunton & Day, 2003) has proved instrumental in insitu upgrading. It is useful in understanding conflicting values during processes that result in different outcomes (Bjørgen et al., 2021; Innes & Booher, 2015). Most upgrading projects globally, for instance, the Baan Mankong program in Thailand, Primed in Colombia, and reblocking in South Africa, insist on participation as being a key determinant for success (Betancur, 2007; Lucci et al., 2015; Patel, 2013). However, participation is often restricted to lead actors eliciting community needs at the beginning of the projects only and has missed actors' dynamics that happen during implementation that are often not planned for and which influence project outcomes.

This paper argues that while participation is essential at the initial project stages, it is not sufficient since a lot of dynamics change during the implementation and post-implementation phases of projects, and dweller needs and priorities consequently change (Innes & Booher, 2015). This in turn influences project outcomes. Therefore, participation needs to be planned for and conducted throughout the project as implicitly observed in the Baan Mankong program, and the associated roles of each actor need to be outlined (De Geest & De Nys-Ketels, 2019; Lucci et al., 2015). It also has to consider the further involvement of different actors, while fulfilling their different roles, with dwellers at different times. Most of the literature on upgrading rarely details how participation manifests for the different actors. For instance, Sibyan (2020) only highlights that conflicts in informal settlement-related projects reflect the difference in perspectives between actors including government, private sector, and residents. However, the author does not elaborate on how the severity or intensity of each of these perspectives could configure, or which of these is sufficient or necessary for successful upgrading. We draw on recent insights from organizational studies to shed light on where these perspectives come from and how they can be bridged (Thornton & Ocasio, 2008).

Participation is typically organized by delegating the exchange of information to a group of elected community members, who then have to mediate between the community at large and the different provider groups. Depending on the modes of operation of these representatives, communication can be more or less effective. A critical view on issues and representation in participation's information exchange processes is thus essential as outlined by Rigon (2014) to avoid elite capture common in upgrading projects.

Based on the background literature discussed, this section introduces the core concept for this paper based on in-depth literature from participation and institutional logics. The institutional logics perspective is useful to the paper and the larger urban literature as it provides a framework to structure actors into coherent groups following similar rules, norms, and rationales. From this perspective, we will furthermore derive a typology of kinds of frictions, mismatches, and challenges that shape interactions between these provider groups and dwellers. The key terms in our explanatory model will then be operationalized.

4.2.1 Participation

Definitions of participation underscore the existence of interactions between two or more actors or actor groups, as they conduct their roles, in a given context of a project or policy (Jiménez et al., 2019; Narayan-Parker, 1995; Patel, 2013; Stoker, 1997). It intends to get communities to contribute to decision-making and activities that relate to and own projects that affect them. Previous research on upgrading globally has concentrated on the role of participation as either a means to achieve services or an end goal for authorities (Ehebrecht, 2015; Lucci et al., 2015; Lüthi, 2012; Patel, 2013), or the nature of participation in upgrading (Das & Takahashi, 2009). Scholars have also warned of its limitations such as its failure to sufficiently address issues of power and control of information and other resources which are fundamental determinants of social change (Cleaver, 1999) as well as its methodological and technocratic limitations (Mansuri & Rao, 2004).

Despite all the stated studies, there is a dearth of quantitative studies causally linking participation to project outcomes. Only two quantitative studies have elaborated causal links between participation and project outcomes (Narayan-Parker, 1995; Prokopy, 2005), and both are in rural settings. Most studies offer qualitative evidence of causality. Patel (2013) for instance indicates that community participation was essential for the upgrade of the Zwelisha informal settlement in South Africa. Koster and Nuijten (2012) and Walubwa (2010) also offer similar insights in Brazil and Kenya respectively. This is mostly due to the limited opportunities for comparability of informal settlements, the upgrading processes as well as limited methodologies due to few similar projects. QCA methodology as described in this study solves the latter problem by providing a case study and causal analysis methodology for situations where only a small number of comparable cases (Rihoux & Ragin, 2009).

In its conceptual form, participation has been widely discussed commencing with Arnstein (1969)'s seminal work. Building on Arnstein's typology, Choguill (1996) later modified it to fit in contexts of less developed countries by basing it on the degree of external involvement by planners or the state in terms of facilitating or carrying out community mutual-help projects. Choguill's levels of involvement include the following rungs: Support, manipulation, rejection i.e. conspiracy and self-management. He concludes that outcomes of developmental initiatives may lead to different results, depending on the attitudes of authorities (providers) towards the community. He further perceives the role of participation as a means to influence decision-making. More recent insights show that self-management is characterized by alternative participation through sociopolitical networks or a complete lack of participation (Swapan, 2016).

Choguill's work has been adopted in interrogating the role of participation in informal settlement studies such as Davidson et al. (2007), Lizarralde and Massyn (2008), and Patel (2013). Questions about the extent, when, and how participation should be conducted to improve project performance still require further research, especially at the interface between different providers and dwellers.

While conducting their roles, different types of providers exhibit different interests, rationalities, and capabilities, and have to interact with dwellers during upgrading (Botes & Van Rensburg, 2000; Choguill, 1996; García-López, 2019). Participation challenge will therefore look different for each provider and this influences their ability to engage dwellers based on Choguill's rungs. To identify and group different providers with similar orientations, we draw on recent insights from institutional sociology and group them according to generic institutional logics to identify specific challenges that have to be accommodated for by the different actor groups.

4.2.2 Institutional logics

There is a need to understand the rationalities and world views of different actors that perform roles in urban processes. Often they are many thus increasing complexities in analyzing how they relate with end users during processes. Sociology literature has identified a limited number of such rationalities—institutional logics—which are useful in aggregating actors that follow similar rationalities thus unbundling the complexity. Thornton et al. (2012, p. 2, pp. 2) define institutional logics as 'frames of reference (or value systems) that condition actors' choices for sense-making, the vocabulary they use to motivate action, and their sense of self and identity.' There are limited ideal type logics, which include market logic, state logic, professional logic, hierarchal/corporation logic, religion logic, community logic, or family logic (Thornton & Ocasio, 2008). These logics influence material outcomes. Institutional logics literature could benefit planners due to its deep understanding of the origins of conflicts or disconnects between different actor groups based on their rationalities. Rationalities are deeply embedded in institutional logics (See Quattrone (2015) for a detailed discussion on this).

This field of literature has extensively explained how specific actors draw from institutional logics to legitimize their actions, influence outcomes, and how the logics influences actors' actions. As an example of the former, McPherson and Sauder (2013) explain how different drug-court actors draw from available institutional logics to influence court outcomes. The literature for the latter points out that, the motives that actors express, are representations of their institutional logics (Meyer et al., 2014). Currie and Guah (2007)'s findings, for instance, indicate that in a healthcare system implementation, the system's success majorly depended not only on the other actors' logics but also on the patients' viewpoint.

Scholars have also explained the dynamics and expectations of coexisting logics. They have shown so far that logics coexist while at the same time exposing points of tension. For example, in individual instances, market logics often conflict (Casciarri, 2009) or coexist (Venkataraman et al., 2016) with community logics, and professional and hierarchal logics may conflict with community logics (Currie & Guah, 2007; Watson, 2003). In addition politicians (state logic) also influence upgrading processes (Hilgers, 2020; Muchadenyika & Waiswa, 2018).

Drawing from these insights, we front two arguments. First, multiple actors can be aggregated into provider groups based on the similarities in their institutional logics of which it would be expected that they confront similar challenges when interacting with dwellers and their representatives. In the context of settlement upgrading at a project level, we identify the following actors that adhere to different institutional logics during their interactions: i) planners and engineers who mostly follow a professional

logic (professional providers). They have a high orientation on technical expertise and quantitative terms of reference. ii) Utilities and contractors who mostly follow a market logic (market providers). They emphasize profits and largely anonymous interactions between suppliers and customers. iii) Politicians who follow a state logic, which focuses on legally backed power and prospects of reelection; and iv) local government officials who are oriented at a hierarchical logic (hierarchical providers). who guarantee that actors are following official regulations. These different institutional logics interact with v) settlement dwellers, who can be subsumed of largely following a community logic (community), where solidarity and mutual help are key for generating livelihoods and dealing with quickly shifting conditions of precarity in their livelihoods.

Secondly, the ability of providers to engage the dwellers (do participation) as they achieve their roles can be derived from the analysis of mismatches between their respective logics. To exemplify these mismatches, the emphasis of market logic resides in documented transaction costs and profit orientation with individual exchange which contradicts community logics where members provide services and resources with the expectation that they will be reciprocated at a future date (Bogaert, 2018; Casciarri, 2009). Similarly, perceptions and actions of actors adhering to the professional logic may misalign with community logics. For example, professionals restrict the exchange of data among themselves because they can trust the proper handling and interpretation of this information (Currie & Guah, 2007). This may however raise trust issues among the community who typically expect transparent disclosure of all the facts or protest when they sense their inputs are not considered (Currie & Guah, 2007; De Geest & De Nys-Ketels, 2019). Hierarchical providers such as regional government officials follow chains of command that often take longer to deliver results contrary to community logic's expectations of instant responses (Burra, 2005). In a similar vein, state providers such as politicians often piggyback on projects as a means and prospect for reelection with the expectation that dwellers adhering to community logic will be passive in projects (Muchadenyika & Waiswa, 2018).

Identifying these points of mismatch is important because it implies that providers will have to tackle different kinds of problems depending on different aspects of an upgrading project and that a blanket approach to participation is likely to miss out on decisive mismatches leading to conflicts and consequent to project failure. Based on this characterization of different interfaces between provider logics and community logics, we may set out for an explanatory model to assess the relevant importance of positive interactions between different providers and the dwellers as illustrated in Figure 4.1. Tentative mismatches as discussed in this section are outlined in Table 4.1.

Figure 4.1: conceptualization of interactions of actors during informal settlement upgrading processes based on their institutional logics

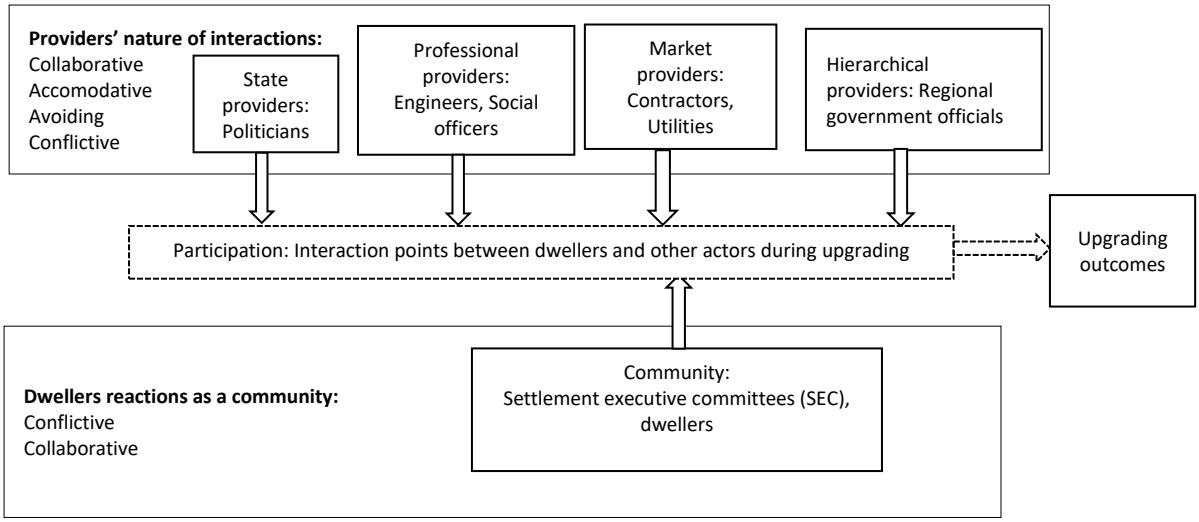

Table 4.1: Potential points of conflict between institutional logics of providers and communities

	Provider groups based on logic			
	Market providers	Hierarchical providers	State providers	Professional providers
Potential reasons for mismatch with extant community logic (Community)	Emphasis on reducing transaction costs, recouping investments, or maximizing profits	Rigidity due to path-dependent procedures and inflexible standards	Driven by personal interest and reelection prospects	Alienation by diction and hoarding of technical information
Typical mismatches with community logics	Unaffordable prices for goods and services Unmanageable payment modalities Poor wages for residents	Slow and inefficient decision-making processes for urgent needs contrary to community expectations	Actions that appease a few to save face but do not transfer overall benefits to the whole community	Mistrust due to limited access to information by the community Poor engagement strategies
Typical actors under this actor group	Contractors, utilities	State officials, regional government officials	Local and regional politicians	Engineers, planners, social workers

4.3 Method

To operationalize the concept developed, a comparative research design was used and a configurational comparative methodology was adopted. A medium-N comparative case study was chosen to analyze the role of providers' interactions with the dwellers in influencing upgrading outcomes (Rihoux & Ragin, 2009; Yin, 2014). QCA can differentiate different combinations of causal conditions that result in similar outcomes (Rihoux, 2006; Schneider & Wagemann, 2012). We applied qualitative comparative analysis (QCA) to fifteen informal settlement upgrading cases in the context of the Kenya informal settlement

upgrading project (KISIP) to gather insights on how provider-dweller interactions combine to influence upgrading outcomes.

The cases included were comparable since their upgrading process context was coherently governed by structures informed by the KISIP Program, which included community representatives, were located in secondary towns in Kenya, were upgraded with relatively similar basic infrastructure and processes but had different outcomes. The cases were also implemented at similar timelines with the consideration of dwellers and in different settlements between 2010 and 2019. The process strived to follow best practices from local and international experiences. All the settlements fitted in UN-Habitat (2016)'s definition of slums. Similar upgrading processes and informal settlements such as the ones highlighted in this paper are common globally and include upgrading of Recife's Prometrópole settlement in Brazil (Koster & Nuijten, 2012), reblocking in informal settlements in South Africa (Basson, 2019) among others. This comparative approach is in line with urban comparative studies, which allow comparison of different urban contexts with similar interventions and strategies to a common challenge (McFarlane & Robinson, 2012; Saharan et al., 2019).

Data sources for this study included sixty key informant interviews (See Appendix A-7), observations from field visits to each settlement, at least two project reports for each case, and grey literature specific for each case. The first author conducted fieldwork between October 2019 to January 2020 and sought consent from all interviewees as well as research permits from local authorities in Kenya. Questions for the interviews sought to reconstruct the upgrading process as well as understand the outcomes from the perspective of the SECs (Settlement Executive Committee members) who were also dwellers, and selected government officials that were involved throughout the upgrading. We interviewed SECS, county coordinators, national office officials, World Bank officials, and village elders.

The interviews and field notes from observations were transcribed and analyzed in two phases. The first phase involved the use of Nvivo (2012) to deductively code themes that aligned with potential provider-dweller interactions for each actor and the upgrading outcomes for each case. This was guided by the conceptualization described in Section 4.2. The coding structure for each settlement is presented in Appendix 6. The coding results were then developed into a framework matrix and summaries for interactions and outcomes were developed. The second phase used fuzzy-set Qualitative comparative analysis software (FSQCA) (Ragin et al., 2006) and followed the procedure recommended by Rihoux and Ragin (2009) and Legewie (2013).

FSQCA was selected due to its focus on cases and their contexts and is useful for causal analysis (Schneider & Wagemann, 2012). It contrasts statistical methods such as regression analysis since it does not assume symmetry in causality (Goertz & Mahoney, 2012) and operationalizes qualitative set relations rather than correlations (Schneider & Wagemann, 2012). It also accommodates for analysis of studies with relatively few cases and can inform different causal paths to a result, usually referred to as *outcome*, since causal factors, usually called *conditions*, act in combinations. A phenomenon referred to as multiple conjunctural causations (Schneider & Wagemann, 2012). This method has recently gained traction and recommendation in urban studies due to the advantages highlighted (Ruhlandt, 2018; Ruhlandt et al., 2020). QCA informs both necessary and sufficient conditions for a given outcome. Necessary conditions are those conditions that must be present for an outcome to be achieved but their presence does not necessarily guarantee the outcome while sufficient conditions constitute subsets of the outcome and their presence always produces the outcome (Rihoux & Ragin, 2009). Models of both necessary and sufficient conditions are assessed using consistency and coverage scores. Consistency scores express the degree to

which a given condition is a subset or superset of the outcome while the coverage score provides a numeric expression for the empirical importance of a given condition (or a combination thereof) for producing an outcome (i.e. how much of the outcome is explained by the conditions in question (Schneider & Wagemann, 2012).

The FSQCA procedure proceeded along the following steps. The framework matrix from the first phase of analysis was calibrated and a set membership table was developed and is presented in Appendix A-1. The calibration procedure is a key process for QCA. Therefore, a detailed procedure for the calibration and a sample case are provided in the section that follows. The set inclusion table was imported to FSQCA and two truth tables for successful and unsuccessful upgrading outcomes were generated. Truth tables facilitate investigation of relations between sets of cases that share a combination of conditions on the one hand and the set of cases with the outcome on the other (Schneider & Wagemann, 2012). Consistency cut-off points of 0.8 were used and a logical minimization process was conducted to generate results for the analysis. During the logical minimization process of the truth tables for both success and failure solutions, prime implicants[7] that contained the market condition were selected. Prime implicants are the most reduced forms of combinations of conditions that when present lead to an outcome. The market condition was chosen based on substantive knowledge in the cases and theory that market logic has a significant influence on upgrading processes since dwellers have low incomes. Other choices of prime implicants resulted in similar solutions. We present the full list of prime implicants in Appendix A-4 and complex and parsimonious solutions for the explanatory models in Appendix A-3. The robustness of the models was assessed by adjusting the cut-off frequencies for the success model to 0.7 and 0.9.

4.3.1 Calibration of conditions and outcome

Provider-dweller interactions were the primary conditions that we examined, understood as representations of participative actions by different provider groups and the dwellers. They are represented by salient interactions of provider groups (market, hierarchal, state, and professional) with the dwellers (Community) during the upgrading process. We noted but ignored providers whose nature of interactions with dwellers were constant — for example the overall coordinating team and the social workers were always collaborative — since they would not affect the model. The providers considered in the analysis were politicians, engineers, county officials, dwellers, and market providers (i.e., contractors and water utilities aggregated). Where more than one actor adhered to the same logic, the nature of their actions was aggregated with a *Logical OR* function[8] as was the case for the market logic providers. This implied that we took a lenient approach to assess collaboration with market actors. The aggregation was only done if any of the providers exhibited varying interactions case-wise.

The nature of interactions was coded as either conflictive, avoiding, accommodative, or collaborative for provider groups, while the reaction of the dwellers was coded as either conflictive or collaborative. We employed a fuzzy scale with values between 0 and 1 to indicate sets of fully conflictive and fully collaborative interactions respectively. Additional cutoff points of 0.33 and 0.66 were used to qualitatively denote actions that were avoidant thus tending towards conflictive, and accommodative which tended towards collaborative respectively. A cross-over point of 0.5 was used implying that at this point, a case

[7] Prime implicants refer to the resultant products of logical minimization process of the truth table through pairwise comparison of *sufficient* term or *path* which combines several conditions by a *logical AND Schneider, C. Q., & Wagemann, C. (2012). Set-theoretic methods for the social sciences: A guide to qualitative comparative analysis. Cambridge University Press.*

[8] 'Creates the *union* between two or more *sets*. *Membership* of cases in the union is determined by their maximum value across these sets.' ibid.

was as much conflictive as it was collaborative (Cooper & Glaesser, 2016). None of the cases in our study had this characteristic Conflictive (0) and avoiding (0.33) actions misalign with the community's expectations whereas accommodative (0.66) and collaborative (1) actions align. The community condition was coded as either conflictive (0) or collaborative (1). We present the set membership table in Appendix A-1 and summarize the operationalization and calibration of conditions in Table 4.2.

Table 4.2 Descriptions and calibration of conditions that were used to develop set inclusion tables for use in Fuzzy-set QCA

Conditions *References*	**Set definition** ***Expectation***	**Actors based on logic**	**Calibration for fully out (0.00)**	**Calibration for more out than in (0.33)**	**Calibration for more in than out (0.66)**	**Calibration for fully in (1.00)**
Market interactions *(Venkataraman et al., 2016) (Watson, 2009) (Currie & Guah, 2007)*	Interactions that follow a market logic (market providers), which emphasizes profits and largely anonymous interactions between suppliers and customers *High collaboration is sufficient for upgrading success*	Utilities, contractors	Salient instances where providers were not collaborative at all and forced their way on the dweller most of the time and in a conflictive manner during the upgrading process.	Salient instances where providers just avoided dweller concerns, interactions, and confrontations and proceeded with their work during the upgrading process	Salient instances where providers accommodated the dwellers' views during the upgrading process	Salient instances where providers fully engaged and collaborated with the dwellers and altered the project based on dwellers' needs while maintaining cordial relations
Hierarchical interactions *(Currie & Guah, 2007) (Watson, 2003)*	Interactions that follow a hierarchical logic, under which they have to guarantee that actors are following official regulations.	County government officials				
Professional providers *(Currie & Guah, 2007)*	Interactions that follow a professional logic, with a high orientation on technical expertise and quantitative terms of reference	Engineers, social officers, planners				
State interactions *(Muchadenyika & Waiswa, 2018) (Hilgers, 2020)*	Interactions that follow a state logic, which focuses on legally backed power and prospects of reelection and leadership appointments	Politicians				
Community interactions *(Currie & Guah, 2007) (Venkataraman et al., 2016; Watson, 2003) (Casciarri, 2009) (De Geest & De Nys-Ketels, 2019)*	Interactions that largely follow a community logic (community), where solidarity and mutual help are key for generating livelihoods and dealing with quickly shifting conditions of precarity. *Collaborative communities are sufficient for successful upgrading*	Dwellers	Instances where dwellers react aggressively and bypass laid down channels if they feel that the SEC i) does not represent their interests, ii) does not effectively function anymore or iii) if SEC is rendered powerless due to providers' actions that severely threaten dweller livelihoods or disrupt their communities.	Not applicable	Not applicable	Instances dwellers to remain collaborative about upgrading projects and follow the laid down communication channels of reporting challenges associated with the project through community representatives (Settlement executive committees - SEC).
Outcome	**Set definition**	**Typical projects implemented as a package**	**Calibration for fully out (Less than 0.47)**	**Calibration for more out than in (Greater than 0.47 but less than 0.52)**	**Calibration for more in than out (Greater than 0.52 but less than 0.64)**	**Calibration for fully in (scores greater than 0.64)**
Successful upgrading	Infrastructure delivered to the community in working status and being used by the community for the intended purpose that it was built for.	Ablution blocks, sewer rehabilitation, roads, footpaths, security lights, drainage	Mostly used for the wrong purpose and not delivered in acceptable working status	Mostly delivered in working status but not used for the intended purpose or not used at all	Mostly delivered in a poor working status but serving the intended purpose	Mostly used for the intended purpose and delivered in acceptable working status

Three to seven different project components of the outcome -i.e. water, sewer, roads, streetlights, ablution blocks, drainage, and footpaths- were implemented in each given settlement. Each component was assessed depending on whether it was delivered to the community in a working or accessible status or not, and whether it was being used by the community for the intended purpose that it was built for or not. The assessment was conducted through insitu observations by the first author in all the settlements combined with interviews with community representatives. If it was doing both, it was assigned a score of 1, and if it did not fulfill either it was assigned a score of 0. If it was delivered in working status but not used for the intended purpose or not used at all, it was assigned a score of 0.33 since it was considered not to serve the immediate need of the community and thus found alternative use or misuse. Furthermore, if the infrastructure was delivered in a poor working status but serving the intended purpose, it was assigned a score of 0.66. A higher score in the latter implies that disruption in changing the community's obdurate practices is not necessary. This resulted in individual scores for each component in the settlement.

The mean of the components scores per settlement was calculated to give an aggregated figure, which ranged from 0 to 1. Qualitatively, the outcome of upgrading was better as the score tended towards 1. This resulted in fifteen outcome scores for the fifteen settlements which ranged between 0.17 and 0.76 as presented in Appendix 1. The 75th, 50^{th,} and 25th percentiles of these outcome scores were selected as cut-off points for QCA calibration for fully in, crossover, and fully out respectively for use as inputs in the QCA models. The values were 0.64, 0.52 and 0.47 respectively[9]. This also aligned with the authors' assessment of the cases qualitatively. A partially similar procedure was used by Chappin et al. (2015).

Using the case of Kihoto settlement to demonstrate the calibration process; the market provider's interactions were assigned 1. Despite the contractors 0 calibration due to conflictive interactions for example, failing to employ locally, delayed payments after they were forced to employ, and ignoring SEC. The utility delivered water to newly connected households at affordable prices thus a score of 1. The overall aggregation using the *Logical or* function thus was 1. Hierarchical provider's interactions were assigned 0.33 because they largely avoided the upgrading process due to lack of incentive. Residents had even opted to develop ways of collecting their waste as well as unclog drains by themselves since county officials were not reliable. Professional provider's interactions were assigned 0.33. Their availability was very limited when the SEC direly needed them to resolve challenges. Despite their more accommodative infrastructure designs on one end and laxity in supervision which was conflictive in itself, we assigned them this value since their avoidance resulted in protests and undermining of SECs by dwellers. State provider's interactions were assigned 0 as most of their actions were conflictive. For instance, each new politician after elections had interests in replacing SEC with people that helped them in campaigns leading to consistent power struggles. The community reactions to the upgrading were assigned 0 because, in several instances, they protested the upgrading process overriding set communication channels via the SEC.

To calibrate the outcome, five components were implemented in Kihoto. Drainage was assigned 0 because it was not functioning after completion and dwellers were dumping waste into it, floodlights, footpaths, and roads were assigned 1 because they were delivered in a functioning state and were being used

[9] Fully in implies that all cases that scored a value equal or greater than 0.64 were successful, those that scored 0.52 but less than 0.64 were relatively less successful. In contrast, those that scored less than 0.52 but equal or greater than 0.47 were much less successful but performed better than those that scored below 0.47 which were least successful.

appropriately by the dwellers. Water supply was assigned 0.66 because the few dwellers already connected, received water at sufficient quantity and time. The overall score for the outcome for Kihoto was 0.73.

4.4 Results

4.4.1 Necessary and sufficient interactions (conditions) for successful upgrading outcomes

The consistency and coverage scores for the five conditions (Providers interactions and community) reveal that none of the provider groups' salient interactions can be considered a necessary condition for successful upgrading (See Appendix A-8). All the consistency scores of the conditions are below 0.9 (Legewie, 2013) implying that none of them is necessary for successful upgrading.

Analysis of sufficiency resulted in three pathways of provider-dweller interactions that result in success and two that do not result in success for the upgrading process. These results were based on truth tables that detailed 32 possible configurations (of provider-dweller interactions) that result in either a successful and unsuccessful upgrading for each solution. A logical minimization process resulted in an intermediate solution presented in Tables 4.3 and 4.4. The intermediate solution, which we discuss, takes into account logical remainders in line with theoretical expectations during minimization. In both instances, our theoretical expectations were that successful outcomes were associated with the collaborative market and collaborative community causal conditions and set the rest of the conditions to contribute to success whether interactions were collaborative or not.

Generally acceptable consistency cut-offs of 0.8 for the successful and unsuccessful models were used. 12 out of the 32 configurations were matched with the empirical evidence while the rest were logical remainders for both models. The truth table with the 12 configurations is presented in appendix A-2. Tables 4.3 and 4.4 illustrate the intermediate solutions for successful and unsuccessful upgrading outcomes respectively.

Table 4.3: Combinations of conditions that result to successful upgrading outcomes

Causal combinations	Cases	Raw coverage	Unique coverage	Consistency
1. Market*Community*Professionals	Mkomani, JomvuKuu, Kariobangi, Kamere	0.51	0.42	0.95
2. ~Hierarchical*Community*~State*Professional	Karagita, Kamere	0.18	0.09	1
3. ~Hierarchical*Market*~State*~Professional	Rhoda , Kihoto	0.22	0.22	0.99
Solution coverage		**0.81**		
Solution consistency		**0.97**		
consistency cutoff		**0.80**		

Note: *The symbols * and ~ represent an AND combination, and absence of that condition respectively. The numbers represents proportions of a whole.*

Table 4.4: Combinations of conditions that lead to unsuccessful upgrading outcomes

Causal combinations	Cases	Raw coverage	Unique coverage	Consistency
1. ~Hierarchical*~Market*~Professional	Kamukunji, Gilani, Ziwa la Ng'ombe, Munyaka,	0.52	0.34	0.97
2. State*~Professional*~Market	Kaptembwa, Jomvu Mikanjuni, Gilani	0.45	0.27	0.92
Solution coverage		**0.79**		
Solution consistency		**0.93**		
consistency cutoff		**0.80**		

Note: *The symbols * and ~ represent an AND combination, and absence of that condition respectively. The numbers represents proportions of a whole.*

The consistency of the successful solution was 0.97 implying that the solution was 97% consistent with empirical evidence and coverage of 0.81 implying that the solution covers 81% of the empirically observed variation. In this solution, three causal combinations are observed. First, collaborative markets and collaborative professional providers in the context of a collaborative community are sufficient for a successful upgrading. Secondly, collaborative professional providers in a collaborative community during upgrading overcompensate for conflictive hierarchical and conflictive state providers as depicted by the second pathway. Lastly, collaborative market providers overcompensate for conflictive provider groups i.e. hierarchical, professional, and state and are sufficient for successful upgrading.

The unsuccessful solution had a consistency of 0.93 and coverage of 0.79. The first pathway of the failure solution reveals that combinations of conflictive market, conflictive professional, and conflictive hierarchical providers are sufficient for unsuccessful upgrading outcomes. The second pathway presents a combination of conflictive professional, conflictive markets overcompensate for collaborative state providers and are sufficient for unsuccessful upgrading outcomes. The results of the robustness assessment for the analysis did not deviate from the models reported and corresponded with the first success path and are presented in Appendix 5.

Three main aspects summarize the different causal combinations sufficient for successful or unsuccessful upgrading outcomes observed. i) collaborative participation pathways that explore sufficient conditions for success as a result of a combination of collaborative providers i.e. professional, community, and market, ii) Complex participation pathways that unbundle complexities of provider-dweller interactions by showing the ability of some interactions to overcompensate others consequently being sufficient for outcomes and lastly, iii) Conflictive participation pathways that are sufficient for failure. We briefly illustrate these pathways in this section quoting expressions from interviews. For ease of understanding, we refer to the providers directly in our explication.

Collaborative participation pathway

A combination of collaborative market providers, professional providers, and community during upgrading is sufficient for successful outcomes. Using Kariobangi settlement case, the water utility

lowered their tariff at the immediate post-implementation phase facilitating affordable access to water at a shorter distance. Contractors on the other hand employed local labor throughout the project and were willing to collaborate with the SEC from the onset and throughout the upgrading process. Dwellers interviewed reported how smoothly issues were resolved during the implementation phase.

> We discussed with the contractors about employment and they agreed to employ locally especially for jobs that were not very technical … The contractors responded positively about that and the residents were employed and we sorted that issue.[10]

Most issues were handled. They never went unresolved since the upgrading was ongoing. Grievances were resolved there and then once you complain early enough.[11]

The scenario was similar in the Jomvu Kuu settlement where the water utility allowed for flexible payments of connection fees when the residents requested it. This motivated more residents to install household connections.

> We were told it would cost KSh 10,000, to be connected … if you do not have the amount you pay in installments. You do not pay it all, just a bit, you are connected and then you will finish the balance later.[12]

Additionally, the engineers supervising the construction works as well as the contractor enjoyed cordial relationships with the residents. The engineers further allowed for flexible road designs and implementation works ran smoothly as one resident reported,

> There was none [challenge], only these roads, they wanted to make bigger ones but we complained [because of space] ...We agreed with the contractor as per our desire…there was no time we stopped the construction work, because of conflict with the contractor everything went well. He was not rude, he understood.[13]

The SEC relayed all dweller issues as expected and the providers were collaborative throughout the process. This configuration presented a recipe for successful outcomes with projects such as Kariobangi scoring the highest (0.76 out of a possible 1). The collaborative actions by the contractors and the engineers had been outlined in the project preparation reports and reported after relocation action plans which detailed the expected conduct of these actors during the upgrading period (MLHUD, 2014a, 2014d).

Complex participation pathways

Using the second causal combination as an example. Collaborative engineers overcompensate for conflictive county officials and are sufficient for success in collaborative communities. Similar to the collaborative participation pathway, in Karagita and Kamere settlements, the SECs were able to counter conflictive political actions. The community had also established ways of filling gaps as a result of county officials sub optimally performing their duties. The residents interviewed did not report any conflicts during their interactions between the engineers and the residents in the two settlements.

[10] Interview, First Kariobangi Settlement dweller, October 2019-January 2020
[11] Interview, Second Kariobangi settlement dweller, October 2019-January 2020
[12] Interview, First Jomvu Kuu Settlement dweller, October 2019-January 2020
[13] Interview, Second Jomvu Kuu Settlement dweller, October 2019-January 2020

In Karagita for example, one resident narrated how they stood their ground despite political interests and influences by local politicians,

> For example, from the time we were elected [by the community] 8 years ago, the member of the county assembly who was there is not the one present now. The one who was there at the time the project was initiated knew the rules but the present one did not. When he was elected, he aggressively pushed to replace the committee [SEC] with people of his choice. We knew it was impossible because the project was not politically related. We had issues before he agreed to work with this committee and it took time but he eventually had to work with us. The challenge was that some people who earlier campaigned for him wanted our positions … He had to work with us because he realized that he had no powers over the committee members.[14]

The failure of county officials to collect garbage prompted the community to organize themselves and develop a per plot garbage collection system. One resident narrated how this system works countering the nonexistent government garbage collection in Karagita in turn reducing solid waste that may otherwise end up deposited on infrastructure. There is also some early evidence of this practice when the upgrading commenced in 2013 with about 17 percent of the residents reporting having a garbage collection system (MLHUD, 2014b).

> **…** we have private projects that charge for and collect the garbage on Wednesday… and on Friday … You pay Ksh1000, per residential plot, and they collect for four days per month **…** so it depends if there are other caretakers… but those who carry the garbage do not charge per tenant, they charge per residential plot.[15]

SECs played a major role in ensuring that they relayed dweller issues promptly and stood their ground in instances where their authority was questioned. This combined with engineers who designed in consideration to existing spaces overcompensated for any other noncollaborative providers. The result of this path was relatively successful upgrading outcomes, 58 percent and 73 percent in Karagita and Kamere respectively. The third success causal combination and the second unsuccessful causal combination also display similar overcompensation characteristics by some interactions to either lead to success or failure

Conflictive participation pathways

The first unsuccessful causal combination reinforces the hypothesis that missing collaborative interactions result in unsuccessful outcomes. In the case of Munyaka settlements, dweller priorities were completely overlooked. For example, engineers designed for ablution blocks while residents had prioritized a sewer line, refused to offer platforms where SECs could ask questions, and cut off SECs as soon as they gained entry into the settlement. Similarly, contractors failed to employ locally, closed out SECs from technical meetings, and constructed where it was convenient for them as opposed to where dwellers wanted. Most SEC members withdrew during the implementation phase as they claimed that they "were used as rubberstamps" just for providers to find a way into the settlement. The community just ignored the providers as they went on with their work as it did not significantly disrupt their livelihoods. This resulted

[14] Interview, First Karagita Settlement dweller-SEC, October 2019-January 2020
[15] Interview, Second Karagita settlement dweller-Elder, October 2019-January 2020

in projects that performed dismally, based on our assessment, with scores as low as 0.17 out of a possible 1.

4.5 Discussion

Our starting hypothesis was that collaborative interactions between providers and dwellers are decisive for successful upgrading outcomes. However, from practice, consistently collaborative interactions for all providers are seldom present, very few upgrading projects have been fully successful and fewer have scaled beyond pilots. Our results affirm that it is not only the presence of collaboration in provider-dweller interactions that is sufficient for successful upgrading outcomes, other combinations of provider-dweller interactions can also overcompensate for each other and result in success. This aligns with Kiefer and Ranganathan (2018b)'s upgrading study in Cape Town whose findings demonstrate that some upgrading projects succeed due to productive tension among actors and Sibyan (2020)'s upgrading cases in Turkey and Indonesia which attribute failure to conflicting perspectives of actors. In this section, we extend their findings by demonstrating how the actor interactions combine in our analysis.

Conjointly interpreting the first success causal combination and the first unsuccessful causal combination, collaboration with dwellers is important for providers to lead to successful upgrading outcomes. Failure to collaborate results in unsuccessful outcomes. This strongly resonates with the urge for transparent and meaningful participation of the settlement community, which has been emphasized in much of the literature on participation (Patel, 2013). However, we extend this insight in two important respects: first, we demonstrate that participation means different things to different actors. Each provider group needs a specific approach to align with the needs and preferences of the local community. Second, participation should not be limited to a one-shot intervention but needs to be enacted over the full cycle of upgrading projects by all actors. This insight speaks in particular against a dominant technocratic approach to upgrading primarily following a professional logic of engineers and planners highlighted in other places such as Morocco (Bogaert, 2018). Similar findings are recorded in Thailand's Baan Mankong program, where community representatives are also part of the program's implementing agency's board. Similarly in Mumbai's community toilets, where designs took into account the specific needs of women and children and the payment systems and ensured that all could afford thus complementing their livelihood contexts (Lucci et al., 2015). Other studies such as Patel (2013) also implicitly posit this.

The two configurations i.e. first and second success causal combinations suggest that collaborative professionals, represented by engineers, play a key role in ensuring successful outcomes during upgrading; their actions may overcompensate for conflictive politicians in contexts of collaborative communities**.** Lack of success on the other hand is almost an immediate consequence of conflictive interactions with market actors and engineers as observed in the unsuccessful paths. Sibyan (2020) reports a similar finding but their study does not analyze how these actors' perspectives configure to result in different outcomes. A major reason for engineers' poor interactions with communities lies in the presumption that settlement dwellers do not understand key technical information nor provide meaningful technical recommendations during the upgrading process. This resonates with Chambers (1994) views on how professionals lack capabilities to enable local people to express, share and extend their knowledge. This view is essentially congruent with the "exchange of knowledge" rationale that we associated with the conventional view on participation in the introductory section. As we can illustrate with our analysis, this view is too narrow, as it is the dwellers that negotiate the settlements daily.

Failure to realign designs and service offerings to the needs of settlement dwellers was often explained by engineers to the SEC simply as the "logical thing to do" technologically or resource-wise. This was very

difficult for the SEC to relay to the rest of the community since most of the SECs never got access to bills of quantities. Neither were they included in technical meetings where changes in projects' scopes were initiated. This attitude often resulted in conflictive interactions with the consequence that dwellers started to not accept or even started to vandalize the offerings and infrastructures. In turn, these actions led to even more strained relationships since communities often interpret them negatively, bordering on corruption allegations. For instance, they did not understand why they could not access information for a project being implemented in their settlement for their benefit. Other times, the new infrastructures and service offerings misalign with their livelihood strategies. Different professional disciplines are gradually noticing this challenge and are recommending a better understanding of informal settlements (Dovey, 2013). One SEC lamented on reasons concerning this;

> …they [providers] never involved anybody in their technical meetings, at one point we had to stop the project for a while… when we asked to see those BQ's [Bill of quantities] they were very angry, they were even closing doors when in those meetings, it brought a lot of conflicts that even caused, demonstrations by the community … the road was ours, what's the problem showing us these details even if we don't have the knowhow?[16]

This committee was just to blind the people, I was there I saw it. People who came from Nairobi [KISIP] had very good intentions but people who were left behind (other providers) are the ones to blame.[17]

Collaborative market providers' interactions with the dwellers also feature prominently in two out of the three success pathways and in the failure model. This suggests that configurations that involve collaborative market actors play a key role in enabling the success of upgrading processes. This is especially due to their capacity to overcompensate for non-collaborative engineers, county officials, and politicians' interactions during upgrading even in conflictive communities as demonstrated in the third success path.

Market actors are largely guided by profits, reducing transaction costs, and the ability of consumers to pay for services offered. However, in uncertain socioeconomic conditions such as informal settlements, innovative ways of providing offerings are essential to cater to the poor who cannot afford the services often because of high initial charges or rigid payment modes. Often water utilities approach informal settlements residents with similar tariffs to those of other residents who are better off. Consequently, these results in unserved residents who either do not connect to the pipe networks installed or are later disconnected since they are unable to pay bills, as is the case of settlements such as Swahili. An additional reason observed is a lack of incentive to connect in Gilani settlement since there was an already existing sewer. Failure due to non-collaborative market logics have also been observed elsewhere in the literature (McGranahan, 2015; Sibyan, 2020). Other market actions that distorted relationships between market actors and dwellers included contractors who failed to pay workers or pay them below expected wages, employing from outside the settlement to avoid retraining, using substandard materials, or generally avoiding inquiries from the residents. All these actions in one way or another reduce direct or overhead project implementation costs. This favors contractors at the expense of the dwellers.

The SECs played a pivotal role in coordinating activities initiated by the different actor groups. This is visible from the presence of collaborative communities in two out of the three success paths. They were however constrained by lack of or poor facilitation, declined community trust, lack of capacity in conflict resolution,

[16] Interview, Gilani Settlement dweller-SEC, October 2019-January 2020
[17] Interview, Munyaka Settlement dweller-SEC, October 2019-January 2020

being directly sidelined by some providers, having to deal with unfulfilled promises and tokenistic tendencies by different provider groups. While they could manage to handle some challenges and relay them through set communication channels, they often withdrew back to the community creating voids in the communication channels when the pressure became too much. Consequently, these voids escalated to protests by the dwellers in some settlements. Such instances have been observed in other upgrading projects especially in India and elsewhere (De Geest & De Nys-Ketels, 2019; Nuijten et al., 2012).

Theoretically, collaborative market logic appeared to overcompensate (at least under certain conditions) for non-collaborative hierarchal logic, state logic, and professional logic to lead to success in the third success pathway. This is a contribution to theory as it suggests that success can be achieved when different provider groups' logics align with community logics. Therefore, providers must develop capabilities that improve their ability to bridge to the community logic where they anticipate implementing projects. This echoes and extends recent and similar evidence of the capability of bridging logics by different actors to achieve different outcomes (Dovey, 2013; Venkataraman et al., 2016). It extends this by demonstrating how these capabilities are different for an environment with more than two logics at play and how the inability to acquire them influences material outcomes.

4.6 Conclusion

The objective of this paper was to establish how constellations of participation, perceived as the totality of interactions between different providers and dwellers, combine and impact the outcomes of informal settlement upgrading processes. Our sample enables us to draw implications both at the practical level for informal settlements, conceptual and methodological levels for urban studies, and other disciplines.

Based on the findings of this study, we outline four key policy recommendations. First, participation as often described in practice, as planners consulting or informing the community, and as the involvement of communities in prioritization of solutions only at the initial stages does not always guarantee successful project outcomes. Rather, in practice, participation requires to be extended further to both implementation and post-implementation stages and should be perceived in terms of interactions by multiple actors guided by distinct norms, values and codes of operation and not just limited to planners to guarantee positive outcomes. Secondly, a combination of collaborative interactions by market and professional providers, and collaborative communities is important and sufficient to lead to successful upgrading outcomes. This is a strong lesson against technocratic project implementation. Third, successful upgrading outcomes may be achieved by different provider-dweller configurations. Lastly, while settlement representatives play a key role in upgrading, it is key to understand their associated challenges and capabilities as well as the backing they maintain from the dwellers throughout the process. These are key traits that planners in charge of selecting some of the providers should look out for.

Conceptually, we link participation to institutional logics, which systematically enables aggregating different actor types based on specifying optimal ways for participation as they conduct their roles. We demonstrate that a differentiated view on how to combine provider logics with community logics influences material outcomes of upgrading projects. This is useful in stakeholder analysis exercises that are essential in urban projects and beyond. We suggest further research on how different actor groups could build capabilities to bridge their rationalities and expectations with those of settlement dwellers. However, our approach is limited in terms of temporal sequences of events, and therefore process tracing studies could provide additional insight into success conditions specific to upgrading projects.

Finally, we offer methodological insights informed by the use of QCA and the structuration of actors for upgrading and other programs. This is useful in larger urban initiatives that comprise many actors as demonstrated by (Kotus, 2013) and is not limited to the global south. This approach has the potential to transform how monitoring and evaluation for participatory processes are conducted by systemizing it in upgrading and developmental projects.

Chapter 5: Learning as an avenue for improving livelihoods in global south cities[18]

Abstract

For implementers, improving infrastructures in informal settlements is daunting due to the limits in forecasting all the dynamics that could make such programs fail. This calls for learning within the program's timeline to navigate daily challenges. This paper explores the role of learning as a means to influence program outcomes within the program's timeline. We situate upgrading challenges within individual upgrading processes to systemize the many challenges experienced during upgrading borrowing from organizational learning insights. Findings indicate that learning can improve program outcomes and well-conceptualized recursive processes that include participation, coordination, communication, and synthesizing information are essential though insufficient for it. Learning barriers include a sudden increase in the number and diversity of program team members and projects, their deteriorating commitment, inequitable incentives, and ineffective/missing tools to support learning. These factors ought to be factored into program design and should be monitored and assessed by implementers.

[18] Wainaina, G. K., Truffer, B., Lüthi, C., & Mang'ira, P. (accepted). We plan; we do, how do we learn? Role of learning in improving outcomes of slum upgrading programs. *Evironment and Urbanization*.

5.1 Introduction

In the wake of the current century, awareness of the challenges posed by informal settlements has been increasing. Despite efforts to improve them, there was and still is a dire need to scale such localized efforts to citywide and nationwide scales for the over 1 billion residents living there (Cities Alliance, 2003; UN Habitat, 2015, 2021). Different countries globally have and are establishing nationwide upgrading programs to improve the living conditions of the urban poor (Bah et al., 2018; French et al., 2019), a shift towards aggregating individual projects and achieving strategic goals. More recently, UN Habitat (2015) has advocated for citywide programs linked to nationwide strategies and actively engages in conferences to seek strategies for improving and scaling upgrading interventions (e.g. UN Habitat (2021)). These employ a programmatic approach that strategically aims at achieving scale, addressing citywide issues, and overcoming scaling needs beyond settlements. Such programs are characterized by multiple and spatially disaggregated local projects that are implemented concurrently or sequentially, and their cumulative performance aggregate to form program outcomes. The programs are plagued by inherent challenges associated with multiple projects' preparation and implementation processes, and the projects' outcomes, that inhibit scaling, which program teams have to navigate (PMBOK® Guide, 2021, p. 73). How program management teams can forecast and resolve the challenges remains an open question especially for upgrading programs which by nature are in precarious empirical contexts.

This paper explores the role of learning as a means for program management teams to navigate through challenges in processes and influence the outcomes of upgrading programs. We depart from the assumption that upgrading programs are organizations that govern multiple projects with the intent to achieve cumulative strategic benefits that individual projects fail to (Müller et al., 2016; PMBOK® Guide, 2021; Turkulainen et al., 2015; Weaver, 2010). These programs face many challenges due to their complexity and the result is often overall inefficient processes in terms of timelines, costs, scope, quality, and ineffectiveness i.e. the program's outcomes fit within the livelihoods of the residents and as a result, are poorly adopted by end users (De Toni & Pessot, 2021; Wainaina et al., Submitted). Challenges here refer to barriers encountered by implementers while achieving their tasks individually or collectively, which hinder the program from achieving its goals (Argote et al., 2021).

Most of the processes are decisive for upgrading outcomes and that make up projects and programs and can be assessed and evaluated independently. We classify them into sequential and recursive processes. Sequential processes refer to the unit and prescribed tasks with actors and set rules and structures, that can be evaluated individually and without which at a given time, upgrading overall cannot proceed. They form a chain of linked processes critical for the project timeline and can be planned and sequenced linearly. They include processes such as project design, procurement, infrastructure construction, supervision and monitoring at scheduled intervals, and project termination process among others (UN Habitat, 2015). Recursive processes on the other hand occur concurrently with the sequential processes throughout the project timeline but occur in short and frequent unpredictable cycles on a need basis. These include participation (implying involvement), coordination, communication, collaboration, and cooperation, and are often structured but their time of occurrence cannot be predefined. They are essential for informing deficiencies and offering means to effect solutions for sequential processes. They can also be deficient. Due to the concurrent relationship between recursive and sequential processes, it is difficult for program management teams to forecast when, how, and where (spatially) these processes

would fail (De Toni & Pessot, 2021) and program teams have to grapple with them when they unexpectedly occur.

The concept of unit processes is useful as a means to aggregate, systemize and understand the many challenges that occur in programs. It explains in which processes the challenges occur, how they occur, are or can be addressed and resolved, spread or not in time, and how they influence the implementation process and outcomes of projects and overall programs. This is a gap that has not been explored as studies in upgrading largely focus on the effect of an individual unit process on upgrading outcomes (see Patel (2013) or Meredith and MacDonald (2017) for instance). A core question arises; how can implementers identify deficient processes, and improve their efficiency and subsequently, overall program outcomes? To answer this, we explore concepts from organizational learning (OL). OL explores means by which an organization gains experience while performing a process and converts that experience to knowledge, which in turn alters the way the organization performs the said process and others with the intent of improving its performance (Argote et al., 2021; De Toni & Pessot, 2021). Based on OL, we define program learning as a means and not an end by which program implementers improve the performance of upgrading processes leading to better outcomes of projects for the cumulative benefit of the overall program.

To identify what the contribution of program learning could be in informal settlement upgrading programs, we study its pitfalls in KISIP (Kenya Informal Settlements Improvement Program). In addition, we explore how alternative outcomes could have been reached due to improved learning. This is not to imply that KISIP failed at large. KISIP's first phase was implemented from 2011 to 2020 in Kenya and has recently been extended into a second phase. It is an exemplary case for analysis due to the complexities and dynamics it exhibited, its recency in completion, availability of data, its size, and the possibility for the World Bank to act as a likely diffusion channel for knowledge accumulated to future programs nationally and globally. Projects under KISIP took place simultaneously in different settlements all over Kenya but often with different start and completion dates. They were all focused on improving the living standards in informal settlements (WorldBank, 2011). This study followed a case study approach, which allowed for analysis of how the program management team identified deficient processes through their interactions with other stakeholders and how they resolved them including the barriers experienced.

Findings demonstrate that program learning can improve the performance of programs. Participation, communication, and coordination are necessary conditions for program learning and conceptually anchor projects to the overall program. However, these are not sufficient for learning to occur at least in the case of KISIP. Human factors such as the inadequate commitment of some of the program team members, technocratic tendencies by implementing actors, and limited capacities to absorb, integrate and synthesize insights are core barriers to learning. In addition, structural elements including incentives to participate, platforms, and tools for learning and knowledge management must be available to enable learning to occur.

The follow-up section explores the OL and project management literature, to characterize and systemize challenges and derive a framework for analysis for this study. Section 3 describes KISIP as a complex program and the methodology followed by this study. Section 4 reconstructs and explores the empirical findings by demonstrating processes that were deficient and characterizes program learning and its deficiencies in KISIP. This is followed by a discussion of the findings in Section 5 which focuses on barriers

to learning for KISIP. The conclusion in Section 6 summarizes three contributions that emphasize a better conception of recursive processes, their role in program learning, and core structural aspects of programs that aid learning.

5.2 Literature review

Empirically, the challenge of successfully implementing informal settlement upgrading projects and programs has been daunting and implementers grapple to find a balance between efficiently completing planned programs and ensuring the effectiveness of the program outcomes (Bah et al., 2018; Boanada-Fuchs & Rohner, 2021; UN Habitat, 2015). Many programs have performed sub-optimally due to deficits in implementation or poor adoption due to misalignments with the livelihoods of residents (Cherunya, Ahlborg, et al., 2020; Chidambaram, 2020; Massey, 2014; Wainaina et al., Submitted; Wainaina et al., 2022). Those termed as successful often report measures at the output level and not the outcome, for instance, the number of households connected to water infrastructure and not those households receiving the water consistently (World Bank, 2020). Both effectiveness and efficiency are measures of outcomes and the program teams ideally target to maximize both despite their competing nature. Successful projects and programs are characterized by their implementation efficiency whose attributes comprise completion within planned cost, expected quality, scope, and time. In addition, they are also characterized by the effectiveness of their outputs, which comprises positive influence on the program team, stakeholder satisfaction, strategic contribution to the parent organization, and fit within a social context (Davis, 2017; Imam & Zaheer, 2021; PMBOK® Guide, 2021; Shao, 2018; Shao & Müller, 2011; Shao et al., 2012).

5.2.1 Programs and associated processes

Program implementers strive to conduct processes successfully (McNamara, 2012; PMBOK® Guide, 2021). However, they cannot predict all deficiencies before the implementation of projects yet such always arise (Mossalam, 2018) especially when the processes face challenges due to complexities associated with diversity, interdependence, dynamicity, and uncertainty (De Toni & Pessot, 2021). Diversity relates to the different types, varied numbers, and heterogeneity of stakeholders and the variety of projects within the program including management hierarchies. Interdependence relates to the interactions and connections among elements in programs that have to be coordinated. Dynamicity relates to time aspects such as rate of delivery or compounding challenges in the evolution of programs. Lastly, uncertainty relates to the unknowns in the program due to novelty, experience, and availability of information. Such challenges have to be resolved to ensure the achievement of program goals while at the same time serving the needs of stakeholders.

The performance of programs reduces drastically if recursive or sequential processes are deficient. For instance, studies have shown that participation is often limited in projects leading to infrastructures that remain unused as the end users' views are ignored (Massey, 2014; Wainaina et al., 2022). In addition, it may take more time than expected and require more specialized skills subsequently increasing project budgets and timelines, which are scenarios that cannot be succinctly planned (Meredith & MacDonald, 2017; Patel, 2013). Other studies have shown that achieving successful infrastructure adoption can be influenced by the type of infrastructure and means by which residents normally fulfill their basic needs (Chidambaram, 2020; Wainaina et al., Submitted).

Select processes are regularly reported as deficient in upgrading programs. Such sequential ones include complex and rigid procurement processes (Magalhães et al., 2016), limited infrastructure adoption (Massey, 2014; Wainaina et al., Submitted), and poor quality infrastructure construction (Chaudhuri, 2017; Magalhães et al., 2016). Recursive ones include participation as a process for establishing and managing modalities for the involvement of the program team and other stakeholders in resolving challenges and making decisions in a project (French et al., 2019; Koster & Nuijten, 2012; Patel, 2013; UN Habitat, 2015; Wainaina et al., 2022). Collaboration albeit implicitly as a process where actors co-create knowledge to achieve solutions to challenges (French et al., 2019; Koster & Nuijten, 2012). Coordination as a process for information flows to and from relevant stakeholders in a project (French et al., 2019; Muggah, 2014). Communication as a process where information is exchanged (De Geest & De Nys-Ketels, 2019; Forcada Matheu et al., 2017) and overall management (Meredith & MacDonald, 2017). The studies commonly highlight the deficiencies in the process and offer recommendations for resolving them from a researcher's view. They often fail to analyze how or whether program management teams knew about and attempted to resolve the deficiencies, thus only presenting a perspective that overlooks their efforts. To explain and explore this, organizational learning literature provides useful insights.

5.2.2 Organizational learning and link to programs

Organizational learning is characterized by interconnected concepts that include knowledge search, creation, retention, and transfer (Argote, 2012; Argote et al., 2021; De Toni & Pessot, 2021). Knowledge search is characterized by the intent of the organization to seek solutions for its current or anticipated challenges, which may act as hindrances in achieving its objectives (Argote et al., 2021). The search process can be oriented towards other organizations for instance in benchmarking exercises, which are explorative, seeking new knowledge. On the other hand, it can be oriented within the organization, for instance when an organization seeks to refine existing knowledge stocks, which is exploitative (based on March (1991)'s seminal work). Knowledge search in programs is anchored on the participation and capabilities of members of the program team and other stakeholders in identifying and communicating relevant deficiencies without distortion, and the core intent of the management team to actively pursue and effect it (Migdadi, 2019).

The knowledge creation process involves extracting, structuring, and organizing insights-–synthesizing—from varied processes for use to improve organizational outcomes (De Toni & Pessot, 2021). It requires collaboration, coordination, and communication among program team members as well as capabilities to understand and integrate different types of data and their relevance to the program (Blomqvist & Levy, 2006). Subsequently, the knowledge created in organizations is often retained in knowledge management systems that can comprise technological and human management aspects. The knowledge retention process involves storing and maintaining knowledge in repositories such as individual routines, manuals, or as transactive memory and associated knowledge management systems (Argote, 2012). To access retained knowledge, communication as well as team member attributes such as the willingness of team members to participate and trust play a key role (Migdadi, 2019). Lastly, the knowledge transfer process can be intentional or unintentional and involves passing knowledge gained from one unit to other units of the organization or to other organizations and vice versa for use to improve the overall organizational performance (Argote & Ingram, 2000; De Toni & Pessot, 2021). This also requires collaboration, communication, and coordination.

The concepts discussed are influenced by the nature of experience and organization or in our case program context (Argote et al., 2021). According to Argote et al. (2021), experience implies the performance of an individual process. For informal settlement programs, this would imply performing unit processes that can be considered successful or failed, which cumulatively influence the overall performance of the program. Experiences are characterized by factors such as novelty, whether a previous and similar experience was a success or failure, heterogeneity, and the timing when a challenge occurs (Argote et al., 2021). Previous literature has enumerated multiple elements of internal organizational context which comprises the organizational culture, its structure, and identity (Argote et al., 2021; Porter & McLaughlin, 2006). We do not focus on the external context such as the degree of regulation or competitiveness in this study. The elements of focus include culture and structure for instance slack resources, power and status, time and absorptive capacity, the extent of specialization, members' capacity and capability, existing tools and processes within the organization, and incentives. In essence, how processes interact with this context determines how effective learning occurs.

Based on this literature, program learning has the identification, transmission, and resolution components. It is a means to improve program outcomes whereby a program team identifies deficient unit processes, communicates these to the program management team through the program structure who collaboratively devise solutions to the deficiencies, and subsequently communicates them to the overall program team members including those not involved in the identification of the deficiency. In addition, the solutions are retained in the program for subsequent reference. The devised solutions could be within the means outlined in the program design or from knowledge generated from previous experiences in the program. Examples of typical solutions would include but are not limited to increasing incentives for participation, providing platforms for effective communication, and improving information absorptive capacity among others.

With this definition of program learning in the background, the following can be posited. Program learning has a role as a means to improve program outcomes by enabling rapid identification of deficient processes (both recursive and sequential) by the program management team even when they occur unexpectedly and addressing them within program timelines. We demonstrate whether learning occurs and if not provide reasons. In addition, we recommend how the program structure can be improved.

5.3 Methodology

KISIP was selected as an exemplary case of a nationwide upgrading program that was relatively successful. In World Bank standards, it was rated satisfactory implying that "there were minor shortcomings in the operation's achievement of its objectives, in its efficiency, or its relevance" (World Bank Group, 2020). Its goal was to improve the living conditions in informal settlements. It has close similarities to other recent upgrading programs and follows the scaling trajectory of future ones (See Bah et al. (2018) for other recent and similar examples). It was a significant pilot program for World Bank and the Kenyan government and was funded at US$ 165 million for the first phase that was conceptualized in 2009 and was expected to run up to 2016 but ran through to 2020 (WorldBank, 2011). The program is currently in its second phase which became effective in 2021 and will close in 2025. We only focus on the infrastructure investments aspect of the program.

KISIP presented an exemplary case to engage complexities faced by urban projects and programs and is representative of many ongoing and future programs as slum upgrading through the provision of basic

infrastructure remains the most preferred method of ameliorating the lives of the urban poor (UN Habitat, 2015). First, it was very diverse, covering 80 informal settlements in 15 urban areas in Kenya. Each settlement in our case represents a local project contributing to KISIP as the overall program. Diversity also manifested in the different infrastructure interventions under each project in the program. At least three of seven infrastructures —water reticulation, roads, footpaths, drainage, security lights, ablution blocks, and solid waste management units—were implemented in a single settlement simultaneously. The average was five infrastructures for the settlements visited. Execution of each project in the settlement followed the preparation, implementation, and post-implementation phases. Secondly, the program team structure was diversely constituted. Each settlement had its community representative committee, multiple committees in a given region were ideally under the coordination of a county team and all county teams operated under the national coordinating team, which was in charge of program management activities and decision making. The program team also had to interact with other stakeholders such as World Bank technical teams, government auditors, the community, politicians, consultants, and contractors who influenced or contributed to the program on a need basis. This is illustrated in Figure 5.1. Third, there was a myriad of uncertainty mainly in how residents would react to the upgrading process due to previous mistrust relations with the government and effects due to overall governance changes in Kenya associated with devolution of administrative units and authorities from previous centralized modes as a result of the 2010 constitution. Lastly, challenges in program implementation influenced the process and outcomes of the program and could not be effectively anticipated.

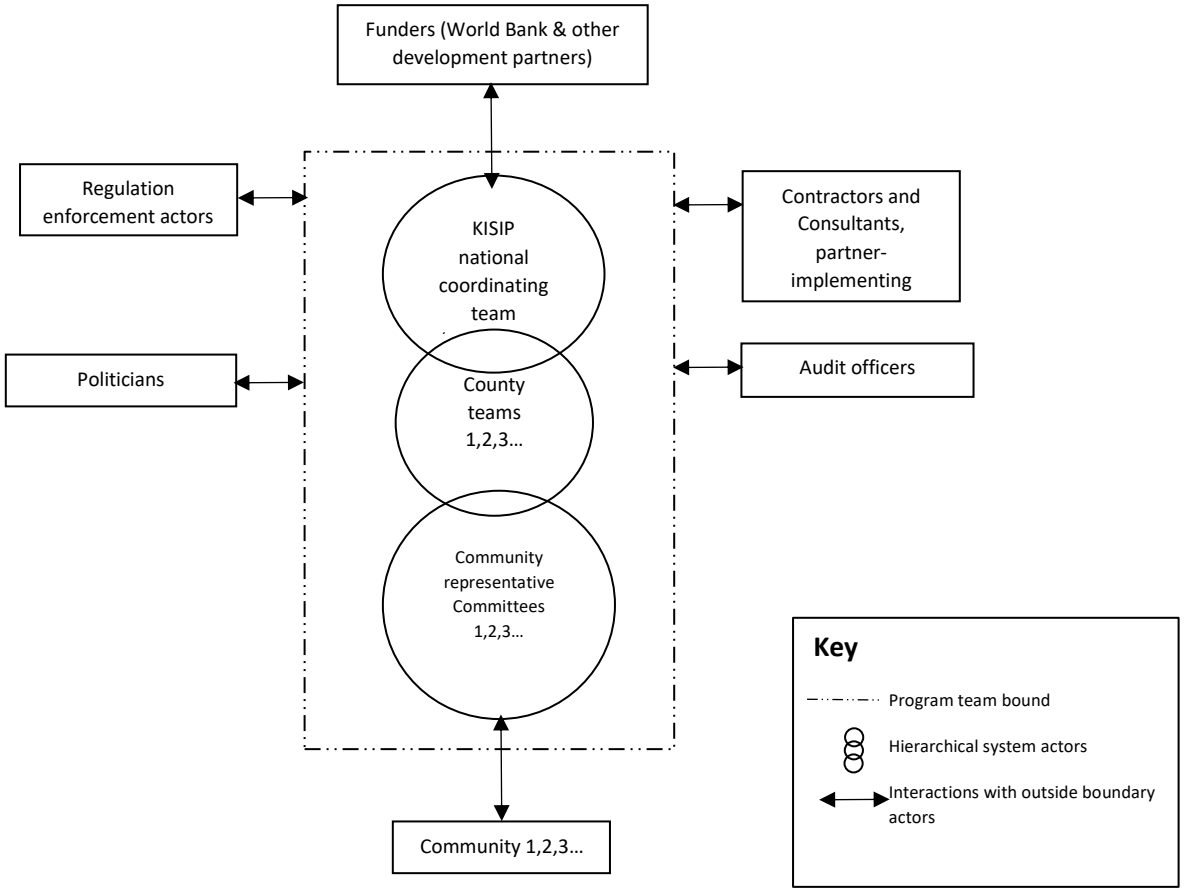

Figure 5.1 Illustration of the structure of KISIP based as conceptualized by the first author

The study followed a qualitative methodology and employed an abductive approach to case research (Dubois & Gadde, 2002). This approach allows for constant iterations between theory and empirical observations consequently improving explanations of different phenomena. Both primary and secondary data were collected by the first author through two campaigns in late 2019 and from August to November 2021. The datasets included 37 interviews with informants from funders (2), 6 KISIP national team, 4 county team members, 23 community representatives, and 2 consultants. In addition to the interviews, 33 reports specific to KISIP, 19 of which were annual implementation status reports, 7 annual audit reports, 2 completion reports, and 5 design phase reports were included in the study[19]. Field observations in 15 informal settlements where projects were already implemented were further conducted to ascertain claims from secondary documents and interviews as well as observe how residents were using the infrastructure conducted under the project.

Interview data was translated and transcribed. Together with the reports, they were analyzed using thematic analysis. Deficiencies during the implementation of KISIP's projects were identified through granular level codes, aggregated to their specific upgrading processes. How these challenges were resolved or not was also coded. The codes were then aggregated to themes that explored barriers to learning for the program management team. This analysis intended to identify how or whether the program management team learned of these deficiencies in KISIP's processes in time, how they resolved them and what challenges were associated with this.

5.4 Findings

5.4.1 Reconstructing the KISIP program, 2011 to 2020: *Setting stage for KISIP*

KISIP was planned to run from 2011 to 2016. However, in 2012, it was still at its inception and appraisal stages and had to be restructured in 2015 to accommodate new funding that was availed. Fifteen towns were identified and 15 informal settlements were included for the first year of investment (WorldBank, 2011). In 2011, the national coordinating team and the program management guidelines that would guide processes were established. The core guidelines included the resettlement policy framework that would guide planning for resettlement and redress of grievances due to any displacements as a result of infrastructure works (MoH, 2011). The processes outlined then included planning for relocations and grievance redress. Secondly, the environmental and social management framework focused on the assessment of environmental impact (GoK, 2014). Thirdly, the procurement plan outlined expertise and services that needed to be acquired based on national-level guidelines and accountability checks from World Bank. Lastly, a monitoring report to outline progress. These guidelines and documents were developed in collaboration with the municipalities (later subsumed by counties), the residents in informal settlements and consultants, and would act as guiding templates for project level activities (see examples in GoK (2014 p.iv)).

Commencement and execution of projects

[19] All these reports can be found at https://documents.worldbank.org/en/publication/documents-reports/documentlist?qterm=KISIP&srt=docdt&order=asc

Towards the end of 2012, baseline studies including socio-economic surveys, environmental and social impact assessments, as well as Relocation Action Plans that assessed and informed of impacts, and redress mechanisms in selected settlements, commenced through consultants procured by the coordinating team for settlements in Nakuru, Eldoret and Mombasa towns. These were completed in 2013 including infrastructure design works and procurement of contractors responsible for construction works. However, construction work could not commence since the resettlement action plans had not been implemented and the affected persons had not been relocated from wayleaves. The national coordination team together with the county level team and the community representatives had to conduct these, including addressing grievances, before commencement.

In 2014 the coordinating team faced the realities at the settlements, increased workload as well as devolution of spatial and administrative units of governance that put the program structure to test. The coordination team through county representatives, community leaders, and the residents of the settlements commenced community mobilization with public gatherings at the settlement and with local leaders. This culminated in the election of community representatives—settlement executive committees and the grievance redress committees. The committees comprised on average 18 representatives for each settlement that were inclusive in terms of gender, housing tenure, and disability among other considerations. This was done for settlements in Nakuru, Eldoret, and Mombasa, and construction works commenced in the settlements after the validation of resettlement action plans by the residents. This was evidenced at all preparation stages of projects as reported by all interviewees, program, and project reports. In the background, the program team was also facilitating capacity development for county teams and procuring supervising consultants for the infrastructure works, and concurrently overseeing the development of baseline studies and resettlement action plans for other urban areas namely, Nairobi Machakos and Nairobi towns.

Beyond the program, two things happened: the structure of the government of Kenya changed due to elections that saw the implementation of a new constitution that introduced counties, and thus the municipalities were no longer a unit for operation, specifically coordination with the settlements as envisioned by KISIP earlier. Accordingly, KISIP's structure had to evolve and include new community representatives and new county officials who were not part of its inception while retaining some municipal officials that were initially there. Secondly, KISIP received additional funding from SIDA and AFD and had to establish modalities of including it in its operations. At this point, the coordinating team through their biannual monitoring exercises already acknowledged that the program could not be completed in 2016 as earlier planned due to additional funding and scope.

Rapid accumulation of projects in the program

From 2015, projects accumulated rapidly. 19 out of 108 construction contracts were underway and more baseline studies and resettlement plans were being conducted and needed validation, all of which were the responsibility of the management team. Notably, the construction of 22 security high mast floodlights was already complete in the settlements where construction works had started earlier. The program was restructured to accommodate additional funding that was availed in that year. Notably, the results framework for the monitoring exercise was revised in 2016. A key indicator that was removed reported the number of infrastructures that were functional one year after project completion and maintenance plans in place. As of 2016, construction works were being undertaken concurrently in 27 settlements and more baseline and resettlement planning was ongoing for additional settlements. This increased to 36 in

2018. More funding from AFD was also secured and the closure dates for the program were extended to 2018.

Closure of projects, program, and overall outcomes

It was unclear to the residents when each project closed. Construction of individual infrastructures in projects was completed at different times and community representatives did not report official handovers of the projects to their knowledge. Officially, the program closed in November 2019 with some projects still ongoing. Overall, floodlights took shorter times to complete as compared to all other infrastructures and were relatively effective in day-to-day improvement of security among the residents but often went unrepaired in case of breakdown. Though most roads were constructed to acceptable standards, they often took longer to construct than planned and often did not consider alternative ways by which residents used such open spaces for instance as markets (Wainaina et al., Submitted). The case was similar for drainage systems that were often clogged as residents disposed of wastes or exacerbated flooding in other areas of the settlements. Ablution blocks and solid waste management units were completed in time and of acceptable quality but few were in use and some were even vandalized. None of the solid waste units visited was in use. The water reticulation systems were effective. In the end, the interviewed community representatives were distrustful of the implementers and felt used at the end of the projects in some of the settlements visited. Those aggrieved were unwilling to be involved in the implementation of similar projects again. They argued that while the management team and consultants who approached them at the onset of projects engaged them productively to gain entry into the settlements, those that executed the projects often ignored their views.

In sum, the sequential processes identified in KISIP included the selection of benefitting settlements, procurement of contractors and consultants, assessment of baselines status of the settlements, planning for relocations, and grievance redress, which comprised the preparation phase of the multiple projects. These were followed by infrastructure construction and periodic supervision at the implementation stage, and adoption of infrastructures at the post-implementation stage. Periodic monitoring (biannual) at the project level only occurred in the preparation and implementation phases of projects but not at post-implementation, while evaluation studies occurred towards the end of the program. All these were to some extent guided by templates developed before the commencement of the projects. Recursive processes included participation only in the form of consultation mostly in the preparation phase of the projects, communication with fellow team members and stakeholders, collaboration to seek solutions, and coordination to aid the transmission of information along the management hierarchy. These were not clearly outlined or detailed before the commencement of projects. For instance, there was information on the importance of participation from the onset but how to execute effectively was not clear nor monitored.

5.4.2 Dynamics between learning and program processes, and resultant program impacts

Procurement delays and rigidity due to the structure of the process itself and the limited capacity of the management team on World Bank procurement processes was a deficiency that the management team and the auditors immediately identified and recorded. It was documented and communicated especially by the auditors repeatedly between 2014 and 2016 and acknowledged in later reports by the World Bank (World Bank, 2020) to the coordinating team. However, the coordinating team was limited in resolving this deficiency since national and World Bank guidelines that required accountability checks could not be

altered and these subsequently lengthened the process leading to delayed timelines. While this was common knowledge at the management team level, other members of the program team at the local level were not aware and misinterpreted it to imply that the projects had stalled. Questions about these delays from the community representatives went unanswered since the county teams were prone to reshuffles in short periods of office and were in implicit conflict with previous municipal officials that were initially involved in KISIP before national governance changes. The residents became skeptical of whether the projects would ever commence to some extent entrenching their belief that this was likely another empty promise from the government. The procurement rigidity and delays further limited the choice of consultants or contractors, which could have improved the quality of contractors and consultants. Some of the contractors and consultants that were engaged were not necessarily the most optimal in terms of capacity, but the ones who best maneuvered the procurement process. This implied that other processes that followed were lacking capacity and thus were significantly deficient for instance in terms of supervision (reported by national and backed by a county-level interviewee).

The grievance redress process was also deficient and the management team realized this only towards the end of the program. This process involved community residents who would ideally record issues in logbooks and communicate them in meetings or directly to the county team and the management team for resolution. It was evident that many challenges were recorded by the residents as planned, however, these issues either did not reach the coordinating team on time or at all. It was clear that these logbooks were still present with the residents at the time of the fieldwork but there was no evidence that the challenges reported were integrated nor synthesized. This was largely due to non-participation and disinterest in the program by the frequently reshuffled county teams and the fact that they were only seconded employees to the program leading to communication breakdown. A second reason was that joint monitoring and field missions by the coordinating team only took place biannually thus they would learn of a challenge even as late as six months if at all it surfaced. Addressing these grievances such as facilitating resettlement often took too long despite the presence of guidelines and structures for the same. However, actual facilitation, for some of the grievances established only occurred much later after the residents had already reconstructed their livelihoods using their funds. As elicited by one community representative, "*some of the residents who deserved facilitation to move in 2015 only received it in 2020 when the program was ending*". This was among the first batch of projects in the program. This disrupted the relations between some of the community representatives and some of the aggrieved residents who felt and even accused the representatives of embezzling the funds. It also contributed to the negative attitude of affected residents towards selected projects.

The infrastructure construction process was riddled with challenges that the management team often learned about quite late in the program and thus addressed them when the consequences were already severe. They were a combination of inherent procurement deficiencies and coordination and communication challenges. For the former, the procurement deficiencies resulted in suboptimal contractors and supervision consultants and the management team got aware of this soon after the projects kicked off. They addressed contractor issues by terminating them as in the case of settlements in Naivasha or by absorbing extra costs where consulting supervisors ordered extended works beyond the scope of the projects despite the management's team knowledge (World Bank, 2020). Some of the contractors either lacked technical or financial capacity and lacked previous experience working in informal settlements. This was exacerbated since they were operating in several settlements concurrently

in a given municipality. There were communication delays and omissions such that significant events including accidents, stoppage of work, and poor quality of work, went unreported to the management team for extended periods as expressed in the quote that follows. In some instances, instructions from supervising consultants to contractors were not communicated to the management team promptly or not communicated at all despite the instructions bearing financial implications that could only be authorized by the coordinating team. This communication breakdown barred the coordinating team from learning and resolving this challenge promptly.

> "A key finding in that mission *(2018)* was that there was local-level awareness to document and report severe injuries and fatalities to resident engineers, contractors, and law enforcement, but there was a systemic failure of reporting to KISIP high-level management and the World Bank," (World Bank, 2020)

The coordination deficiencies were further exacerbated by the introduction of county representatives that were new to the program and had to take authority. This was expressed explicitly as follows:

> "We had challenges in terms of communication. Largely, the establishment of the county was to blame, because we had a lot of turnover of staff. Like in the first two years, a different person was handling the project, and then fast-forward to a different person. There were many changes. Then the lack of full communication. Communication is done but does not land to the right person to do what needs to be done. Therefore, that was a challenge. But it was also a point to learn. Now going into other programs that may come later, we also see the importance of probably maintaining the same staff for continuity and ease of communication," Interviewee at the regional level.

During the construction process, the involvement of the community representatives by the rest of the program team was very limited. For example, in settlements in Nakuru and Eldoret, among other settlements, there were many times when the representatives were locked out of project meetings for a reason that the meetings were too technical for them or because it was claimed that they slowed the construction progress. This implied that most of their challenges went unresolved. Subsequently, the representatives withdrew from their duties leaving the teams with an average of two representatives per settlement as opposed to 18. Lack of facilitation also contributed to this. Communication was also very deficient. It was often conflictive between the community representatives, contractors, and the county team. Contractors largely avoided the community representatives who often sought help from the county team to limited avail and ended up bypassing them and contacting the coordinating team directly. This often overwhelmed the coordinating team due to limited capacity to absorb all the disaggregated communication to them in a context of deficient coordination, especially at the county level and when the projects rapidly increased.

Lastly, the infrastructure handover process was deficient because the respective county governments were expected to own, operate and maintain the infrastructure. The coordinating team did not have any mandate or responsibility for the projects after completion even during the program's timeline. Learning could not occur once the projects were handed over and considered closed since there were no further open channels for communication with the coordinating team on the happenings in the completed projects. Some of those who assumed responsibility did not feel compelled to address any issues that arose due to the projects. In settlements where they did not use the infrastructures at all, they claimed

that what was provided was not what they had agreed on or what was needed as agreed at the start of the project, for instance, ablution blocks in Munyaka settlement in Eldoret signaling deficiencies in participation at the preparation and implementation stages of the projects. An additional reason given for lack of use was that there were no clear modalities of how and who would run the infrastructures, specifically the solid waste units as was the case in Kasarani informal settlement in Naivasha. Where the residents used them for purposes not planned for, such as roads as market spaces, or drainages as disposal points, they claimed that that was the only space available and that is how they were using it before upgrading.

5.5 Discussion

Challenges during the implementation of KISIP occurred randomly and the coordinating team could not forecast their specificities. Learning was thus needed to counter the negative effects of the challenges. Learning was expected in the preparation and implementation stages and to some extent at the post-implementation stage as per the design of the program. From the findings, this did not occur especially during the implementation and post-implementation of the projects. Learning failed to occur either if challenges were not identified by local actors, if they were not communicated and transmitted along the hierarchical chains to the management team, if their synthesis did not occur at the management team or if the management team did not communicate and implement solutions proposed.

In the case of the deficient procurement process, the management team was aware of the challenges and knew the consequences of the projects concerning increased project timelines but failed to inform residents. Withholding this information led to mistrust as projects were halted for over two years at the settlements without any updates. This presented a scenario where there is awareness of a challenge at the top management and little communication to community representatives of the probable impacts of the challenge on the program and the stakeholders themselves. This is a key insight for implementers. While awareness of challenges is essential, when unsolvable within the means provided by a program, the management team must inform the stakeholders of the possible effects due to the challenge. In this case, they could have informed the residents of the delays due to procurement and retained their trust, which they had invested heavily in building in earlier phases of the projects. Therefore, effective communication between implementers, residents and other stakeholders is essential to complete the resolution aspect of learning.

The deficiency in the grievance redress process presents a scenario where learning occurs but with a significant time lag. This affects the attitudes of stakeholders negatively. The lag from the transmission of identified challenges—recorded grievances in the logbooks—to effecting the solution—paying facilitation fees for grievances—was taken negatively by the residents. The key to note is that there were more recorded grievances in the logs throughout the projects than the coordination team could absorb information-wise. Secondly, county teams often felt out of place due to their later entrance into the program and their role in the program was a secondment one. They were also frequently reshuffled. They made coordination of information and tasks very problematic. Bypassing them only created more communication barriers, especially where they were custodians of key information or overwhelmed the management team who took up their roles. For learning to occur, the program team needs to be well embedded into the program to improve communication and coordination, which are essential for the information transmission aspect of learning. For KISIP, this required making the roles of the county teams more permanent in contrast to secondment. As it was, KISIP's work was an additional temporary role on

top of their daily county work. It is also essential to establish the capacity for synthesis and aggregation of information to improve its absorption at the management team level to improve rapid resolutions of challenges. Such capacity for KISIP would include qualitative and quantitative data analysis for information in logbooks or adopting digital grievance recording and resolution systems.

Learning was hampered further by limited integration and synthesis capabilities by the coordinating team, technocratic tendencies of most implementers towards the residents, and limited capability of the consultants to communicate to the program team as espoused by the deficiencies in the infrastructure construction process. Beyond improving capacities for the coordinating team to integrate and synthesize varieties of information, there is a need for them to mainstream attitude change from technocratic tendencies to more collaborative approaches that acknowledge and incorporate views of residents in the resolution of challenges. In addition, there should be clear and efficient channels for communication for stakeholders that directly interact with the management team to avoid lack of or miscommunication, especially regarding instructions for project changes that have financial implications for program management teams. This is both useful for learning and the overall implementation process of the program.

The decline in participation by community representatives as the projects progressed limited identification and reporting of challenges in the projects. Participation was essential for the program team to learn about deficient processes. The community representatives were not sufficiently embedded in the program from the onset resulting in communication disconnects. A core lesson for program designers and implementers is that community representatives are an essential part of the program team, set clear guidelines for their activities and involvement, and budget for their remuneration and activities as part of the program accordingly. They should also be aware of capacities and extents of commitment to the program that all actors can afford to accord the program realistically.

Failure to pay any attention to the dynamics of how infrastructure is used after construction during the program timeline by the management team led to a lack of learning about which infrastructures worked and which did not. This was a five-year missed learning opportunity for improving overall program outcomes cumulatively. It would be essential for management teams to allow for learning at all projects open all through the program timeline and not limit learning to preparation and implementation stages while excluding post-implementation.

It is key to note that even if all the recursive processes had been optimized, retention of the knowledge of how to effect the resolution of challenges would have been limited. The management team did not have any knowledge management system as was expressed by an interviewee in the quote that follows. Platforms for peer exchange were also limited. These would have been useful for reference and exchanges, especially for county teams who were decentralized and faced similar challenges at different times while projects progressed. This, therefore, limited the program's capability to transfer knowledge to other projects within the program.

> "Some of them were retained *(lessons and insights).* However, if I were to propose, it would be to have scheduled *(implying that this was missing)*. County to County learning programs, scheduled, you know. Shared with the committee-to-committee learning or coordinator-to-coordinator learning which are scheduled and where formal learning points are shared, are taken and shared, you know, and documented. That would assist"

We identify what went wrong in KISIP despite its clear design at the onset; however, other aspects of sequential processes can equally face challenges at different times for similar programs. A key recommendation for program designers is to ensure that recursive processes including coordination, communication, participation, information integration, and synthesis that are essential for program learning are designed to allow for adaptability to program contexts and are monitored, assessed, and evaluated regularly throughout the program. Program implementers must approach projects with an experimental mindset paying close attention to the recursive processes and altering them to fit the contexts where the projects are implemented. This thus is a caution, the program requires projects to foresee clear, flexibly designed, and budgeted participation, communication, and coordination plans, realistic incentives for team members, and tools and platforms for knowledge creation and management by providing adequate program-wide structures. While assembling the program team and recruiting consultants and contractors, the capacity to aggregate, integrate and synthesize reported challenges during their interactions with residents as data of various forms and kinds is an essential add-on to other key technical qualifications.

5.6 Conclusion

This study situated program learning's role in improving program processes and outcomes. It further elaborated and demonstrated the extent to which the program management team lost the opportunity to learn and the associated barriers to learning. The findings offer key conclusions that are generalizable for other slum upgrading programs. To start with, the paper introduces a means to systemize the many challenges likely to be encountered in upgrading programs using recursive and sequential processes and outlines the role of the latter in identifying deficiencies of the former to improve program outcomes. It further situates these two types of processes in organizational learning literature, which facilitate defining and specifying program learning. This definition in itself is useful beyond slum upgrading programs.

Secondly, the study establishes recursive processes including participation, communication, and coordination, which are necessary for program learning to occur and subsequently influence program outcomes. These recursive processes become more complex as programs progress and are core in anchoring projects on programs. Therefore, conceptualizing them requires accounting for the likely increase in project stakeholders and increased projects' distribution spatially over time. The study showed that these recursive processes fail due to an increase in the number and diversity of program team members and projects, and the deterioration of program team members' interests, trust, and commitment to the program. In addition, the non-adaptability or ineffectiveness of structures guiding recursive processes, inequitable incentives for the different program team members to be involved, and insufficient tools to support them also contribute to their failure. While participation is a key step for program management teams to enable learning, it is only a first step and has to align with other recursive processes such as communication, coordination, and eventual collaboration to achieve knowledge creation for the resolution of challenges relevant to a context.

Thirdly, while the recursive processes are necessary for program learning as espoused by KISIP, they are not sufficient. Additional tools for information management, storage, and transaction are necessary. The capacity of the management team to use available tools, resources, and platforms productively is also essential in ensuring that the overall program team and stakeholders share the vision of the program and avoid technocratic tendencies. Lastly, trust building and maintenance are also key for learning to occur.

The above insights have implications for policy and program management. They should ensure that recursive processes are clearly defined and flexible for them to avoid programs that are already designed to fail. Key to note while implementing programs is that not all knowledge is immediately actionable for use in the same program.

Chapter 6: Conclusion

The main aim of this thesis was to explain why infrastructure investments fail or succeed in improving the livelihoods of residents in slums in cities of the global south. Its starting point problematized conceptual limitations that impact the planning and implementation of slum upgrading and its subsequent outcomes. It situates this problem theoretically in the literature on planning at the project and urban level, and sociotechnical transitions. In practice, it situates the problem in the broader planning practice, basic infrastructures, livelihoods, and urban transformation. This provides inroads for recommendations that inform urban transformation policies through programs. To summarize the overall contribution of the thesis, this chapter answers the four research questions and synthesizes the conclusions. In addition, it provides the implications to theory, practice, and methods and lastly areas for future research.

6.1 Main findings

The thesis perceives the persistent failure of slum upgrading in improving livelihoods as a conceptual and practice problem. On the one hand, it is conceptual since slums have been and are consistently defined based on what they lack, be it tenure, sanitation, water, mobility, or other basic services. This has prompted planners to implement infrastructures that fill these gaps without paying attention to what exists. This has entrenched the perception of slums as complex disorderly places. This thesis argues against this perception and conceptualizes the infrastructure livelihoods nexus and the infrastructure appropriation process that account for the complexity of the slums (Section 6.1.1). On the other hand, failure is a practice problem due to deficits in the planning process for two reasons. First, the challenge of aggregating multiple actors who participate to understand their influence on upgrading outcomes. Secondly, the challenge of cross-project learning in upgrading programs to enable them to adapt to unplanned events and challenges within their timelines and achieve scale (Section 6.1.2). The subsections that follow present the findings of the research based on the described problems while revisiting the research questions.

6.1.1 Conceptualizing the infrastructure livelihoods nexus and infrastructure appropriation

This thesis questioned the assumption of chaos and the prevailing definition that focuses on what lacks in slums. The thesis argued that slums are manifests of the link between livelihoods and infrastructures—the infrastructure livelihood nexus. This led to the following research question:

i. How can the infrastructure-livelihoods nexus in slums be conceptualized and how is it transformed by slum upgrading interventions?

In addition, the thesis sought to understand mechanisms that guide the appropriation of infrastructures in slums by residents. This is significant since residents proactively use the new infrastructure while securing livelihoods consequently shaping the infrastructure's long-term livelihood impact.

ii. How does the appropriation of new infrastructure by residents occur and how does this influence their livelihoods?

To answer these questions, Chapter 2 develops a conceptual contribution for explaining the infrastructure livelihood nexus of slums. It presents the nexus as comprised of interlinked production, reproduction, and

infrastructure regimes, which are the bundled and interlinked rulesets that guide social, economic, and infrastructure-use activities respectively in a slum. The three regimes in slums align to favor socioeconomic activities at the cost of infrastructures and determine the physical manifestations of deteriorating infrastructures observed spatially. The link between the three regimes is observed at a configuration of four dimensions that include time – when activities are done, space — where activities are done, transaction — how much activities and services cost and how to pay, and organization dimensions — how residents organize to run the service. This is to imply that seeking/using basic services while conducting reproduction or production activities that are part of securing a livelihood is done in partially predefined spaces, time, and costs and involves specific social relations. For example, using a public toilet in an informal settlement is done at partially predefined hours when it is opened and sometimes it is not when expected, residents pay specific amounts for services, and the residents organize around managing it. Based on this concept, this thesis defines slums in their fundamental form. They are spatial urban subsystems that comprise production, reproduction, and infrastructure use activities, guided by interlinked and respective subsets of rules that favor achieving livelihoods over infrastructure sustenance over time.

Slum upgrading from the discussed perspective, therefore, introduces infrastructure that may have different rulesets for use that align, partially align or misalign with the existing infrastructure-livelihood nexus. Rules alignment entrenches the production and reproduction regimes. This leads to a favorable developmental trajectory observed through improved livelihoods as compared to the status quo before upgrading. Partial alignment transforms the infrastructure rulesets in favor of the production and reproduction regimes. In this case, the infrastructures improve livelihoods partially and for a short while but the extant development trajectory of the slum remains. Misalignments lead to no transformation at all. To illustrate, a new community toilet with the intent to offer superior and accessible sanitation services is likely to be adopted or embedded if its rule alignment with extant regimes manifests as follows. If the toilet does not take up significant space already in competitive demand by other re/production activities. If it does not require a significant increase in charges or change in modalities of payment for use as compared to extant alternatives. In addition, if its opening hours coincide with times when toileting is done in the place it is located. Lastly, it does not change how organizing for management of the toilet services is usually done in the slum. The more transformation the toilet demands from the prevailing infrastructure livelihood nexus, the less likely it changes the sanitation trajectory in the settlement for better or worse.

Chapter 3 complements the infrastructure livelihoods nexus concept by introducing an agency perspective that plays a role in the reconfiguration of the infrastructure-livelihoods nexus in slums. It conceptualizes and demonstrates the process and mechanisms for appropriation of new infrastructures. Appropriation determines how residents use infrastructure, how this leads to a shared understanding and use of the new offerings and how this ultimately impacts the livelihoods of residents. The chapter conceptualizes a three-stage mechanism for appropriation that comprises reception, domestication and institutionalization. The chapter demonstrates the following: the approval of new infrastructures by residents at the reception stage is heavily influenced by the quality of participation in ensuring that trust and commitments are not broken. Domestication follows manifesting as either contravention, navigation, negotiation or/and coping actions by residents each chosen based on the contribution of the infrastructure in extending or disrupting the established infrastructure-livelihoods nexus. Notably, contravention is not always negative as in some cases it is even taken up and reinforced by formal authorities. Institutionalization follows domestication

and manifests when the infrastructure embeds in to the social fabric of the slum with its fate either being deterioration or sustenance. Utility of the infrastructure for the residents is determined by the following: a) its costs of access vis a vis alternative. b) Its location vis a vis time it is needed for use. c) The space it occupies vis a vis how the space can be used alternatively for productive activities. d) The organizational changes needed to run the infrastructure vis a vis the associated productive benefits. If most or all of these are favorable for residents, they are willing to contribute to sustaining the infrastructure consequently sustaining improved livelihoods. To reiterate conceptual insights from Chapter 3, we argue that instead of the currently dominant view on infrastructure uptake as an act of acceptance by predominantly passive individual recipients or "beneficiaries", we have to understand post-delivery as a complex, social process, in which slum residents act as co-producers of infrastructure services. This process conditions whether or not improvements of livelihoods can unfold. Interactions among the residents along this process will lead to the institutionalization of a new infrastructure-livelihood nexus in the form of taken for granted practices, norms and material structures. Appropriation overall will therefore lead to what transition scholars refer to as "embedding" of socio-technical systems into local contexts (Fraedrich et al., 2015).

The answers to research questions ii) and i) provide new insights for understanding and defining slums, slum upgrading, and the connection to improved livelihoods. Contrary to prevailing definitions, slums are highly structured places with alternative and often multiple ways of accessing basic services. They are areas shaped by rulesets (regimes) that maximize the efforts of people to secure livelihoods while at the same time incorporating infrastructure available in the best way possible. Slum upgrading then should not be a mere introduction of infrastructures to fill what lacks. Rather, an effort to improve what exists or introduce infrastructures that are adjusted to facilitate securing the livelihoods of residents. Understanding what exists, anticipating how appropriation will occur, and modifying infrastructures call for participation that is conscious of these three aspects during planning.

6.1.2 Improving the planning process at project and program levels

Section 6.1.1 conceptually demonstrates that infrastructure interventions have an impact on the way residents organize their livelihoods by creating new mismatches between production and reproduction regime structures. Consequently, this leads to a variety of appropriation strategies that determine whether infrastructures improve livelihoods and embed in slums to sustain this improvement over time. How then can planners anticipate these processes to promote the improvement of livelihoods in slums and at the national level? To answer this, the thesis establishes two challenges prevalent in current planning practice concerning slum upgrading. These include first, the complexity of understanding how the myriad of actors involves residents—participation—during slum upgrading implementation consequently influencing upgrading outcomes. Secondly, the challenge is effecting inter-project learning in programs to promote scaling of upgrading interventions beyond one slum. To investigate these challenges, this thesis posed the following two questions as a starting point:

iii. How can participation be configured to deliver infrastructures that improve livelihoods at the project planning level?
iv. How can planners leverage synergies from multiple projects through learning to accelerate scaling improved livelihoods at a national scale?

To answer research question iii, Chapter 4 embraces a cross-case analysis of the nature of actor interactions in the participation process and how these enable or inhibit the efficient delivery of successful infrastructures. Infrastructures are deemed successful if they are functional at delivery and if they are of utility to the residents after delivery. The chapter's key contribution is to extend participation in the implementation of infrastructures as opposed to current practice where it is mostly restricted to the plan-making process. To actualize this, the chapter explains the different rationalities of different actors drawing from institutional logic concepts (Thornton & Ocasio, 2008). Institutional logic represents distinctive value systems that condition the actions of specific actor groups and provide specific challenges to establishing collaborative relationships as they (actor groups) conduct their roles. That literature identifies ideal type logic that includes professional, market, community, state, family, and hierarchical logics. Chapter 4 established five groups of actors based on the ideal type of logic namely; professional (e.g. engineers, planners, surveyors), market (e.g. water utilities, contractors), community (e.g. community representatives and residents), state (e.g. politicians at different levels), and hierarchical (e.g. government officials in charge of regulation for each settlement). This aggregation of actors is based on their logic and provides a finite heuristic for classifying all actors in slum upgrading contexts. In addition, it establishes a typology for assessing integrated infrastructure outcomes based on whether the infrastructures are delivered in a functional state and whether they are used as expected by implementers. These two steps provided a means to understand how different actor groups relate with residents during upgrading and the resultant out comes for each of the 15 slums investigated.

Findings showed that three combinations of interactions between actor groups and residents deliver successful infrastructure. The dominant one was when there is professional and market actors in collaborative relationships with residents. Other less dominant pathways included (a) Collaborative professionals and collaborative communities even if the state and hierarchical actors were non-collaborative, and (b). Collaborative market actors even if the state, professional, and community actors were not necessarily collaborative. Failure was prevalent where the market or professional actors were non--collaborative at the same time. The chapter concludes that participation characterized by the collaboration of market, professional, and community-oriented actors is sufficient for delivering infrastructures that are sound structurally and that are used by residents willingly as expected by planners. In addition, it demonstrates that collaborative market actors can overcompensate for non-collaborative relationships between state, hierarchical, professional, and community-oriented actors to lead to successful outcomes. In addition, a combination of collaborative professional and community can over-compensate for non-collaborative state and hierarchically oriented actors. This insight explicitly explains Kiefer and Ranganathan (2018a)'s ideas of productive tension and Patel (2013)'s ideas on participation that allow multiple relationships that lead to successful upgrading outcomes.

Chapter 4 concludes that the success of slum upgrading depends on the capacity and configurations of different actors to accommodate the views and needs of the slum residents during the implementation process. It is not sufficient to find buy-in from planners at the outset of the process because many tradeoffs and problems only come into sight when implementing the plans and after infrastructure delivery. Important is furthermore, that different types of actors – here grouped into different combinations of institutional logics – may play complementary roles for achieving success or leading towards failures at the slum level.

Moving beyond the slum level and looking at scaling the slum upgrading strategy to achieve wider national development and livelihood improvement goals, Chapter 5 addresses inter-project learning as an enabler for scaling because of a myriad of projects implemented at countrywide scales. Programs form the organizational units for achieving this at a countrywide scale and thus among other roles facilitate learning to inform policy changes as well as improve anticipation of challenges for subsequent projects within the timeline of the program. Cross-project learning is the core task that programs have to achieve and this is investigated in Chapter 5. Key findings indicate that constrained processes, missing tools and platforms to facilitate learning, and technocratic attitudes of program team members bar inter-project learning. The Chapter presents three typical process groups that complement each other in slum upgrading programs. These include the *learning processes*, which are responsible for problem identification at both the program and project levels and their resolution as well as providing insights for policy reflection. Learning processes included knowledge acquisition, transfer, synthesis, and integration of insights. The second group of processes was the *sequential program processes* that include program design, procurement, infrastructure construction, periodic monitoring and supervision, and handover processes. These are planned sequentially and focus on ensuring the delivery of project goals for instance infrastructures in slum upgrading programs. Planners can concretely anticipate, monitor, and evaluate these during project planning. Lastly, recursive processes, include participation, communication, planning, and collaboration. Recursive processes cannot be anticipated. *Recursive processes* bridge both learning and the sequential program processes at the projects and the program level. Therefore improving the efficiency and effectiveness of the recursive and learning processes are essential to delivering improved livelihoods at the projects level and relevant policy insights at nationwide scales. It is essential for program management teams to focus on programs as learning platforms and not just as larger projects due to their role in informing policy and practice.

These conclusions partially uphold the aspirations of planning transforming livelihoods at scale. However, this thesis has demonstrated that the planning has to consider the following changes: Participation must account for the infrastructure livelihood nexus. While conducting it, planners need to move away from the notion of lack and seek what exists in line with their intended interventions and align them accordingly to improve livelihoods. In addition, participation has to be structured and monitored during planning and post-implementation of infrastructures. This is essential to ensure sufficient collaborations among actor groups, as well as gather critical information that program managers have to learn from, to deliver infrastructures. Only then can such infrastructures be informed by residents' appropriation constraints/freedoms. To achieve a wider impact at scale, planners of upgrading programs must establish structures for learning at the design stage. In addition, they should effect and monitor those structures during the implementation of program phases and adapt the policies and future projects based on cross-project insights. These can continuously inform policy direction for better future planning and programming while at the same time informing ways of improving the efficiency of processes and effectiveness of outcomes at the project level. Programs, therefore, have to be more flexible to learn and adapt through insights from projects and adapt over time while feeding insights to wider policy.

6.2 Implications of this study

The conclusions that we draw have implications for theory, methodologies, and practice. The subsections below elaborate on these implications.

6.2.1 Implications to sociotechnical and planning literature

Specifically to theory, the findings contribute to the emerging link between planning in urban settings and sociotechnical transitions literature. Inspired by Carroli (2018) and Murphy and Carmody (2019) this thesis explicitly and successfully entrenched this link by demonstrating that where the planning ends, appropriation as informed by sociotechnical transition studies, begins. It further situates this link at the neighborhood scale conceptualizing slums as subsystems of the larger urban systems. To illustrate, the infrastructure livelihood nexus concept can be applied for conceptualizing other spatial subsystems of cities. For instance, gated communities that are emerging among the relatively affluent in the global south cities are a manifestation of production, reproduction, and infrastructure regimes linked to favor reproduction activities while accommodating infrastructure use rules all at the expense of production activities of a majority of the residents. Similarly, industrial area subsystems would have an infrastructure livelihood nexus that favors production at the expense of reproduction activities while accommodation for infrastructure use rules. In both illustrated cases and informal settlements, improvement of infrastructures needs to be planned for and implemented differently, and end users will appropriate it differently based on their nexus constraints and freedoms.

The extension of the focus of transition studies from single to multiple technologies and services was a timely need (van Welie et al., 2018). This thesis contributes to this by the conceptualization of the infrastructure, production, and reproduction regime in Chapter 2. The infrastructure regime incorporates multiple basic services beyond the current focus of sanitation in slums, therefore, providing a conceptual avenue for studying multiple infrastructure systems for the provision of basic services. This is well in line with the renewed calls to focus on multisystem interactions in sociotechnical transitions literature (Rosenbloom, 2020). In a complementary manner, the conceptualization of production and reproduction regime structures that build on Murphy and Carmody (2019) extends sociotechnical transition insights to the realm of livelihoods in the context space beyond the home and into the slum neighborhood. This conceptually bridges Cherunya, Ahlborg, et al. (2020)'s view of household spatial extents with those of Murphy and Carmody (2019) city extent allowing new inroads for new research. It further stretches the literature towards understanding to whom and how transitions benefit.

For the planning literature, this thesis has twofold implications. First, it elaborates on the appropriation process for basic infrastructure. This process is understudied albeit essential for ensuring planning deliverables that embed and improve livelihoods. Since infrastructures as an element of urbanization will continue to be built, the concept remains essential for planning literature both in the global south and the global north (Randolph & Storper, 2023; Roy, 2005; Venter et al., 2021). In the former because planning there is conducted on already settled land. In the latter since city infrastructure there has to be retrofitted due to the impacts of climate change (Norton et al., 2015). The second implication for planning is in resolving the challenge of the multiplicity of actors during participation. This thesis contributes to this by providing a means to aggregate participants based on their logics. This is useful as it reduces the complexity of analysis of participation due to many participants to finite actor groups aggregated based on their institutional logics. Through this, richer analysis can be achieved and more insights gathered on this front without losing the uniqueness of actor interests in action. This is much better as compared to earlier analyses, which dwelt on aggregation based on recipients of interventions vs the outside actors bringing the intervention. It further provides grounds for configurational theorizing, which this thesis implements

as a first. This is in line with advocates such as Morrison (2017b) who advocate for such clustering concepts that reduce complexity to manageable levels but not at the expense of losing its potential insights.

6.2.2 Implications to methods for studying urban phenomena

This thesis used a suite of complementary qualitative methodologies to understand how the improvement of livelihoods occurs in slums. The following methodological implications were derived for the study of slum upgrading and are relevant to other urban and development phenomena. The configurational theorizing facilitated the use of emerging fuzzy set qualitative analysis (fsQCA) in Chapter 4. This resulted in a unique contribution to methods for explaining outcomes of complex urban interventions that occur due to a combination of factors. It was also useful in establishing necessary and sufficient configurations of these factors that lead to specific outcomes without fully losing the value of complexity. In addition, the comparative aspect of fsQCA for a few cases is useful as only a few urban locations and phenomena are comparable on a one-to-one basis. The chapter further offers a method for rapid assessment and comparison of infrastructure outcomes by presenting graduated outcome measures for un/successful upgrading that is both quantitative and qualitative. This is useful for other interventions beyond infrastructures in slums.

Besides these, the method used in Chapter 2 builds on process tracing methodologies and presents the basis for a within-case inference of urban phenomena by analyzing processes and establishing mechanisms that lead to outcomes. This contributes to emerging efforts in planning studies such as Wood (2022) and Saraiva (2022) who appreciate the significance of tracing processes over time and the outcomes they derive for both analytical, conceptual, and productive comparisons. It further offers a means for drawing inferences from single cases to approve or disapprove theories of urban phenomena.

Overall, the use of three methodologies i.e. case study, QCA, and process tracing allowed for intensive methodological triangulation. This enabled interrogation of causal factors that influence the improvement of livelihoods through infrastructure in novel ways. Therefore, this thesis sets precedence for use of more innovative methodologies to unlock more opportunities for research in the sociotechnical transitions and planning fields.

6.2.3 Implications to project planning practice

The findings are further significant for planning practice. They express the need for planners not only to use participation as a means to gain access to the slums and inform residents of planned activities. But the findings are also useful as a means to gain insights on the prevailing infrastructure livelihood nexus, how the appropriation of what exists occurs, and build on it towards a consensus. They should also use it as an avenue to gain insights about infrastructures during construction and adapt it when necessary if it favors its sustained functionality and utility. It is also essential for planners to establish monitoring structures within projects to asses when interactions among combinations of actors go below the sufficiency threshold for collaboration informed by this study. This should be a process indicator for upgrading. In addition, participation should be extended to post-implementation of projects as many insights go unnoticed at this stage.

Closely related, project planners, other professionals, and contractors that are involved in slum upgrading need to develop capacity in establishing relations with residents. This is essential for ensuring that projects can run without interruption and that they can accommodate the needs of the residents. The realization that ignoring residents' views only leads to inutility infrastructure should be a wake-up call for the rest of the stakeholders. In light of the findings of this thesis, this should be a must-have qualification for actors involved in slum upgrading.

The current practice of understanding the infrastructure livelihoods nexus during planning involves employing baseline studies. A key observation in this study is that such baseline studies are characterized by a mere quantification of the basic services that residents lack. Practice needs to shift from these towards more qualitative baselines that establish the how-to question in addition to the what question. This will shift the rationale from filling the gaps of what lacks to employing interventions that build on or align with the infrastructure livelihoods nexus. Where alignment or building is not possible, planners will at least be aware of the appropriation strategies to expect and anticipate how to deal with them in advance.

The rapid assessment method for outcomes of infrastructures employed in Chapter 4 is also a useful tool for planners to understand and learn when infrastructures perform and when they do not. It contributes to the current challenge of qualifying and quantifying outcomes and impacts of upgrading (Boanada-Fuchs & Rohner, 2021). The fact that it objectively assesses when they deliver functional infrastructure reflects on their efficiency in the planning process. Whether the infrastructures are of utility to users speaks to their and the effectiveness of the planning process in understanding the users' needs during participation. It is therefore objective as compared to current performance assessment means. This thus should be a key outcome evaluation indicator for projects. The current ones determine project success based on infrastructure outputs, which though often delivered functional, lack utility in the settings they are delivered e.g. the number of kilometers of roads built (Wied et al., 2021; World Bank Group, 2020).

Lastly, the process tracing-inspired method that elaborated appropriation in Chapter 3 sets an example for the outcome and impact evaluation of slum upgrading projects in practice. This has been an outstanding challenge in practice (see Boanada-Fuchs and Rohner (2021) and Turley et al. (2013)) and this thesis proposes a solution. Mapping the evaluations in the conventional logical frameworks for monitoring and evaluation (Martinez & Cooper, 2020; Uwizeyimana, 2020), the infrastructure investments and human resources represent inputs and can be monitored and evaluated using process evaluation techniques (Butterfoss, 2006). Outputs are the infrastructures constructed and services delivered, which can be evaluated technically based on their functionality. Outcomes are the results of appropriation strategies of the residents. These reflect the utility of the infrastructure in its context. The infrastructure's impact is indicated by embeddedness of the infrastructure and its ability to sustain service provision over time.

6.2.4 Implications to implementation of urban planning policy

At the program level, the thesis further highlights the need for planners to ensure that recursive processes are adaptively structured and facilitated to allow for program learning processes to be operationalized. They should ensure that inter-project challenges are promptly identified and resolved and lessons transferred to ongoing projects. This calls for proper budgeting for both learning and recursive processes

and program designs that allow for the flexibility that the processes require. Program evaluations should focus on how well the program was able to adapt to cross-project needs during its lifecycle and its contribution to policy at the end of its phase.

Concerning planning teams' capabilities and structures planning leads need to watch out for technocratic tendencies during the program implementation as this is a key reason that residents fail to participate. In addition, technological infrastructure and learning platforms need to be well established during implementation to facilitate learning. It is only by achieving these that programs will recursively inform projects and policies to scale upgrading to nationwide scales.

6.3 Scope, limitations, and future research

The scope of generalization of our findings is significant and is as follows. The appropriation and infrastructure livelihoods nexus concepts as derived are useful heuristics beyond slums and the global south. They are relevant for other urban subsystems, whose infrastructure livelihood nexus favor reproduction e.g. gated communities and tourist towns, or production e.g. special economic zones, or smart cities that seek a work-infrastructure-life balance. In line with participation, the findings are generalizable to collaborative planning that occurs in urban and rural development projects globally and the resounding call for social inclusion. This is because the interaction of planners and residents is not restricted to slums and occurs in different locations at different scales. The aggregation of actors based on their ideal institutional logics is portable to different contexts. Participation is also a subset of the wider social inclusion discourse and thus the insights from this study have further potential to form social inclusion practices (Nwachi, 2021). The basic infrastructures studied are a subset of social infrastructures and thus findings and methods for assessing their planning and outcomes further relate and feed into the wider social infrastructures implemented in urban settings. Findings related to program processes are generalizable to development programs that involve the underprivileged as active participants and not just beneficiaries. Spatially, this thesis focuses on a program that was conducted in Kenya, targeting the urban poor in 15 towns and cities. Multiple slums were sampled where upgrading took place and the overall program was assessed. The findings thus encompass a nationwide scope for Kenya and similar countries that are witnessing slum growth in their emerging towns due to the current rapid urbanization.

This study was limited to the infrastructure systems that KISIP implemented in settlements. The infrastructure systems included roads, footpaths, security lights, sewer systems, ablution blocks, solid waste management units, storm water drainage, and water supply systems. While these comprise most of the basic infrastructures, upcoming infrastructures that will be basic soon such as the internet for communication, and other social infrastructures such as schools and hospitals were not considered (as they were not part of the KISIP infrastructure package). Future research could employ insights developed to research further into these. Spatially at the project level, the research was limited to 15 slums that were part of KISIP. Indeed, there are many other slums in Kenya and beyond. Care was taken while selecting the slums resulting in those that were representative of the rest. Despite this, more processes and comparative research are needed in slums to build on the new insights presented.

Future research in sociotechnical transitions in urban subsystems could focus on explaining development trajectories in other subsystems such as gated communities and special economic zones in the context of

infrastructure livelihoods nexus. More research is also needed in the nexus of the subsystems and the overall city to determine the impact that this interaction has on the livelihoods of residents. The concept of appropriation would also be useful to research in the global north where new ways of using infrastructures are being pushed for by residents in urban settings for instance the continued push for the introduction of bikes and other non-motorized lanes in metropolitan towns in Europe. In the realm of comparative planning and larger urban studies, continued focus on comparative studies and configurational perspectives is recommended, based on presented methodologies.

The empirical insights that comprise the arguments in this thesis are entirely drawn from urbanization in the global south. Their relevance however goes beyond. They form an essential piece in the theorizing puzzle for urbanization and its challenges. Recent research argues for a unifying theory for urbanization in the global south and the global north (Randolph & Storper, 2023). This thesis appreciates this view and offers insights and recommendations for urban interventions while taking into account that urbanization in both contexts has similarities as well as differences. The thesis argues in favor of a unifying urbanization theory that commences from structural similarities globally and then the differences based on spatial specificities.

Despite the limitations discussed, this thesis achieved to uncover and elaborate on current challenges that limit infrastructure planning from improving livelihoods in global south cities. Specifically, it resolved the conundrum of the multiplicity of actors in development projects that make participation complex. It showed that there is more to slums beyond lack and uncovered the strategies that underlie appropriation and its outcomes. It explained how learning in programs can be better structured. This unlocks their potential to improve livelihoods at national scales through recursively informing policies and projects. It established methodologies and indicators for managing, monitoring, and evaluating development projects and programs. Lastly, it conceptually extended both sociotechnical and planning literature, providing opportunities for further research.

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Appendix A

1. Set membership table for the informal settlements considered in the study

Cases	**Conditions**					**Outcome**	
Settlements	Hierarchical	State	Professional	Market	Community	Raw upgrading outcomes	Calibrated upgrading outcome
Gilani	0	1	0	0	1	0.17	0.00
Kamukunji	0	0.33	0	0	1	0.33	0.00
Munyaka	0	0	0	0	1	0.4	0.00
Kasarani	0.33	0	1	1	0	0.44	0.01
ZiwalaNg'ombe	0	0	0	0	1	0.49	0.14
Kaptembwa	1	1	0	0	1	0.49	0.14
JomvuMikanjuni	1	1	0	0	0	0.49	0.14
Swahili	1	0.33	0.33	0	1	0.52	0.50
Karagita	0.33	0	1	0	1	0.58	0.82
Mkomani	1	1	1	1	1	0.58	0.82
Rhoda	0	0	0	1	0	0.67	0.98
Kihoto	0.33	0	0.33	1	0	0.73	0.99
JomvuKuu	0	1	1	1	1	0.72	0.99
Kamere	0.33	0	1	1	1	0.73	0.99
Kariobangi	1	0.33	1	1	1	0.76	1.00

Note:

1. *The water utility and the contractors are combined to make up one condition labeled as market using an "or" function. This implied that in cases where any market actor had collaborative or accommodative relationships, the overall market score would be collaborative.*
2. *While we do not have a 0.66 value in this table, it was present for Kisip and World Bank salient actions and it helped rule out their exclusion from the fs-QCA analysis.*
3. *0, 0.33, and 1 represent absence of collaborative relations-conflictive relations, relations characterized by avoidance and presence of collaborations respectively for conditions. They represent qualitative characteristics.*
4. *Raw upgrading outcomes represents aggregated scores based on qualitative assessment of quality of implemented infrastructure and whether it was used for expected purpose by implementers*
5. *Calibrated outcome is the quantile-normalized raw upgrading outcome. The higher the outcome, the more successful the upgrading was.*

2. Truth table demonstrating combinations of conditions and respective outcomes

Hierarchical	State	Professional	Market	Community	Outcome	cases	raw consistency	PRI consistency
0	0	1	0	1	1	Karagita	1	1
0	0	1	1	1	1	Kamere	1	1
1	0	1	1	1	1	Kariobangi	1	1
0	1	1	1	1	1	Jomvu Kuu	0.99	0.989899
0	0	0	1	0	1	Kihoto, Rhoda	0.988024	0.986928
1	1	1	1	1	1	Mkomani	0.864662	0.843478
1	0	0	0	1	0	Swahili	0.746269	0
1	1	0	0	1	0	Kaptembwa	0.353383	0
0	0	1	1	0	0	Kasarani	0.34	0.241379
1	1	0	0	0	0	Jomvu Mikanjuni	0.14	0
0	0	0	0	1	0	Kamukunji, Munyaka, Ziwa la Ng'ombe	0.0524345	0
0	1	0	0	1	0	Gilani	0	0

Note:

1. 0 and 1 represent absence and presence of collaborative relationships respectively for conditions and presence of success or lack of respectively for the outcome

2. Raw consistency scores express the degree to which a given combination of conditions in a case is a subset or superset of the outcome. They are proportions of a whole.

3. PRI consistency—proportional reduction in consistency— per case. See Greckhamer et al. (2018) for further a detailed explanation

3. Complex and Parsimonious solutions respectively

Complex solution

Causal combinations of conditions	Cases: Settlements	Raw coverage	Unique coverage	Consistency
1. Market*Community*Professionals	Mkomani, JomvuKuu, Kariobangi, Kamere	0.51	0.42	0.95
2. ~Hierarchical*Community*~State*Professional	Karagita, Kamere	0.18	0.09	1
3. ~Hierarchical*Market*~Community*~State*~Professional	Rhoda , Kihoto	0.22	0.22	0.99
Solution coverage		**0.81**		
Solution consistency		**0.97**		
consistency cutoff		**0.86**		

Note: *The symbols * and ~ represent an AND combination, and absence of that condition respectively. The numbers represents proportions of a whole.*

Parsimonious solution

Causal combinations of conditions	Cases	Raw coverage	Unique coverage	Consistency
Community*Professionals	Mkomani, JomvuKuu, Kariobangi, Karagita , Kamere	0.66	0.66	0.93
Market*~Professionals	Rhoda , Kihoto	0.22	0.22	0.99
Solution coverage		**0.88**		
Solution consistency		**0.94**		
consistency cutoff		**0.80**		

Note: *The symbols * and ~ represent an AND combination, and absence of that condition respectively. The numbers represents proportions of a whole.*

4. Prime implicants charts

Success solution

Prime implicants	Primitive expression
Market*~Professionals	~Hierarchical*Market*~Community*~State*~Professionals
~Community*~State*~Professionals	
~Hierarchical*Community*~Professionals	

Note:

1. *The symbols * and ~ represent an AND combination, and absence of that condition respectively. The numbers represents proportions of a whole.*
2. *The prime implicants in bold were selected in the truth table minimization process*
3. *Primitive expression shows a combination of prime implicants for which a solution is valid when they account for all observed empirical evidence.*

Unsuccessful solution

Prime implicants	Primitive expressions	
State*~Market	~Hierarchical*~Market*~Professionals*Community*~State	
State*~Professional		
~Hierarchical*~Professionals*Community		Hierarchical*State*~Professional*~Market
~Hierarchical*~Market*~Professionals		

Note:

1. *The symbols * and ~ represent an AND combination, and absence of that condition respectively. The numbers represents proportions of a whole.*
2. *The prime implicants in bold were selected in the truth table minimization process*

3. *Primitive expression shows a combination of prime implicants for which a solution is valid when they account for all observed empirical evidence.*

5. QCA intermediate results for the assessment of the reported model's robustness (success only)

Robustness check with a consistency cutoff of 1

Causal combinations of conditions	**Cases**	**Raw coverage**	**Unique coverage**	**consistency**
~Hierarchical*Professional*Community*~State	Kamere	0.18	0.09	1
Professional*Market*Community*~State	Kamere, Kariobangi	0.22	0.13	0.99
Solution coverage:		0.31		
Solution consistency:		1		
Cutoff frequency		1		

Robustness check with a consistency cutoff of 0.7

Causal combinations of conditions	**Cases**	**Raw coverage**	**Unique coverage**	**consistency**
Professional*Market*Community	Mkomani, JomvuKuu, Kamere, Kariobangi	0.51	0.42	0.95
~Hierarchical*~State*Professional*Community	Karagita, Kamere	0.18	0.09	1
Hierarchical*~State*~Professional*~Market*Community	Swahili	0.07	0.07	0.74
~Hierarchical*~State*~Professional*Market*~Community	Rhoda, Kihoto	0.22	0.22	0.99
Solution coverage:		0.88		
Solution consistency:		0.94		
Consistency cutoff:		0.70		

Note:

1. *The symbols * and ~ represent an AND combination, and absence of that condition respectively. The numbers represents proportions of a whole.*

6. Coding structure

Settlement X

Interactions based on actors

- Community (overall reaction)
- Engineers
- Social officers
- Coordinating team (National)
- County officials
- Contractors
- Water utility
- Politicians

Nature of interactions

- Conflictive
- Avoiding
- Accomodative
- Collaborative

Outcome

- Water supply
- Security lighting
- Roads
- Footpaths
- Drainage
- Ablution blocks
- Sewerage

7. Cases, settlements visited and data sources

Settlements	Data source
Kamukunji	Mangíra et al. (2019); MLHUD (2013a); MLHUD (2013c), three key informant interviews and observations
Kaptembwa	MLHUD (2013b); MLHUD (2014e), five key informant interviews and observations
Rhoda	MLHUD (2013b); MLHUD (2014e), six key informant interviews and observations
Gilani	MLHUD (2013b); MLHUD (2014e), four key informant interviews and observations
Mkomani	MLHUD (2013d); MLHUD (2013e), two key informant interviews and observations
Ziwa la Ng'ombe	MLHUD (2013d) ,MLHUD (2013e), two Key informant interviews and observations
Jomvu Mikanjuni	MLHUD (2013d), MLHUD (2013e), three key informant interviews and observations
Jomvu Kuu	MLHUD (2013d), MLHUD (2013e), Five key informant interviews and observations
Munyaka	MLHUD (2013a); MLHUD (2013c); Nyaigo (2014), three key informant interviews and observations
Swahili	MLHUD (2014a); MLHUD (2014c), four key informant interviews and observations
Kasarani	Kioko (2011); Kuiper (2020); MLHUD (2014b); MLHUD (2014d), seven key informant interviews and observations
Kihoto	Gitonga (2015); Kuiper (2020); MLHUD (2014b); MLHUD (2014d); Philippson (2017), four key informant interviews and observations
Kariobangi	MLHUD (2014a); MLHUD (2014f); Mutavi (2018), three key informant interviews and observations
Karagita	Kuiper (2020); MLHUD (2014b); MLHUD (2014d), eight key informant interviews
Kamere	MLHUD (2014b); MLHUD (2014d),Kuiper (2020) six key informant interviews and observations

8. Analysis of necessary conditions

Outcome: Successful upgrading

Conditions tested:	Consistency	Coverage
Hierarchical	0.478723	0.569620
State	0.365692	0.459099
Professional	0.703457	0.794294
Market	0.768617	0.825714
~Community	0.281915	0.530000
~Hierarchical	0.549202	0.475806
~State	0.678192	0.566038
~Professional	0.341755	0.308153
~Market	0.231383	0.217500
Community	0.718085	0.490909

Authorship statement

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Bernhard Truffer**:** Funding acquisition, Resources, Supervision, Reviewing

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Chapter 2:

George Kiambuthi Wainaina: Project administration, Conceptualization, Methodology, Formal analysis, Software**,** Investigation**,** Data Curation, Writing – original draft.

Bernhard Truffer: Funding acquisition, Resources, Supervision, Conceptualization, Methodology, Validation, Writing – review & editing.

James T Murphy: Conceptualization, Writing – review & editing.

Chapter 3:

George Kiambuthi Wainaina: Project administration, Conceptualization, Methodology, Formal analysis, Software**,** Investigation**,** Data Curation, Writing – original draft.

Bernhard Truffer: Funding acquisition, Resources, Supervision, Conceptualization, Methodology, Validation, Writing – review & editing.

Chapter 4:

George Kiambuthi Wainaina: Project administration, Conceptualization, Methodology, Formal analysis, Software**,** Investigation**,** Data Curation, Writing – original draft.

Bernhard Truffer: Funding acquisition, Resources, Supervision, Conceptualization, Methodology, Validation, Writing – review & editing.

Christoph Lüthi: Supervision, Conceptualization, Writing – review & editing.

Chapter 5:

George Kiambuthi Wainaina: Project administration, Conceptualization, Methodology, Formal analysis, Software**,** Investigation**,** Data Curation, Writing – original draft.

Bernhard Truffer: Funding acquisition, Resources, Supervision, Conceptualization, Methodology, Validation, Writing – review & editing.

Christoph Lüthi: Supervision, Conceptualization, Writing – review & editing.

Peris Mang'ira: Methodology, Validation, Writing – review & editing

Chapter 6:

George Kiambuthi Wainaina: Synthesizing, Conceptualization, Writing – original draft.

Bernhard Truffer**:** Conceptualization, reviewing

Christoph Lüthi: Reviewing

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Curriculum Vitae

George Kiambuthi Wainaina (Limuru 1988) obtained his BSc degree in Water and Environmental Engineering (2013) from Egerton University, Kenya. He managed multiple construction projects in Kenya until 2016 when he started his MSc in Water Policy at The Pan African University and Abou-Bekr Belkaid University and graduated in October 2018. In his masters studies, he collaborated with Caritas Switzerland (Kenya) and Eawag on a project to understand barriers and drivers of consistency of use of household filters in drought contexts.

In December 2019, Wainaina started as a PhD researcher in the Department of Environmental Social Sciences (ESS) and Department Sanitation, Water and Solid Waste for Development (Sandec) at Eawag (Swiss Federal Institute of Aquatic Science and Technology), Switzerland. He was affiliated with the Innovation Studies group of the Copernicus Institute of Sustainable Development at the Faculty of Geosciences of Utrecht University, Netherlands. He published in international journals, presented her work at various conferences and meetings, and (co-)organized international workshops.