

## Planning to transform: How to increase the effectiveness of infrastructure interventions in slums



### Executive Summary

The synthesis contributes to four key areas essential for improving current practices for water, sanitation and hygiene infrastructure investment. These include:

- A better understanding of the slum context beyond its definition of deprivation
- Explaining the underlying process of how infrastructures influence residents' livelihoods,
- Untangling participation, which is an essential aspect of social inclusion
- Proposing program learning as a means to scale livelihood improvement at the city and nationwide scales.

This contribution is important since it explains existing gaps in current delivery of infrastructures essential in transforming the livelihoods of slum residents. In addition, it includes recommendations that are relevant for ensuring that residents adopt new infrastructures that improve their livelihoods.

The world is urbanizing rapidly outpacing the capabilities of governments to plan and provide basic services, especially in low and middle-income countries. As a result, many cities have informal and unplanned settlements having slum-like conditions. Slums are some of the most precarious and vulnerable contexts where basic services severely lack. Despite efforts by governments and development partners to provide basic services, slums remain unserved due to inadequate infrastructure, high population densities, regulatory and planning policy constraints, land tenure issues, and limited human resource capacity among other factors.

The fate of over a billion residents living there is uncertain if current planning paradigms do not improve basic service infrastructures at scale. These are necessary for access to water, sanitation, solid waste, mobility, and security among other services.

This knowledge brief synthesizes the findings of three recently completed research projects that set out to explain what is missing in the current planning approach for basic service provision and establish how to increase the effectiveness of infrastructure interventions in sustainably transforming service provision in slums at citywide and nationwide scales.

Overall, the brief addresses funders, planners and implementers of basic service infrastructure interventions both in the government and the private sector. It is also relevant to multilateral organizations such as World Bank, UN-Habitat, Cities Alliance, etc., who are key players in funding and offering technical support to such programs.

### Basis of insights

The insights and recommendations provided in this synthesis stem from mixed methods primary research in India and Kenya. The research commenced from 2016 to 2023 with extensive visits and stays within the informal settlements. The research content and locations were as follows:

- Livelihoods and, water and sanitation services provision in Kibera, Kenya's largest slum settlement by a water utility in Nairobi,
- Basic services provision in another 16 slums in Kenya's secondary towns funded by the World Bank as part of a wider program comprising 80 slums nationwide
- Sanitation planning practices in Tamil Nadu and Karnataka cities, India

### Opportunities for improving infrastructure's impact in slums

Our findings in this section identify gaps and extend current knowledge on slums as well as the planning and implementation processes in four ways.

#### Gap 1: The limited understanding of the slum context and the influence of new basic service infrastructures

Slums like any other urban context comprise infrastructures that influence and are influenced by socioeconomic activities that comprise livelihoods. Current slum definitions focus on the lack of infrastructures and basic services in high population density contexts prompting implementers to provide such infrastructure and services. This often discounts that residents previously achieved the perceived lacking services informally though either inadequately or unsafely.

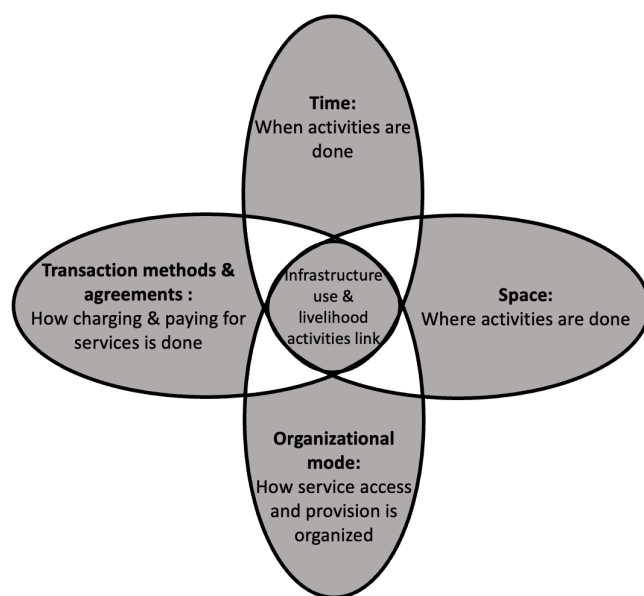


Figure 1: The infrastructure-livelihoods link

While securing livelihoods, residents use infrastructures in whichever form is available. Our findings demonstrate that livelihood activities are intrinsically linked to infrastructures in time (when livelihoods are secured and infrastructure used) and space (where livelihood activities and on which infrastructures they take place). In addition, transaction practices (how payments for services occurs) and how service provision/access is organized (who does what). This is illustrated in Box 1 for sanitation access in Kibera and Figure 1 for conceptually).

Any new infrastructures may create tensions in the infrastructure-livelihood link and may un/successfully transform it [1].

For instance, a new community water supply system may save time and reduce cost for access, and provide residents opportunities to manage the system while not disrupting space use since pipelines go underground. This means that such an infrastructure does not create tension in the infrastructure-livelihood link and is likely to improve livelihoods since it allows the saved time and expenses to be used for other livelihood needs. This is an example of a successful transformation due to the infrastructure.

In contrast, a new utility-managed sewer line creates tensions in a slum since it requires new ways of organizing for sanitation provision and access by including additional new stakeholders, new transaction practices, and may disrupt limited spaces during implementation. In this case, only a partial transformation occurs and livelihood improvements are often only short term especially if utility employees lack the capability to engage residents, and residents prefer other sanitation alternatives such as shared toilets or open defecation. (See Box 2 for a detailed illustration from a water utility's attempts to serve Kibera).

Other infrastructures such as roads implicitly convert spaces that have multiple socioeconomic uses (mobility, trade, and play spaces) into single-use spaces (mobility), limiting livelihood activities and creating tensions between implementers, residents and the infrastructure itself. In extreme cases such as some observed in Brazil, residents even sabotage or vandalize such infrastructure and thus no transformation occurs.

Therefore, new infrastructure creates tensions in the infrastructure-livelihood link consequently determining the chances of their adoption by residents to improve their livelihoods.

### Box 1: Challenges of dwellers in navigating for basic services in informal settlements

Taking the case of Nairobi's informal settlements, only a minority of households have access to the public water supply and public sewerage services – which are less costly. The public water supply in urban middle-income neighbourhoods in Nairobi costs less (USD 0.34-0.53 per 1000 litres), than water supplied by vendors in informal settlements which ranges between USD 0.10-0.50 for a 20 litre jerry can in informal settlements. During the COVID-19 pandemic, the basic services inequalities between informal settlements and middle-income neighbourhoods have been more pronounced. Affording more water for frequent hand-washing presents an economic challenge for the settlement dwellers and maintaining social distancing is almost impossible in the highly congested informal settlements. In their everyday life and activities, informal settlement dwellers need to consider a multitude of factors before simply using the toilet: Which (communal) toilet is currently open? Do I have the 0.1USD to pay for access to the toilet? Is it worth this time to pay 0.1USD to access the toilet? Could the toilet be closed now because of the water shortage? Is it safe at this hour to walk across the neighborhood to the toilet? Perhaps I should revert to the open defecation site because I do not have money now? Perhaps I should not drink water so that I do not have the urge to go to a toilet? Etc. Informal settlement dwellers grapple with such questions constantly because they depend on communal toilets that are situated away from the homes; they are accessed on a pay-per-use basis and are often run by 'cartels' who control pricing. Several cost, security, and practicality questions arise daily for when settlement dwellers require access to water or a bathroom to shower. These challenges exacerbate open defecation practices, have health consequences like the spread of diarrhoeal diseases, and disproportionately affect the lives of women and girls by increasing their work burden when searching for water and finding decent and affordable places to practice daily hygiene.

### Box 2: Capability challenges for water utilities to handle water and sanitation services provision in informal settlements

Water and sewerage utilities have long barely served informal settlements and have mainly focused their services on high-income areas, where they installed water pipes and sewer systems with domestic connections. Utility's conventional capabilities and organizational structures are challenged to operate successfully in informal settlements, due to the high complexity associated with informal ways of organisation, poor infrastructure conditions, differing user needs and widespread poverty.

A few years ago, Nairobi's water and sewerage utility started to expand its operations into the informal settlements. This was challenging, because the utility's conventional capabilities were strongly linked to their operation mode in high-income areas of the city, where they use centralized infrastructures and domestic connections, monthly payment models, written procedures for applications, and have formal interaction with customers.

Different capabilities were needed, however, to successfully operate in informal settlement contexts. For instance, social skills to interact intensively with customers, capacity to collaborate with community groups, skills to deal with cartels, flexible (non-written) application procedures, the ability to use a variety of different infrastructures and sanitation solutions, new public service models, and flexible (non-regular) payment systems.

The development of new informal settlement-specific capabilities within the utility caused tensions within the organization. On the one hand, a dedicated department build-up specific skill that were needed to successfully execute projects in informal settlements. On the other hand, conventional utility's employees, lacked the capacity for intensive customer engagement, did not have the negotiation and social skills, and lacked the time that was needed to successfully perform maintenance tasks in the dense and unplanned settlements. The utility did not manage to solve this paradox and the dedicated department weakened over time [2].

### Gap 2: The limited understanding of how residents take up new infrastructures to improve their livelihoods

Current planning knowledge focuses on ensuring the acceptance of basic infrastructures by residents. It also perceives recipients as "beneficiaries" even when new infrastructures deteriorate their livelihoods. Our findings disclose that residents proactively appropriate infrastructures to shape them as per the needs they consider urgent and important. They may even appropriate them in ways not intended by the planners and implementers even if they accept them.

Our findings demonstrate that the appropriation process involves three main stages: reception, domestication, and insti-

tutionalization. These stages determine whether newly built infrastructure is successfully integrated into the lives of the people who will use it.

**Reception**, the first stage, denotes the residents' initial reaction to the new infrastructure based on the prior experiences with implementers/planners during construction. It is heavily reliant on trust between the implementers and the intended users. If trust is maintained, reception is likely to be smooth. However, if trust is lost, reception can become critical, and it may be challenging to move forward. Trust building and maintenance occurs during participation exercises.



The second stage, **domestication** follows. This is when the residents decide whether and how they want to use the new infrastructure or not. They may choose to use the new infrastructure if it integrates with their infrastructure-livelihoods link with limited tensions, or they may reject it and continue using their old methods if otherwise. Sometimes people also use the new infrastructure by force when opportunities arise if there are access restrictions. All in all, residents eventually develop ways of using the infrastructures provided whether productively or destructively.

The last stage is **institutionalization**, where people incorporate the infrastructure in their day to day lives habitually. If the infrastructure provides a net benefit to their livelihoods, they are more likely to incorporate it into their daily lives and even offer to maintain it. If it doesn't, they may stop using it altogether [3,4].

The appropriation process demonstrates how livelihood improvement occurs and the overall sustainability of infrastructures.

### **Gap 3: Social inclusion in planning: The challenge of multifaceted participation to deliver successful infrastructures**

An extensively studied key challenge concerning social inclusion is participation, implying the involvement of residents in planning and implementation. It is relevant in resolving issues of social justice and equity as well as shaping infrastructures to the needs of residents. Inclusion is a focus of current planning paradigms for basic services (See Box 3 for background on the City-wide Inclusive Sanitation Paradigm). We examined and unbundled the common belief that involving people in the planning and implementation of basic service infrastructures is essential.

We developed means to group actors with similar/shared interests to manage the diversity of actors involved in infrastructure interventions: e.g. market actors such as contractors and suppliers are interested in profits to sustain their businesses while professional actors such as engineers are interested in upholding their professional standards and status. We then identified the minimum number of groups needed to work together to create infrastructure that has a positive impact on people's lives.

Our findings demonstrated that creating infrastructure that improves people's lives requires collaboration between the following actor groups at a minimum: market-oriented actors such as contractors and water utilities, professional-oriented actors like engineers and planners, and community-oriented actors (See Figure 2). These groups need to collaborate during implementation to deliver infrastructure that is positively appropriated leading to improved livelihoods [5].

Actors' capabilities to involve or participate collaboratively are constrained or enabled by social conventions, rationalities, and interests known in the literature as 'institutional logics'. It is such logics among other factors that make introduction and provision of basic services by formal utilities to slum residents complicated as illustrated in Box 2.

### **Box 3: Bringing Equity through Citywide Inclusive Sanitation (CWIS)**

Equity is the first principle of CWIS, and this ensures that no one is left behind. However, bringing about equity in urban sanitation is a complex task and starts with clarifying what equity means in terms of implementation [6]. Equity and inclusion must go hand in hand, which requires the planning process to be comprehensive involving all stakeholders and providing special attention to the marginalized and vulnerable communities. Such an inclusive planning process needs planners with skills beyond conventional engineering, including social skills, such as stakeholder engagement and gender sensitive planning. The CWIS planning framework provides the basis for bridging top-down and bottom-up planning methods, which helps integrate the needs of local communities, which manifests in different ways.

While the needs related to gender, disability and sanitation are being researched upon in relation to CWIS, one area which has had little attention is the needs of residents in urban informal settlements. This is a knowledge gap that has to be urgently filled, since one in every four urban resident lives in an informal settlement with inadequate sanitation facilities. While many pilot initiatives on providing sustainable sanitation in informal settlements have been made in the past decade, such as container-based sanitation, condominial sewers, or fecal sludge management, there is no clear guidance on contextual appropriateness and the regulation of these services. While container-based systems are a private good with public benefits, and condominial sewers are public goods with private benefits in the absence of treatment, and fecal sludge management is a mix of both. The governance and regulations of these systems in urban informal settlements is poorly understood and therefore present a major barrier for planning and implementing equitable sanitation.

### **Gap 4: Program learning: An unexploited means for achieving transformation at scale**

Monitoring, evaluation and learning (ME&L) exercises for infrastructures are scheduled but learning opportunities occur randomly. This mismatch makes ME&L schedules miss learning opportunities. The reason for this is that there are often no structures for capturing, aggregating, synthesizing and resolving challenges at program level. This is especially for complex programs where unexpected challenges (challenges that are known unknowns and unknown unknowns) occur randomly and cannot wait for scheduled ME&L exercises for resolution.

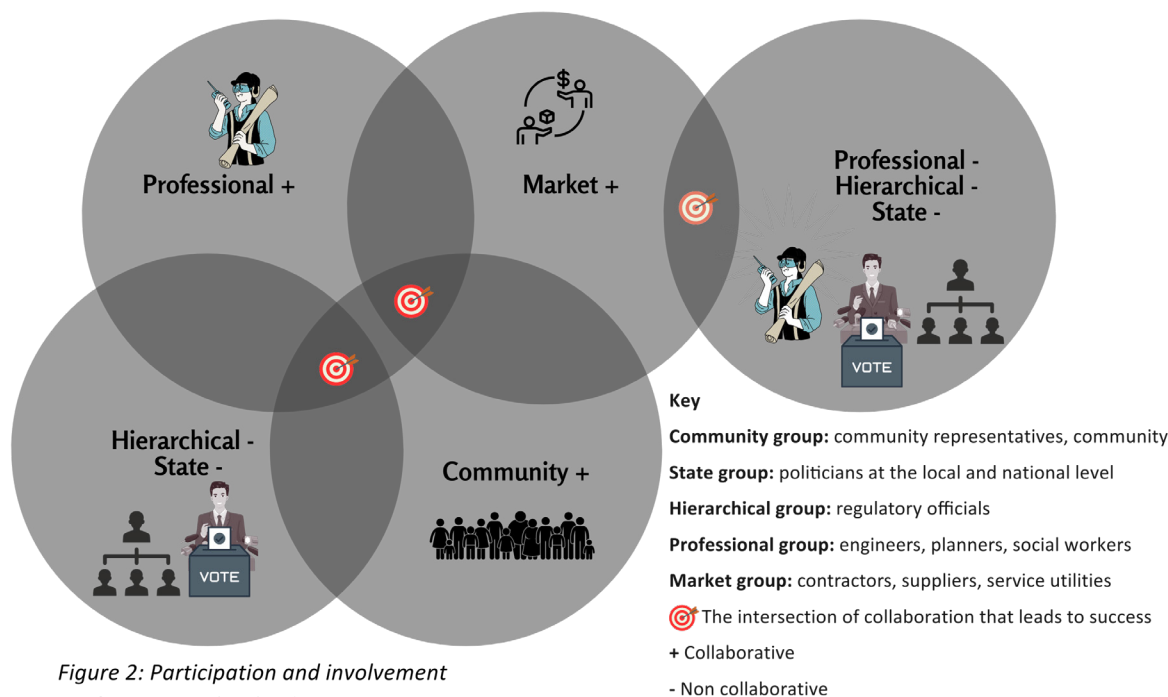


Figure 2: Participation and involvement configurations that lead to success

For such challenges, we developed the concept of program learning—the prompt aggregation of knowledge about challenges and their resolution at the program scale—as a means to scale livelihood improvement at the city and nationwide scales. It focuses on aggregation, synthesis, and resolution of challenges and the replication of tested solutions to challenges in other projects within and outside the program. Program learning relies on effective and systematic recursive processes that include participation, coordination, and communication. It requires human resource capacity as well as budgets for these recursive processes to address challenges [7].

Program learning assists lead implementers to identify and resolve challenges promptly leading to more effective processes and a progressive database of solutions relevant to current and future programs. This strengthens the learning aspect of scheduled ME&L exercises which is hampered by delayed knowledge and resolution of challenges.

### Ways forward: Recommendations for achieving livelihood transformation

To ensure sustainable infrastructure and service for low-income settlements, the following recommendations need to be taken into account while designing and implementing infrastructure intervention programs.

1. Implementers and investors: In addition to cost and access factors ensure that baseline studies explain the time and organizational dimensions both individually and interdependently.
2. Implementers: introduce basic service infrastructures that target reduced disruption and tensions to the infrastructure-livelihoods link to transform livelihoods. If they do disrupt, they should be keen on which aspects of the link are disrupted and preplan mitigation measures to allow for successful transformations.
3. Implementers: anticipate and preplan flexibly for the appropriation process (infrastructure uptake processes) during participation.
4. Implementers: monitor how different actor groups involve residents during the planning and implementation of upgrading programs. They should ensure at minimal, collaborative relations between market, professional, and community-oriented actor groups.
5. Funders: ensure that sufficient funds are reserved for program learning, participation, coordination, and communication. Designers must factor these processes into programs and implementers must monitor their performance regularly in addition to current output and outcome monitoring.
6. Implementers: Monitor the appropriation process which occurs after infrastructures are delivered should be monitored to ensure livelihood improvement.

These recommendations are useful in ensuring sustainable urban transformation and improvement of livelihoods through infrastructures.

### About this Brief

This brief is a product of three research projects namely, Sanitation Upgrading Strategies for Informal Settlements (SUSIS), Sustainability Transitions of Sanitation Regimes in Urban Africa (SUSARA), and Citywide Inclusive Sanitation (CWIS), carried out at Eawag between 2016 and 2023.

These projects were part of the Eawag internal strategic inter- and transdisciplinary research program on Water and Sanitation Innovations for Non-Grid Solutions (WINGS). WINGS strives to develop novel non-grid water and sanitation systems that can function as comparable alternatives to network-based systems.

## Further reading

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4. Wainaina, G.K. and B. Truffer, The missing link for effective informal settlement upgrading: Appropriation shaping the outcome of new infrastructure Environment and Urbanization, Resubmitted.
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6. Narayan, A.S. and M. Agarwal, Equity in Sanitation - The forgotten pillar. Asia Pacific Aff. J. , 2021.
7. Wainaina, G.K., et al., The lack of organizational learning in slum upgrading success: The case of the Kenyan Informal Settlement Upgrading Program 2011-2020. Urban Studies, Submitted.

**About WINGS:** The inter- and transdisciplinary research program Wings (Water and sanitation innovations for non-grid solutions) strived to develop novel non-grid-connected water and sanitation systems that can function as comparable alternatives to network-based systems. The results were synthesized by George Kiambu Wainaina ([george.wainaina@eawag.ch](mailto:george.wainaina@eawag.ch)) and Christoph Lüthi ([christoph.luethi@eawag.ch](mailto:christoph.luethi@eawag.ch)) in collaboration with the program members P. Cherunya, L. Deutsch, S. Hoffmann, A. Narayan, and M. Van Welie

**Website:** [www.eawag.ch/wings](http://www.eawag.ch/wings)

**Program Lead (2015-2022):** Sabine Hoffmann ([sabine.hoffmann@eawag.ch](mailto:sabine.hoffmann@eawag.ch))

**Address:** Eawag/Wings, Überlandstrasse 133, P.O. Box 611, CH-8600 Dübendorf, Switzerland