

Rethinking Incremental Urbanism: co-production of incremental informal settlement upgrading strategies

Mark Swilling, Lauren Tavener-Smith, Andreas Keller, Vanessa von der Heyde, Berry Wessels

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"Curiously, even progressive planners usually share with their conservative counterparts the assumption that the state is the sole urban planning agent"

Marcelo Lopes de Souza (2006) in Pithouse (2009:5)

1. Introduction

In early 2011, a group of Stellenbosch University postgraduate students, based at the Sustainability Institute, concerned themselves with the following question: What does in situ upgrading, as specified by the Upgrading of Informal Settlements Programme (UISP), mean in practice from the perspective of the average shackdweller in South Africa?

The researchers decided to focus their research on an illegal informal settlement of 2400 households called Enkanini ('take by force'), located within walking distance of the centre of Stellenbosch. Enkanini is an unelectrified community that shares 70 toilets and 12 taps; has infrequent waste collection of the 7 open waste skips; no formal drainage, on a steep topography; and no effective leadership structure in order to engage with the municipality to address these infrastructure challenges. A transdisciplinary action research methodology was adopted, given the emphasis that this approach places on the co-production of new and transformational knowledge with the intended beneficiaries of the knowledge outcomes (Callon, 1999; Pohl & Hirsch Hadorn, 2007). This approach goes beyond multidisciplinary methods, which view participation merely as a cooperative tool (Max-Neef, 2005). Indeed, participation is understood to be an essential ingredient for the co-production of shared outcomes.

The NRF has, to date, funded the researchers with a R2,6 million community engagement research grant. The Bill and Melinda Gates Foundation has contributed an additional R2.1 million to pilot initial infrastructure research outcomes in an attempt to derive a model for scaling up the impact; and lastly, the Green Fund has contributed an additional R17million to actualise implementation at scale.

Following a period of problem identification (Section 2), the researchers, through various immersive relationship-building exercises, co-produced three infrastructure interventions with Enkanini residents that were piloted in the settlement (Section 3). By reflecting on commonalities in an emergent participatory process between the three pilots, a tentative framework for initiating micro-scale actions towards larger-scale, longer term upgrading objectives is discussed (Section 4).

2. Problematisation

Breaking New Ground (BNG) set the policy agenda for the post-2004 housing approach, and paved the way for the formation of the UISP. As quoted in the policy, BNG “moves away from the current commoditised focus of housing delivery towards more responsive mechanisms” in order to encourage the formation of more “integrated sustainable human settlements” (DoH, 2004:8). Upgrades should be undertaken as community projects (Pithouse, 2009) since community participation is seen to be essential to the success of any upgrade and to trigger flexible, demand-responsive developments (Tomlinson, 2006).

These progressive policy tenets, however, have either failed to inform practice, or are restrained from doing so, due to the following factors. Firstly, the heavily prescribed nature of the UISP may perpetuate a state-driven, top-down development approach, potentially eliminating the inclusionary and participatory intentions of the programme (Klug & Vawda, 2009; Pithouse, 2009). The immense creative energies of informal settlers, a key facet to their survival in the absence of formalised housing supply, are negated through a state-dominated approach (Bradlow et al., 2011). Indeed, whilst the funding stream under the programme allows for creative responses to land rehabilitation, this creativity will be limited to engineering knowhow (Huchzermeyer, 2006). Secondly, the ever-increasing technical norms and standards, which are often too inflexible for in situ upgrading (DAG, 2007), create a tension between minimum standards for poor people and prescribed engineering norms. Although intended to provide an equitable and safe outcome, the heavily prescribed norms and standards (implemented by a large team of professionals) fail to reach a sensible trade-off between service level (safety, functionality, durability) and a reasonable standard adequate for a first time homeowner. Lastly, there exists reluctance at the local government level in regards to the UISP, and significant re-skilling and capacity development are required in order to commence with the programme¹ (Huchzermeyer (2009). 12

How are these drawbacks and challenges experienced by the ‘average’ South African shackdweller? On average, it takes at least 9 years from commencement of an in situ upgrading project to its completion (DoE, 2011); in the Western Cape those at the bottom of the housing database will wait 32 years before receiving a house². Thus, the short answer to this question is: “Trust and Wait for the infrastructure grids and housing to arrive”. Furthermore, the nature of urban development has come to mean that when informal settlement projects are eventually completed; little is left behind for communities to build on to what has been delivered. This is a recipe for a weak civil society. The fact that post-apartheid urban development has come to mean ‘Trust and Wait’ effectively demobilizes civil society since there is nothing to organize communities around that can result in tangible immediate improvements to daily life. Disorganized communities lack the solidarities and capacities needed to deal with social problems, intra-community violence and the engagements with the state and private sector if and when upgrading does take place.

Given these conflating realities, there is a need for experimental action research to find new workable alternatives with residents and municipalities that give rise to more expeditious service delivery and development outcomes. The approach echoes Mitlin’s notion of ‘co-production’ (Mitlin, 2008), but goes beyond this argument by factoring market actors into the usual equation of state-community actors. Similarly, the approach reinforces the incrementalism of ‘quiet encroachment’ (Bayat, 2000), but breaks from most NGO strategies

¹ To respond to this, the DHS has set up the National Upgrading Support Programme which seeks to train officials, professionals and community members on the design and implementation of the programme and is active in 49 metro’s and municipalities (NUSP, n.d.).

² The province has a housing backlog of 500 000 units in 2012, with only 15 567 top structures having been targeted in the Medium Term Expenditure Framework for delivery in 2012/13 (Madikizela, 2012).

that emphasize the importance of organising first to secure land rights, followed by a struggle for conventionally defines engineering services.

3. Profiles

The researchers commenced with forming new and direct relationships with 'ordinary' residents given the lack of formalised leadership in Enkanini, which made the identification of relevant stakeholders challenging. Through deep immersion, informal discussions, participant observation, as well as visible public art campaigns, the researchers met 4 interested Enkanini residents, which emerged into the core-group and were called the co-researchers. An old abandoned church, made from zinc sheets, became the research center – a meeting space for frequent, daily, focused engagements. These engagements were instrumental in developing a neutral space, developing a shared language, determining critical service delivery problems, identifying potential community stakeholders and brainstorming creative responses. Following is a description of the challenges, responses and outcomes of a development process, composed of key infrastructure interventions that emerged out of the participatory process with the community co-researchers.

3.1 Waste

A waste characterization study undertaken by Stellenbosch Municipality in 2012 found that over 50% (in weight) of waste generated in Enkanini is food waste. Following these findings, a small-scale waste intervention in Enkanini was actioned, which focused on a processing method for food waste as an alternative to landfilling.

The challenge

Collection of refuse in the 7 concrete waste skips is supposed to be performed by the municipality on a weekly basis. Due to difficult road conditions, political instabilities, and insufficient municipal capacity, these collections do not take place regularly resulting in waste remaining uncollected for weeks, sometimes months. The concrete skips are open to the elements, such as rain and wind, and are accessible to pests such as rats, providing an ideal breeding ground. Children and adults are at risk from the pathogens created by the food waste putrefying in the skips which are carried over by flies and rats.

Responding to the challenge

Following the waste characterization study, a 100-household pilot project focusing on alternative food waste processing methods was proposed by Stellenbosch Municipality. Following an extensive engagement with the municipal Solid Waste Department, the researcher was asked to manage and implement a project which sought to address the waste situation in Enkanini. The chosen treatment method was Bokashi³, manufactured by Probio (Pty) Ltd. Bokashi is a 'low-tech' intervention – it is easy to use and does not require heavy infrastructure to implement. It is also convenient for the user as it does not require the user to separate kitchen waste even further and can be used on any type of food waste, cooked or uncooked, meat, fish, or bones.

Through random house calls a representative pilot participant base of 100 households was established. Participants attended numerous information sessions that explained the intentions and practicalities of the pilot as well as the usage of Bokashi. The co-researchers

³ Bokashi is a wheat bran product inoculated with lactic acid bacteria, a type of effective micro-organism, which kickstarts an anaerobic fermentation process of food waste. This allows food waste to be stored for extended periods of time, eliminating pathogens, and resulting in a compostable product.

facilitated these information sessions. Each household received a 25-litre bucket for in-house food disposal which was sprinkled with Bokashi. Buckets could be dropped off at a specific shack, termed the drop-off centre, every Saturday morning over a 9-week period. The contents of the buckets would be emptied into bigger drums, cleaned and handed back to participants, with more Bokashi aggregate if needed. The food waste fermented further in the drums and was subsequently composted using a lasagna layering method.



Figure 1 Bokashi compost



Figure 2. Saturday morning Bokashi drop-offs

The co-researchers led much of the process within the community by helping in the design of the pilot project, holding information sessions, communicating with participants about any problems they were experiencing, and orchestrating and managing the collection days. They also administered surveys to participants, asking for feedback on their experience with Bokashi and the set-up of the pilot. This feedback is used to inform the next phase of the project by incorporating it into its evolving design.

Outcomes

In the 9-week period over 4.5 tonnes of food waste was collected. All households that chose to participate in the project dropped their food waste at the drop-off shack at least once during the pilot phase. Food waste was correctly separated and very little non-food waste was found in the buckets. Most of the food waste was composted locally and used in newly formed as well as existing food gardens in Enkanini. At the conclusion of the pilot, participants were invited to a social event – with music, a braai and raffle. This was the first time that a large crowd (± 350 people) from Enkanini gathered peacefully, with no party political agenda. This created, albeit perhaps briefly, a sense of community and neighborliness around service provision – a topic that is always wrought with frustration, impatience and often aggression for Enkanini residents. Stellenbosch Municipality was satisfied with the outcome, as this was the first time they had managed to implement a project in Enkanini without counter-productive conflictual politicization. Given that relations between the municipality and Enkanini residents are marred by prior tensions, the positive outcome this could well be because the residents were not aware of the municipal support.

Next Steps

Subject to funding availability, the Bokashi waste processing activities will be expanded to further residents in Enkanini. After the researcher's withdrawal from the project, 80 residents chose to continue with Bokashi, and this number continues to rise weekly. Participants reported a decrease in the rat population, unanticipated outcome, and value the efficiency of

the waste processing services. The three co-researchers are currently managing the Bokashi users on their own, without any external inputs, save for the generous donation of Bokashi substrate from Rupert van der Merwe of Probio (Pty) Ltd. The feedback from the pilot participants will be incorporated into the design and execution of a second pilot phase.

2.2 Sanitation

This section describes a small scale sanitation upgrading experiment on-going in Enkanini. Beginning as a technical test of innovative toilets and treatment systems, it has evolved into a collaborative exercise in establishing operating systems to ensure that the technologies operate effectively for users. Strategically, the experiment is an opportunity to develop local sanitation supply capacity and to trigger demand from users, both viewed as prerequisites in order to roll out beyond pilot scales. The intention behind documenting these experiments in alternative modes of delivering sanitation is to influence municipal implementation of informal settlement upgrading.

The challenge

Currently, the municipality provides seven toilet blocks, each with ten toilets, to serve the 2400 households living in Enkanini. In addition to congestion, residents report safety, convenience and cleanliness as their main problems with the communal toilets. At night most residents use buckets in their homes in order to avoid safety threats at communal toilets and many use buckets during the day for convenience reasons. Raw sewage is present in the environment from overflowing and poorly maintained sewers and from open defecation in areas far from communal toilets. Water for domestic use, which is collected from up to 250 metres away is usually disposed of in close proximity to people's homes in open drains or ditches. In the presence of raw sewage and accumulated solid waste, this grey water becomes a major pathway for disease. High reports of diarrhoea incidences in household surveys are unsurprising given the state of sanitation.

An SDI facilitated process to broker partnerships between the municipality and Enkanini residents has not yet borne fruit. Residents remain deeply suspicious of local authorities and the municipality continues to plan and execute service delivery from a distance; live tender documents for multiple informal settlements (including Enkanini) indicate the intention of the municipality to continue to deliver sanitation in the form of communal toilet blocks despite acknowledgement of their inadequacies. This is likely due to inertia in the municipality's machinery to deliver more demand responsive solutions. This institutional inertia is compounded by risk attitudes of decision makers operating from within a context of multi-sector infrastructure backlogs; based on current budget allocations, required capital expenditures⁴ are expected to exceed available budgets by almost double over the next ten years (PDG 2012).

National sanitation policy, which guides municipal delivery, is inconsistent, oscillating between demand responsive and supply driven approaches. Tissington (2011: 60) outlines the "particular policy gaps in relation to those living in dense informal settlements" and indicates the dangers of linking sanitation delivery to housing rollouts. "Free Basic Sanitation only benefits households already connected to the grid" forcing people to "wait to be allocated a housing subsidy (and a house) before their access to sanitation is improved" (Tissington 2011: 66). The UISP has in some ways improved the flexibility of mechanisms to support a wider variety of sanitation delivery strategies (DHS 2009). However, in practice it is difficult to reconcile the proliferation of the municipal communal toilet block response as the logical

⁴ Capital expenditure is required to rehabilitate current infrastructure, service currently unserved populations and a growing population and local economy.

technology choice if interim service provision is to “constitute the first phase of the provision of permanent services” (DHS 2009: 37).

Responding to the challenge

The action part of the research followed an 18-month period of participant observation; focus groups and household surveys in Enkanini; consultations with sanitation experts and municipal officials; and extensive literature reviews on practice, policy and theory relevant to improving urban sanitation. Relationships formed during this research phase led to an emerging partnership that initialised the sanitation upgrading experiment in Enkanini. By linking resident co-researchers⁵ to sanitation technologists from Maluti Water, a research oriented engineering consultancy, designs responding to local conditions and aspirations (as articulated by co-researchers) and technical constraints (guidance from the engineer) were devised.

Households living in close proximity to an Anaerobic Digester, installed by the partnership actors at the Research Centre, were invited to a meeting wherein the partnership actors presented the collaborative designs as starting points. It was communicated from the outset that the designs were tentative starting points that needed to be developed and improved during the experiment. The partnership actors emphasised that household’s participation in the process would be critical in ensuring that the system works effectively for users.

Key features of the technical systems proposed to householders include (i) grey water pour flush toilets connecting via (ii) small-bore shallow sewers to (iii) an Anaerobic Digester which produces biogas as it treats wastewater on-site. Benefits of the toilet, as the point of user interface with the sanitation system, were emphasised: that toilets which do not smell because of the water seal can be installed close to or in people’s homes, that waterborne sanitation is possible without water supply infrastructure and that toilets serve as a convenient and safe grey water disposal facility.

Householders who choose to participate are required to pay service charges⁶ structured to cover a portion of operations, maintenance, and repair costs (largely the costs of remunerating a resident operator trained to undertake these functions). The standard offering, for which only service charges are levied, is for a toilet shared by five neighbours. Residents who prefer a toilet for their household’s sole use are required to cover the cost of the toilet materials and sewer connection.

⁵ who evolved from their original roles as focus group participants

⁶ The partnership finances all shared capital costs and a portion of operating costs in amounts consistent with current capital and operating subsidies allocated to Stellenbosch Municipality.

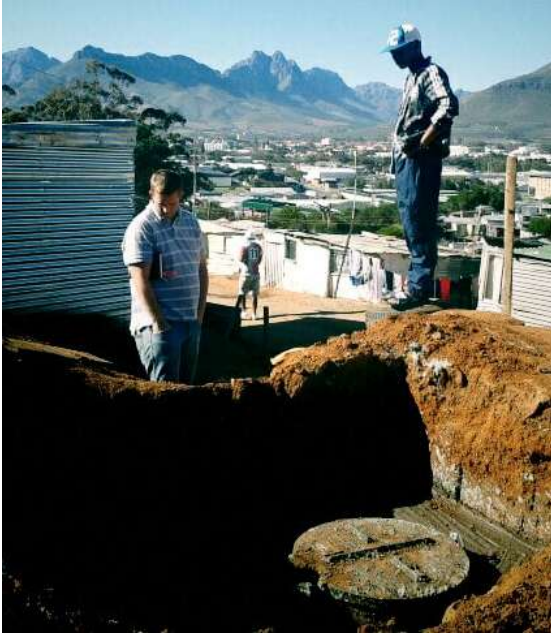


Figure 3 Joint decision making about the Anaerobic Digester

[picture to follow]

Figure 4: Grey water pour flush toilet

Outcomes

Twenty householders have chosen to participate, and have organised themselves into groups sharing four toilets. After interested neighbours had identified themselves (to each other) there was a need for them to interact frequently to solve practical issues and thus began the process of group formation. Some of these interactions were facilitated by the partnership actors, for example drawing sessions which resulted in a shared set of rules relating to cleaning, security, collecting payments and dealing with defaulters. Groups also meet independently, to collect user charges and to fill in user feedback forms designed to elicit householder's reflections on different aspects of the experiment.

The nascent organisation of households into groups sharing a toilet is likely the most significant contribution of the experiment. Households with shared interests formed groups to agree to norms guiding individual behaviours to further these mutual interests. Groups identified roles for themselves that respond directly to governance challenges that frequently undermine development programme performance. Groups formed around permanent sanitation assets are likely to endure; there is a need for them to endure if toilets are to continue functioning. Toilet groups may also have a tendency to federate if their roles expand beyond being users of improved technologies. Householder initiative to form groups has given micro-structure to sanitation operating systems. Could these groups be the building blocks of collective action in Enkanini?

2.3 Energy

The following profile describes an evolving solar energy intervention in Enkanini that expeditiously seeks to provide a high level of diverse energy services to reduce the drawbacks of dangerous energy sources. An innovative Direct Current (DC) Solar Multigrid System was chosen as the most feasible option for rapid and comprehensive electrification given that a) no bulk infrastructure is required; b) all energy services can be met; c) the system is scalable – a core unit can be augmented with energy-efficient appliances over time; and d) the system can be integrated into the electricity grid later, i.e. investments do not become redundant.

Arising out of a small pilot of three households during applied research work; the Sustainability Institute is currently undertaking a 100 household pilot study in Enkanini with funding from the Bill and Melinda Gates Foundation.

The Challenge

The bulk of South Africa's informal settlements remain unelectrified, driven, in part, by the following challenges: unresolved tenure arrangements, inadequate funding, rising levels of informality, existence of illegal and informal electrical connections, costly non-technical losses and an inflexible regulatory environment (Gaunt et al, 2012). The poorest of the poor are often last to receive electricity, denying them their right to Free Basic Electricity. Furthermore, government only subsidizes the electrification of settlements which are on suitable land or those that will not be relocated within 3 years (DoE, 2011). Many informal settlers thus are precluded from, or have to wait extended time periods for, receiving electricity connections. This leaves them no option but to use dangerous energy, giving rise to increasing levels of vulnerability and energy poverty.

The Response

Through a process of informal and random household visits, aided by a church elder, three households were identified to form the basis of a small pilot to determine user acceptability; impact on reduced energy spend on kerosene, candles, gas and wood; and the technical functionality of the Solar Multigrid Systems. Based on the positive feedback of users, the Sustainability Institute secured a grant from the Bill and Melinda Gates Foundation in order to run a 100 (max) system pilot to develop the financial, governance and maintenance operating system, which has been called the iShack Project (= improving Shack).

Through focus group discussions with the Enkanini co-researchers, the preliminary energy needs and affordability criteria of users were determined. This information was fed into a consultative process with the technology provider, which designed a bespoke system consisting of 2 indoor lights, a cellphone charger, outdoor security light and flatscreen colour television.

Simultaneously, the co-researchers collaborated on designing an iShack Project operating system. This centered around the concept of an energy hub that governs a network of trained community solar entrepreneurs. These so called 'hub operators' market, install and maintain Solar Multigrid Systems as well as collect payment from customers. Customers are grouped (based on location and existing affiliations) into household groups of five in order to manage electricity payments on a weekly/monthly basis. The co-researchers furthermore assisted in determining an appropriate electricity tariff structure, a suitable payment method and the means in which defaulters are handled.

Outcomes

The co-researchers identified twenty iShack Project pilot customers. The purpose of the pilot is to assess system performance, affordability levels and an optimal prepayment system (a Watt-hour and a Day-access system is under consideration), which affects user behaviour and thus income variations. All customers are regularly purchasing electricity and paying monthly instalments towards their appliances. The system generation and consumption is being monitored with an electrical logger in order to optimize the system specifications.

The hub operator has received intensive training on installations, maintenance and basic troubleshooting, as well as essential financial literacy and book keeping skills. An increasing waiting list of interested Enkanini residents shows a nascent yet significant demand for solar electricity.



Figure 3. Hub Operator Installing a solar system



Figure 4. A Solar Powered TV

Next Steps

Under the Gates Foundation pilot phase, an additional 80 households will receive solar systems. The Sustainability Institute has received further funding from the Green Fund for an additional 2400 systems, which will see the training of an additional 8 hub operators to manage these systems. The hub operator training programme is being consolidated into a 6 week intensive training programme.

Through an affiliation with SDI, a savings component will be introduced into the household groups in order to build social cohesion and initiate further upgrading initiatives.

4. Discussion

In the following discussion, the theoretical dimensions of participation in the context of development and co-production of knowledge are explored. This builds a backdrop against which to tease out the commonalities and implications for developing a general framework for participatory co-production of new upgrading interventions.

4.1 Theory

Extensive literature suggests that organised communities have a critical role to play in solving governance issues endemic in the delivery of certain public services⁷. Participatory approaches to development have almost become axiomatic in programme design (Jones 2003, Agarwal 2001) and according to Dasgupta and Beard (2007: 244) “community driven development has become the World Bank’s fastest growing strategy for delivering development assistance”. The degree and objectives of participation in development assistance vary widely. In various typologies that have been developed (Arnstein 1969, Pretty 1995, White 1996, Agarwal 2001, Jones 2003), participation is seen to surpass token levels when the poor are involved in making decisions about choices affecting them (Prokopy 2005).

Gains from participation are usually expressed in terms of efficiency and sustainability of programme performance (Prokopy 2005) and in this sense participation plays a functional role in achieving project outcomes (Pretty 1995). In a more profound sense, however, participation is regarded as a route to equity if it leads to the poor lobbying for and influencing the way the state allocates and distributes resources (Prokopy 2005). Agarwal

⁷ See for example Chambers 1997, Ostrom 2000, Bowles and Gintis 2002

(2001: 2623) suggests that “effective participation requires people’s involvement not just as individuals but as a collectivity”. A collectivity may be focussed around a shared interest or challenge and the identity of an individual with a group may be sustained if members interact frequently to take action in response to the challenge (Bowles and Gintis 2002).

Mara and Alabaster (2008) propose that provision of water and sanitation services to groups of households, rather than to individual households, can lead to significant efficiency gains. Gains in this domain usually leverage the governance abilities that organised communities (vis-à-vis states or markets) are well placed to solve (Bowles and Gintis 2002). These may include, for example, peer monitoring and reputation mechanisms in the presence of highly asymmetric information between service users and service providers (Fafchamps 2002, Thorpe et al 2005, Bowles and Gintis 2002).

Groups formed primarily around the coordination of micro-actions to achieve shared benefits may give rise to outcomes of larger scale significance, particularly collective bargaining capacities with external financiers, whether state or agency (Banerjee et al 2007, Mitlin 2008). In a cross country analysis of informal settlement savings groups Mitlin et al (2011: 18) describe the significance of the collective capacity of savings groups both in terms of “what it can do and what it can negotiate” stating that “... savings groups have importance far beyond amounts saved and loaned. They need to be understood in terms of the inter-relationships they stimulate between individual agency, group activity, economic growth and collective democratic political practices.”

Organisational capacity developed as individuals form groups to coordinate actions for mutual benefit is an important precursor for communities to negotiate partnerships with governments and market actors to collaboratively deliver services. Ostrom (1996: 1073) states that “(c)oproduction implies that citizens can play an active role in producing public goods and services of consequence to them”. Mitlin (2008: 340) extends the significance of the concept of coproduction, stating that “(c)o-production has been primarily considered as a route to improve the delivery of services, and it has rarely been considered as a route through which the organized urban poor may choose to consolidate their local organizational base and augment their capacity to negotiate successfully with the state”. It is questionable, however, that this can happen spontaneously. Like any other societal actor, the organisations of the urban poor need to be able to access knowledge networks that assist the complex processes of innovation. But researchers are often trained to extract knowledge for scientific endeavours rather than co-produce knowledge that is socially useful for the urban poor. This is where transdisciplinary research has a role to play.

Transdisciplinary researchers describe the joint production of knowledge, or knowledge coproduction (Pohl et al 2010, Nowotny et al 2001) as an appropriate form of knowledge production in response to complex socio-economic and environmental challenges. The stimulus of research questions from real world challenges and the integration of academic and everyday knowledge in processes wherein mutual learning arises are defining features of TD research (Scholz et al 2007). Although these ideas emerged in quite egalitarian societies with well-developed knowledge capabilities (Switzerland and The Netherlands), when applied in a highly unequal society like South Africa co-production is less about building consensus and more about reinforcing the knowledge capabilities of active networks of the urban poor. In addition to being useful in the construction and testing of theories, intervention experiments as part of the Participatory Action Research toolbox, may provide valuable opportunities to stimulate mutual learning that build capabilities of actors to action social change processes (Argyris and Schon 1989). Through reflexive knowledge coproduction processes, actors expose their underlying theories of change to one another, and

in doing so may be able to reconstruct shared mental infrastructures that are necessary to “initiate change that perseveres” (Argyris 1994). In short, co-production of incremental urbanism between communities, state agencies and private sector players may well depend on researchers who are prepared to co-produce socially useful knowledge with the most marginalized and poorest sectors of society.

4.2 Reflections and preliminary outcomes

In the following section, a tentative participatory framework (Figure 5) for community-led upgrading interventions is discussed, which is informed by the experiences of the three infrastructure interventions as well as the theoretical foundations elucidated above.

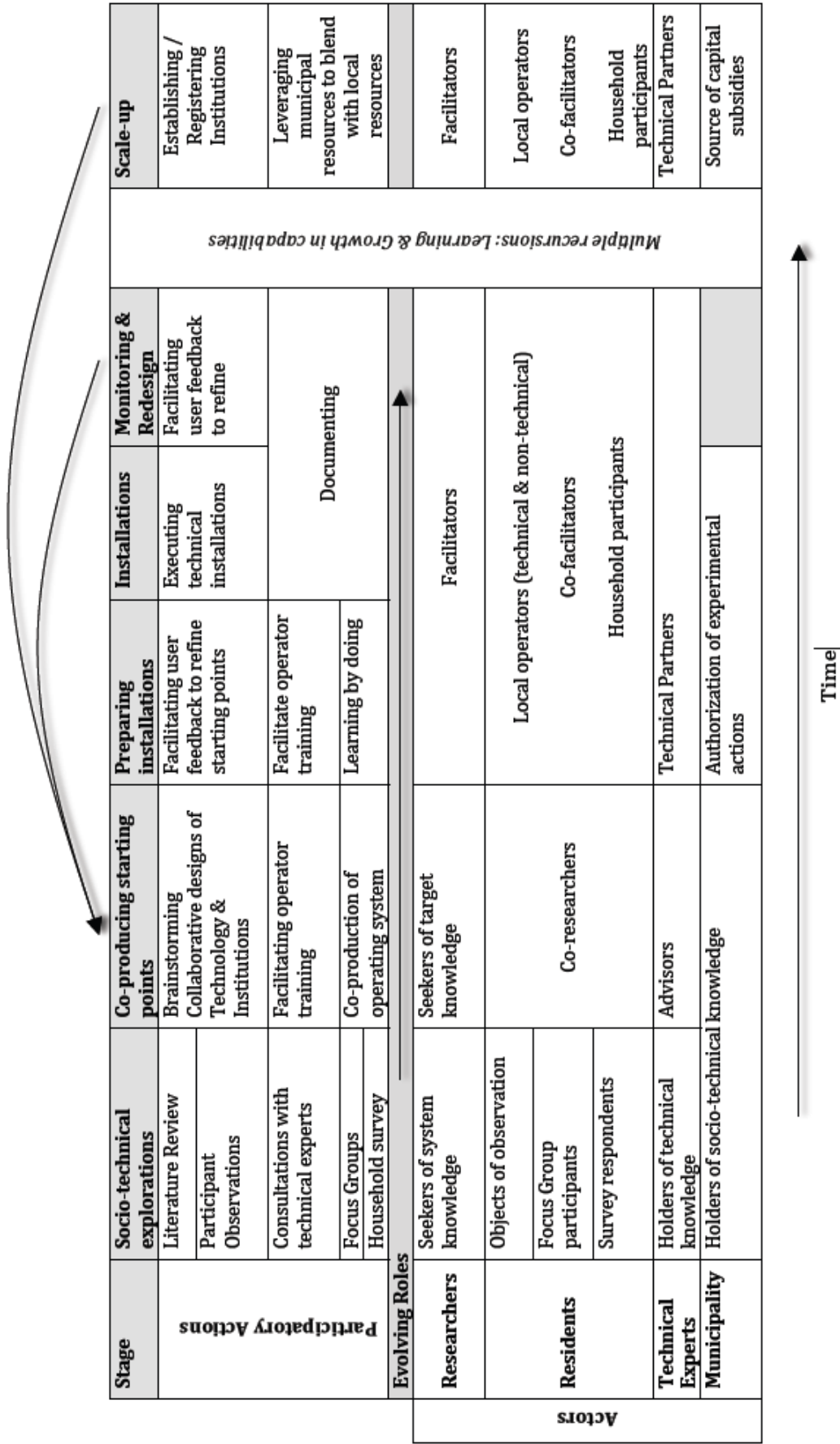


Figure 5. Framework for Participatory Process towards community led upgrading intervention

In order to understand the challenges relating to improving infrastructure in informal settlements, it is necessary to problematize from multiple perspectives and at multiple levels. To this end the researchers employed diverse methods and engaged with a variety of people. In Enkanini immersion, participant observation, household surveys and interviews, focus groups and mapping were used to gain an understanding of the micro-dynamics within Enkanini. Research actions served to simultaneously develop knowledge of challenges from the perspective of householders and represented opportunities for researchers to forge relationships with residents, some of whom have evolved into co-researchers and co-facilitators.

Whilst exploring micro realities in Enkanini, researchers were, in parallel, seeking knowledge regarding the meso-level and macro-level dynamics that affected Enkanini. This meso-participation included engaging the municipality in discourses on upgrading, being part of infrastructure development committees, interviewing officials and conducting participant observations of SDI processes. Concurrently, technical systems knowledge was generated through engagements with technical experts and site visits of working exemplars. To gain a more macro perspective, literature on policy and practice responding to informal settlements in South Africa were blended with international case studies and theory literature.

Having developed a textured understanding of the challenge, researchers began developing target knowledge of workable infrastructure alternatives, through brainstorming exercises with focus group participants. Through these intensive participative interactions, relationships between researcher and householders cohered to give rise to an emergent group of co-researchers. After some time, the researchers introduced the co-researchers to technical experts who had emerged as knowledgeable and committed during the consultation phases. Brainstorming continued, and was focussed on devising a technical and institutional design and action plan to execute a small scale experiment.

The design emerging from collaborative processes between researchers, co-researchers and technical experts was presented to potential intervention participants (Enkanini residents). The team presenting the proposed designs disarmed themselves by not having the answers, and user's feedback was encouraged. The researchers and co-researchers facilitated a process in order to design a functional operating system with the end users – essentially the 'rules of the game' that would determine installations, maintenance and repairs; affordability levels and payment structures; the collective handling of defaulters; and the assignment of roles and responsibilities between participants - in short, the overarching governance of operations. Concurrent to this process, municipal authorisation for the implementation of interventions was secured.

After numerous iterations of the participative design phase, installations commenced under the supervision and guidance of the technical partners, namely Rupert van der Merwe of Probio (Pty) Ltd. for the waste pilot; Jonny Harris of Maluti GSM for the sanitation pilot; and Jonathan Hodgson of Specialized Solar Solutions (Pty) Ltd for the energy pilot. Numerous co-researchers who had shown interest and competency naturally assumed the roles of hub operators, tasked with the implementation and continued operations of the proposed interventions; as well as co-facilitators, instrumental in the management of the installation phase.

The researchers documented the installation and post-installation periods in order to generate a deeper understanding of merits of the process; and to insert these as critical inputs into future design iterations. The learning inherent in multiple recursive steps of the design and implementation phases build the capabilities of all actors; improve the technical designs; and build a foundation upon which to scale up the intervention.

At the time of writing, the researchers are engaged in numerous design and process iterations in order to build replicable and scalable interventions. To scale up the impact, intermediate institutions will need to be established and registered in order to manage the interface between government and the nascent community infrastructure collective. This intermediate stratum is necessary to manage the deployment of critical state subsidies to capitalise the dissemination of the interventions within communities; as well as to manage the nexus between state and community resources.

4.3 Reflections on Co-Production

Common to the energy, sanitation and waste experiments described above is the formation of groups in response to shared interests. In the waste case, group formation is loosely tied to the shared ritual of weekly waste drop offs. Every Saturday morning the same people are likely to be in the same space for the same reason. In the case of energy, the self-selection into groups is a prerequisite to participation, as payments are made as groups of households, not individual households. In the case of sanitation, where payments are also made by groups, household's preferences for shared (as opposed to individual) toilets necessitated the formation of groups of households who share the same asset and therefore need to cooperate for mutual benefits.

Energy and sanitation user groups may have given shape to the elements of an organisational model to effectively govern the operations and use of the infrastructure. Rules that guide the interactions between users and with operators were articulated by users. These rules were distilled from intense debate between householders on how to deal with tricky issues. These rules are shared and binding between group members, yet are still amenable to change, subject to group consensus.

In the case of sanitation, based on the initial choices presented to participants and their responses which centred on affordability concerns, the option to self-organise instead of having an operator undertake cleaning was included, with all households choosing this option. Case studies reporting on sustainability of sanitation interventions when users have been left to self-organise cleaning activities, suggest that incentives to free ride are likely to undermine cooperation, resulting in unclean and un-useable toilets (Gunther et al 2012). This may be avoided if users are organised into groups where members are able to observe one another's behaviour and sanction uncooperative members (Thorpe et al 2005; Bowles and Gintis 2002; Fafchamps 2005). It is premature to judge whether the toilet user groups are effective at inducing and sustaining cooperation around cleaning, however, the initiative that groups have taken as a collective to save on soap by making bulk purchases as a collective is encouraging.

Similar logics underpin the structure of payment systems, where group liability for individual member defaults is meant to harness the benefits of peer monitoring and enforcement. Without external stimulus beyond the stipulation that payments must be made as a group, participants specified, as a role for groups, a means with which to deal with defaulters. The mechanism includes a mixture of tolerating non-payment arising from bona fide inability to pay and sanctioning non-payment arising from an unwillingness to pay. This mechanism leverages the capabilities of groups who interact frequently and thus reveal, at least through observable behaviours, information about one another's economic lives. For up to two consecutive defaults, other group members will cover the service charge of the individual household who cannot or will not pay. If a household fails to pay the group back or resume payments after two months the other cooperating members revoke the key for the toilet from the defaulting household. The redistribution of operational risk related to non-payment from

project operations to participating households may result in regressive designs and is a specific emphasis of monitoring efforts.

The earlier quotation from Mitlin (2011) regarding the significance of savings groups beyond the functional benefits of accruing savings has come to be a meaningful goalpost to embed our micro-actions in larger-scale, longer term objectives. Just as savings groups have played a catalytic role in nurturing the collective capacity of slum dwellers to assert political and resource claims, might organisation around upgrading actions stimulate similar trajectories? Change, by definition, is incremental. The answer to this question will thus reveal itself in time, as more and more people enjoy the benefits of a pest-free environment; reliable toilets in close proximity to their homes; and safe electricity sources.

5. Conclusion

Despite the large number of South Africans living in informal settlements, relative to research on other problems very little research has been conducted that addresses this challenge. A review of published journal articles on this issue yields only a few dozen references compared to, for example, the several hundred references to alien plant invasions. The R2.6 million allocated by the NRF to Stellenbosch University to mount the Enkanini project is a massive financial contribution to the reversal of this trend. However, as this paper has shown, research that addresses the challenge of incremental urbanism is not simply about technical solutions or appropriate policies that the state must adopt. Instead, what we mean by research needs to change. Following transdisciplinary research methodology, the research question is no longer about a particular physical construction (services, houses), but rather the research question becomes 'how can active networks within a given community develop the knowledge capacity they need to generate solutions on their own terms?' The point of departure, therefore, is not poverty (as 'absence of something'), but rather meaningful engagements that lead to co-produced problem statements that then inspire ongoing processes of ever-expanding explorations of workable innovations. It is these innovations that can reinforce the assemblages that sustain the household and collective energies that relentlessly drive the dynamics of incrementalism. In this way, research get connected to the social will of the powerless rather than the political will of the powerful.

In practice, the waste, energy and sanitation innovations that have been co-generated in Enkanini are significant not simply because they represent technical innovations but also because they have become the basis for social organization and network formation. Prior to securing land rights and formal permission to remain where they are, co-produced social innovations have undermined the notion that this is a 'temporary community', created a media profile that suggests active investments in community-constructed infrastructures, and reinforced the notion that researchers have a role to play in redefined processes of co-produced problem solving.

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