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16 Mapping informal settlements

A process for action

Diego Ramírez-Lovering, Daša Spasojević, and Michaela F. Prescott

Mapping is a fantastic cultural project, creating and building the world as much as measuring and describing it... Analytical research through mapping enables the designer to construct an argument, to embed it within the dominant practices of a rational culture, and ultimately to turn those practices towards more productive and collective ends. In this sense, mapping is not the indiscriminate, blinkered accumulation and endless array of data, but rather an extremely shrewd and tactical enterprise, a practice of relational reasoning that intelligently unfolds new realities out of existing constraints, quantities, facts and conditions.

(Corner, 1999)

A context of hardship – social and environmental realities of informal settlements

Developing cities of the Global South are shaped by dynamic cycles of development and transformation between the formal and the informal city (Dovey, 2012). Informal agglomerations, shaped by a mix of need and opportunity, sprout in the most hostile environments, on land that is often flood prone, contaminated or difficult to settle. Paradoxically, it is these informal swathes, occupied by the most impoverished residents, that are often the most difficult and costly to service. As servicing for these locations is not designed pre-settlement but rather retrofitted after the fact into less than optimal development patterns, the informal city is perennially engaged in extensive revitalisation processes sometimes leading to more formal, stable patterns. While some servicing infrastructure is possible to be retrofitted, public open space and other urban amenities are often compromised by the often dense settlement patterns and circuitous processes that characterise these urban agglomerations.

A lack of servicing, infrastructure and open space amenity, coupled with severely degraded environments, often results in ill-health for informal settlement dwellers. However, in an environment of weak governments, with few regulations and a lack of enforcement capacity, the socio-cultural dimensions of communities have as much, if not more, impact on development as land regulation or policy imperatives. In this context, for example, land ownership may be shaped as much by social dynamics, such as kinship, social ties, and conflict, than by harder
elements such as land use and regulatory frameworks. Appropriate responses to these challenges must take into account the socio-cultural as much as the technical dimensions and challenges of communities, but the question is how to do it effectively? In the first instance, we must undertake to understand both the physical and the social conditions and challenges embedded in these generally undocumented contexts. The mapping of these conditions can provide productive directions for responding to such challenges.

**On mapping**

In light of the socio-political and ecological uncertainties mentioned earlier, there is a need to rethink and reframe design solutions: ‘urban political ecology demonstrates how socio-ecological sustainability can only be achieved by means of a democratically controlled and organised process of socio-environmental (re)-construction’ (Swyngedouw, 2006). This investigation is specifically relevant in the Global South, in the context of an absence and failure of infrastructure (Graham and Marvin, 2001; Graham and McFarlane, 2014). In areas without regulatory bodies and processes, the act of mapping the environment can shape the process of urban transformation, formalisation of tenure and future development. In this context, mapping becomes a powerful tool in deciding who and what is visible where, when, and for how long. As such, it is important to interrogate these mapping processes, and open the discussion about their agency and value.

The mapping that we speak of is not interpretive mapping; the combination of desk-based mapping ‘from above’ augmented with fieldwork ‘from below’, nor is it the descriptive urbanism that originated in the 1990s that coupled drawing and mapping with informed descriptions (Shannon, 2008). Both position the hand of the architect or planner as primary in the act of creation. Neither are we referring to mapping in the tradition of ‘radical cartography’ (Mogel and Bhagat, 2007), the right to the city movement (Padawangi et al., 2015), or architectural ethnography (Kajima et al., 2018). While acknowledging that maps are representations of different worldviews and power assemblages, we are using mapping as a communication tool to design and advocate for re-development that is sustainable and resilient. We explore mapping as an operational tool for designing in politically congested, market-led, ecologically degraded environments.

In the context of informality, mapping is political. In informal settlement environments, the mapping of a neighbourhood offers a mechanism supporting collective understanding and agreed action towards multiple possible outcomes. Whether the process aims to formalise land tenure or locate infrastructure, the effectiveness and the scope of communication will depend on what and how things are documented. This essay moves beyond the act of mapping informal settlements for preservation and conscientisation (Sen, 2007) (for example, as practiced in India in the 1980s by activists and NGOs in the development sector). It also moves beyond the ‘counter-mapping’ movement that uses maps as an activist tool to oppose the state and market claims over indigenous territories, and include more voices in spatial planning processes (Radjawali and Pye, 2015). The aim of
this essay is to explore mapping not only as a process of documentation, but as a way to collaboratively re-design informal settlements. To this end, mapping the social and built realities, and making evident connections and interrelationships, allows for the exploration of a range of trade-offs and co-benefits, towards arriving at sustainable design solutions.

We are interested in exploring and exposing the value of mapping in the process of designing in informal contexts through three empirical and intertwined activities: mapping to facilitate collaboration; mapping to generate a systemic solution; and mapping to mobilise stakeholders. These activities were part of the revitalisation process of informal settlement communities, focused on the post-hoc implementation of water-related infrastructure in the Revitalising Informal Settlements and their Environments (RISE) Project. This essay reflects on the operational role that mapping can have, especially in bringing together diverse audiences around designing for environmental and human health.

Mapping the RISE communities

We explore the act of mapping by engaging with the participant communities of the RISE Project, a programme of research, design, and delivery with the ambitious aim to revitalise 24 informal settlements across the cities of Suva, Fiji and Makassar, Indonesia, including approximately 1200 households and 7000 people (Figure 16.1 left). The seven-year action research programme explores an integrated approach to water-sensitive upgrading of informal settlements and investigates its environmental and human health impacts. The examples we interrogate here are from one of the informal settlement communities in the city of Makassar, located in the city’s north-east; this settlement is characteristically plagued by ill-health and degraded environments, and is typical of dense, low lying coastal cities in the Global South.

The design intervention in the RISE Project is based on retrofitting holistic, integrated water management solutions into existing informal settlement communities. This includes blackwater and greywater capture and treatment, flood mitigation and rainwater harvesting, and re-use of infrastructure. The design of water flows (drainage networks, soak areas, collection tanks) and wastewater treatment systems (nature-based systems of constructed wetlands and bio-filters) needs to be located within densely packed communities. We see these contexts as plagued by a complex combination of socio-technical challenges, defined by both built and natural environments: existing houses, roads and pathways, topography, geology – as well as complex social and political frameworks: clans and extended familial structures, social conflicts, social class dynamics, and land rights disputes. The main design challenge is to effectively retrofit space-hungry wastewater treatment systems (such as constructed wetlands) into complex socio-material entanglements, the existing informal settlements – in a manner that complies with the programme’s social safeguard frameworks (as established by the donor, the Asian Development Bank, and Indonesian property law) to protect vulnerable households (identified to be below the poverty line).
As an example of operating in this context, the design and location of a constructed wetland will depend on the complex interplay between social and physical or environmental conditions such as water catchment dynamics, number of people and toilets in the neighbourhood, available space for safe construction, soil properties and available sunlight, while simultaneously being informed by the social relationships between and within households. This includes history of their establishment in the neighbourhood, relationships with community leaders and elders, future plans and aspirations, land ownership dynamics, and their social and economic status, etc. While there may be a hydrologically ideal location for a communal wetland, the social dynamics play an important and decisive role in determining its design and placement and the households it services. Furthermore, the wetland design and position will also be informed by the amount of land owned by one household, their relationship with neighbouring households, family ties and future plans, and any pre-existing conflicts and agreements in relation to land and property.

Figure 16.1 (right) shows the positioning of a cluster of constructed wetlands in one of the RISE settlements. These wetlands will provide blackwater treatment for two large family groups, both comprising several households, living in different houses in close proximity. One family group lives in a set of four houses in plot A, whereas the other group lives within three houses on separate plots (C, D, and E). This design represents an example of a complex trade-off. From a social standpoint, the design was guided by the following considerations. Family A plans to extend their houses in the near future and had no land to accommodate a treatment system. Therefore, family C-D-E agreed to donate land for a wetland that would

Figure 16.1 Left: 24 RISE Communities in Suva, Fiji and Makassar, Indonesia. Right: Positioning the wetland within a socio-material entanglement. Key: land plots (A–F); septic tank (st); constructed wetland (cw); and proposed public pathway (pp).
Source: Image by authors.
treat blackwater (st) from both family groups, on the condition that family A would donate the land which affords direct access to family C-D-E to the main road, formalising it as a public access way (pp). This path must be sufficient for motorbike access, about one metre wide. Based on the total plot size of A, the area of the pathway is also the maximum donation allowed by safeguard controls for this vulnerable family group, since they are below the poverty line. Household C, however, was not able to donate more land than that already allocated to accommodate a communal septic tank (st) and the first segment of the wetland (cw), since the location of their property boundary is in dispute with neighbouring plot B (dashed black line). The next wetland segment begins on plot D, in order to protect a large mango tree that provides residents with shade and fruit. The wetland continues across plot E, occupying the maximum allowable land donation by the household, but ending before an existing bale bale (a traditional outdoor seating platform).

From a technical standpoint, the wetland design had to enable sufficient blackwater treatment for the total number of residents in the cluster of houses, which established the treatment surface area requirements. The wetland’s shape is also constrained by the optimal width-to-length ratio for efficient effluent flow (nominally 1:5). Furthermore, it is positioned to allow for safe construction around fragile houses. The wetland construction seeks to provide co-benefits, such as to reinforce an existing, precarious retaining wall built by the owner of plot F (a private developer), which residents are concerned might collapse. This was discussed with residents as an additional household benefit in donating land for the construction of the wetland.

The design of this wetland system provides a typical example of hundreds of such entanglements that we are contending with across the communities and also serves to exemplify the design approach in RISE; a focus on identifying informal elements and reinforcing and formalising them – connecting existing households, formalising existing pathways, supporting the social use of available common spaces. In this way, the technique of mapping becomes at once a record of existing use and a propositional act, defining boundaries and activities as a claim towards formalisation and preservation.

The next sections explain the mapping tools developed to engage in such processes and resolve these complex socio-material entanglements. These tools include a mapping model, 1:1 physical markings on the ground, and finally, a RISE Infrastructure Map and a Community Map.

**Mapping to collaborate**

The RISE design process for the delivery of upgrades is conceptualised as a loose framework of approaches combining participatory design processes with the design of infrastructure. In order for the intervention to succeed, it was clear at the outset that we needed to develop a process for allowing diverse groups to come together and take an active role in productive, collaborative design and decision-making processes. This had to allow the expert and deep knowledge of community members to be understood, recorded, and leveraged towards the technical
design outcomes. In the first instance we developed a common language as a system of codes and common ground to understand and communicate specific situations we observe and respond to.

This language had to communicate elements in the settlement that are necessary for designing an effective wastewater treatment system in a limited timeframe. Tools had to be developed to not only offer a common ground for dialogue for designers, engineers, and communities, but also to empower community participants to expose their tacit knowledge of their physical and social environment. The mapping system had to be simple and intuitive, to combine elements that are known and familiar to residents, so they can actively participate in all stages of the discussion. It also needed to be able to translate that knowledge into a technical design proposal, embedded in the existing reality.

The main tool that was developed to enable the collaboration between residents, planners, engineers, and architects was a physical model (Figure 16.2a,b). Its primary role was to act as a translator, as a boundary object between differences in their perceptions and knowledges (Leigh Star and Griesemer, 1989; Leigh Star, 2010). The model had to be designed in order to avoid multiple interpretations and confound discussions – the model needed to avoid abstraction and be grounded in reality, enabling the design of post-hoc infrastructure through the political relations that new technology provokes in this community context. Every element of the model served as a political tool, having the power to frame the language about the represented reality: ‘[t]he “political” is the ontological condition of politics and of being together in general; it is performed on many sites related to design, construction and renovation practices; it is enacted by architectural visuals, design experiments, material arrangements and urban artefacts’ (Yaneva, 2017). The model was conceptualised as a system of relations. As the success of the project relies on developing a collective understanding and support for functions beyond individual households and respective property boundaries, the model had to communicate the collective functioning and operations of the neighbourhood, including the communal infrastructure systems of the RISE project. In a context where property boundaries are ill-established and weak, this proved to be a contentious process.

In contrast to mapping practices where designers are responsible for the observation, recording, and analysis of urban environments (such as in Atelier Bow-Wow [2002] or Ramírez-Lovering [2008]), the RISE mapping model was designed to be understood and used by non-designers, typically residents of the RISE communities. Instead of drawing or writing, they used physical markers to map the social and physical characteristics of the space they inhabit such as access networks, the importance and types of shared spaces, location and type of environmental threats in the neighbourhood, and water and sanitation networks (Figure 16.3). In this way, the designers and engineers were able to glean social use and the spatial distribution of activities in the neighbourhood. Through this act of mapping, residents were also exposed to the bigger picture, such as the interconnectedness of environments at neighbourhood level and the impact that one property could have on the broader neighbourhood vis-à-vis sanitation and water management.
Mapping to systematisse

The technical design of the infrastructural system focuses as much attention on the connections between elements, as on the elements themselves. While these connections are regulated by gradients and flows shaped by material and natural conditions, attempts at designing and mapping these configurations relied on a simultaneous recording of social relations between and within households.

An ‘on the ground’ 1:1 ‘map’ (‘RISE Infrastructure Map’) constructed using hazard tape, spray paint, and other markers (refer to Figure 16.2d) enabled a complicated discussion between technical experts and groups of residents. This mapping activity was developed to facilitate understanding of the system as a whole, by drawing the relationships between the system elements on the ground. These relationships were mapped using two types of hazard tape – yellow was used to map connections between infrastructural elements, and red to mark property lines between different private plots (Figures 16.2c and 16.2d). The infrastructural elements (septic tanks, wetlands, and pressure pumps) were first marked with light-weight, movable plastic containers, and spray painted on the ground and walls after the connections and element relationships were collaboratively established (Figure 16.2c) on-site. This marking system enabled a deep understanding of the system function in the real physical context.

Flexibility in the process enabled sensitive political negotiations between experts and residents, and importantly between residents themselves. While the

![Figure 16.2](image) a,b) A physical model as a space for socio-technical discussion; c) Mapping the position of a proposed infrastructural element using plastic containers; d) Mapping the connections between elements in the overall system using brightly coloured hazard tape. Images by authors.
physical model enabled an understanding of the systemic function at the scale of the neighbourhood, the ‘1:1’ mapping was necessary to deal with complex and nuanced trade-offs at household to household scale. The 1:1 markings allowed the team to discover and resolve the entanglements between the technical requirements for the infrastructure and the socio-cultural conditions of informality. The act of agreeing on and physically marking the location of a wastewater pipe became a de facto agreement to protect that use, and a household’s agreement that that space will not be jeopardised in future. In this way, mapping offered a window into understanding and interacting with the social dynamics of this informal settlement. The 1:1 map depicts the ecosystem of the neighbourhood, as conditions and relationships are described by the residents.

Mapping to mobilise

Mapping is political. In the informal city, mapping and documenting a neighbourhood is the first step towards its legal formalisation. Typically, this process will be facilitated by the surveying of land parcel boundaries which assists in resolving land conflict and opens the path for land (and tenure) regularisation. Our mapping processes embraced this premise. However, it was clear that the effectiveness and scope of this process depends on what and how things are mapped and documented. This is one reason why two maps were produced in each informal settlement as a record of the collaborative process.

The first, the ‘RISE Infrastructure Map’, illustrates the position and size of infrastructural elements, as well as the connections with the existing houses. It represents a record of the agreement about elements that will be constructed in the near future. The second, the ‘Community Map’ documents a much broader set of discussions, and represents an attempt to capture the socio-material entanglements of each neighbourhood, the way in which physical spaces are connected to social, economic, ecological or cultural functions (Figure 16.3).

Figure 16.3  Community map: spatial representation of socio-material interactions and the start of the action-plan.

Source: Image by authors.
These moments of socio-material interactions are necessary for the sustainable functioning of the future infrastructural system, as well as supporting other important functions of the broader neighbourhood – the pandanus tree that provides income to old Ms. Dewi for production of decorative graveyard offerings; the custard apple tree that needs to be preserved because Mr. John parks his motorbike underneath; an access way that needs to remain one and a half metres wide to allow for the pa’gandeng (motorbike fish vendor with goods in side baskets) to pass; a dry and unshaded area for drying rice; a place for garbage collection bins. Each notation on the map is further connected to an action box, or set of boxes, capturing the sequence of actions that need to be undertaken by the community, the RISE design team, or the government authorities. In this way, the map represents a connection between the land and the activities of different groups of actors that would not necessarily act in the same place, at the same time, or with the same understanding. The final community engagement activity involves socialising the Community Map with residents, city planning departments, and government authorities to agree on the course of action and roles and responsibilities within it.

Conclusion

The importance of operative mapping of the kind we describe here goes beyond notions of communicative planning, participatory design (Botes and van Rensburg, 2000), and documentation. In the context of informality, people are often focused on the urgency of their immediate needs, shelter and economy. Therefore, it is challenging to explain and demonstrate the value of a project like RISE, focused on the communal benefits of a healthy environment, designing systems for flood mitigation, climate change resilience, objects and things that are either underground (and invisible) or for the not-so-near future. The creation of a shared understanding of the settlement was necessary for further design development. In addition, a process that develops a community’s understanding and ability to come together to solve problems builds collective agency and efficacy and through this a resilience, allowing communities to be better prepared to jointly respond to adversity.

In the informal settlement context where legal processes and boundaries are nebulous, any ambition for systematising solutions, a pre-condition for mainstreaming and upscaling, must not only provide a register of prototypical physical challenges and design responses for such challenges, but must be bolstered by a system for intersecting technical responses with socio-cultural conditions. Mapping of these socio-material entanglements is often in opposition to the neat and clearly classified, typological report. Socio-material entanglements can never be captured completely; one can only observe particular time frames or particular components of a situation in space (Wigglesworth and Till, 1998). However, the characteristics of a component of a system do not necessarily reflect the system itself, which is why in designing for the future it is necessary to find more dynamic ways of mapping towards more sustainable implementation.
In order to address the overwhelming challenges of increasing informal urbanisation globally, we must shift the paradigm of service delivery practices. There is an important reckoning: unless social and cultural frameworks are seriously considered and intertwined with the delivery of physical outcomes such as infrastructure solutions (socio-material entanglements) we will not be able to provide long-lasting, effective responses. The work discussed here presents strategies for contending with the important entwining of the physical and the social. It presents tools and processes that lead towards resolving land and tenure formalisation and infrastructure service delivery, while building community trust and efficacy measures that will outlast any project of this nature. Our experiences to date demonstrate the importance and value of effective community relationship building. Mapping tools and processes that embrace this complexity, provide effective mechanisms for growing the socio-material capital of communities.

Note

1 We were aware that the model had the power to include some discussions and exclude others. It was designed to serve the purpose of designing this infrastructural system.

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