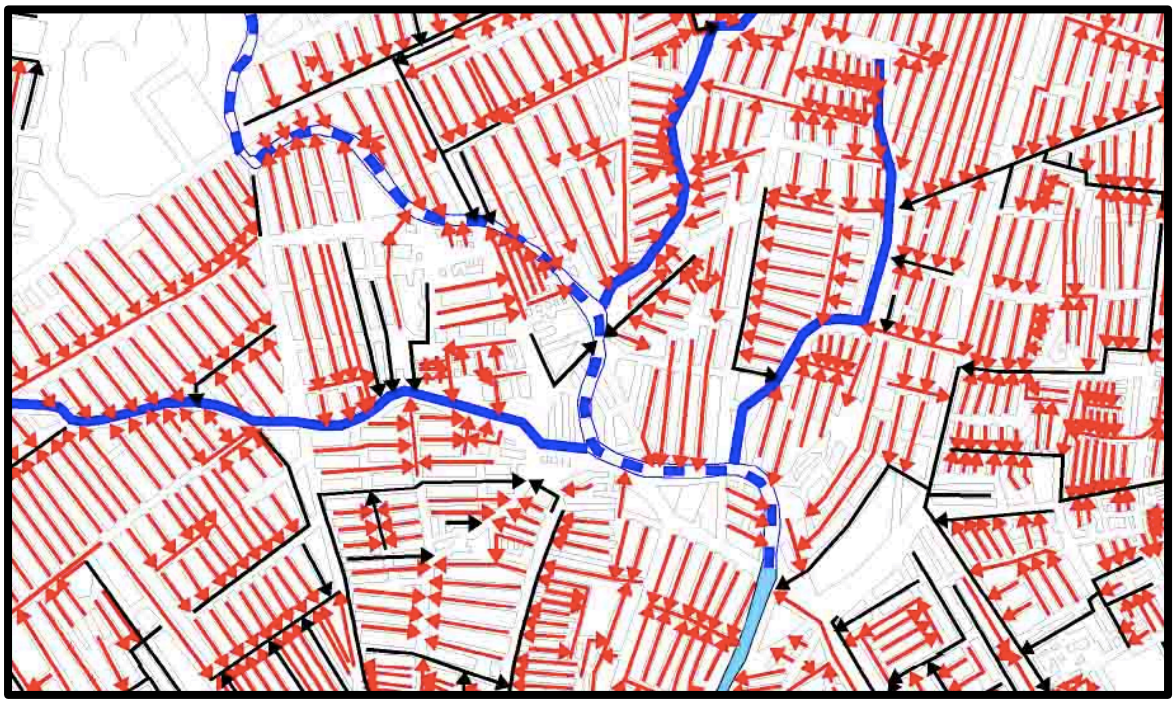
Meaningful Mapping and Urban Development: The Orangi Pilot Project



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ABSTRACT

Why are maps important? Who should map? How are maps used? This paper addresses these questions using the Orangi Pilot Project (OPP) in Karachi, Pakistan, as a case study in community-based mapping and environmental health. What is the relationship between community mapping processes, environmental literacy, and sustainable infrastructure in Orangi? The urban landscape in Karachi is characterized by rampant informality. As a result of high rates of rural-to-urban migration and an acute shortage of housing, high-density informal settlements, or *katchi abadis*, crowd the city. Many of these *katchi abadis* are not recognized by government agencies, and have no formal connections to existing water, sanitation, and health services. When initiating urban development projects, planning agencies in Karachi use outdated maps and only focus on formal communities and regularized informal settlements. Environmental health in these informal communities is thus dismal. The OPP was started in 1980 by Dr. Akhtar Hameed Khan, a Pakistani social scientist and development practitioner, to improve living conditions for residents in Orangi, a *katchi abadi* in northwest Karachi. As part of its low-cost sanitation program, the OPP provides technical assistance to Orangi residents to help them build secondary sewer lines and latrines. One of the key contributions of the OPP, this paper argues, is the systematic surveying and community-based mapping of sewer lines in Orangi and in other informal settlements across Pakistan. The environmental literacy built in Orangi as a result of community mapping processes led to the community's commitment to build, finance, and maintain sustainable infrastructure, and has thus improved environmental health. While the OPP model of community-driven, low-cost sanitation has achieved mixed results in replication, the organization's detailed maps of informal, undocumented spaces have highlighted severe gaps in infrastructure in urban Pakistan and have spurred several communities to undertake their own community-based mapping approaches to improving environmental health. Environmental literacy, as created by community mapping processes, is key in the replication of the OPP model. Environmental literacy has two aspects – awareness of the community's urban landscape on the part of an organization when designing and implementing environmental health interventions, and awareness of one's lived experience in relationship to the environment on the part of residents. This paper ends with lessons for community mapping projects from the OPP case, and poses questions on the feasibility of community-based environmental health projects in weak and violent states.

I. MAPPING AND URBAN DEVELOPMENT

Just as language has no longer anything in common with the thing it names, so the movements of most of the people who live in cities have lost their connection with the earth; they hang, as it were, in the air, hover in all directions, and find no place where they can settle.
-Rainer Maria Rilke, 1903

Mapping is a key aspect of urban development projects but its nuances are often not considered in practice. Why is mapping important? Why does the identity of the mapmaker matter? How are maps used? What is not depicted on maps? Who are left out of the maps and the mapping process? Thinking about these questions is crucial to efficient and inclusive development processes and outcomes.

Meaningful mapping also helps construct a cohesive urban identity. Community mapping processes connect different stakeholders to one another, and weave a collective narrative of differing perspectives on the urban environment. Maps, especially those commissioned by the state, are evidence that a government acknowledges the presence of the landscapes and communities represented on maps. In megacities containing both formal and informal areas, state recognition of informal communities on maps is especially important because maps determine access to formal urban services, including water, sanitation, health, and education, leading to improved environmental health.[1] Mapping processes and maps thus provoke Lefebvre's (1968) idea of the right to the city - who has a right to make demands on the city and its resources, and are they represented on maps important to the state?

This paper delves into the relationships between community-based mapping, environmental literacy,[2] and environmental health using the Orangi Pilot Project-Research and Training Institute (OPP-RTI)[3] in Karachi, Pakistan, as a case study. Since 1980, the OPP-RTI has been providing technical assistance to Orangi residents to help

[1] Environmental health in this paper refers to how characteristics of landscapes affect human mental and physical well-being.
[2] Environmental literacy (or awareness) in this paper refers to knowledge of natural processes and outcomes reflected in the urban environment.
[3] The OPP evolved into several autonomous organizations, including the OPP-Research and Training Institute, in the late 1980s. In this paper, OPP is used to describe the activities of all the organizations under the OPP banner. OPP-RTI is used when discussing low-cost sanitation and mapping. For further information, refer to Section III.

them improve the environmental health of their community, which is located in an informal area in the city.[4] This paper looks specifically at one aspect of environmental health building the OPP undertakes – helping communities build low-cost sanitation systems. The OPP-RTI is also involved in intensively mapping, surveying, and documenting water and sanitation infrastructure in Orangi and in other informal settlements in Karachi and beyond. The community mapping process, along with the maps produced, has created more awareness in the community about the environment and possible points of intervention. The maps also represent the knowledge generated, owned, and utilized by an informal community to negotiate better environmental health conditions. The production of knowledge in Orangi has led to the community's acquisition of valuable skills, like GIS mapping and surveying.

This paper is divided into three sections. Section II explores why maps and mapmaker identities are important. Section III describes the Orangi Pilot Project-Research and Training Institute and its sanitation-related mapping activities. What are the OPP-RTI's achievements? How has it created environmental literacy in the community? What are some of the challenges the organization faces? Section IV outlines the lessons the OPP-RTI case highlights for other community-based, sustainable[5] infrastructure projects addressing environmental health.

II. THE POWER OF MAPPING

The virtue of maps, they show what can be done with limited space, they foresee that everything can happen therein.
-José Saramago, The Stone Raft, 1986

Accurate maps are crucial in urban development projects, which are environmentally conscious. A nuanced understanding of where environmental health problems and underserviced populations are located in an urban landscape is crucial in planning and implementing interventions. This section investigates why maps and mapping processes are powerful and ends with three key questions one needs to consider about urban development maps.

[4] In this paper, informal settlements refer to state-owned areas developed outside of government planning processes through squatting and illegal occupation.
[5] Sustainable infrastructure, in this paper, refers to its ability to be maintained over time.

The cartography and critical cartography literatures describe maps as expressions of power. Wood and Fels (1992) and Kim (2013) highlight three different ways maps demonstrate power relationships: 1. They are selective in what they represent. Maps always have an agenda and they serve interests. 2. Maps are "embedded in the history they construct" (Wood and Fels 1992, p.1) and reproduce the culture that created them. In other words, maps, which are created by inequalities, also reflect these inequalities. 3. Beyond describing a landscape, maps help define territory.

The critical cartography literature further investigates the justifications behind and implications of mapmakers' choices. For example, maps can be manipulated to reflect the intended reality through the alteration of scale. In this manner, some issues are pushed to the background and the intended issues are illuminated in the foreground (Monmonier 2005; Pickles 2004; Wood and Fels 1992). Since maps are social constructions of power, social distance is often larger than the geographical distance depicted on maps (Gans 1962). In Karachi, for example, informal settlements built on agricultural land are not represented on state maps, unlike some informal areas located on government land (Hasan 2006). While located in the same urban landscape, state-recognized informal settlements have a different socioeconomic standing in the eye of the state, compared to the other informal areas, referring to Gans's (1962) idea of social distance.

Mapmaking processes are equally as significant as their products. Mapping by city government officials or foreign aid agencies, for instance, is very different compared to mapping by communities and households. The stakeholders involved in the mapping process, the types of knowledge targeted, and the choices made in representing the landscape all vary. The community mapping literature, which examines mapping processes and products at the community-level, offers three main benefits of engaging community architects and residents in a mapping process (Archer, Luansang, and Boonmahathanakorn 2012; Livengood and Kunte 2012; Patel and Baptist 2012):

1. The process itself leads to larger conversations in the community about its relationship with its environment, leading to improved environmental literacy.

2. By targeting under-represented communities, community mapping processes can ensure that the unmapped are accurately represented on maps. Many unmapped, undocumented communities exist on the peripheries of the physical and socioeconomic city, invisible and illegible to those in power. Community mapping is a strategy of creating meaningful relationships between the state and citizens, and the maps created through these processes are tools for negotiating with the state for better living conditions.
3. Mapping processes at the community-level may ask better questions compared to those at broader levels of society because the stakeholders involved are intimately connected to the community landscape and its residents.

The cartography, critical cartography, and community mapping literatures assert that maps and mapping processes matter. These literatures raise three questions one needs to consider when thinking about the role of mapping in development (Kim 2013):

1. WHO is mapping?
2. WHAT is mapped and what is **not** mapped?
3. HOW are the maps used?

Sections III and IV will explore how the OPP is helping to improve the environmental health of the town through community-based mapping and its emphasis on environmental literacy.

III. THE ORANGI PILOT PROJECT

Clearly there are two apparently irreconcilable approaches to project execution [in Orangi]. One, open-ended, exploratory, and evolutionary with emphasis on sociological particularities, unconstrained by time and cost. The other, target-oriented, systematic, with a professional and technical focus, constrained by time and costs.
-Nicholas Houghton, Chief Technical Advisor, United Nations Center for Human Settlements, Karachi, 1982

The Orangi Pilot Project-Research and Training Institute (OPP-RTI) was started in 1980 in Karachi by Dr. Akhtar Hameed Khan, a social scientist and development professional (Pervaiz, Rahman, and Hasan 2008). Dr. Khan chose to work in Orangi Town because it was the largest informal settlement in Karachi (Zaidi 2001). Through action research,

Dr. Khan and his team identified sanitation as the most significant intervention point in Orangi's environmental health challenges and developed a low-cost sanitation model for residents to finance and build their own sewer lines (Pervaiz, Rahman, and Hasan 2008; "Orangi Pilot Project-Research and Training Institute" 2014). The following sections provide information on the larger urban environment in which Orangi is located, the state of mapping in Pakistan, the OPP's low-cost sanitation model, and an analysis of the OPP's successes, particularly in mapping, replication attempts, and challenges.

A. The Urban Landscape in Karachi

Home to 15 million residents, Karachi is a port city and the economic hub of Pakistan (Figure 1) (Asian Development Bank 2005). The city contributes 20% of national GDP, handles 95% of international trade, and is responsible for 40% of provincial revenues (Asian Development Bank 2005). Often called 'mini Pakistan' because of its diverse demographic profile, the city has been the dream destination for immigrants from all over Pakistan. Unfortunately, the rampant and unplanned growth of the city, combined with political infighting and the mafia-zation of all urban commodities, has created a city always teetering on the brink of civil war.

Figure 1. Map of Karachi, Pakistan[6]

[6] Source: http://www.wordtravels.com/images/map/Pakistan_map.jpg

Chronic violence is an important aspect of urban life in Karachi. Karachi has endured years of ethnic, political, sectarian, and terrorist violence, along with the more traditional types of conflict associated with a developing city. Violence in Karachi is enacted on four levels – international, national, provincial, and metropolitan. Pakistan has been experiencing conflicts related to trans-national Islamist terrorist groups and anti-Western sentiments post-9/11, which have played out in the city. Karachi is also dealing with the consequences of varying developmental patterns across the country and the region, which make the city an attractive destination for immigrants. At the provincial level, the urban, industrial city has had trouble relating to its rural hinterland of Sindh, and its cosmopolitan character has led to ethnic and language wars between ethnic Sindhis and other immigrants (Raman 2012).

Despite chronic violence, Karachi still attracts many migrants from all over the country, increasing the burden on city resources, particularly housing. The acute lack of housing has led to the proliferation of informal settlements, or *katchi abadis*, in Karachi. Because the city experiences high rates of rural-to-urban migration, demand for housing is high. Karachi's annual housing demand is 80,000 units, and from 2001 to 2006, the formal sector constructed 26,700 units per year. Existing housing stock is also constantly under threat by megaprojects commissioned by the land mafia –politicians, bureaucrats, and real estate developers (Hasan 2006).

61% of Karachi's residents live in 539 *katchi abadis*, which are located on government-owned land and on unofficially divided agricultural land on the periphery of the city (Pervaiz, Rahman, and Hasan 2008; Hasan 2006). Many informal settlements do not have basic access to drinking water, formal sanitation services, education, and healthcare facilities (Hasan 2006; Pervaiz, Rahman, and Hasan 2008). The national *Katchi Abadi* Improvement and Regularization Program has been in effect since 1973, and is financed through World Bank and Asian Development Bank Loans. Unfortunately, only 1.5% of informal settlements have been upgraded and regularized per year, which leaves the rest of the *katchi abadis* in a deplorable state (Hasan 2006).

Sanitation, in particular, is a tremendous challenge for informal settlements. While Karachi does have an underground sewage network, the system has not been able to

keep up with the rate of industrialization and urbanization. The sewage system has been expanded on an *ad hoc* basis, with most informal settlements and new houses disposing their sewage into natural drainage channels and bodies of water. Wastewater treatment plants are unable to pick up sewage flows from natural drainage channels, and untreated waste pollutes the sea. 90% of Karachi has access to sanitation services (compared to the official estimate of 40%) – out of this 90%, 50% of sanitation infrastructure has been built by non-governmental organizations (NGOs) and communities, 20% by the Karachi Water and Sewerage Board (KWSB), and 30% by other government agencies (Pervaiz, Rahman, and Hasan 2008).

B. Surveying and Mapping in Pakistan

One of the reasons for weak infrastructure provision in Karachi is the poor quality of maps that urban service providers work with. The Survey of Pakistan (SOP) is the country's mapping and surveying agency, and it works closely with the Pakistan Space and Upper Atmosphere Research Commission to produce an array of remote-sensing data products that include the National Land Use Mapping Project. The last urban aerial maps SOP produced were in the 1960s and 1970s. These maps, which are currently used and updated by planning agencies on an *ad hoc* basis, only depict planned settlements and regularized informal settlements, leaving out all the other informal settlements that also contribute to the growth of Pakistan's economy (Hasan 2006).

State mapping of informal settlements is an even messier process. Private consultants hired by the *Katchi Abadi* Directorate and major city governments only map informal settlements on government land, intentionally ignoring the *katchi abadis* located on the outskirts of the city built on agricultural land (Hasan 2006). Urban service providers in cities either use maps made available to them by city governments and SOP or make their own maps with consultants (Hasan 2006). All these maps produced by various levels of power in Pakistan are not comparable; they map different landscapes and have different scales (Hasan 2006). Thus, no common map for a Pakistani city exists, especially one that can be easily upgraded to reflect rapidly changing socio-demographic and urban environmental trends.

C. OPP and Environmental Health in Orangi

In this landscape of ineffective governance and chronic violence, Dr. Akhtar Hameed Khan, a social scientist and development practitioner, started the Orangi Pilot Project to help Orangi residents improve their environmental health. Located in the northwest part of Karachi (Figure 2), Orangi has been the destination of many immigrant populations since it formed in the peripheries of 1960s Karachi. The town is actually a low-income settlement that is considered to be 85% *katchi abadi*. 1.2 million people live in Orangi, and it is often referred to as a 'mini-Karachi' because of its heterogeneous population. Many of the dominant ethnic groups often live in union councils segregated by ethnicity. The town has a mixture of income classes, including lower middle class, and many residents work as transporters across Pakistan (Raman 2012). Before the involvement of the OPP in Orangi, the urban environment in the area was abysmal – streets were overflowing with waste, potable water was scarce, rates of disease were high, and mobility was low (Hasan 2006; Zaidi 2001; Raman, 2012).

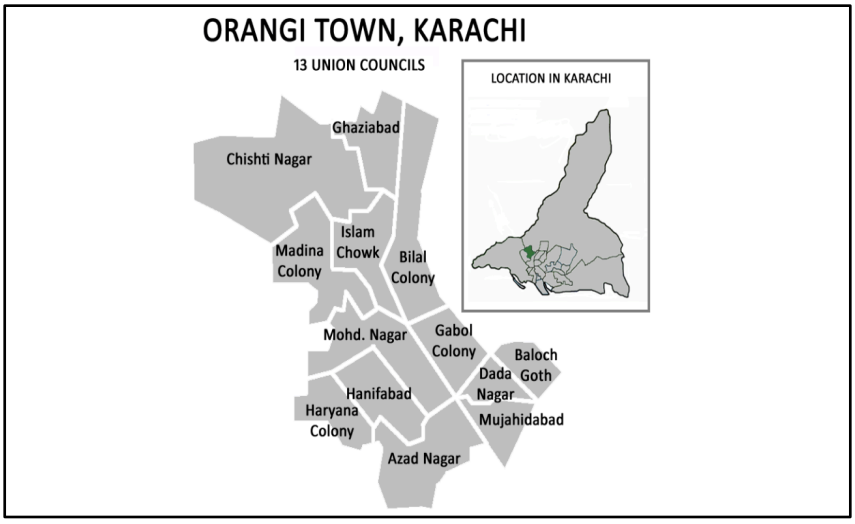

Figure 2. Map of Orangi Town and its union councils[7]

The OPP was the result of the Bank of Credit and Commerce International's (now known as Infaq) exploration of development projects in Orangi (Raman 2012). From Dr. Khan's interviews with residents about their relationship to their urban environment

[7] Source: http://upload.wikimedia.org/wikipedia/commons/a/a5/OrangiTown_Karachi.PNG

emerged a general plan to build low-cost sanitation services focusing entirely on community ownership of space, devoid of foreign intervention (Hasan 2007). Dr. Khan's previous experiences with development projects in and beyond Orangi funded by multi-lateral institutions left him skeptical of the effectiveness of non-community-based interventions (Raman 2012). He was convinced that sustainable approaches to environmental health in informal areas could only be achieved by total investment on the part of the community – both financial and labor investment (Zaidi 2001).

The OPP's low-cost sanitation program was based on a component-sharing model, which the organization termed "internal/external" (Zaidi 2001). The Orangi Pilot Project-Research and Training Institute (OPP-RTI) provides technical assistance to Orangi residents who wish to build and finance internal sanitation infrastructure like indoor latrines and secondary sewer lines (Pervaiz, Rahman, and Hasan 2008; Hasan 2006; Hasan 2005; Zaidi 2001). Houses in Orangi are organized around straight lanes (see Figure 3 for a photo of a lane in Orangi). The construction of secondary sewer lines requires an organizational unit bigger than a house but smaller than a union council. The lane thus became a convenient organizational unit. To apply for technical help from the OPP, residents have to organize themselves logistically by lane and then sort out financial arrangements to fund and build sewer lines (Hasan, 2006).

External sanitation infrastructure, which includes primary sewer lines and waste treatment plants, are supposed to be the responsibility of the state (Pervaiz, Rahman, and Hasan 2008). The OPP assumed that if the government appreciated the self-help nature of informal communities in improving their environmental health, it would step in and complement community efforts (Hasan, 2006).

The OPP also intended to operate its sanitation program at minimal cost to ensure that residents found it financially feasible to invest in their environment. The low-cost aspect of the model comes from using local materials, relying on community labor and financing, cutting out contractors and middlemen, keeping salaries and overhead low at the OPP, and working with nearby universities to leverage their expertise in GIS and mapping (Zaidi 2001; Pervaiz, Rahman, and Hasan 2008). Orangi also lies on a natural slope, which made it easier and cheaper for the OPP to plan a sanitation system that

complemented and harnessed the town's topography, instead of working against it.[8]

D. OPP's Successes

By the late 1980s, Orangi's environment was radically transformed and the OPP expanded its environmental health agenda in the town to improve health and education by evolving into four autonomous institutions – the OPP Research and Training Institute, the Orangi Charitable Trust, the Karachi Health and Social Development Agency, and the Rural Development Trust (Zaidi 2001; Hasan 2006; Pervaiz, Rahman, and Hasan 2008). By the early 2000s, more than 95,000 households had built internal sanitation infrastructure by investing $1.4 million (Hasan 2006). If the government carried out the same work, it would have cost them $10.5 million (Hasan 2006).

The low-cost sanitation program in Orangi is a resounding success. In the first few years of the program, infant mortality rates dipped and mobility throughout the settlement drastically improved because the roads were no longer filled with waste (Figure 3) (Zaidi 2001). Because of rapid public health and mobility advancements, residents in Orangi started to open small businesses, leading to economic development in the town (Zaidi 2001).

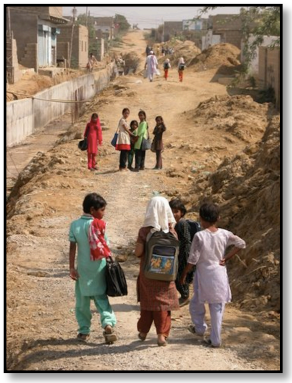

Figure 3. A useable lane in Orangi Town[9]

As an organization, the OPP remains dedicated to reflection, transparency, and

[8] See Raman (2012) for a more developed discussion of socio-spatial capital, the idea that places have benefits derived from both the structure and quality of social and spatial networks that includes topography.
[9] Source: James Wescoat

documentation. The OPP website ("Orangi Pilot Project-Research and Training Institute" 2014) has some of the digital maps the OPP-RTI has created, along with descriptions of various programs and a critical evaluation of its own work. The organization publishes comprehensive quarterly reports containing the financial status and progress of all its programs, and the latest reports can be downloaded from their website (OPP-RTI 2014a; OPP-RTI 2014b).

E. OPP's Achievements in Mapping

Meaningful community mapping is a key aspect of the success of OPP's low-cost sanitation model. The OPP's mapping process emphasized environmental literacy in the community, which spurred residents to take charge of their environmental health using the OPP's help. Breaking down the mapping process into the three main questions raised in Section II helps unpack OPP-RTI's approach.

1. WHO is mapping?

A surveyor, draughtsperson, and an adviser (usually from a local polytechnic), along with OPP's social organizers and community activists, walk through the community, and survey and map the lanes which have applied for technical assistance (Hasan 2006). OPP staff deliberately chose to forego hiring private consultants to carry out mapping because they wanted to forge partnerships between the community and local academic institutions for two reasons (Hasan 2006). First, they wanted to highlight the benefits of community participation to planning and engineering students, and perhaps expand the traditional academic focus of those disciplines (Hasan 2006).

Second, OPP staff wanted to provoke debates in the community during the mapping process with social organizers and activists about environmental health issues and about the residents' commitment to self-help (Hasan 2006). Before the OPP started work in Orangi in 1980, some residents were already responding to their dismal urban environment by laying down individual sewer lines in front of their houses (Zaidi, 2001; Hasan 2006). By conducting walk-throughs to the town with the mapping team and social organizers, the OPP inspired more residents to consider the state of their environment and to think about possible points of intervention. Essentially, the visible, community-based mapping approach helped residents examine their relationships with

their urban environment and incited them to seek change.

2. WHAT is mapped and what is not being mapped?

When residents apply for technical assistance, the mapping team visits their lane and surveys existing sewage disposal trends (Hasan 2006). They map the position of manholes, direction of natural drainage channels, land use, and topography to produce a cohesive map for the lane before providing advice on building techniques and materials (Hasan 2006). When the OPP first started, they opened up the low-cost sanitation program to residents who lived in lanes next to natural drainage channels (Pervaiz, Rahman, and Hasan 2008; Hasan 2006). When residents all across town started expressing interest in building internal sanitation infrastructure, the OPP had to prepare a drainage master plan for Orangi to illustrate natural drainage channels, collector sewers to link houses far from drainage channels, and existing sewer infrastructure (Hasan 2006).

Figure 4 shows an updated sewer line map developed by the OPP-RTI. Each red arrow on the map represents a sewer line financed and built by Orangi residents. Since the OPP-RTI produces maps that are updatable and comparable, the organization can effectively keep track of the pace of infrastructure development in the town and can identify households that remain unconnected to primary or secondary sewer lines.

In the OPP-RTI's low-cost sanitation program, sewage infrastructure is the focus of the maps. While the topography, land use, and lanes are described on the map, sociodemographic, economic, and political issues like ethnicity, religious and political affiliation, and violence (all factors that may influence community sewer line building) are not depicted on infrastructure maps. The OPP has tried to remain apolitical in a politically charged and socio-politically diverse environment, and its reticence to engage in hot-button issues like political affiliation has made its services accessible to the different groups of people who live in Orangi.

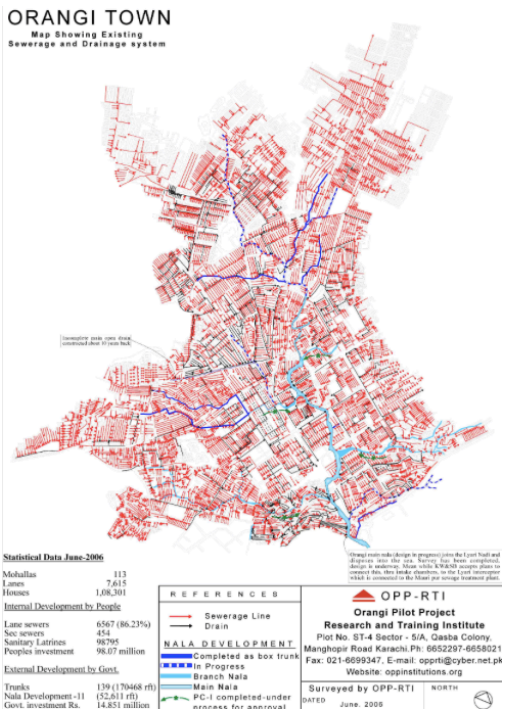

Figure 4. OPP drainage map[10]

3. HOW are maps and mapping used?

OPP-RTI has used its sewage maps to negotiate with urban service providers like the Sindh *Katchi Abadi* Authority (SKAA) and the Karachi Water and Sewerage Board to convert natural drainage channels into box trunk sewers to ensure that the town is not covered in open, overflowing drains, obstructing mobility and causing health problems (Hasan 2006). In fact, the OPP-RTI has done such a good job of demonstrating the program's effectiveness to authorities that the SKAA officially adopted the internal/external concept of community infrastructure building and asked the OPP to train its staff (Hasan 2006).

The organization has also used its knowledge of community infrastructure mapping to map infrastructure in informal settlements across Karachi as part of its advocacy work to help other *katchi abadis* replicate the successes of OPP's low-cost sanitation program (Hasan 2006). Finally, the OPP recognized the acute need for digital mapping and surveying skills especially in informal settlements, and started the Youth Training Program in 1994 ("Orangi Pilot Project-Research and Training Institute" 2014). This

[10] Source: www.oppinstitutions.org

program trains interested students in sanitation provision, surveying, documenting, construction technology, and community mobilization (Hasan 2006). Besides the educational and professional development of youths, the OPP-RTI has used the Youth Training Program to expand its mapping activities to document educational and healthcare facilities in informal settlements and to digitize existing maps (Hasan 2006).

F. Replication Attempts

In the late 1980s, several communities in Karachi applied to the OPP for help in replicating the successful low-cost sanitation program (Hasan 2006). Early attempts at replication were unsuccessful because communities did not have mapping and documenting capabilities, and did not have on-site, dominant community organizations to build community buy-in and negotiate with authorities on their behalf (Hasan 2006). These unsuccessful replication attempts spurred the OPP to work with other communities to develop mapping, surveying, and documenting capacities to highlight urban infrastructure gaps on maps, and eventually support independent, community-based infrastructure programs (Hasan 2006).

To date, the low-cost sanitation program has been replicated 284 times in 11 towns in Pakistan but Orangi remains the most successful case (Hasan 2007). In other areas, replication attempts have failed for various reasons, from the lack of cohesion at the lane-level to different political parties hijacking OPP proposals for political gain at various stages of the construction process (Hasan 2007). Sites with successful replication, like Lodhran Town and Faisalabad, have community organizations which have dedicated themselves to GIS mapping (Hasan 2006). These organizations also model their mapping processes after the OPP's, and thus create awareness of environmental conditions and health in their communities, which in turn inspire communities' commitment to improving living conditions. With the environmental awareness and literacy component missing from the community mapping process, it is difficult to ensure the community's sustained interest and commitment to self-help.

G. Challenges Faced by the OPP

The OPP's successes do not come without controversy. One significant criticism of the OPP is its attitude towards external financing (Zaidi 2001). While the OPP is backed by

a Pakistani charity called Infaq, it has consciously rejected external funding and subsidies to support internal infrastructure built by communities. The organization is zealous about its commitment to ensure community financing, and has often challenged non-governmental organizations funded by foreign agencies and international donor institutions (Zaidi 2001). The OPP believes that external financing comes with strings attached, does not accurately match the needs of communities it is trying to help, and is unreliable (Zaidi 2001; Raman, 2012).

While community financing was key to the success of the low-cost sanitation model, the OPP fails to realize that external support is not just financing; support comes in many forms from financial to technical to political and bureaucratic. The OPP itself is fortunate to receive "external" support from INFAQ and the academic institutions it works with. In areas with less favorable conditions (challenging topography and low rates of housing ownership, for example), external support is needed to complement the low-cost sanitation program (Zaidi 2001). The OPP needs to figure out nuances in its campaign against external financing to better help other settlements which wish to address environmental health challenges but are also operating under a different set of constraints.

Further, while the OPP wishes to remain neutral in a politically charged, violent environment, it can no longer afford to do so. In 2013, the OPP director, Perween Rehman, was shot dead on her way home after many threats were made on her life over the years ("Perween Rehman: A Fighter for the Poor Silenced" 2013). The latest quarterly reports from 2014 state that the OPP is moving its offices to downtown Karachi (it moved once before in the 1990s according to Hasan 2006) for security reasons (OPP-RTI 2014a; OPP-RTI 2014b). How will the organization cope with the death of its leader? Will Orangi continue to maintain sewer lines without the direct presence of the OPP? How will the death of Rehman change the OPP's negotiation and advocacy strategies? Should the OPP align itself with a political party?

IV. LESSONS FROM THE ORANGI PILOT PROJECT

In every dust particle of the city rage a hundred cataclysms.
-Adapted from the poetry of Mirza Ghalib

The previous sections highlighted how meaningful mapping processes at the community level can create awareness of environmental health in informal communities, which in turn inspire residents to seek help in improving their living conditions. This new environmental awareness helped residents, in the case of Orangi, to invest in upgrading and maintaining their sanitation system, which they built and financed. This section will briefly outline five lessons the OPP case holds for community-based mapping and environmental health:

1. The OPP's mapping capabilities emphasize **the importance of generating, owning, and effectively using knowledge in informal settlements**. We live in a global knowledge economy in which ownership of knowledge is crucial. Often, marginalized communities around the world are exploited to produce knowledge by different more powerful entities like governments, universities, and international development agencies. This knowledge is neither generated nor owned by these communities, and besides being left out of capital flows, these communities continue to be ignored in knowledge flows. Without high-quality sewer infrastructure maps and a strong community mapping process, the OPP would not have been successful in negotiating with government agencies to improve living conditions. Community-generated and –owned knowledge is key to successful community development, whether the knowledge comes in the shape of maps or census data.

2. Besides implementing the low-cost sanitation program, the OPP is also involved in **community development** through the Youth Training Program and through its work with other NGOs in Karachi and beyond. In addition to expanding its mapping and documenting work of informal settlements, the OPP has created a new generation of architects and planners from informal settlements who will use their expertise to intervene in other aspects of living conditions in *katchi abadis*. Creating lasting ripple effects through community education is one way to ensure sustainable development practices that are bottom-up.

3. Studying replication attempts of the low-cost sanitation program highlights **the need for an activist entrepreneur**, whether a person or an organization like the OPP. Without

the OPP's technical assistance, mapping capabilities, and interest in community organizing and negotiating with government agencies, Orangi's streets would still be overflowing with waste.

4. The OPP's conscious engagement with nearby academic institutions is another facet of its success. **Academic partnerships** forged by the OPP have resulted in breaking down some of the barriers between theory and practice, and have provoked schools to examine ways of applying knowledge to improve environmental health in their own city (Hasan 2006).

5. **Environmental literacy, as evidenced by the OPP case, has two aspects – awareness of the community's urban landscape on the part of an organization and awareness of one's lived experience in an environment on the part of residents**. The OPP model of participatory action research, devoid of assumptions, emphasizes the need to first understand the community's environment, history, and desires before designing and implementing interventions. If the OPP had decided to unilaterally implement a low-cost sanitation program without interviewing residents and figuring out that some of them were already starting to lay down sewer lines, it would not have achieved the same level of success because it would not have harnessed and developed the community's own agency and wishes. Further, the OPP's community mapping process created environmental awareness and literacy in the residents, which in turn inspired them to take advantage of the OPP's assistance. If the mapping team, complete with activists and social organizers, did not conduct walk-throughs and surveyed the topography and natural drainage channels directly in the community (as opposed to aerial mapping done by private consultants, for example), Orangi residents would probably not have critically considered their environmental health and potential community-level solutions.

Powerful community mapping processes can lead to drastic improvements in environmental health through the creation of environmental awareness, as evidenced by the OPP case in Karachi. These community mapping processes also lead to community development in the realm of community-based knowledge production and the creation of valuable mapping and surveying skills in residents.

The Orangi example also brings up several questions about mapping, environmental health, and sustainable community infrastructure, which are potential avenues for future research. What should the role of the state be in mapping? Can governments and government agencies initiate fair community mapping processes and still create environmental literacy at the level of the community? Can sustainable infrastructure be built at the community level with external financing from foreign donors? How and where does one intervene to improve urban environmental health in a weak and violent state? Is Orangi an exception? Will Orangi residents continue to build and maintain their sanitation system in the face of chronic violence and state neglect?

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