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Water trajectories through non-networked infrastructure: insights from peri-urban Dar es Salaam, Cochabamba and Kolkata

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For many urbanites, infrastructural uncertainty refers to ‘predictable shocks’ rather than constituting a quotidian experience. By contrast, for the peri-urban poor, the sources of uncertainty underpinning water and sanitation services are endless: uncertainty about cost, about being evicted and indeed about ever becoming connected to networked systems.

Drawing on a number of case studies, we argue that across the urban global south, the future is not one of networked systems but rather one of ‘infrastructural archipelagos’ that need to be thoroughly understood in order to bridge the growing gap between everyday and large infrastructural planning practices.

Keywords: urban WASH; peri-urbanisation; urban services governance; service coproduction; decentralised infrastructure; urban global south

Introduction

For many urban dwellers, infrastructural uncertainty refers to ‘predictable shocks’ (such as increasing water tariffs or lower pressure during certain days of the week), rather than constituting a quotidian experience. The picture is significantly different when it comes to considering the meaning and experience of water uncertainty by the peri-urban poor in the global south. In such context, the sources of uncertainty underpinning access to services are endless: uncertainty about cost, about being evicted, about ever becoming connected (or networked). Indeed, about 60% of the new urbanites expected to live across the global south over the next 25 years, will be exposed to all these uncertainties on a daily basis, without networked infrastructure to access essential basic services such as water and sanitation. In this context, the future is not one of networked systems but rather one of – paraphrasing Karen Bakker (2003) – ‘infrastructural archipelagos’, shaped by misrecognised practices of everyday planning.

Everyday planning practices are those adopted on the ground by ordinary women and men to access water and sanitation, and they range from ‘needs-driven practices’, which are based on some form of collective action – whether within communities or between communities and the state – and those that are undertaken individually and might rely either on solidarity among

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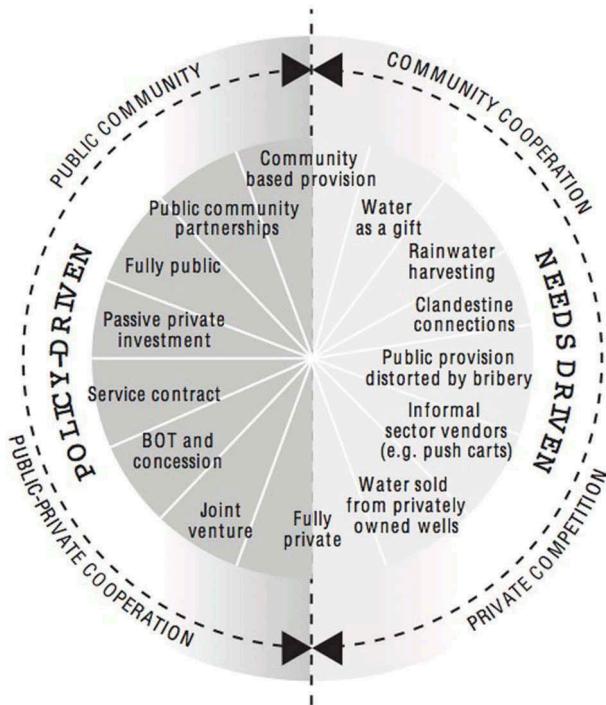


Figure 1. The waterwheel: Mapping the universe of practices governing access to basic services in peri-urban areas. Source: Allen 2005, published in Allen, Davila, and Hofmann (2006a). With permission of Bartlett Development Planning Unit.

households – such as when water to the most vulnerable members of a particular settlement is provided as a ‘gift’ by households who might have a privately owned borehole – or on market-based mechanisms, as in those cases when water is bought from small independent providers, whether these are informal or licensed water vendors. In any given context, everyday practices coexist with what could be termed as ‘policy-driven practices’, undertaken by the state and utilities. The waterwheel (Figure 1) captures the spectrum of practices and the type of relations that are commonly at play in the peri-urban context.

Previous studies revealed that in peri-urban areas developing without or with limited physical networked infrastructure, people tend to rely on a vast diversity of needs-driven practices and are unlikely to get connected to the network in the near future (Allen, Davila, and Hofmann 2006a; Mulenga and McGranahan 2011). There is ample evidence pointing to the fact that policy-driven practices are unable to meet the water needs of the peri-urban poor, failing to support the expansion of centralised network systems to realise the right to water and sanitation in such context (Nganyanyuka et al. 2014; Andreasen and Møller-Jensen 2016; Allen, Davila, and Hofmann 2006b; Mehta et al. 2014; Mehta and Karpouzoglou 2015). Furthermore, conventional formal approaches to urban infrastructural planning and management tend to neglect the potential of urban metabolisms to handle critical resources and material flows in a sustainable way, while treating grassroots incremental responses as substandard practices that are at best tolerated as temporary coping mechanisms or at worst combated as backward and undesirable.

Nevertheless, across the urban global south, infrastructural deficits are being increasingly addressed by active experimentation in new ways to abridge or co-produce

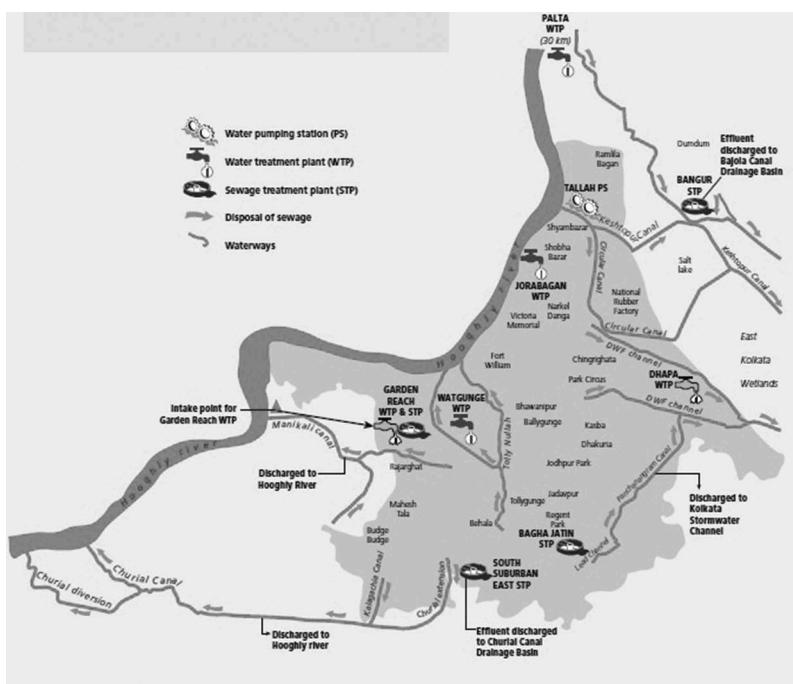
community-led efforts with those of the state not just to fill provision gaps but also to do so at scale, while integrating watershed management and activating citizens' rights and entitlements (Allen, Davila, and Hofmann 2006b; Marshall et al. 2009; Allen 2014). As many countries appear to be endorsing the human right to water and in some cases shifting into distinctive 'post-neoliberal projects', diverse configurations of public, private and community providers are fast developing to meet the water and sanitation needs of the unserved. For instance, it is estimated that there are over 80,000 community-led water systems in Latin America alone, serving over 40 million people in rural and peri-urban areas and with capacity to serve an additional 18 million (Ochoa, Soto, and Burt 2011). While the redistributive capacity of these systems in rural areas has been the subject of various investigations (Boelens, Getches, and Guevara-Gil 2010), there has been little in-depth research into how community-led initiatives are working with the state to co-produce water management practices in the urban fringe. Furthermore, while a number of studies have explored the more strategic implications of co-production partnerships and their scope to redress unequal power relations (Joshi and Moore 2004; Mitlin 2008; Allen 2012; Bustamante, Crespo, and Walnycki 2011), the wide spectrum of alliances and relationships emerging through these partnerships have rarely been considered in great depth and even less been examined in light of the wider hydro-political trajectories of the urban regions in which they operate.

This article explores the universe of practices to be found in the peri-urban context of three urban regions: Kolkata (India), Cochabamba (Bolivia) and Dar es Salaam (Tanzania), where unmet needs are growing fastest and where conventional centralised networks are unlikely to become the norm now or in the future. The concept of 'infrastructural archipelagos' allows us to move beyond a focus on networked provision to consider the growing gap between everyday and large infrastructural planning practices. In doing so, we pay particular attention to those practices that rely on some form of collective action, whether this involves cooperation among grounded organisations of the poor, or with state-led agencies. Furthermore, our focus is not just on the extent to which these practices are improving access to water and sanitation services but also on their capacity to disrupt unjust trajectories through governance approaches that abridge community-led and state-led efforts. As revealed through the contrasting trajectories found in each of the three aforementioned urban regions, what emerges is a spectrum of co-production partnerships with varying potential towards more just peri-urban water futures.

The analysis draws on primary and secondary research undertaken by the authors and consolidated through a seed-grant awarded by the International Social Science Council (ISSC). The ISSC project¹ entitled 'Translocal Learning for Water Justice' focused specifically on exploring the transformative potential of alternative water supply arrangements (small-scale, low-cost management practices and new configurations of water governance) that are undertaken for and by the peri-urban poor in the three aforementioned urban regions. Applying the same analytical framework to reflect on fieldwork that was undertaken independently in each urban region provided the authors and project partners with an opportunity to examine how and with what consequences basic services are being co-produced between ordinary citizens and the state in three contrasting scenarios. Individual fieldwork was carried out periodically between 2008 and 2015 and involved ethnographic and participatory research through qualitative interviews, focus group discussions, transect walks and observations. Where possible, the researchers linked their activities in each region to existing processes of community knowledge production.

Kolkata: water poverty in a water-flush city

The city of Kolkata is often described as ‘triple-blessed’: possessing a river for drinking water, another to dispose of waste and the wetlands in between to treat its sewage and produce its food (Banerjee and Chaudhuri 2012). Yet, despite these rich advantages, significant disparities exist across the growing population of 14.38 million of Kolkata Metropolitan Area (KMA) – and particularly in relation to the access to and control over water and sanitation services (Census 2011). Two agencies are jointly responsible for water supply and sanitation of Kolkata: Kolkata Municipal Corporation (KMC) and Kolkata Municipal Water and Sanitation Agency (KMWSA). While KMC is in charge of water supply to all the wards within KMC, KMWSA covers the rest of the metropolitan area. KMC officials claim to cover 85% of the population by piped supply and 50–55% by sewerage network.² A recently published Technical Assistance Consultant’s Report of the Asian Development Bank (ADB) entitled *India: Preparing for Kolkata Environmental Improvement Project Phase II* claims that the municipal piped water supply system covers almost 92% of the KMC population, the current coverage being higher than the national average of 81% but 8% short of the 100% national target benchmark. However, the water supply service level is distinctly different for the various water supply zones – respectively supplied from Palta, Garden Reach, Jorabagan and Watgaunge Water Treatment Plants or by groundwater supply (Map 1). Similarly, the sewerage and drainage service level in the central city area is distinctly different to that enjoyed in the outer areas of KMC (Asian Development Bank 2012). Though water is provided free of charge by the municipality, this piped coverage is disproportionately lower (and almost non-existent) in the peri-urban areas of Kolkata Metropolitan Area. Here, lower-income communities residing in informal neighbourhoods rely upon groundwater extraction of poor quality, or the use of water vendors, at a cost of 5–20 Indian Rupees for a jar of 20 litres (0.08–0.4 USD approximately).



Map 1. Major water treatment plants and sewage treatment plants in Kolkata. Source: adapted from Banerjee and Chaudhuri (2012).



Photo 1. Fishermen in the East Kolkata Wetlands. Source: Pascale Hofmann (January 2015). Image reproduced with permission of the rights holder.

This unequal distribution of services is perhaps nowhere more evident than in the south-eastern peri-urban interface of the city, known as the East Kolkata Wetlands (EKW). Here, lack of policy-driven municipal water and sanitation services has prompted residents to develop a range of co-produced water and waste management (CWWM) practices to meet their quotidian needs.

The peri-urban wetlands play a critical role in the socio-ecological functioning of the city. The EKW and the adjacent Dhapa landfill area absorb currently 750 million litres of waste water and 2500 metric tonnes of waste generated by the city on a daily basis (Mukherjee and Ghosh 2015). These are then recycled by fishermen and farmers residing in the area, using low-cost traditional techniques paving the way towards three major eco-environmental practices: waste water fisheries (see Photo 1), effluence-irrigated paddy cultivation, and vegetable farming on garbage substrates (Kundu, Pal, and Saha 2008). Around 25% (150 tonnes) of the total vegetables and 20% (22 tonnes) of total fish traded daily in the Kolkata market originate from EKW. The synergy between the livelihoods strategies of communities living in the EKW and the ecological sustainability of the city represents a key mode of co-production at work in peri-urban Kolkata (Figure 2).

The EKW covers parts of KMC, Bidhannagar Municipal Corporation (BMC) (ward no. 17) and adjoining gram panchayats (GPs) (Map 1). Today, the entire EKW region, including the core and buffer zones, is inhabited by approximately 150,000 people, mostly living in houses on the narrow strips of land in-between *bheris* (sewage-fed ponds) (Mukherjee and Ghosh 2015).³ The vast majority of residents lack access to filtered piped water supply. Instead, they rely upon a number of largely needs-driven arrangements: purchasing water from municipal tankers, private vendors and NGO-supported community drinking water projects (water treatment plant that provides water at lower prices than vendors), or for the poorest households, collecting water from the *bheris* (Figure 3).⁴

As far as sanitation is concerned, 50% of Kolkata's population and 55% of the KMC area are covered by the sewerage network measuring 1610 km and consisting of 1430 km of piped sewers and 180 km of brick sewer lines (Anon 2011). KMC and Kolkata Metropolitan Development Agency (KMDA) are in charge of these sewerage networks.

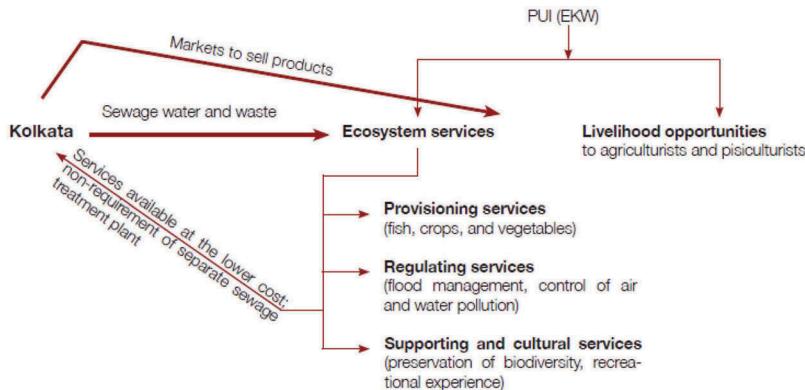


Figure 2. Sustainable flows between Kolkata and its peri-urban interface. Mukherjee, J. 2015b. Sustainable flows between Kolkata and its peri-urban interface: Challenges and opportunities. Figure 2.1: Sustainable Flows between Kolkata and its PUI, 36. In *Untamed Urbanisms*, edited by A. Allen, A. Lampis and M. Swilling. New York: Routledge. Reproduced with permission from Palgrave MacMillan.

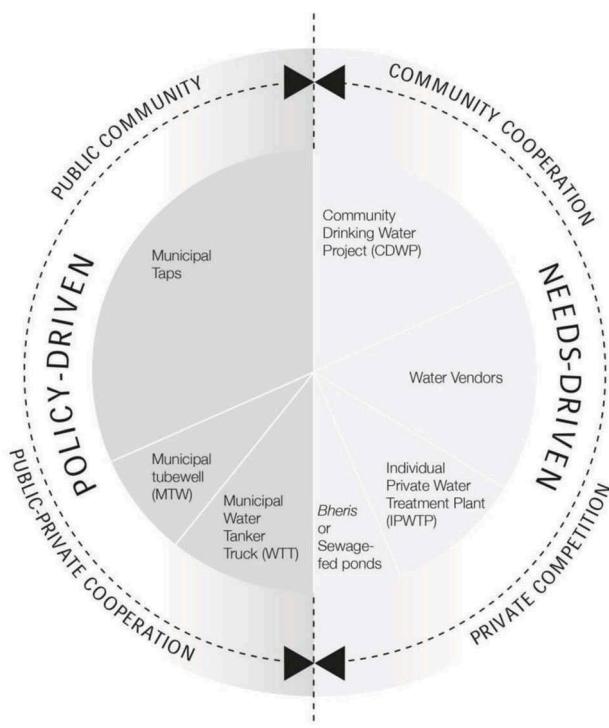


Figure 3. Water practices in peri-urban Kolkata (EKW). Source: Mukherjee and Ghosh (2015). With permission of Bartlett Development Planning Unit.

The city has no sewage treatment plants (STPs) within municipal boundaries. There are three small KMC treatment plants located outside the municipal limits at Bangur, Garden Reach and Bagha Jatin (Map 1) but with low capacities of 45 million litres per day (mld),

48 mld and 2 mld, respectively. The KMC intends to upgrade the Garden Reach STP from 48 to 52 mld. Therefore, the EKW serves as the only and major natural recycling infrastructure, relying upon low-cost techniques adopted and practiced by poor farmers and fishermen following a complex mechanism (Ghosh 1991, 1997; Kundu, Pal, and Saha 2008; Carlisle 2013; Mukherjee 2015a). It has an interesting history of evolution and emergence since the colonial times when canals were excavated (known as the 'eastern canal system') with a dual purpose of trade-transportation and drainage-sewerage-sanitation of the rapidly expanding city (Mukherjee 2015b). The city drains the bulk, over 75% of its rainwater and sewage, through channels into the Kulti River, which acts as the major outfall channel, through the EKW. However, despite this significant contribution to the overall 'environmental sanitation' of the city, at the household level, residents of EKW lack adequate access to sanitation options. Here, individual sanitation practices vary from the use of single and double pit latrines connected to septic tanks, to makeshift community sanitation systems interconnected to municipal canals (CSIMC), to open defecation. While these options remain limited, cooperative fisheries operating in the area are now highly discouraging open defecation and CSIMC practices, as these ultimately degrade the *bheris*. Though fish in the *bheris* consume faecal matter, cooperative members have recently become aware that this may reduce the price of fish in the Kolkata market. Some cooperative fisheries like the *Baro Chaynavi* (with 67 members) in Bidhannagar ward no. 17 have begun to allocate funds and/or loans to their own members with zero interest rates to enable households to construct their own pit latrines. 60 out of 67 members have now pit latrines constructed with support from the cooperative.

In the three types of *bheris*: government, private and cooperatives, distinguished primarily through their ownership patterns (Figure 4),⁵ CWWM practices involve multilevel stakeholders. Fishermen and farmers depend on the municipal supply of waste water and solid waste for piscicultural and agricultural activities. Fish production in the *bheris* is determined by a number of factors including the coordination among various stakeholders. Within the

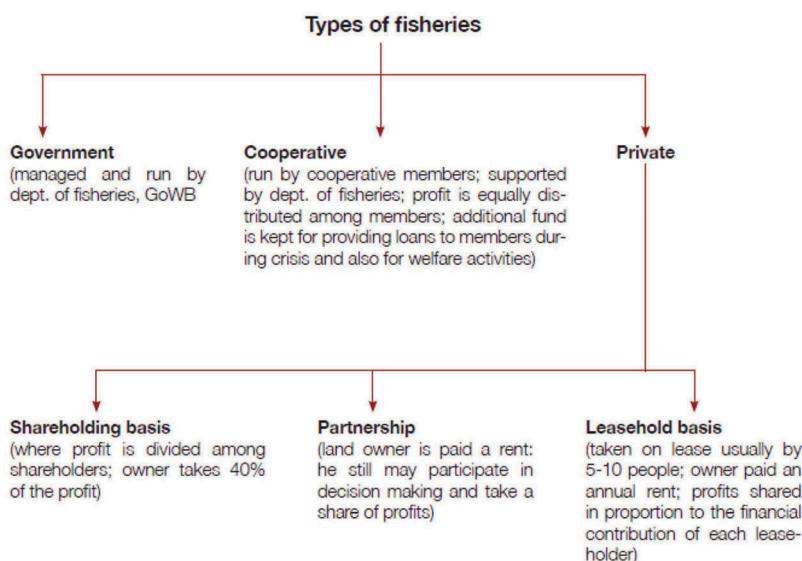


Figure 4. Types of fisheries based on ownership pattern. Source: Own elaboration based on Edwards (2002) and fieldwork data.

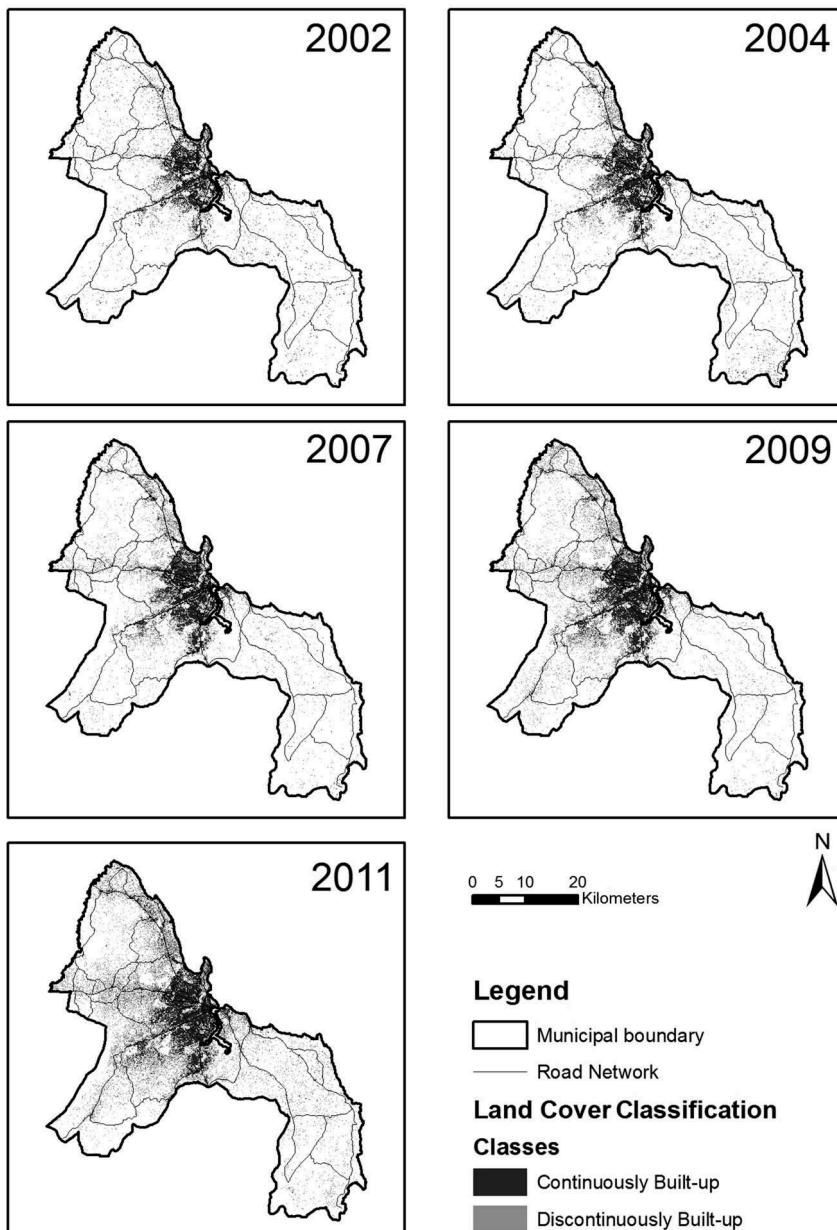
government, this includes the KMDA, KMC, the Department of Irrigation and Waterways (DoIW), the Department of Environment (DoE), the Department of Fisheries (DoF) and the West Bengal Pollution Control Board (WBPCB). It also involves external supporting agencies and programmes such as the ADB that funded the Kolkata Environmental Improvement Investment Programme (KEIIP). Finally, this also includes fish producer associations and fishermen and women.

However, in recent years, a number of threats have been experienced to the detriment of the ecological and socio-economic fabric of the EKW. Cooperative fisheries are increasingly becoming privatised, selling *bheris* to commercial companies operating in the region. This has been particularly problematic for the fishermen making a living in the EKW, who generally receive lower wages from private companies, ranging between 100 and 150 Indian rupees per day (1.5–2.3 USD), and suffer from a greater level of job insecurity. Unlike fish farms managed under the cooperative model, private farms focus primarily on the generation of profits and do not engage in the distributive activities of the cooperatives, including the allocation of funds to members for welfare measures, such as the construction of pit latrines, or other community and household goods. Moreover, in recent times, there has been an escalating conflict among the KMC, KMDA, DoIW and Fish Producer Associations over the operation of lock-gates on the main sewage canal at Bantala, which controls the flow and supply of waste water into the *bheris*. A recent report published in *The Times of India* commented: ‘The flow of sewage into the fish farms or *bheris* has been deliberately reduced in an attempt to snuff out fishery and farming and make way for conversion of the land into real estate’ (Niyogi 2015). To clarify this point, the waste is directly flowing into the Kulti River without diversion and treatment through EWK. Instead of allowing accumulation of the water to a certain height so that it can smoothly flow to EKW via linked channels and cuts constructed by fishermen, the irrigation department is diverting water to the outfall channel at reduced height. This is harming the lives and livelihoods of fishermen and also affects the river that is receiving untreated waste (Niyogi 2015). This mirrors wider trends of urban development within the city, impinging upon hard-fought rights for the ecological protection of the wetlands.

CWWM practices in Kolkata’s fringe, while holding a critical impact at the city scale, also offer hints for alternate modes of cooperation which have the potential to address some of the everyday challenges of water and sanitation for residents of the EKW. These can contribute to both the ecological sustainability and empowerment of local communities, and show potential to be scaled up across different sites but would require support from the government, for example, the irrigation department to start with. More detailed examination and exploration on how these operate, would facilitate the recognition of the value of these networks, building upon the strength of these practices, and generating the conditions and opportunities to foster greater dialogue and interdependence among multilevel stakeholders operating in Kolkata and its peri-urban interface and embedded, integrated and complex land(water)scape.

Dar es Salaam: a pragmatic approach to bridging service gaps

Critically, Dar es Salaam is facing growing challenges with the equitable provision of adequate quality water services. Over the past 25 years, rapid population growth exacerbated by accelerated urban sprawl (Andreasen and Møller-Jensen 2016) has generated new requirements for residents of the city (see Map 2). Demands for water have intensified with the increase in population and concurrent growth of economic activities requiring water as an input, including hydropower generation, large-scale irrigated agriculture, industries, tourism, mining, raising livestock, domestic uses, fisheries and wildlife and forestry



Map 2. Urban growth of Dar es Salaam between 2002 and 2011. Source: Congedo and Munafò (2014) Urban Sprawl as a Factor of Vulnerability to Climate Change: Monitoring Land Cover Change in Dar es Salaam. Figure 5.4: Land Cover Classifications of Dar es Salaam, 84. In Macchi, S. & Tiepolo, M. (Eds.) Climate Change Vulnerability in Southern African Cities. Cham, Switzerland: Springer International Publishing. With permission of Springer.

activities. Further factors contributing to stress on local water resources include degradation due to pollution, over-extraction, poor land use practices and the encroachment of land for agriculture, urbanisation and industrial development (URT 2012).

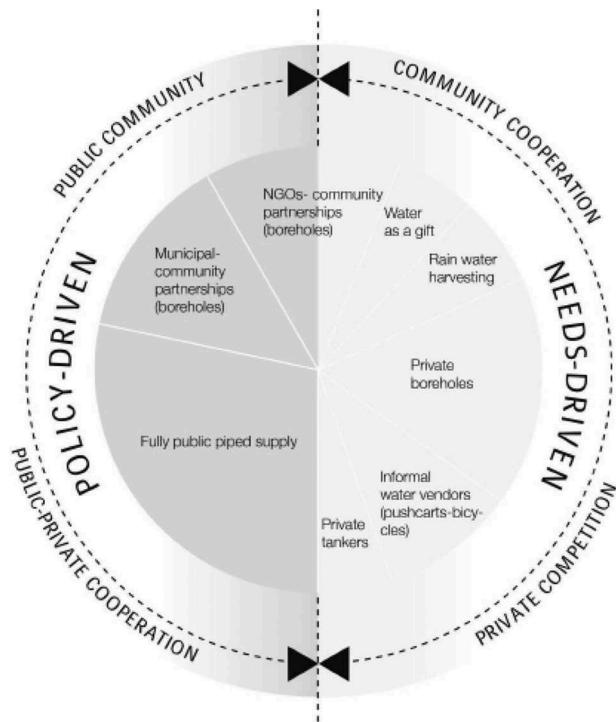


Figure 5. Policy-driven and needs-driven water practices in peri-urban Dar es Salaam. Source: Kombe, Ndezi, and Hofmann (2015). With permission of Bartlett Development Planning Unit.

After recent local government policy reforms, public service provision, including water, falls under the responsibility of Dar es Salaam's three municipalities (MoW 2011). Following a short period of private sector participation in the early to mid-2000s, the city's water supply and sanitation system (WSS) is currently managed by two public entities. The Dar es Salaam Water and Sanitation Authority (DAWASA) is the asset holder, while the Dar es Salaam Water and Sanitation Corporation (DAWASCO) is in charge of operation and maintenance through a lease contract with DAWASA. According to recent official statistics, the formal system reaches approximately 50% of the city population, largely benefiting higher-income citizens, as 44% of domestic connections supposedly serving 17% of households in low-income areas of the city are dysfunctional (EWURA 2014; Pauschert, Gronemeier, and Jebens 2012). The remaining inhabitants, first and foremost almost 90% of those living in informal low-income areas, rely on alternative practices to meet their water needs at a cost that is often considerably higher compared to the official rates charged by the utility (Kombe, Ndezi, and Hofmann 2015; Pauschert, Gronemeier, and Jebens 2012). Most of these practices are needs-driven (see Figure 5) and heavily dependent on the unregulated use of groundwater sources, as a result of diminishing surface water supplies and the limited coverage of the network infrastructure. More than 40% of low-income residents in Dar es Salaam rely on water from private boreholes (Pauschert, Gronemeier, and Jebens 2012).

Roles and responsibilities of local government in WSS are ambiguous as they are not well defined but there are examples in Dar es Salaam, particularly in more peripheral settlements lacking provision by the utility, where the municipality has taken an active



Photo 2. Community-managed distribution point in peri-urban Dar es Salaam supplied with water from a local borehole. Source: Pascale Hofmann (June 2015). Image reproduced with permission of the rights holder.

role in developing water supply solutions that are subsequently managed by local communities. Each of the municipalities has a dedicated cross-departmental team that works with local communities under their jurisdiction on issues of **water, health, education and community development** (WAHECO). The state currently considers community-managed water supply systems as the most feasible option to provide low-income settlements with water, particularly in peri-urban areas far away from the mains. In 2003, DAWASA established a small Community Liaison Unit (CLU) with the purpose of supporting community-managed non-networked WSS schemes, initially adopted as part of a World Bank project to improve WSS in Dar es Salaam.

Only recently, in 2014, DAWASCO followed suit with a dedicated pro-poor unit to extend services to lower-income households. It is unknown how many community-managed schemes exist across the city but estimates are high, as approximately 75–80% of the city population live in informal settlements where formal utility supply is extremely limited. The majority of these schemes tend to be community-managed boreholes where water is pumped to overhead storage tanks and subsequently supplied through a number of distribution points installed across the settlement (see [Photo 2](#)) and an increasing number of household connections.⁶ Costs to run these systems include electricity bills, stipends for water vendors and security personnel and repair and maintenance expenses. While the technical arrangements are largely the same, the city portrays a range of community-managed systems with regards to how they emerge and concerning their management. WAHECO teams and CLU have been involved in establishing a number of these water supply schemes. In other areas, NGOs have worked with communities to set up local systems. They are managed by water committees or water user associations (WUAs), with the former granting local government most of the decision-making power while the latter represents a more institutionalised and autonomous form of collective management whereby WUA members, that is, the users of the system, take the decisions. Preliminary findings reveal potential of some of these schemes to address water injustices in the city at scale, particularly those where residents and public authorities are jointly involved in the delivery of services. However, contributions by the state (be it the utility and/or municipal government), both in terms of financial and human resources, tend to concentrate on putting the system in place with limited support during operation

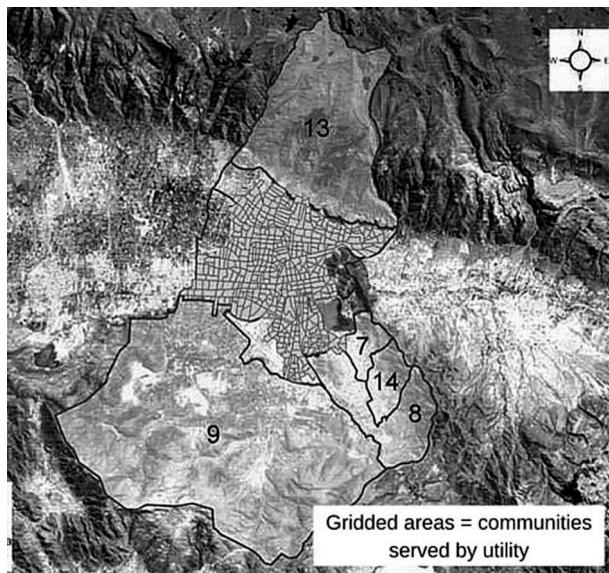
and maintenance. As these community-managed schemes are expected to be financially and managerially self-sufficient government involvement is largely limited to occasional technical support and the approval of spending requests (Hofmann, fieldwork notes 2015).

Dar es Salaam further demonstrates several innovations in co-produced sanitation. These range from decentralised waste water treatment solutions (DEWATS) where the role of the state is latent, to more active collaborations with the utility to develop affordable sanitation solutions through simplified sewerage.⁷ DEWATS are schemes run by small-scale businesses or community-based organisations (often with support from NGOs) that provide natural faecal sludge treatment through low maintenance, decentralised plants that do not require energy inputs. The treated water can be used for agricultural irrigation and some of the plants also produce biogas that can be used for cooking (see <http://www.borda-sea.org> for more information). Not all of these schemes are functioning well and challenges remain to bring them to work at scale (Banana et al. 2015). Dedicated units in DAWASA and DAWASCO for WSS provision in lower-income communities offer a good basis towards pro-poor service delivery but unless their approach is mainstreamed across the institutions, the capacity for scaling up is limited, particularly since both units are extremely small (5–6 staff members) compared to overall members of staff in the utility (Peal and Drabble 2015). Furthermore, water committees and WUAs often face problems in relation to management and monitoring with limited capacity to expand the system and increase the number of beneficiaries.⁸ Performance varies across the city and is largely dependent on the individual management capacity of each committee or WUA. Where they do work, access to WSS has improved considerably for their users, though not all of the schemes have succeeded in enhancing poor people's citizen status.

Those schemes where collaboration with and support from government authorities is minimal and the community largely steps in to compensate for the limited capacity of the state show no evidence of increased recognition of those hitherto neglected by the formal WSS system (Allen 2012). Conversely, examples where there is significant collaboration between poor communities and the authorities have led to the inclusion and representation of low-income dwellers in political processes and decision-making (Banana et al. 2015). Nevertheless, most schemes are not fully inclusive. Limited availability of funding and scarcity of available land to install the necessary infrastructure, such as boreholes and water distribution points, is one of the factors that influences the location of WSS schemes and has led to an uneven supply of facilities in beneficiary settlements. In the case of co-produced sanitation provision like the simplified sewerage project, beneficiaries tend to be homeowners and landlords with a slightly better income or access to microcredit and tenants are likely to be disadvantaged unless they have developed a good relationship with their landlord (Hofmann *forthcoming*). What is more, the fact that most of the community-managed water supply systems rely on unregulated groundwater abstraction puts a strain on the water source and jeopardises the long-term use and replicability of such schemes.

Cochabamba: grades of state-community service co-production

Cochabamba is a city of just under a million people, but it gained its international notoriety when irrigator communities, communal urban drinking water providers and local citizens organised to overturn the concession awarded to the Bechtel-led Aguas Tunari concession in 2001 (see Aguilar 2008; Perreault 2005; Olivera and Lewis 2004). The uprising served to further legitimise the role of 'informal' community water providers in the eyes of the state, and also attracted financial support from national and international NGOs. The public utility has been plagued by institutional challenges, lack of investment



Map 3. Limits of Cochabamba city, surrounded by the Metropolitan area (east and west), and highlights its outskirts (districts 7, 8, 9, 13 and 14), which are not covered by the public network (gridded area). Adapted from Ledo, C. (2005), Pobreza, Vulnerabilidad y Exclusión social en Bolivia, CEPLAG-UMSS, Cochabamba, Bolivia.

and water shortages. The utility relies on a few local water sources, and the system is subject to significant losses through leaks and clandestine connections (Shultz and Draper 2008). The long-awaited Misicuni dam, due to be completed in 2015, but which has been plagued by significant financial and institutional setbacks, promises to bring a more reliable water source, although this continues to be contested. The utility does not extend to the peri-urban southern Zone or *Zona Sur* of the city (districts 7, 8, 9 and 14) (Map 3). This is the poorest part of the city, which urbanised largely without formal infrastructure, and so the formal and informal communities here rely exclusively on community-led drinking water providers and water vendors (Walnycki, fieldwork notes 2011).

The state has engaged with and supported drinking water committees (DWCs) indirectly through decentralisation and reforms linked to popular participation during the 1990s (see Torrico and Walnycki 2015). More recently, support has been given through national reforms that were ushered in following the Water War, and following the election of Evo Morales which led to a constitutional commitment to universalise access under the banner of the right to water. Since 2006, there have been a range of national and local processes that have sought to consult, capacity build, fund or develop infrastructures for DWCs, as a means of improving access to water in low-income communities. This seemingly progressive approach sought to develop and incorporate informal providers in low-income settlements (see Walnycki 2013).

However, the processes by which the state has engaged with different community providers has been inconsistent. Cochabamba is often referred to as a dual city, because of the patterns of socio-economic segregation that exist, and are particularly pronounced between the centre and the southern fringes of the city. By taking a closer look at the informal water service providers that have emerged in the *Zona Sur* and the partnerships that they have



Photo 3. Carolinas – informal settlement of less than 5 years – without communal drinking water provider. Source: M.E. Torrico. Image reproduced with permission of the rights holder.

developed with the state over time, it is clear that the diverse coping mechanisms that have developed reflect high degrees of socio-economic inequality within the Zona Sur.

Levels of formality clearly relate to different coping mechanisms to access water across Cochabamba's outskirts. Formally recognised settlements can access municipal resources through the local district council (e.g. by using the *Ley de Participación Popular*⁹) and many use these resources to develop water services. Meanwhile, informal settlements have to manage with their own resources and/or depend on NGOs support. The path towards formalisation in some cases can be difficult, costly and slow. The poorest communities, which tend to be newly established informal communities, tend to rely on water tankers, which provide the most expensive and least reliable water source (Photo 3). It takes time to develop the communal structures to invest and build a water system, particularly in the newest barrios in the hills on the edge of the city. There are also specific resource challenges, as it is difficult to access good water sources in the area, which means that communities have to raise enough money not only to build their water networks, but to buy water in bulk.

Community water systems are prevalent in the more established communities, but they take diverse forms. A recent study from Ledo (2013) has been able to georeference around 200 independent systems in districts 7, 8, 9 and 14 of Cochabamba city. The predominant form of managing these systems is through water Committees (46%), followed by water Associations (20%), the Territorial Base Organizations (OTBs, 15%) and the Cooperatives (11%). Meanwhile, the Metropolitan Master Plan MMAYA (2013) has identified 189 small local systems managed by OTBs (23 cases), self-management (122), small cooperatives (11), private urbanisations (26) and agrarian *sindicatos*¹⁰ (7). These diverse forms reveal a little about the sort of engagement that they may have had with the state. Community water providers linked to OTBs will have developed using decentralised development funds that are made available to communities on a per capita basis as part of the Popular Participation Law that was introduced in 1994. These funds are only accessible to formal or legal communities. Water Committees are informal community water providers, while water associations are community water providers that have applied for a license, and are thus formally recognised by the state. In principle, these organisations can receive technical and capacity building support from the state to address infrastructural deficits, capacity deficits and institutional challenges, in order to build the sustainability of these water providers. There have also been a series of programmes and projects that the

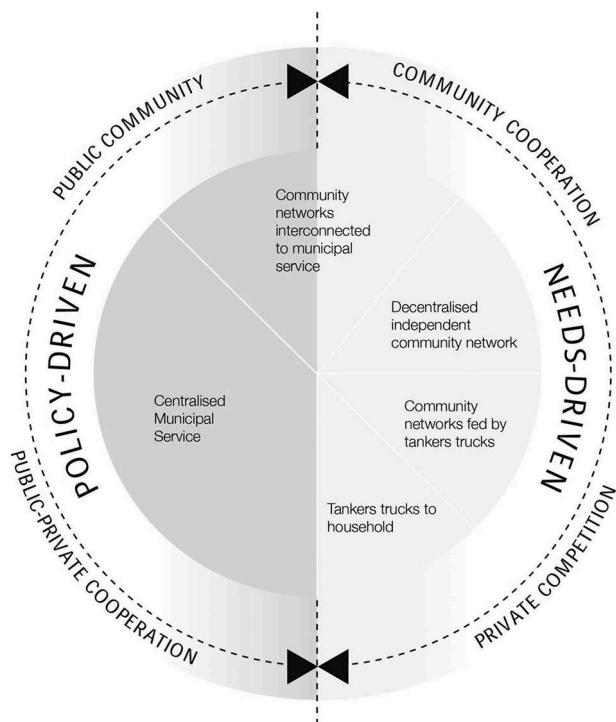


Figure 6. Policy-driven and needs-driven water practices in peri-urban Cochabamba. Source: Zegada et al. (2015). With permission of Bartlett Development Planning Unit.

state has developed since 2006 to extend infrastructure or provide funding for infrastructural development at the community level, however, they have been undermined by water shortages. Infrastructure is in place but there is no water flowing through the pipes, as communities in the Zona Sur await the completion of the controversial Misicuni project.

Figure 6 sets out the wide variety of needs-driven and policy-driven practices that can be found in this context. The only policy-driven practice in the city of Cochabamba for both drinking water and basic sanitation is the municipal service provided by Semapa, which has a coverage level of approximately 50% (a little bit more in sanitation than water).

Citizens engage in the four needs-driven practices that we have identified and sometimes more than one is practiced simultaneously. These include community systems with and without own water sources, and the provision of water through the domiciliary purchase of water from tanker trucks. In the latter case, households buy water directly from tanker truckers (private water vendors), paying an average of up to 20 USD for the first 5 cubic meters, and store the water in barrels or home storage tanks.

Meanwhile community systems can be divided in three types: those with their own water source (usually wells), those without (virtual networks) and those interconnected to the municipal system. Systems with water source are more independent, but quality of water may be low because of underground water contamination. Systems without a water source are called virtual networks: they buy water from private vendors such as tanker truckers, fill their storage tanks, and then distribute the water to households through their piped network. Management is independent, but the sourcing of water depends on private

vendors (quality and prices). Another kind of systems are those interconnected to the municipal system: instead of buying from tanker trucks, the system buys water from Semapa, who delivers an amount of water to the community system that is then distributed to the beneficiaries (household connections). In Cochabamba's southern outskirts it is most common to find the first three needs-driven practices, namely: households directly buy from private water vendors, community systems with water source and systems with virtual networks. Interconnections to Semapa are not yet very widespread, although some virtual network systems are considering this option for the future, once the Misicuni project is a reality.

Navigating through non-networked trajectories

The three case studies examined reveal the multiple paths through which ordinary women and men access water in contexts where non-networked water supply is the norm, and how these trajectories might develop in the future. In all three cases, people are not only forced to rely on multiple strategies – in which access is stratified through their ability to pay – but also to approach access to basic services as a collective affair.

In the case of Kolkata, this is underpinned by a long history of cooperativism eroded in recent decades through the gradual privatisation of the bheris. This process in turn has broken previous links between common livelihoods and common settlements, as the bheris are a source of livelihoods for some, of water to others and the only treatment facility available to digest millions of gallons of waste water produced daily by the much larger population of metropolitan Kolkata. Although the latter enjoy the graceful gift of the ecological services provided by the wetlands at scale and without any cost, the understanding of this system as a common patrimony only features in the mind of a few. With the state obstructing the continuation of waste water reuse the future of EKW is in jeopardy.

In the case of Dar es Salaam collaboration between the government and low-income communities materialises in different ways, with most current schemes focusing on water supply and a few initiatives on sanitation. Existing arrangements demonstrate different ways by which communities can fill gaps where the government has limited capacity to provide a service. In Dar es Salaam, support from the utility and local government in the operation and management of water services in low-income settlements is generally in short supply. However, units like CLU have been actively engaged in establishing and testing different community-managed models and are exploring ways to replicate and scale up such initiatives using savings from the revenue collected. However, service co-production appears to be approached here as a relatively ad hoc route, with insufficient resources devoted to support community-led initiatives. The priorities of the utility are unlikely to disrupt the infrastructural archipelagos that characterise the development of Dar es Salaam, thus offering little potential for more progressive and pro-poor service governance arrangements.

In Cochabamba, efforts to institutionalise service co-production on the basis of regular cooperation between citizens and the state have been stronger than in the other two cases. There is a grey area between needs-driven and policy-driven practices. There have been specific policies and projects that have indirectly or directly provided support to community water providers over time. This has included decentralisation, which provided funds for communities to develop their water sources since 1994, and fuzzy legislative and regulatory frameworks that tolerated and sometimes sustained informal community water providers. Since 2006, the state has developed institutions and implemented projects to

build capacity and regulate community water providers. This has been part of a process that gained some ground as part of reforms to realise the right to water, but which has lost steam in recent years.

While co-production mechanisms exhibit potential to bridge concerted action between the state and grassroots groups in all three cases, such arrangements are characterised by diverse water struggles and institutional trajectories. In Kolkata, co-production is rather latent in the management of waste water flows at the metropolitan scale, while at a more local scale, those settled in areas without networked infrastructure rely on precarious forms of free public provision complemented by unstable and expensive forms of informal water provision. The longstanding notion that the state should provide for basic services such as water is not enough to meet in practice the needs of peri-urban dwellers but this is not openly recognised, therefore preventing more proactive experimentation with abridged forms of state–citizen provision. In Dar es Salaam by contrast, the state and utility seem to be taking a pragmatic approach, engaging in some form of cooperation with poor communities outside the network on an ad hoc basis. Public sector involvement is largely limited to the initial stages of setting up public facilities, which are then handed over to local communities to operate. Failure to establish stronger forms of co-production partnerships affects the sustainability of many of these interventions and also limits their potential for scaling up. In Cochabamba, we witness a process towards the institutionalisation of state–citizen service co-production. However, this is not without tensions or shortcomings, as many peri-urban dwellers continue to fall through the net of ongoing initiatives.

Building meaningful and transformative alliances between low-income and politically marginalised groups and the state presents a number of challenges. As demonstrated in the Bolivian case, the process is often iterative and by no means linear. Communities might move two steps forward, only for local or national political shifts to take the relationship a step back, while nevertheless offering opportunities for low-income groups to influence service provision and policy. Meanwhile tolerance of and tokenistic support for informal service provision, reveals that often co-production operates in a latent form, whether intermittently (as seen in Dar es Salaam) or over an extended period (as in Kolkata). Latent co-production might improve people's access to services but without offering strategic scope for low-income groups to influence planning and development.

A key lesson offered from a cross-reading of these three case studies is that efforts to bridge the growing gap between everyday and large infrastructural planning that underpins peri-urbanising processes need to be fully grounded on the local and wider social, spatial and environmental relations that regulate the politics of service provision and the management of nature outside networked urban futures. Otherwise, these processes are unlikely to promote and sustain new forms of governance that can disrupt the production and reproduction of infrastructural archipelagos and the unjust trajectories that many of the peri-urban poor are subjected to.

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2. A series of interviews were conducted with officials of Kolkata Municipal Corporation (KMC) and Kolkata Municipal Water and Sanitation Agency (KMWSA) between December 2014 and February 2015 as a part of the ISSC project.
3. The core area of 12,500 hectares was declared a Ramsar site in 2002, that is, a wetland of international importance under the Ramsar Convention, which is an international treaty to conserve and sustain the utilisation of wetlands. This happened in response to environmental activism of leading NGOs of the city and other grassroots action groups (Dembowski 2001).
4. The findings are based on fieldwork conducted in the three selected areas of East Kolkata Wetlands (EKW): Bidhannagar (ward no. 17), Bantala and Dhapa, as a part of the ISSC-funded project mentioned above.
5. In 1995, when the *Land Reforms Amendment* was passed in West Bengal, many private *bheris* were vested from their owners by the state and transferred to fishery groups and cooperatives. This led to the decline of large privately owned fisheries; though some smaller, household-managed ponds continued to exist. Some of the large fisheries also became directly acquired by the government through the State Fisheries Development Corporation.
6. The city also has over 200 DAWASCO water kiosks that are connected to the utility network, however, only a fraction of them actually provide water (EWURA 2014; Hofmann, fieldwork notes 2014).
7. The simplified sewerage scheme connects household toilets to a nearby sewerage stabilisation pond using simplified technology. The utility has been a collaborator in the setup of the system and its main responsibility now focuses on operation and maintenance of the manhole and the ponds while the community, with local NGO support, is in charge of the system until it reaches the manhole.
8. With lack of reliable data, it is difficult to quantify the number of beneficiaries for such schemes across the city. Based on estimates arrived through data collected during fieldwork for some of these schemes, a borehole system with 10–15 distribution points can serve between 200 and 400 households in addition to household connections, which can range between 60 and more than 300 per scheme (Hofmann, fieldwork notes 2014 and 2015). It is not uncommon to find more than one community-managed borehole system per settlement.
9. The Ley de Participacion Popular (Popular Participation Law) was introduced as part of a series of political and administrative decentralising reforms across Bolivia. The reforms decentralised development processes and decision-making to the local level, and provided formally recognised communities with per capita resources for upgrading (see Torrico and Walnycki 2015).
10. Agrarian Sindicatos (peasant unions) are organisational structures created after the Agrarian Reform of 1953, and constitute the maximum authority at rural community level. They are both formally recognised as a legal organisation and it usually legitimately represents the inhabitants in each community. Every person owning land in a community must affiliate to the Sindicato. Many local issues, which in many cases include local water management for irrigation and domestic purposes, are governed through the Sindicato, and it is through this organisation

that each community establishes contact with state and non-state organisations. Although Cochabamba city is a majoritarily urban space, there are still agricultural lands particularly in districts 8 and 9, where sindicatos may still persist as a communal organisational structure.

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