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The impact of decentralized water and sanitation services on the urban production. The case of the peri-urban municipality in Cochabamba (Bolivia).

Incidence des dispositifs décentralisés de gestion de l'eau sur la production de la ville: l'expérience de Cochabamba (Bolivie)

Federica Natalia ROSATI[1] & Juan E. CABRERA[2]

Résumé : On constate dans un certain nombre de pays des initiatives, soutenues ou non par les pouvoirs publics, de production décentralisée d'eau potable : pompage décentralisé et développement de micro-réseaux d'adduction d'eau. Dans bien des cas, ces initiatives citoyennes viennent pallier le manque de services publics dans les quartiers défavorisés ou informels. Ils peuvent s'accompagner (même si cela reste très rare aujourd'hui) de dispositifs pour la récolte et le traitement des eaux usées.
Nous nous intéressons dans le champ de l'urbanisme à ces initiatives dans la mesure où elles permettent d'assurer un accès à l'eau potable à des quartiers qui jusque-là en étaient dépourvus. On constate toutefois que ces initiatives peuvent renforcer la fragmentation urbaine (gouvernance urbaine cadrée sur les périmètres des réseaux décentralisés) et l'étalement de la ville (urbanisation de terres agricoles, lotissements informels). Il convient par ailleurs de souligner que la durabilité environnemetale des solutions proposées n'est pas toujours assurée. Ces différents aspects ont amené le développement d'une réflexion sur l'institutionalisation de ces dispositifs, de manière à garantir leur intégration à part entière dans les mécanismes de production de la ville, tant en terme de gouvernance que de durabilité sur le long terme.
Nous nous proposons d'illustrer ces tensions à travers un cas d'études choisi dans la ville de Cochabamba en Bolivie. Cette recherche est actuellement soutenue par un projet FNRS PRD développé en collaboration entre ULB (Luisa Moretto) et ULg (Jacques Teller).

Mots-clés : coproduction, eau potable, fragmentation urbaine

Abstract : In a number of countries there are initiatives, supported or not supported by the public authorities, that decentralize the production of drinking water: on-site wells and development of micro-water networks. In many cases, these citizen-led initiatives come to terms with the lack of public services in disadvantaged or informal neighborhoods. They can be accompanied (although still very rare today) with devices for harvesting and treatment of wastewater.
We are interested in these initiatives in the field of urban planning insofar as they make it possible to ensure access to drinking water in neighborhoods that were previously lacking it. However, these initiatives can reinforce urban fragmentation (urban governance based on the pre-meter of decentralized networks) and urban sprawl (urbanization of agricultural land, informal housing estates). It should also be stressed that the environmental sustainability of the proposed solutions is not always assured. These different aspects have led to the development of a reflection on the institutionalization of these mechanisms, so as to guarantee their full integration into the city's production mechanisms, both in terms of governance and long-term sustainability. We propose to illustrate these tensions through a case study selected in the city of Cochabamba in Bolivia. This research is currently supported by an FNRS PRD project developed in collaboration between ULB (Luisa Moretto) and ULg (Jacques Teller).

Keywords : co-production, water supply, urban fragmentation

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INTRODUCTION

Although two-thirds of the earth is covered by water, the human right of access to water is perhaps one of the most widely denied rights in the world. More than one billion people lack access to safe drinking water and more than 2.6 billion people live without the conditions to dispose of human waste and to maintain personal hygiene, and are more likely to be exposed to illness and diseases (UNDP, 2006) In the Urban South, half of the population suffers from health problems related to inadequate water and sanitation (UCL, 2011). Given the rapid pace of urbanization, the institutional capacity of local and national governments and water utilities to manage the delivery of services is becoming critical: high rates of unaccounted water (mainly due to leakages and obsolescence of the infrastructures), unsustainable tariffs and weak systems of governance contribute to further reduce water service quality and the consumers' willingness to pay (UN, 2015). The inability, or unwillingness, of local and national governments to provide adequate and equal facilities to the urban poor generates a form of exclusion which has long-term impact on marginalized communities who are more likely to remain poor, lacking opportunities for health, education and employment (UNDP, 2006).

Traditionally the construction of water and sanitation infrastructures has been considered as best performed by the public sector, and has therefore been directly undertaken by public agencies or assigned to private for-profit contractors, through delegation contracts. The reason rests on the technical expertise needed to design large-scale infrastructures, on the considerable economic resources requested, and on the difficulties in acquiring rights on private lands (OSTROM, 1996). However, as many authors argue, infrastructure networks have often legitimated a policy of spatial segregation and urban socio-economic and political fragmentation, which contributed to exclude a large part of the urban population from the access to basic services (COUTARD & RUTHERFORD, 2015). At the same time, the rapid growth of peri-urban areas, generally characterized by lower population densities and higher distance to centralised service networks, makes centralised solutions unaffordable for the poor (ALLEN *et al*., 2017; UCL, 2011).

However, in few large cities in the Global South, the number of housing units connected to low-cost waterborne sanitation systems has been consistently growing throughout the last decades (MITLIN, 2008), at the same time as the emergence of the phenomenon of urban informality, namely the exclusion of the poor from the formal mechanisms of access to the city. In fact, in the absence of formal service provision, communities largely rely on alternative forms of service provision, which differ from the conventional services, namely a large urban infrastructure that is networked centralized either through public or private agents and organized through an integrated and uniform service delivery system (JAGLIN, 2012; MORETTO & RANZATO, 2017; COUTARD & RUTHERFORD, 2015). Emerging forms of service provision are mainly decentralized, city-driven, often "invisible" to the public sector (UCL, 2011). They are adopted on a daily basis by ordinary women and men (non-professionalized actors) to access water and sanitation, individually or collectively, with or without forms of support from the State and water utilities (ALLEN *et al*., 2017).

In Cochabamba, Bolivia, the formal water distribution network provides a publicly subsidised service to higher income households mainly located in the north of the city, while the informal system run by water vendors, provides a more expensive supply to marginal and unserved communities in the south (MARVIN & LAURIE, 1999).

In between the formal and informal service delivery models, co-production is emerging as a new and hybrid model of urban services management, challenging the formal/informal divide and proposing new sets of strategies to increase levels of connection to services through users taking a central role in the installation, management and administration of small scale water networks.

This article is produced in the framework of a research project funded by the French-speaking Belgian Research Agency and titled "Typologies of Institutionalised Coproduction of Water and Sanitation Services in the Global South – TYCO-WSS". It aims at making a contribution on the debate on sustainable urban service provision in the Global South by questioning the impact of water and sanitation co-production on city's production mechanisms, both in terms of governance and long-term sustainability. Through the analysis and comparison of five case studies (Hanoi, New Dehli, Addis Ababa, Kinshasa and Cochabamba) the project aims at identifying the factors that enhance the sustainability of WSS co-production systems, in respect to economic viability, socio-spatial equity and environmental sustainability, and eventually at suggesting under which conditions those systems can co-evolve toward more sustainable configurations.

The research is based on the assumption that co-production of water and sanitation services is not a "panacea", since it may raise social, environmental and economic issues, which have hence to be evaluated against sustainable urban service provision objectives. Second assumption is that there exists a co-evolutionary dynamic between socio-spatial urban patterns and co-production arrangements (typologies of co-production), which is suitable for being investigated from multiple perspectives. The analysis of this dynamic makes it necessary to extend the theorizations on service co-production beyond the boundaries of public administration and management literature, to mobilize disciplines which focus on the most "physical" (environmental and

urban) dimensions of service delivery. In particular, an analysis of the urban morphology and incremental development of infrastructures, represent an important tool for understanding the trajectories and anticipate future transformations of settlements and related services.

By presenting the case study of Quillacollo, a peri-urban municipality in the Cochabamba metropolitan area, this contribution aims at offering a spatial perspective on the analysis of decentralized and participatory approaches for service delivery as well as raising the issue of urban sustainability of those practices. This contribution is grounded over the results of a research "Fragmentation urbaine à travers les réseaux techniques: L'exemple de stratégies locales de gestion de l'eau", delivered by Juan E. CABRERA, PhD researcher at ULg, in 2015.

COCHABAMBA: URBANIZATION AND STRESS OF WATER RESOURCES

Located 2500 meters above the sea level, in the eastern Bolivian Andes, Cochabamba is the largest metropolitan area in the country, with approximately 19.000 hectares occupied and 1,2 million people living in seven municipalities (Sacaba, Cochabamba, Tiquipaya, Colcapirhua, Quillacollo, Vinto and Sipe Sipe). Right after its foundation in 1571, Cochabamba appears as an agglomeration of small villages whose main function is of supporting the mining cities of the country through the provision of agricultural products. After the 1950s, as a result of the National Revolution and Land Reform, its productivity is complemented with commercial and industrial activities and a process of urbanization starts. It is during the 1980s, overcoming the deep economic crisis resulting from the decline in mineral prices, that the entire country experiences the transition from a statist model to a free market economy. The government, by transferring the country strategic state companies to the hands of private entrepreneurs, causes the closure of many of the largest state-owned enterprises and the expulsion of hundreds of thousands of families from secondary cities, resulting in a rapid urban growth of Bolivia's main urban poles. As the national economic crises push Bolivians into cities to find work, Cochabamba gets the major part of migration and squatter settlements start to arise in the water-poor south side of the city (WUTICH, 2010).

Between 1962 and 2016 the urban footprint of the metropolitan area grows from 2,481 to 19,487 hectares, or 17,004.6 hectares in 54 years, with an occupancy rate of 314.6 hectares per year and 26.24 hectares per month (CABRERA & DE LA FUENTE, 2017) (Fig. 1).

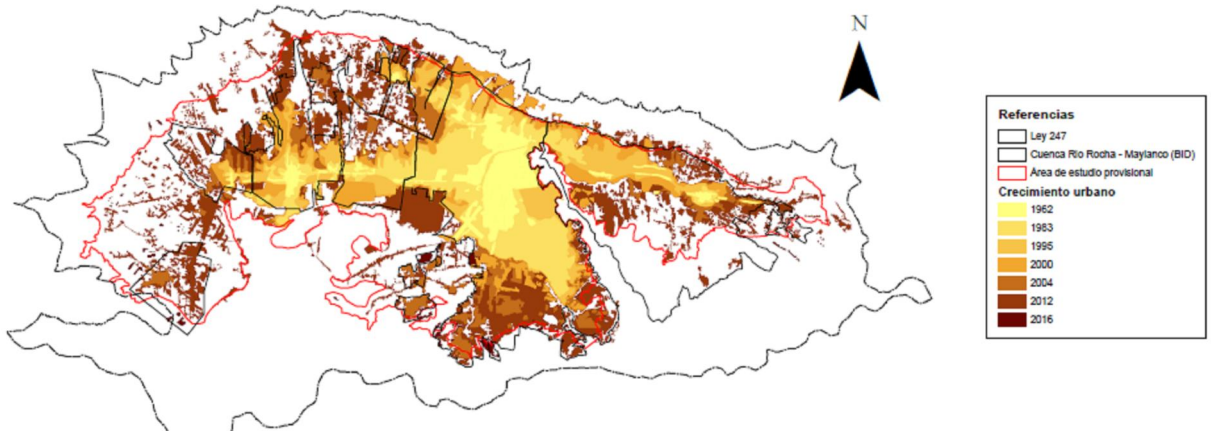


Fig. 1 : Urban growth of Cochabamba Metropolitan Region.

After 2006, as a consequence of new economic model, economic and population growth due to the nationalization of hydrocarbons and foreign demand for raw materials, the city undergoes a great dynamism in the construction sector and a new phase of rapid urbanization, which leads to the proliferation of informal settlements in the peripheral areas of the city. As a result of this dynamic, in the last years the crisis of access to basic services has increased. The densification of certain areas of the city has saturated existing systems and exacerbated problems related to access to water. In 1997 only 60 % of the urban/capital area and 53% of the population are connected to water systems either inside or outside their homes and only 23% of those connected benefit of a 24-hours supply service. (MARVIN & LAURIE, 1999).

On the recommendation of the World Bank, the Bolivian government decides in 1999 to sell SEMAPA, the public enterprise in charge of water service, to Aguas del Tunari, a consortium between the British firm International Waters (55%), the Spanish engineering construction firm Abengoa (25%) and Bolivian companies (5% each). Once the contract entered into force, water rates increased rapidly and every OLPE (water operator), including cooperatives, OTBs, water and peasant associations who had built their own water systems, were

required to be connected to the concessionary's network, without being compensated. Households who still did not have access to water networks were also billed, on the assumption that they should pay for a service that would be available in the near future (DE LA FUENTE, 2003). Through resistance movements and widespread violent oppositions which are known as Cochabamba Water War, Aguas del Tunari was expelled and the water system returns under municipal control.

Even though the expulsion of the transnational consortium can be understood as a victory of the population against the interests of small elites attempting to have the monopoly over a natural resource, SEMAPA still struggles to improve water coverage and quality, seriously threatened by industrial and domestic pollution as well as overexploitation and urbanization in the aquifer recharge areas. SEMAPA water is supplied by well-fields located in the alluvial fan system in the northwest of the valley (WUTICH, 2010), by reservoirs located outside the valley and by the recently constructed Misicuni dam.

Although the largest water supply project (Misicuni), a project linked to providing potable water, irrigation and power generation has begun to operate in September 2017 (more than 60 years after its inception), only the capital municipality is connected to the network of water that allows the connection to the large water intakes of Misicuni. Moreover, the obsolescence and inadequate section of the current water network and the lack of pipes prevents this water from being distributed. So far, none of the other municipalities are connected, lacking main pipes to distribute water from the Misicuni intake. In those areas, self-management, under different governance structures, is still the main strategy for communities to access to urban water supply. Cochabamba water company (SEMAPA) still lacks good quality water, (chlorination is the only treatment that SEMAPA performs before distribution) and new pipes, while unaccounted water counts for about 45%. Today only the 30% or less of the metropolitan population use water services provided by the public operators, while the rest is produced by decentralized systems and managed by small-scale operators.

QUILLACOLLO: A CASE STUDY IN PERI-URBAN COCHABAMBA

With a population of approximately 137.000 inhabitants, Quillacollo's demography reaches 12% of the total metropolitan area. Through the establishment of relevant factories and the construction of the railway connecting Cochabamba and Oruro in 1971 which allows the transfer of products to the mining centers, Quillacollo undergoes rapid urbanization, following first a west-east direction and later a south-north development and resulting in a heterogeneous urban tissue. On one hand, it is characterized by the linear development of the old settlements that raised along the main axis, as a result of the valley morphological configuration and the path of the Rocha river (near Avenue Blanco Galindo). On the other hand, it is shaped by the juxtaposition between the irregular morphology of the central areas; and the regular spatial organization in the sectors where the first Spanish settlements have taken place (late eighteenth century) and progressively expanded, generating a nearly regular tissue compared to the rest of the city.

The territory of Quillacollo, like the rest of the municipalities of Cochabamba Metropolitan Area, has relatively scarce conditions in terms of available water resources and economic power. The urban sprawl has mainly extended to the north of its jurisdiction and has led to the occupation of the most ecological fragile areas, the ones of aquifer recharge and with greater agricultural potential.

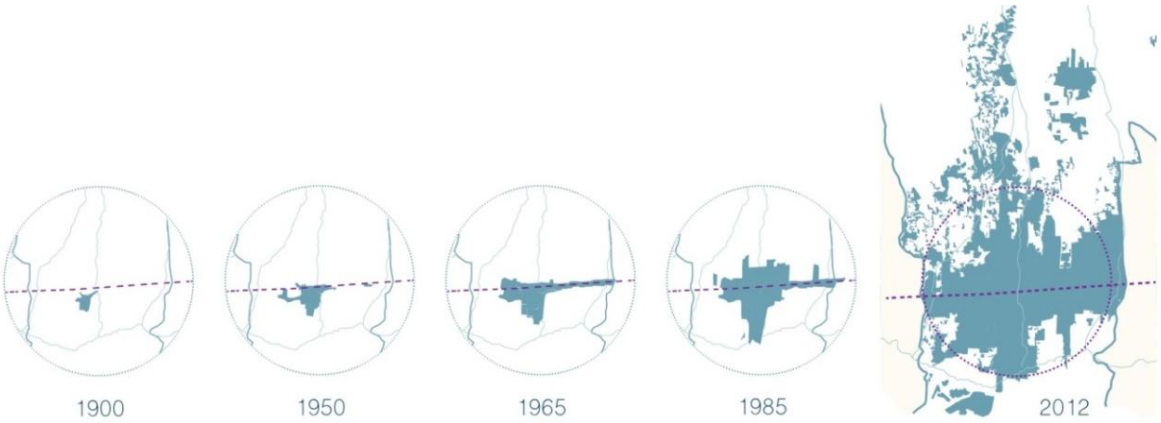


Fig 2. Quillacollo urbanization (elaborated on CABRERA 2015).

In Quillacollo, EMAPAQ (Municipal Enterprise of water and sanitation of Quillacollo) is the entity responsible for the management of the municipal water network. Its network covers only 30 of the 220 neighborhoods registered in the municipal urban area while connecting the 30% of the dwellings. In all the other neighborhoods, the water supply is provided by organized groups of citizens officially recognized through decentralization and reforms linked to the Popular Participation Law during the 1990s. Accordingly, every neighborhood organization is identified under the name of OTB (Territorial Base Organization) or J.V. (Junta Vecinal). While OTBs are resident's groups officially recognized by the municipality, JVs do not have any formal recognition and are often found in informal settlements. However, all the JVs can become OTBs, through a political process of urban regularization. Both neighborhoods types are run by councils with specific responsibilities. OTB organizations have rights in the planning and management of municipal development, as well as assume political and social representation, and control and represent relevant actors in the management of several public services, as water supply and distribution.

Although the first references of those neighborhoods associations in Quillacollo have been found since the 1960's (after national revolution and land reform), it is since 1994 that those organizations have started to receive resources from the Municipal Government, for developing and improving their water networks. These small water systems are managed through OLPES (small-scale local operators) which in some cases may be the OTB or the JV or external appointed organizations, such as water associations or water cooperatives.

Quillacollo includes around 220 neighborhoods and approximately 80% of them are OTB. Nevertheless, all kinds of organization (OTB or JV) confront with the municipal government in the exercise of their functions. In each neighborhood the number of inhabitants goes from 60 to 600 families. Unlike the public operator, the coverage of the OLPE service of neighborhood networks oscillates between 70 and 100% of its population. Those small-scale service operators demonstrate a great capacity to provide the service; also in terms of economic accessibility, as the cost of the service is way cheaper than the one from EMAPAQ and the provision guaranteed for more hours in a day (CABRERA, 2018).

THE SPATIAL DIMENSION OF OLPES WATER NETWORKS

It is important to highlight that Quillacollo urban development as a large part of Cochabamba metropolitan area has been conditioned by the presence of water networks, as in the majority of urban settlements in the history of urbanization. Before being subjected to rapid urbanization in the 1980s, Cochabamba had a strong agricultural productivity. In order to transfer water to arable areas, almost all its surface was covered by irrigation channels, built and owned by landowners until 1950, then transferred to regional governments. These channels played a role as structuring pathways for the definition of OTB/JVs jurisdictions which is suitable for a spatial observation. A morphological analysis of the neighborhoods in Quillacollo, reveals how the different urban structures are articulated and defined by the relationship between water structures and the boundaries of the neighborhood's jurisdictions. The set of irrigation networks represented the first structure on which a spatial organization occurred, first with the installation of the road network and later with the plot distribution, as well influenced the boundaries of the OTB/JV jurisdiction (see Figure 3)

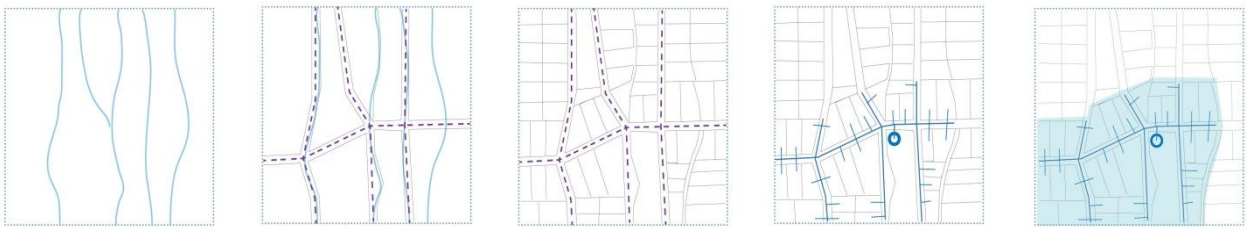
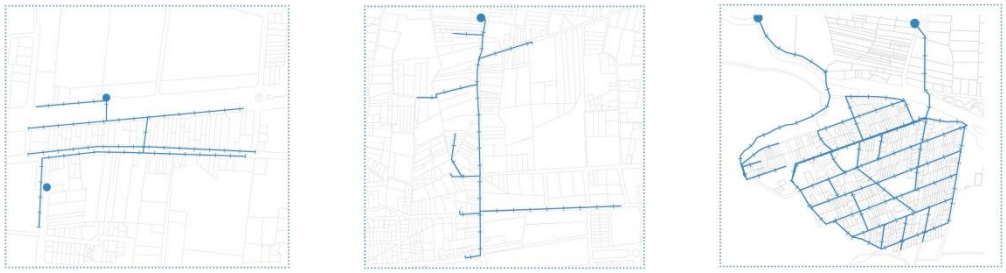


Fig 3. Waterscapes. The production of the urban forms in Quillacollo started from the distribution of irrigation canals which determined the jurisdiction of the neighbourhoods (elaborated on CABRERA 2015).

Through the analysis conducted on a sample of 30 cases, it is possible to identify different typologies of water and sanitation networks' structures which help to understand the level of consolidation of the neighborhoods (Figure 4). Linear structures, normally following the irrigation canals, represent the first phase of the establishment of the OLPE networked infrastructure while tree structures generally are found in more consolidated areas. Usually these two structures are still open to further connections, and might be continued with the incremental expansion of the settlement. Mesh structures are pointed out as the final stage of network

consolidation and generally lack possibilities of further extension. At present, the greater part of Quillacollo urban morphology is configured on the ground of the former irrigation canals and the consequent spatial distribution of the OLPE water networks in the neighborhood.



Iquircollo Sur Antofagasta Norte Villa Urkupiña

Fig 4. Typologies of water networks in Quillacollo (elaborated on CABRERA 2015)

From a spatial perspective, these neighborhoods are kind of urban islands, characterized by local dynamics which contribute to fragment the urban space without making use of physical barriers (as gates and walls), but by adopting a set of rules, urban initiatives and systems of representation through the management of the water networks. In terms of urban fragmentation, the phenomenon is a very particular one among others which can be identified in Latin America, characterized by the deepening logics of autonomy and pseudo autarky around water management issues. If, on one hand, OLPES represent key actors in the provision of basic services, as they engage communities around the management of common goods, the spaces they generate are not spaces of solidarity and cooperation, rather spaces of conflict and competition as it will be explained in the following chapter.

CONFLICTS OVER DECENTRALIZED WATER MANAGEMENT

Several conflicts emerge around the OLPEs water management system, mostly between community and the public operator (EMAPAQ). The lack of coordination between the two parties results in deficiencies and weaknesses of the service cycle, with negative impacts for humans and the environment. If, on one hand, the public sphere has more economic capacity to carry out large infrastructure works (see Misicuni dam) and to build a sewerage system with centralized wastewater treatment plants, on the other OLPEs can guarantee an almost uninterrupted water distribution at a convenient price. Moreover, OLPEs often play an important role in the urban development and the provision of community services. The revenues collected through water bills are often used to finance public infrastructures and small equipments (such as sport fields, markets, road paving), to build an “emergency fund” which can be used in case of extraordinary events or to promote solidarity among community members (for example to sustain funerals or community events).

However, it should be stressed that neither public nor community operators cover all phases of the water circle. The former does not provide a good quality water, as well as account for a high rate of water losses. OLPEs often lack any sanitation network and by freely discharging in waste water in the environment, they contribute to further contaminate underground water.

The overexploitation of water resources with unlimited drilling of wells, leads to a series of conflicts over the control of land, infrastructure and resources, which first involves the public and private operators. Private water truck entrepreneurs often extract and distribute water to the population without any license or approval, which makes impossible any quality control. Conflicts also involve the municipality and the neighborhoods.

The land fragmentation due to OLPEs control over infrastructure areas, results in an increasing weakness of the public operator who is reluctant to take the control over the resources under the neighborhoods jurisdiction. Consequently, EMAPAQ lacks control over water extracted from OLPEs but also from individuals (private well owners, industries, which often evacuate the remains of industrial water into existing sanitation systems or directly to rivers).

CONCLUSIONS

The largely found decentralized water systems in Quillacollo, run by different kinds of OLPEs, represent an unorthodox case of co-production of urban services, as the two actors do not really collaborate but rather compete in the provision of water to urban dwellers. The uncontrolled drilling, especially in areas of aquifer

recharge, the lack of wastewater treatment and the weakened role of the city government in exercising control over the fragmented urban landscape that results from those models of management, threaten the sustainability of those initiatives. Moreover, this contribution sheds light on some issues that are suitable for further investigations, often disregarded by literature on co-production: the implications that community-led initiatives have on the production of urban space. The incremental nature of those infrastructure emerges from an understanding of the different typologies and their degree of consolidation. Those mini-networks are continuously reconfigured to respond to urban and environmental transformations and to growing scarcity of water resource. This re-configuration, which is related to the capacity of OLPEs to decide about the extension of their network and the inclusion of new service users, also determine the re-configuration of the neighborhoods and the jurisdiction of the city.

In terms of actors, a variety of typologies of co-production initiatives emerge: different structures of governance, degrees of institutionalization of the organizations in charge of running the water system appear in the different neighborhoods.

A comparative analysis of different case studies in Cochabamba and their understanding in relationship with similar initiatives in other cities, would help developing a wider understanding on how those different typologies of community-based service delivery are integrated within current urban planning schemes and regulation. This could help to build a more comprehensive framework for addressing the impacts of those initiatives, in terms of economic viability, socio-spatial cohesion and environmental sustainability.

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