

Challenges of water and sanitation service co-production in the global South

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ABSTRACT Co-production of water and sanitation services, especially in the global South, implies that recipients of a service play a fundamental role in managing water resources. In the context of citizen–government synergies, service recipients are more than consumers, and (co)-production alters their involvement in the service production process, with respect to their relationships with both the natural resources and the delivery process. Our hypothesis is that a meaningful understanding of co-production for water and sanitation services is only possible through an interdisciplinary approach that takes into account natural and social dimensions. The objective is to develop a possible new conceptualization of service co-production that can foster a renewed citizenship while taking into account the risks of urban fragmentation.

KEYWORDS co-production / service providers / sustainability / urban / water and sanitation services

I. INTRODUCTION

Ensuring effective and equitable service provision in the global South is a continuing challenge, especially given the rapid urbanization processes in these parts of the world. Conventional models for water and sanitation service provision, based on monopolistic and centralized public and/or private sector solutions, have proven their limitations. Accordingly, the option of service co-production is gaining a renewed interest in current research⁽¹⁾ and is increasingly supported by international bodies.⁽²⁾

Theorized in the early 1970s by Elinor Ostrom, co-production has progressively entered the debate on service provision and emerged as a serious alternative to dominant urban governance models that once conceived of policymaking as a top-down process.⁽³⁾

Although its definition is still debated, there is a wide agreement around two main features of co-production. First, it is an original solution in the repertoire of available institutional arrangements, which can be mobilized by public sector organizations seeking to achieve their purposes.⁽⁴⁾ Second, it is based on an active involvement of citizens in the production of public goods and services.⁽⁵⁾

Mainstream literature on service co-production has largely been developed by scholarship in public governance and management.⁽⁶⁾ This branch of literature focuses mainly on social, not necessarily networked, services such as education, health facilities or police protection. This research is mostly directed to governance systems favouring this service model, and on the roles and responsibilities of the different actors involved.⁽⁷⁾

Joshi and Moore⁽⁸⁾ introduced the concept of institutionalized co-production, which they defined as “...*the provision of public services (broadly defined, to include regulation) through a regular long-term relationship between state agencies and organized groups of citizens, where both make substantial resource contributions*”. Institutionalized co-production includes “unorthodox” institutional arrangements, understood as “*smart adaptations to prevailing local circumstances*” where different agencies interact with citizens and where governments play indirect, and often systemic, regulatory roles.⁽⁹⁾

By contrast, in contemporary urban studies, co-production is viewed as a specific arrangement and a fair and sensible alternative to the modern infrastructural ideal.⁽¹⁰⁾ In this framework, co-production of conventional urban services, such as water and sanitation, has been shown to contribute to the emergence of hybrid infrastructure landscapes of “localized,” “decentralized” or “needs-driven” service configurations,⁽¹¹⁾ where citizens play a substantial role in developing arrangements to bridge the gap left by absent or poor networked infrastructure.

Some scholars have framed co-production within the process of hybridization of planning models in the South, while highlighting its impact on urban development and its evolutionary nature.⁽¹²⁾ Others have emphasized specific outcomes of co-production, such as the universalization of access to services,⁽¹³⁾ affordability,⁽¹⁴⁾ and the capacity to secure political influence for citizens.⁽¹⁵⁾

More recently, some research considering co-production of water and sanitation has highlighted that both social and environmental perspectives are relevant, and therefore concerns about service accessibility, environmental sustainability and spatial considerations cannot be left aside.⁽¹⁶⁾ In the urban environment, water has to be considered a basic resource, primarily available in nature, and at the same time a processed resource, in the form of drinking water supply, sanitation disposal and drainage management. Studying water “production” – the transformation of the natural resource into services, through provision or disposal – is relevant from a social point of view (who is involved in this process and how), but also from a physical one (in terms of available technologies/devices to produce and process the resource, and space concerned). Understanding the mechanisms that regulate co-production and its impact on the environment is seen therefore as a key step in guaranteeing its economic, social and environmental sustainability.

Considering this debate, our article aims to advance knowledge about the co-production of water and sanitation in the urban realm. It therefore addresses both institutional and physical issues, through a crosscutting reading of varying co-production practices in the global South. The article specifically aims to identify challenges in the relationship among the institutional aspect, the resource,

and the urban dimensions of co-production. We therefore adopt a critical reading of co-production, considering a series of existing community-based practices and their outcomes in different contexts. This diverges from an approach where co-production would be assumed to be ontologically beneficial to end-users, thereby limiting the range of possible experiences deserving to be considered.

From a methodological point of view, the paper is based on an exploratory approach, grounded in the analysis of four case studies of water and sanitation co-production. Our selection of case studies is further explained in Section III, as it is based on the three main dimensions of co-production identified in Section II. These case studies have been systematically analysed through a combination of desk-based analysis of water policy documents, interviews with local stakeholders (especially those in charge of water co-production), a mapping of water networks/devices at the neighbourhood scale, and face-to-face surveys amongst the local population.⁽¹⁷⁾

II. ADDRESSING THE INSTITUTIONAL, RESOURCE AND URBAN DIMENSIONS OF CO-PRODUCTION

In this paper we highlight three dimensions of the co-production of water and sanitation services: i) the institutionalization of co-production practices (namely the governance systems supporting or opening space for those arrangements); ii) the nature of users' engagement throughout the water provision and treatment cycle and their relationships with the resources processed; and iii) the scaling up of those initiatives and their role in the everyday making of the city.

According to the literature on co-production from the public administration perspective, two main types of actors are engaged in the service delivery process: a wide range of regular “providers”, including administrators from the public sector, state agencies, utilities, etc., who act with “professional capacity” and duties in order to deliver a service⁽¹⁸⁾; and members of civil society or non-state actors who contribute to one or more phases of the service cycle. In the global South, co-production increasingly implies a change from a basic form of collaboration between two co-producers to a flourishing of intermediaries (such as volunteers, community groups and NGOs, and private actors) who take on the role of both producers and negotiators. For some authors, co-production is limited to the service delivery phase⁽¹⁹⁾ – that is, to situations where a “regular producer” and a “co-producer” effectively deliver a service. For others, co-production can be applied to all phases of the public service cycle: operational, strategic, and the integration of the two.⁽²⁰⁾ Research shows that co-production develops new modalities in which power, authority and control of resources are distributed between the state and groups of citizens.⁽²¹⁾ It is therefore important to address the organization of these state–citizen arrangements in the water and sanitation sector and to highlight the nature of drivers that make co-production desirable or possible in each case study.

Users may be engaged in water and sanitation services in multiple ways, from endorsing a traditional role of “captive consumers” to more participatory or active roles, when contributing to the

technological systems that support the consumption of water and the provision of sanitation services.⁽²²⁾ They can operate as individuals, groups and collectives, influencing the scale of the co-production activity, the distribution of benefits,⁽²³⁾ and the relationship with the resources processed.⁽²⁴⁾ As evidenced within the literature, the kinds of relationships established among the actors in governing the resource have an impact on the ways resources are processed and the ecological system is maintained.⁽²⁵⁾ The introduction of elements to regulate water supply and sanitation (WSS) practices such as monitoring, control and conflict-resolution mechanisms, and the access and sharing of information between actors, are fundamental for the sustainable management of the system.⁽²⁶⁾

Consequently, the role of users is framed by the availability of water resources and reciprocally influences its transformation into a service, at different stages of the water service cycle, be it for supply or treatment. It is therefore interesting to unveil in each case study the nature of citizens' engagement, the scale of their operation, and the formal/informal governance structures that govern the management of the common resources.

Literature on urban production in the global South highlights how different models of domination and power have contributed to increasing urban fragmentation while exacerbating inequalities in access to the city and basic services.⁽²⁷⁾ Water and sanitation services are specifically configured socio-physical metabolic processes that involve communities in the everyday making of the city. The features of those configurations are tied to specific historical/geographical, social, political or economic conditions, as well as to different forms of governance.⁽²⁸⁾ The transition from networked systems, usually organized and managed through centralized and top-down policies, to co-produced practices,⁽²⁹⁾ implies a re-articulation of power relations that may affect different interrelated geographical scales.⁽³⁰⁾

A broader grasp of urbanization processes is required to understand how cities and their underlying infrastructure are produced. A more immediate contextual perspective, at the same time, will highlight how spatial configurations affect power relations at a local scale. Especially at the scale of the settlement, sociotechnical services can result in an "archipelago" of technical options influencing and at the same time influenced by resources and their distribution in space.⁽³¹⁾ It is therefore important to address the spatial side of co-production arrangements of WSS in urban areas. This means, on one hand, considering broader urbanization dynamics and related service delivery models and, on the other, highlighting context-specific characteristics that determine the boundaries and configurations of observed practices.

III. FOUR CASES OF WATER AND SANITATION CO-PRODUCTION IN THE GLOBAL SOUTH

We will discuss four co-production cases in the global South, in Kinshasa (Democratic Republic of

Congo – DRC), Hanoi (Vietnam), Dar es Salaam (Tanzania) and Cochabamba (Bolivia). These cases have been selected to cover a variety of co-production situations, in contexts where networked and non-networked water supply and sanitation coexist at a large scale. Our analysis has mainly been oriented towards understanding existing practices, considering that co-production may occur without being designed or designated as such.

The political and institutional context of these four cities is extremely different, with highly centralized and controlled decision-making systems in Vietnam and Tanzania versus more decentralized political systems in the cases of Bolivia and the DRC. In none of the four cases is co-production a marginal phenomenon. It is a widely applied and sustained approach at the city scale. In the cases of Dar es Salaam and Kinshasa, co-production appears to be a way to “fix” pre-existing urbanization processes. It has been institutionalized to legitimize and/or sustain local practices in specific urban areas that lack a centralized and equitably distributed network. In contrast, in the cases of Hanoi and Cochabamba, co-production is extensively deployed at the city scale and further fuels urbanization processes.

Our proposal is to highlight the way these practices evolved in their respective contexts, framed by state–citizen arrangements and specific relations with the natural resource. The comparative approach will help us to identify some main challenges related to co-production, with respect to an altered relationship among service recipients, water providers and the environmental resources.

a. Fragmented water supply landscapes in Quillacollo (Cochabamba, Bolivia)

The metropolitan area of Cochabamba is composed of seven municipalities. It has almost 1.5 million inhabitants and has developed in a valley of approximately 95 thousand hectares, occupied by a metropolitan space of approximately 19,000 hectares.⁽³²⁾ The public networks of the seven municipalities only serve 30 per cent of the metropolitan population. The water distributed by SEMAPA, the public water distribution company, in the municipality of Cochabamba is considered potable. None of the other municipal public networks delivers truly potable water.

The second most populous municipality in the metropolitan area is Quillacollo. The public water distribution company of this municipality (EMAPAQ) covers 30 per cent of the urban area with approximately 8,000 connections, where more than 30,000 would be required for full coverage.⁽³³⁾ This is in line with the situation faced by the other municipalities, where only 30 to 40 per cent of the population has access to the public network.⁽³⁴⁾

Accordingly, water services have been partly transferred to local groups in all seven municipalities. The so-called local small-scale operators (OLPEs) are developing self-organized co-production practices. These OLPEs have been developed around the exercise of the “human right to water” recognized by the 2009 Political Constitution of Bolivia. They typically function in peri-urban areas not covered by the centralized networked systems.

OLPEs may be organized along three main legal lines: as cooperatives, associations or basic territorial organizations (OTBs).⁽³⁵⁾ The latter, OTB, is acknowledged in the Bolivian Constitution as the smallest territorial unit with official status. OTBs are partly funded by the national government and the municipality in order to support their costs and organization. Regarding their activities in terms of water provision, they normally fulfil only the earlier stages: capture (through wells), distribution and consumption (direct through local water networks). This means that discharge occurs with no process of purification or treatment, and with a significant impact on the environment. As regards political representation, OLPEs are officially included in municipal decision-making. Networks managed by OLPEs are both technical and social. OLPEs have succeeded in building not only hundreds of small water network systems, but also neighbourhood structures capable of urban management, beyond government control.

Arrangements around water services are related to the ability of OLPEs to build small technical networks, which are easy to reproduce and used as social mechanisms for the reproduction and control of urban space. OLPEs develop sociotechnical networks of small-scale reticular interdependence, where participating actors within the organization further consolidate their bonds every day. Apart from the development and maintenance of small-scale water networks per se, these OLPEs typically invest part of the revenues from the distribution of water in the improvement of public spaces (especially roads), outdoor facilities (sport facilities, playgrounds) or social events, like the organization of funerals of members of the group. The autonomy of these small-scale local arrangements tends to minimize the need for relationships with the rest of the city.

It should further be stressed that the economic model of these OLPEs is intrinsically based on pumping water from underground reserves. There is presently no monitoring or regulation of the combined effect of the myriad of small-scale networks operating this way. Still, it may obviously have an impact on the sustainability of the water resource. This is even more the case as the development of these networks is fuelling uncontrolled growth at the periphery of the city, directly above underground water reserves.

In spatial terms, the physical configuration of OLPEs is directly driven by the size and shape of the small-scale water networks they operate. At the city scale, the surface and shape of neighbourhoods are progressively framed by the extension of the water networks managed by each OLPE. The ability of OLPEs to decide internally about the extension of their network and the associated new connections (households) contributes to determining the configuration of the jurisdictions and the city. In political terms, this process is related to a weakening of the city government. OLPEs become increasingly self-sufficient organizations. Their control over the local resource and service gives them a more general and legitimate control over local urban space. The urban fragmentation of municipal space by these small technical networks reflects tensions between two ways of managing the territory: a centralized vision supported by the public sector and a decentralized vision advocated by local communities. The conflict between these two visions

highlights the uncomfortable and marginalized position of urban planning, hampered in its capacity to act in highly fragmented urban areas with complex governance structures, considering that common water resources are scarce or endangered.

b. Co-management of water and sanitation infrastructures in Hanoi's New Urban Areas (Vietnam)

The landscape of water and sanitation services in Hanoi is highly fragmented, and a variety of co-produced practices have been set up, with different institutional, infrastructural and territorial configurations. In urban districts, largely connected to the water supply network, co-production arrangements are a compensatory strategy that citizens, beyond the networked infrastructure and mainly at the individual level, adopt to access water supply and sanitation.⁽³⁶⁾ Inequality in access to basic services is particularly problematic in peri-urban areas, where rapid transformations are occurring through densification of former villages and conversion of large rural areas – mainly rice and paddy fields – into urbanized land.⁽³⁷⁾

The rapid urbanization process is a consequence of the wave of reforms that started with Vietnam's opening to a market economy after *đổi mới*.⁽³⁸⁾ The large-scale infrastructure required by this urbanization process is financed through the so-called land-for-infrastructure mechanism, whereby land is used as an in-kind contribution for financing infrastructure.⁽³⁹⁾ This mechanism is largely applied in New Urban Areas (NUAs) as part of a decentralization policy that delegates wastewater treatment and the provision of basic infrastructure to real estate developers.

NUAs are large-scale urban projects, conceived as autonomously administered entities, mainly built on peri-urban agricultural land. These “islands of wealth” for the rising middle class and upper class are producing large-scale socio-spatial fragmentation and exacerbating inequalities.⁽⁴⁰⁾ In terms of urban development, they result in a patchwork of western building types (high-rise buildings, multi-storey villas) and exclusive facilities for their residents (hospitals, schools, shopping malls). Disconnected from surrounding villages, they increase fragmentation in access to water and sanitation services. NUAs are equipped with their own water treatment plants for pre-consumption and post-consumption. In the perimeters of these areas, wastewater and drainage flow into separate pipes and are afterwards discharged in the public sewerage system. This often causes local flooding in neighbouring villages.⁽⁴¹⁾

The control of this self-operated infrastructure is entrusted to experts with access to networks, valves and their complex hidden geography. Users are generally passive consumers,⁽⁴²⁾ with little knowledge of the infrastructure and its functioning. They just turn on the tap, flush the toilet, and pay the bills (which are generally higher than in the rest of the city).

Times City is one of these new residential areas, built by the prominent Vietnamese real estate investor VINGROUP on a former brownfield site. Specific co-production arrangements between the

national government and citizens were set up in this area. Decisions on management and common funds are handled by a complex set of actors representing three parties: the government, the real estate developer and citizens. The area is managed by a management board, which represents the investor interests and negotiates with residents and authorities. The board resolves grievances and complaints and reports on apartment structures. It also manages a common fund made up of the contributions paid in when buyers purchase their apartment (2 per cent of the total apartment cost). This fund is planned to cover the costs for maintenance of infrastructures and public space for 10 years, after which residents are expected to cover costs through additional contributions. The management board establishes the prices of water, electricity and other common services, through constant negotiations with the resident representatives.

Residents of each tower are represented by a *tổ dân phố* (TDP), a political and self-monitoring body, implementing the Communist Party of Vietnam's policies at the local level. In some buildings, it is reported that in parallel to TDPs, alternative administrative boards have been set up to negotiate with the management board on prices and to influence budget allocations for maintenance. Similar situations have been reported in other NUAs where local residents, after forming a cooperative, took over the management of infrastructure from the management board. This redistribution of power resulted in improvements of building conditions and decreased costs of service supply.⁽⁴³⁾

The co-production of water and sanitation facilities in these NUAs appears to be the output of a synergistic relationship between planning authorities and the private sector, attempting to cope with dynamic urbanization processes. It nevertheless has major shortcomings. These autonomous islands, employing high-tech decentralized infrastructure, not only transfer higher costs to their residents, but take no responsibility for wastewater after treatment and outside their boundaries, when it is recombined with untreated water. Moreover, these arrangements are socially disruptive, promoting an elitist vision of the city while increasing spatial fragmentation and inequalities in access to basic services.

c. Community-based water management practices in southern Dar es Salaam (Tanzania)

The regulatory framework regarding water supply in Dar es Salaam involves many actors at national, regional, district and local levels. Two authorities operating under the Ministry of Water, the DAWASA and the DAWASCO, are responsible for managing the municipal water network, which currently serves about 25–30 per cent of the population's total water demand, mainly covering planned and affluent areas in the north–northwest of the city centre.⁽⁴⁴⁾ A large share of the population, especially in informal settlements and peri-urban areas, relies on alternative water supply, with variable quality and prices (although costs are generally higher than for the networked water).⁽⁴⁵⁾

From the late 1990s, following a series of local government policy reforms, three Dar es Salaam municipalities were conferred responsibility in providing water service.⁽⁴⁶⁾ In particular, along with

the rapid urbanization process that triggered an uncontrolled development of peri-urban areas, the Tanzanian National Water Policy promoted a decentralization of decision-making with a wider stakeholder engagement in water initiatives. NGOs and community-based entities were invited “*to finance, develop and manage the water supply and sewerage service in low-income urban areas*”.⁽⁴⁷⁾

This policy resulted in a wide diffusion of co-production practices. Community-based management was considered to be the most pragmatic option for water supply in those peri-urban areas disconnected from the networked system. Alternative practices emerged as semi-institutionalized forms of collaboration between groups of users, represented by water management committees or organized into water user associations, with the local government, the water authority, and possibly international donors or NGOs.⁽⁴⁸⁾

Community-based water management systems developed rapidly over the last 20 years in many low-income areas of the south of Dar es Salaam (Temeke Municipality), disconnected from the municipal networked system. Community-based entities operate as local co-producers/users, operating mainly low-cost, small-scale technologies, basically hand-pumped shallow wells and water tanks. Wells are usually funded by NGOs or by the municipality, while DAWASA provides technical support in well building, water treating and equipment hiring. Specific responsibilities of the head of the local government unit and the water committee include identification of space for wells, technology and service management, supervision and information dissemination.⁽⁴⁹⁾ Households contribute labour and donate land for the required equipment. In most cases, a low price for a jerrycan of water, or a flat fee for direct household connection, is introduced. These revenues partly cover maintenance,⁽⁵⁰⁾ and in some cases are used for further development of the system.⁽⁵¹⁾

Many authors⁽⁵²⁾ agree on the pivotal role of these co-production practices for service delivery in the southern peri-urban communities of Dar es Salaam. These practices initially helped secure more reliable access to water, allowing involved households to get affordable water closer to home.⁽⁵³⁾ Still these benefits manifested rather unevenly, according to contextual physical and social factors.

In many cases, the sustainability of the co-produced practices was related to the communities' progressive use of more efficient technologies, namely what Kyessi⁽⁵⁴⁾ calls a “*step by step development model*” with an evolution from shallow to deeper wells with motor pumps. This implied well-organized fee collection and the investment of revenue for maintaining and upgrading the systems. It also ensured higher-quality water and a more efficient reliable supply in the face of falling water levels. In recent decades, many community wells, especially in coastal areas, have faced a falling water table from increasing groundwater exploitation as well as shallow aquifer salinization.⁽⁵⁵⁾ This forced households to use this water only for domestic purposes (cooking, cleaning) and to seek alternative, more expensive, solutions for potable water – from private vendors or distant neighbourhoods. This imposed new financial barriers for the poorest inhabitants.⁽⁵⁶⁾

With respect to the relationships between actors, Kyessi⁽⁵⁷⁾ and Dill⁽⁵⁸⁾ report cases of significant community involvement at every stage of the planning and implementation, with effective

participation in decision-making. This enabled a deeper control of the resource, fostered community awareness and knowledge, and improved efficiency in water management, especially compared with uncontrolled groundwater use in other informal areas of Dar es Salaam.⁽⁵⁹⁾ Proper management had spatial and social effects, with broader inclusion for all the neighbourhoods, provision for repair, and less social conflict and spatial fragmentation. Still, in most cases, insufficient attention to pro-poor service, poor management and coordination from local government, and lack of communication between governance levels limited the potential of the co-production.⁽⁶⁰⁾

d. Decentralized water, sanitation and hygiene services in Kinshasa (DRC)

In Kinshasa, in the Democratic Republic of Congo, peri-urban areas are experiencing the development of off-grid supply systems and/or point-by-point service delivery alternatives, based on the participation of several actors as well as formal and informal arrangements. The government supports a programme called Villages et Ecoles Assainies (VEA – “Sanitized Villages and Schools”). The VEA programme aims to improve drinking water supply services, hygiene and sanitation (WASH) through the inclusion of public authorities and citizens.⁽⁶¹⁾ Based on an institutionalized co-production of services, it is commonly deployed within “health zones” delineated by public authorities.⁽⁶²⁾ This alternative provision of water services was much needed in Kinshasa’s peri-urban area, traditionally perceived as an “out-of-the-field” zone.⁽⁶³⁾

According to field observations in eastern Kinshasa,⁽⁶⁴⁾ the provision of water and sanitation is characterized by a “hybrid” and fragmented landscape of service typologies. In some areas, the supply is ensured by the public utility Régideso. Areas outside the scope of Régideso are serviced by the VEA programme (through drilling and manual pumps), or by pre-existing programmes developed by such partners as the Japanese cooperation agency JICA and the British NGO Oxfam. Those programmes make use of traditional wells, pit latrines and handwashing facilities for access to WASH services. The point-to-point system supported by the VEA programme (Bornes Fontaines) is based on hand pump drilling, extracting water from the aquifer at a depth of at least 30 metres through a borehole. A mechanical manual steel pump, with “one arm”, is then mounted on a concrete coping (wall covering – 5 x 1.5 metres). The local installation NGO sells spare parts for maintenance and provides support from a trained mechanic, often a member of the local community.

The actors involved in the delivery of the co-produced water services are the Sanitation Department (DAS) of the Ministry of the Environment, the National Service of Rural Hydraulics (SNHR), and the Politico-Administrative Authority (APA), the main organizer of the sector at the local level. UNICEF and local NGOs, as intermediaries, are responsible for monitoring and checking the infrastructure. Community involvement in the process is further encouraged through a *fontainier* (well keeper).

Local resident end-users are involved in the VEA programme in many ways, providing space

for the borehole, participating in construction, and being available for the well keeper role. Residents are invited to be members of the Village Assaini (Sanitized Village) committee, which oversees daily management and maintenance of water points. The local organization supports capacity building through appropriate training and regular monitoring and evaluation of water works, guaranteeing the sustainability of interventions in this “health zone” approach. There are also limitations to community involvement, however. Only plot owners are represented in the Village Assaini committee, while tenants (often around a third of the households) and sub-tenants have no role in decision-making. In addition, the co-production, which focuses on co-implementation, co-maintenance and co-evaluation, does not include all phases of the service cycle.

It should finally be noted that the provision of services and the location of WASH works can be constrained by topography and the geomorphology of the site – for instance in the flood zone along the Nsanga River and in the extensively eroded Salakiaku Avenue in the Biyela neighbourhood. Continuity and equity in service provision can consequently only be ensured through a hybrid approach.

IV. FOUR MAIN CHALLENGES RELATED TO WATER AND SANITATION SERVICE CO-PRODUCTION

A reading of our four cases, combined with our literature survey, draws attention to some key challenges in the relationship among the institutional, resource and urban dimensions of co-production of water and sanitation services. We highlight such factors as the availability of water resources and the characteristics of the urban spaces covered by the delivery of water services.

a. A closer relation to the resource

Co-production is based on a close relationship of citizens with the resource. It increasingly operates at different stages of the water service cycle. The shift from service recipient to service producer means that citizens both use the resource and participate directly in its processing.⁽⁶⁵⁾ In the cases of Cochabamba, Dar es Salaam and Kinshasa, citizens are engaged in the earlier phases of the service delivery (production and treatment), providing labour and land for the hydraulic systems. In urban areas of Hanoi connected to the public network, the gap left by public utilities in terms of pressure and quality is encouraging people (mainly individually) to install devices processing the water in later phases (treatment and delivery), at either the plot or community scale.

This improved user–resource relationship is usually related to a lack of access to the main service and/or to remote resources. This encourages consideration of alternative resources that are normally wasted. However, this close relation with the resource does not prevent resource waste or guarantee conservation. For example, in the coastal areas of Dar es Salaam, the co-production of

water depends on local wells, but this increasing water usage results in groundwater exploitation. As this exploitation lowers the water table, it contributes to groundwater salinization.

Centralized water and sanitation services, characterized by standardized solutions, leave limited room for the recipient–resource interaction. In co-production, by contrast, the recipient–resource relation is inherently dynamic, responsive to both the availability of the resource and/or the changing conditions of the recipient (e.g. increased financial availability). In Cochabamba, for instance, the extension of the small-scale water networks operated by the OLPEs is facilitated by the availability of common water resources. In Dar es Salaam, due to increasing groundwater pollution and salinization, the resource–recipient relation embedded in the co-production of supply water has evolved, since the local communities have increasingly had to search for water at deeper levels – from shallow wells to deep wells. This has contributed to recipients’ awareness of the resource and its dynamics. All cases fail to address the closed-loop nature of the water service cycle, due to poor or even absent wastewater treatment. Shifting from co-production of part of the cycle to attention to the entire cycle is therefore an outstanding challenge, mostly reflected in inefficient control mechanisms (Hanoi), poor capacity and investment from the state (Dar es Salaam and Kinshasa), or the lack of coordination among the myriad of OLPEs operating in parallel (Cochabamba).

The multi-scalar nature of water resources means that they are usually impacted by larger urban and environmental transformations. These may be a threat to local co-production practices, as in peri-urban areas in Hanoi where contamination of underground water threatens the use of individual or community wells. Accordingly, these are progressively replaced by other non-co-produced practices (mainly rainwater harvesting and water purchases from private vendors). Similarly, in Dar es Salaam, when co-produced systems were no longer satisfactory for ecological, technical or social reasons, people were forced to combine co-produced services with the other water supply modalities when available.

In all cases, co-production is not just a relationship between actors, but also a different way to consider the service and the resource. Both hybridization and incompleteness of the water cycle have equity consequences in mostly affecting the poorest inhabitants, who usually lack the financial flexibility to adapt to the changing boundary conditions of the resource.

b. The key role played by technologies

Co-production of water and sanitation services often implies the introduction of small-scale solutions (devices/technologies) alternative or complementary to the large-scale infrastructure – or the “heroics” as defined by Sofoulis⁽⁶⁶⁾ – which have long dominated the implementation of urban water services. Sofoulis⁽⁶⁷⁾ explains that the sociotechnics associated with the centralized model conventionally imply that “*a centralised public or corporatised utility pursues large scale engineering projects—dams, pipelines, central sewage treatment plants—and assumes almost*

complete responsibility for supply of drinking and disposal after all-purpose”.

Conversely, co-production of water and sanitation services could unlock this dominant system, at least to a certain degree, breaking what Shove⁽⁶⁸⁾ presents as a path-dependent trajectory of sociotechnical change. Co-production often relies on hybrid and/or decentralized systems, making the service – and the resource(s) – accessible where large, centralized and standardized techno-scientific systems fail.⁽⁶⁹⁾ This applies to the development of hybrid and/or decentralized systems in Cochabamba, where small-scale groups organized as OLPEs implemented mini-networks connected to onsite wells, while some of them still have access to the centralized system. In Kinshasa, VEA devices complement the main network and a multitude of other pumps and taps introduced by international aid at the community level.

As shown in some cases, the increased capacity of users to act within a sociotechnical system can raise new challenges, especially when we consider the central role played by intermediaries in operating and managing the technical systems. In Dar es Salaam, problems arise with respect to the poor capacity of engaged local government and water committees, together with the application of low-quality technologies. In Hanoi’s New Urban Areas, which rely on large-scale decentralized wastewater treatment plants, the effectiveness of these emerging co-production initiatives will largely depend on the capacity of the intermediaries to scale up their operation, namely to collaborate and organize collectively, overcoming the conflicting interests of residents’ groups.

Water and sanitation service co-production expands the portfolio of available systems,⁽⁷⁰⁾ introducing a number of alternative devices and user interfaces differing from the conventional ones. As discussed above, the sociotechnical hybridization that can occur in co-production can bring the user closer to the resource and the resource’s processing. However, co-production, with its potential for changing and diversifying the user–resource interaction, does not necessarily result in a balanced relationship. Today’s ecological optimism is largely oriented towards technological innovation.⁽⁷¹⁾ Hybridizing the infrastructural portfolio via the introduction of decentralized solutions may contribute to this agenda. But this ecological modernism often pushes for technological solutions that are unaffordable to large sections of our society. These solutions can also sometimes trivialize the use–resource relationship because greater access to the service can give the user the impression that the resource is infinite. In some cases, technical devices are so advanced that results are mysterious and completely independent from the labour of the service recipient.

This highlights the need for decentralized technologies that adapt to the specific context beyond strictly technical terms. In the case of Dar es Salaam, for instance, evolutionary technology – or what Kyessi⁽⁷²⁾ defines a “*step by step development model*” – was required to overcome the problems of pollution and salinization of shallow wells. It thereby contributed to increasing the accessibility and the quality of the service. In Kinshasa, even though the pump at the basis of the co-produced service is of very low technical complexity, its maintenance remains its main weakness: the drinking water service shuts down every time the engine of the pump breaks down.

c. Co-production and citizenship

Mainstream co-production literature underlines how this specific production and delivery model has the potential to provide room for different roles and responsibilities in the service provision system.⁽⁷³⁾ This happens in two ways. The first relates to the users' perception of their enhanced comprehension of the water service cycle and their improved management skills. The second relates to their resulting role as citizens in the decision-making system. In the case of Cochabamba, the OLPEs have managed to build not only hundreds of small water network systems, but also neighbourhood strategies for management, based on solidarity bonds. A more nuanced situation is apparent in peri-urban Kinshasa. Here, despite the possibilities for community involvement, given their proximity and knowledge of the resource (as in the case of the well keeper), the lack of land property rights prevents residents from taking part in the co-production process.

The co-produced service potentially brings a double value. It represents a resource that should be understood and could be transformed into a service, and, at the same time, a practice to allow this transformation. The combination of the notions of resource and practice has already been theorized by Huron,⁽⁷⁴⁾ with respect to the urban commons, and later by Ranzato and Moretto⁽⁷⁵⁾ in relation to the role of co-produced water, energy and waste services in informing sustainable urban commons. The consideration of water as a natural resource, first, opens possibilities for individual and/or collective management of a common pool of resources.⁽⁷⁶⁾ Secondly, water as a practice carries the potential for producing new political imaginaries based on alternative governance arrangements where citizens are directly included in decisions about urban transformations.⁽⁷⁷⁾ The example of Quillacollo (Cochabamba) is particularly informative in this respect: the OLPEs are in many cases proposing a micro-scale alternative form of urban management, based on the sociotechnical water network, which influences the configuration of the jurisdictions and the city.

Accordingly, co-production practices can lead to two contrasting outcomes.⁽⁷⁸⁾ They can be opportunities to genuinely democratize and repoliticize conventional service provision, as in the case of the growth and management and planning tasks for the OLPEs in Cochabamba. But their shortfalls can also lead to a depoliticization of the service production and delivery process, as in the case of Dar es Salaam, where strategic choices are left to higher levels of authority, and in the case of Hanoi, where participation in decision-making is limited and highly controlled by decentralized state bodies. In Hanoi, the gap left by the state in service provision shifts the responsibility for service delivery to private developers and households, but also opens up alternative depoliticized arenas for citizens' engagement and negotiations, as in the case of New Urban Areas.

d. Co-production in the everyday making of the city

Graham and Marvin⁽⁷⁹⁾ once generalized the notion of fragmentation, considering all services in a network and a set of economic regions in the world. Their thesis of “splintering urbanism” suggests that powerful factors contribute to the disintegration of network infrastructure, fostering the fragmentation of the social and material structure of cities. The authors argue that universal services had an integrating character, but that their privatization and liberalization has contributed to the disintegration of universal network infrastructures and to an increased urban fragmentation, defined as a double movement of de-spatialization and de-solidarization of urban areas. The control of networks by powerful coalitions of private actors would promote the separation and segmentation of the infrastructure into different elements and packages. This separation would typically occur through “bypass” strategies that look for the connection of “valuable users” or “powerful places”, discarding or dodging users and places with less value. In peri-urban Hanoi, the diversification of sociotechnical infrastructure related to the development of New Urban Areas is embedded in the process of metropolization that, rather than guaranteeing spatial and social cohesion, produces large-scale fragmentation while increasing marginalization of the urban poor.

One of the weaknesses of this thesis is related to the fact that it does not consider unfinished networks.⁽⁸⁰⁾ Fragmentation may well be temporary from this perspective. Coutard⁽⁸¹⁾ indeed considers that networks are constantly evolving and suggests that the “bypass” effect may be a phase in the development process of networks. In the same vein, he further stresses that a network that is initially unequal may become universal or vice versa. Arguably, the vision of Graham and Marvin⁽⁸²⁾ is centred on the fragmentation related to centralized networks. It does not consider the likely effects of other reticular organizations, such as the set of small or medium networks, generally local and/or informal, that may also contribute to fragmenting cities. The small-scale water networks produced by the Bolivian OLPEs strengthen their own internal socio-spatial cohesion, but increase differentiation from the rest of the city. Similarly, in Dar es Salaam, the community-based water management practices in southern peri-urban areas are part of a pragmatic approach pursued by the National Water Policy, which contributes to the city’s evolution as a complex and fragmented landscape of unconnected networks.⁽⁸³⁾ Even if social ties are in most cases reinforced through the management of common resources, spatial and social connections with the rest of the city and the surrounding neighbourhoods are limited. Finally, it should be stressed that co-production can also contribute to “micro-fragmentations” within a given area,⁽⁸⁴⁾ as in the case of Kinshasa and some areas in Dar es Salaam, where community-based practices have often been unable to involve and serve the entire community potentially interested in the service.

V. CONCLUSIONS

The varied and changing relations among end-users/citizens, providers, existing resources and urban spaces requires new ways to conceptualize the alternative service delivery inherent to water and

sanitation co-production.

Two main conclusions can be drawn from our research. First, co-production should be regarded as an opportunity to deepen citizenship even though it may have contradictory effects on the relation between individuals and the society at large. Second, co-production is a way to build more resilient social infrastructures, and this is also the case in such “technical domains” as the provision of water and sanitation services.

The empirical evidence mobilized in this article confirms recent findings about the political dimension of service co-production. A collaboration between water agencies and citizens across the full-service cycle (from co-planning/creation to co-delivery/evaluation) has the potential, first, to bring citizens into the service sector through a renewed vision of citizenship, based on residents’ voice, participation and control in the decision-making process. In practice, actually, most co-production practices include only some phases of the service delivery process.⁽⁸⁵⁾

When co-production takes place in the first phases of the delivery process, it provides room for political inclusion in the decision-making process, but it risks jeopardizing the universalization and equitable distribution of the benefits of these initiatives. In Dar es Salaam, the Tanzanian legal framework fostered such practices, and in some cases there was potentially room for citizen participation in decision-making, and a high involvement of local political leaders.⁽⁸⁶⁾ Likewise, in Cochabamba, OLPEs are recognized by the government, but their outcomes depend heavily on the organization and functioning of each association. In both cases, fragmentation arises in social and spatial terms.

When, on the contrary, co-production takes place in the later phases of the process, there is an increased chance of sustainability in terms of results, but a danger of downgrading this alternative into a co-management (or co-learning) practice, as suggested by Duque Gómez and Jaglin.⁽⁸⁷⁾ Although formalized at the national and international levels, the VEA scheme in Kinshasa mobilizes co-production at the delivery, maintenance and evaluation levels. In practical terms, this has the potential to increase the sustainability of the system,⁽⁸⁸⁾ but it does not allow for choice in the kind of water source used and the technology mobilized, since these are replicated on all sites involved in the project. The typology and characteristics of the institutional and political support to co-produced practices hence heavily shape the political relationships amongst actors and the on-the-ground results of these alternative practices.

These case studies confirm that co-production plays a role in extending the portfolio of natural resources mobilized and of technological devices implemented. The cases have highlighted that the improved capacity of users to intervene technically within the water service cycle needs to be investigated, taking a multi-scalar perspective that considers both spatial and social dimensions. The hybridization of the water cycle within co-produced systems can be considered an element of spatial reconnection, mostly operated directly by people with different water redistribution and buying/selling practices instead of through purely physical networks. This is evident in the case of

peri-urban Dar es Salaam, where inhabitants need to develop sociotechnical adaptability in the face of urban and environmental transformations. This leads them to couple co-production with other forms of service delivery.⁽⁸⁹⁾ Similarly, in Kinshasa or Hanoi, the production of constellations of different water alternatives (both co-produced and not co-produced) can be seen as real substitutes for the (absent) universal network.

This hybridization of alternatives can be regarded as a fundamental – not marginal – system of socio-spatial relationships able to directly act in, and transform, the space and its natural resources – by echoing here the concept of “people as infrastructure” developed by Simone.⁽⁹⁰⁾ From this perspective, combining a socio-political with a resource-based and an urban approach to water services co-production, as proposed throughout this paper, may certainly help us reach a better understanding of the potential role, as well as associated risks and limitations, of these practices.

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³ Bovaird (2007).

⁴ Alford (2009), page 10.

⁵ Ostrom (1996).

⁶ Pestoff et al. (2012); Osborne and Strokosh (2013).

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⁸ Joshi and Moore (2004), page 40.

⁹ Joshi and Moore (2004), page 32.

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¹² Coutard et al. (2014); Monstadt and Schramm (2015).

¹³ Jaglin (2012).

¹⁴ McGranahan (2013).

¹⁵ Mitlin (2008); McMillan et al. (2014).

¹⁶ Yu et al. (2012); Moretto and Ranzato (2017); Ranzato and Moretto (2018a).

¹⁷ Face-to-face surveys were conducted with 10 to 20 inhabitants in each of the neighbourhoods considered in the research. These surveys have mostly been designed for intra-city comparisons, between different co-production systems/areas at the city level. This research paper constitutes a first attempt to build a comparative approach between different cities.

¹⁸ Bovaird (2007).

¹⁹ Alford (2009).

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- ²⁰ Osborne and Strokosh (2013).
- ²¹ Joshi and Moore (2004).
- ²² Van Vliet (2006).
- ²³ Nabatchi et al. (2017).
- ²⁴ Ostrom et al. (1999); Anderies et al. (2004); Van Vliet (2006).
- ²⁵ Ostrom et al. (1999); Agrawal (2003); Anderies et al. (2004).
- ²⁶ Anderies et al. (2004).
- ²⁷ Gandy (2006); Silver (2014).
- ²⁸ Swyngedouw (2010).
- ²⁹ Jaglin (2012); Coutard et al. (2014); Allen et al. (2017); Moretto and Ranzato (2017).
- ³⁰ Swyngedouw (2010).
- ³¹ Moretto and Ranzato (2017); Ranzato and Moretto (2018a).
- ³² Cabrera (2015).
- ³³ INE (2012).
- ³⁴ Cabrera (2015).
- ³⁵ Cabrera (2015).
- ³⁶ Zérah (2000). To counteract gaps in service delivery (i.e. low pressure in the pipes that does not allow the water to reach upper floors, as well as an often irregular and unclean water flow), the majority of households respond/adapt to the municipal supply by equipping their houses with water storage tanks, pumps, filter columns and other devices to ensure uninterrupted water flow at sufficient pressure and to increase drinking water quality.
- ³⁷ Beauséjour and Viet Anh (2007).
- ³⁸ In 1986, in response to a period of economic instability, Vietnam undertook the *đổi mới* reforms, opening to the world's market economies. Through this policy Vietnam moved from a centrally planned economic model to a decentralized one, where allocation of resources is determined by a mix of market mechanisms and socialist principles adopted by central control. This "hybrid re-ordering model" triggered large urban development projects in peri-urban areas. Labbè and Musil (2013).
- ³⁹ Labbè and Musil (2013).
- ⁴⁰ Sassen (2005); Labbè and Boudreau (2011); Schramm and Wright-Contreras (2017).
- ⁴¹ Labbè and Boudreau (2011); Schramm (2016).

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- ⁴² Schramm and Wright-Contreras (2017).
- ⁴³ Schramm and Wright-Contreras (2017).
- ⁴⁴ URT, 2011; Dodi Moss et al. (2013).
- ⁴⁵ Kjellen (2006); Nganyanyuka et al. (2014).
- ⁴⁶ Pastore (2015).
- ⁴⁷ URT (2002), page 43.
- ⁴⁸ Allen et al. (2017).
- ⁴⁹ Kyessi (2005).
- ⁵⁰ Kyessi (2005).
- ⁵¹ Dill (2010).
- ⁵² Kyessi (2005); Dill (2010); Smiley (2013); Allen et al. (2017).
- ⁵³ Kyessi (2005); Dill (2010); Smiley (2013); Allen et al. (2017).
- ⁵⁴ Kyessi (2005).
- ⁵⁵ Mjemah et al. (2009); Faldi and Rossi (2014).
- ⁵⁶ Faldi and Macchi (2017).
- ⁵⁷ Kyessi (2005).
- ⁵⁸ Dill (2010).
- ⁵⁹ Kyessi (2005).
- ⁶⁰ Allen et al. (2017); Faldi and Macchi (2017).
- ⁶¹ MSP and MEPSP (2010); ATLAS (2015).
- ⁶² DRC (2006), page 4.
- ⁶³ Lemenager (2013). “Out-of-the-field” zone refers to a part of the city that is largely ignored by urban planning instruments (plans and policies) and conventional networked services.
- ⁶⁴ Ilito Boozi (2018).
- ⁶⁵ Ranzato and Moretto (2018a).
- ⁶⁶ Sofoulis (2009, page 88) uses the term “heroics” to refer to the “certain kinds of intentions (and “non-intentions”) about heroic engineering, civilization, public health and municipal order” that the advent of municipal water and sewerage infrastructures have “baked into” water services.
- ⁶⁷ Sofoulis (2005), page 448.

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- ⁶⁸ Shove (2003).
- ⁶⁹ Yu et al. (2011).
- ⁷⁰ Moretto and Ranzato (2017).
- ⁷¹ Pincetl et al. (2012).
- ⁷² Kyessi (2005).
- ⁷³ Bovaird (2007); Pestoff et al. (2012).
- ⁷⁴ Huron (2017).
- ⁷⁵ Ranzato and Moretto (2018b).
- ⁷⁶ Ostrom (1996).
- ⁷⁷ Susser and Tonnelat (2013); Becker et al. (2017).
- ⁷⁸ Moretto and Ranzato (2017).
- ⁷⁹ Graham and Marvin (2001).
- ⁸⁰ Jaglin (2004).
- ⁸¹ Coutard (2002).
- ⁸² Graham and Marvin (2001).
- ⁸³ Pastore (2015); Monstadt and Schramm (2017).
- ⁸⁴ Navez-Bouchanine (2002).
- ⁸⁵ See Moretto and Ranzato (2017).
- ⁸⁶ See also Kyessi (2005); and Dill (2010).
- ⁸⁷ Duque Gómez and Jaglin (2016).
- ⁸⁸ Iito Boozi (2018).
- ⁸⁹ Ricci (2016).
- ⁹⁰ Simone (2004).